The International SummerSchool 2016
Entrepreneurship and Innovation in Organizations and Societies: Ecosystems, workplace & social innovation, social quality
Entrepreneurship and Innovation in Organization

The International Summer School 'Entrepreneurship and Innovation in Organizations and Societies: Ecosystems, workplace & social innovation, social quality'

2016

2016年国际暑
"企业创新，组织创新和社会
社会生态，工作环境和社会创新与社会

企业创新和组织创新
Entrepreneurship and Innovation in Organizations

The Chinese Academy of Social Sciences (CN)中国社会科学院
Zhejiang University (CN)浙江大学
Utrecht University (NL)荷兰乌特勒支大学
Research and Technology Organisation TNO荷兰创新研究所
联合举办
Hangzhou·China 中国·杭州 2016.07.18-07.23

International Workshop

Entrepreneurship and Innovation in Organizations and Societies:
Ecosystems, Workplace & Social innovation, Social quality

Mengmingwei Building 140, Zijingang Campus, Zhejiang University
2016.7.18 Hangzhou, P. R. China

Opening Ceremony 09:00-10:00	Speakers	Chair: Ka Lin, Zhejiang University 主持人：林卡 浙江大学
Opening address 开幕式致辞 09:00-09:45 Group Pictures 合影 09:45-10:00	Xuehua Shi 施雪华	The Chinese Academy of Social Sciences 中国社科院
	Eric Stam	Utrech University, The Netherlands 乌特勒兹大学
	Xiaobo Wu 吴晓波	School of Management, Zhejiang University 浙江大学管理学院
	Weiwen Zhang 张蔚文	School of Public Affairs, Zhejiang University 浙江大学公共管理学院
	Peter Oeij	TNO 荷兰创新研究院
Theme: Innovation and Management		
10:00-10:30	Eric Stam	Professor, Utrecht University Independent Entrepreneurship and Entrepreneurship: Micro and Macro Relations
10:30-11:00	Xiaobo Wu 吴晓波	Professor, Zhejiang University Beyond the Catch-up
11:00-11:30	Klaas ten Have	Professor, TNO Why the need for workplace innovation within organizations is not self-evident
11:30-11:45	Discussion	
Theme: Social Innovation		
13:30-13:50	Qin Miao 苗青	Professor, Zhejiang University Understanding the Pattern of Social Entrepreneurship
13:50-14:10	Peter Oeij	Senior Researcher, TNO The Role of Social Scientists to Make Workplace Innovation Happen in Organizations
14:10-14:30	Ka Lin 林卡	Professor, Zhejiang University Innovation Studies and Social Innovation in Promotion of Social Quality
14:30-14:45	Discussion	
Coffee Break 14:45-15:00		
15:00-17:30	Baiqian Hou 侯百谦	Program Introduction and social activities for the international summer school

The scheme of the summer school (July 18-23, 2016)

Time slots	Monday 18-07	Tuesday 19-07	Wednesday 20-07	Thursday 21-07	Friday 22-07	Saturday 23-07	Sunday 24-07
	Morning						
08.00--10.00	Registration Opening session (start at 9:00) photo and tea break (Room 140)	Lecture UU: Entrepreneurship and Innovation Policy (Erik Stam) (Room 250)	Lecture TNO: Workplace innovation / Dynamics of innovation teams (Peter Oeij) (Room 250)	Lecture CASS Emergence and Transformation of Chinese Business Elites (Peng Lu) (Room 250)	Lecture CASS Social Survey: Practice in China (Wei Li) (Room 250)	Presentations of students (small groups) (Room 250、266、264、246、348)	Free Time Departure
10.00-12.00	Outline Lecture 1 (Room 140)	Lecture SOM: New Trends in Innovation Management (Gang Zheng) (Room 250)	Lecture SOM: Innovation and Intellectual Property Right (Can Huang) (Room 250)	Lecture SPA: Social Innovation and Social Enterprise (Qing Miao) (Room 250)	Lecture SPA: Social quality and social innovation in China (Ka Lin) (Room 250)	Presentations of students (small groups) (Room 250、266、264、246、348)	Departure
Lunch 12.00-13.30	Afternoon						
13.30-15.30	Outline Lecture 2 (Room 140)	Visit Hangzhou Field visits Dreamtown	Lecture TNO/HU: Corporate Entrepreneurship (Klaas ten Have) (Room 250)	Visit Hangzhou Field visits Xiezhi Hotel & Museum of China's Community Construction	Lecture CASS: Social Innovation, Social Service and Social Enterprise (Yi Pan) (Room 250)	Reporting the discussion from different plenaries (Room 250)	Departure
15.30-17.30	Introduction / social activities Summer School (SPA; SOM) (Room 140)		West Lake (SPA)		Lecture TNO/SPA: Social innovation in Europe (Peter Oeij) and Asia (Ka Lin) (Room 250)	Closing session Graduation (SPA; SOM) (Room 250)	Departure
Dinner 17.30-19.30	Evening					18.00-00.00	
19.30-21.00		Feedback + tutorials		Feedback + tutorials		Dinner & Farewell Party (SPA; SOM)	

Lecturers of the summer school

Erik Stam	Professor	**Utrecht University** School of Economics
Gang Zheng	Professor	**Zhejiang University** School of Management
Peter Oeij	Senior Researcher	**TNO, Innovation for Life** The Netherlands Organization for Applied Scientific Research
Can Huang	Professor	**Zhejiang University** School of Management
Klaas ten Have	Professor	**TNO, Innovation for Life** The Netherlands Organization for Applied Scientific Research
Peng Lu	Senior Researcher	**Chinese Academy of Social Sciences** Institute of Sociology
Qing Miao	Professor	**Zhejiang University** School of Public Affairs
Wei Li	Senior Researcher	**Chinese Academy of Social Sciences** Institute of Sociology
Ka Lin	Professor	**Zhejiang University** School of Public Affairs
Yi Pan	Professor	**Chinese Academy of Social Sciences** Institute of Sociology

Reading Materials

Entrepreneurship and Innovation in Organization

Innovation Adoption: A Review of Theories and Constructs

Jennifer P.Wisdom·Ka Ho Brian Chor·Kimberly E.Hoagwood·Sarah M.Horwitz
George Washington University and New York University

Abstract: Many theoretical frameworks seek to describe the dynamic process of the implementation of innovations. Little is known, however, about factors related to decisions to adopt innovations and how the likelihood of adoption of innovations can be increased. Using a narrative synthesis approach, this paper compared constructs theorized to be related to adoption of innovations proposed in existing theoretical frameworks in order to identify characteristics likely to increase adoption of innovations. The overall goal was to identify elements across adoption frameworks that are potentially modifiable and, thus, might be employed to improve the adoption of evidence-based practices. The review identified 20 theoretical frameworks that could be grouped into two broad categories: theories that mainly address the adoption process (N = 10) and theories that address adoption within the context of implementation, diffusion, dissemination, and/or sustainability (N = 10). Constructs of leadership, operational size and structure, innovation fit with norms and values, and attitudes/motivation toward innovations each are mentioned in at least half of the theories, though there were no consistent definitions of measures for these constructs. A lack of precise definitions and measurement of constructs suggests further work is needed to increase our understanding of adoption of innovations.

Keywords: Adoption; Evidence-based treatments and practices; Organization; Innovation; Implementation

Introduction

Aarons et al. (2011) point out that there are a number of models to ‘‘summarize factors at multiple levels of the social and organizational context that potentially influence the process of translating research into effective improvements in practice’’ (p. 5). These authors go on to say that many models divide the process of implementation of evidence-based practices (EBPs) into phases and that while there are many common elements in these models they often emphasize different factors. Further, they assert that the implementation and diffusion literature has focused most heavily on the implementation phase of the process with less emphasis on the exploration/adoption phases (also known as pre-implementation) or the maintenance/sustainability phase (also known as post-implementation). The implementation of an EBP or treatment (called EBP in this review) is predicated on the organization’s decision to adopt that EBP (Panzano and Roth 2006). Adoption, the decision to proceed with a full or partial implementation of an EBP, is a complex process and understanding this process may provide insights for the development of strategies to increase the uptake of EBPs (Fixsen et al. 2005).

Adoption usually starts with the recognition that a need exists and moves to searching for solutions, then to the initial decision to attempt the adoption of a solution and finally to the actual decision to attempt to proceed with the implementation of the solution (Damanpour and Schneider 2006; Gallivan 2001; Mendel et al. 2008). Greenhalgh et al. (2004) characterized in the adoption process: pre- adoption (e.g., awareness of innovation), periadoption (e.g., continuous access to innovation information), and established adoption (e.g., adopters’ commitment to the adoption decision). Alternatively, Frambach and Schil- lewaert (2002) discussed two stages associated with adoption: the organization’s decision to pursue adoption and the staff's acceptance and initiation of their individual processes of accepting the innovation. Adoption will either move to initial implementation activities or revert to de- adoption. There is little information about de-adoption (Frambach and Schillewaert 2002; Gallivan 2001). Finally, just as the decision to adopt is a process, how the adoption proceeds is better characterized in terms of level, rate, or degree of adoption (Mendel et al. 2008). The better the process of adoption can be understood, the more likely adoption challenges can be addressed thus leading to initial implementation.

On an organizational or system level, the adoption process is complex. It is particularly challenging to promote change in routine practice when decision-makers within organizations do not perceive changes as necessary (Garland et al. 2010). Despite the similarity to individual-level adoption, Aarons et al. (2011) suggest that individuals in organizations may have difficulty knowing, weighing, or selecting appropriate innovations to solve particular problems, or their decision to adopt is often complicated by organizational factors (e.g., hierarchy, culture, values) that are not necessarily experienced in individual problem-solving.

Further, organizations, like individuals, can be classified as low-, medium-, or high-adopters, regardless of the innovation of interest (Rogers 2003). These classifications of adopters, while meaningful for planning and descriptive purposes, need further empirical inquiry into whether there are strategies that can change organizations from medium or low adopters to high adopters (Greenhalgh et al. 2004; Oldenburg and Glanz 2008).

Current State of Research

There is limited research on the adoption phase of the implementation process (Panzano and Roth 2006) in human service organizations (Horwitz et al. 2010), even though prior to actually implementing an EBP there has to be a decision to proceed with the adoption of the EBP either fully or partially. Although Tabak et al. (2012a) synthesized a collection of 61 theoretical frameworks that are necessary for quality dissemination and implementation research, their review did not identify the active ingredients of adoption. Thus, there is a need to identify modifiable factors with the ultimate goal of crafting interventions to improve adoption. Although understanding adoption in regard to its endpoint—implementation—is important, it may overlook the complexity in the adoption process itself and the impact of the adoption process on implementation and eventually sustainability. If successful adoption precedes successful implementation (Panzano and Roth 2006), then there needs to be a focused exploration of adoption theories and constructs. Therefore, the purpose of this review is to: (1) identify key theoretical frameworks that address adoption; and (2) synthesize constructs that are hypothesized to be related to adoption of EBPs into a unifying, overarching theory of adoption of innovations.

Methods

This paper applies a narrative synthesis approach (Popay et al. 2006) that incorporates aspects of realist review methods (Pawson et al. 2005) to summarize theories and constructs associated with innovation adoption. Narrative synthesis is a way of systematically reviewing and synthesizing findings from multiple studies relying primary on the use of words and text to summarize and explain findings (Popay et al. 2006). The product of a narrative synthesis is a summary of the current state of knowledge in relation to a particular review question.

This study's phenomenon of interest—adoption of innovations—is best described by theories rather than by a prescribed program or protocol, given the long casual chain linking an innovation to its eventual adoption. Improving innovation adoption is therefore a form of complex quality improvement intervention. Specifically, this review's scope maps appropriately to Wong et al. (2010) definition of ''complex interventions'' as those with a significant number of (a) interacting components within experimental and control settings (e.g., interacting adoption constructs that lead to adoption), (b) difficulty of behaviors required by those delivering or receiving the intervention (e.g., complexity and difficulty of enhancing adoption), (c) groups or organizational levels targeted by the intervention (e.g., client-level, clinician-level, and organization-level adoption), (d) variability of outcomes (e.g., successful innovation-specific adoption has different connotations—adoption of improved psychotropic prescribing is vastly different from adoption of a psychosocial intervention), (e) degree of flexibility of the intervention permitted (e.g., the same innovation can be adopted differently by different organizations), and (f) degree of dependence on context in which interventions take place. We define context as details of the setting, organization, political climate, etc. that may influence innovation adoption.

In this study, we integrate existing adoption theories to generate a ''middle-range theory,'' defined as a theory that is at the correct level of abstraction to be useful (Wong et al. 2010), such as one that draws broad conclusions and implications based on adoption constructs to enhance innovation adoption across adoption contexts and innovation types. A middle- range theory stresses that an underlying mechanism helps explains an outcome across contexts. We define mechanisms as any processes or techniques for achieving a result. Broadly, this review seeks to understand what it is about innovation adoption that works in organizations, as well as when adoption works, under what circumstances, how and why the identified mechanisms promote adoption. Specifically, this review aims to integrate existing adoption theories by examining specific adoption mechanisms championed by the theories to guide the development of measurements and interventions for adoption; and to improve the transferability, generalizability, and external validity of adoption theories.

Analysis and review of literature followed narrative synthesis methodology as described by Popay et al. (2006):(1) Develop a theory of how the intervention works, why and for whom; (2) Develop a preliminary synthesis of findings of included studies; (3) Explore relationships in the data; and (4) Assess the robustness of the synthesis.

Develop a Theory of How Innovation Adoption Works, Why and for Whom

Once the review was conducted and no new findings were identified, we then extracted and organized data from included papers in order to identify and list facilitators and barriers to adoption and to identify how the facilitators and barriers may interact. Due to the variety of literature admitted to the review, we did not use a standard form of extracting information (e.g., preferred reporting items for systematic reviews and meta-analyses [PRISMA]). Three independent reviewers studied the adoption theories carefully to: (a) extract and identify specific adoption constructs; (b) map the constructs to the appropriate level (i.e., external-, organization-, innovation-, or individual-level); and (c) identify the directionality of the association between the adoption constructs and adoption. We created an initial, simple version of Fig. 1 and began to populate it with information from included studies. In addition, we began preliminary tables to cross reference concepts with each other.

Explore Relationships in the Data

This is the key analytic step in the narrative synthesis process; it is designed to consider factors that may explain differences in facilitators and barriers to successful adoption and to understand why adoption is important (Popay et al. 2006). We reviewed and analyzed data from our preliminary figure and tables to create an understanding of how data were related to each other. This step also resulted in our overarching theoretical model, as presented in Fig. 1. The synthesis entails theory refinement and presenting the contextuality of conclusions drawn. Specifically, the synthesis clarifies, compares, and contrasts constructs and their associations with adoption championed by the theories, as the foundation to improve measures and interventions for adoption. The operationalization and refinement of eventual adoption constructs expand upon previous reviews of the adoption literature (e.g., Aarons et al. 2011; Greenhalgh et al. 2004).

Assess the Robustness of the Synthesis

This step provides an assessment of the strength of the evidence for making conclusions about the synthesis results and identifies the appropriate population to which the synthesis findings can be generalized. We assessed the robustness of the synthesis on criteria by examining each article's relevance (fitness for purpose) and rigor (appropriate theoretical complexity for a multi-level synthesis), as well as by identifying the consistency of data across theories and the conclusions drawn from the synthesis.

Results

Following specification of our initial model (Narrative Synthesis Step 1), the iterative search processes led to two groups of theoretical frameworks: theories that directly address the adoption process (N = 10) and theories that address adoption within the context of implementation, diffusion, dissemination, and/or sustainability (N = 10), both summarized in Appendix 2. We then present our synthesis of the theories to explicate specific constructs (e.g., readiness for change) within contexts (e.g., political environment) that are associated with pre-adoption or adoption across theories (Step 2) and exploration of relationships in the data (Step 3). Finally, we present our assessment of the robustness of the synthesis (Step 4).

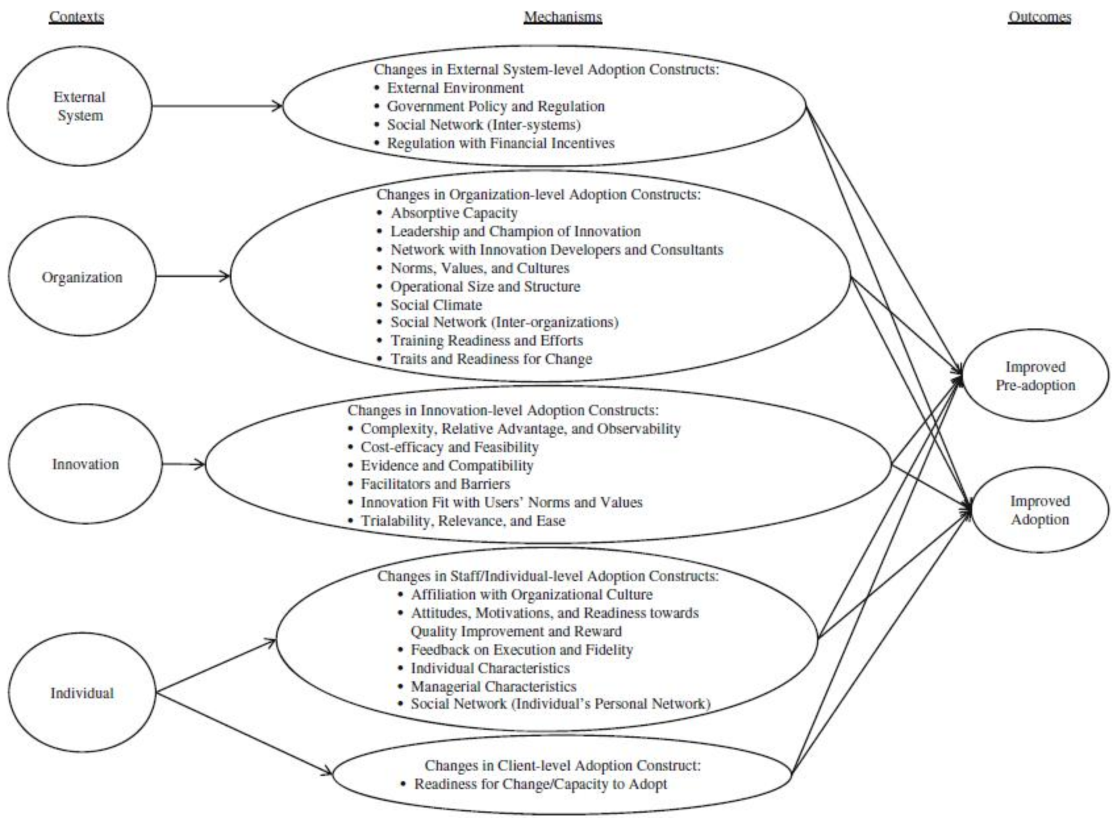

Fig. 1 Context-mechanism-outcome configurations for this review

Synthesizing Theories of Adoption and Exploring Relationships in Data

We analyzed the 20 key adoption theoretical frameworks and identified several integrative themes. First, whether adoption is considered a standalone entity or a component of implementation the literature suggests that an interactive, multi-level understanding of adoption is needed. Second, adoption is a process through which change occurs in phases or stages in terms of pre-adoption and actual adoption. Third, although there are some constructs that appear in only one framework, there is considerable overlap of constructs across frameworks that pertain specifically to adoption and which are separate from other phases of implementation. Appendix 3 summarizes key adoption constructs across the 20 theoretical frameworks by levels of adoption (i.e., sociopolitical influence, organizational, individual) and Table 1 identifies the associations between key adoption constructs and stages of pre-adoption and adoption. Our preliminary synthesis and overarching theory is illustrated in Fig. 1 and important constructs by level of adoption syntheses appear in Table 2.

Socio-political and External Influence

As adopting organizations operate within their contexts and outside environments, adoption theoretical frameworks have identified socio-political and external factors that can influence adoption.

External Environment

Two theoretical frameworks assert that extra-organizational environment is associated with adoption, though the direction of association varies and there is no theory on pre-adoption. For instance, urbanization and development around an adopting organization have a positive association (Damanpour and Schneider 2006, 2009; Meyer and Goes 1988), though a competitive environment to succeed has mixed theoretical underpinnings (Frambach and Schillewaert 2002).

Government Policy and Regulation

In the pre-adoption stage, two theoretical frameworks indicate that external policy and regulation are positively associated with adoption, including specific enactment of policies, legislation, or regulations on innovation adoption (Aarons et al. 2011; Oldenburg and Glanz 2008; Rogers 2003). Similarly, during the adoption phase, legislation and regulatory agencies and accreditation standards are associated with increased adoption (Aarons et al. 2011; Berta et al. 2005; Feldstein and Glasgow 2008; Mitchell et al. 2010), as are the fit of political and cultural climate (Glasgow 2003; Glasgow et al. 2003).

Reinforcing Regulation with Financial Incentives to Improve Quality Service Delivery

Mendel et al. (2008) identifies financial incentives and reward systems for adoption to be positively associated with the pre-adoption stage.

Social Network (Inter-Systems)

Social networks and linkages between systems outside an organization are theorized to be positively associated with pre-adoption (Mendel et al. 2008; Oldenburg and Glanz 2008; Rogers 2003; Valente 1996), and with adoption (Berta et al. 2005; Frambach and Schillewaert 2002; Valente 1996). For example, social networks and linkages among organizations within the same system promote the uptake of the behavior of those organizations located in central positions within a network, especially in the field of medical innovation adoption (Mendel et al. 2008). Alternatively, the lack of external support such as advisory boards and regulatory agencies, or the lack of coordination between systems such as governance and administrator- managed task systems, are negatively associated with adoption (Backer et al. 1986).

Organization Characteristics

Absorptive Capacity

An organization's absorptive capacity, the capacity to utilize innovative and existing knowledge, is associated with pre-adoption and adoption (Aarons et al. 2011; Cohen and Levinthal 1990; Frambach and Schillewaert 2002; Greenhalgh et al. 2004). For example, organizations with preexisting good knowledge and skills, have the capacity and mechanisms in place to incorporate new knowledge or innovations, are more likely to first explore followed by eventual adoption (Aarons et al. 2011).

Leadership and Champion of Innovation (e.g., Styles, Attributes, Management)

Organizational leadership, particularly in championing innovations, is important to pre-adoption and adoption. Four theoretical frameworks identify leadership in the form of CEO's influence, opinion leader, top management sup- port, and leadership promotion, as positively associated with the pre-adoption stage (Aarons et al. 2011; Feldstein and Glasgow 2008; Gallivan 2001; Meyer and Goes 1988; Solomons and Spross 2011; Valente 1996). There is greater variability in the proposed direction of association during the adoption stage. The same leadership variables (i.e., CEO's influence, champions, opinion leaders etc.), managerial and organizational support for innovation, and prior experience in adoption, are positively associated with adoption according to nine theoretical frameworks (Aarons et al. 2011; Backer et al. 1986; Berta et al. 2005; Feldstein and Glasgow 2008; Gallivan 2001; Graham and Logan 2004; Greenhalgh et al. 2004; Meyer and Goes 1988; Simpson 2002; Solomons and Spross 2011). Top-down leadership, however, is negatively associated with adoption (Backer et al. 1986).

Network with Innovation Developers and Consultants

Six theoretical frameworks find that organizational net- works and collaboration with innovation developers, consultants, professional associations, and potential users are positively associated with pre-adoption (Aarons et al. 2011; Backer et al. 1986; Feldstein and Glasgow 2008; Greenhalgh et al. 2004; Mendel et al. 2008; Mitchell et al. 2010). Both direct and indirect networking are positively associated with adoption (Feldstein and Glasgow 2008).

Table 1 Key adoption constructs associated with adoption process

Constructs	Pre-adoption	Adoption
Sociopolitical and external influence		
External environment*		Urbanization[a]
		Competitive environment[b]
Government policy and regulation	Enactment and implementation of policies, legislation, or regulations[c,d]	Legislations and policies of regulatory agencies, accreditation standards include innovation[e,c,f,g]
		Political and cultural fit[h]
Reinforcing regulation with financial incentives	Policies and incentives[i]	
Social network (inter-systems)	Social networks, linkages, and cultural groups[j,i,d]	Social networks and network externalities[b]
		Similar communities have adopted[e]
		Lack of external support (e.g., advisory boards, legislatures, regulatory agencies, citizen groups, advocacy groups)(negative association)[k]
		Lack of coordination/agreement between administrator-managed task system, professional identity, and governance system (negative association)[k]
Organizational characteristics		
Absorptive capacity	Organizations' absorptive capacity[l,c]	Organization's ability to identify, capture, interpret, share, reframe, and recodify new knowledge to link it with existing knowledge base and to put it to appropriate use[m]
	Organizations' usage of existing knowledge and skills base[l,b]	

Leadership and champion of innovation (e.g., styles, attributes, management)	Top management support[n] Leadership promotion[o,c,f]	CEO's influence, champions, opinion leaders (expert and peer), local leaders, self-efficacy of leadership, and leadership agreement[e,p,m] Leadership promotion[n,o,c,f,q] Organizational support for innovation[k] Prior experience in innovation adoption, skills and years since completion of training/education[f] Top-down leadership (negative association)[k]
Network with innovation developers and consultants	Bi-directional collaboration, networking, and personal contacts with outside consultants, innovation developers, credible professional associations, and potential users[k,c,f,m,i,g]	Direct and indirect networking[f]
Norms, values, and cultures	Shared health professionals values and patient-centeredness[o,c,i]	Shared health professionals values[o,c] Problem-solving norms[d]
Operational size and structure	Availability and mobilization of organizational resources committed to innovation[r,p,i,q] Formalized and centralized structure[b,n] Larger size and greater differentiation in personnel and structure[i] Lack of agency formal research infrastructure (negative association)[o]	Availability of organizational resources committed to innovation[q] Large, mature, observable, differentiated, specialized organizations with foci of professional knowledge[e] Size and size-practice fits[a,b,c,m] Structures in place to support adoption (e.g., training, communication)[e] Formalized and centralized decision-making structure (negative association)[b] Lack of agency formal research infrastructure (negative association)[o]
Social climate	Positive social climate and social learning[c,i] Social pressure[b]	Adoption decision at individual- or group-level[q] Social factors[b]
Social network (inter-organizations)	Inter-organizational networks[j]	Interconnectedness and multiple inter-organizational networks[b,j,m]
Training readiness and efforts*	Organizational and management support[b] Building in methods for maintaining staff competence and performance over time[k]	Innovations that are incorporated into training/education curricula[b,g] Targeting/communication about innovation[b]

Constructs	Pre-adoption	Adoption
Traits and readiness for change	Receptive context and readiness for change[c,m]	Innovativeness[b] Readiness for change[c] Risk reduction[b]
Innovation characteristics		
Complexity, relative advantage, and observability		Innovations are clarified as to what they are and what their implementation might entail[p,q] Innovations that are perceived as simple to use[k,p,m,d,q] Innovations that have a clear, unambiguous advantage in effectiveness over preceding idea, product, or program[p,m,d] Innovations that require less expertise[h] Innovations with benefits that are visible to intended adopters[p,m] Knowledge required to use the innovations is transferrable[p,m] Low complexity[p,m] Relative advantage of new program over existing practices[k] Staff can observe a demonstration[k] Tacitness of instruction (negative association)[e]
Cost-efficacy and feasibility	Cost efficacy and evaluation[f,g] Feasibility and evaluation[g,s] Perceived benefits exceeding expected costs[i]	Innovations that have a clear, unambiguous advantage in cost-effectiveness[a,b,p]

Evidence and compatibility	Research evidence and practice efficacy[f,g,s]	Adaptability of innovation[k] Compatibility with existing practices, intended users' values, norms, beliefs, and perceived needs[h,p,m,d] Evidence of practice efficacy[f] Innovations that can be "reinvented" to suit organizational needs[p]
Facilitators and barriers	Assessment of barriers and facilitators[p] Training, empowerment, and interest in practice[o] Lack of awareness, familiarity, time, autonomy, and ability to access research (negative association)[o,f]	Assessment of barriers and facilitators[p] Management of organizational or system level barriers[p] Training, empowerment, and interest in practice[o] Lack of awareness, familiarity, time, autonomy, and ability to access research (negative association)[o,f]
Innovation fit with users' norms and values*	Assessment of potential adopters' perceptions of the characteristics of the innovation[p] Fit of setting with current practice, users' values, norms, strategies, goals, skills, technologies, and ways of working[t,m,d,s]	Fit with accepted therapeutic scheme, users' abilities, values, formed opinion, and knowledge, job description, current users of innovation, and existing procedures[b,t,c,f,i,d,q] EBT match with organizational culture[o,f] Psychological resistance to adoption (negative association)[k]
Risk	Low risk[m,g]	Perceived uncertainty (negative association)[b]
Trialability, relevance, and ease	Ease and meaning of use[c,m] Partial trial of innovation[d]	Ease of use[c] Innovation impact[a] Partial trial of innovation[b,p,m,d] Link with positive health outcomes[k,e] Number of others using innovation[b] Relevance to solving a clearly identified problem[k] Degree to which innovation can be installed one step at a time with evidence of incremental success[k]
Staff/individual characteristics		
Affiliation with organizational culture	Fit with organizational culture[o,c]	

Constructs	Pre-adoption	Adoption
Attitudes, motivation, readiness towards quality improvement and reward	Adequate readiness and motivation for change[r,t,m,q] Assessment of attitudes towards change[p] Holistic approach to quality improvement[o] Building in methods for rewarding adoption and innovation[k]	Attitude toward change and pro-innovation attitude[b] Holistic approach to quality improvement[o] Positive attitude[r,c] Motivational readiness and perceived needs influences adoption decision at individual or group level[q]
Feedback on execution and fidelity		Assessment of participation/adoption rate of expected participants[h] Decisions made about what constitutes adoption, how adoption is to be measured, and who will be responsible for monitoring[p] Feedback to practitioners about variation from best practice[f,p,g] Frequent evaluation of innovation use as part of routine practice[s]
Individual characteristics (e.g., awareness, knowledge/skill, competence, current practice, demographic factors)*	Assessment of awareness of innovation, skills and experiences required, and current practices[p,m] Fit with individual adopter characteristics[c] Innovativeness[b] Intra-individual factors such as learning style, tolerance of ambiguity, meaning, and concerns in pre-adoption stage[d] Experience with intervention[b] Lack of skills and appreciation of research (negative association)[o]	Awareness knowledge, procedural knowledge, and principles knowledge[m,d] Early adopters have higher degrees of mass media exposure and higher propensities for risk-taking[i] Fit with individual adopter characteristics[c] Lack of skills and appreciation of research (negative association)[o]
Managerial characteristics		Managers' influence on workers' motivation, morale, and rewarding innovation and change[a]
Social network (individual's personal network)	Extensiveness of social networks[j]	Extensive social network, and strong, diverse, and organic intra-organizational networks[m,j]
Client characteristics		
Readiness for change and capacity to adopt	Early involvement of influential potential users in the planning, research, and development of the innovation[k]	Attitudes/Beliefs toward change[b] Patient/User readiness[t,f] Willingness of stakeholders to adopt and adapt innovations[h]

[a] Damanpour and Schneider (2006, 2009), [b] Frambach and Schillewaert (2002), [c] Aarons et al. (2011), [d] (Rogers 2003, Oldenburg and Glanz 2008), [e] (Berta et al. 2005), [f] Feldstein and Glasgow (2008), [g] Mitchell et al. (2010), [h] (Glasgow 2003, Glasgow et al. 2003), [i] Mendel et al. (2008), [j] Valente (1996), [k] Backer et al. (1986), [l] Cohen and Levinthal (1990), [m] Greenhalgh et al. (2004), [n] Gallivan (2001), [o] Solomons and Spross (2011), [p] Graham and Logan (2004), [q] Simpson (2002), [r] Godin et al. (2008), [s] Stetler (2001), [t] Weinstein et al. 2008)

* There were several theories that indicated a construct could have both positive and negative associations with successful adoption. These are: External environment (adoption): Competitive environment (Frambach and Schillewaert 2002); Training readiness and efforts (pre-adoption): Information technology and training supportb; Innovation fit with users' norms and values (pre-adoption): Social norms (Frambach and Schillewaert 2002); Innovation fit with users' norms and values (adoption): Product independence (Frambach and Schillewaert 2002); Individual characteristics (adoption): Users' gender and age (Frambach and Schillewaert 2002)

Norms, Values, and Cultures

Organizational norms, values, and cultures are critical to pre-adoption and adoption. Three theoretical frameworks champion the following aspects that are positively associated with pre-adoption, including shared professional values and patient-centeredness (Aarons et al. 2011; Gallivan 2001; Mendel et al. 2008; Solomons and Spross 2011). During the adoption stage, similar organizational culture variables have a positive association with adoption in two theoretical frameworks (Aarons et al. 2011; Gallivan 2001; Solomons and Spross 2011), and an additional framework identifies a culture of problem-solving as positively associated with adoption (Oldenburg and Glanz 2008; Rogers 2003).

Table 2 Synthesis of findings of the five levels of adoption constructs

Construct level	Findings
Socio-political and external influence	• Positive external influences, such as a physical environment of development and growth; policies, regulations, and accreditation standards supportive of innovation; financial incentives, and social environment supportive of adoption are proposed to promote adoption. • There are few negative theorized associations that demonstrate that lack of these external influences hamper adoption, suggesting that evidence is consistent for the role of external influences on adoption.
Organizational characteristics	• Organization characteristics present the intersection of the environment and the workers, and accordingly is an area of contradictory findings. • Leadership support for and experience with adoption leads to better adoption, but a hierarchy of top-down leadership may hinder adoption. Organizations with a research infrastructure, and additional resources facilitate adoption, but if the organizational structure is too formal and centralized or requires too much from individuals, adoption is less likely to be successful. • Similar to the external environment, positive social climate and interactions with innovation developers are useful, but if the organization's culture focuses responsibility of learning on the organization, it is less effective than if individuals are responsible for learning.
Innovation characteristics	• Findings at this level were generally consistent. • Innovations that are easy to use, better than current practice, observable, cost-effective, adaptable to the organization, evidence-based, compatible with the organization's and users' norms and values, relevant, and low risk are more likely to be adopted. Few studies indicate that the absence of these innovation characteristics were more likely to lead to adoption failure. • Innovations that engender resistance or those that staff are unaware of, not familiar with, and for which evidence cannot be obtained are less likely to be adopted. Organizations that assess these characteristics, monitor fit, and address barriers are likely to be more successful.

Staff/individual characteristics	• Individuals' attitudes and motivation for adoption, particularly positive attitudes toward change, the need for change, and quality improvement are important for successful adoption. Feedback on the adoption process is useful in increasing adoption, and individual characteristics such as skills and experience, innovativeness, tolerance of ambiguity, propensity towards risk taking are associated with increased adoption. As seen in external and organizational characteristics, extensive social networks of individuals are associated with adoption. • Job tenure and lack of skills are negatively associated with adoption for staff, but education and tenure are positively associated with adoption for managers.
Client characteristics	• Fewer researchers addressed this topic than many of the others. In general, similar to staff and manager characteristics, client attitudes, beliefs, and readiness toward change are all associated with better adoption. Additional work is needed in this area.

Operational Size and Structure

Six theoretical frameworks identify organizational operation resources and size, a formalized, centralized, and differentiated structure as positively associated with pre-adoption (Frambach and Schillewaert 2002; Gallivan 2001; Godin et al. 2008; Graham and Logan 2004; Mendel et al. 2008; Simpson 2002). Alternatively, a lack of formal research infrastructure is negatively associated with pre-adoption (Solomons and Spross 2011). During the adoption stage, organizational resources and size play a substantial role as indicated by seven theoretical frameworks. Organizational resources and technical resources committed to innovation, a formalized, centralized, and differentiated structure, administrative intensity, and the fit between scope of practice and organizational size are positively associated with adoption (Aarons et al. 2011; Berta et al. 2005; Damanpour and Schneider 2006, 2009; Frambach and Schillewaert 2002; Gallivan 2001; Greenhalgh et al. 2004; Simpson 2002). A formalized, centralized organizational structure, however, according to Greenhalgh et al.(2004) and Frambach and Schillewaert (2002) are also negatively associated with adoption, as are a lack of formal research infrastructure (Solomons and Spross 2011), and slack resources after accounting for what is needed to maintain operations (Greenhalgh et al. 2004). Further, inconsistent adoption may result from heavy organizational coordination requirements or strong interdependencies across multiple adopters (Gallivan 2001). There is no evidence to suggest that unionization is related to adoption (Damanpour and Schneider 2006, 2009).

Social Climate

The social climate and social influence with an organization are related to pre-adoption and adoption. Positive social climate, social learning, and increased social pressure to adopt, are associated with pre-adoption according to three theoretical frameworks (Aarons et al. 2011; Frambach and Schillewaert 2002; Mendel et al. 2008). Similarly, social factors and adoption decision at an individual or a group level are positively associated with adoption (Frambach and Schillewaert 2002; Simpson 2002). For example, social persuasion and communication from peers within an organization help identify with and achieve adoption (Frambach and Schillewaert 2002).

Social Network (Inter-Organizations)

Social networks on the organizational level are important to pre-adoption and adoption. Multiple inter-organizational networks foster pre-adoption (Valente 1996). During the adoption phase, three theoretical frameworks identify multiple, informal inter-organizational networks, and general interconnectedness among organizations to be positively associated with adoption (Frambach and Schillewaert 2002; Greenhalgh et al. 2004; Valente 1996).

Training Readiness and Efforts

Innovation adoption entails training and performance efforts, which are both associated with pre-adoption and adoption. Two theoretical frameworks propose that organizational and management support for training, fewer years since completion of relevant training, and built-in methods for maintaining staff competence and performance positively associated with pre-adoption (Backer et al.

1986; Frambach and Schillewaert 2002; Meyer and Goes 1988). Two theoretical frameworks identify continuation of training, provision of resources, incorporation of innovations into curricula, and communication about innovations positively associated with the adoption phase (Frambach and Schillewaert 2002; Greenhalgh et al. 2004; Mitchell et al. 2010).

Traits and Readiness for Change

An organization can be characterized in terms of traits and readiness for change. Two theoretical frameworks identify receptiveness and readiness for change to be positively associated with pre-adoption (Aarons et al. 2011; Greenhalgh et al. 2004). Two theoretical frameworks suggest that the same readiness for change, innovativeness of an organization, and propensity towards risk reduction are positively associated with adoption (Aarons et al. 2011; Frambach and Schillewaert 2002).

Innovation Characteristics

Complexity, Relative Advantage, and Observability

These characteristics become particularly important during the adoption stage. Seven theoretical frameworks characterize adoptable innovations as clear in purpose, simple to use, unambiguously more advantageous than current or prior practice, minimal expertise needed to implement them, observable, and transferrable (Backer et al. 1986; Glasgow 2003; Glasgow et al. 2003; Graham and Logan 2004; Greenhalgh et al. 2004; Oldenburg and Glanz 2008; Rogers 2003; Simpson 2002). Tacitness or implicitness of an innovation, however, is negatively associated with adoption (Berta et al. 2005). Two theoretical frameworks find the following characteristics have no association with adoption: observability, workability of an innovation, and visibility of benefits associated with adoption (Frambach and Schillewaert 2002; Greenhalgh et al. 2004).

Cost-efficacy and Feasibility

Four theoretical frameworks indicate that cost efficacy, feasibility, evaluation of cost efficacy and feasibility, and perceived benefits exceeding expected costs to adopt are positively associated with pre-adoption (Feldstein and Glasgow 2008; Mendel et al. 2008; Mitchell et al. 2010; Stetler 2001). Three theoretical frameworks indicate that innovations with an unambiguous advantage in cost-effectiveness compared to existing practice are more likely to be adopted (Damanpour and Schneider 2006, 2009; Frambach and Schillewaert 2002; Graham and Logan 2004).

Evidence and Compatibility

Three theoretical frameworks indicate that innovations with clear research evidence and practice efficacy, coupled with compatibility with existing practice are more likely to be considered during pre-adoption (Feldstein and Glasgow 2008; Meyer and Goes 1988; Mitchell et al. 2010; Stetler 2001). During the adoption stage, six theoretical frame- works identify the following characteristics as positively associated with adoption: adaptability to suit organizational needs, compatibility with practice norms, and evidence of practice efficacy (Backer et al. 1986; Feldstein and Glasgow 2008; Glasgow 2003; Glasgow et al. 2003; Graham and Logan 2004; Greenhalgh et al. 2004; Meyer and Goes 1988; Oldenburg and Glanz 2008; Rogers 2003)

Facilitators and Barriers

Two theoretical frameworks find assessment of barriers and facilitators, and training, empowerment, and interest in practice as facilitators, associated with the pre-adoption stage (Graham and Logan 2004; Solomons and Spross 2011). One theoretical framework identifies the following barriers as negatively associated with pre-adoption: lack of awareness, familiarity, time, autonomy, and ability to access research (Feldstein and Glasgow 2008; Solomons and Spross 2011). During the adoption stage, two theoretical frameworks find that continuous assessment and management of barriers and facilitators, training, empowerment, and interest in practice as facilitators, are positively associated with adoption (Feldstein and Glasgow 2008; Solomons and Spross 2011). The same barriers identified in the pre-adoption stage by two theoretical frameworks—lack of awareness, familiarity, time, autonomy, and ability to access research—also apply to the adoption stage (Feldstein and Glasgow 2008; Solomons and Spross 2011).

Innovation Fit with Users' Norms and Values

The goodness-of-fit between an innovation and its intended user is critical to pre-adoption and adoption. During pre- adoption, five theoretical frameworks identify assessment of this fit, and the specific fit with existing practice, users' value, goal, and skills as positively associated with pre-adoption (Graham and Logan 2004; Greenhalgh et al. 2004; Oldenburg and Glanz 2008; Stetler 2001; Weinstein et al. 2008). During the adoption phase, nine theoretical frameworks indicate that innovation fit—with accepted scheme, organizational culture, abilities, values, knowledge, current practice, task performance—is positively associated with adoption (Aarons et al. 2011; Feldstein and Glasgow 2008; Frambach and Schillewaert 2002; Greenhalgh et al. 2004; Mendel et al. 2008; Oldenburg and Glanz 2008; Rogers 2003; Simpson 2002; Solomons and Spross 2011; Weinstein et al. 2008). When an intended user experiences psycho- logical resistance to adoption, this poor fit is negatively associated with adoption (Backer et al. 1986).

Risk

Considering or adopting an innovation may incur risk- taking. During pre-adoption, two theoretical frameworks find that an innovation with low risk is associated with pre-adoption (Greenhalgh et al. 2004; Mitchell et al. 2010). During the adoption stage, when an innovation elicits perceived uncertainty of adopting, this type of risk-taking is negatively associated with adoption according to one theoretical framework (Frambach and Schillewaert 2002).

Trialability, Relevance, and Ease

Whether an innovation can be experimented, related, and easy to use contribute to pre-adoption and adoption. Three theoretical frameworks find that ease and meaning of use, and partial trial are positively associated with the pre- adoption stage (Aarons et al. 2011; Greenhalgh et al. 2004; Oldenburg and Glanz 2008; Rogers 2003). During the adoption phase, continuing ease of use and installation, partial trial, and relevant innovation impact (e.g., problemsolving, outcome, and impact on other adopters) are associated with adoption according to eight theoretical frame- works (Aarons et al. 2011; Backer et al. 1986; Berta et al.2005; Damanpour and Schneider 2006, 2009; Frambach and Schillewaert 2002; Graham and Logan 2004; Greenhalgh et al. 2004; Oldenburg and Glanz 2008).

Staff/Individual Characteristics

Affiliation with Organizational Culture

Two theoretical frameworks identify that the fit between a staff member with an organizational culture is positively associated with pre-adoption (Aarons et al. 2011; Solomons and Spross 2011). No theoretical frameworks particularly highlight this affiliation during the adoption phase.

Attitudes, Motivation, Readiness Towards Quality Improvement and Reward

Seven theoretical frameworks indicate that individual readiness and motivation for change, assessment of attitudes toward change, endorsing a holistic approach towards quality improvement, and utilizing a reward system are associated with the pre-adoption stage (Backer et al. 1986; Godin et al. 2008; Graham and Logan 2004; Greenhalgh et al. 2004; Simpson 2002; Solomons and Spross 2011; Weinstein et al. 2008). During the adoption stage, five theoretical frameworks indicate that continuing endorsement of a holistic approach towards quality improvement, adopting pro-innovation attitudes and individual positive attitude, and individual- and organization-level motivational readiness and perceived needs for change are positively associated with adoption (Aarons et al. 2011; Damanpour and Schneider 2006, 2009; Frambach and Schillewaert 2002; Godin et al. 2008; Greenhalgh et al. 2004; Simpson 2002; Solomons and Spross 2011).

Feedback on Execution and Fidelity

This kind of feedback is more important during the adoption stage than the pre-adoption stage. Five theoretical frameworks note that feedback might entail assessment of adoption rate, frequent monitoring of adoption progress, and feedback to practitioners about alignment with or deviation from best practice (Feldstein and Glasgow 2008; Glasgow 2003; Glasgow et al. 2003; Graham and Logan 2004; Greenhalgh et al. 2004; Mitchell et al. 2010; Stetler 2001).

Individual Characteristics (e.g., Awareness, Knowledge/ Skill, Competence, Current Practice, Demographic Factors)

Five theoretical frameworks identify key individual characteristics that are positively associated with pre-adoption,including assessment of awareness of innovations, innovativeness, skills and experience, knowledge of applying an innovation, and general fit with adopter characteristics such as learning style, tolerance of ambiguity, and concerns in pre-adoption stage (Aarons et al. 2011; Frambach and Schillewaert 2002; Graham and Logan 2004; Greenhalgh et al. 2004; Oldenburg and Glanz 2008; Rogers 2003; Solomons and Spross 2011). Alternatively, individual lack of skills and appreciation of research are negatively associated with preadoption (Solomons and Spross 2011). During the adoption phase, according to four theoretical frameworks, a continuing general fit with adopter characteristics, innovativeness, tolerance of ambiguity, and training carried over from pre- adoption, individual knowledge base, and exposure to mass media and propensity towards risk-taking are positively associated with adoption (Aarons et al. 2011; Gallivan 2001; Greenhalgh et al. 2004; Oldenburg and Glanz 2008; Rogers 2003).One theoretical framework identifies individual characteristics such as longer job tenure and lack of skills and appreciation of research that are negatively associated with adoption (Gallivan 2001; Solomons and Spross 2011).

Managerial Characteristics

Although managerial characteristics are not highlighted during the pre-adoption phase, one theoretical framework finds that managers have a direct influence on workers' motivation, morale, and rewarding innovation and change (Damanpour and Schneider 2006, 2009).

Social Network (Individual's Personal Network)

Social networks on the individual level are important to pre-adoption and adoption. One theoretical framework emphasizes the positive association between extensiveness of staff social networks and pre-adoption (Valente 1996). During the adoption stage, social networks become more critical. Three theoretical frameworks indicate social ties within and outside an organization, extensiveness, quality, diversity, and organicity of such networks are positively associated with adoption (Greenhalgh et al. 2004; Mendel et al. 2008; Valente 1996).

Synthesis of Staff/Individual Characteristics

Individuals' attitudes and motivation for adoption, particularly positive attitudes toward change, the need for change, and quality improvement are important for successful adoption. Feedback on the adoption process is useful in increasing adoption, and individual characteristics such as skills and experience, innovativeness, tolerance of ambiguity, propensity towards risk taking are associated with increased adoption. Job tenure and lack of skills are negatively associated with adoption for staff, but education and tenure are positively associated with adoption for managers. As seen in external and organizational characteristics, extensive social networks of individuals are associated with adoption.

Client Characteristics

Readiness for Change and Capacity to Adopt

One theoretical framework notes that, in addition to net- working with innovation developer and researcher, early involvement of potential users (staff or client) is positively associated with pre-adoption (Backer et al. 1986). During the adoption stage, four theoretical frameworks suggest that client attitudes, beliefs, and readiness towards change, and willingness to adopt and adapt innovations as needed are positively associated with adoption (Feldstein and Glasgow 2008; Frambach and Schillewaert 2002; Glasgow 2003; Glasgow et al. 2003; Weinstein et al. 2008). For example, clients' competing demands for their attention and pre-existing conditions may facilitate or impede their participation in adoption (Feldstein and Glasgow 2008).

Discussion

Several mechanisms for change can be consolidated across contexts: Leadership, innovation fit with norms and values, and attitudes/motivation toward innovations each are mentioned in at least half of the theories and across organization, innovation, individual, and client contexts. Although some of these constructs (e.g., attitudes) may be frequently studied because of ease of measurement, and not all of them have consistent directionality of findings, these factors are clearly important to understanding adoption. They provide a suggested direction for researchers to focus future investigations on the drivers of adoption and may serve as the basis for developing interventions to promote adoption of EBPs. This consistency, however, is limited by a lack of precise definition and measurement of mechanisms that can lead to con- fusion for policymakers and organizations attempting to adopt innovations. For example, when leadership is conceptualized as CEO influence or the presence of champions or opinion leaders, it has a positive effect on adoption. Other conceptualizations of leadership, such as centralized or overly formal, top-down leadership, are not conducive to adoption, and leadership metrics such as tenure, education, and recency of education are not associated with adoption.

The 20 cited theoretical frameworks hypothesize about relationships between constructs and innovation adoption but only five include empirical data to test hypotheses. Four adoption-specific theories (Cohen and Levinthal 1990; Damanpour and Schneider 2009; Gallivan 2001;Valente 1996) and one theory of adoption within the con- text of implementation (Greenhalgh et al. 2004; Meyer and Goes 1988) provide either quantitative or qualitative data to support the constructs in their models. From a practical standpoint, however, empirical data can most effectively illuminate next steps for practitioners, researchers, and policymakers. These studies present an important first start to a compilation of studies that can support a meta-analysis. They also suggest challenges regarding obtaining sufficient numbers of organizations that can be studied efficiently.

When we consider how adoption-specific theories and theories that described adoption in the context of implementation are different, we found that theories that described adoption in the context of implementation were more likely to include characteristics of the innovation as central to adoption. Damanpour and Schneider (2009) clarified the key role of innovation characteristics as most important in whether an organization adopts the innovation, whereas Klein and Sorra (1996) suggested it is rather the fit of the innovation with organization's values that is most important. Characteristics of innovations, however, are likely to have varying salience depending on the type of innovation since well defined interventions such as hand-washing have more concrete and observable stages of adoption compared to the implementation of complex psychosocial interventions (Weinstein et al. 2008). Adoption-specific theories were also more likely to focus on early markers of feasibility, such as leadership, attitudes toward adoption, and organizational size and structure, whereas theories in the context of implementation were likelier to address issues related to long term implementation and sustainability, such as cost-efficacy, relative advantage, and government policy and regulation. These findings suggest adoption should be considered a separate construct from the other stages of implementation.

As suggested above, these findings suggest opportunities for clarification of innovation adoption theory. Although this synthesis focuses on theories, review of included studies suggested measurement of mechanisms varied considerably and also contributed to a lack of clarity. For example, the two studies that measured leadership each measured it in a different way: Gallivan (2001) conducted interviews with 53 individuals over 2 years in a single organization and determined qualitatively that the nature of leadership (top-down, bureaucratic) was associated with adoption, and Valente (1996) assessed opinion leaders using social network nomination procedures in multiple case studies. To facilitate decision-making by policymakers and organizational leaders, researchers should reconcile these specific construct-measure combinations in a way that will provide standardized measurement to increase validity and replicability of the findings here. Similarly, measurement of the dependent variable, adoption, also was measured in different ways. Systematization through a single, widely accepted outcome measure would be useful. Future studies should identify measures that are feasible within evaluation or research contexts and that have demonstrated validity in predicting adoption.

Although this review provides thorough information on external, organizational, staff, and innovation characteristics, perspectives from the beneficiaries of innovations (e.g., clients, patients, customers, or other stakeholders) are not well represented and suggest research is conducted primarily from the organizational perspective, not from a consumer perspective. Only five studies included any information on these beneficiaries. Given the importance of stakeholders to service delivery (Aarons et al. 2009), and increasing importance of patient perspectives in health care (Sox 2010), consideration of these perspectives when generalizing findings could strengthen the theories of adoption.

Conclusions

This review identified 20 theoretical frameworks with multiple major constructs associated with theories of innovation adoption. These theories range from extremely specific models with a single identifiable construct (Cohen and Levinthal 1990) to comprehensive models that incorporate as many as 17 constructs (Greenhalgh et al. 2004). Theories incorporated mechanisms within the contexts of sociopolitical and external influence, organizational characteristics, innovation characteristics, staff/individual characteristics, and client characteristics. Theories also confirm that adoption is a process that moves from pre- adoption where staff within an organization become aware of an innovation and access information with which to make a decision, to established adoption, where the organization decides whether to proceed with and commit to the innovation (Frambach and Schillewaert 2002; Greenhalgh et al. 2004). Figure 1 presents our overarching theory of the adoption of innovations process based on the information suggested by this review.

This review has several limitations that affect its generalizability. First, as a narrative synthesis review, it explored the complex social intervention of innovation adoption by clearly examining the literature on this topic. It does not, however, demonstrate the rigor of a meta-analysis of multiple randomized trials and provides only preliminary evidence to inform future directions of research. Although it necessarily does not include every paper published on the topic, it provides a reasonable synthesis of what mechanisms within which contexts are likely to lead to adoption. Improvements in standardizing the measurement of constructs and including consumer perspectives when formulating innovation adoption theories would be useful in improving the application of these theories. The latter aspect has particular implications when organizations tailor their services to specific client populations, each with unique characteristics that may influence the adoption process when innovations are introduced.

This review, like others, offers methodological reflections on this complex area of research (Tabak et al. 2012b). First, reviews of constructs must contend with the inevitable lexical disagreement and inconsistency of definitions in the literature (e.g., ‘‘formalized’’ vs. ‘‘centralized’’ organizational structure, ‘‘organizational culture’’ vs. ‘‘organizational climate’’ etc.). More importantly, when contradictory findings are associated with such constructs, conclusions, as this review has shown, must be drawn with necessary cautions. Complex adoption constructs by nature should not and cannot be over-simplified or universally agreed upon. However, overly detailed differentiation of similar if not identical constructs will hinder the advancement of generalizable and usable theoretical frameworks. In this review, a preliminary cross-referencing of adoption concepts helped eliminate redundancies and clarify constructs. The exhaustiveness of literature research varies depending on the pre-specified search strategies (e.g., narrative synthesis review vs. realist review vs. Cochrane review), which also sets the boundary for the point to ‘‘stop searching.’’ Similarly, the criteria for study relevance and rigor inevitably carry at least some subjectivity, which is not necessarily a limitation if reviews on a similar topic (e.g., theories of adoption and implementation) can be critically compared to one another to elucidate both discrepancies and consistencies stemming from different methodological approaches.

Future research on innovation adoption is likely to yield advances that can directly improve the quality of health service delivery. Policymakers could choose to focus limited resources on external environments, organizations, and staff that measurably demonstrate these positive qualities that are likely to lead to successful adoption. Organization leaders can con- duct self-assessments and seek to improve the culture and attitudes in their organization prior to innovation adoption. Researchers can continue to clarify, standardize, systematize, and confirm relationships between contexts, mechanisms, and outcomes. This review provides one step toward understanding adoption of innovations by delineating constructs that affect adoption and offering suggestions for future research. The ultimate goal is to improve both our understanding of the complex process of adoption and of interventions that may encourage organizations to more quickly adopt evidence-based treatments and practices.

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The Profession of IT
Why Our Theories of Innovation Fail Us

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Abstract: Only 1 in 500 patents makes its inventor money, and businesses are awash in great ideas of dubious market value (only about 4%make money).[1] So why do people think innovation begins with a creative idea, is sold through an imaginative story, and diffuses through society because of novelty and merit? Innovators mobilize people to adopt ideas. Although they might start with idea creation, innovators focus mostly on other aspects: market offers, market testing, beta prototyping, production, sales, and customer-support infrastructures that companies use to get products adopted. In fact, 90% of innovation is in fostering adoption.1,4 Ideas are often stories invented after the fact to explain innovations that already emerged, as with the iPhone example discussed later in this column. Yet the media telling of the story makes it sound as if ideation—the creation of ideas—is 90% of the work of in-novation. Ideation has produced many inventions that never became innovations because no one adopted them. Many people are misled by stories that inaccurately equate innovation with invention. People who believe these stories put too little effort into adoption and are disappointed by their low success rates.[1,5]

Bob Metcalfe, the inventor of ethernet, tells the story of 3Com, a company he founded to make and sell Eth-ernets.4 His story is full of accounts of his having to convince executives of companies they needed a network product they never heard of before, and then living up to the expectations he left them with. He spent one year developing his Ethernet idea and the next 10 years selling Ethernets. Sales do not matter in invention, but they matter in a big way in innovation. He summarized his effort with his famous saying, "Invention is a flower, innovation is a weed."

Three Flawed Memes: Hindsight, Oversimplification, and Ideation

Innovation stories are tremendously influential in guiding our perceptions (and interpretations) about innovation process and hence our actions. An example is the innovation pipeline: an innovation begins as an idea and flows through stages of prototyping, production, and marketing before ar-riving in the marketplace. Another is the innovation funnel: a set of ideas is progressively winnowed by reviews, prototype tests, and market tests, until the few with greatest merit make it to the marketplace. A third example is network diffusion: an innovator injects an idea into a social network, where it spreads out across the communication channels of the network until everyone has a chance to adopt it. A fourth is the innovation cell, a protected pocket of innovators spinning off ideas into the surrounding environs. These stories are all "sticky." It is easy to form a mental picture of a pipeline with ideas flowing through it, or a series of progressively narrower funnels flowing one into the next, or waves of adoption washing through a network, or ideas spinning off a round-table. They are memes that hold our attention. However, these sticky stories contain flaws that lead the unwary into actions that do not work.

The first flaw is that our stories about innovation are retrospective. In hindsight, we can see all the actions involved in an innovation and de-scribe a pattern they seem to follow. But as innovators "in the trenches" we experience things quite different-ly. Every action seems to have an un-predictable outcome and we cannot tell if it leads us closer to our desired innovation. So many things depend on actions of other people. Doubt and uncertainty are irreducible. You cannot "see" where you are in the pipeline, funnel, network, or cell; only future historians can pass those judgments. Bob Metcalfe did not find executives ready and waiting for ethernets; he constantly had to confront their doubts about a product they never heard of before, persuade them of its benefits to their companies, and convince that he would be a trustworthy supplier of Ethernets. If you try to form an innovation plan around the pipeline, funnel, network, or cell model, your plan will almost always fail because the people involved can-not tell where they are in your imagined structure.

The second flaw is that our stories about innovation are tremendously oversimplified. The stories present the successful actions of innovators as de-liberate, considered, and sometimes inspired choices by persons able to make sense of the situation and control it. Their individual actions fit together into neat causal chains whose outcomes align with the innovator's intentions. Bob Metcalfe could say afterward that he visited the "ABC" company, overcame their doubts, and got their order for Ethernets. But when he was there nothing was certain. He had to learn their doubts and concerns, find a way to show them Ethernet took care of an important concern, and build trust in him as the salesman and supplier. How did he learn their doubts? Discover their unmet concerns? Construct a proposal on the spot for how they could try Ethernets at acceptable risk? Lead them to the conclusion he was sincere, competent, and had their best interests at heart? Bob will tell you he often had no idea what it would take to close a deal, and in many cases he failed to close a deal. He did not feel in control. The best he could do is approach each encounter with a sense of confidence he could lead the conversation to a successful conclusion. How did Bob cultivate a mood in himself that dis-posed him toward success?

The third flaw is all the innovation models assume an idea starts the process. Someone's idea triggers the pipeline, or feeds the funnel, starts a wave in the network, or seeds the cell. What if most innovations do not be-gin with an idea? For example, social innovations such as Mothers Against Drunk Driving or more recently legalized marijuana and same-sex marriage welled up in popular opinion and swept many people along. The leaders of these movements report they were reacting to injustices and not creating ideas. Many technology innovations seemed to well up out of circumstances of the time without anyone claiming to have put an idea into action. For example, the iPhone and smartphones that imitated it seemed to catch on because "the time was right" even though many previous similar attempts had failed. Blogging seemed to well up without anyone inventing blogging or even stepping forward afterward when there was an opportunity to claim credit and be recognized in Wikipedia. These examples illustrate the larger pattern: most innovations "emerge" in the practices of communities and are not caused by someone's good idea.[3] In fact, most of what we call "ideas" behind innovations are actually stories made up in hindsight to explain the practices al-ready emerging.

With these flaws, it is difficult to see how careful strategic planning, in-novation process management, and charismatic leadership can work consistently well. In a review of Barbara Tuchman's March of Folly: From Troy to Vietnam, written many years ago, Gordon Wood wrote there was but one big lesson of history: "Nothing ever works out quite the way its managers intended or expected."6 This larger lesson un-fortunately has not yet made it into our dominant narratives about innovation.Sticky innovation stories are easy to recall and fun to retell. The only way to displace these stories is to interpret innovation with new and bet-ter stories. You need a new story to dislodge a story.[3]Inovations are new practices adapted in a community, which displace other practices.

If Not Ideation, Then What?

If ideation is a relatively easy 10% of your effort, how should you spend the other 90%? What should you do? We like the story from Fernando Flores about innovation emergence.2 This story begins with the notion that i-novations are new practices adopted in a community, which displace other practices. Emergence of a new practice begins when someone makes a proposal to combine existing practices in a new way to meet an unmet concern. The proposal is contingent on many factors: technologies and practices al-ready in existence, unmet concerns in the community, the proposer's timing and choice of concern to address, the social power of the proposer's network, and the strength of the opposition.2 Bringing an innovation into reality, therefore, is unpredictable and relies on explicitly working for adoption.

For example, Steve Jobs did not simply create iPhone in a flash of genius and sit back and wait for the profits to roll in. His contribution was to believe in a vision of a lightweight portable phone that could be customized to its owner's detailed personal preferences, and to mobilize a business network to make it happen. The Apple company invested a lot of work to transform the iPhone vision into an adopted technology. The transformation was contingent on the existence of other components already, or soon to be, in place. Apple worked with suppliers to build smaller and more energy-efficient components such as hard disks, touch displays, scratch-resistant gorilla glass, sensors for GPS and motion, and batteries. Apple adapted the operating system MacOS into iOS that would manage an interface presenting a large collection of user-chosen apps. Apple adapted the iTunes store into an apps store and cultivated a net-work of a million programmers to populate it with downloadable apps. Apple worked with the telecommunication companies, initially AT&T, to create data plans within the cellular phone network. Apple worked with professional product designers and marketers to position the iPhone as a lifestyle enhancer rather than a mobile phone. The iPhone was contingent on all these components and the business deals that made them work. Its adoption took a great deal of business and political skill. Yet the popular stories focus on Jobs alone and ignore the huge amount of work Apple invested to get the iPhone widely ad-opted. You will find similar stories in all the other technology companies. The standard stories focus on the genius of the founders and ignore the hard work they put into adoption.

Six Fundamental Skills

The six skills in the accompanying table nicely summarize what innovators do.2 Innovations emerge in spaces of practices, which are constantly drifting and changing as powerful forces converge and conflict. Innovators pro-pose changes of practice and shape their adoption. In the swirl of the forces nothing is certain. Multiple people are likely to come up with competing proposals at about the same time, each responding to the sense of an un-met concern that anyone who cares to listen can detect. These six skills are based on your ability to listen for concerns, histories, movements of social power, barriers, moods, reactions to offers, and followers in networks. They depend only loosely on communicating your ideas or telling your stories.

Offering and mobilizing are the core skills. Your offers are proposals to take designs into social movements. Can you make offers that intrigue people with new possibilities to address their (often unspoken) concerns and do not seem too risky? Can you turn your networks (or build a network) into a following of people who commit to the new practices the offer brings? Do you understand who will resist or support and what actions will harness the power of the network to shape the emerging new future?

Detecting, appropriating, navigating, and surfing all support the core skills. Detecting means to sense an unmet concern and form an inkling that you can do something about it. Appropriating means to immerse in related domains to discover marginal practices and interpretations that can help you with your inkling. Navigating means to move toward a goal in a complex and uncertain world; the metaphor recalls seafaring explorers in open oceans who must respect the power of the waves and the limitations of their crews, avoid storms, and deal with emergencies. Surfing means to ride waves that move in the direction you seek and keep your balance when turbulent network forces buffet you.

To be an innovator, learn these six skills.

Six skills for achieving adoption.

Offering	Making proposals of combinations of existing practices and technologies to meet an unmet concern, then observing reactions and modifying the offer to be more attractive.
Mobilizing	Getting a social network to back your offer and help make it happen; depends on the social power of the network and on your personal power.
Detecting	Sensing an opportunity in an unmet concern or a disharmony; being unsettled by an anomaly.
Appropriating	Investigating related domains to understand their history behind their concerns, and to discover existing practices that might help with the concern you are dealing with.
Navigating	Finding your way amidst conflicting waves of possibilities, coming to your goal without having a detailed plan to get there.
Surfing	Finding waves of possibilities moving toward your goal and riding with them, retaining your balance and center when hitting turbulence.

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Correlation Between Brand Longevity and the Diffusion of Innovations Theory

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Abstract: This article attempts to apply the diffusion of innovations theory to the current concepts of branding of products and services that have roots in both marketing and communication. The authors attempt to analyse the diffusion of innovation theory and to draw correlations between the fundamental principles of diffusion and those of branding of products and services in practice. The following research question was posed: What are the correlations between the diffusion of innovations theory and branding principles and practices today? The concepts of 'diffusion of innovations' and 'diffusion of information' are used interchangeably throughout this article. The rationale for this is that in some cases, a technology may be almost entirely composed of in- formation although a methodological problem in such studies is that their adoption cannot be so easily traced or observed in a physical sense. The innovation–decision process is essentially an information-seeking and information-processing activity in which the individual is motivated to reduce uncertainty about the advan- tages and disadvantages of the innovation.

Introduction

One reason why there is so much interest in the diffusion of innovations (DOI) is because getting a new idea adopted, even when it has obvious advantages, is often very difficult, particularly in a developing environment. There is often a legitimacy gap in many fields between what is known and what is put into use (Rogers, 1983, p. 1).

The objective of a diffusion model is to repre- sent the level of spread of an innovation among a given set of prospective adopters in terms of a simple mathematical function of time that has elapsed since the introduction of the innovation. The purpose of the model is to depict the succes- sive increase in the number of adopters and predict the continued development of a diffusion process already in progres (Mahajan and Muller, 1979, p. 55).

Foundations of the Diffusion of Innovations Theory

The DOI theory was made known by Everett M. Rogers in the late 1960s. Up to this point, some research had been conducted on this phenomenon. The following are some of the earlier contributors (Masson, 2003, pp. 3–4; Orr, 2003):

1903: Gabriel Tarde introduces the sigmoid (s- shaped) curve for diffusion processes.

1943: Ryan and Gross identify the adopter categor- ies—innovators, early adopters, early/late major- ities and laggards.

1957: Katz makes the connection between media, opinion leaders and opinion followers.

Further studies have been completed by Hägerstrand (1965), who studied diffusion in an agricultural context with his model based on proximity, and Bass (1969), who developed differential equations borrowed from physics to formulate an alternative model of diffusion of innovation (Masson, 2003, p. 6).

According to Rogers (1983, p. 6), 'Diffusion is a kind of social change, defined as the process by which alteration occurs in the structure and func- tion of a social system. When new ideas [the ——————————————————————————————————innovation] are invented, diffused, and adopted or rejected it leads to certain consequences, ultim- ately social change occurs'. Diffusion of inno- vation is (1) the process by which an innovation; (2) is communicated through certain channels; (3) over a period; (4) among the members of a social system (Rogers, 1983, p. 10). Therefore, the ele- ments of the diffusion of an innovation are as follows.

The innovation

An idea, practice or object that is perceived as new by an individual or other unit of adoption. 'Any idea perceived as new by the citizens of the community applies to this [diffusion] process, the perceived newness of the idea is what counts, not its objective newness' (Littlejohn, 1989, p. 263). This novelty is relative to the system under investigation. What may be a new concept to one society could have been in common practice for centuries in another.

Communication through channels

'The essence of the diffusion process is the informa- tion exchange by which one individual communicates a new idea to one or several others' (Rogers, 1983, p. 17). Communication is a convergence of meaning achieved by symbolic interaction. The adoption, rejection, modification or creation of an innovation is a product of this convergence process (Littlejohn, 1989, p. 264). Rogers and Kincaid, as quoted by Littlejohn (1989, p. 263), state that al- though mass communication channels may play a significant role in diffusion, interpersonal networks are the most important.

Members of a social system or network

This element is almost inseparable from the previ- ous one. As was stated earlier, 'The social system constitutes a boundary within which an innovation diffuses' (Rogers, 1983, p. 24). The degree to which ideas are accepted and modified depends in large measure on the interaction along the [formal and informal] links in the social network (Littlejohn, 1989, p. 263). 'The structure of a social system can facilitate or impede the diffusion of innovations in the system' (Rogers, 1983, p. 25). The transfer of [new] ideas is better and more easily facilitated within a homogeneous group, or a group that have similar attributes such as language, beliefs, education and social status, etc. (Rogers, 1983, p. 18).

One should also take the system's norms and values into account. 'A system's norms can be a barrier to change.. .' (Rogers, 1983, p. 27). 'When a person's [adoptive] behaviours violate the culture's norms, social sanctions are usually imposed' (Lustig and Koester, 2006, p. 91). There- fore, before considering the diffusion of an innovation within a particular culture or social system, one should make a comprehensive at- tempt to understand the culture and the possible reaction that an innovation might receive.

Period

Time is intrinsic to the process of communicating, even more so if the concept being communicated is unknown to the audience. 'Diffusion of innovation is a time-consuming process. Many years may be required for an idea to spread' (Littlejohn, 1989, p. 263). Should diffusion be successful, it is evident from the x-axis in Figure 1 that the period is directly proportionate to the number of units that adopt the innovation.

Adopter Categories

With reference to Figure 1, it is apparent that there are certain adopter categories in the diffusion of innovation process. These categories move along a continuum of innovation adoption. The categories of adoption are as follows.

Innovators

This group has a low level of uncertainty avoidance, meaning that they have a high tolerance for ambi- guity, take risks easily and try new things (Lustig and Koester, 2006, p. 119). They most often have cos- mopolite (diverse) social relationships and the fi- nancial backing to lessen the monetary pinch should the innovation be unprofitable (Fill, 2005; Rogers, 1983).

Early adopters

These individuals are more integrated into their so- cial system. This category has the largest relative number of opinion leaders. They are also the most likely to be consulted by potential adopters with regards to the innovation (Fill, 2005; Rogers, 1983).

Early majority

The early majority relies on informal sources to gain information about the innovation. They might take a relatively long decision period to adopt the innovation (Rogers, 1983, p. 249).

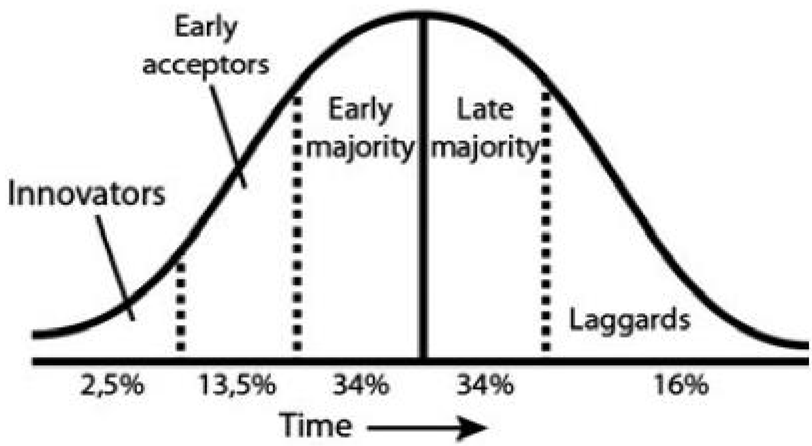

Figure 1 Slow diffusion of an innovation (Source: Hawkins et al. as quoted by Fill, 2005, p. 54)

Late majority

This category adopts after the mean (average) part of the population has adopted, their main characteristics being that they are sceptical and cautious. Laggards, a synonym for late majority, could be persuaded to adopt, but the acceptance of peers is the critical fac- tor if adoption is to ensue (Rogers, 1983, p. 249).

'In the early stages of the diffusion of an innovation, when relatively few individuals have adopted, the rate of the adoption proceeds ex- tremely slowly. The cumulative rate of adoption is characterised by almost a straight line... But eventually enough adopters are reached when many individuals in the system perceive that 'everybody is doing it.' At this point enough other individuals have adopted so that an individual considering adoption of the innovation perceives that the innovation would have sufficient utility to justify its adoption' (Mahler and Rogers, 1999, p. 721).

Markus (1987, p. 494) complements the above by writing, 'Innovation spreads when others either observe the early adopters and imitate them to replicate their profits or communicate with early adopters and are persuaded or induced to adopt.' According to Mahler and Rogers (1999, p. 721), the 'critical mass' can be defined as 'The minimal number of adopters of an innovation for the further rate of adoption to be self-sustaining.'

Opinion leaders play a prominent role in the cumulative rate of adoption. Rogers (1983, p. 27) identifies an opinion leader as someone who is able to influence other individuals' attitudes or overt behaviour informally in a desired way with relative frequency. Opinion leadership is earned and maintained by the individuals' technical competence, social accessibility and conformity to the system's norms.

Change agents often make use of opinion leaders by giving them incentives to adopt (for example, discounts on the innovation; see Hanson and McEachern, 2008) in order to facilitate the adoption by the rest of the system. 'The change agent/change agency is an individual or conglomerate of individuals that influence the client's innovation decisions in the direction that the change agency wishes' (Haider and Kreps, 2004, p. 5; Rogers, 1983, p. 28). 'The change agent does not usually form part of the community or system in which he/she is disseminating the information about an innovation' (Barker, 1987, p. 362). A direct and positive relationship exists between the extent to which the change agent can communicate an innovation from the client's perspective and the adoption by the client. 'Change agent empathy with clients is especially difficult when the clients are [demographically et cetera] different from the change agents. We expect change agents to be more successful if they can empathise with their clients' (Rogers, 1983, p.321).

Stages in the Innovation Decision Process of Adoption

Given that decisions are not authoritative or collective, each member of the social system faces his or her own adoption decision that follows a five-step process (Rogers as quoted by Orr, 2003). These stages are sequential and are characterised by the different factors that are involved in each stage (for example, the media used by the individual) (Fill, 2005, p. 52).

Knowledge

This term is synonymous with awareness. The mass media is mostly used by the change agents to create awareness or knowledge. Socio-economic characteristics, communication behaviour and personality variables have an effect on where and what type of information is obtained during this phase.

Persuasion

During this phase, the consumer or stakeholder in general becomes aware that the innovation may be of use in solving known and potential problems. Testimonies from those who have experience of the product become very important (Fill, 2005, p. 52). Positive perceptions of relative advantage, compatibility complexity, trialability and observability are processes necessary in order to proceed to the next step. In other words, the individual stakeholder must be convinced of the benefits the innovation holds for him or her.

Decision

The innovation is either adopted or rejected during this phase. In the case of the former, continued adoption or discontinuance could be a result, whereas the latter could result in continued rejection or with more time and information might translate into a later adoption. Implementation and confirmation follow in either case.

Rogers (1983, p. 1), when referring to the diffusion of an innovation, said, 'There is a wide gap... between what is known and what is put into use'. A consumer or stakeholder in general may be aware of a number of potentially need satisfy- ing products in a product category, called an evoked product set (Clow and Baack, 2007, p.70) where only casual knowledge about each brand is held (Rogers, 1983, p. 20).

Contemporary Use of the Diffusion of Innovation Theory

Not much has changed in the structure of the DOI theory over the years. Rogers has recently brought out his fifth edition (2003) of the original DOI, and the theory still remains popular and empirically relevant. Authors have applied the theory to vari- ous fields including policing (Skogan and Hartnett, 2005) and the job environment of the working poor (Chatman, 1986).

Holt's (2004) theory on the relation of brand loyalty to the social network rests heavily on the diffusion of innovation's basic principles of adoption, opinion leadership, change agents and the elements of diffusion: an innovation, communication channels, periods and social systems. Conducting a historical longitudinal analysis of the diffusion of several product brands that rely primarily on their intangible brand capital as opposed to their physical performance or attributes (for example, Mountain Dew, Bud Light and Coca-Cola), Holt introduced a model of which fundamental characteristics are grounded in the diffusion of innovation theory. In order to secure longevity or continued adoption (see Figure 2) with regard to iconic brands, Holt (2004, p. 127) proposes the following: '[market] relevance is not about clothes or haircuts. It's about keeping up with changes in society. As their [the brands'] patrons' dreams and anxieties get pushed around by real changes in the economy and society, new kinds of myths [stories that address societal imbalances] are needed.' Underlying the DOI the- ory is that, in order to secure the successful diffu- sion of an innovation, it must be perceived as culturally relevant and appealing to the norms of the system one wishes to diffuse it into. This aspect applies to almost every area where the fields of communication, politics, marketing and public affairs are concerned.

Holt's model explains that iconic brands nurture loyalty through the chemistry of diffusion between the brand's three constituents: insiders, followers and feeders. 'Brand loyalty... is determined in large part by the relationship between these constituencies and is a product of this social network' (Holt, 2004, p. 140) (see Figure 3). Littlejohn (1989, p. 263) has the following to say about the DOI and networks: 'Networks are more than a simple information linkage between opinion leader and follower... How individuals understand ideas and the degree to which ideas are accepted and modified depend in large measure on the interaction along the links in the network.'

'Followers form the nucleus of the icon's customer base, for they find the greatest value in its myth' (Holt, 2004, p. 140). The followers are those consumers who have invested some of their identity in the brand and are loyal to the brand but not necessarily to the extent that they don the brand merchandise as part of their everyday attire. A good example is a corporate executive wearing a Harley Davidson jacket at rallies and breakfast runs but not every day of the week.

Insiders, on the other hand, play a critical role in bestowing legitimacy and credibility on the brand, albeit not so much in generating revenue. Insiders act as opinion leaders, positioned to make authoritative judgements as to whether the brand really has populist appeal or not (Holt, 2004, p. 147).

If enough people [followers and insiders] register deeply with a brand's myth, their passionate use of the brand creates a magnet effect on others who then become the brand's feeders. Feeders, who are attracted to the status and social ties that the brand produces, use the brand as a vehicle to build social solidarity with friends and colleagues.

'[Feeders] are fair-weather fans: promiscuous fans who jump on the bandwagon of any winning team. For example, the pleasures of watching and talking spectator sports are shaped by feeders' friends and, particularly, by the media' (Holt, 2004, p. 147). Feeders take a much shorter period than insiders and followers to move through the stages of adoption in the innovation decision process of adoption (see Figure 3) but are also exponentially more likely to discontinue adoption once the next 'big thing' arrives. They default at the decision stage of the innovation decision process of adoption to a discontinued adoption.

The extraordinary devotion of followers and the credibility bestowed on the brand by insiders together create an easily accessible and effective identity currency that sustains feeders. Feeders do not imbibe much in the myth experience but instead feed off the experiences of others to construct an identity for themselves (Holt, 2004, p. 149).

Diffusion of Innovation Theory: Practice and Application in Branding of Products and Services

Diffusion of innovations theory can be applied and associated across a myriad of branding principles and concepts. In its elementary relation to DOI branding is concerned with change agencies or the organisation that wishes to establish differential and unique perceptions of their product and/or services in order to diffuse that innovation/product among a system/network or target market with the aim to influence the network favourably towards adoption. Although branding is such an extensive concept, for the purposes of this article, the concept of 'product brand' is used and for this one needs to differentiate between two broad categories of product brands.

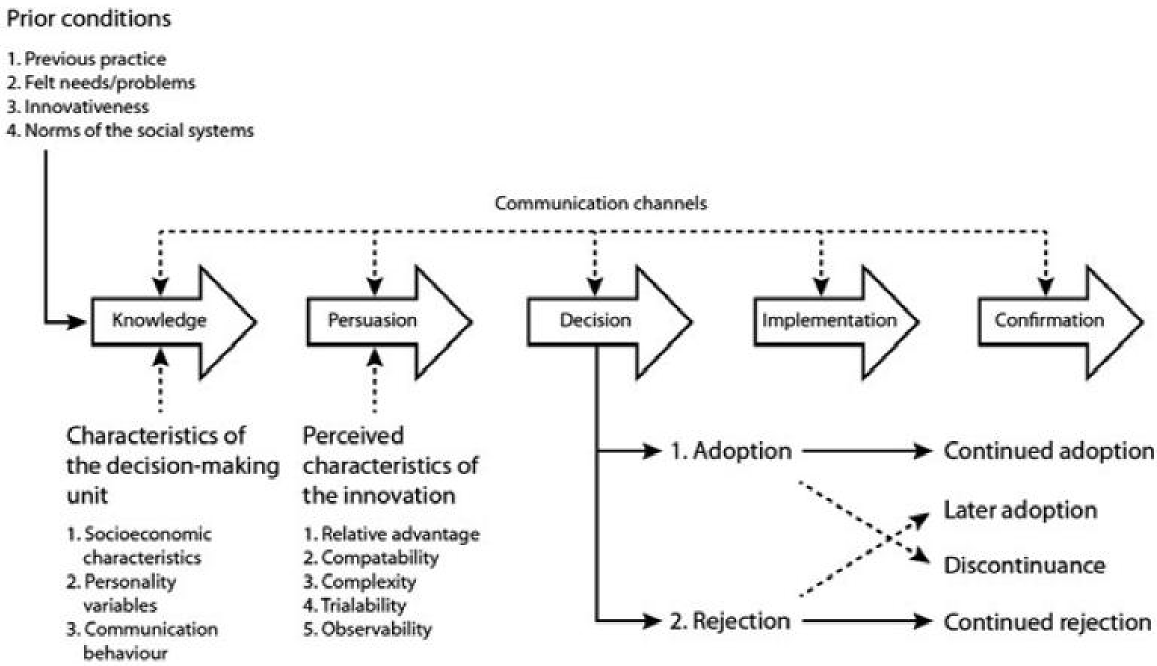

Figure 2 Stages in the innovation decision process of adoption, Rogers (Source: Fill, 2005, p. 53)

The first category is fast moving consumer goods (FMCGs) like washing powder, milk and stationery. It should be kept in mind that with the right differ- entiation, these products could add to social status and emotional value, but in most cases, they are purchased to fulfil a definite functional purpose. The second category is high-involvement products such as fashion clothing, expensive cars and other products that transcend the mere physical need fulfilment of a consumer to portray social symbolism (aiding in the construction and acceptance of a social world) and self-symbolism (acting as an extension of the consumer's identity) (Elliot and Percy, 2007, p. 25).

Fast moving consumer goods and diffusion of innovations

Primarily where FMCGs are concerned, consumers are only interested in fulfilling a functional need. Rational thought or cognition is applied to the ex- tent of perceiving the need and acquiring a product to fulfil the need. ‘In most cases awareness of the brand is a key predictor of a purchase’ (Elliot and Percy, 2007, p. 11). With relation to the stages in the innovation decision process of the adoption model (see Figure 2), this implies that the journey from the knowledge to decision stage is relatively short and superficial. Products in this category are also not much different from each other, bidding several offerings or brands of the same functional product. From a product branding perspective, it is therefore important for communication managers to manage perceptions by portraying relative advantage, compatibility, complexity, trialability and observability in a direct and arresting way.

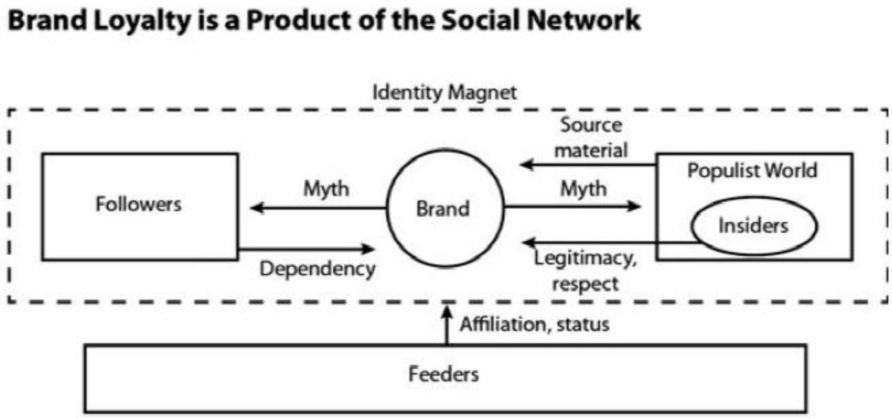

Figure 3 How brand loyalty functions within the social network (Source: Holt, 2004, p. 140)

High-involvement products and diffusion of innovations

In this category, high levels of risk accompany the acquisition of products. High-involvement products are for the most part very expensive (more so than others fulfilling the same functional purpose), carry definitive connotative capital in the minds of the consumer/adopter’s collective society or social sys- tem and can be used as valuable social currency. However superficial it may sound, the products in this category are often used to leverage social accept- ance (social symbolism) and to depict an image and reputation, as well as extension of oneself through one’s material possessions (self-symbolism). Quoting Veblen, Elliot and Percy (2007, p. 66) maintain that ‘It is a basic fact of human society that people need to display their social status, and that consumption of goods could be used to maintain a position of social prestige.’

High levels of uncertainty and risk accompany all the levels of the stages in the innovation decision process of the adoption model when this type of innovation is being acquired. Even after a purchase has been made, post hoc rationalisation takes place where the consumer tries to justify the product acquisition with cognitive rationale (Elliot and Percy, 2007, p. 26). ‘It is useful to conceptualise the diffusion and adoption of innovations in terms of a framework based on information and uncertainty.. . Uncertainty, or the perception of risk, implies a lack of predictability, of structure, of information. In fact, information represents one of the main reasons of reducing uncertainty’ (Rogers, 1983, p. 6).

Because of the lack of solid identity and grounded core beliefs, people search for something more and often see material possessions as the only fulfilment of this intrinsic compulsion. According to Elliot and Percy (2007, p. 133), in order to reduce risk (and ultimately materialise a purchase), consumers need to be persuaded that the chosen brand is different from the competition (either positively or negatively), and that this point of difference is unique to the brand and therefore worth paying more for the product. This leaves opportunity for the brand coordinators and communication managers to comfort and inform consumers with regard to their brand. These individuals should be certain that they are communicating from the cautious consumer's perspective in order to effectively address uncertainties and secure maximum possibility of adoption.

Regrettably, and true to the DOI theory, perceptions formed by external media and change agents are not necessarily the deciding factors in acquiring a high-risk product, service or innovation. 'Thus the choice between certain brands may be seen as dem- onstrating relative amounts of cultural capital and individual choice, which is very likely to be partly determined by.. .social background rather than re- cent marketing activity' (Elliot and Percy, 2007, p. 67). This statement reinforces the idea that the diffusion of an innovation is mostly reliant on the social acceptance of a collective social system and only partly on the change agent's or communication manager's initial awareness–creation campaigns.

Conclusion

A brand holds a unique challenge in maintaining popularity. Unlike other 'true' innovations, intrinsic to a brand is its history. History holds the danger of consumers becoming complacent with a brand. However, true to DOI principles, society is constantly evolving, and if a brand or communication manager can proactively recognise the uncertainty gaps of possible adopters—be it functional, social, psychological or on any other level—these gaps can be exploited. The brand stands a chance not only to maintain its relevance but also to become a beacon of stability, comfort and need satisfaction. But proactive brand and communication manage- ment are paramount activities. Okonkwo (2007, p. 11) writes that consumers expect brands to be in- novative in designing products and creating trends. She further states that consumers do not expect brands to wait around to understand the consumer's psychology, changing tastes and way of thinking—they should do so before even the consu- mers do.

Timely communication links into proactive branding. Elliot and Percy (2007, pp. 242–243) claim that, in order to be believable, the benefit claims made must be real, true and consistent with how people currently think about that innovation. Other- wise, it leaves open the likelihood that the target audience will consciously counter-argue the message. Diffusion is essentially concerned with the non- economic factors that influence an individual to make a decision. This is directly aligned with branding, communication and reputation management. Brand- ing concerns those intangible factors that influence an individual to adopt one innovation with the opportunity cost and exclusion of another.

The DOI theory can be revisited by a variety of areas in the communication, marketing, public rela- tions and public affairs disciplines—particularly where the adoption of new ideas and innovations are concerned. It can be particularly useful in a developing environment like South Africa.

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Workplace innovation in European companies

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Introduction

A workplace innovation (WPI) is a developed and implemented practice or combination of practices that either structurally (through division of labour) or culturally (in terms of empowerment of staff) enable employees to participate in organisational change and renewal and hence improve the quality of working life and organisational performance. This report looks at reasons for enabling WPI, along with its adoption and implementation, and the impacts of it from the viewpoints of the organisation and management, employees and employee representatives. From the database of the third European Company Survey (ECS 2013), some 51 companies were selected from 10 EU Member States in which case studies were undertaken.

Policy context

In light of the Europe 2020 Strategy, which aims at achieving smart and inclusive growth, the European Commission views WPI as an important driving force for the European economy. Specifically, the Commission sees WPI as a motor for innovation and competitiveness, and as a way to transform workplaces to make better use of human talents and skills. However, there is a need for greater clarity about what policy- makers can do to stimulate WPI and therefore it is important to gain an understanding of why and how WPI is implemented by the companies looked at in this study.

Key findings

Using qualitative comparative analysis (QCA), the study identifies WPI innovation practices, the motives for their introduction, the process of implementation and impacts. It also identifies paths that companies take to realise WPI.

Types of practices

Among the 51 cases, five practices were distinguished overall; three were WPI-related:

WPI-structure: these are practices related to teamwork, job design, organisational restructuring, etc (14% of all practices).

WPI-culture: these include practices that enhance com- munication, knowledge sharing, employee participation, employee–manager dialogue, and management–employee representation dialogue (20% of all practices).

WPI-mixed: these are combinations of the above practices (19% of all practices).

Two non-WPI practices were distinguished: HR practices – the largest category of all practices (39%); and other practices, such as technology-related interventions (8% of all practices). Most companies in this study combine different practices in order to simultaneously improve the quality of organisational performance and the quality of work. A minority of practices is directed exclusively at improving either quality of performance or quality of work.

Reasons for introducing WPI practices

To get a better understanding of WPI, the study explored (with managers, employee groups and employee representatives) the reasons companies introduce WPI practices. From the organisation perspective, it is primarily done to: improve efficiency; gain competitive advantage; and enhance innovative capability.

From the perspectives of managers and employees, economic and business goals remain the predominant reason but learn- ing and development opportunities and performance are also considered important reasons for introducing WPI practices.

Five paths to WPI

The research identified five paths that companies have taken towards WPI practices. The analysis of case descriptions reveals a process model that companies apply when implementing WPI practices. On the ground, quite a variety of WPI practices emerge. Overall, it seems that companies differ in the types of WPI practices they implement, but the process of why and how these are implemented shows considerable similarity. The five paths applied by companies that have implemented WPI practices are:

Path 1 – Top-guided WPI: This relates to companies in which employees perform innovative behaviour. The initiative for WPI practices is top down; however, employees engage in a participatory implementation process for change and renewal.

Path 2 – Autonomy-driven WPI: This concerns companies whose employees have in the past participated in developing the organisation's model. Employees in these companies have proven that they have job autonomy in combination with the presence of employee participation. The establishment itself has the latitude to make its own choices, which means it is not dependent on a mother company. These companies show hierarchical levels – that is, a certain division of labour.

Path 3 – Integral WPI: This path is taken by companies where WPI forms an integral part of work practices. These companies also have latitude to make their own choices, but show a preference for limiting the division of labour. Moreover, the implementation process of WPI is a bottom-up initiative. Their employees display innovative behaviour.

Path 4 – Employee-driven WPI: This path represents companies that facilitate employee participation in developing the organisation's model. The implementation process is a participatory, bottom-up initiative. These organisations have latitude to make their own choices.

Path 5 – Innovative behavioural-driven WPI: This path is followed by companies whose employees have not par- ticipated in developing the organisation's model. Nonetheless, employees show innovative behaviour, and the organisation is characterised by a preference for limiting the division of labour.

All five paths result in WPI; however, they vary since each path is a different combination of factors. Moreover, while organisations have room for making strategic choices, this does not mean that 'anything goes'. The company cases indicate that while there is variation of WPI practices within paths, there is similarity in that all seem to combine practices of WPI- structure, WPI- culture oriented and HR-related.

Process model and impacts

The implementation of WPI practices seems to follow a generally applied pattern. WPI practices were introduced primarily for economic reasons; however, in order for their implementation to be successful, it is essential that employees play a central role in it. The majority of respondents agreed that the three factors that facilitated implementation were: employee involvement; top-management commitment; and leadership. The impacts on the organisation (as perceived by managers, employees and employee representatives) are employee engagement, sustain- ability and high performance. Learning opportunities, voice, and challenging jobs are cited as the impacts on employees. Hav- ing a stronger employee voice, a sustainable organisation and equality and fairness at the workplace level are some of the impacts on the employee representation.

Policy pointers

Companies are urged to give greater prominence to WPI alongside the prominence given to economic and technical innovation and research programmes and initiatives. To achieve this objective, policymakers and companies need to: encourage continued agenda-setting at European level to increase the implementation of WPI practices within enterprises;enhance communication and information about the opportunities of WPI; encourage sectoral-level approaches with low thresholds for companies, mobilising sector and cluster organisations to play a role;encourage existing public programmes that support business and companies to adopt WPI;develop training programmes on the issue for both employers and employees;stimulate discussion and further research to formalise the ('sensitising') concept of WPI and its monitoring;develop diagnostic and intervention tools for companies to assess their situation and take steps towards more substantial WPI practices;facilitate the integration of WPI in innovation in general; promote WPI at national and regional level, particularly for small and medium-sized enterprises (SMEs); encourage the topic of WPI to become part of accredited education programmes in management, business, HR and (work and organisational) social sciences; stimulate EU Member States to increase employee participation and employee representation as it is beneficial for business and the quality of working life; support research on WPI to optimise greater strides towards WPI for sectors, occupational professions and SMEs; create 'Forums on the Workplace of the Future', with a strong focus on worker participation, work organisation and job design in securing innovative, productive and healthy workplaces; boost the participatory role of employees in designing and implementing the WPI practice, and the dialogue with employee representatives regarding changes and the company's future (participation and dialogue); develop fundraising for innovation programmes (research and development for practice) that include WPI.

Introduction

This report explores workplace innovation (WPI) practices across a number of EU Member States based on qualitative follow-up interviews of the third European Company Survey (ECS 2013).1 An overview of the results of the third ECS is published in Eurofound (2015), which reports on the incidence of practices of work organisation, human resource (HR) policies, employee involvement and social dialogue.

The current study builds on the Eurofound 2015 report. From the sample population, 51 companies were selected and follow-up interviews were held examining their workplace practices from the perspective of WPI. The applied case-study approach provided in-depth, qualitative information about the establishments' WPI practices. The motivations and actions of different actors (employees, representatives and managers) were investigated, as were the ways in which these actors contribute to developing and implementing WPI practices. Possible outcomes and effects of WPI practices, such as company performance and quality of work, were examined as well. The report intends to provide policymakers at European and national levels with insights into those WPI practices that benefit both companies and employees.

The applied working definition of WPI practices is: a developed and implemented practice or combination of practices that structurally (through division of labour) and/or culturally (in terms of empowerment of staff) enable employees to participate in organisational change and renewal to improve the quality of working life and organisational performance.

Case studies and the ECS

The ECS is a telephone survey of establishments in Europe with 10 or more employees, among virtually all economic sectors, in the 28 EU Member States (EU28) as well as Iceland, Macedonia, Montenegro and Turkey. From a total of 30,000 establishments ('companies' in this report), 1,284 were select- ed based on their score on a specially constructed WPI Index. This WPI Index score was constructed with ECS variables that are indicators of WPI (see the Methodology in the Technical annex, which is available separately). A selection grid broken down by pre-selected Member States, company size class and ranking on the WPI Index resulted in a listing of companies. A total of 51 cases were incorporated into the study according to the following regional breakdown:

Continental and western Europe – Denmark, Germany, Ireland, the Netherlands, UK – 22 cases;

Southern Europe – Greece, Spain – 12 cases;

Central and eastern Europe – Bulgaria, Lithuania, Poland – 17 cases.

The sampling of countries was based on instructions in the tender specifications – to achieve a certain degree of variation in WPI across Europe – and is based on the wider regional grouping (seven groups) employed in an earlier report on work organisation (see Eurofound, 2013). The aim of the sampling was to ensure variation in terms of context, culture, institutions and entrepreneurial behaviour.

Three interviews were held in each company – wherever possible, with a manager (mostly a director or HR manager), a group of employees and an employee representative. For each case, a coding matrix was completed: this comprised an interview guide in which all the answers were incorporated in a system- atic manner, and which could be used for statistical analyses. A mini-case study report (2–3 pages) was produced as well.[2]

Purpose of project and research questions

The project aims to explore the determinants and effects of WPI on the basis of 51 cases in the 10 aforementioned countries. The overall objectives of this project are to: collect in-depth, qualitative information on companies' practices regarding WPI; provide information on the motivations and actions of dif- ferent workplace actors (employees, representatives and managers) and how they contribute to outcomes in terms of participation and performance; provide policymakers at European and national level with insights into workplace practices that benefit companies' performance and quality of work; explore the link between specific workplace practices and organisational outcomes.

The research seeks to answer the following questions.

Which kind of organisation is the research dealing with and what is the overall situation of the organisation? Aspects to be studied are sector and size, national and cultural back- ground, and European region.

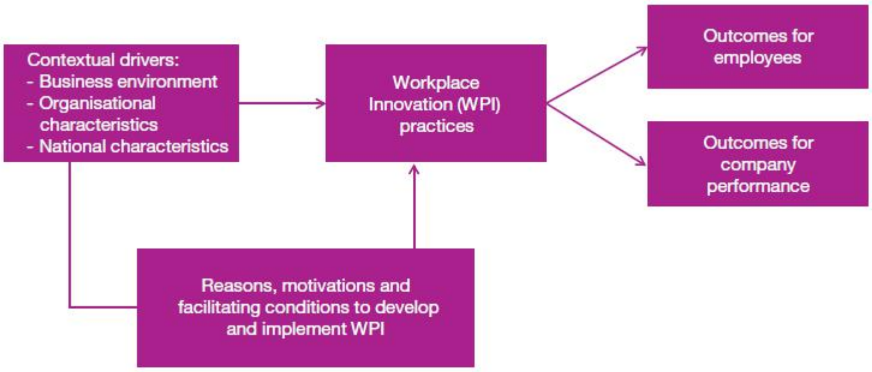
What type of WPI is applied? Aspects to be studied are the kind of practices that have been implemented and whether clusters of practices ('bundles') have been applied or not.

What are the main motivations and drivers for WPI? Aspects to be studied are the reasons and drivers for companies to adopt WPI practices, and the motivations and actions of different workplace actors (employees, representatives and managers).What is the method of adoption and implementation ofWPI? Aspects to be studied are how companies adopt he WPI practices, their process of implementation, and the role of different actors in implementing WPI practices.

What is the impact of WPI? Aspects to be studied are the link between WPI practices and organisational outcomes, and impacts and results in terms of company performance and employees' quality of work.

The basic conceptual framework is given in Figure 1 below and will be discussed later.

Figure 1: Conceptual framework



Previous Eurofound research

Eurofound has published two previous studies looking at WPI – Work organisation and innovation (Eurofound, 2012) and the Third European Company Survey – Overview report (Eurofound, 2015).

The study Work organisation and innovation was based on case-study research in 13 EU Member States. In this study, WPI was conceptualised under the restricted label of high- performance work practices (HPWPs). According to the findings, pressure to improve performance was the main driver for WPI. The research showed that this was particularly true in the context of the current economic crisis, as well as being due to the need to meet the challenges posed by demographic change and increased competition. Some companies adopted a dual approach to WPI, consisting of a top-down decision to innovate, followed by a bottom-up implementation approach.

The case-study evidence in the research suggested that the presence of social dialogue and the involvement of worker representatives make a valuable contribution to the implementation of HR innovations. It was found that WPI, under the label of HPWPs, led to increased knowledge sharing and problem sharing and solving. Innovatory practices involving lean management, teamworking, flexible working practices, workplace redesign and employee involvement were most commonly associated with positive features – such as increased company productivity, greater organisational commitment, improved service quality and, to a lesser extent, reduced customer com- plaints. Lean management, teamworking and flexible working also contributed to reduced operational costs.

The Third European Company Survey – Overview report illustrated separate aspects of work organisation and company practices in HR management, employee participation and social dialogue (Eurofound, 2015). Significantly, the report made a comprehensive overall classification of companies by examining how practices across these areas relate to each other. This resulted in five overarching groups defined by the ways in which they combine certain workplace practices into 'bundles' as follows: 'Interactive and involving' (12% of all 'establishments') – joint decision-making on daily tasks, moderately structured internal organisation, limited investment in human resource management (HRM) but extensive practices for direct participation; 'Systematic and involving' (30%) – top-down decision-making on daily tasks, highly structured internal organisation, high investment in HRM, extensive practices for direct and indirect participation; 'Externally oriented' (25%) – high levels of collaboration and outsourcing, top-down decision-making on daily tasks, moderately structured internal organisation, moderate investment in HRM, and little direct and indirect participation; 'top-down and internally oriented' (21%) – top-down decision-making on daily tasks, little collaboration and out- sourcing, highly structured internal organisation, moderate investment in HRM, and moderately supported direct and indirect participation; ‘Passive management’ (12%) – top-down decision-making on daily tasks, moderately structured internal organisation, hardly any HRM, and little direct and indirect participation.

According to the latter study:The five groups differ most in the degree to which they structure their internal organisation, with ‘Systematic and involving’ and ‘Passive management’ at the two extremes of the spectrum. The second most important indicator for the overall classification is practices with regard to direct employee participation: the ‘Interac- tive and involving’ and ‘Systematic and involving’ groups are both substantially different from the other three groups on this indicator. … Three out of the five types that have been distinguished show quite a close resemblance with approaches to work organisation and human resource management.(Eurofound, 2015, p. 125)

Establishments in the ‘Interactive and involving’ and ‘Sys- tematic and involving’ groups score best on establishment performance. Establishments in the ‘Interactive and involving’ group score best on workplace well-being. Both groups differ, but have in common a favourable environment for direct employee participation. These studies give an insight into how bundles of workplace practices are related to clusters of organisations (the five overarching groups) and how these relate in different ways to performance and well-being as outcomes. The present study goes one step further by investigating what kind of workplace practices were implemented by 51 companies that participated in the ECS.4 Most importantly, the study tries to identify if differ- ent combinations of certain variables can still lead to WPI, fol- lowing the general notion that renewal may take different roads.

Data Analysis

For this study, 51 cases studies were undertaken. The information gathered was imputed into a data file (the ‘coding matrix’) and each case was described in a mini-case study report (2–3 pages). In a first step, an expert evaluation was made to assess the ‘substantiality’ of WPI practices in the cases. Substantiality of WPI can either point to recent, distinctive WPI practices that align with the working definition of WPI, or to a WPI ‘maturity- level’ of the company as a whole. The latter covers companies with WPI practices that fit with the definition, but that may have introduced them earlier and can now be viewed as ‘WPI mature’. This expert evaluation resulted in assigning the cases to ‘sets’ of cases with different levels of ‘substantial WPI’. Using qualitative comparative analysis (QCA) subsequently, an analysis was made of the ‘conditions’ within these companies that explain the presence of substantial WPI practices. These conditions together constitute ‘configurational paths’ that can be regarded as implicit strategies applied to be or become a WPI company. Qualitative information from the interviews and case study reports were used to assess whether types of WPI practices could be distinguished. These strategies and types can be related to the theoretical notions discussed later. To get a richer description of contextual factors, drivers and motivations, ways of developing and implementing WPI, and the impacts of WPI, an in-depth analysis was conducted of the companies and their WPI practices.

Structure of Report

This report is divided into five chapters. Chapter 1 examines more closely the concept of WPI and places it within the con- text of current literature and policy at European level. Chapter 2 provides a description of the sample of 51 case studies and the 168 WPI practices implemented by these companies. Chapter 3 presents the QCA analysis, which results in five paths that companies choose to arrive at WPI. Examples of cases and what they do are discussed. Chapter 4 analyses the reasons, motives, leverages and impacts of WPI practices. Chapter 5 provides a summary and comments on the study and outcomes, presenting a process model that describes the mechanism of initiation, design and implementation of WPI practices in the companies. The chapter ends with conclusions and policy implications of the study. Details of the project team are given in the annex to this report. A separate Technical annex contains four elements: research methodology (including information about the fieldwork and analyses), tables used in the research, full list of WPI practices and separate references list (for technical annex).

CHAPTER 1: Understanding WPI

WPI – setting Boundaries

WPI is a relatively new, broad and still rather imprecise concept (European Commission, 2014). Herbert Blumer (1954) contrasted 'definitive' concepts with 'sensitizing concepts'. The latter do not involve using 'fixed and specific procedures' to identify a set of phenomena, but instead give 'a general sense of reference and guidance in approaching empirical instances'. The two terms, workplace and innovation, are interpreted in various ways. Although workplaces are usually restricted to establishments,5 in this study the workplace is defined as both the immediate working environment and the organisation as a whole. This ranges from a single work station where employees carry out their direct tasks to a multilayered organisation of which employees are members through the employment relationship. Still, the workplace can be very broad and, for example, involve the combination of 'work organisation', 'labour relations' and 'network relations' (that is, relations with parties outside the organisation) (Eeckelaert et al, 2012). Alternatively, in another example, it can refer to aalchemic combination of 'work organisation', 'structure and systems', 'reflection, learning and innovation', and 'workplace partner- ship' (Totterdill, 2015; Totterdill and Exton, 2014). This section clarifies the way in which the sensitising concept of WPI encapsulates both structural and cultural aspects of work organisation. Structural aspects refer to the production system and the design of organisational departments, teams and jobs. Cultural aspects point to behavioural phenomena such as cooperation and communication as well as enabling certain behaviours, attitudes and motivations.

There are clear links between studies on WPI and using the concept of HPWPs. This explains why some researchers have decided to regard HPWP as the equivalent of WPI (for example, as in Eurofound, 2012). As will be discussed further, this notion is too limited: WPI can be expanded to include production management and operations management as well. However, viewing HPWP and WPI as common concepts is understandable as HPWP studies try to gather evidence that certain practices, and 'bundles' of practices, are beneficial to the business performance of companies. HPWP studies are both troublesome and attractive. They are troublesome because they seem to include almost anything that is included in human resources management (HRM) as well as employment relationships and industrial relations. So, for example, the division of labour ranging from job design to labour market recruitment policies, remuneration and working conditions, and employee representation can all be part of such a definition. On the other hand, HPWP studies are attractive because they seem to cover the most important ingredients of most conceptual definitions of WPI – namely, the role of an involved and committed workforce, and how this affects organisational performance.

To understand the still quite extensive range of issues within HPWP, Boxall and Macky (2009) identified two categories. One is concerned with high-involvement work practices (HIWPs). The other concerns employment practices relating to high-commitment management (HCM). 'Work practices' deal with work organisation and job design that enhances employee involvement, while 'employment practices' concern employment relations that enhance the commitment of employees. Contrasting different HIWP approaches, there are practices where managers try to control decisions and those where employees are more responsible and involved in decision-making. Similarly, contrasting the employment prac- tices that improve commitment, there are practices that seek little enduring employee commitment and those that seek a much longer, more motivated attachment to the organisation. Control can be seen as an indicator of the division of labour – that is, the division of control capacity (de Sitter et al, 1997) and decision latitude or job autonomy (Theorell and Karasek, 1996). Conversely, commitment can be understood as the way in which people relate to each other in organisations. Such relational factors can be distinguished according to three components of the employment relationship – the operational relationship, the contractual relationship and the social relationship. The operational relationship is equivalent to the division of labour (task and job design) and associates with 'control'. The contractual relationship is associated with the terms of employment, such as remuneration, working time and (numerical) flexibility. A central notion of the social relationship is how people deal with each other as human beings – for example, showing mutual respect and granting each other trust and personal space. Control and commitment are two sides of the same coin in the sense that together they constitute how human resources are 'mobilised', not managed, to achieve an organisation's goal (de Sitter, 1995; Korver, 2006). However, it is helpful to disentangle them to get a better understanding of WPI practices. It is important to note that HPWP does not pay attention to the design of production systems that have 'root-cause' consequences for autonomy of employees (MacDuffie, 1997).

The two branches of HPWP – HIWP and HCM – also lack important aspects compared with WPI. The latter is rooted partly in a special approach to production management systems (for goods or services), which organises production in 'flow structures' (Christis, 2010; de Sitter et al, 1997). Flow structures of production oppose functional structures. Functional production structures divide, in a Tayloristic sense, management tasks and executing tasks at all organisational levels. Orders run through the organisation that have to be (partially) processed by different departments, each of which performs specialised operations on each separate order. Such organisations are organised in silos, feature centralised support departments and employ employees who perform specialised operations. In such organisations, coupling between orders, operations and tasks are tight and inflexible.

At shop-floor level, however, employees may stand next to one another in adjacent work stations, perform the same operations and yet have nothing to do with each other or anyone else, as each employee is working on separate orders. In a flow structure, by contrast, management and executing tasks are not (so rigorously) divided. In such structures, employees are responsible for preparatory tasks (for instance, work planning, material planning, resources planning) and support tasks (for example, quality control, maintenance, internal logistics). Control or management tasks are decentralised, which implies that employees have an adequate overview and the authority to intervene in the production process if necessary. Flow structures provide employees (and often related teams) with a high level of autonomy, not only in their jobs, but also in organising the work processes in relation to adjoining teams and departments, even outside the company if needed (see, for example, Dhondt et al, 2014). Flow structures enhance both autonomy and the motivation of employees to play a role in innovation (Christis, 2010).6 WPI thus implies a capability approach, which aims to improve the innovative and competitive capability of the organisation as a whole by enhancing the capabilities of each organisational member.7 The opportunity to learn new skills interplays with the opportunity to cooperate in solving new issues and finding new ways to continuously improve.

Figure 2: Demarcating WPI

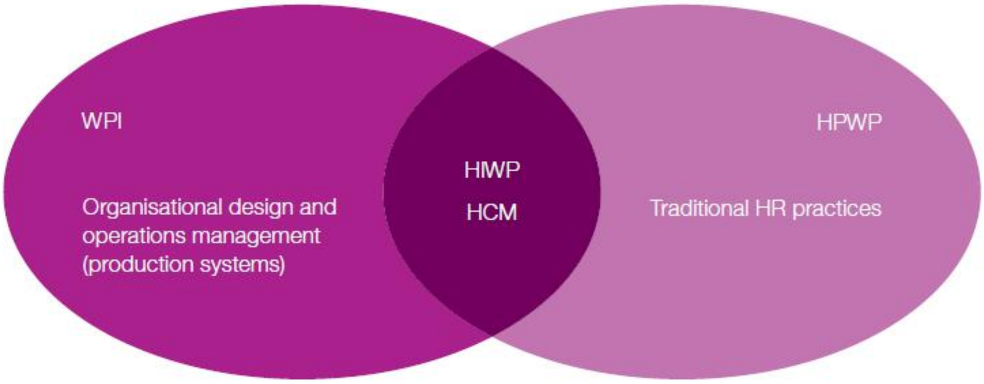


Figure 2 shows the distinction and overlaps between WPI and the aforementioned practices. WPI overlaps with HPWP: first, there is overlap with high-involvement work practices (HIWPs) regarding the structuring of work and jobs to enhance employee autonomy; second, WPI overlaps with HCM regarding 'culture' aspects, such as participatory employment relations and giving employees voice. WPI differs from HPWP in relation to 'traditional' HR practices, meaning HR measures that are not focusing on employee engagement. Traditional HR practices, for example, include staffing and he administrative role of HR.8 WPI also excludes measures such as 'traditional' recruitment and selection, training and development, appraisal and performance management, if they do not enhance employee engagement. In addition, WPI differs from HPWP, notably HIWP, regarding the attention paid to the 'structure' aspects of production systems ('Organisational design and operations management' in Figure 2). Choices made in the production system have consequences for job design and quality of work. This in turn affects 'cultural' aspects as well, such as participation and commitment.

WPI basically reflects two types of practices – one that relates to structure and control capacity and another that concerns culture and commitment behaviours. Regarding the second part of the term – innovation – this usu- ally refers to an invention that is being implemented or applied. With regard to products and services, innovation refers to instances where new products and services find a market and are deemed profitable or, in the case of public innovations, are experienced to enhance public value. In terms of WPI, there is a particular usage of the term – that is, its application as a contrasting or complementary term to technological innovation (Pot, 2011). One line of reasoning is that technological innovation may be a necessary condition for change and improve- ment, but not a sufficient one as long as WPI is lacking. WPI, in this sense, refers to necessary accompanying social and organisational changes that help technological innovation to successfully embed, being applied by employees or taken up by customers, citizens, clients and patients.[10]

Based on the above, this study chose a pragmatic approach to WPI, seeing it as having the following characteristics.

Involves employees: WPI underlines the involvement of employees: when organisations change, renew or innovate, there is a role for employees. However, the exact role that employees play is often not entirely clear. From a theoretical viewpoint, when changes are both developed and implement- ed solely from the top down, there is no WPI; when changes emerge or are implemented from the bottom up, with commit- ment from top management, there is clearly WPI.[11]

New to the organisation: WPI practices are new to the organisation: Because organisations across Europe will differ in their WPI 'maturity', the same practices may have been applied elsewhere earlier in time.

Structural and cultural applications: As a consequence of the two workplace practices, WPI practices may be 'structural' and/or 'cultural'. WPI can be related to the design of jobs and work organisation, to organisational behaviour and to supportive policies. 'Structural' means the work system, which includes work organisation as a division of labour. 'Cultural' means enabling employees to participate; this includes enabling leadership styles.

Enables performance and well-being: WPI practices are possible enablers for improved organisational performance and/or improved quality of working life. WPI does not neces- sarily and causally result directly in improved organisational performance or better quality of working life.[12]

Means, not an end: As an enabler, WPI is a means to achieve desired results. WPI is not a result or goal in itself.

The working definition of WPI practices is: a developed and implemented practice or combination of practices that structurally (division of labour) and/or culturally (empowerment) enable employees to participate in organisational change and renewal to improve quality of working life and organisational performance.

In Table 1, which is an elaboration of Figure 1, the following aspects are identified: types of practices; drivers, reasons and motivation; adoption, development and implementation, and facilitators; and impacts and outcomes. Taking the structure and culture orientation as a point of departure, a comparison could be made between HPWPs (including HIWP and HCM), as distinguished by the Eurofound study on work organisation and innovation (Eurofound, 2012), and the concept of WPI as the 'Fifth element' model by Workplace Innovation Limited/UK WON (Totterdill, 2015; Totterdill and Exton, 2014).

Table 1: Comparison between WPI practices and similar approaches

WPI practices	HPWPs*	The 'fifth element' of WPI**
Types of practices		
Structure orientation: • Job autonomy, control capacity, decision latitude • (Autonomous) teamwork, team autonomy • Co-creation, co-design, co-decision-making, participative design • Self-management, self-reliance • Employee budget control • Recruitment and selection by team • Organisational design/operations manage-ment for flow structures[13]	• Teamwork/autonomy • Job design	Work organisation: • Job autonomy • Self-managed teams Structure and systems: • Reducing organisational walls and ceilings

Culture orientation • Communication, consultation, voice • Social dialogue • Employee participation • Contributing (innovative) ideas	• Knowledge-sharing • Communication • Employee involvement	Structure and systems: • Supporting employee initiative • Fairness and equality • Trust Learning and reflection: • Continuous improvement • High involvement innovation • Learning and development • Shared knowledge and experiment Workplace partnership: • Dialogue • Representative participation • Involvement in change • Openness and communication • Integrating tacit and strategic knowledge
Other: • 'Traditional'/'ordinary' HR policy • Appraisal interviews/job performance interviews • Personnel surveys	• Training and personal development • Rewards and performance management • Flexible working practices and contracts • Recruitment and selection • Health and safety advice and support	Work organisation: • Integration of technology • Flexible working
WPI practices	**HPWPs***	**The 'fifth element' of WPI****
Drivers, reasons, motivation		
Organisational perspective:[14] • To improve efficiency • To gain competitive advantage • To enhance innovative capability • To become an attractive employer • To enable acceptance by employees • To enable the embedding of new technology and ICT • To improve industrial relations with unions Employee and manager perspective: • Economic and business goals • Learning and development opportunities • Performance • Public goals • Flexibility • Shareholder interests • Labour market position • Balancing private/work life situation		

Impacts, outcomes

For the organisation:[15] • Employee engagement • Longer-term sustainability • High performance • Better customer focus, client focus • Establishing good work • Efficiency • Profitability • Enabling culture • More positive employment relations • Resilience	• Service quality • Complaints/rework • Efficiency • Productivity • Gross value added (GVA) • Profit margin • Market share • Increased turnover • Employment levels	• Customer focus • Positive employment relations
For managers: • Efficiency • More sustainability • Competitiveness • Innovation • Satisfied client, customer • Effectiveness • Profitability • Good labour market image		

WPI practices	HPWPs*	The 'fifth element' of WPI**
For employees: • Learning opportunities, skills • Voice, participation • Challenging, active jobs • Healthy work • Job security • Flexibility • Good quality of jobs, autonomy • Good terms of employment • Work–life balance	• Job satisfaction • Staff turnover and absence • Enhanced motivation • Well-being (job strain, work-life balance) • Control over pace/volume/work tasks • Discipline and grievance cases	• Employee engagement • Positive employment relations
For employee representatives: • Employees voice • Sustainable organisation • Equality, fairness • Job security • Union membership		
Other	Behavioural outcomes (increased suggestions, flexibility, knowledge sharing, attitude to risk and failure, willingness to change, organisational commitment, motivation, engagement)	• Enabling culture • Resilience

Benefits of WPI

Research on WPI is limited in volume and heterogeneous in its conceptualisation (European Commission, 2014). The relevance of this overview is to portray studies that are usually not within the field of HPWP studies. An important message to get across is that organisations can make choices that come under the categorisation of WPI practices. These are not only observable within HR-related domains, but can also be found in connection with redesigning organisational structures and production systems.

There are at least three streams in the literature on WPI and its effects. One stream has an economic basis and examines workplace organisation from this viewpoint, particularly looking at its relation to economic performance. Another stream is more sociological in basis and examines WPI in relation to quality of work and organisational performance. The third stream, less theory driven, is related to the practice of innovation management and innovation policy and programmes. This section will give some examples of each stream, starting with the last stream.

Evaluations of Innovation Policy

Some of the literature traced developments over time in Euro- pean countries that carried out national innovation programmes to combat declining economic growth, employment and com- petitiveness (Pot, 2011; Eeckelaert et al, 2012; Pot et al, 2012a, 2012b) . These programmes were based on the understanding that competitiveness is not realised through merely stimulating new technological developments and cost-cutting efficiency policies. In order to realise sustainable economic growth and welfare provision, continuous innovation and growth in productivity are needed. Achieving this requires the full use of the potential workforce and creation of flexible work organisations. A number of European countries, such as Belgium, Finland, Germany, Ireland, the Netherlands and the UK, have started national programmes or initiatives to meet these challenges (Totterdill et al, 2009). These programmes have been launched under the heading of 'social innovation' or 'workplace innovation'.

There are several reasons for the growing attention to workplace innovation (Pot et al, 2012b): the need to enhance labour productivity to maintain levels of welfare and social security in the near future owing to fewer people in the workforce as a result of the ageing population; the need to develop and use the skills and competencies of the potential workforce to increase added value as part of a competitive and knowledge-based economy; private and public work organisations can only fully benefit from technological innovation if it is embedded in WPI, making technology work by means of proper organisation; WPI itself appears to be quite important for innovation success – that is, innovation in general.[18] Pot presents results of these national programmes for Finland, Germany, Ireland and the Netherlands.19 Although these programmes differ in how they measure WPI and its effects, Pot cautiously concludes that this research at national level indicates that through WPI, positive effects in terms of organisational performance can be expected. Simultaneous improvement in quality of working life and productivity are possible, particularly in projects with strong employee participation (Pot et al, 2012b).

Economic Organisation Research

Within the stream of economic organisation studies, an important discussion is whether or not management is capable of choosing the desired organisational model and whether market forces drive management merely to follow organisational forms that look most promising: the question arises whether strategic choice is an option (Dhondt and van Hootegem, 2015). Can companies choose to be 'workplace innovators'? Within the economic organisation literature, there is no agreement on this issue. Borghans and ter Weel (2006) and Akçomak et al (2011) firmly reject the notion that there is a 'preferred organisational model' for companies. They argue that companies adapt to whatever shape needed to sustain competition. In their investigation of Dutch organisa- tional practices, they observe a high degree of specialisa- tion in jobs. This would explain the disintegration of larger organisations into smaller units. Managers simply have no choice but to choose the right organisational model, as bad choices might lead to bankruptcy.

However, Bloom and van Reenen (2010) and van Reenen (2011) have quite a different opinion. They categorise the opinions of ter Weel and others as organisational design: that is, organisations adapt them- selves in one way to environmental pressures. Bloom and van Reenen see room for managerial discretion in the design of organisations – there is space for strategic choice. They talk instead about 'managerial technology': managers have the opportunity to select different kinds of models that can help the organisation adapt to environmental pressures. In their World Management Survey (Bloom and van Reenen, 2010), they monitor 18 capabilities that managers may (or may not) develop in their organisation. They are able to visualise the spread of management practices in separate countries and to compare national averages to one another. The authors show that paying attention to the 18 capabilities improves companies' performance substantially. They call this a choice a choice for organisational innovation.

Bloom and van Reenen have also tried to see if such organisational choice could be connected to WPI – for example, investing in work–life balance (Bloom and van Reenen, 2006; Bloom et al, 2011). Their research question asks whether such a connection helps to improve company performance. They view organisational innovation as being connected to better performance on the part of companies: better management leads to better performance. However, they do not see that the connection to quality of work enhances productivity itself. This view undermines support for the win–win models of work–life balance and productivity. However, Bloom and van Reenen warn that such a conclusion should not lead to a negative view of work–life balance. The fact that companies do not experience a loss of performance is at least remarkable because these extra policies do come at a cost. This extra cost does not, however, weaken performance.

Sociological Organisation Research

The sociological organisation stream of WPI literature is concerned with simultaneous effects on the quality of work and organisational performance. This stream has a tradition that goes back to sociotechnical systems studies in the 1950s, and is connected with the job demand-control studies that emerged since the 1980s.21 Developments in the late 20th century and beginning of the 21st century are linked to the aforementioned Finnish and German programmes as well as the Dutch 'modern sociotechnical' variant (van Eijnatten and van der Zwaan, 1998) of the sociotechnical systems studies. The hallmark of this stream is its sympathy for the 'labour process approach' and 'critical management studies'; more specifically, it is critical of declining autonomy and the increasing risks of higher workload and work intensification, and supportive of the combined effort to be both productive and innovative as an organisation, while providing challenging, healthy jobs for employees. Some evidence that WPI is beneficial for both organisational performance and the quality of work can be found in more recent studies on WPI (Kalmi and Kauhanen, 2008; Ramstad, 2009, 2014; Oeij et al, 2010,2011, 2012).

Recently, an emerging convergence could be observed across these streams with HPWP studies, which is relevant to the notion of WPI. As mentioned earlier, Boxall and Macky (2009) derive two main streams from the HPWP literature. The first is the high-involvement work system stream that seems to con- centrate on job structure, structural autonomy and how man- agement tries to manage the development and implementation of these ingredients to boost organisational performance. The other stream is the employment practices of HCM, which pays attention to practices that influence employee commitment through contracts, rewards and employee participation. Box- all and Macky raise the question of who benefits from such measures. For organisations, it is obvious that they win when performance and innovative capabilities improve. However, for employees, it depends on whether high involvement or high commitment will lead to, besides fair pay, more challenging jobs that are fulfilling or instead result in serious work intensification and health risks. This may play out quite differently for different industrial sectors and occupations. Often, professionals, knowledge workers and managers have challenging jobs but significant work intensification, while 'middle-level' employees may have lower wages and less decision latitude, but experience less stress. Furthermore, within organisations, there are also different management strategies regarding the control and commitment of employee categories (dual HR systems), such as how a company deploys core employees (for example, highly skilled employees and scarce resources) versus peripheral employees (for instance, part-time employees, replaceable workforce) (Boxall and Macky, 2014).

This points back to the earlier studies in which a combination of Karasek's job demand-control model and the sociotechnical insights of having control capacity or decision latitude at one's disposal determine whether employees have 'passive/ boring' jobs, 'low strain/no learning' jobs, 'high strain/stress' jobs or 'active' jobs (Theorell and Karasek, 1996). Active jobs, with high demands but enough control capacity to balance those demands, are jobs in which people can learn and work in both a healthy and productive way. Such jobs are well designed in terms of high-involvement work systems and create the commitment that emerges from high-commitment employment practices. The work intensification in active jobs (efforts and rewards) is 'balanced'. 'Well designed' in this context means that the production system is much closer to a flow structure than to a functional structure. WPI in the organisational, sociological, critical management stream normatively favours these kinds of jobs and organisations. The general idea is that the organisation can be used as a strategic tool to induce not only higher performance, but also better quality of work (Pot, 2011). WPI can lead to more 'active jobs' in terms of the desired form of work organisation – which could be characterised as 'complex jobs', which are rich and meaningful, or defined as 'simple organisations', which are clear regarding management structure, division of labour and transparent responsibilities (de Sitter et al, 1997). Organisations can choose production systems that enable these results, such as flow structures (Christis, 2010).

WPI – room for Choice

If organisations can make a strategic choice to implement WPI, it is important to be able to understand what practices they select exactly. For example, do they choose practices that influence the 'structure' (high-involvement, control capacity) or practices that improve the 'culture' (high-commitment, employee engagement)? Does this help us to understand why they do this, and whether it is intended to have an impact on both economic performance and quality of work?

Policy Background

WPI is a sensitising and therefore seemingly 'fuzzy' concept. According to the European Commission DG Enterprise and Industry (now DG GROW) website:

Workplace innovation can mean many things such as a change in business structure, Human Resources management, relationships with clients and suppliers, or in the work environment itself. It improves motivation and working conditions for employees, which leads to increased labour productivity, innovation capability, market resilience, and overall business competitiveness. (European Commission, 2015)

Despite the lack of consensus on defining WPI, there is a common understanding of the relevance of WPI – namely, that improving workplaces is beneficial for both organisational performance and workplace well-being (European Commission, 2014).

Work organisation and workplaces have been on the European agenda since the 1990s. The starting point may be marked by calls for a balance between the flexibility demands of compa- nies and the flexibility risks and opportunities of employees in so-called 'flexible firms' (Eurofound, 2002; Oeij et al, 2006; Pot et al, 2012b). This discussion eventually fed into policy thinking on 'flexicurity' – that is, combining flexibility for companies with social security for workers – as well as on work organisation and innovation (European Commission, 2002). Between 2004 and 2010, the Work-In-NET network, within the EU Research Area (ERA), gathered and disseminated knowledge on work- related innovations, voicing a 'philosophy ... that only by increasing the quality of work and the creativity of employees as well as a new balance of social security and flexibility of organisations, Europe will be able to meet the demands of the knowledge-based economy of the 21st century' (Work-in- NET, 2010a). Work-In-NET made a plea for such sustainable work in its 2010 Berlin Declaration (Ramstad, 2009). Since the economic crisis of 2008, two issues gaining importance could be observed: one was the sense of urgency to create more jobs (as expressed in the title of the Kok report Jobs, jobs, jobs: Creating more employment in Europe – European Commission, 2003) and to enhance skills; the other was the focus on innovation.23

Initially, the Europe 2020 flagship initiative Innovation Union did not mention WPI as a separate topic – although the 'Employment Guidelines' and accompanying document did relate to work organisation, quality of working life and social innovation (Pot et al, 2012b). However, in 2011, a convergence was observed between social innovation and WPI, whereby WPI was to become a recognised branch of the European drive for social and economic innovation (Eeckelaert et al, 2012; Pot et al, 2012b). There emerged a growing currency of WPI in Europe, and eventually another declaration calling for WPI helped to put it on the agenda – that is, the Dortmund/Brussels Position Paper (June 2012). The industrial policy adopted by the European Commission explicitly mentions WPI and states that 'the Commission will promote the transformation of work- places that stimulate new forms of "active jobs" and encourage the development of new skills, including e-skills' (European Commission, 2012). All these efforts eventually resulted in the establishment of the European Workplace Innovation Network (EUWIN) by the European Commission's DG Enterprise and Industry (European Commission, 2013). EUWIN is a Europe- wide learning network tasked to stimulate WPI across Europe (European Commission, 2015). Thus, it can be concluded that there is growing attention to WPI at policy level as well as a need for greater clarity about what policymakers can do.

As a follow-up to a recent policy debate, Eurofound put even more emphasis on work organisation and innovation in the research agenda and (re)designed the ECS to be able to address WPI – that is, in terms of specific issues of work organisation, HR practices and different forms of employee involvement (Eurofound, 2015).

CHAPTER 2 Overview of Company Cases and WPI Practices

This chapter introduces the company cases and the WPI practices. The chapter presents descriptions of the cases and discusses and compares types of WPI practices. The research questions are thus answered regarding what types of organisations are in the sample and which types of WPI they apply.

Company Cases

The research for this report investigated 51 cases from the ECS 2013 that score high on the WPI Index (for selection, fieldwork and response, see 'Methodology' in the Technical annex). Cases are 'establishments' that are regarded in this report as 'companies'. As mentioned, the dataset at hand comprises companies from various European regions, operating in different sectors, having distinct products and services, and varying in size. Based on Table 2, a description of the cases is provided in this section.

The companies in Table 2 are broken down by company size and sector: company size: SMEs with between 50 and 249 employees (27 companies) and large companies with 250 employees or more (24 companies); branch: industry (comprising manufacturing, construction, pharmaceuticals, energy, agro-business – 21 companies); commercial services (comprising retail, finance information, consultancy, transport, waste management, hotels – 14 companies); social services (comprising education, social work, arts, administrative, testing, science, journal- ism, libraries – 16 companies).

The 51 companies came from 10 different countries grouped according to the following geographical regions that cover most of Europe: Continental and western Europe (CW) – Denmark, Germany, Ireland, the Netherlands, UK (22 companies); Mediterranean (western and eastern) (ME) – Greece, Spain (12 companies); Central and eastern Europe (CE) – Bulgaria, Lithuania, Poland (17 companies).

There were more substantial examples of WPI in the CW countries than in the CE countries.25 The organisations were also distinguished according to structural aspects and types of products or services as follows.

Companies differ not only in country of origin, but also in terms of structural aspects – that is, being independent or not and national or foreign. Of the cases examined, 26% were independent units with no other divisions, while 31% were main units with other dependent elements. The majority (43%) of companies were subunits (not the main units). If companies were not singular units, they were asked what kind of company was the main unit – a national or foreign organisation. Three companies did not answer this question; among the remaining cases (35 cases), 57% answered that the main unit was national and 43% that it was foreign.

Different organisations produce distinctive products and services; however, companies were asked to indicate if their products or services were more standard, standard with variations or specified to the customer. With one missing answer, the other results were: 18% chose 'standard', 28% selected 'standard variants' and 54% indicated that their products or services were specified to the customer.

Table 2: Descriptions of the companies by category

		Company size		Sector			Total (%)
		SME 50–250 employees	Large ≥250 employees	Industry	Commer-cial services (%)	Social services (%)	
Region	Continental and western Europe	41%	43%	43%	44%	44%	43%
	Mediterranean	19%	24%	24%	13%	13%	24%
	Central and eastern Europe	41%	33%	33%	44%	44%	33%
Total		100%	100%	100%	100%	100%	100%
Number		27	24	21	14	16	51
Organisation structure	Independent unit without dependent units	30%	14%	14%	38%	38%	26%
	Main unit with dependent other units	22%	33%	33%	44%	44%	31%
	Unit, not main unit	48%	52%	52%	19%	19%	43%

Total		100%	100%	100%	100%	100%	100%
Number		27	24	21	14	16	51
National or foreign	National organisation/public institution	55%	43%	43%	91%	91%	57%
	Foreign organisation/public institution	45%	57%	57%	9%	9%	43%
Total		100%	100%	100%	100%	100%	100%
Number		20	15	14	10	11	35
Type of products/ services	Standard products/services	23%	19%	19%	20%	20%	18%
	Products/services with standard variants	35%	24%	24%	20%	20%	28%
	Products/services to customer specification	42%	57%	57%	60%	60%	54%
Total		100%	100%	100%	100%	100%	100%
Number		26	24	21	14	15	50

Types of WPI Practices

From the company cases, a variety of WPI practices can be observed. A closer look at these WPI practices clarifies why some of them are 'structure oriented', 'culture oriented', a mix of the two or typical HR-related practices (non-WPI).

Eventually, five practice types could be distinguished (three WPI and two non-WPI).

WPI-structure: This includes practices of organisational restructuring, teamwork and job design (14% of all practices).

WPI-culture: These are practices that are variants of employee participation, cooperation and dialogue between employees and management, and between employee representatives and management (20% of all practices).

WPI-mixed: Several companies had a combination of structural and cultural practices (19% of all practices).

HR practices: These comprise 'typical' or 'traditional' HR practices in the field of, for example, personnel recruitment, training, competency development, performance appraisal, working conditions, remuneration, flexibility and health, risk and safety measures. This is the largest category (39% of all practices). The way in which these measures are linked with structural changes might not always be clear; however, they may influence behaviours and the organisation's culture.

Other: These comprise a miscellaneous cluster of interventions that are related to IT systems or technology, to lean production and lean management practices, and to 'indefinable' practices (8% of all practices). The lean practices that were found seem to have a stronger focus on cost-effectiveness than on enhancing autonomy in a structural sense, which is why they are not classified under WPI-structure.

The practices target three goals: quality of performance (14% of all practices); quality of work (18% of all practices); both quality of performance and quality of work (69% of all practices).

Therefore, most practices were directed at both goals – the enhancement of company performance and quality of work. There were no great differences between WPI practices and HR and other practices. As expected, the category of 'other', with several lean practices, is more targeted at quality of performance, but the absolute number is too limited to draw firm conclusions.

Some examples of the practices are presented in Table 3.

Table 3: Examples of practices

Types of practices	Examples
WPI-structure orientation	DE-SERV-TEST-L: A structural change made to the organisation and workplaces has led to 'subject- or theme-related teams' across the different departments.
	BG-EDUC-UNI-S: Self-managing teams have been introduced as a system for organising day-to-day duties and activities. This approach ensures that the team members will have sufficient flexibility to decide on how to implement their tasks, taking into account their own capacities and time schedule.
	ES-SCI-ENVIRONM-L: Minimising organisational levels and enhancing autonomous teams is done by ensuring that there are no more than two hierarchical levels between the lowest and the highest levels. This also facilitates the existence of self-managed working teams that have the freedom to organise themselves.
	NL-INFO-NEWS-L: Job enlargement has been enabled by expanding sales jobs with account management tasks. In addition, cross-functional teams have been installed to realise innovation projects across departments.
WPI-culture orientation	DK-ART-MUSEUM-S: Partnership with the unions has been fostered, whereby new projects and organisational changes are debated in a joint committee with union representatives, occupational health and safety (OHS) representatives and management representatives. This committee is initiating new practices, such as training and support for new employees.
	BG-ENER-GAS-S: The Knowledge Management System, OGpedia, is a voluntarily developed, IT-based information sharing measure. All employees can share and gain new knowledge.
	PL-ADM-TAX-S: Monthly meeting with managers and union representatives help to communicate changes and the current situation status, allowing for consultation on decisions and initiatives.
	LT-SERV-POST-L: 'Loyalty Day' aims to enhance communication and knowledge sharing between managers and first line workers. Managers voluntarily visit workers on their working site and gather information about specific processes and possible issues. This improves sustainability, efficiency and good organisational communication.
WPI-mixed	ES-SCI-WORK-L: Flexitime practices allow workers to have a say regarding their working times – they can adjust their start and exit hours, and ad-hoc exits (with manager's permission) are allowed as well.
	EL-FIN-BANK-L: An initiative for personal development has been introduced, whereby every year teams of one to two people take part in a challenge defined by the top leaders. In this way, ideas can be passed from the younger talent to the top management. Young talent is supported through coaching sessions and assessment tools, helping them to gain experience.
	DE-AGRO-PETFOOD-S: An overall qualification was given to production staff ready to do any job on the production line, enabling employees to take over any job in the production process. After the mechanisation of production, most of the employees had the chance to upskill and take over a skilled worker's task.

Types of practices	Examples
HR related	DE-SOC-HANDICAP-L: A yearly working time account allows workers to collect overtime working hours on a yearly basis and to take extra time for holidays (at a time convenient to the company).
	PL-TRANSP-BUS-S: Additional learning opportunities, such as courses, are offered to employees to improve their performance. Employees feel more accepted and are more willing to work for the company's efficiency and stability.
	UK-TRANSP-CAR-S: Employee recognition programmes and monetary awards are a way to celebrate success, encouraging employees to bring new ideas and making them feel valued and appreciated.
Other	PL-EDUC-INFO-SCHOOL-S: A new coordinated computer information system has been installed, integrating the university's information processing and communication procedures. The measure facilitates communication between the university, students and employees, and reduces the time employees spend on simple tasks.
	UK-MANU-TYRES-S: Cross-functional teams help to promote continuous improvement within the company. Through 'Kaizen' activities, employees from different parts of the business meet up to discuss and resolve business issues in order to improve understanding and efficiency.

The application of practices differs across companies when looking at company size and sector. It also differs for the three European regions of the study.

Size

It can be observed that companies do not significantly differ when comparing practices that are applied in SMEs with those adopted by large companies (250 or more employees). In large companies, there are somewhat more WPI practices oriented to a change of culture, while SMEs more often tend to adopt mixed WPI practices. SMEs also have a greater proportion of 'other' activities that are neither WPIs nor HR policies than do larger companies. However, there is a small number of these 'other' practices in general (only 14 in total).

Sector

Companies across different sectors adopt similar WPIs, but some marginal differences can be noted. Companies that work in industry (such as manufacturing or construction) tend to have more culture-oriented WPIs.

Region

Across the regions, there is evidence of some differences in applying WPI practices, although it should be underlined that this is not necessarily representative. As expected, due to varying WPI maturity levels and WPI Index scores (based on the ECS 2013 data), different European regions apply quite distinct practices. Culture-change oriented WPIs occur significantly more often in continental and western Europe than in the central and eastern European region. In the central and eastern region, there are more non-classified (not WPI or HR) 'other' practices than in the Mediterranean countries. Conversely, the Mediterranean countries (EL, ES) have significantly more HR policies than the continental and western European countries. It could be summarised that continental and western European countries have mostly WPI practices (68% of all their practices), Mediterranean countries have a significant amount of HR policies (592%) and fewer WPIs (39%), while central and eastern European countries have a similar proportion of WPIs and HR policies (43% and 39% respectively) as well as a substantial proportion of non-classified practices (18%).

CHAPTER 3 Paths to WPI Practices

This chapter discusses whether dominant paths to WPI can be identified among the 51 cases. A path is a combination of variables that – to a substantial degree – explains the presence of WPI. Qualitative comparative analysis (QCA) is applied as a method to identify variables underpinning such paths. The starting point is an overview of the possible variables that may help to explain why organisations choose WPI. The QCA results are then described, showing the five paths that emerged. These paths are interpreted. Subsequently, for each path, company descriptions are provided and the WPI practices that those companies have implemented are shown. Finally, the main conclusions are drawn.

Selecting Variables and Preparing QCA Analysis

QCA consists of 'condition' variables and 'outcome' variables. Measures were formed on the basis of the most relevant theoretical aspects of WPI and data quality.

Condition variables are comparable to independent variables in conventional statistics (thus, they are also called 'causal conditions'). By using QCA, the analysis seeks first to assess the condition variables and to investigate if these conditions are necessary or sufficient. A necessary condition means that a variable must be present for WPI to emerge, regardless of other variables. A sufficient condition implies that no other variables are required besides this variable for WPI to be present. However, it will become evident that such necessary and sufficient conditions do not appear, and this means that varying combinations of variables can result in WPI.

Secondly, the analysis seeks to determine which paths lead to WPI. In this study, five paths emerged, which means that among this group of 51 companies, five specific combinations of variables resulted in WPI (this is why such paths are also called 'configurational paths').

Thirdly, for each path, examples are given to illustrate how companies arrived at WPI, proving the point that it is not a case of 'anything goes' but that there is nevertheless room for 'organisational choice' in designing WPI practices.

Based on theoretical grounds, seven measures were constructed for the condition variables that were divided into three topics – contextual factors, features of WPI, and adoption and implementation.

Contextual Factors

Decision latitude of the organisation (DECLAT): This variable concerns the organisation's autonomy in changing the work organisation, systems structure, learning reflection and workplace partnership or voice. The variable indicates that the company has a certain degree of freedom to introduce self-chosen WPI practices.

Organisation model (ORGMOD): The research investigated what type of basic model organisations apply. Organisations can choose a model that is directed at better organisational performance (an economic target), better quality of work (a social target) or a combination of both. A variable could be constructed that indicates to what degree organisations have a model that indicates the importance of the quality of the organisation (performance driven) in combination with the quality of work (people driven). The organisational model or management philosophy therefore mirrors a preference for limited or significant division of labour.

Features of WPI

Innovative behaviour of employees (INNOBEH): Employees perform in such ways that initiatives are taken, knowledge is shared, processes are improved and new information is sought, or they are supported to do so.

Autonomy and participation (AUTPAR): Employees can make decisions in their jobs and share tasks (in teams). At the same time, there is much open communication and participation.

Adoption and Implementation

Participation in organisational model (PARTMOD): This variable concerns participation in decisions about the organisational model. It reflects the participatory role in organisational design of middle management and first-line workers.

Bottom-up and people-driven initiative (BOTUPIN): This variable indicates whether the initiative for WPI is bottom-up and people-driven. The initiative can be either bottom-up or top-down. Moreover, it can be either people-driven by intrinsic arguments to improve the situation of employees, or organisation-driven by extrinsic arguments, namely to account for business and market circumstances.

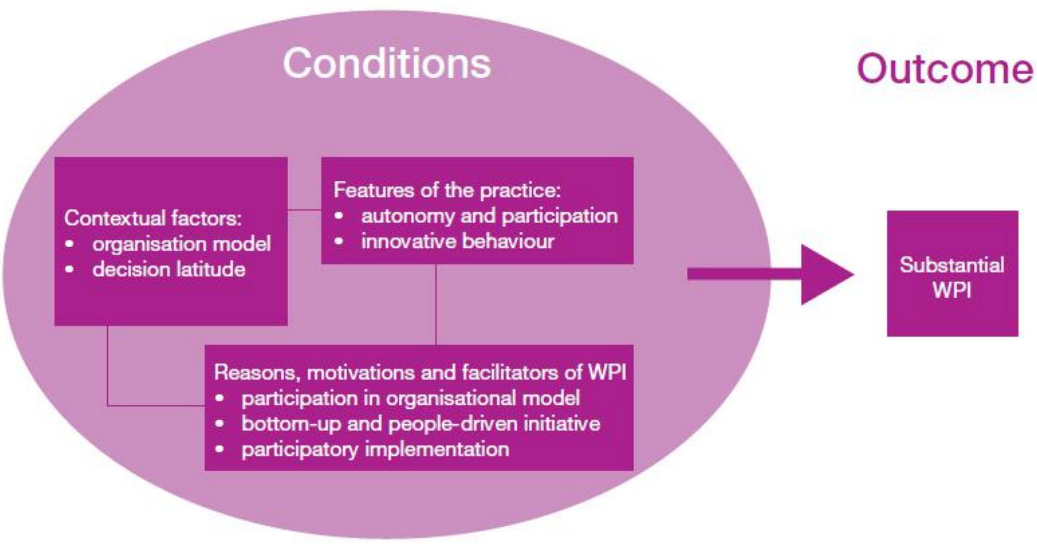
Participatory implementation (CONOR): This variable indicates the presence of a control orientation during the implementation process. It informs whether WPI is implemented on a participative basis and supported by employees. Implementation can be participative participatory or top-down, and the change process for WPI practices can be characterised by more or less support from employees.

Besides causal conditions, there is an outcome variable. An outcome is the equivalent of the dependent variable in conventional statistics. In this research, it is defined as 'substantial WPI'. WPI is a means to achieve a goal such as improved performance or quality of working life. Follow-up analyses in the next chapter will reveal the motives, implementation leverages and impacts of companies with various WPI practices. A preparatory step, simply put, is to assign the 51 cases to groups with many or fewer WPI practices. In QCA, such groups are 'sets' and when a company is 'in' a set, QCA speaks of 'set membership'.

The outcome variable was constructed so that all 51 cases could be assigned 'set membership' to either the set where 'substantial WPI practices' were present or the set of 'non- substantial WPI practices' where 'substantial' practices are absent (see Methodology in the Technical annex). Since all companies are derived from a sample of companies with a high WPI Index score, 'non-substantial' is not a negative term in this instance. It just means that the ranking is lower than that of 'substantial WPI' companies.

Substantiality of WPI can either point to recently implemented, distinctive WPI practices that align with the working definition of WPI, or it can suggest a WPI 'maturity level' of the company as a whole. Such latter companies cover WPI practices that fit the definition, but may already have introduced the practices and can now be viewed of as 'WPI mature'.The basic model that is researched is shown in Figure 3.

Figure 3: Basic model of research



Data and Analysis

Although data have been gathered from managers, employees and employee representatives, for these initial QCA analyses the manager data for the 51 cases have been used as leading sources.34 Table 4 presents the descriptive statistics and correlations of the outcome and condition variables.

Table 4: Main descriptive statistics and correlations

Descriptive statistics					Correlations						
Outcome	Min	Max	Mean	SD	Substantial WPI	PARTMOD	INNOBEH	AUTPAR	BOTUPIN	CONOR	DECLAT
Substantial WPI	2.33	9.67	5.95	1.58							
PARTMOD	0	9	7.12	1.62	.16						
INNOBEH	20	35	30.35	2.99	.02	.17					
AUTPAR	24	35	29.41	2.48	.18	.25	.67**				
BOTUPIN	0	1	0.53	0.5	.14	.0	.22	.1			
CONOR	-2.22	1.97	.0	0.99	.26	.18	.23	.34*	.36*		
DECLAT	6	12	10.9	1.55	.15	-.14	.13	-.14	.09	.15	
ORGMOD	44	70	57.35	6.67	-.07	.11	.17	.17	.18	.04	-.22

Note: *Correlation is significant at the 0.01 level (2-tailed)

** Correlation is significant at the 0.05 level (2-tailed)

DECLAT – Decision latitude of the organisation

ORGMOD – Organisation model

INNOBEH – Innovative behaviour of employees

AUTPAR – Autonomy and participation

PARTMOD – Participation in organisational model

BOTUPIN – Bottom-up and people driven initiative

CONOR – Participatory implementation

Table 4 shows that most correlations between condition variables are either not significant or not strong, with the exception of ‘Autonomy and participation’ (AUTPAR) and ‘Innovative behaviour of employees’ (INNOBEH) (.67). There are also no significant relationships between the outcome WPI and the causal conditions that can be easily identified without deeper analysis.[35]

Research Results

The fuzzy set qualitative comparative analysis (fsQCA)36 was run and the results are presented in Table 5. These results show that the outcome ‘substantial WPI’ can be reached through five paths that altogether explain 52.1% of cases with a consistency of 81.1%. Consistency indicates to what degree cases are in line with the given conditions. It is somewhat comparable to an ‘if-then’ reasoning: ‘if... (condition 1, 2, 3, 4 and/or 5) then... (WPI)’. The other cases have paths that are not sufficiently consistent, which implies that they were discarded from the final results of the QCA (but included in the descriptive analyses in the next chapter). For each of the five paths, a black dot ‘●’ indicates the presence of a condition relevant to the outcome, while a blank space points to the irrelevance of a condition. The symbol ‘○’ indicates the absence of a condition: absence highlights the relevance that a condition is not present for the outcome to emerge. A fully blank position of a cell means that the variable is ‘irrelevant’.

Table 5: Configurations explaining substantial WPI (parsimonious solution)

Path	Causal conditions							Consistency %
	ORGMOD	DECLAT	INNOBEH	AUTPAR	PARTMOD	BOTUPIN	CONOR	
1 – Top-guided WPI			●			○	●	84.1
2 – Autonomy-driven WPI	○	●		●	●			83.5
3 – Integral WPI	●	●	●			●		83.7
4 – Employee-driven WPI		●			●	●	●	82.7
5 – Innovative-behavioural-driven WPI	●		●		○			68.6
	Contextual factors		Feature of WPI		Adoption and implementation aspects			

What do these results mean? The first point to highlight is the aspect of causality and theory. Subsequently, there is guidance on how to interpret each of the five paths. This is followed by an illustration of the content of these paths with empirical cases. From a causality perspective, it is possible to state that there are no necessary conditions and no sufficient conditions. The first statement means that none of the causal conditions is an absolutely necessary condition for the outcome, 'substantial WPI', to appear. The second statement implies that there is no path where one causal condition is sufficient for the outcome to emerge: there is always more than one condition needed for substantial WPI.

The results show varying configurational paths that all lead to substantial WPI in an equifinal way. Equifinality allows for different, mutually non-exclusive paths for the outcome. Correlation- based approaches could never have produced such seemingly deviating results that, nonetheless, better fit most people's understanding that different roads indeed 'lead to Rome'. From a theoretical point of view, innovative behaviour of employees (INNOBEH), a bottom-up and people-driven initiative (BOTUPIN) as well as participatory implementation (CONOR) are necessary conditions, as these link with the 'WPI-culture orientation' and the notion that employee participation is a key aspect of WPI. It can be observed that these aspects are not always deemed necessary according to the companies; moreover, in Path 2, all three of these aspects are absent. Each of the five paths is now outlined below, uncovering 'causal recipes' for arriving at substantial WPI.

The configurational paths leading to substantial WPI are as follows.

Path 1 – Top-guided WPI: states that 84% of the companies with the combined characteristics of innovative behaviour, the absence of bottom-up initiatives (that is, the presence of top- down initiatives) and a participatory implementation process are members of the set Substantial WPI. Five cases followed this path. A more complete name is 'Top-guided, participative and innovative WPI'.

Path 2 – Autonomy-driven WPI: states that 83% of the companies with four characteristics in conjunction are members of the set Substantial WPI: employees participate in develop- ing the organisation's model; employees have job autonomy combined with employee participation; the organisation itself has decision latitude to make its own choices; and the organisation does not show a preference for limiting the division of labour. Eight cases chose this path. A more complete name is 'Autonomy-fuelled survival-driven WPI'.

Path 3 – Integral WPI: states that 84% of the companies with four characteristics in conjunction are members of the set Substantial WPI: employees show innovative behaviour; the implementation process is a bottom-up initiative; the organisa- tion itself has decision latitude to make its own choices; the organisation shows a preference for limiting the division of labour. Seven cases took this path. A more complete name is ‘Innovation and quality driven innovative WPI’.

Path 4 – Employee-driven WPI: states that 83% of the companies with the following characteristics in conjunction are members of the set Substantial WPI: there is employee participation in developing the organisation’s model; the implementation process is a bottom-up initiative and also a participatory implementation process; the organisation itself has decision latitude to make its own choices . Nine cases chose this path. A more complete name is ‘Self-autonomous and employee-driven WPI’.

Path 5 – Innovative behavioural driven WPI: states that 68% of the companies with three characteristics in conjunction are members of the set Substantial WPI – employees have not participated in developing the organisation’s model; employees show innovative behaviour; the organisation shows a preference for limiting the division of labour. Three cases chose this path. A more complete name is ‘Innovative and quality-driven WPI’.

For each path, some examples of WPI practices from the cases are presented. The examples give a flavour of what companies do in implementing WPI practices.

Top-guided WPI (Path 1)

Cases in this path have a WPI initiative that comes from top management. However, these top-guided initiatives are accompanied by participatory implementation and support from employees. In addition, these cases reflect innovative behaviours from employees.

The German and Dutch examples present initiatives from management. Both initiatives coincide with the creation of more autonomy in jobs or teams. This helps to explain why employees benefit, as it makes their work more challenging. Both companies highlight the importance of learning, either through HR-related measures or by participating in innovation activities.

Deservtestl

This company deals with consumer counselling and testing and assessment of products. The company was losing income but needed to perform at a high-quality level. The company established a culture of continuous improvement and development. A structural change of organisation and workplaces led to ‘subject- or theme-related teams’ across the different departments. New cooperation and communication across divisional and hierarchical borders, along with continuous participation on the part of employees, are now guaranteed.

The WPI practices comprised three elements. First, ‘subject-related teams’ were introduced from two departments with different professions (scientists and journalists), who had worked separately before. The problem was that good scientific work was not being edited in an interesting way for customers. To improve the cooperation between scientists and journalists, the employees moved to the same floor so they could work more closely together. Now, the scientists, engineers and journalists work together on a test theme from the test phase to the publication of results stage. Project management during the testing phase of products is in the hands of the scientists but shifts at the publication stage to the journalists, while a cooperative method of production is maintained between both groups.

Second, ‘company internal fairs’ are organised once a year. Different parts of the company present to each other in a transparent way what they are doing and how their work is related to other parts of the company. Contents and themes of the divisions are discussed and criticisms put forward by the public are analysed together. The purpose is to let the whole company participate in this process so they can learn from each other and from mistakes.

Third, 'institutionalised employee participation' is stimulated through several HR-related instruments. For example, yearly appraisal interviews and team meetings are set up to integrate the employee's perspective and knowledge and to monitor their continuous training. Institutionalised participation procedures, such as monthly team meetings, editorial meetings, and yearly informal meetings between the line manager and employees, are set up for employees to articulate their ideas and to foster their career and training planning. With limited formal hierarchical levels and an emphasis on team orientation, the company is fostering 'mosaic' careers as 'horizontal' careers, by offering employees the chance to participate in new projects, different tasks, themes and positions.

NL-INFO-NEWS-L

This media organisation publishes regional newspapers and news media. Recently, the company was taken over from an investment fund by a publishing company willing to reinvest. Due to a loss of subscriptions and advertisement sales, digitalisation and social media, as well as changing news gathering habits of the younger generation, there was an urgent need for new business concepts for the company to survive. Forty percent of the staff were laid off in the last decade. However, in recent years, the cost-cutting strategy has been gradually replaced by an innovation strategy, including WPI. This is due to the appointment of a new CEO with a passion for innovation and a new owner company willing to invest.

Six WPI practices have been rolled out. First, job expansion was proposed to improve sales activities. Accordingly, jobs in the advertise-ment department 'Sales' were expanded to 'account management'. The new job seeks to build relations with clients and to consult them about ways to reach their customers more effectively. This is a change from passive selling to active, outdoor selling and to advising clients. Courses and training have guided the job transition. By upgrading the job, work in sales has become more challenging and has contributed to the employability of the salespersons, while increasing the effectiveness and resilience of the company.

Second, the company recently started to reorganise the editorial department to produce more in-depth articles. For most journalists, this has resulted in more professional autonomy and more interesting, challenging tasks. The project is called 'Empowerment from the core'. Internet and social media have been put in place, being much faster in spreading the news. The journalistic research department has been strengthened and theme groups (such as health, sport, education) have been put in place, alongside a small group of journalists still operating as the 'first line' in the region. The in-depth articles can be sold to other newspapers as well.

Third, the new CEO has encouraged dialogue and idea management, also introducing lunch sessions where every employee is offered the opportunity to have lunch with the CEO and to tell him their ideas for improvements or innovations. There is now a list of 80 ideas, of which four have been elaborated by cross-functional project teams (see below). Employees proposed regular 'innovation cafés', where colleagues could present their innovation project. The dialogue contributes to employees' sense of being heard and taken seriously. It enhances their engagement and contributes to the innovative capabilities of the company.

Fourth, four cross-functional teams for innovation projects have been established to realise an innovation project. Teams comprise employees from all departments and the members get new jobs. Encouraged to cooperate with external partners (such as a local broadcasting company), they are trained and coached to realise this project and they work full time on it until it is completed. One example is sponsored content, where partners – such as a hospital – pay for an article (for example, on the prevalence of certain chronic diseases in Limburg). Another example is a new app that has been developed with a radio broadcasting organisation. The cross-functional teams not only provide an opportunity for employees to take up a new and challenging job, but also contribute to breaking down barriers in the company and to improving its innovative capability.

Fifth, a plan to start a media campus has been developed. Taking up an initiative put forward by the CEO, employees and the works council offered their cooperation enthusiastically. Such an initiative will provide learning and reflection opportunities, thus contributing to the development of skills and improvement of innovative capabilities. In the meantime, talks with a regional university have started the process to establish this campus.

Six, several other plans have been initiated, one of which involves renting office space in the building to start-ups. Management and the works council share the idea to offer (cheap) office space to entrepreneurs who want to start a business in the media sector. This idea stems from sites like Silicon Valley, Philips Brain Port and Chemelot around DSM, where partners such as media groups, broadcast companies, universities and start-ups work together on new projects. This plan is in line with the fifth practice.

Autonomy-driven WPI (Path 2)

This configurational path concerns companies that use their organisational autonomy to develop WPI practices in order to survive or restructure so they can secure their future. At the same time, there is some autonomy for employees and space to participate. The first priority of these organisations is to guarantee a good future rather than having an organisational model that pursues best quality of performance or quality of working life.

One Spanish and one Danish example are provided below, reflecting the need for companies to be prepared for the future or to be able to adapt to changes quickly, change being unavoidable. Employees and employee representatives are closely involved in these moves towards new WPI practices – either through business participation and dialogue, or through more autonomous work and partnering in innovation trajectories.

ES-SCI-PHARMA-L

This company is a large-scale producer of commercial active pharmaceutical ingredients (API) as well as high-potency hormones and sterile steroids (by filtration). The company is active in research and development (R&D) activities, with up to 20% of staff dedicated exclusively to R&D; approximately half of the workforce are university graduates and doctors. The company has experienced robust growth in recent years, with annual rates approaching 15% to 20%, and can be considered a key player in the global API market. The company pays a great deal of attention to WPI practices and this is strongly influenced by the personality of the company's founder. Although future prospects are positive, the company is fully committed to continuing its strong emphasis on HR and on the development of WPI practices as a key tool underpinning the future of the company. The WPI practices facilitate the greater engagement of employees, a good working environment where ideas can be brought forward to flourish, and positive employment relationships within the company. Staff turnover is low and the company is perceived as an excellent employer. The employees feel that they are 'part of the company' in the sense that the company 'belongs' financially and emotionally to them. Under the heading 'Rowing all together in the same direction', there are five WPI practices that contribute to this success.

First, an 'active competency development policy for employees' has been introduced to combine several (although non-specific) HR measures. The competency development policy covers activities in different domains (such as specific technical training, risk prevention training, and training on general skills/capabilities) agreed between employees and managers. This is complemented by a backup policy, where each job can be performed by at least two individuals. The recruitment policy has resulted in the creation of a multinational, gender-balanced workforce from different countries and of different ethnic origins, but with shared values. The company fosters voluntary horizontal and vertical mobility of employees.

Second, an 'open and participative business culture' has been created. For instance, the company decided to sell shares to the employees, irrespective of their position. Furthermore, management has developed a profit-sharing scheme by which a 3% share of annual profits is distributed to all employees in addition to existing performance schemes. The company organises meetings to inform all employees of the main results and future directions. It also fosters an 'open door' business culture in which each employee is invited to discuss issues with all hierarchical levels, including the CEO.

Third, the company's 'emphasis on the health and well-being of employees' has resulted in an active safety and hygiene at work committee related to risk prevention and safety at work. Moreover, the company has incorporated 'flexitime' practices, with a certain degree of flexibility in the working times to reconcile enterprise and personal needs. The company trusts its employees, favouring results and not mere presenteeism.

Fourth, there is 'fluent social dialogue with the legal employee representation' in areas of interest to both parties (such as working conditions, wages and working times). Interestingly, the company's legal employee representatives are independent workers who are not affiliated to a trade union. They are selected by their job colleagues. The company also has its own enterprise collective agreement with better conditions than the provincial one.

Fifth, a model of 'management by values' is being developed to help identify common values that underpin the company and its culture, and that are to be shared by all employees. A participatory process has defined five main values and associated characteristics (transparency; development of talents; improvement; teamwork; flexibility); currently, this process is being used to identify areas of improvement and to evaluate the work of employees.

DK-EDUC-SCHOOL-S

This municipal primary and lower secondary school had to meet educational reforms in Denmark – that is, a merger with another school and a new collective agreement for teachers' working hours. The maximum weekly teaching time is now agreed locally. The school had a low intake of applicants in the municipality so it was an important motivation to attract more students by creating a more exciting and innovative school. There are two WPI practices underway at the school.

First, the school changed the work organisation through new autonomous and interdisciplinary teams. Instead of individual teachers being responsible for teaching specific subjects across year groups, teachers in interdisciplinary teams are now responsible for an entire year group in a team of teachers and pedagogues. This process requires change because staff in the team teach a broader set of subjects. In addition, a shift took place from a preoccupation with solely academic competencies to a greater focus on didactics. Teamwork demands cooperation, more adaptability to change and employee influence in planning work. This was difficult for many of the employees.

Second, workplace partnership has been fostered through discussion forums as a basis for innovation. Changes are discussed in several forums with both direct and indirect participation from employees, such as on educational development. Changes are also discussed with union representatives. Employees find management receptive to their suggestions and innovative ideas flow freely.

The organisation uses partnerships with committees and employees to support dialogue and thereby handle new challenges. It formed its new work organisation (interdisciplinary teams) by conducting meetings with committees and employees to formulate a common goal – that is, to develop the best municipal school. The organisation participated in joint training sessions to ensure that all were involved as partners in the process and to create a new way of organising work in an adaptive and exciting way. The implementation approach has been to adopt practices in a 'big bang' fashion by conducting joint training for managers, representatives, teachers and pedagogues. Combined with a clear goal – to create a better school for the students – and extensive participation, this has been seen as a leverage factor.

Integral WPI (Path 3)

WPI practices in this configuration are initiated bottom-up with the help of employees, providing employees with possibilities for innovative behaviour. The company has decision latitude to make its own choices and a preference for limiting the division of labour. It integrates structural and behavioural elements.

In three examples, employees play strong but quite diverging roles. The Lithuanian company presents a strong HR-related set of measures that were largely incorporated from their UK-based mother company. Much attention is paid to improving the competencies and quality of employees' working life. While the Lithuanian example has a rather formalised character, the UK example seems more informal and driven by an organisational change of culture led by the CEO. At the same time, this CEO makes lots of space for employees to join in and build constructive relations with the employee representatives. The third example, from Spain, indicates great care given to worker well-being and an active dialogue with employee representatives. All examples reflect a need for innovation and good personnel. All companies offer good employment and working conditions.

LT-MANU-RESPIR-L

This company is a designer, manufacturer and supplier of a wide range of medical devices for respiratory support. The company provides patient solutions for airway management, anaesthesia, critical care, and oxygen and aerosol therapy. This establishment is one of the company's biggest production sites, with a wide range of scientific research. The main issue is to remain competitive. For that purpose, four WPI practices have been developed.

First, self-managing teams have been introduced because products and processes were becoming increasingly complex. This involves giving more responsibility to empower the ground production level (especially to first-line managers who are below middle management level) and middle management in terms of team self-management and more job autonomy, also leading to additional remuneration. The teams on the production lines are more responsible for planning (especially production time management), aspects of production organisation, quality and aspects of the production process.

Second, the company is supporting employee initiatives, which implies that each person irrespective of their position is invited to submit proposals regarding product or production process improvements. Each proposal is reviewed and discussed to assess its feasibility. If the decision is taken to proceed, responsible persons are assigned to the implementation process and to get the necessary resources assigned.

Third, the company has a range of HR-related measures under the heading of ‘Organisational learning and development’. This is especially important because the company is among the world leaders, particularly since this site is responsible for both scientific research and production of products. Five aspects are important in this respect: 1) constant learning and professional development through training and development programmes and a performance review of high-skilled employees (in addition, every employee is encouraged to submit to their line manager their reflections on how to improve the working environment and working organisation, contributing to two-way learning and overall organisational development); 2) internal career opportunities in the company and support for the person to develop either internally (training, assessment, career orientation) or externally (for instance, gaining a formal education diploma); 3) organising learning and awareness sessions with the product distributors for all company employees: clients show how a product is used in practice, which then contributes to mutual learning; 4) investing in people – for instance, the company brings over high-level specialists from abroad for internal company training; it sends teams abroad for training and runs an apprentice programme in the company; 5) use of new technologies in the learning and professional development process – for instance, the use of mobile training stations by senior assemblers to familiarise the team with the assembly of a new product with the help of video material directly at the workplace. The company has also deployed a learning management system, in which each team and employee will have their own profile, with all training needs and completed training recorded. This system can also contribute to recognition of non-formal and informal learning (especially gained through the working experience), particularly for low-skilled employees or employees without any formal education.

Fourth, ‘employee-friendly forms of flexible working’ are available for families with small children. Employee voice is important throughout the development of these practices.

UK-MANU-BATH-L

This company is a family-owned business and a leading supplier of showers, taps and bathrooms, with exports to Europe and Russia. It consists of four divisions: trade, retail, heritage bathrooms, and commercial. The group is part of a US-based global leader in home products. The company is led by a CEO who joined the group in 2009 when it was a family-owned ‘can do’ company, but with ‘a lack of clear focus and inconsistent objectives’. Although the company has retained its family atmosphere, the CEO’s arrival has been transformative, mainly in the realm of organisational behaviour and organisational culture.

First, the senior team ensures that everyone works according to the group’s SHINE values – Straightforward, Helpful, Innovation, No Limits to Customer Service and Empower and Engage. At the end of the year, the company holds an awards ceremony where the SHINE Star of the Year is named. The practices that follow are related to SHINE as well.

Second, ‘leadership by behaviour’ is promoted, comprising a number of elements. ‘Leading by example’, the CEO has created a culture of shared leadership, values and behaviours. He highlights that all employees have two duties: to develop themselves and to change and develop their roles.

The CEO is passionate as well about bringing his people with him. He holds a ‘big briefing’ – a quarterly meeting to keep every-one up-to-date on company progress, results and updates. At this meeting, employees can ask questions and give feedback. Everyone attends in prearranged hourly slots and employees are encouraged to send the CEO emails on the topic he presents.

Third, the group enables line managers to drive the organisation and to make their own decisions on how to lead their teams. Self-managed teamwork means that in a culture of non-hierarchical behaviour, teams are empowered to address issues from customers directly, working within boundaries set to allow room for entrepreneurial behaviour. Open-plan offices and working groups enable cross-functional collaboration throughout the company, and job swaps provide opportunities to work in different areas and to support career progression.

Fourth, training, skills development, apprenticeships and career progression are a priority, and the majority of the senior team have been promoted from within the company. Leadership by behaviour training is cascaded from the senior team to all managers. Employees' individual development goals, learning needs and SMART objectives are discussed at conversational one-to-one meetings with line managers each month. Together with mid-year reviews, these measures lead to a 'no surprise' year-end appraisal.

Fifth, continuous improvement (CI) has been introduced. CI champions have organised improvement projects and teams organise cross-functional working groups seeking to improve the way they work. There are 146 CI initiatives in progress, each based on an opportunity identified by an employee. Every employee is also encouraged to sign up for a Kaizen project, taking time out for a week to join a cross-functional team (Kaizen being a Japanese concept of continuous improvement).

Sixth, an 'employee forum' offers opportunities to discuss improvement, through which employee representatives attend meetings with senior management. The forum helps to run 'PeopleFest', an event encompassing sessions on well-being, career, financial and health advice, cycling to work, benefits, discount vouchers and childcare information.

Open leadership, communication and trust have enabled the group to undertake a reduction in overall staff numbers and the closure of sites, while retaining high levels of staff engagement. Profits have risen and employees have gained yearly pay rises, and even bonuses, throughout the recession.

ES-MANU-XXXX-S

This manufacturing enterprise is a leader within its sector. The company exports a large amount of its produce to EU countries and North Africa. It originally belonged to a large industrial group, but was purchased by an international investment fund in 2014. Despite difficulties, the company has experienced positive economic results in the last five years. The company has a workforce comprising mainly men involved in production-related tasks. The average age of the workforce is relatively high so there is a great need to recruit new people in the coming years. Management and employee representatives work together for the benefit of everybody. Despite belonging to a larger industrial group, the company has always been fully independent in deciding its own WPI practices. During recent years, the company has developed a whole set of WPI practices.

First, there is a fluid and rich social dialogue between management and employee representatives, highlighting elements of formal and informal communication, consultation and two-way dialogue. For instance, employee representatives are provided with comprehensive and updated sector/company-related information. Furthermore, employees are consulted early regarding important decisions and ideas stemming from employee representatives (that could eventually be accepted by the management after discussion) are encouraged. This smooth-flowing social dialogue is favoured by management, which has a positive and proactive attitude. There is also vigilant employee representation, committed to the improvement of working and employment conditions and to the future of the company.

Second, the very favourable employment and working conditions within the company's own enterprise collective agreement has resulted from the existing social dialogue practices. The agreements are favourable compared with collective agreements at provincial, regional and national levels. These include higher salaries, 35 working hours per week, lower annual working time (1,592 working hours per year) and, finally, the reduction of overtime work.

Third, there is 'the presence of innovative work organisation practices'. The company has developed the so-called 'sliding work organisation system', through which employees are encouraged to partially assume activities that correspond to their immediately higher position rank, and in different production lines. This work organisation measure helps individuals to gain thorough knowledge of all the different working processes, as well as making it possible to move personnel among the different production lines. In addition, the company introduced the so-called 'biological calendars', an innovative working time organisation practice (suggested by the employee representatives) intended to match the company's demands with the needs of the workforce. Not least, the work is organised around self-managing teams that enjoy a certain degree of autonomy in the way their human resources are organised.

Fourth, 'high attention to risk-prevention activities' means that the company is very active in the risk prevention domain. Training and information transfer are highly developed.

The WPI practices facilitate a good employment climate, the availability of a well-motivated workforce, the lack of social conflicts and the use of the workforce's innovative capabilities. Consequently, the company is perceived as a good employer and as a net creator of employment. This is particularly valued by the employee representatives. It helps to explain the company's positive economic results, despite the economic crisis.

Employee-driven WPI (Path 4)

In this path, WPI is initiated from the bottom up and implemented in a participatory manner. While the organisation has decision latitude to make its own choices, it also gives employees room to participate in developing the organisation's model. The following Polish and German examples illustrate the participation of employees in changing work practices and the organisation. In the Polish rehabilitation centre case, professionals co-redesigned the work and then coordinated work processes supported by HR-related measures. The German example shows significant trust between management and the employees. This results in contributions to innovation from employees, who are self-managing, learning new competencies and operating flexibly. They can decide their own working times to a large extent.

PL-EDEC-REHAB-S

This centre for rehabilitation, education and pedagogy provides multiprofiled educational, therapeutic and rehabilitation assistance to children and youth with disabilities. It also creates optimal conditions for fulfilling the schooling obligation based on an individual programme. The organisation faced problems attracting funding and raising the number of pupils, with only those entities with the highest expertise and achievements in the market achieving success in these areas. In order to achieve this status, the organisation implemented WPI practices of two kinds.

First, the practice of 'partnership in management' has led to the creation of a Coordination Team aimed at integrating decision procedures that were formerly split across different groups. This integrated team consists of four representatives of all groups of workers: physiotherapists, speech therapists, psychologists, teachers and management (director and deputy directors). The body is an informal advisory and consultative structure and, owing to its openness and broad employee representation, it acts as an intermediate body between employees and management. Employees freely share their ideas with the Coordination Team, discuss new projects and feel they take part in the decision-making process concerning important matters of the centre. This also ensures that the development of the centre is both continuous and creative.

Second, there is the practice of 'institutional development through individual employee development'. The centre applies several HR-related practices, which provide employees with autonomy and initiatives in accomplishing assigned tasks. The innovative Incentive Scheme (including financial and non-financial aspects) for team management is one example. In return for high achievements, such as receiving additional funding from structural funds and creative contribution to accomplishing assigned tasks, the employees receive bonuses. Participation in educational classes, including training, studying and internship, is rewarded with an additional salary. Employees are also entitled to use specialised rehabilitation equipment and the centre's premises after working hours.

Another example is allowing employees to expand their competencies – for example, by financing postgraduate studies and through nationwide and international exchange and internship projects. The Self-Education Council, formed by teachers and specialists of the organisation, enables them to share knowledge and raise workers' skills for the benefit of the pupils as well as the employees' own educational level and labour market position. A further example is the integrated computer schedule created by employees and covering the use of rooms, specialists' working time and pupils' individual schedules. The application supported a more efficient use of space and time for the pupils' needs, and of the specialists' time and skills. Lastly, management and staff willingly participate in planned and spontaneously organised integration meetings for employees and their families, as well as for pupils. This contributes to bonding among employees, creating a good work atmosphere as well as employee commitment to carrying out their professional tasks and implementing improvements.

The high level of employee involvement and open, energetic leadership contribute to the organisation becoming a strong competitor with innovative solutions and programmes. Employees feel that they share responsibility for decisions taken and implemented by management.

DE-AGRO-HORTICULT-L

This worldwide chemical company has customers in more than 70 countries. For over 100 years, it has produced substrates, base and peat products, providing innovative standard and customer oriented products. The company is not restricted by external limitations when deciding about its work organisation and structures; it can decide on these issues independently. Employees jointly decide on the implementation of WPI measures. Employees are seen as a key ingredient for success. The participative culture of the company has existed for many years.

The company has implemented five WPI practices. The first is that of working times based on trust. Employees can work at any time they wish, acting responsibly without any formal control by management or line managers. Naturally, employees have to align their own preferences with those of their working team (teamwork is the core element of work organisation) and respect work order peaks. Apart from this, no constraints exist and employees can combine private and family life with working times in a much better way. Trusted working times are part of an official agreement between management, employees and their representatives. It shows how employees can have a say in influencing the organisational model and actively participate in implementing WPI practices.

The second practice concerns innovation proposals – specifically, how employees can articulate their voices, share ideas and make suggestions through the 'improvement system'. Innovation proposals are sought from the employees in a systematic and formal way (written down in a company agreement). About 80 to 100 proposals a year are generated by administration staff and production workers. A strict and anonymous procedure guarantees fair selection of the proposals, feedback is guaranteed, a prize for relevant (workplace) innovation proposals is offered, and small gifts are given for creative proposals.

The third practice is the Theatre Pedagogy Factory/Workshop. The participants (employees) develop their own play and present this to the other employees as an audience. Teamwork, work division and organisation are the main themes of the plays. This joint project with a theatre pedagogic centre is a personnel development measure seeking to improve team spirit and bring together different working group cultures (for example, commercial and production related staff, different professions). The practice is only possible due to the active participation and support of employees, who have to develop their own ideas to strengthen team spirit.

Fourth, the company implements practices that ease knowledge sharing and communication – such as the Junior and Elder Staff Exchange or On Feet Meetings. The former focuses on developing young talents by bringing them to the production machines together with older, skilled workers. This helps to manage demographic change. On Feet Meetings are spontaneous standing meetings of staff held on the work floor. This reduces the duration and number of formal meetings, improves day-to-day work organisation, and makes the meetings and cooperation more lively, productive and efficient.

Lastly, health promotion during working time is offered by the company and was developed by a health circle, with the participation of the company's medical officer, employee representatives and management representatives. This helps to prevent negative physical consequences at work, since employees still carry out a lot of physical work. For instance, training to strengthen back muscles is given not only in-house in meeting rooms but also on the work floor, directly beside the production machines and in the peat lands.

The impact of these practices is directly seen in the organisational and personnel development of the company (for example, self-responsibility, new competencies and flexibility for the employees). The intrinsic motivation of the employees is seen as the main grounds for the success of the company, which addresses the needs of employees and provides them with meaningful work. Giving responsibility instead of controlling employees is the motto of the company, ensuring that it remains innovative and successful in the market.

Innovative Behavioural-driven WPI (Path 5)

Companies choosing this path to WPI show a preference for limiting the division of labour and for enabling employees to perform innovative behaviour. However, employees do not play a role in developing the organisation's model.

The example below illustrates how the appointment of a new CEO introduces the values of the mother company to its UK subsidiary, while at the same time introducing incremental changes to create an open culture. Employees and employee representatives seem to be involved wherever possible. The other example concerns a Danish factory that replaced management control with autonomous teamwork. Management proposes ideas, but then gives employees the chance to suggest how these ideas could be developed and put into practice. Management in both companies is open to change and to receiving innovative ideas and feedback from employees.

UK-CONS-BUILD-L

This company is a leading project development and construction group. It is one of the country's largest contractors, and its diverse portfolio includes several iconic buildings and major infrastructure projects. One of the big transformations was to adopt the mother company's approach to openness and transparency, in an attempt to combat the construction industry's poor image – one tarnished by corruption, issues of quality, insufficient regard to safety, a poor environmental record and the blacklisting of union activists. In particular, the appointment of a new CEO demonstrated a clear commitment to break with the past. Embracing high ethical principles relating to safety, the environment, transparency and quality, the CEO shows leadership that articulates clear values and these values are lived by all managers in the company. This was recognised as a powerful driver of employee engagement and an enabling culture. The case study is not a dramatic example of WPI, but rather illustrates a sustained series of incremental innovations leading to a strategic change in culture, working practices and employee engagement. Apart from adopting the mother company's approach and core values (such as zero accidents, zero environmental incidents, zero tolerance of bribery and corruption, and zero defects), mutually reinforcing WPI practices were put in place to reflect 'the culture change journey', comprising six ingredients.

First, the practice of 'breaking down silos' points to the historical merger of three businesses with separate cultures and practices. The primary objective was to demolish the walls between different parts of the organisation, centralising such enabling functions as HR and finance. This helped to create common values and allowed consistent, company-wide initiatives to develop, addressing management development, healthy working and environmental sustainability.

Second, there is the practice of 'changing management behaviour', with a focus on culture, not basic procedures, such as the 'great boss initiative'. This measure defines expected management competences and behaviours, and measures progress towards achieving them through an annual working climate survey.

A third practice is 'reinforcing ethical behaviour'. During regular management team meetings, time is spent exploring an ethical dilemma relevant to the business, reinforcing the message that the organisation is a values-driven one.

A fourth measure is 'trade union partnership', where the organisation works closely with the trade unions, which are seen as vital partners in reinforcing company values and in ensuring health and safety.

The fifth practice, an 'injury-free environment', promotes safe, healthy working, an ideal driven from the top. It is seen as part of a shared learning culture rather than a regulatory stick. Employees and union safety representatives play a critical role in highlighting risks and identifying better ways of working. This extends to the supply chain.

Sixth, 'engaging employees in improvement and innovation' is a measure that shows recognition of the need for several routes to engage employee initiative. An open and enabling management culture is the starting point, supported by specific initiatives. Such initiatives include local consultation forums for frontline workers and union representatives, the Company Way Week (a focus for dialogue on important issues such as well-being and mental health), a You Said/We Did board, and even an Innovation App that enables employees to take a picture to illustrate ideas for improvement.

DK-MANU-FABRIC-S

This international company produces fabrics for different customer groups (such as retail, hotels and furniture manufacturers). The company's headquarters are located in Denmark, but the products are manufactured in different European countries.

The company's products are at the higher end of the price range. New demands in the market and the achievement of business goals have driven the introduction of autonomous and semi-autonomous teams and a 'flat' management structure. Until 2000, the organisational model was characterised by management control. The company regards WPI as a way to ensure renewal and the ability to offer a service that customers will choose over others. This approach is not new, but part of a longer tradition of sharing knowledge and supporting employee participation. What stands out in recent developments is the organisational restructuring and measures to ensure employee participation.

First, 'new multidisciplinary customer segment teams' have been introduced, whereby product developers, designers, customer service assistants, logisticians and representatives from the department of quality and environment work together across countries. The subsidiary companies also take part in the teamwork. Teamwork practice provides employees with a better understanding of the customers' needs, enabling them to share knowledge and accommodate new demands. The teams have recently initiated partnerships with customers (in relation to corporate social responsibly, environmental issues, quality and logistics) and can now offer them a much better product and a better-targeted service. The multidisciplinary teams are centred on specific customer segments (for example, hospitals and retail), and they discuss their work organisation continuously, sharing knowledge and experiences. The company's structure is characterised by having few organisational ceilings and walls, limited layers and no strict lines of command.

Second, 'ensuring employee participation' revolves around organisational culture issues. The culture is focused on direct and informal dialogue. The old 'proposal box' has been replaced by proposing changes directly to management. The management group focuses on promoting trust by formulating performance scores and goals in cooperation with employees. For example, the product development department conducts continuous innovation meetings. All sorts of utopian and 'crazy' ideas about how to organise work can be proposed, and sometimes the organisation transforms these into specific solutions.

The company encourages employees to renew the products by inviting artists and arranging trips to art museums.

Implementation ensures participation from employees. New practices (such as the customer segment teams) were proposed by the management group, but they quickly 'let go' of the process to enable employees to develop and implement the team structure in a way that they considered useful. The implementation was an incremental change in which employees continuously test new ideas and change them along the way. The company's future and employee influence in the workplace are considered a shared responsibility. Interdisciplinary cooperation and knowledge sharing gives the company a competitive advantage, a greater understanding of the market and motivated employees.

WPI Practices

The sample of companies is too small to draw final conclusions about the WPI practices applied and developed. Nevertheless, some observations can be made from these cases. For instance, all the companies mentioned more than one WPI practice, which may be an indication of 'bundles'. However, the practices do not often constitute a coherent programme, and in many cases they reflect developments over a number of years. In most cases, a combination of WPI-structure oriented, WPI-culture oriented and HR measures can be observed.

The top-guided companies cited having implemented WPI- structure oriented changes, such as introducing teamwork, reorganising tasks and setting up cross-functional teams. In addition, they showed an interest in innovation and renewal through employee participation. Typical HR-related instruments such as appraisal interviews were also cited.

The autonomy-driven WPI companies cited several WPI- culture oriented interventions, such as open culture, dialogue and partnership. These were accompanied by changes in WPI- structure oriented work organisation and HR-related measures of competence development.

Companies with integral WPI mention several WPI-culture oriented practices, whereby employees are encouraged to pro- pose innovative ideas and dialogue takes place with employees and their representatives. Management behaviour to support these practices seems vital. Nonetheless, WPI-structure oriented and HR-related practices are not lacking among these companies: self-managing teamwork and task variety are present, as are learning and development programmes.

Cases of employee-driven WPI seem to have a preference for significant employee roles. WPI-culture oriented practices are dominant and point to partnership in management, employee development as a driver for development of the organisation, and knowledge-sharing through meetings and discussion.

Innovative behavioural driven WPI also has practices that provide a significant role for employees. Its WPI-culture oriented practices combine new, innovative and participative behaviour, including from management, with WPI-structure oriented measures seeking to tear down silos and introduce multidisciplinary teams.

There is quite a variety of WPI practices within paths. It appears that companies combine WPI practices from the different categories of WPI-structure oriented, WPI-culture oriented and HR-related practices.

Summary

Assuming that there is variety among companies that innovate in their workplaces, this chapter investigated the roads that companies take on their journey to WPI. The QCA results show that companies follow different routes to become a substantial WPI practising organisation. The companies combine different causal conditions on the five paths to WPI that emerged from the analysis. To be a substantial WPI company, there are no necessary conditions observed among the 51 cases, which means that no aspects as such have to be present. There are also no sufficient conditions, meaning that the presence of a certain, single, condition would be enough to count as a substantial WPI companies. There are always combinations of conditions present among organisations regarded as substantial WPI companies. It would be wrong to conclude that ‘any combination goes’. In fact, each configurational combination of causal conditions is an implicit strategy to become a WPI company. While an explicit strategy is a highly deliberate and conscious activity, the implicit strategies can be seen as a process that may take years and that expresses the organisational or management ‘philosophy’ behind the move. Although such strategies may not be highly deliberate, they constitute choices that organisations make and therefore may be considered as ‘implicitly strategic’.

The analysis identified five implicit strategies. The basic model of the QCA included ‘contextual factors’, ‘features of WPI’ and ‘adoption and implementation aspects’ (reasons, motivations and facilitators). The five paths make clear that it is not necessary for elements of all three blocks to be simultaneously present for WPI to appear. Examples of WPI practices demonstrate that companies show a variation of WPI practices within paths. However, the findings shows similarities in the way the companies seem to combine practices that are WPI-structure oriented, WPI-culture oriented and HR-related. This is in line with the findings in Chapter 2, where it was observed that 53% of the practices were WPI-structure, WPI-culture or WPI-mixed, and 39% were HR related.

This shows that certain combinations enhance the presence of substantial WPI, while others do not. People in organisations – managers and employees – have a certain freedom to choose their own solutions. It also shows that WPI has never been launched as a one-size-fits-all initiative like, for example, the Ford system, lean production and the European Foundation for Quality Management (EFQM) quality model. In the next chapter, motives for WPI are discussed, the process aspects of developing and implementing WPI are investigated, and impacts of WPI for organisations and employees are explored.

CHAPTER 4 Motivation, Implementation and Impacts

The purpose of this chapter is to provide a more in-depth description of the companies and to answer the following questions.

- Why do companies initiate WPI and what is the motivation of actors?
- How do they develop and implement WPI and what is the role of different actors?
- What are the impacts, if known, for organisational performance and for employees?

The assumption is that WPI companies tend to view relations with the workforce and their representatives as important and to see the workforce as an important factor in achieving desired economic results. It is assumed that this tendency associates with employee engagement in various ways, and that this engagement is reflected in why and how companies introduce WPI and in the impacts this may have for the organisation and the actors within it. These assumptions are based on the outcomes of the Eurofound report Work organisation and innovation, which states that:

Pressure to improve performance was the main driver for innovation (in work organisation) in the case study companies. This pressure was driven by the economic crisis and the need to meet the challenges of demo-graphic change and intense competition. In most of the companies, inspiration for the innovation came from managers and employees were then consulted. In a number of companies, there was a dual approach consisting of a top-down initial decision to innovate, followed by a bottom-up approach for implementing and selecting improvements. Convincing staff of the benefits of innovation in work organisation remained a critical part of the implementation process. Working groups were frequently used to bring together staff from different parts of the organisation to ensure their views were taken into account. (Eurofound, 2012, p. 1)

From the Eurofound study, it can be assumed that management, driven to improve performance, takes the initiative and then quickly consults employees. A top-down initiative was soon followed by bottom-up input for designing and implementing work organisation improvements; views and interests of others were taken into account through dialogue and involvement in working groups.

To investigate the questions above and this assumption, cross tabulations were made of the companies against the data on reasons and motives for WPI, adoption and implementation of WPI, and impacts of such innovation. Within the companies, interviews were held with management, a group of employees and employee representatives on these same topics, making it possible to compare the answers of these three groups. Since all 51 cases are companies with a relatively high WPI Index score, all cases were analysed as one, relatively homogeneous group.

In this chapter, the reasons and motives for WPI are examined firstly. Subsequently, light is shed on the leverage factors concerning the adoption and implementation of WPI. Finally, the impacts of WPI are examined, in so far as organisations already experience tangible effects. At the same time, the evaluations and experiences of managers, employees and employee representatives are compared.

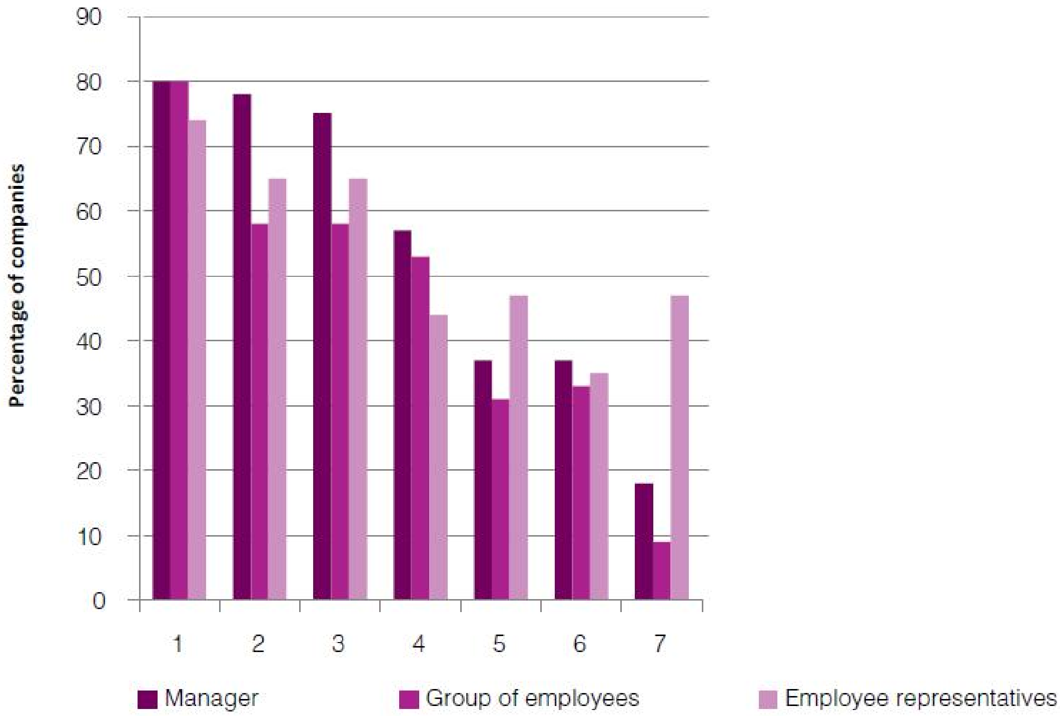
Reasons for Introducing WPI

One of the main goals of this report is to increase understanding of the reasoning of and drivers for companies that initiate WPI. The first consideration is to look at motives for introducing WPI for the company as a whole. A second consideration is looking at the desired outcomes for the actor groups of managers, employees and employee representatives. Since the 51 cases in the sample are among the most innovative organisations in their countries, the goal is to understand the common background of these companies. Among 51 cases, there are companies from 16 distinct sectors and various European countries; however, the results in Figure 4 show that these companies share common motives for WPI initiation.

As shown in Figure 4, the most prominent general reason for initiating WPI for the organisation as a whole, according to all interviewees in the companies, is to improve efficiency.38 About 75% of employee representatives and 80% of managers and groups of employees cited this reason. The second most significant motive, again as agreed among all interviewees, is to gain competitive advantage. The third most prominent general reason cited for WPI implementation is to enhance innovative capability. It is important to note that all three top reasons are oriented towards better organisational performance. This is in line with research, which states that economic goals are the main reasons for companies to implement HPWP practices (Boxall and Macky, 2009; Boxall, 2012). Of course, when companies adopt new models, they also do so to improve how they reach their economic goals. However, it is not possible to answer why they chose these models over others – that is, what their options are for strategic choices. It is also important to highlight that all three groups representing the company are in agreement about the importance of these aforementioned reasons.

He one notable difference in reasoning for WPI is with regard to improving industrial relations with unions. For managers and groups of employees, this was considered the least important reason. It was mentioned by less than a fifth of managers and employee groups, whereas employee representatives chose this reason in almost half of the cases, which is easy to under-stand. However, the number of respondents should be taken into account when trying to understand this difference. In some companies, there were no employee representatives or unions, so it is natural that managers and employee groups did not choose this option; on the other hand, among the companies where formal employee representatives were present (34 out of 51), their selection of 'improved relations with unions' becomes more understandable.

Figure 4: Main reasons for introducing WPI – for organisation as a whole (%)



Note: x-axis legend: 1 – To improve efficiency, 2 – To gain competitive advantage, 3 – To enhance innovative capability, 4 – To become an attractive employer, 5 – To enable acceptance by employees, 6 – To enable the embedding of new technology and ICT, 7 – To improve industrial relations with unions.

Examples of Reasons for Introducing WPI

To improve efficiency EL-SERV-RETAIL-S implemented a new enterprise resource planning (ERP) system as it wanted to simplify the company's procedures and make them more congruent with the rest of the companies in the group. The company expected to increase the speed of reporting and to minimise the amount of mistakes made.

To gain Competitive Advantage

BG-EDUC-UNI-S competes with local and foreign universities to attract more students. It conducts weekly roundtable discussions with employees and management. Employees can make suggestions and give ideas on how to solve issues. They can discuss solutions and make joint decisions on how to proceed and remain competitive in the market.

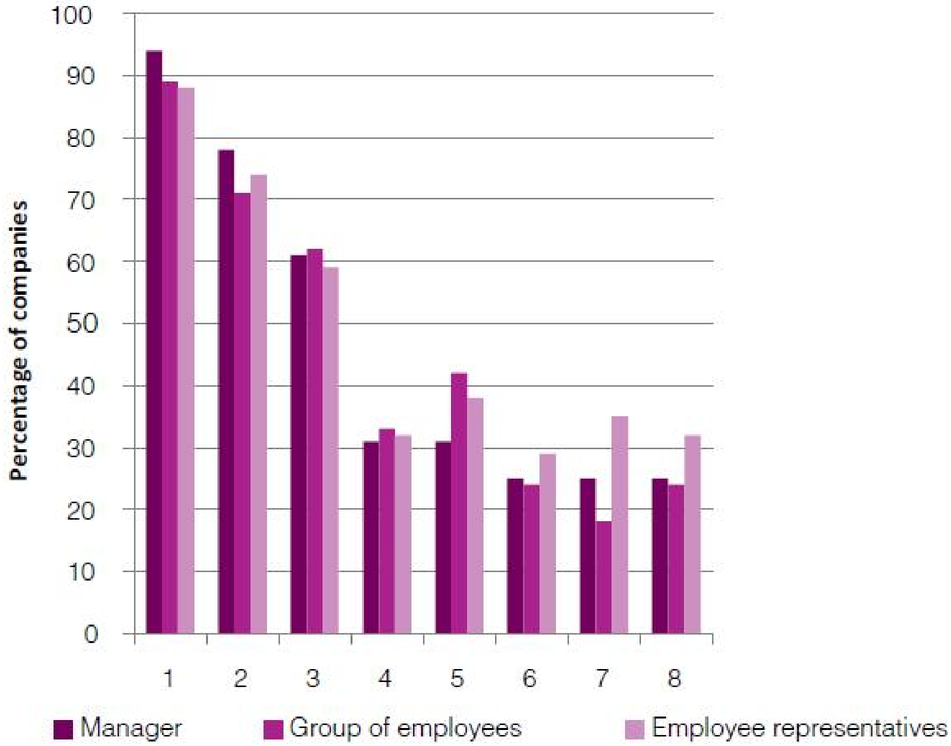
To enhance Innovative Capability

DE-TRANSP-TRAIN-L reported that new ideas are essential for the organisation. In order to enhance innovative capability, employees from various levels have been involved in projects related to innovation development and projects.

To become an attractive employer BG-ENER-GAS-S works closely with education institutions, pro- moting work perspectives in the gasification sector, supporting various competitions, and increasing awareness of the company and its name so it is more recognisable to students as an attractive employer.

Motives among the actor groups (Figure 5) for WPI implementation are aligned with the general motives for the organisation as a whole to initiate WPI. This question focused on possible impacts of WPI for management, employees and employee representatives from the managers' and employee groups' per- spectives. The most salient motive is economic and business goals, chosen by almost all companies (ranging between 88% and 94%, depending on the actors). In Figure 5, it is also shown that learning and development opportunities were chosen by approximately three-quarters of the companies. Performance was indicated as the third-most significant motive by all interviewees. All other motives received much less attention, being chosen by approximately one-third of the companies. Overall, motives related to quality of organisational performance were more prominent than those related to quality of work.

Figure 5: Reasons for introducing WPI – managers' and employees' perspectives (%)



note: x-axis legend: 1 – Economic and business goals, 2 – Learning and development opportunities, 3 – Performance, 4 – Public goals, 5 – Flexibility, 6 – Shareholder interests, 7 – Labour market position, 8 – Work–life balance.

Examples of Reasons for Introducing WPI

Economic and business goals BG-ENER-GAS-S suffered from a lack of qualified human capital. This motive was indicated as the main reason for WPI.

Learning and Development Opportunities

DE-TRANSP-TRAIN-L's talent management programme aims to identify and foster employees with high potential. The company describes this initiative as not merely training, but as 'sustainable further development'. In this way, young talent has the opportunity to grow.

Performance

PL-MAN-SHIP-S was affected by the economic recession of 2008 and acquired by an international group. The changes became a stimulus for transformation in the area of management and planning.

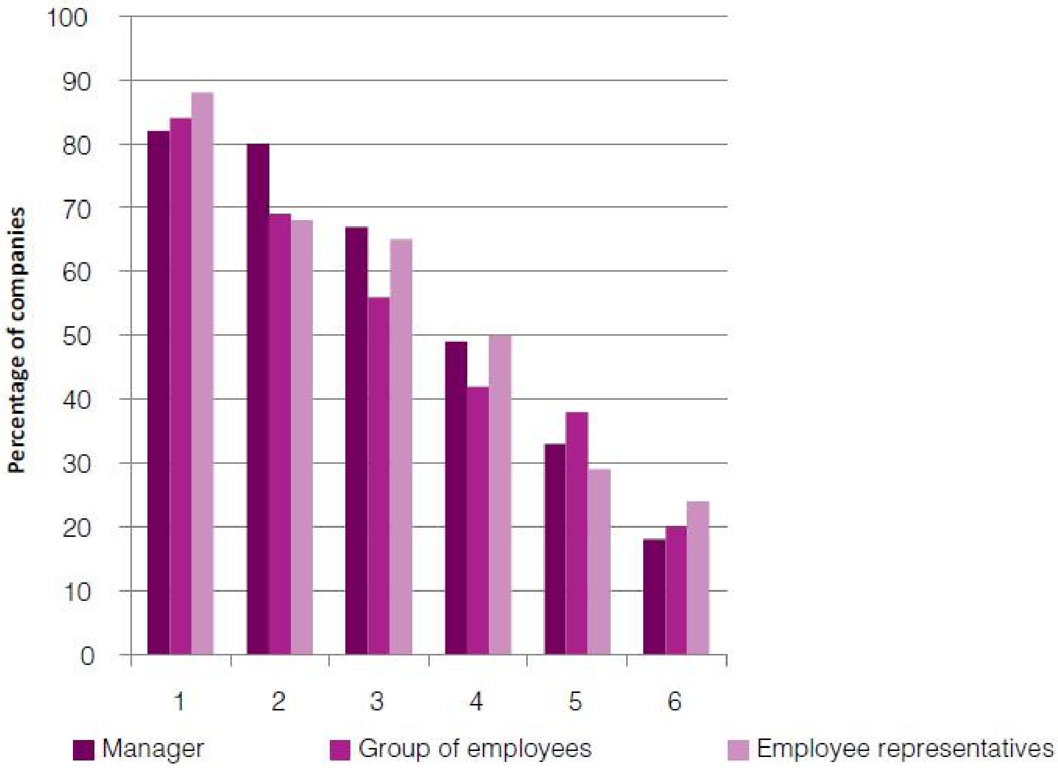
Leverage Factors for Adoption and Implementation of WPI

The implementation of WPI practices is seldom technology- driven, but rather either management-driven, employee-driven or participatory-driven. From the leverage factors experienced, it is possible to get a picture of the methods behind their implementation, and thus how WPI was implemented. Although it is difficult to disentangle how and why WPI was introduced, the study reveals a difference between the two. WPI was introduced primarily for economic reasons, as shown above, but how it was introduced demonstrates the importance of the role of employees: it seems that – primarily – management initiates WPI, while its implementation is more employee-driven, as was observed in an earlier Eurofound study (Eurofound, 2015). Management-driven WPI practices may be conceived as top-down and in the interests of management, whereas employee-driven practices are viewed as bottom-up and in the interests of employees; participatory driven practices may point to cooperation between management and employees. Technology-driven WPI practices in this context include, for example, applications (‘apps’) and IT solutions that support the planning and monitoring of work schedules and HR systems.39 Leverage factors are actions, measures or means that drive the successful implementation of WPI practices.

Empirical data show that the most important leverage factor for WPI implementation is employee involvement, a factor that was reported most often by all three groups of interviewees (Figure 6). The second most important leverage factor is the commitment of top management, followed by leadership. As stipulated already, it is clear that employee involvement is a key factor.

All other factors in Figure 6 were mentioned by less than half of the three interviewee categories. Factors receiving less attention were more related to conditional factors such as availability of resources (time, money and people). As with reasons and motives for WPI implementation, all actors were in agreement about the leverage factors considered the most and least important.

Figure 6: Leverage factors for WPI implementation (%)



Note: x-axis legend: 1 – Employee involvement; 2 – Top management commitment; 3 – Leadership, powerful person, 4 – Organisational; non-conflictive climate; 5 – Resources, enough money and people; 6 – Time, no interference from reorganisation.

Examples of Leverage Factors

Employee Involvement

PL-EDUC-MED-SCHOOL-S had to create new curricula. Employees were the main force behind this change: they actively participated in sharing their knowledge and formalising new programmes. The school started to actively participate in various external projects (related to other institutions) because workers were enthusiastic about the new activities.

Top Management Commitment

LT-SERV-POST-L initiated 'Loyalty Day', a WPI practice that relies on management's willingness to participate in the activity. Managers are expected to visit various company locations and to get information from frontline workers. Since management paid attention to and spent time on this activity, the company has been able to learn from this practice.

Leadership, Powerful Person

UK-CONST-BUILD-L has been on a sustained journey of trans- formation since the appointment of a new CEO in 2009. The move enabled the company to distance itself from traditional industry practices by embracing high ethical principles relating to safety, the environment, transparency and quality.

Impacts of WPI on Organisation and Employees

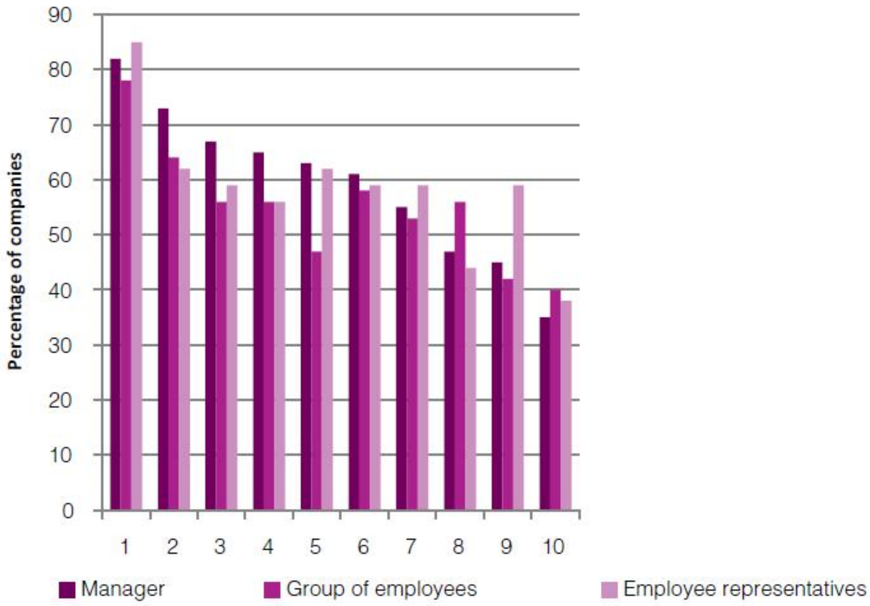
Impacts of WPI practices can be divided into effects upon the organisation's performance and effects that benefit employees. Respondents were asked to indicate these effects.

First, Figure 7 (overleaf) shows the results regarding the out- comes for the organisation according to managers, employees and employee representatives. Employee engagement was cited as the most important outcome of WPI, with approximately 80% of companies choosing this option. Longer-term sustainability was the second most salient outcome. In addition, more than half of the companies cited high performance, better customer or client focus, efficiency and profitability as outcomes of WPI. For employee representatives, notable outcomes were establishing good work and more positive employment relations. Perhaps surprisingly, for employees, establishing good work was subordinate to efficiency, profit- ability and high performance as an outcome of WPI.

Second, the study looked at the impacts or outcomes of WPI practices for the three actor groups – managers, employees and employee representatives – again according to these three groups.

Looking at Figures 8 to 10, a first observation is that the three actors are largely in agreement about the impacts of WPI. Turning first to the impact of WPI from the perspective of managers' interests, efficiency and greater sustainability dominated as outcomes (Figure 8, overleaf). Effectiveness and good labour market image received the lowest scores for all three actors (less than 50%).

Figure 7: Impacts on the organisation (%)



Note: x-axis legend: 1 – Employee engagement; 2 – Longer-term sustainability; 3 – High performance; 4 – Better customer focus, client focus; 5 – Establishing good work; 6 – Efficiency; 7 – Profitability; 8 – Enabling culture; 9 – More positive employment relations; 10 – Resilience.

Examples of Impacts on the Organization

Employee Engagement

When PL-TRANSP-BUS-S initiated informal communication practices, employees became more involved in decision-making. The employees were able to give more suggestions and became more interested in the company's success.

Longer-term Sustainability

LT-SERV-POST-L implemented 'Loyalty Day', an initiative that focuses on knowledge sharing between managers and first-line workers. This shared knowledge helps to increase sustainability by securing the company's know-how, boosting common company identity and improving stable working processes.

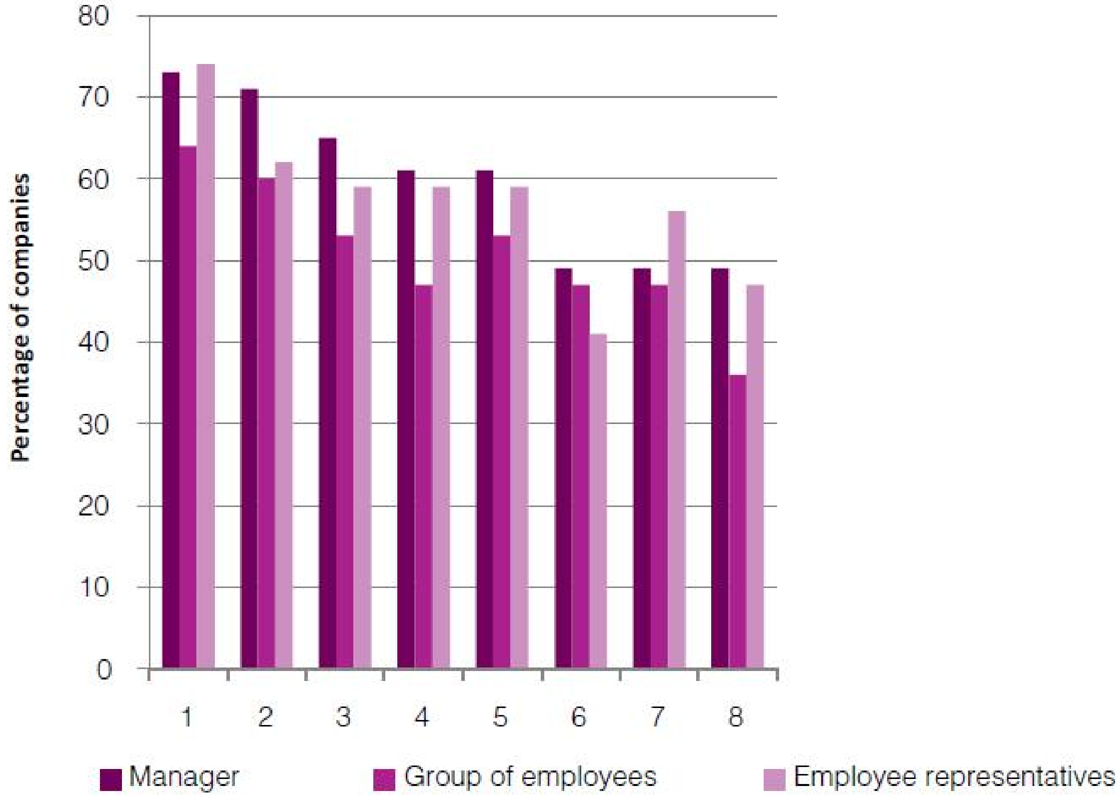
High Performance

EL-SERV-RETAIL-S implemented a new enterprise resource planning (ERP) system, which enhanced performance by supporting project management and enabling better decision-making.

Better Customer or Client focus

PL-ADM-TAX-S introduced a WPI practice that evaluates and rewards the best employees for their effective performance regarding customers. Upgraded performance and services led to a better public opinion of the company.

Figure 8: Impacts on managers or managers' interests (%)



Note: x-axis legend: 1 – Efficiency; 2 – More sustainability; 3 – Competitiveness; 4 – Innovation/innovation capability; 5 – Satisfied client, customer; 6 – Effectiveness; 7 – Profitability; 8 – Good labour market image.

Examples of Impacts on managers

Efficiency

DE-ENER-ELEC-L introduced 'Innovative Working World', an initiative resulting in improved surroundings and easier communication between managers and other employees. Open office areas allowed for more informal and spontaneous communication, which improved working efficiency.

More Sustainability

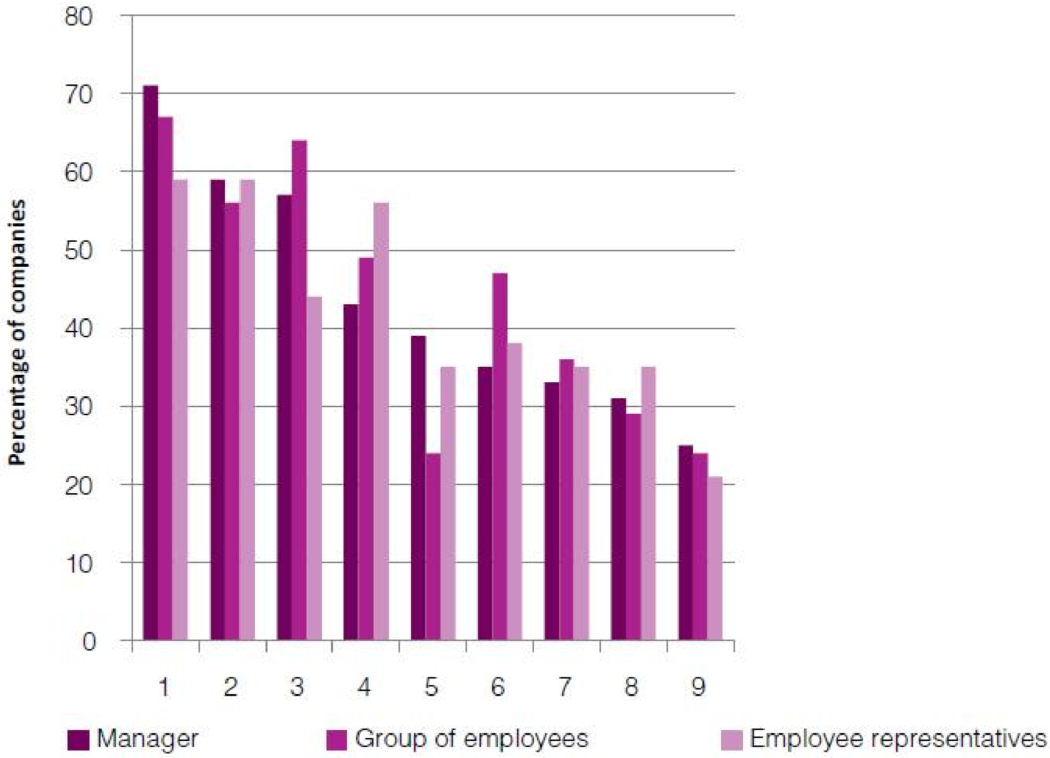
BG-MANU-CLOSURES-L introduced WPI practices (regular technical working meetings, 5S method and IT systems) that have helped to address the company's need for constant efficiency improvement, competitiveness and long-term sustainability.Competitiveness

PL-EDUC-MED-SCHOOL-S introduced new curricula, enabling the school to attract new students.

Innovation/innovation Capability

LT-CONST-BUILD-L implemented WPI practices that focused on active employee engagement in the company's development and innovation. Various measures were used, such as boards for writing ideas down and specialised processes for implementing innovative ideas. After the first few months, impacts were already tangible.

Figure 9: Impacts on employees or employee interests (%)



Note: x-axis legend: 1 – Learning opportunities; 2 – Voice, participation; 3 – Challenging, active jobs; 4 – Healthy work; 5 – Job security; 6 – Flexibility; 7 – Good quality of jobs, autonomy; 8 – Good terms of employment; 9 – Work–life balance.

Examples of Impacts on Employees

In terms of impacts of WPI from the perspective of 'employee interests', the most important outcomes were enhanced learning opportunities, greater voice or participation, and challenging and active jobs (Figure 9). Work–life balance received a significantly low score for all three actors, with fewer than one-third of the interviewees citing this impact.

Learning Opportunities

BG-ENER-GAS-S launched a Knowledge Management System to enable knowledge sharing and information gathering. This programme is internet based, giving employees easy access to all of the resources.

Voice and Participation

ES-SCI-WORK-L initiated WPI practices that focus on employee participation. First, the company ensured a continuous information flow by establishing a system to inform employees about changes and future perspectives of the company.

Second, intranet and social media were used to ensure that everyone is informed and can give feedback and suggestions.

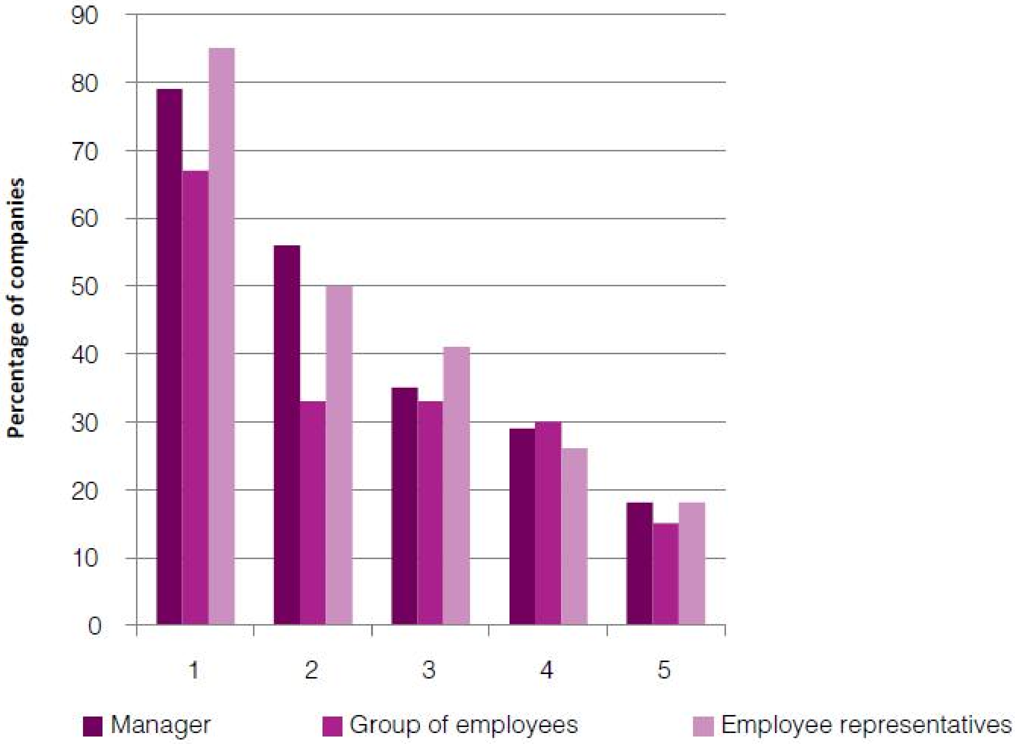
Challenging and Active Jobs

DK-ART-MUSEUM-S developed a new work organisation that supports autonomy and facilitates development opportunities for the museum hosts ('Good hosting project'), making them feel more valued and an integral and active part of the museum's experience. Training was given and new 'work codes' were formulated on how to greet guests, which products to sell, and how to inspire guests to explore the exhibitions and other facilities.

Good terms of Employment

EL-SERV-RETAIL-S's Health and Wellness programmes improved terms of employment by providing various benefits to all employees. These included computerised programmes on healthy living, visits to dieticians and reimbursements for fitness programmes.

Figure 10: Impacts on employee representative or union interests (%)



Note: x-axis legend: 1 – Employee voice; 2 – Sustainable organisation; 3 – Equality, fairness; 4 – Job security/income security; 5 – Union membership.

Examples of Impacts for Employee Representatives

Finally, looking at the impacts of WPI from the perspective of 'employee representative or union interests' (based on a lower number of respondents – that is, only the companies with employee representatives present), the most important impact cited was employee voice (Figure 10). Job and income security seemed much less important.

Employee Voice

EL-SERV-RETAIL-S adopted a performance management and employee development approach that enabled employees to express their opinions and needs. The well-developed '5 Conversations Framework' initiative allowed employees to engage in a clear and candid conversation, during which they could give and receive feedback.Sustainable organisation

DK-SERV-JOURNAL-S is an example of how knowledge- sharing and employee participation can prevent organisational vulnerability. 'Helicopter meetings' were focused on future topics, such as employment policies and priorities in the collective agreements. These meetings were extensions of the participatory culture, whereby employees, management and politicians discussed how they could develop the organisation in the future.

Implementation Process

Companies adopt and implement WPI in their own specific way. Three examples – from the UK, Denmark and Lithuania – give a flavour of cultural differences. The UK example shows how leadership enables employee participation, while the Danish example reflects a stepwise approach that was agreed with unions. The Lithuanian case exemplifies the fostering of dialogue between management and employees, which is relatively new to the region.

Examples of the Implementation process

Leadership

UK-ENER-ELEC-L's head of HR describes the company's philosophy as follows: 'We want this to be a business where views are listened to and where communications are open and honest. We also want this to be a workplace where positive ideas are encouraged and where achievements are celebrated.' Open Forums have replaced the previous company-wide meetings and suggestion schemes that had struggled to stimulate open and constructive dialogue and feedback. The CEO's open leadership has created trust and employees feel confident about the future. According to one employee: 'It is interesting isn't it – you go to the Open Forums and people will say what they think and absolutely nobody will turn round and go "I can't believe he said that"... They might not agree with you but nobody will actually knock anyone for having a view because we are encouraged to have a view. That's really empowering I think.'

Partnership with Unions

DK-SERV-PARK-S allows for discussion of organisational changes between the manager and the union representatives. They have a partnership and value each other's opinions. The manager explains: 'It is nice to have representatives who are not afraid to step up against me in a constructive dialogue.' The implementation approach involves the following steps: 1) management takes the initiative; 2) external consultants sup- port the process; 3) 'experiments' are conducted (for example, a work gang tests new meeting practices); 4) an 'invitation' to the same knowledge is issued for all (training); and 5) the practices are implemented, but not necessarily in the same way everywhere. No evaluation has been conducted, but adjustments have been made along the way. Both management and employees believe that it is important to design the process in a manner that creates 'enthusiasts' among the employees.

The union representative explains: 'It gives a huge boost to the company that we work together to create a great workplace. ... That is what made us "The Best Workplace" (a Danish award) in 2004.' The employees believe that, even though management determines the direction, they must have trust to be able to discuss it. According to one employee: 'It should be perfectly legal to say our outspoken opinion to our manager – and it is. There may well be disagreement, but you have to be able to discuss things.'

Dialogue with Personnel

LT-ACCOM-HOTELS-S adopted the WPI practice 'Think Guest Feedback', which consists of regular middle management meetings. At these meetings, middle managers from all departments (front office, reservations, conference hall, lobby, restaurant, room service, marketing and others) regularly meet and review hotel ratings on dedicated social media platforms. They discuss particular guest feedback cases and joint actions that could improve guest experiences (and feedback as a result). Together, they brainstorm ways in which guest feedback could be stimulated and collectively addressed, relay important information back to their department teams for further action, produce minutes of their observations, offer recommendations to top management on improvement of various hotel operational aspects, and share experiences with each other. Think Guest Feedback involves, for example, prompt reaction to guest feedback (especially when negative) before guests leave the hotel, and constant organisational learning from any mistakes made. It implies staff empowerment – not only through enabling them to solve emerging problems straight away, but also by making each member of staff feel like owners of the business and encouraging them to be proactive in preventing negative guest experiences. Mutual trust, goodwill and respect across departments (not to solve one's own issues at another's cost) and among all levels of organisational management are encouraged. According to the Director General, the initiative is still very new, but after a few months it is already showing benefits.

These examples show differences in the interplay between management, employees and their representatives. However, they are similar in the sense that cooperation between actors is fundamental to improving the business.

Observations

Pattern and agreement Two striking observations stand out. First, companies that introduce WPI seem to follow a pattern starting with economic goals as the main motive for introducing WPI, but quickly involving employees and employee representatives in the further design and development of such a practice. Such companies seem to understand the importance of the role of employees. The consequence of this is not only the achievement of economic goals, but also more employee engagement and often a better quality of working life as well. Those who introduce workplace innovations in a company generally align themselves with employee interests. It can be assumed that such patterns are much less prevalent in the low-ranking WPI Index score companies that were not investigated. Second, there is agreement among managers, employees and employee representatives on WPI motives, leverage factors and impacts for various internal agents.

While motives for introducing WPI are primarily economic (and there is agreement on that) its success is not always guaranteed. The companies participating in the study agreed that the most important prominent leverage factors for a successful implementation of the WPI practices are: employee involvement; the commitment of top management; and leadership.

From an organisation point of view, the impacts of WPI practices implemented in a company are employee engagement, sustainability and high performance. Implementation of WPI practices does have an impact on employees themselves, since it enables them to acquire more learning opportunities, offers possibilities to participate actively in the workplace and have more challenging jobs. Employee representatives feel that – through the new practices – employees' voice becomes more important, as does the long-term sustainability of the organisation and equality and fairness.

These findings are very much in line with previous Eurofound research on innovations in work organisation (Eurofound, 2012). The key finding of the Eurofound report highlights: first, that there are external forces that drive the improvement of performance; second, that it is management who take the initiative to innovate in the work organisation; and third, that the involvement of employees follows quickly. In short, a top-down initiative is soon matched with bottom-up input for adopting and implementing work organisation improvements, as employees are involved in working groups. The results outlined in this report corroborate this.

More Commonalities than Differences

Thus far, there seems to be considerable agreement between managers, employees and employee representatives. The fact that there is a great deal of agreement across the companies is partly due to the fact that the 51 cases are selected from companies with high WPI Index scores. Nonetheless, in trying to assess differences between cases with substantial WPI practices and cases with the lowest scores regarding the presence of WPI, both groups were compared in terms of contextual factors, motives, adoption and implementation methods, and impacts from the manager perspective (for the organisation, managers, employees and employee representatives).41 This comparison indicated that the substantial and non-substantial WPI companies did not differ greatly in a significant way. Moreover, employees, employee representatives and managers from both types of companies had similar views on the reasons and motives for WPI and the leverage factors and impacts of WPI.

CHAPTER 5 Results, Conclusions and Policy Pointers

This chapter begins with a summary of the results of the study and a reflection on those results. An integral answer to the five research questions is provided. This is followed by the conclusions, including a reflection on the study design and its practical value, as well as its links with previous and future Eurofound research. Finally, policy pointers are set out.

The five central questions that have been answered in a comprehensive manner in this report are as follows.

What kind of organisations and context are researched? (Introduction and Chapter 1)

What types of WPI are observed? (Chapters 1, 2 and 3)

What are the main motivations and drivers for WPI? (Chapter 4)

What is the method of adoption and implementation of WPI? (Chapter 4)

What is the impact of WPI? (Chapter 4)

A blended sample of 51 companies was researched, all of which scored relatively highly on the WPI Index score based on the ECS 2013 dataset. Coming from different industrial sec- tors and varying in size, their locations range in geographical region, covering 10 EU Member States. Some of the organisations are doing quite well, while others face economically difficult times. Some are confronted with austerity measures and restructuring, while others have room for investment and growth. Regardless, all of these organisations chose to implement WPI practices to improve their performance, the quality of jobs, or both.

Types of WPI

WPI is a practice or combination of practices that structurally (in terms of division of labour) and/or culturally (in terms of employee empowerment) enables employees to participate in organisational change and renewal so as to improve the quality of working life and organisational performance.

All companies combine practices and in doing so appear to reflect ‘bundling’. However, this does not mean that there is a coherent ‘programme’. There are cases where a company develops practices step by step over a period of years, reflecting their management model and the level of maturity of WPI. This can be regarded as an implicit strategy of the company.

However, not all practices are WPI according to this working definition. Slightly more than half of the practices are those with a WPI-structure orientation, practices with a WPI-culture orientation or a mixture combining elements of both. A significant share of practices is strictly HR related or of another kind (such as ‘lean’ practices).

The combinations that companies develop do not seem to show any coherent structure. The 51 cases implemented 168 practices. Almost all cases combine WPI practices with HR practices.

Five types of practices could be distinguished: WPI practices (53%), of which: practices with a structure orientation (14%); practices with a culture orientation (20%); mixed practices that combine elements of both (19%); HR-related practices (39%); ‘other’ practices (8%).

WPI-structure practices include, for example, job, task and organisation redesign measures that often enhance the autonomy of employees. WPI-culture practices include dialogue and participatory and communication measures that often enhance the engagement of employees and employee representatives. HR-related practices include personnel recruitment, training, competency development, performance appraisal, working conditions, remuneration, flexibility, and health, risk and safety measures. ‘Other’ interventions are related, for example, to IT systems or technology, lean production and lean management practices.

It can be stated that HPWPs partly cover the WPI ‘structure’, ‘culture’ or ‘mixed’ practices and the HR practices. WPI practices differ from HPWPs in that the latter include ‘traditional’ HR systems, while the former include production systems.[42]

Implicit Strategies for WPI

Using the research technique of fsQCA, five implicit strategies were defined for arriving at a certain level of WPI – that is, ‘substantial WPI’. The term ‘implicit strategy’ is used to indicate that this, while not a completely deliberate strategy, is nevertheless an organisational choice to involve employees in organisational decision-making. Each implicit strategy combines characteristics of the organisation. However, every strategy is a specific path. A path is a combination of variables, characterising a company, that together lead to WPI. But this does not mean that there is only one way to become a substantial WPI company. Companies can develop their own trajectories, knowing that some paths are more likely to be successful than others. The variety that is observed implies that it is not possible to easily plan the desired impact or to easily copy another company’s success (Helfat et al, 2007). The successful paths or solutions are as follows.

Top-Guided WPI (Path 1)

The organisations that follow this path have a WPI initiative that comes from top management. However, these top-guided initiatives are accompanied by participatory implementation and support from employees. Moreover, these cases reflect innovative behaviours on the part of employees.

Autonomy-Driven WPI (Path 2)

This configurational path brings together companies that – in order to secure their future, survive or restructure – use their organisational autonomy to develop WPI practices. At the same time, there is considerable autonomy for employees and space to participate. These companies’ first concern is to ensure their future existence, rather than having an organisational model that pursues best quality of performance or quality of working life.

Integral WPI (Path 3)

WPI practices in this configuration are initiated bottom-up with the help of employees, providing employees with possibilities for innovative behaviour. The organisation has decision latitude to make its own choices and has a preference for limiting the division of labour. It integrates structural and behavioural elements. In Path 2, management takes the initiative to secure the company’s future. In Path 3, there is participation by employees right from the start.

Employee-driven WPI (Path 4)

In this solution, WPI is initiated bottom-up to a significant extent and implemented in a participatory manner. While the organisation has decision latitude to make its own choices, it also gives employees the chance to participate in developing the organisational model.

Innovative Behavioural Driven WPI (Path 5)

Companies choosing this WPI path show a preference for limiting the division of labour and for enabling employees to perform innovative behaviour. However, employees do not play a role in developing the organisation's model.

This research shows that certain combinations of practices enhance the presence of substantial WPI, while others do not guarantee success. This implies that there are more routes to WPI and that companies do have room to make their own strategic choices. A common feature of the paths examined, however, is that the role of employees should be substantial if WPI practices are to be introduced.

Reasons, drivers and Impacts

To determine why companies introduced WPI practices, a distinction was made between two drivers or targets – namely, to improve the quality of performance of the organisation or to improve the quality of working life and employee engagement. There proved to be a third category as well, which combined both drivers. Although economic reasons drove the decision to introduce WPI, most practices (69%) target both goals: enhancing company performance and improving quality of working life. The remaining practices are approximately equally divided between those that focus on quality of working life (18%) and those that address quality of performance (14%).

As a consequence, economic goals are achieved along with greater employee engagement and often a better quality of working life. Workplace innovators seem to naturally align themselves with employee interests, and there is agreement among managers, employees and employee representatives on what has priority and what is less important.

Comparing the drivers, there is no difference between WPI practices and HR practices. Interestingly, the HPWP literature reports on the dominance of organisational performance goals as drivers. It is possible that this sample of relatively high WPI. [42]For the sake of readability, this report refers throughout to WPI practices that encompass all types of measures, unless indicated otherwise. companies differs from most companies researched in that stream. Although the category of 'other' practices is very small, it seems to be more directed at organisational performance than quality of working life.

Returning to the five paths to WPI mentioned above, all companies in these paths applied more than one WPI practice, often a combination of structure oriented, culture oriented and HR measures. This may indicate the relevance of 'bundling' measures, as is proposed in the HPWP literature. No conclusions about combinations of WPI practices can be drawn as there is a considerable variety of WPI practices within paths.

Returning to the complete sample of 51 cases to summarise reasons, motives, leverage factors and impacts of WPI, the opinions of managers, employees and employee representatives were compared and much agreement was reported.

Reasons

Although companies did choose varying paths to substantial WPI, the reasons why they initiate WPI conversely reflected much commonality. There was a predominance of economic- oriented motives. However, many companies understand that achieving economic goals largely depends on the role played by employees. In this sense, from the viewpoint of the organisation as a whole, the most prominent general motives for initiating a WPI implementation were improving efficiency, gaining competitive advantage and enhancing innovative capability.

The investigation of motives was also approached in terms of possibly desired impacts for management, employees and employee representatives. The analysis showed that motives for WPI implementation from both the managers' and employees' perspectives overlap, also resembling the general reasons for initiating WPI. The three most salient motives were: economic and business goals; learning and development opportunities; and performance.

Motives related to quality of organisational performance were regarded as more important than those related to quality of working life, according to all three actor groups.

Leverage Factors

Leverage factors are actions, measures or means that drive the successful implementation of WPI practices. The most significant three leverage factors for WPI implementation were: employee involvement; the commitment of top management; and, at a distance, leadership or the involvement of a powerful person. Again, these factors were reported by all three groups of interviewees. While reasons and motives to initiate WPI point to business-related arguments, employee involvement seems an essential condition when it comes to adoption and implementation.

Impacts

Impacts of WPI practices, like drivers, can be divided into effects upon organisational performance and benefits for employees. Four types of impacts were examined: for the organisation; upon management; upon employees; and on employee representatives.

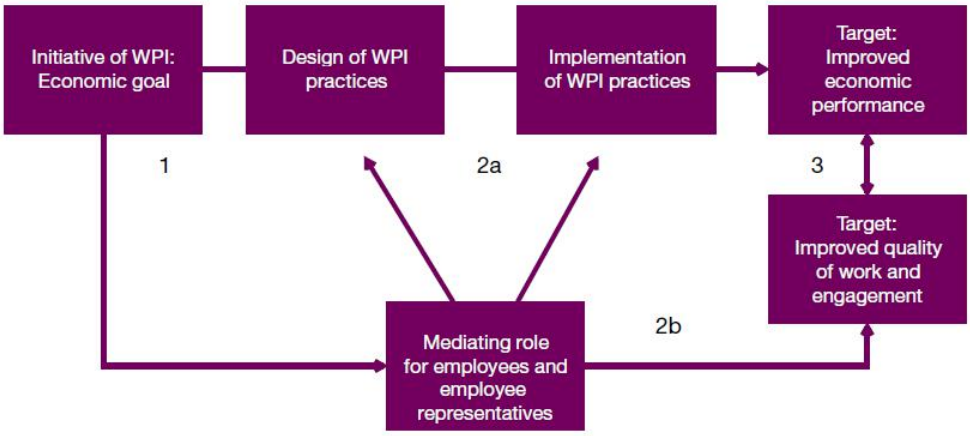
For the organisation (according to managers, employees and employee representatives), employee engagement was the most significant impact of WPI. This was followed by long-term sustainability and, at some distance, high performance, better customer/client focus, efficiency and profitability. For employee representatives, notable impacts were also the establishment of good work and more positive employment relations. Per- haps surprisingly employees ranked establishing good work lower than efficiency, profitability and high performance.

The most significant impacts of WPI from the perspective of managers' interests were efficiency and sustainability. From the perspective of employee interests, learning opportunities, voice/participation, and challenging and active jobs ranked highest as impacts. With regard to employee representatives and union interests, employee voice was the most significant WPI impact.

Process of Initiation, Adoption and Implementation

Looking at how WPI practices get implemented, the research reveals a common pattern (Figure 11). As described above, companies chose paths that differ. However, within companies, there is agreement among managers, employees and employee representatives about why to introduce WPI, how to do it and what impacts are desired. The research suggests, as indicated previously, that often the initiative for WPI lies with management. Once this decision is made, employees join in to help design and implement the intervention. Consulting employee representatives is common among the companies favouring communication and employee interests.

Figure 11: Pattern of implementing WPI practices



The initiative for WPI often has an economic purpose (see 1 in Figure 11), although in many cases WPI practices are not purely targeted at economic goals alone. Often, they are combined with or embedded in organisational, job and HR-related measures. Many WPI practices are a combination of HR-related measures that, on the one hand, may improve employee skills and competences and, on the other hand, consist of appraisal and performance instruments. In short, where WPI practices are aimed at more than one goal, there is almost always an economic purpose and very often it is dominant.

Once the WPI initiative is formulated as a measure or set of measures, employees – and often employee representatives – play an important role in (co-)designing and developing the WPI practice and its implementation (see 2a in Figure 11). Management realises it is often impossible to get WPI implemented without the engagement of employees – first, because the measure often deals with employees and their interests and, secondly, because management realises that employee participation is crucial for support and success. As employee participation in the design and implementation phase is inescapably connected to employee engagement and possibly to improved quality of working life (as a result), there is an immediate link with goals that are favourable to employees (see 2b in Figure 11).

The goal of improved economic performance is often not a direct effect of the implemented WPI practice, but in most cases is influenced and supported ('mediated') by employees and employee representatives. When economic targets are achieved, they may well coincide with the goal of improved quality of working life and employee engagement. Similarly, an improved quality of working life and employee engagement can also fulfil the goals of improved economic outcomes (see 3 in Figure 11).

Therefore, it can be concluded that (initial) reasons and motives for introducing WPI are mainly economic. Then, as a next phase, concrete WPI practices are designed and implemented; here, it becomes apparent that employees get to play a major role. The most significant leverage factor for adoption and implementation is employee involvement. Once again, managers, employees and employee representatives seem to share a similar outlook. Other significant leverage factors are top management commitment and leadership.

Given that economic goals trigger the initiation of WPI and that employee involvement is a key factor in its introduction WPI, it is interesting to see how much agreement emerges when looking at the impacts upon the organisation and on the interests of managers, employees and employee representatives. All three actors share the following opinions: employee engagement, longer-term sustainability and high performance are the most significant impacts for the organisation; efficiency, greater sustainability and greater competitiveness are the most significant impacts for managers; learning opportunities, greater voice and participation, and challenging and active jobs are the most significant impacts for employees; employee voice is the most significant impact for employee representatives.

Therefore, in the process of introducing WPI practices, in many instances, the eventual impacts improve economic performance, employee engagement and quality of working life.

Conclusions

Reflection on Study

Application of QCA

WPI is a complex and multifaceted topic and therefore suitable to explore through case studies. Little is known about what exactly constitutes WPI, which makes QCA suitable for enhancing understanding of this practice and for identifying cues for further theorising on the topic. QCA has proven to be a useful method for exploring complex issues for which linear methods may be less appropriate. There are different routes to 'substantial WPI', a notion which fits in with everyday experience that innovation is intricate and that no unique recipe exists.

The study revealed several 'roads to WPI', but there will undoubtedly be more roads towards innovating workplaces. In this regard, the research is not conclusive; indeed, this was never the intention. More WPI practices and varying configurations of causal conditions as well as types of WPI may be revealed. A problem with HPWP research is the indeterminacy of what bundles of measures lead to desired outcomes and which do not. This study does not provide a decisive answer but has been helpful in identifying a certain pattern towards WPI. Successful paths seem to start with management setting a clear target – often improved economic performance – and then continue with management allowing employees and often employee representatives to play a significant role in further designing and implementing the WPI practices. Quite unexpectedly, the study made clear that WPI companies show a notable level of agreement between management, employees and employee representatives on motives and leverage factors for introducing WPI and its impacts.

Aligning interests between management and employees; WPI-structure and culture

The assumption deduced from this practice is that favourable attitudes on the part of management towards cooperation with employees and their representatives encourage a culture of consensus and conflict limitation. In one Spanish case, there were cross-cutting policies and lay-offs that were acceptable to union representatives because the company was in an open, constructive and honest dialogue with them; this provided them with a voice about the company's and the employees' future. In this case, empowerment was neither merely 'rhetorical' (Herriot, 2001) nor 'fake' (Boxall and Macky, 2014). Restoring the employment relationship as a social relationship, instead of limiting it to an economic exchange relation, would imply a major change for many companies that are immersed in the capital yield economy of today (see, for example, Stacey, 2010). Follow-up studies could investigate how seemingly contradictory motives between management and employees can lead to synergetic solutions that benefit all parties, as a basic ingredient for the process of initiating and introducing WPI practices.

This implies, for the theoretical notion of supporting cooperation between management and employees on the basis of equality, that WPI-structure orientation makes sense in terms of optimising control capacity and voice in decision-making, as does WPI-culture orientation in terms of enabling the involvement of employees.

Critical Reflection

The study deployed interviewers and researchers from different parts of Europe, indispensable when researching content, language and culture in local situations with local expertise. A critical reflection could be made as well. In all the cases, interviewers and representatives of the companies answered from their own perspective – that is, interviewers from the same countries share the same cultural and national background. This could mean firstly that all interviewers are aware of the fact that the subset of their national cases belongs to top WPI cases in their country. Secondly, it could mean that the evaluation 'within cases' (per country) shows limited variety, because interviewers study a rather homogeneous sub-sample with a rather similar 'mindset'. There should be caution that, in theory, it is possible that cases from lesser developed economies are evaluated relatively more positively because: a) interviewers may differ in how they assess practices as innovative or not; and b) certain WPI practices may indicate a substantial step forward in country A, but only a relatively modest step in country B.

The companies in the sample differ in terms of the level of maturity of WPI , despite the fact that they all fall into an ECS group of companies with a relatively high WPI Index score. In many cases, the continental and western European cases have a relatively high level of maturity of WPI, because they have had WPI measures in place for a longer period. This could mean that recent measures taken do not show much difference among the cases in the whole dataset. Advanced companies may not show much progress since they are already quite mature, while less advanced companies may make consider- able progress as there is still significant room for improvement. This could lead to a convergence of WPI levels.

As the focus of the study was on companies, institutional factors such as the role of government and social partners (for example, employer organisations, unions, peak/sector organisations), the labour market situation and the economic crisis were not included – although these do have an effect on the behaviour of organisations regarding WPI.

Given the limited number of cases, it was not a goal to test theory or models, or to test relations between variables (such as inputs with outputs). However, saying this does not detract from the present study because its goal was to explore and describe why and how WPI practices were implemented (Yin, 2009).

Validity of Research Model

The basic research model (see Introduction and Chapter 2) identified contextual factors as organisational characteristics, motivations and leverage factors for adopting and implementing WPI, types of WPI practices, and impacts or outcomes for the organisation and for employees. The QCA did not reveal conclusive results about dominant factors, and there were no necessary or sufficient conditions identified. Organisations thus have a degree of choice. The overall analysis of the 51 cases indicated that economic goals were the main initiating factors and that employee involvement was a major leverage factor for achieving employee engagement, sustainability and high performance. In that sense, the basic model proved to be valid.

Link to Theory and Consequences

The results of the study are in line with other research and with policy goals and assumptions regarding WPI. The sample of 51 companies consists of organisations that scored high on the WPI Index score. They are relatively WPI-mature compared with other companies in the ECS 2013 dataset, from which these 51 cases were drawn. Almost every company has implemented more than one WPI practice and HR measure, combining practices into bundles. Although no conclusions can be drawn about the composition of such bundles, companies often seem to have implemented WPI-structure and WPI-culture practices in a mixed way, either with or without HR measures. The research elected not to look at structural practices related to production systems: examining production system practices would require on-site observation techniques and interviewing of technical and line managers, approaches not within the scope of the present study. Nonetheless, some examples were mentioned of organisational redesign, restructuring and reorganising of work processes – through the introduction of interdisciplinary teamwork – which seemed to significantly enable employee autonomy and learning opportunities. These are indications that the production system angle, as a part of WPI-structure, is a valid supplementation of the concept of WPI. A consequence for future research would be to include root cause analysis (MacDuffie, 1997) of how production systems may affect employee autonomy and the quality of working life. A consequence for policymakers might be that efforts to encourage WPI should also take into consideration the relevance of innovation and change in production systems. This line of thought goes back to the European Commission's initiative for 'new forms of work organisation', mentioned in Chapter 1.

The notion that HPWP literature on its own gives an incomplete picture of WPI practices has implications for future research and models of WPI. A more complete picture could be arrived at by combining production systems research with (or within the tradition of HPWP research. It can be assumed that management preference for certain organisational models and 'management philosophies' has associations with the choice and implementation of production systems and with the related outcomes for structural and cultural aspects of the organisation.

Connecting Different Approaches – Multi-method Approach

In order to better understand why and how companies adopt WPI practices and to understand the practices themselves and their outcomes, different approaches were applied. First, QCA informs about contextual factors, features of WPI practices and their implementation. Second, case descriptions clarify the route from economic goals, through employee involvement, to their engagement with improved company performance and working life. Third, theory sheds light on the cultural and structural aspects of WPI. Fourth, analysis of practices themselves shows that they benefit the company as well as employees. It is important to mention that this multi-method approach is not only complementary, it also leads towards the same finding – that is, regarding the synergy between employees and management and how this synergy improves company culture, structure and overall performance.

Reflection on Practical Value

It follows from the study that companies and employees both benefit from close cooperation between management, employees and employee representatives. The practical con- sequences are therefore quite straightforward. Building control capacity and decision latitude into jobs and functions to co- determine WPI practices is an important condition. Enabling cooperation through dialogue and communication, whereby opinions are discussed and weighed so that the best options are selected, is highly relevant as well. The picture regarding the general pattern of how WPI practices are introduced could be converted into a manual or tool for practitioners.

Previous and Future Eurofound Research

The present research fits in with the Eurofound tradition of pay- ing attention to work organisation and its relation to employees' working conditions. The findings are more or less in line with the results of the Eurofound study on work organisation and innovation, although that study placed a stronger emphasis on HPWPs (Eurofound, 2012). In particular, the mechanisms for introducing WPIs reflect significant similarities. Another recent study on the ECS 2013 data (Eurofound, 2015) also shows similarities with the results of this study – especially in terms of employee participation being favourable to establishment performance and workplace well-being for employees. That study also indicates that successful companies apply bundles of HR-related practices. The current study presents a new aspect to this research in three ways: 1) by unveiling implicit strategic paths of companies towards WPI; 2) by seeking to unravel parts of the process of initiating, designing and implementing WPI practices; and 3) by trying to differentiate WPI practices from HR practices. The theoretical notions of the WPI-structure orientation and the WPI-culture orientation proved useful as well. Future waves of the ECS could consider incorporating these topics.

Future studies could test the results from the present study. First, more paths could be laid bare – for example, within separate countries or regions. Second, vignette studies could be under- taken on the known motives, leverage factors and impacts. Third, statistical relations between the applied variables could be researched with larger datasets. Using cluster analysis and factor analysis could reduce the data, resulting in clearer patterns.

Overall Conclusion

From the research, a number of general conclusions emerge as follows.

The initiative to start WPI practices comes from the management or ownership of the company. In only a minority of the companies studied does this first step originate from the employee side. These managers or owners understand that the role and participation of the employees and their representatives is crucial for the success of WPI and for the company's performance and sustainability. Management decides to implement WPI practices mainly for reasons of efficiency, competitiveness and enhancing innovation. In a number of cases, the management decision to implement WPI has been triggered by such factors as: a situation of crisis or difficulty in the company's performance that requires significant changes if the company is to survive and remain competitive in a changing and globalised market; a takeover by (or merger with) another (multinational) company, which brings in new forms of work organisation and new work practices or systems that involve WPI, resulting in a kind of 'WPI know-how transfer'.

In several of the central and eastern European case studies, the privatisation of public enterprises and the associated reorganisation processes have served as a background to the implementation of WPI, with companies seeking greater efficiency and employee involvement than before. Factors related to job quality and good working conditions do not appear as primary reasons or motivation for introducing WPI, but more as preconditions for, or results of, its implementation. This means that the objective of introducing WPI is not to improve working conditions or the working environment as such; however, in order to enhance employee involvement and their contribution to the company's performance and processes of innovation, a good set of working conditions is required (although the monetary aspects of this, such as higher wages and variable pay, are seldom mentioned in the cases studied).

The results are in line with economic research highlighting that 'organisation matters' for performance (Bloom and van Reenen, 2010) and with research into HPWPs, which largely comes to the same conclusion.

It seems to make the emergence of WPI more likely if the position of employees and employee representatives is strengthened: this can help boost WPI practices, which in turn may improve both economic performance and quality of working life.

WPI is supported by all actors in the companies – that is, managers, employees and employee representatives.

Policy Pointers

WPI has gained currency in Europe in terms of boosting the innovative capability of companies and organisations. This capability can contribute to economic growth, high-quality employment, adaptive capabilities and improved employment relationships. Improvement and innovation can no longer be built solely on economic and technological innovation: better use should be made of the human potential to innovate – that is, of social innovation in the workplace (European Commission, 2014). The main policy pointers for the present and the near future can be defined as follows.

Define European WPI policy agenda: A WPI policy agenda could be defined at European level as part of the EUWIN initiative to foster and guide actions by governments and social partners with the purpose of increasing the implementation of WPI practices within enterprises. Such efforts should be continued.

Raise awareness: Through the communication channels of policy, industrial sectors, social partners, business communities, and knowledge and consultancy institutions, greater awareness should be raised about the opportunities that WPI offers. Disseminating examples of good practices through, for example, ambassadors and business-to-business learning events could be of great assistance in helping companies understand the beneficial outcomes of WPI.

Launch sector-level initiatives: Approaches at sectoral level could be particularly interesting because the sector is a domain where companies have a clear sense of belonging. In this sense, cluster organisations could play an influential role.

Improve business assistance programmes: There should be an analysis conducted of how existing public programmes to assist business activity could be improved to increase awareness of the benefits of WPI and support its uptake by companies.

Communicate benefits of WPI: Communication materials (such as brochures, factsheets, websites, newsletters) could be produced to facilitate information and education on the issue. In addition, training programmes addressed both to employers and employees would help to increase their engagement in these types of practices. It would be helpful if both management and employees realised there was room for choice. If actors define common objectives, it strengthens relational bonding, leading to mutually beneficial outcomes.

Formalise concept of WPI: Discussion and research should be encouraged to formalise the concept of WPI, its dimensions, and constituent elements and drivers. Measures and indicators of WPI should be developed as well to monitor development and adoption. In particular, research on the motivation and incentives for companies to implement WPI practices should be developed, along with policy approaches for acting on them.

Develop tools for companies: Diagnostic tools should be developed for companies to assess their practices regarding WPI and to obtain recommendations on how to take future steps towards more substantial practices. In addition, tools should be developed to measure the impacts and outcomes of actions taken in terms of productivity gains, innovation initiatives, results and workplace climate, among others.

Integrate WPIs with EU-level initiatives: The integration of WPIs should be encouraged in relation to how innovation in general is being promoted (for example, the Flagship Initiative Innovation Union, Europe 2020, Horizon 2020).

Introduce WPI in national and regional initiatives: At national and regional level, WPI concepts should be introduced within programmes to support innovation activities in companies and to limit the consequences of the economic crisis in companies. Particularly for SMEs, WPI practices can help to strengthen and formalise organisation patterns and restructuring, thus fostering more efficient management.

Create cooperation between business and management education: Businesses and organisations delivering management courses should come together to stimulate the topic of WPI as part of accredited education programmes in management, business, HR and (work and organisational) social sciences. Moreover, WPI contents (work organisation and innovation issues) could be introduced in the curricula of vocational training centres. In this way, both future managers and workers would be familiar with practices that will contribute to better company performance and better workplace quality.

Encourage employee participation: EU Member States should be encouraged to increase employee participation and employee representation, as they are beneficial for business and quality of working life. These issues should be introduced within social dialogue at national and European level so that social part- ners include elements related to WPI in collective agreements.

Boost research on WPI: Research on WPI should be encour- aged to facilitate greater progress towards substantial WPI for sectors, occupational professions and SMEs. This is crucial, since the closer the WPI practices match the company's specific characteristics, such as activity and size, the greater the possibility of WPI being adopted successfully.

With regard to research topics, the relation between WPI and production systems should be a feature, since production systems are a relevant root cause for outcomes at the level of quality of working life and organisational performance.

Develop human capital: The development of human capital is crucial for competitive advantage. Successful WPI companies developed employment relationships that have grown into engaged partnerships. This can be a lesson for policymakers, sector organisations and social partners.

Publicise benefits of WPI: The effects and returns on investment of WPI are somewhat intangible, indirect and difficult to quantify, making companies reluctant to introduce WPI. However, organisational, economic and other research is building up evidence of positive effects of WPI. It would be a disadvantage for companies not to take up WPI due to fear of high costs and short-term arguments. Entrepreneurship should be encouraged by pointing to results of successful companies.

Put WPI at centre of workplace social dialogue: WPI should be introduced as a core issue within workplace social dialogue at workplace or company level. This would help to restore the employment relationship as a social relationship that makes possible the conciliation of apparently contradictory motives between management and employees to achieve synergetic solutions from which all parties benefit.

Implications for Policymaking

Public policy is multidimensional and includes regulatory measures that help to shape the workplace directly (for example, health and safety, employment law); indirect or contextual policy frameworks (such as vocational education); and proactive interventions designed to stimulate change (ranging from fiscal incentives such as innovation grants, subsidies and tax breaks to knowledge creation and distribution measures such as action research, learning networks, management development pro- grammes and knowledge banks). Crucially, policymakers should assess the extent to which each layer of intervention is aligned towards encouraging, resourcing or sustaining WPI, creating a system of mutually reinforcing regulations and incentives. In addition, policy implications can be drawn from the experiences of EUWIN, the European Network on Workplace Innovation (EUWIN, undated). There is an urgent need for new thinking on how European and national policy can help to shape more productive and healthier workplaces through WPI in much of Europe.

As a starting point, governments and other stakeholders would do well to consider the creation of a

‘Forum on the Workplace of the Future’, with a strong focus on the contribution of worker participation, work organisation and job design in securing innovative, productive and healthy workplaces. Such a forum might: identify shared objectives that translate into actionable measures for all stakeholders; improve the quality of employment regulation and link it to the standard of work organisation, people management, inclusion and employee participation; and underline the importance of the fact that employment issues have consequences for the workplace, which should be reflected in government policy and regulations. Forums could enlarge and sustain the process of dialogue on the future of work and organisations, harnessing research evidence and building a common language, which draws on diverse voices and the rich but separate strands of experience that need to come together to enable stakeholders to understand how to create workplaces for the future.

Finally, what does the variety of paths to WPI imply for policymaking? A common element seems to be the presence of the participatory role of employees in designing and implementing the WPI practice, along with dialogue with employee representatives regarding changes and the company’s future. Policymaking could be directed at enhancing and ensuring this participation and dialogue. The presence of works councils and employee representatives differs across Europe. These are better developed in the continental and western (Denmark, Germany, Ireland, the Netherlands and the UK) and southern European countries (Greece and Spain), and less present in the central and eastern European countries (Bulgaria, Lithuania and Poland) that acquired EU membership more recently. Another institutional element regarding participation and dialogue that could play a role is the collective labour agreement. Of course, this is first and foremost a matter for social partners within industrial sectors. Policymakers can stimulate interaction between social partners within industrial sectors, or across industrial sectors at national and European levels, through advisory bodies, committees and other forms of tripartite consultation related to work and organisation issues.

The concept of WPI rests on a capability approach to improve skills and human capital and to enhance the dynamic capabilities of organisations. Dynamic capability is the capacity of an organisation to purposefully create, extend or modify the resource base – that is, its tangible and intangible assets or resources – and consists of patterned and somewhat practised activity (Helfat et al, 2007). To deploy a set of WPI practices that provides an organisation with competitive advantage over others is such a dynamic capability. Policymaking can stimulate the ongoing emergence and development of (new) WPI practices by earmarking resources for national and European innovation programmes that go beyond technical innovation. Such programmes should not be solely dependent on market triggers or tax regulations to raise funding. Finland and Germany are among the favourable examples.

However, in the Netherlands, for example, there is a debate involving the Ministry of Economic Affairs, which argues that innovation is a task of entrepreneurs, not of the governing bodies, unless there is an uneven playing field. The Ministry of Social Affairs and Employment contends that its role in enhancing human capabilities is restricted to per- sons with limited access to the labour market. The risk exists that WPI will not be implemented, on the one hand, markets give no incentive for investing in it and on the other, policymaking leaves it to the markets or the social partners. Researchers and advocates of WPI should gather more evidence that WPI is beneficial to quality of working life (and the capability of workers) as well as to the economic performance of organisations (and their dynamic capabilities). This has only just begun. However, if individuals are to remain active in the labour market, and if organisations are to remain economically competitive, action needs to precede proof, not only with regard to innovation but especially regarding social innovation and WPI, the benefits of which outweigh the costs.

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Collaborative Entrepreneurship and Strengthening the Sense of Possibility

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FOREWORD

The past year was exciting for me: the renewed acquaintance with the theme of entrepreneurship and connecting it to my work of recent decades, work that is mainly related to organizational innovation and the work of professionals and craftsmen. In addition, there was a chance encounter with the work of Nassim Nicholas Taleb; even the titles of his books are disturbing2. The combination of these factors was an explosive mixture which is still in turmoil. Again and again, it proved to be the 'coincidental' events, usually reading a book or changing jobs, which have determined my development.

As I will explain later, it is more often the events than the trends that determine the course of life and history. Events such as the financial crisis and the emergence of the Internet illustrate this clearly. Who could have predicted these events? Nobody!

Although in retrospect, both events seemed to be a logical consequence of what preceded them, and both events are now commonplace. This phenomenon – the virtually unbounded human capacity to discover explanatory patterns in retrospect – obscures the most important characteristic of events in general: they are not predictable. We do not know what the world will be like in 10 years, which innovations or catastrophes (including catastrophes resulting from innovations and innovations resulting from catastrophes) will then dominate our lives. We are generally unaware of this lack of knowledge about the future.

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2 Fooled by Randomness. The Hidden Role of Chance in Life and the Markets, 2004; The Black Swan. The Impact of the Highly Improbable, 2007; Antifragile. How to Live in a World We Don’t Understand, 2012.

“IT IS BETTER TO BE BROADLY RIGHT RATHER THAN PRECISELY WRONG”
1.COLLABORATIVE ENTREPRENEURSHIP

Entrepreneurial Behaviour and Entrepreneurship

The name of the lectorate to which I am connected is Coöperatief Ondernemerschap. This is generally translated into English as Collaborative Entrepreneurship. ‘Cooperative Entrepreneurship’ is also possible, but less common. In fact, we are trying to cover the entire scope of ‘entrepreneurial behaviour in collaboration’. This type of formulation (…behaviour…) could easily lead to the misconception that entrepreneurship is primarily a skill or characteristic of the individual; either you have it or you don't, and it is perhaps possible for some people to learn it. Successful entrepreneurs are the heroes of our era, and these heroes may also have wonderful human qualities and capacities which we can use as an example. However, the study of entrepreneurship has gradually resulted in a more sceptical view of this interpretation. As early as the 1980s, Low and Mac Millan wrote the following:

“Being innovators and idiosyncratic, entrepreneurs tend to defy aggregation. They tend to reside at the tails of personality distributions, and though they may be expected to differ from the mean, the nature of these differences is not predictable. It seems that any attempt to profile the typical entrepreneur is inherently futile.” (cited by Sarasvathy and Venkataraman (2010, p. 127)).

This idiosyncratic (i.e. specific to a time and place, individual or context) aspect of entrepreneurs does not makes it easy to learn something from them. However, entrepreneurship, like every other competency, takes shape and becomes active only in a specific context. And for entrepreneurship these contexts are extremely varied: grocery, retail chain, consultancy, app builder, high-tech entrepreneur, fast-growing start up. And if we take an even broader view: cultural, political and criminal entrepreneurs. Or to go in a slightly different direction: entrepreneurship in the market and entrepreneurship within an organization. All of these contexts for entrepreneurship have entirely different rules for successful entrepreneurial behaviour. But also within each context separately, few general conclusions can be drawn about successful entrepreneurship: each ‘enterprise’ is a world in itself! Behaviour and context are inseparable, and this is a functional relationship. The development of entrepreneurship is an interactive and iterative process that resists generalization. One of my main objectives in this essay is to explore and clarify the aspects of entrepreneurship that are delimited by time and location.

Our students are facing a future in which they will take the role of employee or employer, and perhaps first one and then the other, or perhaps both simultaneously or both in continuous alternation. In all roles, entrepreneurial behaviour will be required. Therefore, this essay is not only about self-employed entrepreneurs, but also about skilled workers and professionals, as these are the roles that students usually take in later life. Although entrepreneurship and workmanship often appear to be similar, they also differ in crucial aspects.

In this essay I will not address the most recent developments in the scientific debate surrounding entrepreneurship, but primarily focus on several basics of entrepreneurship, which are partly hidden assumptions and partly things that everyone already knows. This will result in a description of the research lines and the ambitions of the lectorate. The narrative concerns entrepreneurship and workmanship as sources of renewal in our economy and our society. Some things are very robust, and both entrepreneurship and workmanship can grow in the face of adversity. This remarkably interesting relationship between entrepreneurship and workmanship will gradually become clear.

But why are entrepreneurship and workmanship so important? After all, isn't innovation concerned with scientific developments and their valorization? Fortunately, the WRR report Naareen lerende economie (2013) [Towards a learning economy] provided an urgently needed contribution to a different perspective on the 'linear model' of innovation (from knowledge, via expertise, to earning potential) and to the also urgently needed upgrading of the concept of expertise itself (due to the term knowledge circulation). And especially the upgrading of the role of expertise as a source of renewal for both professional practice and science. Entrepreneurs and skilled workers are the bearers of expertise, if only because in their professional practice must give shape to new business models (new ways of developing, manufacturing and supplying products and services, new ways of organizing and new approaches to management and entrepreneurship). They excel in understanding the intransigence and potential of professional practice.

Pattern or Coincidence?

Perhaps it is a good idea to introduce Roubini at this point. The story of Nouriel Roubini is remarkable. This professor of economics at New York University was given the nickname ‘Doctor Doom' because he was one of the few who apparently predicted the global financial crisis. For some time – and according to some critics he always held this position – Roubini believed that the global system was on the verge of collapse. As a result of this prediction, he became famous, which may have been quite a shock to him. But the simple fact is that he was one of the voices in the wilderness who believed that things were not going well during the period preceding what we now call the Lehman Brothers crisis (September 2008), while the multitude continued to believe that things were going well. There are always many of both types of forecasters, as everyone knows who has paid any attention to the stock market. It was pure coincidence that Roubini emerged as the economist who had foreseen everything. Since then he has become a celebrated expert and soothsayer.

However, besides Roubini there were other economists and non- economists who also saw clearly what was happening in the economy. But unfortunately for them, Roubini ended up with all the fame, prestige and publicity. This phenomenon – i.e. that success amounts to being at the right place at the right time to be part of this self-amplifying process of reputation enhancement – is an essential characteristic of social success. Coincidence plays a crucial role in this process. It happens to scientists and writers, artists and politicians and also to innovators and entrepreneurs. Roubini went 'viral' at the beginning of the crisis and it is interesting to see how this changed him from a modest professor into a true soothsayer. In the meantime he has again become a garden variety academic who creates the impression that he has about as much to say about the next economic crisis as you and I: in other words, nothing sensible 3. When John Cleese was recently asked how you can become a celebrated comedian, he answered: "Persistence and luck, and especially the latter." He is a wise man.

With successful entrepreneurship, this dependence on time, place and path also plays a very important role. In this essay, we will focus on the coincidence and unpredictability of successful entrepreneurship. This provides a first impression of 'Entrepreneurship'. In the remainder of this introduction we will first give an additional explanation about the relationship between workmanship and entrepreneurship, and after that we will reflect on the term 'Collaborative'.

New workmanship

Work and collaboration are almost synonymous, certainly for professionals and skilled workers. Working in an organization is not just about earning your salary (exchange) and receiving and completing assignments (authority) but also, and perhaps especially, about collaboration (Bolweg, 1976). Collaboration means that we don't have to specify every detail in contracts and measure everything with complicated systems. This advantage is perhaps the most important reason why organizations exist (Williamson, 1981). In general, organizations are more adaptable than contracts. The recent decades have primarily been characterized by attempts, some more successful than others, to make organizations more manageable and predictable. This is an Anglo-Saxon-Tayloristic wind that has continued to blow 4. Today however, more and more organizations have come to the realization (and not: organizations are increasingly realizing!) that predictability and manageability, in the sense that employees must do what the bosses tell them to do, is unproductive. If employees do what they have to do, things are bound to go wrong! No, people should do what has to be done, and that is something different. This refers especially to the external function that must be fulfilled and the problem that must be solved.

It was the famous management guru Peter Drucker who formulated this clearly, in books such as Knowledgeworker productivity,the biggestchallenge(1999).He pointed out that you cannot manage knowledge workers in the old way, you can only create the conditions in which they flourish. And these conditions have more and more to do with the possibilities for collaborating, learning and innovating. I want to contrast this new workmanship (for Drucker, the concept of 'knowledge worker' includes skilled workers as well as professionals) with entrepreneurship: what is similar and what is different and what can one learn from the other? In The Innovators (2014), Isaacson described the development of crucial technological innovations. He ascertained that they are often the work of collectives consisting of brilliant individuals with primarily technical knowledge who built on previous steps, leading to innovations such as the modern computer and the Internet. In other words, workmanship is the basis. Often these innovators are quirky troublemakers who, despite or precisely because of these characteristics, can tolerate and appreciate each other's company.

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3 I now have a neutral opinion about Roubini; he is only one of many. However, if he had invested several hundred thousand dollars before the crisis in the possibility that the stock market would collapse, and became a millionaire as a result, then I would admire him. To explain this another way, predicting that everyone will die is easy, but it is usually impossible to predict how and when people will die. By the same token, we are very certain that the next economic crisis is on its way!

4 Of course, this pursuit of control and predictability undermines the benefits of the organization with respect to the market, and in that sense is irrational

The process that begins in the stereotypical 'garage' and ends with a global enterprise is as fickle and unpredictable as Roubini's success. It also shows that – certainly at the beginning – workmanship is often at the core of innovation, and is sometimes the beginning of entrepreneurship. In an interview (VK 3 January 2015) Isaacson said the following: “Stay in school until your first company is successful.”

Collaborating organizations, entrepreneurs and skilled workers In recent years the interest in collaboration between organizations has increased greatly. At one time, entrepreneurship belonged to the domain of the invisible hand of the market and workmanship belonged to the visible hand of management/the organization. Between these worlds of competition and coordination, there is the world of collaboration; cooperation between autonomous organizations. This ‘in- between world’ has increased greatly in importance in the present economy, but of course it has always existed: back in 1989, Hånkinson wrote No Businesses is an Island. Every entrepreneur and enterprise interacts with customers (potential or current), partners, suppliers, advisers and many other parties.

But the current trend for sharing ambitions and resources, marketing, innovation and production (open innovation and open… fill in anything) together with the modularization of products and production processes makes organizations more closely linked together, more dependent, more changeable and more unpredictable than they already were. Entrepreneurship, innovation and production increasingly take place in networks or in 'ecosystems': collaborations between large companies and start-ups, universities and research institutes and professional service providers, government agencies, 'brokers' and financiers. These ecosystems are also where ‘Entrepreneurship’ can perhaps find the most effective forms of ‘Collaboration’, for entrepreneurs as well as skilled workers.

In Chapter 2 of this essay, we will reflect on entrepreneurship, and especially on the issue of the unpredictability of success. In Chapter 3, we will address workmanship, and determine to what extent workmanship can be a model for entrepreneurship. In Chapter 4, we will examine the two core themes of the lectorate: the relationship between entrepreneurship and workmanship, and the important role of the socio-economic environment (network) of entrepreneurship, i.e. the significance of ecosystems. This will be followed by a discussion of the three lines of research. In the final chapter, we will arrive at a tentative conclusion.

IF YOU’RE SO RICH, WHY AREN’T YOU SO SMART?”
2.ENTREPRENEURSHIP AND SUCCESS

Entrepreneurs and Coincidence

Everyone who does well in school has heard the question: if you're so smart, why aren't you rich? The short answer is that you don't get rich by working for a salary! And the somewhat longer answer is that the relationship between education (in school) and income is very different for entrepreneurs and for employees. For full-time employees, education level 'explains' approximately 24% of the variance in income, but with the self-employed it 'explains' almost nothing (less than 1% of the variance) (Moonen, 2012). Moonen also ascertained that the incomes of the self-employed have more outliers, both above and below average, then the incomes of employees.

The conclusion must be that 'education-based smartness' has a substantial effect – but is not highly determinant – on the incomes of employees, but for the self-employed, there is no relationship between education-based smartness and income. If you want to become rich (the positive outlier), then apparently it is better to become an entrepreneur, at any rate if you dare take the risk of becoming/staying poor (the negative outlier). To become wealthy, you apparently need something other than education-based smartness!

For employees, the chance of success (financial or otherwise) has a 'normal distribution'. Most employees earn approximately the average for their education cohort, plus or minus 40%, depending on the sector in which they work, the size of the company and, of course, their skills. Not to mention bad luck or good luck. In contrast, for entrepreneurs the distribution of probability for income/profit is very skewed. There is a high probability of failure and a very small probability of major success and wealth. We are familiar with only the successful entrepreneurs and we disregard the many who failed or did not succeed in upscaling (selection bias). In such a distribution of probability, good luck and bad luck play the leading roles, supplemented of course with perseverance as a fundamental precondition. This role of bad luck or good luck – coincidence – is not unique for entrepreneurship (we are already familiar with Roubini), but it is certainly an important component. We want to face this fact directly, because it appears to be crucial. After all, if no generalizations can be made about entrepreneurial success, if it is only coincidence, then what can we do with knowledge development, knowledge transfer and knowledge circulation in this respect?

Organizations and Coincidence

In contrast to what we often think, such a situation also occurs with larger and more well-established companies, which I learned more than 20 years ago. My dissertation was on measuring and explaining various types of markets, organizational structures, leadership and HRM and the growth of industrial companies based on a company sample (n=600) from the first survey of the OSA-Arbeidsvraagpanel (Institute for Labour Research). It turned out that everything was measurable and explainable, with an explained variance above 50%, with the exception of ...change and growth.

I was unable to identify any factors, or combinations of factors, that could explain business success and change, even though the available theory provided clear indications. Nothing, nothing at all! Are coincidence and unpredictability also involved here? Previously, this question was identified as an Area of Tolerance (Child, 1972) when designing an organization; apparently, the same success can be achieved with various organizational constellations (so there is freedom of choice!). However, as a right-minded methodologist, I thought this was primarily an ‘Area of Ignorance’; apparently, we are unable to identify the determinants of enterprise success. Moreover, if the ‘Area of Tolerance’ is almost

85% (the percentage of unexplained variance in my analyses at that time), then the design of the organization appears to have little effect. That cannot be! What is going on here?

At the time I concluded that enterprise success is primarily determined by a constantly changing set of variables that differ per enterprise5; there are no generic and stable characteristics, or combinations of characteristics, that determine enterprise success. Each enterprise is a world in itself! After that I never performed another statistical analysis, and I became an organizational advisor; I determined that idiosyncratic ‘processes’ and ‘events’ are dominant in the success of organizations and not ‘factors’ and ‘variables’. For that matter, every investor (amateur or professional) on the stock market understands that the market valuation of enterprises is unpredictable. Because if this was not the case, everyone would get rich on the stock market, no one would get rich, or perhaps there would no longer even be a stock market. I have persuaded a few people with this rather indirect evidence, but it has not really penetrated. To be honest, at the time I did not take the consequences of this argument very seriously myself.

New general Recipes

The success of managers/organizations does not follow the logic of contingency theory (the fit between factors determines success), but is idiosyncratic in nature, i.e. it depends on place and time (processes and events). There is no general recipe for success. And this is exactly why 'organization-land' is constantly awash with new recipes! We actually knew this already based on all the lists – also those emerging from scientific research – of successful enterprises and the underlying analysis of the causes of this success: after five years, the lists are worthless. We have an almost unlimited capacity to discover patterns in retrospect, which ensures that this phenomenon (lists of toppers and floppers) continues to exist, against our better judgment.

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5 For a social scientist trained in traditional methodology, this is an unprecedented standpoint. Some others would simply shrug their shoulders: so what? And still others would say: “yes I've also seen that in my area of expertise”. It appears to be a general phenomenon in sufficiently complex systems that stable causal patterns rarely exist, and if they do exist they are not particularly interesting.

However, organizations are remarkable due to this combination of unpredictability of success (exactly the same as in entrepreneurship), with a stable and understandable way in which we work and work processes are organized. This seems to me to be the most important difference between a beginning entrepreneur and a successful entrepreneur who has built an organization; the stabilizers and buffers become increasingly important. These static aspects give the organization an inertia that results in next year's operation and performance being similar to this year's (normal distribution), while the dynamic aspects over the somewhat longer term result in an irregularity and unpredictability that rivals entrepreneurship (skewed distribution). Within organizations it is therefore logical that the jobs that are ‘closer’ to the market (CEO, Marketing/Sales) seem to be more like entrepreneurship in terms of remuneration: many fail and fade away, and a few become rich; these fall easily outside the standard salary variance of plus or minus 40%. Organizations, just like people and just like societies, involve unique combinations of predictable and unpredictable behaviour.

Work and coincidence

For most of my career, I have been involved with the study of work. Nevertheless, I learned about the most important aspect of work only recently: the difference between scalable and nonscalable work. My friend Hans Dekkers, now deceased, always spoke about this when we were able to talk about things that we felt were important. Such as about the total elimination of HRM or, even more radically, the elimination of organizations themselves (I have long thought that the best organization is the one that doesn't cause you any suffering. By the way, most skilled workers and professionals share this belief). Hans wanted to develop an enterprise that provided a product-like service; after all, you can manufacture a product, keep it in stock, and sell it.

Moreover, he wanted this enterprise to have a secret recipe, so that no one could imitate the service. Initially, I did not believe that this standardization and sales-oriented approach would work, because at that time I was an 'artisanal' organizational advisor; I believed that every management problem is a world in itself. But now the attractiveness of the idea has begun to dawn on me. He spoke about entrepreneurship!

The work of the dentist, the advisor, the bookkeeper, the hairdresser, the prostitute, the taxi driver: these professions are not easily scalable; providing more service requires more and more hours of work. However, the work of the writer, the songwriter, the singer, the speculator and the stock market trader is scalable; with the same effort, they can sell 1, 10, 1000, 10,000 or 1 million copies of their 'service'. With nonscalable work, the income inequalities between members of the same profession are limited or 'mild', while with scalable work the inequalities are 'wild' (Taleb, 2007, p 35). Is this the explanation for the obscure relationship between smartness and wealth discussed at the beginning of the chapter? Are the earnings from nonscalable work normally distributed and those from scalable work skewed? This is indeed correct.

Extremistan and Mediocristan

Regarding scalable and nonscalable work, Taleb (2008) referred to typical examples of two very different 'worlds': Mediocristan and Extremistan, both parts of our real world. In Mediocristan, an additional event adds little to the average of many events; consider the average weight of 1000 people and the addition of one extremely fat person weighing 200 kg: this has little effect on the average. In Extremistan, however, adding an additional event can drastically affect the average; consider the assets of 1000 people and the addition of Bill Gates, or the average number of scientific citations of 1000 scientists and the addition of Professor Nijkamp. According to Taleb, everything that is 'physical' will suffer under the laws of gravity and will be Mediocristan, and everything that is 'social' and is in fact 'only' a number will be Extremistan. Moreover, Extremistan is bigger than we usually think and it grows at the expense of Mediocristan. The world is becoming more entrepreneurial, more coincidental and more unpredictable; more on this later. Extremistan is a dangerous country: most people remain poor and a few become fabulously rich due to events that no one can predict. Moreover, past performance is no guarantee for the future.

Take the example of the Christmas turkey. Every day he becomes happier about how he is being treated... until it is Christmas. The past says nothing about the future.[6]

Research

Am I exaggerating? Hardly! To my great surprise and pleasure, entrepreneurship research discovered this phenomenon of unpredictability, including the explanations that I had conceived, long before I completed my thesis. Apparently, I didn't pay attention at the time7!

Research into routes for growth and the chances of survival for start-ups (Coad, et al., 2013)8 has shown that: The growth of the enterprise is almost entirely random (there is a relationship with the usual 'success characteristics' of age, sex, previous experience and education, but it is limited; growth, or the lack of growth, is not permanent, but can change rapidly over time.

The authors concluded that the pattern is consistent with a 'Gamblers Ruin' model, in which growth performance is random and the chance of survival depends on the financial resources that are available or have been acquired, exactly as you would expect in a casino. The competing theory/hypothesis – the 'Resource Theory' – states that enterprise performance can be understood as the consequence of the availability of resources and how they are deployed, was not confirmed. Randomness (coincidence) is the most important component in the 'explanation' of growth (Coad et al., p 618). And now the quotation:

"More than half a century after Gibrat (1931) put forward his explanation of firm growth in term of a multiplicative random shock model, Geroski concluded, after a wide-ranging survey of the empirical evidence that: "The most elementary 'fact' about corporate growth thrown up by econometric work on both large and small firmsisthat firm sizefollowsarandomwalk"(Geroski, 2000, p.169.).

Based on the results of their own analysis, which confirmed the Gamblers Ruin hypothesis, Coad et al. concluded:

"However…, we do not view this as "a negative state of affairs"… but rather as the reverse. We argue that it is necessary to build theories of new business performance – of which growth is one dimension – around explicitly recognizing that performance is primarily, but perhaps not exclusively, a game of change." (Coad et al., p 626).

So, there you are. The question that I had been thinking deeply about (off and on) for more than 20 years previously had been solved completely. However, I have little confidence in the route that Coad et al. are probably going to take: even more advanced quantitative analyses and a further qualification of the success indicators. They do not acknowledge the 'the-organization-as-a- world-in-itself' solution that I advocate. The latter solution creates new space for explanations that are not based on coincidence; after all, local factors, actors, processes and events contribute to the explanation of enterprise success. Some authors have indeed chosen this route.

Interventions Do not Work

The unavoidable consequence of the unpredictability of the success is that no successful generic interventions with respect to entrepreneurship and management can exist. I understand very well why I did not dare to make this unavoidable conclusion 20 years ago: it is far-reaching, perhaps too far-reaching.

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6 This is an ancient philosophical problem; the induction problem.

7 The absence of an entire library is probably more the rule than the exception in the scientific community. Even with the most advanced tools, the chance is small that you will notice this absence. The scientific community is as compartmentalized as organized reality itself. There is a much greater need for generalists than specialists, but unfortunately generalism is not rewarded with scientific points. Why does 'doing the right things' always provide fewer benefits than 'doing things the right way'? Doing things that you know are not right is cynicism, which the world is full of.

8 More than 6000 observations of new enterprises in England and Wales from 2004, which were tracked for six years.

And I notice that everything in me resists this. I would be happy if the significance of the generic approaches (such as Lean Management, Stroomsgewijs inrichten, HRM, and Total Quality Management) would be drastically relativized to the benefit of acting according to circumstances. But this is the voice of the artisanal advisor who does not believe in the scalability of his work: copying yields nothing, only the anomalous creates value! At the same time, I understand that the above-mentioned approaches not only have a substantive component, but also a methodological one, and that this methodological component could perhaps be the strongest and most effective. For example, consider the simple but effective Plan-Do-Act-Check cycle of Demming. In more general terms, the above does not preclude that successful and unsuccessful entrepreneurs and enterprises can differ systematically regarding specific process characteristics, i.e. how people do things.

Moreover, our emphasis on processes and events at the level of the entrepreneur and the enterprise does not mean that we are choosing the easy route by any means. As stated previously, people are masters in retrospective pattern recognition. If entrepreneurs or managers are asked what determines their success, and what determines how they will go further, their answers do not say very much. In any case, these are not answers that you can use without careful consideration. Achieving an intersubjective picture about what is really going on requires a powerful study of everyone involved and a great deal of experience; even then you have only shaky hypotheses. That's life! It is in this specific context that learning processes can and must be given shape.

Scalability and Technology

It was in 2003 that my colleague Ben Fruytier, now deceased, and I submitted a research proposal to the Management Studies Foundation on the productivity of service enterprises. Service productivity grows much more slowly than manufacturing productivity. One of the many interesting phenomena in this area is the ‘untraceable’ growth of productivity. I quote part of the proposal:

“The productivity of the Concertgebouw Orchestra has, in terms of efficiency, not increased in the past century. Fortunately, there are still just as many musicians trying to provide this service. Performing Mahler's eighth Symphony in a chamber orchestra formation will always lead to loss of quality. If we define the function of the orchestra as 'providing a high-quality listening experience for the largest possible audience', then it would appear that an enormous increase in productivity has occurred in the past century. A century ago, for a music lover the opportunity to hear an orchestra play a specific piece of music was the 'chance of a lifetime'. But now, due to modern recording, distribution and reproduction technology, everyone can enjoy listening to any desired piece of music at any desired time. And with this functional alternative, a productivity increase has been achieved that remains entirely hidden if the 'system boundary' is limited to the concrete activity at hand."(Fruytier and Ten Have, 2003)

Taleb (2007, p.29) introduced Giaccomo, an opera singer in the era before music recording equipment was invented. He performed in local concert halls and earned a reasonable income, although not as much as the top artists in Milan, but the inequality was ‘mild’. However, the invention of recording apparatus created an enormous inequality because the top artists, in a process similar to that described by Roubini, would become known and famous. At that time there were undoubtedly many singers in Italy who were at least as good as the top artists. Taleb takes scalability a step further; the discovery of the alphabet also made scaling possible from what could be experienced in a small group: from telling stories and listening to reading and writing.

Taleb wrote this in 2007 and Ben Fruijtier and I wrote the above in 2003. Fortunately, we were not overtaken by history! Technology is an important means for the scalability of activities, and in combination with entrepreneurship it makes the step from Mediocristan to Extremistan possible. My previous idea – that only the artisanal, specific and anomalous create value, and that a scaled-up, standardized service does notwas incorrect.

I did not understand the unique contribution that an upscaled service (or product) can provide for the total 'system' of existing (to be improved or replaced) services: a configuration of standard elements can certainly be unique and can add value. Upscaling, which it is now supported by ICT and social media and is often made possible for the first time, is the essence of entrepreneurship.

Economic and social success is determined by constellations of temporally and spatially bound factors, processes and events, which make it virtually unpredictable. For a successful, independent enterprise, scalability is crucial. Scalability leads to Extremistan, the world of many who have little and few who have a lot. In the following chapter, we will step into a world which appears more like Mediocristan: the world of skilled workers and professionals, to determine what we can learn from them for the purposes of entrepreneurship.

“ALL I WANT IS TO DO SOMETHING REAL”
3.OLD AND NEW WORKMANSHIP

Skilled Workers are Troublesome

Skilled workers do not work for a boss or customer, but for themselves. Their work is satisfying because they continually improve their skills for using the ‘material’ and the ‘tools’ of their profession, and experimenting with alternative approaches if the usual ones do not work. The material is often recalcitrant, complex and changeable. Glassblowers, goldsmiths, carpenters, teachers, management consultants, automobile mechanics, engineers and family doctors all understand this.

Just like the material, skilled workers are often recalcitrant and they appear to distance themselves from the demands of the present time, such as having a certain degree of customer orientation and organizational sensibility. To an audience of managers from a large Dutch company, I once argued that educating your customers and managing your boss are the most important processes in knowledge-intensive work. The room became quiet, because they apparently did not learn this when studying for their MBAs, but this statement will be immediately recognized by skilled workers. Large-scale attempts have been made to bring skilled workers up-to-date with courses, training programmes, systems and instructions for performance management and customer orientation, with all kinds of trendy names and titles. Virtually all the skilled workers and professionals who stand ‘above’ these modern approaches have been eliminated or have become extinct, which is unfortunate because they are needed now more than ever. I hope and believe that the true potential of skilled workers, despite everything, is still present and can be mobilized, because this concerns a deeply human motivation.

Work itself has changed dramatically during the past century, but the ways of organizing and managing work have stayed remarkably constant. Standardization and rationalization of processes and results, combined with supervision/monitoring, are still the mainstream of managerial activity. Approaches such as managing according to inputs and managing by means of mutual coordination have actually been marginalized. As stated previously, it was Peter Drucker (1999) who pointed out the urgent necessity of inverting traditional management values with respect to the rapidly growing group of knowledge workers in developed economies. Drucker referred to knowledge workers, but we can interpret this as skilled workers and professionals.

With physical work, the question of WHAT must happen almost always has a clear answer, and productivity revolves around the question of HOW that should happen. With knowledge work, this is inverted: the answer to the WHAT question is crucial, and the HOW question is a derivative. Stated another way, knowledge work is primarily concerned with the question of ‘are we doing the right things’ and only secondarily with the question ‘are we doing things the right way’: effectiveness first, followed by efficiency. The productivity of knowledge work is determined by the quality of the service, not as a constraint, but as an objective. In knowledge work, the question "WHAT is the task?" is not easy to answer, and in a group of skilled workers this always leads to an intense and very meaningful discussion. What is the task of the teacher? What is the function of the teacher for students? What alternatives are there to fulfil this function? In short, these questions lead to a search for better, more effective ways of working. Besides posing and answering the question of 'WHAT is de task', Drucker identified five other ingredients for making knowledge work more productive:

The knowledge workers should be responsible for their own productivity; they should manage themselves; they should have autonomy.

Continuous innovation must be part of their work; this is the task and the responsibility of the knowledge workers themselves.

In knowledge work, continuous learning and continuous mutual teaching by the knowledge workers is essential.

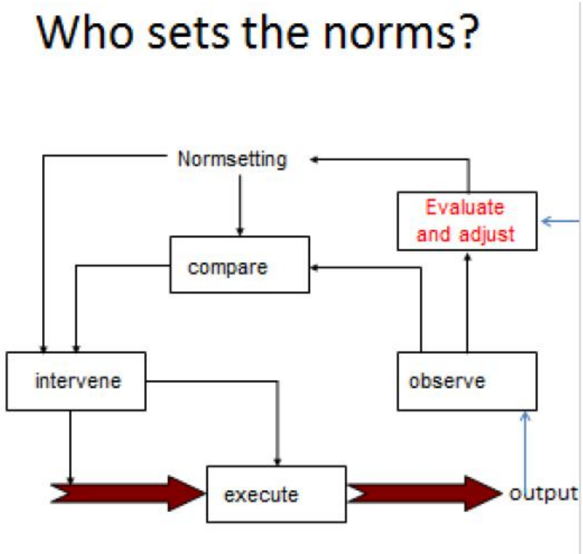
Productivity primarily concerns the quality of the output, with much less attention to quantity.

Knowledge workers are more of an asset than a cost. This is why knowledge workers should decide to work at this organization and not at another one.

Continuing with Drucker's ideas: new workmanship consists of innovation and improvement, learning and teaching, and that is the responsibility of the skilled workers themselves. This should not be seen as a desirable goal, but a necessity in the learning knowledge economy: with skilled work, the manager and the customer are sources of inspiration, but they do not set the standards. Let us examine why that is so.

Each targeted activity, therefore including work (and entrepreneurship), can be shown schematically as a control loop: inputs are converted by the transformation process into outputs. The result is observed/measured, and then compared with a standard (is it good or not?). If it is not good, then intervention is required in the inputs or in the transformation process. Repeating this cycle creates a learning process. The worker becomes more and more familiar with the process as a result of the reactions to the intervention, and in time can even predict which interventions will generate which reactions. However, if the output continues to be substandard, then the nature of the process and the standards must be reconsidered. The evaluative control loop goes into operation: are the standards too strict or perhaps not strict enough? Can the transformation process be structured otherwise? Are there other alternatives for the output to be delivered which have the same effect on the outcome? And so forth.

This process is shown schematically below.



We will now discuss the diagram again from top to bottom and from inside to outside, based on the work of a teacher in a class. Halfway through the lesson, the class indicates that it has not understood specific aspects or something in general. The teacher observes this, decides that it is a problem (professional standard) and tries to clarify things in a different way (intervention). The class appears to understand this, and the teacher has then learned how he can effectively transfer the knowledge in this situation. By repeatedly going through this loop, he acquires memory and experience. In this way the loop becomes a learning loop.

But after several years, the teacher notices, for example, that the students understand the CANVAS model intellectually, but are still unable to develop understanding of what is really involved in setting up, developing and changing an enterprise. This teacher is a professional and wants his students to really learn something they can use later on in practice; in fact, the result does not meet his standards. Then the second learning control loop goes into effect: the evaluative control loop.

The teacher asks himself: what is my task? He discusses this with his peers and they recognize his narrative. Together they brainstorm about a way to teach the students something real (or to really teach them something). The tentative answer is that they want to let the students experience live what it is to set up or manage an enterprise. Explaining and discussing the CANVAS model is useful for this purpose, but inadequate, and they think about other forms of teaching. Perhaps it is an idea to have the students actually start a business! He understands the random nature of successful new enterprises, and sets the following standard: the students must truly experience what it is to fail as an entrepreneur (and have a successful case as bycatch). This has a major impact on the teaching method.

What matters is, first of all, that the professional standards of teachers stand alongside those of others stakeholders, and sometimes clash with them. Perhaps many students simply want an explanation of the model. Perhaps the education manager simply wants classical knowledge transfer. Perhaps the Ministry of Education simply wants testable, reproducible knowledge in the heads of the students. In this way, the professional/teacher enters a world of conflicting sets of standards and is faced with the task of reconciling his picture of good education with the claims of many others. A remarkably strong and motivated group of skilled workers is required to withstand this clash of standards, but this is crucial for giving substance to the concept of workmanship. If the teacher does not want to take the dominant role in the evaluative control group, or is unable to do so, then others will take over.

And these others may have less understanding of knowledge transfer, certainly in the specific case of a degree programme or course.

Secondly, the control loop or learning loop only works if it is closed, concise and integrated. It must be closed because otherwise nothing at all can be learned; it must be concise, because otherwise the learning will be poor; and in must be integrated (defined here as including all relevant quality and cost criteria) because otherwise the learning will be suboptimal. In other words, a control loop must not be fragmented. But in many environments this is the case, and it is no longer the skilled workers who reflect on the competing sets of standards. Many practitioners are no longer in any position to be reflective at all. These simple requirements for good work, for a good organization and for good results, i.e. that the learning control loops must be closed, concise and integrated, are not commonplace. Quite the contrary.

And thirdly, there is no individual professional autonomy, and there are no individual standards in the control loop. Professionality and workmanship are, by definition, collective affairs under penalty of arbitrariness and underachievement. This form of collaborative, learning and innovative workmanship is called New workmanship. Many organizations, in both the public and private sectors, are discovering that they will not continue to exist in the long term if they are unable to develop and utilize this form of workmanship. Innovative, agile organizations must have access to distributed, shared, decentralized intelligence.

Workmanship and Intrapreneurship

Workmanship, as described based on the control loop, is a model for the functional relationship that should exist between working, learning, improving/innovating and entrepreneurship. This model gives a tangible place and time to the idiosyncratic process of performance, and shows that haphazardly selecting a few characteristics of this process and then comparing a large number of these selections, which is done in survey research, is unlikely to identify solid (nominal, statistical) relationships: if the functional relationship is broken, then all that remains is noise10. It is this 'true' experience, whether that of a worker, that of an organization or that every entrepreneur who is not included in the picture if the view is too distant: the world is a complex interplay of these local experiences, and not just the sum of the experiences11.

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10 As stated previously: This restoration of the local relationship makes the process and the results significantly less ‘coincidental’.

11 Pragmatism, the school of philosophy that flourished in the second half of the 19th century in the United States, refers to this functionally coherent process simply as ‘experience’. Charles Pierce, William James and John Dewey were the founders of this school. The school has a sober, natural undertone, and emphasizes that all theory, knowledge and information are only relevant to the extent they can lead to tangible, observable changes in our environment.

But knowledge is also created as part of the actions of real people who have to deal with real problems. The central idea is human experience – or experiencing as a human – not only direct, perceived experience, but also indirect reflected experience. Knowledge emerges from this process as an adaptive activity with which people can sustain themselves in a social and natural world that is complex and dynamic. Research is inherent to this adaptive process, and the quality criterion of knowledge and research is then based on the contribution that it provides to sustaining oneself. In this way, knowledge and research are completely stripped of their 'supernatural' status aiming at or searching for permanent truths. They are not fixed, but evolve together with the human experience. Research is not something that must be added to practice, but is inherent to practice. For a good introduction to pragmatism, see: Hildebrand, 2008.

For the new professional proposed by Drucker, it is crucial that the control loop, including the evaluative component, is intact, because only then do real learning processes become possible. Equally important is the horizontal or peer character of the evaluative control loop; workmanship and professionality are always collective, which means that they are based on collaboration. Finally, with respect to the content of the evaluative control loop: considering functional alternatives in the task in the light of the intended output is a preeminently creative activity. Then you come to the conclusion, for example, that the primary process at a school is not teaching, but learning. Or to the insight that because an individual is 20 years old, this fact alone makes them into an outstanding applied researcher, regardless of their academic performance. In the evaluative control loop, creative leaps take place that cannot be compelled from outside, but only facilitated. This new workmanship is non-trivial and shares a common core with entrepreneurship.

Non-trivial work and creativity

Von Foerster (1984) made a distinction between trivial and non- trivial systems. Everything can be defined as a system with inputs, outputs and corresponding internal processes. An automobile is also a system. As with many other systems, an automobile is preferably a trivial system: a specific input, such as stepping on the brake, always leads to a specific output: reduction in velocity. If an automobile does not behave in this way, and then it must be taken to the trivialization specialist: the automotive mechanic. Other examples of systems that are preferably trivial are computers, houses, bicycles and telephones: the more predictable their behaviour, the better.

It is technically very simple to build a non-trivial system: a system that does not generate predictable outputs from specific inputs. These systems do not follow 'if-then' logic, but have a will of their own, so to speak. With these systems, the output is determined not only by the input, but also by a changeable internal situation. With each input, the output is always in question. They are unpredictable.

The work of professionals and skilled workers is non-trivial. The professional is continually faced with new problems concerning the recalcitrance of the material to be processed, the tools or the product or service itself. And it is precisely these ‘blockades’ that can lead to new learning processes and innovations, as we saw with the evaluative control loop.

That which we previously referred to as the Anglo- Saxon/Taylorististic management style is in fact a vast and largely successful attempt to trivialize work (to decouple the evaluative control loop of work). The traditional social science research model12 is also a trivialization technology, which looks for fixed input-output relationships. Can you assume that this would work perfectly with 100% explained variance? Can you assume that your partner, child, parent, manager, or employee no longer has a will of their own and has become completely predictable?

It is not difficult to find trivialization tendencies in every societal subsystem: healthcare, education, science, organizations, child welfare services, politics, corporate management. It is also not difficult to find critics within these systems. All these critics have in common that they resist trivialization, and prioritize the principle of openness (and unpredictability) of the future: the possibility that things will go differently than anyone imagines. Perhaps those who advocate de-trivialization on moral grounds also have the winds of change in their favour. After all, the industrial society based on standardization and general rules has had its day. In contrast, the knowledge society is based on innovation, creativity, uniqueness, engagement and identity.

12 The empirical cycle in combination with quantitative data sets of the type: relatively few observations of a relatively large number of research units.

13 The automobile must remain essentially trivial, although researchers at TNO think otherwise.

In the knowledge economy, only the anomalous creates value. De-trivialization is the demand of the knowledge economy!

And this applies to skilled workers as well as entrepreneurs.

We are therefore happy with everything we do not know, especially because it offers the possibility and the necessity to make the world. The 'Area of Freedom', 'Area of Creativity' and 'Area of Possibilities' are dear to me, even though they are born in an 'Area of Ignorance'. The restoration of the functional coherence of the learning loop of skilled workers and entrepreneurs offers possibilities to acquire more clarity about the freedom or optionality that is contained in the loop. It is particularly the role of the professional in the evaluative control loop that can serve as a model for the creativity of entrepreneurship: struggling with a sense of possibility, in combination with a sense of reality, tinkering and bricolage (crafts, piecing something together) is the academically acceptable wording for this process (Weick, 1998)!

In the next chapter we continue with the topic of collaboration, but we begin with the relationship between entrepreneurs and skilled workers. These two topics are the unique feature of our lectorate. After this, the research lines of the lectorate are addressed.

"WITHOUT SOME GOALS AND EFFORTS TO REACH IT, NO MAN CAN LIVE"
4. THE COLLABORATIVE ENTREPRENEURSHIP PROGRAMME

We will focus much attention on the relationship and the collaboration between entrepreneurs and intrapreneurs (entrepreneurial employees) within 'ecosystems' because we expect that this relationship has much unused potential for innovation and growth. Not all skilled workers are intrapreneurs14 and not all intrapreneurs are skilled workers. In the literature on Corporate Entrepreneurship, various types of intrapreneurship are distinguished, in which the link between professional expertise, applicable knowledge and market knowledge is central. Workmanship is an essential precondition for intrapreneurship, but certainly not the only precondition.

The independent entrepreneurship that we discuss here also has a proviso: we are interested in what has become known as 'ambitious entrepreneurship' (Stam, 2012): entrepreneurship that has high ambitions in terms of creating value and consequently for innovation and growth. It is precisely at this point where intrapreneurs and entrepreneurs come together.

We begin with the two substantive themes of the electorate: 'entrepreneurship and intrapreneurship' and 'collaboration within ecosystems'. After this we will discuss the three lines of research. Finally, we will reflect on the relationship between the electorate and the Utrecht region.

Entrepreneurship and intrapreneurship

Over the longer term, 'ambitious entrepreneurship' and 'organization-internal entrepreneurship' are two alternative ways to modernize the economy, as Schumpeter previously showed with his two models of innovation (and thus of 'creative destruction'). Essence of entrepreneurship: upscaling. It is known that the growth of start-ups is sometimes restricted by the primarily technical/substantive involvement of the entrepreneurs.

14 Moreover, as suggested previously, workmanship contains an element that esists the essence of entrepreneurship: upscaling. It is known that the growth of start-ups is sometimes restricted by the primarily technical/substantive involvement of the entrepreneurs.

In independent entrepreneurship, innovation takes place through the ‘birth and death’ of enterprises (Garage innovation) and in the corporate entrepreneurship through the continuous adaptation of existing companies to new environments (Corporate innovation). Over the very long (but increasingly shorter) term, the first process is dominant by far: the biggest and fastest growing concerns in the world are younger than 25 years!

This trade-off between independent entrepreneurship and corporate entrepreneurship can perhaps result in an effective ‘third way’: the exploitation of the complementary strengths and weaknesses of both economic change modes, i.e. large and small enterprises, and entrepreneurs and skilled workers. Let us examine how both are related. What do they have in common? What is complementary? What can be learned from both sides?

Common to workmanship and entrepreneurship is the idiosyncratic, non-trivial struggle with recalcitrant reality involving repeated run-throughs of the control loop (tinkering). Both workmanship and entrepreneurship are familiar with this intensive and probing confrontation between what is and what should be. They understand the feeling that Pirsig (1974) once described as follows: quality emerges at the interface between object and subject, and that is where a new reality is created. This is essentially the same as what later became known as ‘flow’ and ‘mindfulness’ (although these terms are much too psychologizing). Both workmanship and entrepreneurship also resist the very common idea that organizations generate work, which then must be done by people (passive work). Both in fact create work, the emphasis being on the creative, value-adding aspect of work (active work). They also have dissatisfaction with the existing in common: it can be different, it can be better. Both are idealists and world changers. This tension between ‘what is’ and ‘what can be’ is the most important source of innovation for both daydreamers and idealists. Both want and do things that cannot be learned in school, for which formal knowledge is insufficient and is sometimes even counterproductive.

The most important difference is the scalability of the work. Intrapreneurs perform nonscalable work and entrepreneurs can only be truly successful (ambitious entrepreneurship) with a scalable product or service. One remains primarily in Mediocristan and the other in Extremistan; this is not a difference in degree, but in kind. There are also differences of degree, such as the specificity of the standards of the control cycle, with which the intrapreneur is bound to all the frameworks of the enterprise and the profession, while the entrepreneur is bound ‘only’ to the law. The entrepreneur has more freedom in choosing options, which necessitates not only more realism, but also a greater sense of possibility15. And the entrepreneur will also be more susceptible for events, disturbances and blockades, but this is a logical consequence of entering Extremistan.

Complementarity exists in various ways. First of all this is because in the current and future labour market, many people are expected to work for multiple employers, in combination with periods of independent entrepreneurship (DeFilippi and Arthur, 1994). ‘Combination jobs’ are also increasing in number (Dorenbosch, 2014), for example working three days per week as an employee (to pay the bills) and two days for yourself (for really enjoyable work and for the chance of real success!). In an uncertain labour market, these are attractive strategies to reduce vulnerability. And then there is the possibility of collaboration between entrepreneurs and intrapreneurs based on the complementary strengths and weaknesses of large existing organizations (network, resources, existing customers, knowledge, experience) and small start-ups (dynamic, decisive, unfettered, fast). Moreover, Isaacson previously pointed out another complementarity: that successful technological entrepreneurship often appears to begin with enthusiastic workmanship.

Finally, we refer to the phenomenon of public-private partnership and social entrepreneurship, in which skilled workers from public agencies collaborate with entrepreneurs.Entrepreneurship and workmanship, entrepreneurship and intrapreneurship: these are phenomena that are closely related in their economic functions. We believe that these are among the most powerful means for social and economic renewal. By bringing these worlds together, new possibilities can be created for innovation, entrepreneurship and growth, and that is in fact what we see happening around us within existing ecosystems. This forms the second theme of the lectorate.

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15 This relationship between sense of reality and sense of possibility is an important theme in the book Der Mann ohne Eigenschaften (Robert Musil, 1933, 1943).

Ambitious collaboration in ecosystems

A particularly accessible introduction to the concept of ecosystems in relation to entrepreneurship is that of Stam (2014). The discussion is primarily about what is new in this approach relative to previous approaches (economic clusters for example) and is strongly policy-related. It is clear that this often concerns regionally linked networks of economic actors within which entrepreneurs are in the lead. The thinking about and work on entrepreneurial ecosystems is also partly a reaction to the remarkable situation in the Netherlands: the number of ‘entrepreneurs’ has risen extraordinarily during the past decade, but that did not lead to innovation and economic growth: these are the freelance professionals. The vast majority of these ‘entrepreneurs’ have no ambition to grow into an enterprise with employees, and no real possibilities to do so. As a response to this situation, policy has focused increasingly on ambitious entrepreneurship, with less emphasis on the numbers of entrepreneurs than on the likelihood of successful growth.

Of course, the success story of Silicon Valley has inspired the ecosystem approach, but in the associated debate and research, the first lesson that emerged was “Stop imitating Silicon Valley" (Isenberg, 2010). Here as well, the local conditions determine success; every ecosystem is a world in itself. Isenberg, who also founded the Babson Entrepreneurship Ecosystem Project (BEEP), identified six domains that impact the effective operation of an entrepreneurial ecosystem: an entrepreneurial culture, policy and leadership, the availability of suitable financing, the quality of human capital, and the presence of markets and support organizations.

Another important aspect, which differs from the cluster approach, is that ecosystems function on behalf of entrepreneurs and are led by entrepreneurs; the entrepreneurs are the leaders, and the others are the 'feeders'. Clearly, we are dealing with an approach that is ‘under development’, but it is an approach – whatever it is called – that connects with a widespread and well-known practice of entrepreneurs: they always work together. This includes entrepreneurs who share the same location or facility, entrepreneurs who are each other's suppliers or buyers (chains), and entrepreneurs who collaborate on innovation, manufacturing and marketing (alliances and networks).

Consequently, ecosystems are not new, but the renewed attention for this topic does offer possibilities to increase the potential of collaboration and capitalize more on it. We understand that simple recipes are useless here, but we also think that the relationship between start-ups and large enterprises and between entrepreneurs and intrapreneurs has promising potential for improving leverage. We believe that strengthening collaboration within ecosystems, which enterprises have always done in a certain way and to a certain extent, is a method to strengthen the optionality (the perception, assessment and realization of opportunities; which Shane and Venkataraman (2000) called the supply and demand of opportunities) of entrepreneurship. This concerns more than just access to resources, which is the primary focus of recent literature on this topic. It also concerns the acquisition of practical experience with entrepreneurship within a community of experienced, critical and business-like peers and competitors.

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16 For examples, see Saravathy with her Effectuation approach (2008); Ries with the Lean Startup (2011); Blank with the Four Steps (2006) and Brown with Design Thinking (2008).

This is a context, moreover, in which ideas and plans are tested directly and concretely. It is our hypothesis that popular approaches to stimulate entrepreneurship will also be more effective16 within such a community. In fact, for the entrepreneur an effectively functioning ecosystem is analogous to an organization for the professional: it is the most important social context for answering the question of whether an action is profitable or not!

The Lectorate Coöperatief Ondernemerschap aims to promote entrepreneurship in all its forms to make the economy of Utrecht more innovative and to enable it to grow faster. To achieve this aim, ambitious entrepreneurship is essential: creating an abundance of economic and societal value. Our students also need entrepreneurial skills, not only in their future professional practice within organizations, but also as beginning entrepreneurs (a large proportion of the students are considering careers as entrepreneur). In recent years, partly under the influence of the crisis, collaboration has become an important means for enabling ambitious entrepreneurship to truly succeed.

Fewer and fewer entrepreneurs and intrapreneurs are working on their own, but are participating in networks to share experience, resources, creativity, strength and capital (to amplify is better!) in order to take big steps. The ecosystem approach is promising in this regard. We want to make a contribution to the transition to an ambitious, collaborative approach to entrepreneurship through the following lines of research.

Lines of Research

Line 1 Entrepreneurship and intrapreneurship

The promotion and development of entrepreneurship, both independently and within organizations, is the first topic of this line of research; Entrepreneurial Ecosystems is the central theme. Within this line of research, the primary focus is on more– and especially better – collaboration between large established enterprises and small ambitious start-ups. How can the complementarity in strengths and weaknesses be utilized for innovation and growth? To help answer this research question we developed a RAAK PRO proposal, together with UU, TNO, regional SMEs and various parties who are endeavouring to promote entrepreneurship.

The second topic within this line of research concerns alternating and combined entrepreneurial and intrapreneurial careers, based on the expectation that this phenomenon will increase in magnitude on the labour market, which itself is changing more and more rapidly. Two interesting questions are the following: 1) How and to what extent can entrepreneurial education contribute to such careers? 2) What does this contribute to regional innovation and growth?

Research into the role of Human Factors in entrepreneurial project management is also part of this line. Project management is changing rapidly from the implementation of ‘closed’ – in principle technically manageable – projects to ‘open’ innovation and change projects. This places other demands on project participants and project managers, and especially on the interaction between project and customer. Our network of contacts related to this theme is extensive and strong, it includes NWO, TUT, EUR, UM, UU, TNO and IPMA.

Line 2 Creating Shared Value

Following the decades that were dominated by Anglo-Saxon thinking (short-term, bottom-line thinking), all kinds of ambitions and ideas that focus on the longer term and on multiple value creation are being given more room. In a certain sense, it is simply back-to-basics. Indeed, the only reason you need an economy is for society! Porter and Kramer (2011) put this topic on the map as the next step after Corporate Social Responsibility.

Sustainability, including its social dimension, must be integrated into the primary process of enterprises, and not simply attached as a staff department. This transition requires new business models, new styles of leadership and entrepreneurship, new governance methods and new labour relations. It often involves various forms of chain, network and system innovation, and actually concerns the development of organization-transcending joint business models.

These forms of collaboration can be partly understood as a reaction to incapacity; the incapacity of the government, of the market and of civil society (failures). The only way to deal with this incapacity and to solve problems is to enter into frameworks of cooperation – specific to each issue – involving actors from government, the market and civil society. All these problems have the characteristics of ´wicked problems´; they are multiinterpretable, have no simple solution, are actually unsolvable and are only approachable interactively and iteratively. The construction of these collaborations, which always concern connections between and the transcendence of individual/organizational objectives, is a young field of expertise. The development and stabilization of collaborations between these parties requires a community of dependent and engaged partners, often public and private ecosystems.

Moreover, this combination of giving shape to profitable business models and solving societal issues is now anchored in the 'top sector' policy of the Ministry of Economic Affairs. We have intensive contacts with the De Groene zaak/Het Groene Brein, NWO, EUR and TNO in order to bring this research line to fruition.

Line 3 International entrepreneurship

Traditionally, the Netherlands has had a very open economy and has been more dependent on export for the growth of its national economy than other countries in the EU. Processes of globalization have only increased the international trade in goods. Today, very few products are manufactured from beginning to end in the same country, but consist of components that are produced in countries throughout the world. Due to the worldwide access to capital, knowledge and labour, enterprises can now produce the required goods and services much more efficiently at locations with a comparative cost advantage.

Research has shown that internationally oriented enterprises consistently perform better than non-internationally operating ones: they grow faster, are more innovative and are more productive (see

Geneeand Fortanier, 2010; Helpman et al., 2004). For that matter, an important remaining question is whether this improved performance is the result or cause of the internationalization. Internationally operating enterprises often have better access to new sources of financing, technology and processes (see forexampleBernardand Jensen, 1997).

Although the number of internationally operating SMEs in the Netherlands is still relatively small (Alberda et al., 2013), the fragmentation of the worldwide production process also offers new opportunities for ambitious entrepreneurs searching for new markets for their products, certain raw materials and semi- manufactured products, qualified personnel, and of course lower labour costs. Specific knowledge and capital is required to enter a foreign market or to enter into collaboration with foreign companies, especially if the 'psychic distance' between two countries has become larger, which is the case between the Netherlands and most emerging markets. It will therefore be especially the more ambitious enterprises that dare to take this step.

The presence of internationally oriented enterprises in a region can also improve the productivity of other local enterprises due to positive spillovers or increasing competition. This research line shall, in close cooperation with the degree programme in International Business Studies, focus on successful collaboration formulas between entrepreneurs, universities and research institutes and government agencies to promote the internationalization – and thereby the growth, productivity and innovation – of SMEs.

Within this line, we cooperate, among others, with the partner universities in the Consortium on Applied Research and Professional Education (CARPE): HAW (Hamburg), TUAS (Turku), UPV (Valencia) and MMU (Manchester) and with the 'Dutch Dream Foundation'.

The Utrecht Region

With these themes and research lines, the electorate focusses especially on enterprises in the Utrecht region, in particular the regional SMEs. Utrecht is an exceptional economic region in the sense that it has traditionally performed well without a clear profile; perhaps there is less need to establish a clear profile precisely because the region performs well. For example, Utrecht was named the most competitive region of Europe (EURegional Competitiveness Index 2013) but this primarily concerned conditions for entrepreneurship such as education level and infrastructure (and many other conditions), and that is different than the results in terms of innovation and growth. Nevertheless, it is a widely shared diagnosis that Utrecht is strong, but has a fragmented economic structure. There is still much to be gained in the area of collaboration between enterprises and the realization of innovation and growth (Hilhorst,2014).

A recent study conducted in the Utrecht region (Olden, 2014) showed that the economic crisis also led to loss of employment in Utrecht. Although the number of enterprises has grown at an above-average rate, the growth rate for freelance professionals is also higher than average. Without these freelancers, the growth in the number of enterprises would fall below the national average. The study also showed that the growth in employment originates from young enterprises, while employment in larger and older ones has contracted. Moreover, the growth of enterprises is not sector-specific: in shrinking sectors, flourishing enterprises can be found and in growing sectors, bankruptcies are taking place.

Here as well, success and growth are primarily enterprise-specific. These are all reasons to assign a high priority to the theme of ambitious entrepreneurship and to look for promising approaches to promote this type of entrepreneurship, such as strengthening collaboration between enterprises. We want to study and promote entrepreneurial ecosystems, with a special role for using the complementary strengths and weaknesses of small new enterprises and large existing ones, and thus for entrepreneurs and intrapreneurs and entrepreneurship in public-private partnerships, as a possible contributions to solving the problem of the Utrecht economy. As part of this process, the lectorate wants to become a think-and-do-tank focusing on ambitious, collaborative entrepreneurship that is recognized and acknowledged by the region.

"LIKE BRITAIN IN THE INDUSTRIALREVOLUTION,AMERIKA'S ASSET IS, SIMPLY,RISK TAKINGANDTHE USE OF OPTIONALITY, THIS REMARKABLE ABILITY TO ENGAGE IN RATIONAL FORMSOFTRIAL AND ERROR,WITH NO COMPARATIVE SHAME IN FAILING, STARTING AGAIN, AND REPEATING FAILURE"

5.IN CLOSING

Starting with the first sentence that I wrote for this essay, I knew that the introduction, which is about coincidence and unpredictability, would make it difficult to write a persuasive final chapter. After all, the final step in ambitious entrepreneurship is to actually take big risks. If you want to promote entrepreneurship, only one general answer is possible: ensure that as many people as possible, as early as possible and as well prepared as possible, take this step time and time again. There is much to learn for an entrepreneur, and heterogeneous, broad and deep experience is crucial, but this is inevitably followed by the risky venture, the jump and the first failure17. Entrepreneurship can be promoted through effective collaboration: the creation and utilization of environments that are rich in interactivity, iterativity and optionality. This is the challenge of entrepreneurial ecosystems and the onus of the lectorate.

Regarding the initial proposition – it is more likely that events (which are unpredictable) than trends (which are known) will determine the future – I now believe this is more tenable than I thought previously. The most important interventions of which we can conceive therefore have the aim of making the social and technological infrastructures more robust; in other words, better able to withstand any event whatsoever. In his most recent book, Taleb goes even further and argues that robustness must not be the aim, but anti-fragility; societal infrastructure should become stronger under the influence of negative shocks, and not simply remain intact. This is a powerful idea.

He believes that financial institutions and nation states, as well as large enterprises, are outstanding examples of fragile systems, and he believes that reduction in scale is an efficacious general strategy. I believe that the key players in this essay – entrepreneurs and skilled workers – are outstanding examples of the anti-fragile elements of not only our economy, but also of society. Without actively creative work, there will be no active citizens and consumers.

The fact that successful entrepreneurship is dependent on time, location and path, whereby factors, actors, processes and events form unique combinations, means that entrepreneurship cannot be automated. It is remarkable that we reflect on the far-reaching automation of work, but never on the automation of entrepreneurship. For that matter, new workmanship, as described here is also impossible to automate because judgment and creativity resist this. In the course of history, we see that what is called work is that which cannot yet be automated. Ultimately, that which remains is truly the work of people!

The idea that only the anomalous creates value is not my own discovery. Florida's Rise of the Creative Class (2004) is an impressive argument that the driving forces of our economy are changing. The future belongs to this creative class: entrepreneurs, artists, outcasts and failures, eccentric financiers, etc. These nonconformists have a strong tendency to find each other and inspire each other; we could call them communities or ecosystems. They can already be found in big cities across the world, and sometimes at other surprising locations. Florida believes that the economic map consists primarily of peaks, and is certainly not flat as Friedman (2005) argues. In this new world, dominated by diversity and creativity, we of course recognize extremists, and we also see the emerging contours of a new and different meritocracy that is much less linked to academic performance than the current one. I believe that connecting young people to these new experience-based contexts is the most important challenge for educators and teachers, but by doing so we run the risk that they (young people) are already much farther along in this respect than we are (people who are not young).

Learning in the form of acquiring real experience is the most powerful means to promote entrepreneurship, and it is this 'real'experience that also activates formally acquired knowledge. In education it is beautiful to see that young people are substantially more interactive and iterative than we were at their age. First do and then think: this is a breath of fresh air! But I doubt that optionality also develops by its own accord in the direction of more ambitious entrepreneurship. The development of a sense of possibility is still in its infancy

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The Case Against Patents

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The case against patents can be summarized briefly: there is no empirical evidence that they serve to increase innovation and productivity, unless productivity is identified with the number of patents awarded—which, as evidence shows, has no correlation with measured productivity. This disconnect is at the root of what is called the "patent puzzle": in spite of the enormous increase in the number of patents and in the strength of their legal protection, the US economy has seen neither a dramatic acceleration in the rate of technological progress nor a major increase in the levels of research and development expenditure.

Both theory and evidence suggest that while patents can have a partial equilibrium effect of improving incentives to invent, the general equilibrium effect on innovation can be negative. The historical and international evidence suggests that while weak patent systems may mildly increase innovation with limited side effects, strong patent systems retard innovation with many negative side effects. More generally, the initial eruption of innovations leading to the creation of a new industry—from chemicals to cars, from radio and television to personal computers and investment banking—is seldom, if ever, born out of patent protection and is instead the fruit of a competitive environment. It is only after the initial stage of rampant growth ends that mature industries turn toward the legal protection of patents, usually because their internal growth potential diminishes and they become more concentrated.

These observations, supported by a steadily increasing body of evidence, are consistent with theories of innovation emphasizing competition and first-mover advantage as the main drivers of innovation, and they directly contradict "Schumpeterian" theories postulating that government-granted monopolies are crucial to provide incentives for innovation. A properly designed patent system might serve to increase innovation at a certain time and place—and some patent systems, such as the late-nineteenth century German system allowing only process but not final product patents, have been associated with rapid innovation. Unfortunately, the political economy of government-operated patent systems indicates that such systems are susceptible to pressures that cause the ill effects of patents to grow over time.

The political economy pressures tend to benefit those who own patents and are in a good position to lobby for stronger patent protection, but disadvantage current and future innovators as well as ultimate consumers. This explains why the political demand for stronger patent protection comes from old and stagnant industries and firms, not from new and innovative ones. Our preferred policy solution is to abolish patents entirely and to find other legislative instruments, less open to lobbying and rent seeking, to foster innovation when there is clear evidence that laissez-faire undersupplies it. However, if that policy change seems too large to swallow, we discuss in the conclusion a set of partial reforms that could be implemented as part of an incremental strategy of reducing the harm done by the patent system.

Do Patents Encourage Productivity Growth?

If there is to be any rationale for patent systems, with all their ancillary costs, it must be that they increase innovation and productivity. What is the evidence? Simply eyeballing the big trends shows that patenting has exploded over the last decades. In 1983 in the United States, 59,715 patents were issued; by 2003, 189,597 patents were issued; and in 2010, 244,341 new patents were approved. In less than 30 years, the flow of patents more than quadrupled. By contrast, neither innovation nor research and development expenditure nor factor productivity have exhibited any particular upward trend. According to the Bureau of Labor Statistics, annual growth in total factor productivity in the decade 1970–1979 was about 1.2 percent, while in the decades 1990–1999 and 2000–2009 it has been a bit below 1 percent. Meanwhile, US research and development expenditure has been oscillating for more than three decades in a narrow band around 2.5 percent of GDP. The recent explosion of patents, in other words, has not brought about any additional surge in useful innovations and aggregate productivity. In new industries such as biotechnology and software—where innovation was already thriving in their absence—patents have been introduced without any positive impact on the rate of innovation. The software industry is an important case in point. In a dramatic example of judge-made law, software patents became possible for the first time in the early 1990s. Bessen and Meurer, in a large body of empirical work culminating in Patent Failure (2008), have studied the consequences of this experiment and have concluded that it damaged social welfare.

Academic studies have also typically failed to find much of a connection between patents and innovation. In Boldrin and Levine (2008b), we conducted a metastudy gathering the 24 studies (including three surveys of earlier empirical work) we could find in 2006 that examined whether introducing or strengthening patent protection leads to greater innovation. The executive summary states: "[T]hese studies find weak or no evidence that strengthening patent regimes increases innovation; they find evidence that strengthening the patent regime increases patenting! They also find evidence that, in countries with initially weak IP [intellectual property] regimes, strengthening IP increases the flow of foreign investment in sectors where patents are frequently used." Actually, the issue of promoting foreign direct investment, while a well-established empirical consequence of strengthening patent regimes, is entirely beside the point of this essay. There are a number of ways to strengthen a country's institutions and infrastructure in a way that would encourage foreign direct investment—and, in any case, foreign direct investment is not equivalent to innovation.

Our conclusion was in keeping with other studies that have addressed this question. Some studies have failed to find any connection even between changes in the strength of patent law and the amount of patenting, while others fail to find a connection between patents and some measure of innovation or productivity. For example, after failing to find a single study claiming that innovation increased as a consequence of the strengthening of US patent protection in the 1980s, Gallini (2002, p. 139) wrote in this journal: "Although it seems plausible that the strengthening of US patents may have contributed to the rise in patenting over the past decade and a half, the connection has proven difficult to verify." Similarly, Jaffe (2000) also examines many studies and concludes: "[D]espite the significance of the policy changes and the wide availability of detailed data relating to patenting, robust conclusions regarding the empirical consequences for technological innovations of changes in patent policy are few. There is widespread unease that the costs of stronger patent protection may exceed the benefits. Both theoretical and, to a lesser extent, empirical research suggest this possibility." 1

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1 The study by Kanwar and Evanson (2001) illustrates some of the issues that arise in these kinds of studies. They have two five-year averages on 31 countries for the period 1981–1990. They find support for the idea that higher patent protection leads to higher research and development spending as a fraction

of GDP. However, a different story seems equally plausible. Countries with a larger market can more easily pay the fixed costs of innovation. Indeed, one perspective is that their data essentially compares countries with relatively small economies, little intellectual property protection, and low R&D spending with countries with relatively larger economies, greater intellectual property protection, and higher R&D spending. For example, R&D spending as a fraction of GDP in their data ranges from a ten-year average of 0.2 percent in Jordan to 2.8 percent in Sweden. If we combine their data with GDP data from The 1990 CIA World Fact Book to take account of the size of the economy, increasing the strength of intellectual property protection from 0 to 1 to 2 on their five-point scale does increase R&D expenditure. But as intellectual property protection is increased further, the gains to R&D expenditure levels then falls. Even at the lower levels, we are probably observing primarily the effect of foreign direct investment: that is, among poor countries with near-zero intellectual property protection, increases bring in more foreign investment and in doing so directly raise R&D spending. In higher-income countries with larger economies, foreign investment is not an issue, and increases in intellectual property have little or no effect on innovation.

The Lerner (2002) study is especially notable because he examined all signifi- cant changes in patent law in all countries over the last 150 years. His conclusion: "Consider, for instance, policy changes that strengthen patent protection. Once overall trends in patenting are adjusted for, the changes in patents by residents of the country undertaking the policy change are negative, both in Great Britain and in the country itself. Subject to the caveats noted in the conclusion this evidence suggests that these policy changes did not spur innovation." This, in summary, is what is currently known as the "patent puzzle"—although as we will explain, it is substantially coherent with a theory of innovation that emphasizes the gains from competition and first-mover incentives, rather than benefits from the monopoly power of patents.

Evidence at the sectoral level of the US economy shows the same disconnect between patenting and productivity. In Boldrin, Correa, Levine, and Ornaghi (2011), we carried out a sequence of statistical tests and econometric estima- tions on two datasets: an original microeconomic dataset obtained by combining firm-level information obtained through Compustat, the National Bureau of Economic Research, and the Bureau of Labor Statistics and an enriched version of the dataset used by Aghion, Bloom, Blundell, Griffith, and Howitt (2005) in their study of industry-level mark-ups. Conclusions must of course be drawn with care from this kind of data because, across industries, the strength of competi- tion, patenting, and productivity are simultaneously determined and intertwined with technological change. With that reservation appropriately noted, at the industry level there is, in general, no statistically significant correlation between measures of productivity (whether measured by labor or total factor productivity) and of patenting activity (whether measured by number of patents or citations of patents).

We then investigated the relationships between patents, competition, and productivity further. When we regressed measures of patents (or patent citations) on a measure of competition (as measured by the inverse of profitability) used by Aghion, Bloom, Blundell, Griffith, and Howitt (2005), we found a positive relationship that is remarkably robust to changes in industry classification, time period, and set of sampled industries. That is, patents were more common in competitive industries. We also studied the correlation between the same measure of competitive pressure and objective measures of labor productivity growth. In our preferred specification, we found that average annual growth of productivity in the sectors with the highest level of competition is up to 2 percent bigger than in the sectors with the lowest level of competition. These are strikingly large differences when cumulated over various decades, as it is the case in our dataset. This finding of a positive correlation between competition and productivity at the sectorial level replicated a pioneering, and unfortunately forgotten, pattern reported in Stigler (1956).

The accumulated findings of no positive relationship between patenting and productivity are not conclusive, and arguments have raged over the specific data used, whether to look for a structural break in the data, how the researcher seeks to correct for endogeneity, and so on.2 However, it is fair to say that the sector-level, national, and cross-national evidence fail to provide any clear empirical link from patents to innovation or to productivity. This lack of connection is consistent with the view that the use of patents either as a defensive or as a rent-seeking tool is more widespread than one might have predicted. In addition, the empirical evidence is consistent with the proposition that greater competition, not patents, is the main factor leading to innovation and greater productivity.

Theory and Practice of Patents and Innovation

There is little doubt that providing a monopoly as a reward for innovation increases the incentive to innovate. There is equally little doubt that granting a monopoly for any reason has the many ill consequences we associate with monopoly power—the most important and overlooked of which is the strong incentive of a government-granted monopolist to engage in further political rent seeking to preserve and expand its monopoly or, for those who do not yet have a monopoly, to try to obtain one. These effects are at least to some extent offsetting: while the positive impact of patents is the straightforward partial equilibrium effect of increasing the profits of the successful innovator to the monopolistic level, the negative one is the subtler general equilibrium effect of reducing everybody else's ability to compete while increasing for everyone the incentive to engage in socially wasteful lobbying efforts.

Downstream Innovation, Defensive Patenting, and Patent Trolls

In the long run, even the positive partial equilibrium effect of patents in providing an incentive for innovation may be more apparent than real: the existence of a large number of monopolies created by past patent grants reduces the incentives for current innovation because current innovators are subject to constant legal action and licensing demands from earlier patent holders. The downstream blocking effect of existing monopoly grants on incentives for future innovation

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2 For a sense of these controversies, Aghion, Bloom, Blundell, Griffith, and Howitt (2005) find an "inverted-U" relationship between the extent of competition, as measured by the inverse of mark-ups, and a measure of patenting activity, based on a dataset of US patents of UK firms. In other words, they find that the maximum innovative effort (as measured by patents) occurs at some "intermediate" position between a high and low level of competition. However, Hashmi (2011) reexamines the inverted-U relationship using data from publicly traded US manufacturing firms and finds a robust positive relationship between the inverse of markups and citation-weighted patents. Correa (2012) reexamines the same dataset of UK firms and shows that the prediction of an inverted-U is overturned when allowing for the possibility that innovations follow a "memory process," where the current probability of introducing a new innovation increases when a firm successfully innovated in the previous period. He also finds a

structural break in the data in 1981, when the Court of Appeals for the Federal Circuit was established to hear appeals of patent cases. Overall, Correa finds a positive innovation–competition relationship for the memory industries before the 1982 reform, but no relationship between innovation and competition for those industries that he classifies as memory-less.

has greatly increased in recent decades because modern products are made up of so many different components. The recent—and largely successful—efforts of Microsoft to impose a licensing fee on the large and expanding Android phone market is but one case in point. With the exception of Motorola Mobility, all the handset manufacturers have agreed to the fee, and Motorola lost its first battle against the fee in spring 2012—fought not in court but in the more receptive domain of the US International Trade Commission (Investigation Number 337-TA- 744, May 18, 2012). Microsoft is attempting to charge a licensing fee solely over a patent involving the scheduling of meetings—a rarely used feature of modern smart- phones. The meeting-schedule feature is but one of many thousands of patented "ideas" used in a modern smartphone, and each owner of each patent potentially can charge a licensing fee. Hence, the main dynamic general equilibrium effect of a patent system is to subject future inventions to a gigantic hold-up problem: with many licenses to be purchased and uncertainty about the ultimate value of the new innovation, each patent holder, in raising the price of his "component," imposes an externality on other patent holders and so charges a higher than efficient licensing fee. In Boldrin and Levine (2005) and Llanes and Trento (2009), we and others have explored the theory; and many case studies involving patents (and other fractionated ownership problems) can be found in Heller (2008).

To understand more about the actual effect of patents in the real world, consider the recent purchase by Google of Motorola Mobility, primarily for its patent portfolio not for the ideas and innovations in that portfolio. Few if any changes or improvements to Google's Android operating system will result from the ownership or study of these software patents. Google's purpose in obtaining this patent portfolio is purely defensive: it can be used to countersue Apple and Microsoft and blunt their legal attack on Google. These remarks apply to the vast bulk of patents: they do not represent useful innovation at all and are just weapons in an arms race. This is not news: the same message emerged decades ago from the Levin, Klevorick, Nelson, and Winter (1987) and Cohen, Nelson, and Walsh (2000) surveys of research and development managers.

One could argue that the costs of building up a patent portfolio to engage in this sort of defensive patenting are not too large: after all, it can cost as little as $15,000 to file a successful patent application, and filing applications on a larger scale might be cheaper. However, the acquisition of large patent portfolios by incumbents creates huge barriers to entry. In the smartphone market, for example, Apple is the market leader and Microsoft is unable to produce a product that appeals to consumers. Each are incumbent firms with a large patent portfolio. In this market, Google is the new entrant and innovator and, while wealthy, Google found itself lacking a large defensive patent portfolio. Hence we see both Apple and Microsoft attacking Google with patent litigations, generating hundreds of millions in wasteful legal costs and no social benefit whatsoever.

Despite the fact that patents are mostly used for arms races and that these, in turn, are driven by patent trolls, there does not yet exist convincing formal models of the ways in which this interaction can inhibit innovation. In a pure armsrace theory, if all firms get counterbalancing patent portfolios and all innovate, then they would all have innovated in the absence of patents—hence, patents do not encourage innovation. This follows because with counterbalancing patent portfolios, no firm can sue any other firm—exactly as would be the case in the absence of patents. Hence in this setting patents simply add a cost to innovation: if you wish to innovate, you must acquire an expensive patent portfolio to avoid trolls. On the other hand if a patentholder does not produce a marketable product and hence cannot be countersued—like Microsoft in the phone market or other patent trolls in other markets—then patents become a mechanism for sharing the profits without doing the work. In this scenario, not only do patents discourage innovation, but they are also a pure waste from a social standpoint.

Patents and Information Disclosure

Another widely cited benefit of patent systems—although not so much in the economics literature—is the notion that patents are a substitute for socially costly trade secrecy and improve communication about ideas. From a theoretical point of view, the notion that patents are a substitute for trade secrecy fails in the simplest model. If a secret can be kept for N years and a patent lasts M years, then an innovator will patent when N < M. In other words, ideas will be patented when it seems likely that the secret would have emerged before the patent expired and not patented if the secret can be kept. In practice, it is uncertain when the secret will leak out, but it can be shown that the basic intuition remains intact in the face of uncertainty (Boldrin and Levine 2004; Ponce 2007).3

It is also the case that the extent of practical "disclosure" in modern patents is as negligible as the skills of patent attorneys can make it. It is usually impossible to build a functioning device or software program from a modern patent application; this is made especially clear by the fact that some patented ideas do not and cannot work. For example, US Patent 6,025,810 was granted for moving information through the fifth dimension. While detailed studies of the usefulness of disclosure in patent applications are not available, companies typically instruct their engineers developing products to avoid studying existing patents so as to be spared subsequent claims of willful infringement, which raises the possibility of having to pay triple damages. According to sworn testimony by Google's chief of Android development during the legal battles between Oracle and Google (for example, Niccolai 2012), the engineers that developed Android were unaware of Apple (or other) patents, and so were unlikely to have been helped by them. The opinion of Brec (2008), a Microsoft developer, reflects that of many practitioners: own patents. The legal claims section—the only section that counts—was indecipherable by anyone but a patent attorney. Ignorance is bliss and strongly recommended when it comes to patents.

[Microsoft policy is for developers to] never search, view, or speculate about patents. I was confused by this guidance till I wrote and reviewed one of my.

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3 A more subtle point is that secrecy may bias the type of inventive activity away from innovations that are not easily kept secret to those that can be. In this symposium, Moser offers some of the historical evidence on this point.

The related idea that patents somehow improve communication about ideas, thereby creating some positive externality—a notion key to the "public–private" partnership between governments and private research organizations in which the government funds the research and then gives the private organization a monopoly over what is developed in the course of research—is backed by neither theory nor evidence. It is impossible to study the history of innovation without recognizing that inventors and innovators exchange ideas as a matter of course and that secrecy occurs, when it occurs, typically in the final stages of an innovation process when some ambitious inventors hope to corner the market for a functioning device by patenting it. A good case in point is that of the Wright brothers, who made a modest improvement in existing flight technology that they kept secret until they could lock it down on patents, then used their patents both to monopolize the US market and to prevent further innovation for nearly 20 years (Shulman, 2003). The role that Marconi and his patent played in the development of the radio is altogether similar (Hong 2001), as are innumerable other stories. At the opposite extreme we have, again among many, the example of the Cornish steam engine discussed in Nuvolari (2004, 2006). Here engineers exchanged non-patented ideas for decades in a collaborative effort to improve efficiency. The contemporary FLOSS (Free/Libre and Open Source Software) community is another successful example of how collaboration and exchange of ideas can thrive without the monopoly power granted by patents.

First-Mover Advantages and Incentives for Innovation

In most industries, the first-mover advantage and the competitive rents it induces are substantial without patents. The smartphone industry—laden as it is with patent litigation—is a case in point. Apple derived enormous profits in this market before it faced any substantial competition. The first iPhone was released on June 29, 2007. The first serious competitor, the HTC Dream (using the Android operating system) was released on October 22, 2008. By that time, over 5 million iPhones had been sold, and sales soared to over 25 million units during the subsequent year, while total sales of all Android-based phones were less than 7 million. In the tablet market, the iPad has no serious competitor as of late 2012 despite having been introduced on April 10, 2010. While it is hard to prove this delayed imitation also would have occurred in the complete absence of patents, intuition suggests— and our formal model in Boldrin and Levine (2004) predicts—that there is little reason to assert patent rights while the first-mover advantage is still active. Apple did not initially try to use patents to prevent the Android phones from coming into its market and the subsequent "patents' fight" has been taking place largely after 2010; these facts are consistent with a substantial first-mover advantage. How valuable for Apple was the delay in the Android phones entry? Largely because Apple kept its first-mover advantage in spite of a large imitative entry in this market, the value of Apple stock—during a severe market downturn—rose by a factor of approximately five. While there may have been some delay in entry from the competition due to Apple's threat— since executed—of patent litigation, the fact is that similar but less-successful devices had been available for a number of years before Apple finally cracked the market. Less anecdotal than the story of the iPhone is the survey of research and development managers in Cohen, Nelson, and Walsh (2000). Here, over 50 percent of managers indicate lead time (first-mover advantage) is important to earning a return on innovation; outside the pharmaceutical and medical instruments industry, less than 35 percent of managers indicate that patents are important.

To understand patents in practice, it is necessary to examine the lifecycle of industries (for example, Jovanovich and MacDonald 1994; Scherer 1990). Typically a new, hence innovative, industry begins with a competitive burst of entries through which very many innovators try hard to get their products to market. In these early stages, many firms bring different versions of the new product to the market (think of the American auto industry in the early twentieth century or the software industry in the 1980s and 1990s) while demand for the new product grows rapidly and the quality of products is rapidly improved. At this stage of the industry lifecycle, the price elasticity of demand is typically high; what is important is not to dominate the market, but rather to get your own products quickly to market and to reduce costs. From the perspective of competing firms, your cost-reducing innovation is good for me in the same way that my cost-reducing innovation is good for you—hence, let us all imitate each other and compete in the market.

As the industry matures, demand stabilizes and becomes much less price elastic; the scope for cost-reducing innovations decreases; the benefits of monopoly power grow; and the potential for additional product innovation shrinks. Typically there is a shakeout in which many firms either leave the industry or are bought out. The automobile industry is a classical historical example, but many readers will have a more vivid memory of the bursting of the dot-com bubble, which makes this point even more forcefully. At this stage of the industry lifecycle, rent seeking becomes important and patents are widely used to inhibit innovation, prevent entry, and encourage exit. If we look at patent litigation in practice—and as predicted by theories of first-mover competition (Boldrin and Levine 2004, among others)—it takes place when innovation is low. When an industry matures, innovation is no longer encouraged; instead, it is blocked by the ever-increasing appeal to patent protection on part of the insiders.

While patent litigation has increased, few patents are actively used. Patent litigation often involves dying firms that have accumulated huge stockpile of patents but are no longer able to produce marketable products and that are now suing new and innovative firms. For example, Texas Instruments was one of the first producers of microchips, and many in our generation remember the capabilities of their first TI calculator. But Texas Instruments was unable to make the transition to the personal computer revolution and became, for a while, the symbol of a dying company trying to stay alive by suing the newcomers.4 In more recent times, Microsoft—once the giant bestriding the software industry—has been unable to make the leap to portable devices such as telephones and tablet personal computers. Thus, Microsoft now uses patent litigation to try to claim a share of the profits Google generates in this market. Back in 1991, Bill Gates said: “If people had understood how patents would be granted when most of today’s ideas were invented and had taken out patents, the industry would be at a complete standstill today ... A future start-up with no patents of its own will be forced to pay whatever price the giants choose to impose.” Today, Microsoft lobbies across Europe and Asia for the introduction of software patents, a prize it has already obtained in its home country.

The cost of litigating patents is not insubstantial either. Bessen and Meurer (2008) used stock market event studies to estimate the cost of patent litigation: they estimate that during the 1990s such costs rose substantially until, at the end of the period, they constituted nearly 14 percent of total research and development costs. A related but more difficult-to-quantify phenomenon is the rise of uncertainty caused by the legal system. A case in point is the NTP Inc. patents that were used to threaten the Blackberry network with a shutdown. In 2006, Research in Motion (RIM), the producer of Blackberry, agreed to pay $612.5 million to license the patent in question from NTP (Svensson 2006). The patent was later invalidated by the court—but RIM did not get its money back (Salmon 2012). Here, the behavior of a single judge cost RIM more than half a billion dollars. In this setting, it is no surprise that patent trolls hope to get rich quickly.

It is easier to list the main social welfare implications of the tradeoff between costs of legal monopoly and incentives to patent holders than it is to calculate their magnitudes. Still, the provisional evidence we have suggests that the net welfare effects of the current patent system could easily be negative. It is somewhat conventional to think of welfare losses from distortions as small, with the idea that welfare triangles due to monopoly power are small being the paradigmatic case in point. Unfortunately, monopolies have no incentive to avoid large social losses even when the private gains are small. Witness, for example, the fact that patented pharmaceutical products often sell for hundreds of times the marginal cost of production, as some astonishing pricing differences between the US and the European markets show. Most revealing is the empirical study of the Quinolones family of drugs (Chaudhuri, Goldberg, and Gia 2006). It measures the economic consequences of the introduction of pharma- ceutical patents for this family of drugs and concludes that the consequence of patent protection to India will be nearly $300 million in welfare losses—while the gain to the pharmaceutical companies will be less than $20 million.5

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4 Texas Instruments is such an important source of litigation that empirical work on patent litigation usually uses a dummy variable for TI. Empirical studies of the importance of firms no longer doing busi- ness in an industry to litigation can be found in Bessen and Meurer (2005) and Hall and Ziedonis (2007).

5 Although the focus of this paper is on patents rather than copyright, it is worth noting that most of the copyright wars revolve around measures to prevent piracy, empirically a relatively minor factor as far as profits of media corporations are concerned (see for example Sinha, Machado, and Sellman 2010; Danaher, Dhanasobhon, Smith, and Telang 2010; Sanchez 2012).

Pharmaceuticals

This brings us to the controversial issue of drug patents. The standard argument says: No patents, no drugs. The total cost of developing a new drug, including failures, is quickly approaching the $1 billion mark (DiMasi, Hansen, and Grabowski 2003). So how can anyone, faced with such a gigantic fixed cost and a microscopic marginal cost of reproduction, innovate without the protection of patents? But consider the following facts: Under current law, the chemical formula and the efficacy of the cure as established by clinical trials are made available to competitors essentially for free. About 80 percent of the initial fixed cost of drug development comes from Stage III clinical trials, a public good that legislation requires be privately produced. The downstream social cost of monopoly pricing of pharmaceutical products is highest for life-saving drugs, and the cost of monopoly pricing of other pharmaceutical products is also quite high. Given all this, various economists, such as Kremer and Williams (2009), have argued that if government intervention is indeed needed in this market, a system of prizes might be superior to the existing system of monopolies.

There are four things that should be born in mind in thinking about the role of patents in the pharmaceutical industry. First, patents are just one piece of a set of complicated regulations that include requirements for clinical testing and disclosure, along with grants of market exclusivity that function alongside patents. Second, it is widely believed that in the absence of legal protections, generics would hit the market side by side with the originals. This assumption is presumably based on the observation that when patents expire, generics enter immediately. However, this overlooks the fact that the generic manufacturers have had more than a decade to reverse-engineer the product, study the market, and set up production lines. Lanjouw's (1998) study of India prior to the recent introduction of pharmaceutical patents there indicates that it takes closer to four years to bring a product to market after the original is introduced—in other words, the first-mover advantage in pharmaceuticals is larger than is ordinarily imagined. Third, much development of pharmaceutical products is done outside the private sector; in Boldrin and Levine (2008b), we provide some details. Finally, the current system is not working well: as Grootendorst, Hollis, Levine, Pogge, and Edwards (2011) point out, the most notable current feature of pharmaceutical innovation is the huge "drought" in the development of new products.

With these four factors in mind, it is possible to make proposals for reforming the pharmaceutical industry along with the patent system. For example, we could either treat Stage II and III clinical trials as public goods (where the task would be financed by National Institutes of Health, who would accept bids from firms to carry out this work) or by allowing the commercialization of new drugs—at regulated prices equal to the economic costs of drugs—if they satisfy the Food and Drug Administration requirements for safety even if they do not yet satisfy the current (overly demanding) requisites for proving efficacy. In other words, pharmaceutical companies would be requested to sell new drugs at "economic cost" until efficacy is proved, but they could start selling at market prices after that. (It is ensuring the efficacy—not the safety—of drugs that is most expensive, time-consuming, and difficult.) In this way, companies would face strong incentives to conduct or fund appropriate efficacy studies where they deem the potential market for such drugs to be large enough to bear the additional costs. The new policy could begin with drugs aimed at rare diseases, which, because of their small potential market, are not currently worth the costs of efficacy testing; without the new policy, they might never make it to market at all. If this new progressive approval approach works for rare diseases, it could be adopted across the board. Our broader point is that, rather than just ratcheting up patent protection, there are a number of moves we could make to reduce the risks and cost of developing new drugs.

The Political Economy of Patents

We do believe, along with many of our colleagues, that a patent system designed by impartial and disinterested economists and administered by wise and incorruptible civil servants could serve to encourage innovation. In such a system, very few patents would ever be awarded: only those for which convincing evidence existed that the fixed costs of innovation were truly very high, the costs of imitation were truly very low, and demand for the product was really highly inelastic. (The curious reader may check Boldrin and Levine, 2008a, for a more detailed explanation as to why these three conditions need to be satisfied to make a patent socially valuable). There is little dispute, among these same colleagues, that the patent system as it exists is very far from satisfying such requirements and it is, in fact, broken. To quote a proponent of patents, Shapiro (2007): "A growing chorus of scholars and practitioners are expressing concerns about the operation of the US patent system. While there is no doubt that the US economy remains highly innovative, and there is no doubt that the patent system taken as a whole plays an important role in spurring innovation, the general consensus is that the US patent system is out of balance and can be substantially improved." Actually, we believe the evidence is clear that the patent system taken as a whole does not play an important role in spurring innovation. But if a well-designed and well- administered patent system could serve the intended purpose, why not reform it instead of abolishing it?

To answer the question we need to investigate the political economy of patents: why has the political system resulted in the patent system we have? Our argument is that it cannot be otherwise: the "optimal" patent system that a benevolent economist–dictator would design and implement is not of this world. It is of course fine to recommend patent reform. But if political economy pressures make it impossible to accomplish that reform, or if they make it inevitable that the patent system will fail to meet its goals, then abolition—preferably by constitutional means as was the case in Switzerland and the Netherlands prior to the late nineteenth century—is the proper solution. This political economy logic brings us to advocate dismantle- ment of the patent system.

The political economy of patent protection is shaped by many players, but "consumers" are not prominent among them. On one side, the side of the potential patentees, there are individual inventors, corporate inventors, and patent trolls. Other players include the patent office, the patent lawyers who file and litigate patents, and the courts where the litigation takes place. The rules of the game are established by some combination of legislation, judicial action, and custom. But because patenting is a technical subject about which few voters know anything with clarity, interests of voters are not well represented. In many spheres of government regulation, this lack of representation for voters has often led to "regulatory capture"—as Stigler (1971) and other public choice theorists have argued—where regulators act in the interests of the regulated, not the broader public. Nowadays, if there is one "regulator" who is captured, it is the one in charge of regulating patents. To understand why, we need to understand the motivation and incentives of the relevant players.

Let us start with the US patent office and the infamous "one-click" Patent#5960411 issued to Amazon in September 1999. According to 35 U.S.C. 103, the statute under which the Patent Office operates, to obtain a patent "the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been not obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains..." Now consider the patent in question, which claims, among other things, a monopoly over:

> 11. A method for ordering an item using a client system, the method comprising: displaying information identifying the item and displaying an indication of a single action that is to be performed to order the identified item; and in response to only the indicated single action being performed, sending to a server system a request to order the identified item whereby the item is ordered independently of a shopping cart model and the order is fulfilled to complete a purchase of the item.

The idea of taking a single action to accomplish a goal is hardly innovative, and applying the idea of taking a single action to making a purchase is obvious to anybody who has ever used a soft drink machine. Purchases were already being made over the Internet in 1999. It was thus clear that orders would be made by a credit card, and either the credit card information would be provided at the time of the transac- tion, or stored in advance by the retailer. Either way, the user must identify itself when the purchase is made. Those obvious steps are exactly what Amazon describes in its patent, albeit with a few flow charts thrown into the eleven-page patent application. But through the fog of those flow charts, it is relatively easy to see that the verbal description of the single-click procedure applies equally well to what happens on the Amazon site and to what happens in front of millions of vending machines every day. The Amazon patent was reexamined by the US Patent Office starting in May 2006. After a preliminary finding that, indeed, "obvious" means "obvious" evenat the Patent Office, the office then reversed itself and in October 2007, reaffirmed the Amazon patent, albeit limiting its scope slightly. So we cannot dismiss such an absurd patent as an aberration.

What lead the US Patent Office to interpret, essentially, the words "not obvious" as meaning "obvious"? The Patent Office is constantly under pressure from applicants and their lawyers to be more generous in issuing patents—that is, to adopt lower standards of obviousness and steeper standards for what is considered "prior art." The following statement by David Kappos (2010), director of the US Patent Office concerning the allowance rate—what fraction of patents are accepted—is revealing: "Overall in FY 2010, the allowance rate increased to 45.6%, compared to an allowance rate of 41.3% in FY 2009 . . . So, while we still have a lot of work to do, I think we are on the right path." Apparently, accepting a higher fraction of patents applications is defined as "the right path." Talk about "regulatory capture"!

Patent lawyers play a large role in the political economy of patents. According to Quinn (2011), who is a patent attorney, legal fees for filing a patent run upwards of $7,000 and roughly half are rejected. In 2010, according to the US Patent Office, 244,341 patents were issued, which would imply roughly $3 billion in legal fees per year. Obviously, patent attorneys as a group have a tremendous incentive to see that more patents are issued. This insight helps us understand better the role of the courts and their relatively recent reform. In 1982—lobbied by patent lawyers— Congress passed the Federal Courts Improvement Act, which moved federal patent appeals out of the regular court system to a special court system for dealing with patents. Naturally, many of the judges for this new court were chosen from the ranks of patent attorneys. For example, when a court voted, in a 1994 decision, to expand the scope of patents to software (In re Kuriappan P. Alappat, Edward E. Averill and James G. Larsen 33 F.3d 1526 [July 29, 1994]), of the six judges who voted in favor, half had previously been patent attorneys, while of the two that voted against, neither had been. The referee of the patent game is biased both materially and ideologically. As Landes and Posner (2004, p. 26) write in their discussion of the political economy of patents: "That has been the experience with the Federal Circuit; it has defined its mission as promoting technological progress by enlarging patent rights."

Notice, too, that many patent lawsuits have a public goods aspect. Consider a case in which the plaintiff is asserting that its patent has been infringed. If the plaintiff wins the lawsuit, by confirming its monopoly position it appropriates all the benefits of winning the lawsuit. A victory by the defendant, by contrast, benefits partly itself, but also other firms that might be sued by the plaintiff for patent infringement as well as consumers who would have a more competitive market. Thus, the defendant receives only a slice of the overall benefits from winning the lawsuit, and will be willing to spend less on such lawsuits than it would if it were to receive all the benefits. This dynamic is nothing but the patent court version of the (already noted) fundamental asymmetry in the distribution of economic incentives that defines the foundations of the political economy of patent law.

Finally, political economy can be influenced by how standard terminology frames a problem. Landes and Posner (2004) point out that there is an "ideological"argument in support of stronger patent rights: supporters of free markets tend to favor institutions of private property, and patents and copyright are intellectual "property." Hence, strengthening them is ideologically and politically consistent with the general principle that "private property is good for growth." But as we (Boldrin and Levine 2008b) and many others elsewhere have argued, patents are just a monopoly, not property.

Given this set of players and their incentives, the patent game moves naturally towards its equilibrium, as we have observed over time. Two centuries or so ago, patents were restricted in their areas of applicability and limited in both depth and duration over time; they were somewhat "reasonable," to the extent social gains and costs seemed balanced. But we have witnessed a steady process of enlargement and strengthening of patent laws. At each stage, the main driving force was the rent-seeking efforts of large, cash-rich companies unable to keep up with new and creative competitors. Patent lawyers, patent officials, and wannabe patent trolls usually acted as foot soldiers. While this political economy process is pretty straight- forward in broad terms, we are still missing an empirical, quantitative analysis of the stakes involved and of the gains and losses accruing to both the active players and to the rest of society, from the general public to the innovators that never emerged due to preexisting patent barriers.

Perhaps surprisingly, despite the key importance of political economy in under- standing why we have the patent system we have, economists have had relatively little to say on the subject. The few prominent papers that we know of on this subject typically build from analyses very similar to what we have presented here—but then shy away from drawing the logical conclusions. For example, Landes and Posner (2004) recognize that patent laws are mostly designed by interest groups keen to increase their monopoly rents, not aggregate welfare, and that this drove the enormous growth in patent legislation and judiciary activity during the last 30 years. The more elaborate writing by Scherer (2009) on "The Political Economy of Patent Policy Reform in the United States" follows a similar approach. It focuses on the fact that "government emphasis on patent systems increased" while academic research was starting to become more and more aware that patents are playing a minor positive role, if any at all, in creating incentives for high R&D and in fostering productivity growth. After providing a concise and very well-informed historical survey of all major changes in US patent policies over the last century or so, Scherer (p. 195) wonders why the political system would increase patent protection so much in light of the fact "that the record of debates on the enabling bill contains no solid evidence that the change would in fact stimulate R&D, and that there is no evidence of an acceleration in company-financed R&D between the 27 years before the bill was enacted and the 18 years thereafter." He then extends the same argument to the international arena, paying particular attention to the case of pharmaceutical patents. While Scherer's language and arguments are strongly critical of current trends in patents, he does not seek to explain why an institution, such as the patent system, that was supposed to be theoretically sound would degenerate into something so socially damaging over same 30-yearperiod that academic researchers were realizing the institution's limitations and potential dangerousness.

In our view, even insightful writers such as Landes and Posner (2004) and Scherer (2009) seem unable to shake themselves free of the belief that patents are essential in fostering innovation and that any problems can be fixed with some tweaks to the patent system; they fail to seriously consider the possibility of intrinsic problems with the design of the institution itself. This belief in patents flies in the face of the structural realities: Marginal extensions of patents result in substantially higher per capita rents for the few holders of the right while marginally reducing the individual welfare of the much larger number of nonpatent holders. The rent of the monopolist is a lot higher than an individual consumer's deadweight loss, so the monopolist has an incentive to perpetuate the system while the individual consumer has no incentive to fight it. Those who possess a patent do not hold a "property right" in the conventional sense of that term, but they do hold a socially granted "monopoly" right, and will tend to leverage whatever initial rents their monopoly provides in order to increase their monopoly power until all potential rents are extracted (and, in all likelihood, also largely dissipated by the associated lobbying and transaction costs). This scenario helps explain how patents interact with the industry lifecycle— why patents are either ignored or scarcely used in new and competitive industries, while being highly valued and overused in mature and highly concentrated ones.

Conclusion

In 1958, the distinguished economist Fritz Machlup in testimony before Congress famously said: "If we did not have a patent system, it would be irrespon- sible, on the basis of our present knowledge of its economic consequences, to recommend instituting one. But since we have had a patent system for a long time, it would be irresponsible, on the basis of our present knowledge, to recommend abol- ishing it." A proposal to abolish patents may seem "pie in the sky." Certainly, many interim measures could be taken to mitigate the damage caused by the current system: for example, properly enforcing the standard that patents should only be granted for nonobvious insights; requiring genuine disclosure of working methods in patents (the opposite of certain recent "protectionist" proposals to institute secret patents); and allowing an "independent invention" defense against claims of patent infringement. But why use band-aids to staunch a major wound? Economists fought for decades—ultimately with considerable success—to reduce restrictions on international trade. A similar approach, albeit less slow, should be adopted to phase out patents. Because policy proposals are often better digested and metabolized in small bites, here is our list of small reforms that could be easily implemented.

Patents are time limited, which makes it relatively easy to phase them out by phasing in ever shorter patent durations. This conservative approach also has the advantage that if reducing patent terms indeed has a measurable effect on innovation, the process can be reversed. Stop the rising tide that, since the early 1980s, has extended the set of what can be patented and has shifted the legal and judicial balance substantially in favor of patent holders. Because competition fosters productivity growth, antitrust and competition policies should seek to limit patents when they are hindering innovation. This policy may be of particular relevance for high-tech sectors, from soft- ware to bioengineering, to medical products and pharmaceuticals.

Current international trade negotiations that affect patents often occur as part of either the Agreement on Trade-Related Aspects of Intellectual Property Rights (TRIPS), which was signed in 1995 as part of the World Trade Organization negotiations, or as part of the World Intellectual Property Organization, an agency of the United Nations. The nature of these agree- ments and organizations is well indicated by the use of the propaganda term "intellectual property" in their titles. In both cases, these talks are often focused on how to prevent ideas from high-income countries from being used in low-income countries—what we would characterize as essentially a neo- mercantilist approach toward free trade in goods and ideas. We should be highly cautious about this agenda. Within a couple of decades, the "balance of trade in ideas" between the US and European economies and emerging economies in Asia might easily equalize or reverse. Engaging in "mercantilism of ideas" may seem favorable to certain large US firms now, but such rules may become costly to the US economy if they are applied to protect patents held in the future by producers in the now-developing Asian economies.

If the US economy is to have patents, we may want to start tailoring their length and breadth to different sectoral needs. Substantial empirical work needs to be done to implement this properly, although a vast legal literature is already pointing in this direction. Patents should not be granted based only on technological insights, but should also take economic evidence into account. For example, if an inven- tion is easy to copy or has a high fixed cost, then patent protection to pro- vide an incentive for the inventor may be more suitable. Ultimately, patents should be awarded only when strictly needed on economic grounds, as spelled out earlier.

We advocate returning to the rule prior to the Bayh–Dole Act of 1980 accord- ing to which the results of federally subsidized research cannot lead to pat- ents, but should be available to all market participants. This reform would be particularly useful for encouraging the dissemination of innovation and heightening competition in the pharmaceutical industry. In several industries, notably pharmaceuticals, it would be useful to rethink all of the government policies that bear on incentives for invention. The broad point is that there are a number of ways to reduce the risks and cost of developing new drugs, rather than just trying to ratchet up patent protection.

In general, public policy should aim to decrease patent monopolies gradu- ally but surely, and the ultimate goal should be the abolition of patents. After six decades of further study since Machlup's testimony in 1958 has failed to find evidence that patents promote the common good, it is surely time to reassess his conclusion that it would be irresponsible to abolish the patent system. The patent system arose as a way to limit the power of royalty to award monopolies to favored individuals; but now its primary effect is to encourage large but stagnant incumbent firms to block innovation and inhibit competition.

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How Do Patent Laws Influence Innovation? Evidence from Nineteenth-Century World's Fairs

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Studies of innovation have focused on the effects of patent laws on the number of innovations, but have ignored effects on the direction of technological change. This paper introduces a new dataset of close to fifteen thousand innovations at the Crystal Palace World's Fair in 1851 and at the Centennial Exhibition in 1876 to examine the effects of patent laws on the direction of innovation. The paper tests the following argument: if innovative activity is motivated by expected profits, and if the effectiveness of patent protection varies across industries, then innovation in countries without patent laws should focus on industries where alternative mechanisms to protect intellectual property are effective. Analyses of exhibition data for 12 countries in 1851 and 10 countries in 1876 indicate that inventors in countries without patent laws focused on a small set of industries where patents were less important, while innovation in countries with patent laws appears to be much more diversified. These findings suggest that patents help to determine the direction of technical change and that the adoption of patent laws in countries without such laws may alter existing patterns of comparative advantage across countries. (JEL D2, K11, L51, NO, 014).

Studies of innovation have focused on the effects of patent laws on levels of innovative activity, but have ignored the effects on the direction of technical change. This omission is critical if differences in the direction of innovation help to determine patterns of comparative advantage and international differences in economic growth (Simon Kuznets, 1963; Nathan Rosenberg, 1974). This paper introduces a new source of cross-country, economy-wide data on innovations with and without patents, which makes it possible to examine the effects of patent laws on the direction of innovation. I have collected such data for close to fifteen thousand innovations from the catalogues of two nineteenth- century world's fairs, the Crystal Palace Exhibition in London in 1851 and the Centennial Exhibition in Philadelphia in 1876. Exhibition data provide economy-wide data on innovation with and without patents for 12 countries in 1851 and 10 countries in 1876.

The empirical analysis tests the following argument: if innovative activity is motivated by expected profits, and if the effectiveness of patent protection varies across industries, then innovation in countries without patents should focus on industries with strong alternative mechanisms to protect intellectual property. Exhibition data confirm that innovation in countries without patent laws concentrates in a small set of industries where patents are less important, while innovation in countries with patent laws appears to be much more diversified. These findings suggest that patents serve to expand the set of industries where innovation is attractive to inventors. But they also indicate that patents may help to determine the direction of innovation and that the adoption of patent laws in countries without such laws may alter existing patterns of comparative advantage across countries.

A necessary condition for patent laws to influence innovation is that innovation, or a significant share of it, must be responsive to profit incentives. A long tradition of empirical studies has established this fact. As early as 1883, surveys of inventors have suggested that inventive effort is motivated by expected profits (Procks-verbal du Congres Suisse ..., 1883; S. C. Gilfillan, 1930; Joseph Rossman, 1931). Zvi Griliches (1957) corroboratest hese findings in a pioneering empirical study of geographic pat-terns in the adoption of hybrid corn, which proves that the diffusion of innovations is re-sponsive to market size. Jacob Schmookler (1966) constructs further evidence for the importance of profit incentives as he shows that the number of U.S. patents for railway equipment increases with a short lag after sales of railway equipment. Kenneth Sokoloff (1988) and Zorina Khan and Sokoloff (1993) present further evidence for the responsiveness to demand from nineteenth-century patent data and the behavior of "great inventors."

William Nordhaus (1969) and later studies of innovation have emphasized the role of patent laws in determining the incentives to invent. Nordhaus identifies the trade-off between strong incentives to inventors through long-lived patents and the deadweight loss from a monopoly distortion caused by long-lived pat-ents. Paul Klemperer (1990) and Richard Gil-bert and Carl Shapiro (1990) add the breadth of patent grants as a further policy instrument, thus capturing the range of technologies that are covered by each patent. In a study of Japanese patents after the reform of 1988, Mariko Sakak- ibara and Lee Branstetter (2001) find little evi-dence that patent breadth increases the incentives to invent. Suzanne Scotchmer (1991) provides a potential explanation based on the cumulative nature of innovation, whereby strong patent rights may reduce the number of inventions, if exclusivity to early generations of inventors weakens the incentives to invent for later generations. 1

Although previous studies have recognized the importance of patent laws for determining the incentives to invent, they have neglected the influence of patent laws on the direction of technical change. Yet, the importance of the direction of innovation for economic growth has long been recognized. Kuznets observed in 1963 that innovation at any given time tends to concentrate in a small sector of industries and countries, and argued that such differences help to determine differences in rates of economic growth across countries. Economic history sup-ports these claims: Germany's focus on chemi-cal innovations is widely understood to have enabled Germany to replace Britain as the in-dustrial leader in the late-nineteenth century. Edwin Rothbarth (1946), H. J. Habakkuk (1962), and Rosenberg (1972) argue that America's growth rates overtook Europe's at the be-ginning of the twentieth century because American innovations focused on labor-saving innovations in machinery.2 Although the United States is generally recognized as the country with the most advanced patent system in the nineteenth century, the influence of patent laws on the direction of innovation has never been considered.

This paper proposes to extend the standard accounts of the effects of patent laws by exam-ining their influence on the direction of techni-cal change. Similar to the classic approach in Nordhaus (1969), it supposes that the incentives to invent increase with the strength of monopoly rights that are granted to successful innovations. This paper then relaxes the assumptions of the classic models by allowing for alternative mechanisms, in addition to patent grants, to create incentives to invent. For example, inven-tors may be able to achieve conditions similar to patent monopolies by keeping innovations se-cret, by beating competitors to the market, or by maintaining tight control over assets that are complementary to the commercial exploitation of the innovation. Surveys of 634 American R&D labs in 1983 by Richard Levin et al. (1987) and of 1,478 firms in 1994 by Wesley Cohen et al. (2000) suggest that secrecy is par-ticularly valuable as an alternative mechanism to protect intellectual property.

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1 See Joel Mokyr (2002) for a historical analysis of the cumulative nature of innovation. More generally, William Baumol (1990) and Kevin Murphy et al. (1991) show that individuals are more likely to chose socially productive activities (such as inventing) if property rights protect the returns from such activities.

2 Peter Temin (1966) counters these arguments with a standard two-goods neoclassical model,

which shows that resource abundance does not necessarily lead to greater capital intensity and mechanization, since both capital and labor are scarce. The discussion of the Habakkuk-Rothbarth hypothesis and the labor-saving nature of American tech-nologies continues with Gavin Wright (1990), Nathan Rosenberg (1972), David A. Hounshell (1985), Daron Ace-moglu (1998), and Charles Jones (2004).

Exhibition data create a unique opportunity to evaluate the importance of patenting across industries and countries. Mid-nineteenth-cen-tury patent laws had been adopted in a relatively ad hoc manner, depending on legal traditions rather than economic considerations (Edith Pen-rose, 1951). Large differences in patent systems existed across countries, and patentees de-pended on domestic patent laws since patenting abroad was prohibitively expensive and coun-tries discriminated heavily against foreign pat-entees (John Coryton, 1855; Richard Godson, 1840). As a result, domestic patent laws played a more important role in creating incentives for domestic invention than at any later stage in his-tory. Moreover, data from nineteenth-century world's fairs grant a rare opportunity to study the patenting decisions of inventors who pre-sented innovations both with and without pat-ents at the fairs.

Data from the Crystal Palace Exhibition on more than six thousand British and American innovations with and without patents make it possible to measure differences in the propen-sity to patent across industries and across coun-tries. Such data indicate that inventors' propensity to patent varies strongly across in-dustries but not across countries. In Britain, one in nine innovations appears to have been pat-ented, compared to one in eight in the United States. The propensity to patent varies strongly across industries in both countries, however, suggesting significant sectoral differences in the usefulness of patent projection. Patenting rates, calculated as the share of innovations that are patented, range from 7 percent in textiles, 8 percent in food processing, and less than 10 percent in scientific instruments to more than 20 percent in manufacturing machinery, engines, and other types of machinery. Differences across industries are almost identical for the British and American data, despite the fact that British patenting rates are constructed from ref-erences to patents in the exhibition data, while American rates are constructed by matching exhibits with entries in the lists of all patents in the Annual Reports of the United States Patent Office between 1841 and 1851. These parallels in patenting behavior are especially remarkable considering the vast differences between the British and the American patent system, at a time when patent applications were 60 times more expensive in Britain than in the United States. In addition to comparisons across na-tions' patent laws, inter-industryd ifferences in the propensity to patent are robust to compari-sons across rural and urban areas, and adjust-ments for the quality of innovations.

If the relative effectiveness of patents varies across industries, the payoffs for invention in countries without patent laws should be highest in those industries where alternative mechanisms are prominent relative to patenting, and innovation in patentless countries should focus in those industries. Exhibition data indicate that innovations in the patentless countries concen-trated on two industries with low patenting rates: scientific instruments and food process-ing. At the Crystal Palace, every fourth exhibit from a country without patent laws was a sci-entific instrument, while no more than one-seventh of other countries' innovations occurred in this industry. Countries without patent laws also have significantly larger shares of their overall innovations in textiles, especially dye stuffs, and in food processing. After the Netherlands abolished its patent system in 1869, the share of Dutch innovations in food processing increased from 11 to 37 percent. At the same time, patentless countries had smaller shares of innovation in machinery, especially in machin-ery for manufacturing and agriculture; in these industries, innovations appear to have depended crucially on patents.

This paper presents these comparisons in more detail. Section I describes the exhibition data and discusses potential sources of bias. Section II compares estimates for the propensity to patent across industries, Section III examines the direction of innovation across countries, and Section IV concludes.

I. The Data

The Crystal Palace exhibition of 1851 was the first world's fair that allowed inventors and firms to exchange information on technological innovations across countries. At a time when London had fewer than two million inhabitants, it attracted more than six million people; its companion, the American Centennial Exhibi-tion, drew ten million visitors in 1876 (Table 1; see Evelyn Kroker, 1975, p. 146). Even those who stayed at home would read about the fairs in weekly updates in trade and general interest journals, such as Scientific American and the Illustrated London News, and peruse detailed reports by their national commissions (e.g., Bericht, 1853). In 1851, the Crystal Palace was the largest enclosed space on earth; its exhibi-tion halls covered 772,784 square feet, an area six times that of St. Paul's Cathedral in London, and housed a total of 17,062 exhibitors from 25 countries and 15 colonies. In 1876, a visitor would have to walk more than 22 miles, the equivalent of a three-day stroll, to see all 30,864 exhibitors from 35 countries (see Bericht III, 1853, p. 674; Kretschmer, 1999, p. 101). From the catalogues that guided visitors through these fairs, the reports of national commissions, the diaries of committee members such as Edgar Alfred Bowring (1850), and many letters of exhibitors and visitors to the fairs, I have col-lected detailed information on each of close to fifteen thousand exhibits, including brief de-scriptions of the innovation, its industry of use, its exhibitor's name and location, its patent sta-tus, and whether the exhibit received an award for exceptional inventiveness.

TABLE 1—STATISTICS ON THE WORLD'S FAIRS OF 1851 AND 1876

	Exhibition	
	Crystal Palace	Centennial
Location	London	Philadelphia
Year	1851	1876
Countries		
Total	40	35
N. Europe	12	10
Exhibitors		
Total	17,062	30,864
N. Europe	11,610	6,482
Visitors	6,039,195	9,892,625
Area (in acres)	25.7	71.4

Sources: Bericht III (1853) and Kretschmer (1999).

A.Advantages over Patent Data

Empirical analyses of the effects of patent laws on innovation typically rely on patent data, although patents may not be an ideal measure to study the effects of patent laws. Most importantly, the way in which patent data measure innovation depends on the details of patent laws, and the definition of what constitutes a patentable invention varies considerably across countries. For instance, in the mid-nineteenth-century United States, only "first and true" inventors were allowed to patent, while France granted patents to any person importing new technologies (Coryton, 1855, pp. 235-64). In the best case, patents measure new ideas that have proven to be feasible at least in theory. But such patents capture an early input in the process of innovation and only a small share of them reach later stages (Griliches, 1990, p. 1669; Harold I. Dutton, 1984, p. 6). For the twentieth century, for example, firm-level surveys have found that only between 5 and 20 percent of patents become economically useful innovations (Peter Meinhardt, 1946, p. 256). In the nineteenth century, usefulness was often not even required for a patent grant (Coryton, 1855, pp. 235, 239).3

Even if patent data were a perfect measure of innovation, such data exist only for a handful of countries in the nineteenth century, excluding those without patent protection. Moreover, economy-wide patent data are not available when countries exclude specific industries from patenting. In the nineteenth century, for example, Austria, Belgium, France, and Saxony did not issue patents to inventions in chemicals, foods, and medicines (Coryton, 1855, pp. 241, 244, 249, 266). As a further complication, patents are classified by functional principles and often cannot be assigned to a specific industry of use. For example, the functional class "dispensing liquids" includes holy-water dispensers along with water pistols, while "dispensing solid" groups tooth paste tubes with manure spreaders (Schmookler, 1972, p. 88). As a result of this classification by function rather than industry, empirical studies based on patent counts had to exclude important innovations such as power plant inventions and electric mo-tors, because they could not be assigned to a specific industry (Schmookler, 1972, p. 89). Fi-nally, Griliches (1990, p. 1669) observes that patented inventions differ greatly in quality. Manuel Trajtenberg (1990) addresses this problem by constructing measures of the value of patented inventions based on the number of succeeding patents that refer to them. However, historical citations data are extremely costly to collect and they may underestimate the quality of innovations in those industries where patents undercount inventions.

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3 The most prominent alternative to patent data, firms' expenditure on R&D (e.g., Sakakibara and Branstetter, 2001), captures an even earlier stage of the innovation process (see Griliches, 1990, p. 1671).

Exhibition data, as a complement to nineteenth-century patent data, offer a way to address these concerns. Most importantly, exhibition data measure innovations regardless of whether they were patented or not, whereas patent data count only those inventions that inventors chose to patent. Uniform rules of selecting exhibits ensure that exhibits are comparable across countries, regardless of domestic patent laws. Exhibition data include information on three patentless countries: Switzerland and Denmark in 1851, and Switzerland and the Netherlands in 1876. No other data are available to study innovation in these countries. Exhibition data cover innovations in all industries, including those barred from patenting. Depending on an innovation's country of origin, exhibition data either include references to mark patented inventions or can be matched with patent data to distinguish innovations with and without patents. Awards to the most innovative and useful exhibits provide a measure for the quality of innovation.

B. Description of the Exhibition Data

A typical entry in the exhibition catalogues includes the name of the exhibitor, his location, and a brief description of the innovation. For example:

32 Bendall, J. Woodbridge, Manu.-A universal self-adjusting cultivator, for skimming, cleaning, pulverizing, or sub-soiling land; pat.

This exhibit is classified in the Crystal Palace industry class number9 , "Agricultural and

Horticultural Machines and Implements," and in the Centennial class 670, "Agricultural Machinery and Instruments for Tillage." For the Crystal Palace data, a total of 13,876 such exhibits have been classified according to 30 industries of use. For the Centennial data, I have counted 19,076 exhibits in 344 industry classes. I have been able to match all Centennial classes to Crystal Palace classes except for systems of education and exhibits of marine mammals (live, stuffed, and salted), which were exhibited only in Philadelphia. Industry classes span the entire spec-trum of production, ranging from mining and minerals, chemicals, and food processing to engines, manufacturing machinery, and scientific instruments.

Based on the original classification scheme of the 1851 catalogue, I aggregate the exhibition data from 30 into 7 industry classes: mining, chemicals, food processing, machinery, scientific instruments, textiles, and manufactures. This creates a system of mutually exclusive and unordered industry classes. For example, Tweedale & Son's "superfine Saxony and fine twilled cricketer's flannel," Britain's exhibit number 4 in the Crystal Palace class "wool," could also be classified under "clothing." Combining the data into broader industry classes addresses the problem of overlap between the original classes and also the related issue of treating discretely a choice between "woolens" and "flax" (closely related industries in the textiles sector), and a choice between "woolens" and "scientific instruments."Aggregating in this way also increases the number of exhibits in each class and thereby avoids the problem that classes with exceptionally small numbers of exhibits receive a disproportional weight in tests of the equality of distributions.

A uniform system of selecting exhibits ensured that all participating countries chose exhibits according to the same criteria of "novelty and usefulness" (Bericht, 1853, p. 50). Countries valued the exhibitions to showcase their technologies, and often competed to demonstrate their technical supremacy in certain industries (The Times, October 20, 1849). National commissions delegated the authority to select exhibits to local branches. For example, Britain's national commission for the Crystal Palace nominated 65 local commissions to select exhibits at the local level. Local commissions typically consisted of between two and ten academics and businessmen, representing the area's main industries (Bericht, 1852, pp. 37, 90). In their applications to their local commission, all potential exhibitors were required to report "what is novel and important about the product, how its production shows special skillfulness and proves an original approach" (Bericht, 1853, pp. 50, 117).

Awards to the most innovative exhibits helped to enforce the selection criteria. International panels of between 6 and 12 researchers and businessmen ranked all exhibits according to their "novelty and usefulness" and awarded prizes to the top 30 percent. All exhibits were included, and no one could excuse himself from the jury's evaluation. Signs such as "Not entered in the competition" were explicitly prohibited (Bericht, 1853, pp. 29, 50, 98, 111). At the Crystal Palace, 5,438 exhibits received awards (Bericht, 1853, p. 707; Utz Haltern, 1971, p. 155). Juries awarded Council Medals, the highest honor, to 1 percent of all exhibits, Prize (or silver) Medals to 18 percent, and Honorable Mentions to 12 percent of all exhibits (Bericht, 1853, p. 707; Haltern, 1971, p. 155). These award-winners can be matched with the entries from the exhibition catalogues to construct a measure for the quality of innovations.

C. Potential Weaknesses of the Exhibition Data

There are, however, potential sources of bias in the exhibition data. Space restrictions and transportation costs appear to be the most important potential sources of bias for the number of innovations that countries brought to the fairs. At the Crystal Palace, Britain's Central Commission allocated exhibition space according to their subjective perception of each country's relative importance. Space restrictions, however, appear to have been flexible: when the United States Commission to the Crystal Palace thought that U.S. exhibitors would be short on exhibition space, it asked the British Commission for more room and was granted its request (Haltern, 1971, p. 150). Floor plans for the Centennial exhibition show that countries built additional exhibition space on the Centennial grounds: Australia, Brazil, Canada, Egypt, Ger-many, Great Britain, Japan, Morocco, Spain, Sweden, and Turkey constructed temporary structures to house further exhibits.4

Heavy and fragile innovations, which would otherwise have been underrepresented due to transportation costs, could be exhibited as models or as blueprints. Of 194 British exhibits in class 7, "Civil Engineering, Architecture, and Building Contrivances," 88 exhibits, or 45 per-cent, were represented by models. For example, T. Powell of Monmouthsire, Britain, exhibited a "Model for apparatusused for shipment of coals from boats or waggons at Cardiff dock"; A. Watney of Llanelly, Wales, exhibited "Models of anthracite blast furnaces." Among the engi-neering exhibits, there was a model of the sus-pension bridge that was being constructed across the river Dnieper in Kiev. Robert and Alan Stevenson (grandfathera nd uncle to Robert Louis Stevenson) displayed models of light-houses for the Bell Rock and for Skerryvore (see L. T. C. Rolt, 1970, p. 157).

Perhaps the most important weakness of the exhibition data is that they may under report innovations that are easy to copy, if such innovations were not displayed for fear of imitation. Exhibition data may therefore be biased against innovations that are omitted from the patent counts. Contemporary records indicate that imitation was a more serious concern if the host country to the exhibition did not have patent laws. Yet even in these countries only a few exhibitors decided to withdraw their innovations from the fairs:

"In a meeting of the Central Commission for the Swiss Exposition in Lucerne, they had declared that they would not exhibit at Zurich unless Switzerland would adopt patent laws. ... It is a fact though, that, despite this false alarm, of the 5,000 exhibitors only 50, no more than 1 percent, retracted their applications" (Procks-verbal du Congres Suisse, 1883, p. 68).

At both fairs, exhibitors found ways to advertise without disclosing the secrets of their innovations. Rather than exhibiting a new piece of machinery, or describing a new process, exhibitors often chose to display samples of their final output. For example, Drewsen & Sons of Silkeborg, Jutland, exhibited "Specimens of pa-per, glazed by a machine constructed by the exhibitor," instead of the machine itself, which he kept secret (see Official Catalogue, First Edition, 1851, p. 210). P. Claussen of London, an inventor and patentee, exhibited "Samples of flax in all its stages, from straw to cloth, prepared by the exhibitor's process" (Official Catalogue, 1851, p. 28). In addition, a system of registration, which was available to all exhibitors, acted as a cheap and fast patent system; at the Crystal Palace only 500 of 13,750 exhibitors took advantage of it (Bericht III, 1853, pp. 697-701). If exhibition data undercount

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4 Visitor's Guide (1875, p. 18). The mean area per exhibitor was approximately equal at both fairs, with 0.00118 acres (4.7753 square meters) in 1851 and 0.00125 acres (5.0586 square meters) in 1876.

D. Are Patent Laws Endogenous to Innovation

All empirical analyses of the effects of patent laws on innovation are plagued with the problem of endogeneity, and this study also must be mindful of the problem. From the mid-nineteenth century onward, domestic interest groups began to lobby strongly for what they considered the most favorable patent laws. In the 1880s, two of Switzerland's most important industries- chemicals and textiles- opposed the introduction of patent laws (Proces-verbal du Congres Suisse, 1883; Penrose, 1951) and, as a likely outcome of such pressures, the first patent law in 1888 required inventors to deposit models with the patent office, effectively excluding chemical processes and dyes from patenting (see Penrose, 1951, p. 16; Eric Schiff, 1971, pp. 86, 93). International treaties in the 1880s, which could serve as an instrument for patent laws (Josh Lerner, 2002b), were influenced by foreign interest groups whose fears of competition reflected international patterns of innovative activity and industry structure (Pen-rose, 1951, pp. 15-17, 117-24).

Endogeneity, however, is less likely to be a problem for the mid-nineteenth century than for any later period, even though it cannot be excluded with absolute certainty. Lerner's (2000) observation that legal traditions and political systems appear to be a primary force in shaping patent laws is especially true for this period. Historical records indicate that patent systems were initially adopted in a relative ad hoc manner, without knowledge or consideration for their effects on specific industries (Penrose, 1951, p. 19) and they document that the influence of innovation on patent laws was limited prior to the exhibitions:

"In 1839 Brougham's Act was amended for a minor technical reason, and in 1844, the Judicial Committee of the Privy Council was empowered to extend patents up to a period of fourteen years. Neither of these changes appears to have resulted from pressure applied by the invention interest" (Dutton, 1984, p. 57).

Dutton (1984) offers a variety of potential explanations for the limited involvement of nineteenth-century inventors:

"Patent laws were technically complex and intrinsically uninteresting. Many inventors were probably too ignorant to offer any interference and few MPs were able or willing to master the subject. ... Secondly, the invention interest was not sufficiently unified, and remained organized on a local basis only, right through to the late 1840s" (Dutton, 1984, p. 64).

Nevertheless, endogeneity deserves consideration and will be addressed in detail later using a variety of robustness checks. The following section combines exhibition and patent data to measure the importance of patenting across industries.

II. Cross-Industry Variation in the Importance of Patent Protection

Moser (2004) uses exhibition data to measure inventors' propensity to patent across industries and countries. Two different methods are used to distinguish innovations that are patented. For Britain's innovations, patented innovations are identified from references to patents in the de-scriptions of exhibits in the catalogues.5 For example, J. Bendall introduced "A universal self-adjusting cultivator, ... ; pat." Patenting rates are constructed by dividing the number of exhibits with references to patents by the total number of exhibits.6 For American innovations, I identified patented exhibits by matching all 549 American exhibitors at the Crystal Palace with lists of all patents granted between 1841 and 1851 and recorded in the Annual Report of the United States Patent Office. For example, "U.S. patent No. 4387; Otis, Benjamin H.; Dedham, Mass; Mortising machine; granted

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5 References to patents will be most accurate if exhibi-tors report patents truthfully. As an

approximation, this seems reasonable: exhibitors benefited from reporting the patents that they owned and jurors carefully checked all exhibits, so that fraudulent references faced a real risk of discovery.

6 This means that patenting rates are defined as patents per innovation, which may be preferable to the common use of the term "patenting rates" to denote patents per year. Feb. 20, 1846," from the Annual Report for 1846, and "U.S. exhibit 23; Otis, B. H.; Cincin-nati, Ohio; Boring and mortising machine," from the Official Catalogue (1851), constitute a match between a patent and a Crystal Palace innovation.

TABLE 2—PATENTING RATES ACROSS INDUSTRIES IN 1851

	Patenting rate	
Industry of use	Britain	US
Mining	5.0%	5.8%
Chemicals	5.1%	4.0%
Food processing	7.9%	4.3%
Machinery	20.4%	36.4%
Scientific instruments	9.7%	14.9%
Textiles	6.9%	6.0%
Manufactures	10.1%	13.5%
Total	11.1%	14.2%

Notes: Patenting rates measure the share of exhibits that are patented. For Britain, innovations with patents are identified as exhibits whose description in the *Official Catalogue* (1851) refers to at least one patent. For the United States, innovations are matched with lists of all patents reported in the *Annual Report of the United States Patent Office* between 1841 and 1851.

Comparisons of American and British patenting rates reveal remarkable similarities in patenting behavior, despite important differences between the American and the British patent laws. Although the upfront costs of patenting were extremely high in Britain, at the equivalent of 37,000 current U.S. dollars (Lerner, 2000) but modest in the United States (at 618 U.S. dollars), the share of innovations that were patented was similar in Britain and in the United States: 11.1 percent in Britain com-pared to only 14.2 percent in the United States (Table 2). Moreover, British and American inventors chose to patent (and not to patent) in the same industries. In Britain and the United States, innovations in machines, such as new types of engines, manufacturing machinery,and agricultural tools, were patented more frequently than innovations in any other industry. Table 2 shows that one-third of American innovations in engines, manufacturing machinery, and agricultural machinery were patented,c om-pared to one-seventh across all industries. In Britain, these same industries had the highest patenting rates, despite significant differences in patent laws. One-fifth of British innovations in these industries refer to patents, compared to less than one-ninth of British innovations economy wide. In contrast, inventors chose to patent between 3 and 10 percent of innovations in scientific instruments, food processing, chemicals, textiles, and mining.

These inter-industry differences in patenting are robust to quality adjustments. For 1,803 British innovations that received awards for inventiveness, the proportion of patent holders is only slightly higher than in the overall population of British innovations: approximately 14 percent of British award-winners refer to patents, compared to 11.1 percent of all British innovations. Moreover, the patenting behavior of award-winning innovations corroborates the patterns of cross-industry variations in the over-all data, as patenting rates are close to 20 per-cent for machinery, but significantly lower in other industries, such as instruments, chemicals, and food processing.

Aggregating the data into larger industry classes may lead to underestimating inter-industry differences in the propensity to patent. The industry class "textiles," for example, includes dye stuffs innovations, which were extremely difficult to reverse-engineer and therefore less dependent on patent protection, along with advances in weaving and other types of innovations, which were copied with much greater ease. Similarly, the class "instruments" includes telegraphs and improvements to the pianoforte which were easy to imitate, along with optical and scientific instruments, which could be protected by secrecy. Half of all telegraphs are patented, compared to 14 of 101 British inventions in optical instruments and watches.

Contemporary industry reports and letters from inventors attest to the importance of alter-native mechanisms to protect innovations, especially in instruments and food processing.7 Eugene Jaquet and Alfred Chapuis (1945) relate many instances when Swiss watchmakers went through great trouble to keep new production processes secret. For example:

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7 The analysis concentrates on secrecy, which appears to be the most important alternative mechanism, but it could be easily extended to include others, such as lead time or complementary assets. The central issue is that alternatives to patent laws exist, and their effectiveness relative to patents varies across industries.

"Many of Geneva's watchmakers- Lovousy, Latard, Boureaux, Geneqund, Girod, Bagan, Boinche, to name a few-employed their own inventions of new tools, which they did not allow anybody to see. Nobody was permitted to enter their workroom, not even those who brought work to them."8

Another group of watchmakers in the Valle6 de Joux, who shared the secret of the "sonnerie des minutes," measuring minutes, entered into a verbal agreement not to take any apprentices in order to protect their intellectual property. They succeeded in honoring this agreement from 1823 to 1840 (see Jaquet and Chapuis, 1945, p. 165). Watchmaking may have been especially suitable to secrecy because innovations were difficult to imitate. For example, the German Commission reports that Dutch and Swiss inventions in optical instruments, such as the rectangular prisms of Swiss glassmaker T. Daguet of Soleure, or Danish barometers and surgical instruments, proved impossible to reverse-engineer (Bericht I, 1852, pp. 813, 819, 930, 941).

In food processing, the history of margarine illustrates the effectiveness of secrecy relative to patents. Although margarine was first in-vented and patented in France, it turned profit-able in the Netherlands, at a time when the country did not have patent laws. Two Dutch firms, Jurgens and van den Bergh, began to manufacture margarine in 1871, after the original patent holder, a French chemist by the name Mbge Mouribs, freely told them how to produce margarine from suet, considering margarine protected by his patent. Trade secrets protected future improvements: when the van den Bergh factory developed a new and less repulsive type of margarine, they kept this innovation secret. As late as 1905, long after the original patent would have expired, the Jurgens firm had not succeeded in reverse engineering by chemical analysis or by hiring away its rival's workers (Schiff, 1971).

In sum, Moser (2004) documents that the effectiveness of patent protection varies across industries. Therefore, if innovation is motivated by expected profits, inventors in countries with-out patents should focus on industries with low patenting rates and strong alternative mechanisms. The following section uses exhibition data to test this hypothesis.

III. Empirical Tests with Exhibition Data

This section uses data on exhibits for two years (1851 and 1876) and 13 countries (Austria, Bavaria, Belgium, Britain, Denmark, France, the Netherlands, Norway, Sweden, Prussia, Saxony, Switzerland, and Wiirttem-berg) to examine the relationship between patent laws and the direction of technical change.9 Together, these countries contribute 10,792 exhibits at the Crystal Palace and 4,143 at the Centennial Exhibition. Although this adds to a total of almost fifteen thousand observed innovations, all variation occurs at the level of countries and industries, which effectively reduces the number of observations to the number of countries times the number of industries. With 12 countries in 1851, 10 countries in 1876, and 7 industry categories, the analyses are based on 154 observations of exhibits per year, country, and industry. Although exhibition data would be available for almost all nineteenth-century countries, including the United States, Russia, China, and Japan (countries for which exhibition data are the only source of data on innovation), I focus the analysis on Northern Europe, because the selection process for these countries is well documented, and differences in unobserved characteristics, such as climate, culture, and religious beliefs, are relatively small, whereas differences in patent laws are significant. 10

For states whose borders are comparable between 1850 and today, I use Lerner's (2000, 2002) data on patent laws. These data, constructed from inventors' manuals on patenting in foreign countries, proceed in 25- year intervals, which include 1850 and 1875. For states with border changes, such as pre-unification Germany, I obtain additional information from inventors' guides to inter-national patent laws by Godson (1840), John Kingsley and Joseph Pirsson (1848), and Coryton (1855). This adjustment is important because there was a large amount of variation in mid-nineteenth-century patent laws for countries that are unified today. Within Ger-many, patent lengths varied from 10 years in Wiirttemberg to 15 years, and "prolonged at pleasure" in Bavaria. At the same time, Wiirt-temberg's patent officers charged fees that were 20 times higher than those demanded by their Prussian counterparts.

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8 Jaquet and Chapuis (1945, p. 170), author's translation. See David Landes (1983) for further examples.

9 Table 3 summarizes data on patent length, size, GDP, and levels of education for these countries. An earlier version of this paper also examined the effects of patent laws on the number of innovations and included patent fees as an explanatory variable. Countries without patent laws brought large numbers of innovations to the fairs and received a disproportionate share of awards for high-quality innovations. For example, mid-nineteenth-century Switzerland had the second highest number of exhibits per capita in 1851.

10 Including data for the rest of the world strengthens the measured effects of patent laws, but these effects may be driven by largely unobservable differences across countries, such as geographic location and resource endowments.

TABLE 3—COUNTRY CHARACTERISTICS

	Patent length		Population		GDP		Primary education	
Country	1851	1876	1851	1876	1851	1876	1851	1876
Austria	15	15	3,950	4,730	6,563	9,395	389	426
Bavaria	15	—	4,521	—	6,673	—	—	—
Belgium	15	20	4,449	5,303	8,042	14,849	549	582
Britain	14	14	25,601	30,662	60,479	107,661	555	680
Denmark	0	5	1,499	1,973	2,549	4,008	—	—
France	15	15	36,350	38,221	60,685	84,014	515	737
Germany	—	15	—	24,023	—	—	—	732
Netherlands	15	0	3,095	3,822	5,844	52,805	541	639
Prussia	12	—	16,331	—	24,105	—	730	—
Saxony	12	—	1,894	—	2,796	—	—	—
Norway & Sweden	15	—	4,875	—	5,993	—	615	—
Norway	—	3	—	1,803	—	2,650	—	658
Sweden	—	3	—	4,363	—	8,006	—	568
Switzerland	0	0	2,379	2,750	1,986	5,787	—	759
Württemberg	10	—	1,745	—	2,575	—	—	—

Notes: Patent length measures the maximal duration of patent grants (Lerner, 2000; Coryton, 1855). Data on population and GDP (in million 1990 dollars) are drawn from Maddison (1995, 2001). Population data for Bavaria, Prussia, Saxony, and Württemberg from the *Annuaire statistique* (1916). Primary education is measured as the number of children in primary education per 1,000 persons between the age of 5 and 14 (Lindert, 2004).

The variable "patent length" is defined as the maximal duration of the patent that inventors can be granted at the time of application. For countries without patent laws, I record patent length to equal zero. Denmark, a country that offered only rudimentary protection to certain types of manufacturing processes, is recordeda s having patent length zero. Other countries with zero patent length are Switzerland, which did not adopt its patent laws until the twentieth century, and the Netherlands, after the abolition of patent laws in 1869 (Coryton, 1855, pp. 245, 260).11 Plots of the patent length variable reveal that patent length clusters around a few values rather than being continuous. To account for the discrete nature of these data, I divide patent length into three categories: no patents, short patents, and long patents. I follow studies of twentieth-century patent renewal data such as Ariel Pakes (1986), which chose ten years as the cutoff point to distinguish short and long patents. Two countries are without patent laws in both 1851 and 1876; one country has short patent grants in 1851, but three have short patents in 1876.

A.Tests for the Equality of Distributions

If patent laws influence the direction of innovation in a similar way to that proposed in Section II, the distribution of innovations across industries should differ across countries with widely divergent patent laws, and should be quite similar for countries with similar patent systems. Chi-square statistics in Table 4 con-firm that large differences exist in the distribution of exhibits across industries, especially among countries with dissimilar patent laws. For European countries with different patent lengths, the hypothesis that innovations are distributed equally across industries is strongly rejected. Table 4 also provides weaker evidence that countries with equal patent length are more similar to each other. Differences in distributions increase with increases in patent lengths. As Mark Schankerman and Pakes (1986) argue, the life cycle of innovations is much shorter than the statutory patent grant for all but a small minority of innovations. Consequently, for long patents, further increases in patent length exert little influence on innovation, whereas for short patents, increases in patent length appear to be much more important. In the Crystal Palace data, large differences in patent length are associated with large differences in the distribution of innovation, while for countries without patent laws, chi-square tests narrowly fail to reject the hypothesis (at 1-percent significance) that innovations are distributed identically across industries.

11 Switzerland adopted an earlier draft of patent laws in 1888, which Schiff (1971) calls "the most incomplete and selective patent law ever enacted in moderm times" (p. 93). For example, the law of 1888 offered no recourse to the courts, and therefore no means to defend patents, and it excluded all process innovations.

TABLE 4—CHI-SQUARE TEST OF THE HOMOGENEITY OF DISTRIBUTIONS

	1851		1876	
Industry categories	Seven	Ten	Seven	Ten
No patent protection	18.22	23.46	68.15	78.51
	(6)	(9)	(6)	(9)
Short and medium patent lives	89.16	91.09	55.70	67.59
	(12)	(18)	(12)	(18)
Patent length exceeds 12 years	768.83	802.68	237.27	265.91
	(54)	(36)	(24)	(36)
All countries	1349.99	1395.22	639.72	693.50
	(66)	(99)	(54)	(81)

Notes: The categorization into seven industries distinguishes innovations in mining, chemicals, food processing, machinery, instruments, textiles, and manufactures. For ten industries, machinery innovations are further separated into engines, manufacturing machinery, civil and military engineering, and agricultural machinery. Degrees of freedom are reported in parentheses.

Figure 1 reveals that the patentless countries share a strong focus on a narrow set of innovations. In 1851, one in four exhibits from both Switzerland and Denmark was a scientific instrument, such as an optical lens, an improved watch movement or a watch escapement, a barometer, or a theodolite. Twenty-seven percent of Switzerland's exhibits and 23 percent of Denmark's exhibits at the Crystal Palace were such instruments. At the same time, no other country, regardless of its level of industrialization, had a comparable share of innovations in this class, although instruments were among the key high-tech industries of the nineteenth century. For Britain, undoubtedly the most technologically advanced country of the mid-nineteenth century, only 8 percent of innovations occurred in instruments, a share that equals the mean and slightly exceeds the median of 6 percent across all countries. After Switzerland and Denmark, Bavaria, where patents lasted up to 15 years but were ill-enforced, had the third highest share: 14 percent of Bavaria's exhibits were in instruments.

This parallel focus of innovations is even more striking for two countries that differ so strongly in their natural endowments. Switzerland is land-locked, mountainous, and largely isolated, whereas Denmark is open, flat, and maritime. The following section presents discrete-choice regressions, which control for such non-patent characteristics that may affect the direction of technical change.

B. Discrete-Choice Regressions

The aim of this section is to assess the effect of patent laws on an innovator's choice between industries. Innovations are divided into seven distinct industry classes: mining, chemicals, food processing, machinery, scientific instruments, textiles, and manufacturing. This categorization, which I have described in the data section, removes the hierarchies among industry classes, so that the remaining, larger classes are unordered and mutually exclusive, i.e., each innovation can occur in only one class. Potential inventors choose simultaneously between industries; their choice may be influenced by patent laws, as well as by other characteristics of their work environment. Multinomial logit regressions, as introduced by Daniel McFadden (1974), provide the most natural approach to measure such effects.12

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12 Alternatively, I have fitted logit models separately for the six pairings of responses (omitting manufactures as the largest class). Parameter estimates obtained in separate fit-ting of logit models are less efficient than those obtained by simultaneously fitting the multinomial logit, especially when the probability of being classified in the omitted (baseline) category is small, but they are a useful check on the data, and results remain largely unchanged.

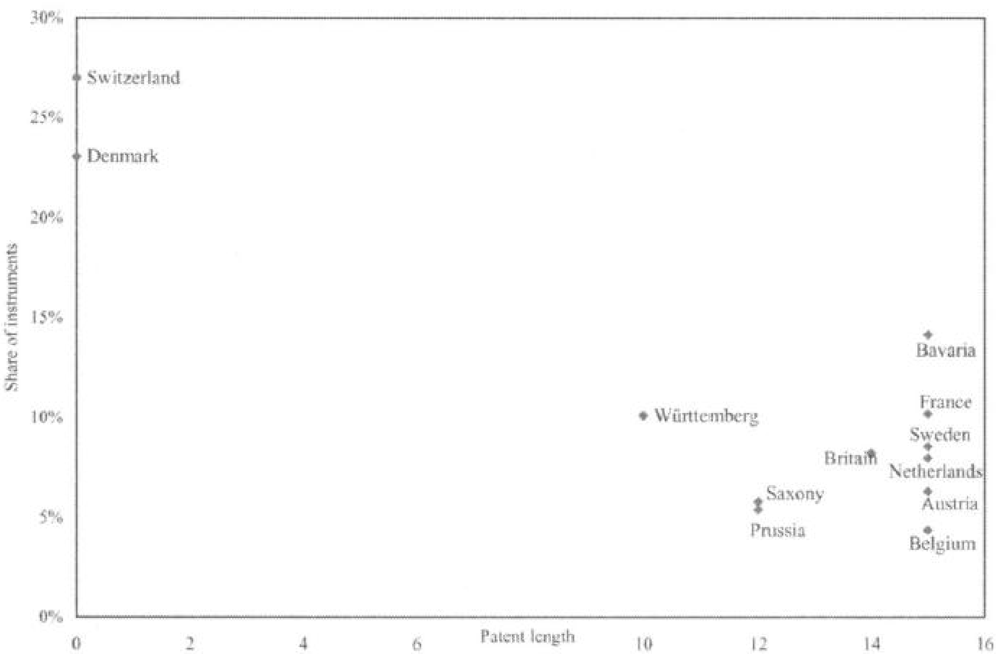

FIGURE 1. SHARES OF EXHIBITS IN SCIENTIFIC INSTRUMENTS AGAINST PATENT LENGTH IN 1851

Notes: "Share of exhibits in scientific instruments" measures the proportion of a country's exhibits that occurs in the industry class "scientific instruments." "Patent length" measures the maximum duration of a patent grant in 1851 as reported in Coryton (1855) and Lerner (2000).

Results in Table 5 confirm that patent laws have a strong influence on an inventor's choice of industry. The focus of inventive activity on instruments persists even when we control for country size, GDP per capita, and levels of education. Predicted values in Table 6 and Figure 2 demonstrate that 1 in 4 innovations from patentless countries are instruments, compared to 1 in 15 innovations from other countries (holding population and GDP per person constant).13 This strong positive effect is robust to changes in the specifications, to dropping Switzerland from the regressions (column IV), to dropping Britain, and to restricting the data to award-winners only.14

Textile innovations,p articularly of dye stuffs, also attracted is proportionates hares of inventors in the patentless countries. The variable "no patents" consistently exerts a positive and statistically significant effect on the share of textile innovation in countries without patent laws, even when omitting Switzerland. A closer examination of Swiss textiles at the Crystal Palace reveals that 20 percent of Switzerland's innovations were related to dyes. Turkey red, heavily dependent on specialized knowledge and widely regarded as the most complex dyeing process ever invented, was most prominent among Swiss innovations in dyes.'5 Similarly, predicted shares in another secrecy industry, food processing, are 13.5 percent for countries without patent laws, but only 9 percent for countries with patent laws.

In contrast, inventors in patentless countries are less likely to focus on machinery innovations that depend on patenting. Predicted shares for machinery are 11.4 percent for countries with patents and only 8.8 percent for countries

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13 Predicted values are calculated as Iri(xij) = exp(ai + jiXj)/[exp(aOmining + -miningXj) + - - + exp(armanufactures + 3manufacturesXj)] from regressionsc ontrollingfo r GDP per person and the logarithm of population.

14 In the awards regressions, mining and chemicals are combined to increase the number of observations per cell.

15 The process involved thoroughly cleansing the yarn by boiling with alkali, steeping in rancid oil, soda, and sheep dung, mordanting with alum and sumac, dyeing in a batch of madder, ox blood, and chalk, and finally washing to brighten the color (Archive of the Society of Dyers and Colourists, http://www.sdc.org.uk).

TABLE 5—MULTINOMIAL LOGIT REGRESSIONS

	(1) 1851 and 1876	(2) 1851 and 1876	(3) 1851 only	(4) 1876 only	(5) 1851 and 1876	(6) (excl. Switzerland)
Mining						
No patent laws	−1.8171	−1.5864	−2.1358	−1.1898	−1.2505	−1.8636
	(0.4996)	(0.4058)	(0.7379)	(0.4971)	(0.4024)	(0.6289)
ln population	−0.4344	−0.2004	−0.2558	−0.2369	−0.0823	−0.4348
	(0.0575)	(0.0444)	(0.0697)	(0.0620)	(0.0388)	(0.0576)
GDP per person	0.6960	0.5682	1.0752	0.2117	—	0.6970
	(0.0931)	(0.0896)	(0.1566)	(0.1206)		(0.0931)
Education	0.0031	—	—	—	—	0.0031
	(0.0006)					(0.0006)
Crystal Palace	−0.0368	−0.4213	—	—	−0.4977	−0.0389
	(0.1048)	(0.0813)			(0.0793)	(0.1046)
Constant	−0.4759	−0.4307	−1.3793	0.6829	−0.3307	−0.4677
	(0.4299)	(0.3851)	(0.5522)	(0.5644)	(0.3787)	(0.4299)
Chemicals						
No patent laws	0.4573	0.2674	0.0441	0.4981	0.2916	0.4094
	(0.3272)	(0.2591)	(0.6315)	(0.3085)	(0.2528)	(0.3819)
ln population	0.0071	0.0265	0.0937	0.0091	0.0314	−0.0039
	(0.0701)	(0.0482)	(0.0899)	(0.0592)	(0.0457)	(0.0703)
GDP per person	0.0617	0.0252	−0.3926	0.0537	—	0.0578
	(0.1010)	(0.0971)	(0.1879)	(0.1116)		(0.1013)
Education	0.0010	—	—	—	—	0.0011
	(0.0007)					(0.0007)
Crystal Palace	−1.5264	−1.6426	—	—	−1.6442	−1.5101
	(0.1231)	(0.0897)			(0.0895)	(0.1232)
Constant	−1.7836	−1.2523	−2.7001	−1.1568	−1.2468	−1.7597
	(0.4924)	(0.4510)	(0.7981)	(0.5663)	(0.4485)	(0.4925)
Food processing						
No patent laws	1.6874	1.4607	0.4947	1.7711	1.1626	1.9918
	(0.2499)	(0.1805)	(0.4687)	(0.2334)	(0.1723)	(0.2813)
ln population	0.0297	0.0705	0.0724	0.0636	0.0035	−0.0252
	(0.0556)	(0.0393)	(0.0758)	(0.0486)	(0.0380)	(0.0552)
GDP per person	−0.4960	−0.5016	−0.7290	−0.5166	—	−0.5554
	(0.0949)	(0.0891)	(0.1658)	(0.1059)		(0.0975)
Education	0.0012	—	—	—	—	0.0020
	(0.0005)					(0.0005)
Crystal Palace	−1.7268	−1.9538	—	—	−1.9380	−1.6327
	(0.1010)	(0.0771)			(0.0770)	(0.1002)
Constant	−0.5366	−0.0741	−1.5780	0.0132	−0.4469	−0.4228
	(0.4033)	(0.3706)	(0.6703)	(0.4701)	(0.3720)	(0.4037)
Machinery						
No patent laws	0.6709	0.5385	0.1055	0.8235	0.9710	0.3944
	(0.2565)	(0.1893)	(0.3073)	(0.2570)	(0.1850)	(0.3089)
ln population	0.0836	0.1890	0.2070	0.0803	0.3367	0.0869
	(0.0474)	(0.0380)	(0.0581)	(0.0532)	(0.0342)	(0.0476)
GDP per person	0.8619	0.8201	1.3817	0.3905	—	0.8644
	(0.0675)	(0.0654)	(0.1059)	(0.0909)		(0.0675)
Education	0.0016	—	—	—	—	0.0015
	(0.0005)					(0.0005)
Crystal Palace	0.1289	−0.0920	—	—	−0.2050	0.1239
	(0.0851)	(0.0622)			(0.0604)	(0.0853)
Constant	−4.3031	−4.1753	−5.6702	−2.1330	−3.7859	−4.3061
	(0.3986)	(0.3592)	(0.5251)	(0.5134)	(0.3443)	(0.3986)
Instruments						
No patent laws	2.4863	2.3773	2.2218	2.5962	2.3000	1.2958
	(0.2560)	(0.1733)	(0.2275)	(0.2677)	(0.1667)	(0.3687)
ln population	0.2778	0.2325	0.1878	0.2646	0.2099	0.3174
	(0.0557)	(0.0440)	(0.0580)	(0.0687)	(0.0418)	(0.0570)
GDP per person	−0.0976	−0.1420	0.0667	−0.4003	—	−0.0467
	(0.0860)	(0.0833)	(0.1118)	(0.1336)		(0.0858)

TABLE 5—Continued.

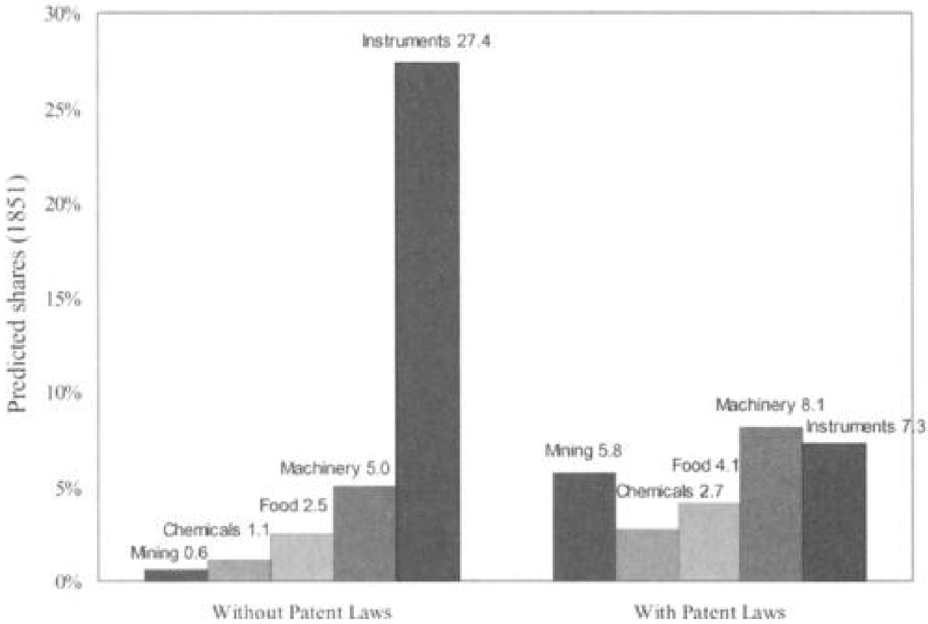
	(1) 1851 and 1876	(2) 1851 and 1876	(3) 1851 only	(4) 1876 only	(5) 1851 and 1876	(6) (excl. Switzerland)
Education	0.0002	—	—	—	—	−0.0004
	(0.0005)					(0.0005)
Crystal Palace	−0.1229	−0.0794	—	—	−0.0733	−0.2043
	(0.1017)	(0.0754)			(0.0753)	(0.1034)
Constant	−3.8866	−3.2276	−3.3038	−2.9822	−3.3033	−3.9462
	(0.4851)	(0.4169)	(0.5221)	(0.6853)	(0.4198)	(0.4852)
Textiles						
No patent laws	1.3350	1.1660	0.9741	1.3625	1.0243	0.7340
	(0.2194)	(0.1440)	(0.1881)	(0.2224)	(0.1397)	(0.2856)
ln population	−0.0342	−0.0216	−0.0132	−0.0208	−0.0677	−0.0282
	(0.0350)	(0.0272)	(0.0342)	(0.0453)	(0.0250)	(0.0351)
GDP per person	−0.1762	−0.2312	−0.3201	−0.0525	—	−0.1636
	(0.0603)	(0.0581)	(0.0737)	(0.0885)		(0.0603)
Education	0.0012	—	—	—	—	0.0011
	(0.0003)					(0.0003)
Crystal Palace	0.2214	0.0965	—	—	0.1117	0.2060
	(0.0670)	(0.0535)			(0.0534)	(0.0670)
Constant	−0.2653	0.5422	0.7365	0.1565	0.5077	−0.2648
	(0.2862)	(0.2446)	(0.2956)	(0.4323)	(0.2457)	(0.2861)
Exhibits	14,221	14,935	10,792	4,143	14,935	14,025
Countries	16	22	12	10	22	15

TABLE 6—PREDICTED VALUES

	1851 and 1876		1851 only		1876 only	
Patent laws	No	Yes	No	Yes	No	Yes
Mining	0.0101	0.0764	0.0062	0.0575	0.0133	0.0932
	(0.0023)	(0.0239)	(0.0014)	(0.0170)	(0.0008)	(0.0246)
Chemicals	0.0334	0.0554	0.0114	0.0274	0.0557	0.0935
	(0.0206)	(0.0350)	(0.0008)	(0.0034)	(0.0029)	(0.0039)
Food processing	0.1374	0.0904	0.0245	0.0406	0.2425	0.1553
	(0.0889)	(0.0665)	(0.0040)	(0.0081)	(0.0244)	(0.0346)
Machinery	0.0883	0.1139	0.0503	0.0810	0.1197	0.1388
	(0.0288)	(0.0622)	(0.0198)	(0.0524)	(0.0190)	(0.0414)
Instruments	0.2289	0.0685	0.2739	0.0730	0.1849	0.0611
	(0.0176)	(0.0171)	(0.0189)	(0.0128)	(0.0067)	(0.0201)
Textiles	0.3764	0.2988	0.4619	0.3783	0.2965	0.2134
	(0.0943)	(0.0797)	(0.0364)	(0.0459)	(0.0053)	(0.0110)
Manufactures	0.1255	0.2965	0.1718	0.3422	0.0874	0.2448
	(0.0168)	(0.0463)	(0.0012)	(0.0132)	(0.0031)	(0.0047)

Notes: Predicted values are calculated as $\pi_i(x_{ij}) = \exp(\alpha_i + \beta_i x_j)/[\exp(\alpha_{\text{mining}} + \beta_{\text{mining}} x_j) + \cdots + \exp(\alpha_{\text{manufactures}} + \beta_{\text{manufactures}} x_j)]$ from multinomial regressions that control for the logarithm of population, GDP per capita, and time (Table 7, columns 2, 3, and 4).

without patents. While this gap is relatively small, especially considering the pronounced importance of patenting for machinery, it is economically significant when considering other aspects of the data. A closer look at Switzerland's innovations, for example, reveals a strong difference in the composition of innovations within the machinery class relative to countries that have patent laws. British and American innovations concentrate on engines and manufacturing machinery, which are strongly dependent on patent protection, while Swiss inventors focus on innovations that tend not to be patented even in the British and American data.Tools for skilled manufacture, such as J. Erbrau's "turning, pivoting, and depthening tools" (exhibit 4), hunting rifles, such as J. Van-nod's "improved fowling piece" (exhibit 69), and agricultural tools, including J. A. Faessler's "milk tubs" (exhibit 229), are most frequent among Swiss inventors. These innovations are not patented. In contrast, innovations in manufacturing machinery and engines are extremely rare in the Swiss data.



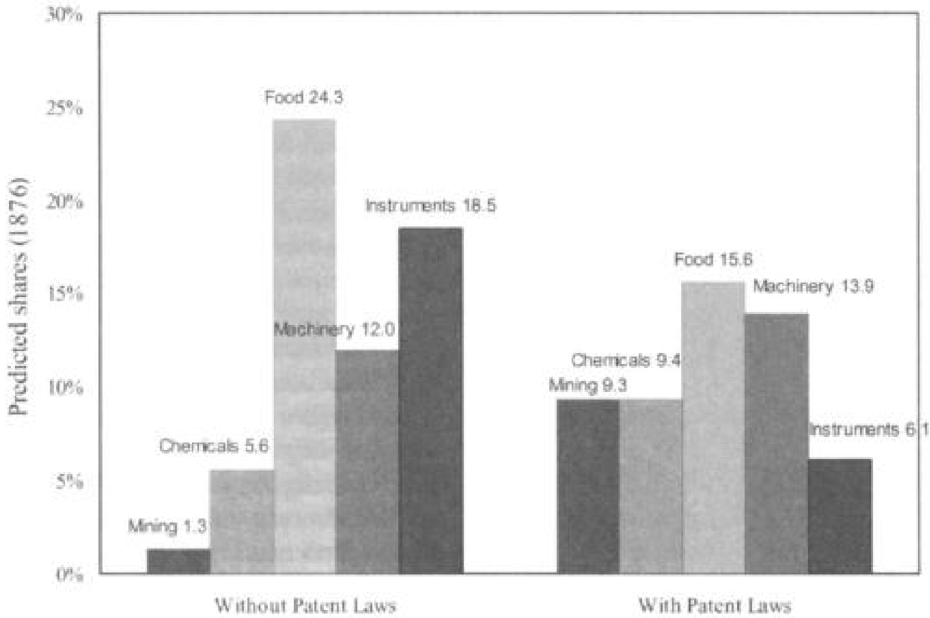


FIGURE 2. PREDICTED INDUSTRY SHARES, 1851 AND 1876

Notes: Predicted values are calculated as $\pi_i(x_{ij}) = \exp(\alpha_i + \beta_i x_j)/\Sigma \exp(\alpha_i + \beta_i x_j)$ from multinomial regressions that control for the logarithm of population and GDP per person (Table 5).

For mining innovations, the lack of deposits of iron and coal, not surprisingly, outweighs the influence of patents. Mining innovations have among the lowest patenting rates, and they may therefore serve as a haven to inventors in countries without patent laws. However, Switzerland, Denmark, and the Netherlands all lack significant endowments in iron ore and high-quality coal, which would have made such innovations possible (Schiff, 1971, p. 35).

Resource wealth also plays a key role in determining the feasibility of chemical innovations, especially at the earlier exhibition. Ideally, the regressions would control for such endowments, but there are no systematic data for the nineteenth century. Instead, I verify that including these resource-intensive industries does not distort effects on other variables. As transportation costs decrease, the negative coefficient of mining weakens for countries without patent laws.

Education, population, and GDP per capita are other important influences on the distribution of innovative activity across industries. The effects of education are intuitive; countries that invest more in education also have larger shares of their innovations in nineteenth-century high-tech industries, chemicals, and scientific instruments, which were at the vanguard of technological progress in the nineteenth century (Mokyr, 2002). Size, as measured by population, may allow large economies to develop innovative capacity in sectors where inventive activity depends on large scale to be profitable (Schmookler, 1966). Large markets for innovations, proxied by GDP per capita, may create opportunities for specialization and knowledge spillovers among competing firms (Sokoloff, 1988; Michael Kremer, 1993).

Table 6 and Figure 2 also suggest that the effects of patent laws change with the nature of technological progress. For example, the effects of patent laws on food become stronger as the industry evolves from methods of preservation in 1851 to methods of processing in 1876, including instant meals and mass-produced staple goods, such as margarine. In 1851, innovations in foodstuffs had shares of about 2 percent in countries without patent laws and 4 percent in other countries (columns 3 and 4). By 1876, the share of foodstuffs had risen to about one-quarter for countries without patent laws and to nearly 16 percent for countries with patent laws (columns 5 and 6). Many important innovations in food processing originated in late-nineteenth-century Switzerland, such as milk chocolate, liquid soup seasoning, bouillon, and baby food (see Schiff, 1971, pp. 54-58, 111-12).

At the same time, the focus on scientific instruments weakens between the exhibitions: in 1851, 27 percent of all exhibited innovations from patentless countries were in scientific instruments compared to 7 percent for other countries. In 1876 these shares dropped to 19 and 6 percent, respectively. This drop coincides with a shift from specialized skilled manufacture to mechanization and mass production, which relied heavily on progress in manufacturing machinery (Jaquet and Dupuis, 1945; David Landes, 1983). As the nature of innovation changes, leadershipi n instrument-making shifts from Switzerland, a country without patent laws, to the United States, which had adopted a strong patent system.

C. The Netherlands' Abolition of Patent Laws in 1869

Changes in patent laws between the Crystal Palace and Centennial exhibitions also help to address the problem that the direction of innovation may depend on unobserved country characteristics. While there are too few observations to calculate country-fixed effects, the Netherlands' decision to abandon patent laws creates a situation that resembles a natural experiment for examining the effects of patent laws. According to Penrose (1951), the central reason why the Netherlands abolished patent laws in 1869 was the ideological link between patents and protectionism; patent laws were at odds with the Netherlands' commitment to free trade. Innovation may have played only an indirect role in the decision, yet after the Netherlands abandoned patent laws in 1869 the country experienced a strong shift toward food processing, an industry where secrecy was important. The proportion of Dutch innovations in food processing increased from 11 to 37 percent between 1851 and 1876, replacing textiles as the most prominent sector (Figure 3). At a time when the focus of textiles innovation shifted from dyes to manufacturing machinery and mass production, the Netherlands' share of innovations in textiles fell from 37 to 20 percent. Equally, as mechanization and machinery became central to the manufacturing sector, the share of manufactures dropped from 26 to 12 percent. At the same time, the proportion of innovations in scientific instruments stayed constant at 8 percent, while other countries reduced their focus on that industry.

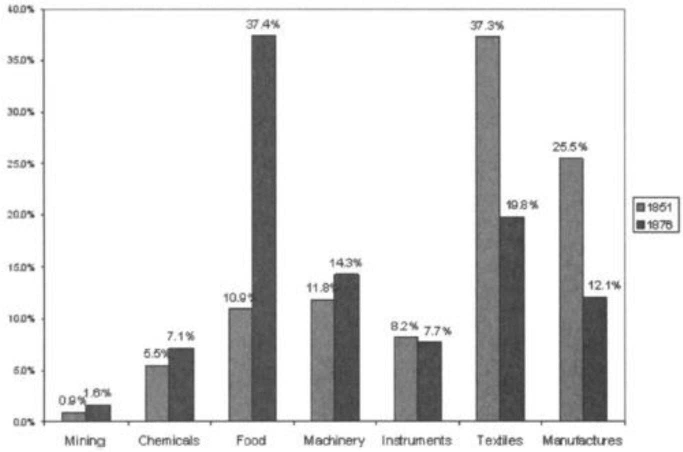


FIGURE 3. DUTCH INNOVATIONS ACROSS INDUSTRIES BEFORE AND AFTER THE ABOLITION OF PATENT LAWS IN 1869

Note: Calculated from entries in *Official Catalogue* (1851) and United States Centennial Commission (1876).

D. Constructing a Synthetic Switzerland with Patent Laws

Another way to address the possibility that preexisting factors influence the adoption of patent laws is to construct a synthetic country without patent laws from data for countries with patent laws that match the characteristics of patentless countries as closely as possible. Following Alberto Abadie and Javier Gardea-zabal (2003), I use a Mahalanobis matching estimator to construct this synthetic country.16 Abadie and Gardeazabal create a synthetic Basque region (without terrorism) from the characteristics of other Spanish regions to evaluate the effects of terrorism on GDP growth over time; I create a synthetic "Switzerland" with patent laws from the characteristics of other European countries as an additional check for the effects of patent laws on the distribution of innovations across industries.

The synthetic country is created by matching the characteristics of the real Switzerland and Denmark as closely as possible through a weighted average of the characteristics of other European countries with similar characteristics, but with patent laws. Let J be the number of available control countries with patent laws and let W be a (J X 1) vector of non-negative weights (w1, w, ... wj)' that sum to one. The scalar wj represents the weight that country j is given in constructing the synthetic Switzerland. Let X, be a (K x 2) vector of population, GDP per person, and education in Switzerland and Denmark as re-ported in Table 3, and let X0 be a (K X J) matrix of the values for these same variables in the set of possible control countries. Let the (K X K) matrix V be the inverse sample variance covariance matrix of the matching variables. This is the weighing matrix of the Mahalanobis matching estimator (Rubin, 1977; Rosenbaum and Rubin, 1983). The vector of weights W* is chosen to minimize (XI - WXo)'V(XI - WXo). Each country is allowed to be used as a match twice, equivalent to allowing one replacement.

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16 Abadie and Gardeazabal (2003) construct a weighing matrix to mimic the growth path of GDP in the Basque country. Similarly, Yi Qian (2004) uses the Mahalanobis estimator to examine the effects of a country's pharmaceutical patent policy on R&D expenditure in pharmaceuticals and on U.S. patents granted to residents of that country. See Abadie and Guido Imbens (2002) for a comprehensive discussion of the Mahalanobis estimator.

TABLE 7—MAHALANOBIS NEAREST NEIGHBOR MATCHING
(Treatment is "No Patent Laws"; Control variables are population in log form and GDP per person)

	ATE			ATT		
Data	1851	Awards in 1851	1876	1851	Awards in 1851	1876
Mining	−0.0379	−0.0366	−0.0662	0.0647	0.0911	−0.0422
	(0.0336)	(0.0509)	(0.0302)	(0.0110)	(0.0195)	(0.0107)
Chemicals	−0.0173	−0.0707	−0.0612	−0.0910	−0.1883	−0.0457
	(0.0216)	(0.0341)	(0.0210)	(0.0220)	(0.0287)	(0.0171)
Food processing	0.0310	0.0515	−0.0867	−0.0889	0.0197	0.0455
	(0.0484)	(0.0254)	(0.1668)	(0.0598)	(0.0272)	(0.1178)
Machinery	0.0590	−0.0506	−0.0449	0.0014	−0.0424	−0.0202
	(0.0615)	(0.0131)	(0.0241)	(0.0599)	(0.0158)	(0.0038)
Instruments	0.1696	0.2535	0.2524	0.1387	0.1329	0.1559
	(0.0200)	(0.0528)	(0.1092)	(0.0075)	(0.0421)	(0.0639)
Textiles	−0.0922	0.0340	0.1867	0.1887	0.4916	0.0237
	(0.1455)	(0.1762)	(0.1266)	(0.1901)	(0.2274)	(0.0888)
Manufactures	−0.1121	−0.1811	−0.1801	−0.2136	−0.5046	−0.1160
	(0.0640)	(0.1103)	(0.0427)	(0.0812)	(0.1295)	(0.0324)
N	12	12	10	12	12	10
N_1	2	2	2	2	2	2

Notes: ATE denotes the average treatment effect for both treated and control observations, and ATT denotes the treatment effect on the treated observations only. Matches are constructed with one replacement; $m = 2$, each observation is allowed to be used as a match two times. N_1 reports the number of observations that receive the treatment. Coefficients are bias-adjusted as discussed in Abadie and Imbens (2002).

Table 7 and Figure 4 report the results of this estimation, which lends further support to the hypothesis that the absence of patent laws helped to encourage a focus on secrecy industries in countries without patent laws. In a counterfactual Switzerland and Denmark with patent laws, the share of innovations that occurred in scientific instruments would have been between 14 and 25 percent lower than it was in the observed countries. Although the effects on food processing and machinery are not significant in the overall data, estimation on a subset of high-quality innovations, the award-winners in 1851, indicate a positive treatment effect on food processing and a negative effect on machinery (5 and -5 percent, respectively, in column II). In addition to reducing the share of machinery innovations, the absence of patent laws strongly reduced the proportion of manufacturing innovations, especially of high quality, as this manufacturing became increasingly dependent on innovations in machinery and mechanization. The results also indicate that the absence of patent laws increased the share of innovations in mining compared to a counter-factual country with patent laws (treatment effects on the treated, columns 4 and 5), lending further support to the hypothesis that patent laws exert a noticeable influence on the direction of innovation.

VI. Conclusions

This paper has introduced a new dataset on innovations at two nineteenth-century world's fairs, which allows an empirical examination of the effects of patent laws on the direction of technical change. The data have been constructed from the catalogues of the Crystal Pal-ace Exhibition in London in 1851 and the Centennial Exhibition in Philadelphia in 1876. Exhibition data indicate that patent laws influence the direction of innovative activity. In the nineteenth century, the absence of patent laws appears to have guided innovation toward industries where mechanisms other than patent laws protected intellectual property. Innovators in countries without patent laws concentrated in industries where secrecy was an effective alter-native to patent grants, such as scientific instruments, food processing, and dye stuffs, and countries without patent laws became techno-logical leaders in those industries. At the same time, inventors in the patentless countries tended to avoid innovations in manufacturing and other machinery, which were strongly dependent on patent protection, and the patentless countries lost their early lead in manufacturing industries as machinery and mechanization be-came more important.

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17 Allowing one replacement produces higher quality matches by increasing the number of possible matches.

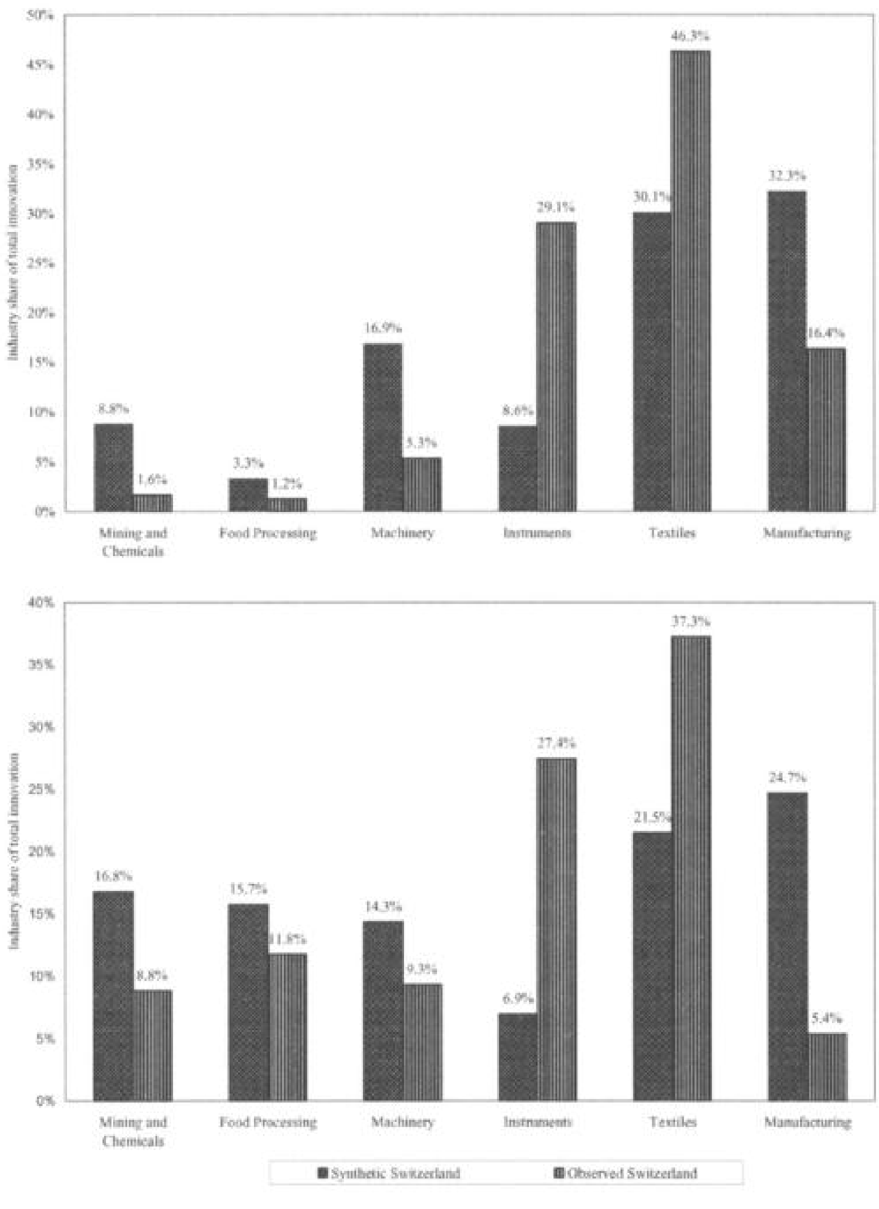

FIGURE 4. SYNTHETIC VERSUS OBSERVED SWITZERLAND, 1851 AND 1856

Notes: Industry shares for the synthetic "Switzerland" are calculated as a weighted average of countries with patent laws that are most similar to the patentless countries in each year. The matching method is Mahalanobis nearest neighbor (Rubin, 1977; Rosenbaum and Rubin, 1983; Abadie and Imbens, 2002).

This result may help to resolve a long-standing debate over the relative importance of demand and supply factors in determining the direction of innovation. Schmookler (1966) interpreted variations in the number of annual patents across a small number of industries as evidence of the importance of demand factors, while Rosenberg (1974) argued that an exogenous supply of scientific progress, and government policies encouraging such progress, played an equally important role. The availability of economy-wide international data on innovations has made it possible to examine the relationship between patent laws and the distribution of innovations across industries and across countries. Such data suggest that patent laws help to shape direction of innovation by influencing the incentives to invent across industries. Patent policies help to determine how inventors respond to differences in the demand for innovations across industries, and, to the extent that knowledge is cumulative, as Scotchmer (1991) and Mokyr (2002) suggest, they also help to determine the supply of knowledge.

These findings suggest an important consideration for international patent policies: the introduction of strong patent laws may trigger changes in the direction of innovative activity in developing countries and initiate significant changes in international patterns of comparative advantage. In the nineteenth century, a focus on manufacturing machinery allowed the United States to evolve from a backwater of Europe to the world's most technologically advanced and fastest growing economy. While the focus on machinery innovations has been explained by the scarcity of labor (Rothbarth, 1946; Habbakuk, 1962; Rosenberg, 1969), the results of this paper suggest that the decision to adopt strong patent laws at the beginning of the nineteenth century may have played an important role in encouraging the American focus on manufacturing machinery that spurred economic growth toward the end of the century.

Unlike the case of the nineteenth-century United States, the introduction of patent laws in developing countries today may slow rather than accelerate economic growth if patent laws lead them to compete more directly with innovations from developed countries. Alan Deardorff (1992) and Elhanan Helpman (1993) argue that patent laws that work well in industrialized countries may prove detrimental to developing economies. Strong patent laws benefit developing countries only if they encourage technologies that differ from those invented in developed countries (Ishac Diwan and Dani Rodrik, 1991). The results of the current paper, however, suggest that the introduction of uniform patent laws across the world may reduce rather than increase variation in the direction of innovation between the developing and developed world.

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Appropriating the Returns from Industrial Research and Development

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To HAVE the incentive to undertake research and development, a firm must be able to appropriate returns sufficient to make the investment worthwhile. The benefits consumers derive from an innovation, how- ever, are increased if competitors can imitate and improve on the innovation to ensure its availability on favorable terms. Patent law seeks to resolve this tension between incentives for innovation and widespread diffusion of benefits. A patent confers, in theory, perfect appropriability (monopoly of the invention) for a limited time in return for a public disclosure that ensures, again in theory, widespread diffusion of benefits when the patent expires.

We are grateful for the support of the National Science Foundation and especially to Rolf Piekarz of the NSF's Division of Policy Research and Analysis. We also wish to thank the 650 respondents to our survey and the R&D executives who helped us pretest it —-especially Ralph Gomory, Bruce Hannay, and Lowell Steele. Donald DeLuca, Wendy Horowitz, and other members of the Roper Center for Survey Research helped manage the survey. Robert W. Wilson, and Margaret Blair, Marc Chupka, Emily Lawrance, Constance Helfat, Andrew Joskow, Kathleen Rodenrys, Somi Seong, Andrea Shepard, and Hal Van Gieson also provided valuable assistance.

Previous investigations of the system suggest that patents do not always work in practice as they do in theory.1 On the one hand, appropriability is not perfect. Many patents can be circumvented; others provide little protection because of stringent legal requirements for proof that they are valid or that they are being infringed. On the other hand, public disclosure does not always ensure ultimate diffusion of an inven- tion on competitive terms. For example, investments to establish the brand name of a patented product may outlive the patent itself.2 And patents may not always be necessary. Studies of the aircraft and semiconductor industries have shown that gaining lead time and exploit- ing learning curve advantages are the primary methods of appropriating returns. Other studies have emphasized the importance of complemen- tary investments in marketing and customer service.3

Evidence on the nature and strength of conditions for appropriability and on the working of the patent system is, however, scattered and unsystematic. Because imperfect appropriability may lead to underin- vestment in new technology, and because technological progress is a primary source of economic growth, it would be useful to have a more comprehensive empirical understanding of appropriability, in particular, to identify those industries and technologies in which patents are effective in preventing competitive imitation of anew process or product. It would also be desirable to know where patents can be profitably licensed. Where patents are not effective, it would be useful to under- stand why they are not and whether other mechanisms are.

1.F. M. Scherer and others, Patents and the Corporation: A Report on Industrial Technology under Changing Public Policy, 2d ed. (privately published, 1959); and C. T. Taylor and Z. A. Silberston, The Economic Impact of the Patent System: A Study of the British Experience (Cambridge University Press, 1973).

2.See, for example, Meir Statman， "The Effect of Patent Expiration on the Market Position of

Drugs， ” in Robert B. Helms, ed., Dmgs and Health: Economic Issues and Policy Objectives (Washington, D.C.: American Enterprise Institute, 1981), pp. 140-51.

3.The importance of lead time and learning curve advantages is documented in Almarin Phillips, Technology and Market Stn (Lexington Books, 1971); and John E. Tilton, International Diffusion of Technology: The Case of Semiconductors (Brookings, 1971). For the importance of marketing and customer service, see Marie-Therese Flaherty ，“Field Research on the Link between Technological Innovation and Growth: Evidence from the International Semiconductor Industry，” working paper 84-83 (Harvard University, Graduate School of Business Administration, no date).

This paper describes the results of an inquiry into appropriability conditions in more than one hundred manufacturing industries. We discuss how this information has been and might be used to cast light on important issues in the economics of innovation and public policy. Our data, derived from a survey of high-level R&D executives, are informed opinions about an industry's technological and economic environment rather than quantitative measures of inputs and outputs.

Although our use of semantic scales to assess, for example, the effectiveness of alternative means of appropriation introduces considerable measurement error, more readily quantifiable proxies would probably not serve as well. Remarkable progress has been made toward developing a methodology to estimate the economic value of patents. 4 But suitable data are as yet unavailable in the United States, and European data lack sufficiently reliable detail to support inferences about interindustry differences in the value of patents. Ourjudgment was that asking knowledgeable respondents about the effectiveness of patents and alternative means of appropriation was at least as likely to produce useful answers as asking for quantitative estimates of the economic value of a typical patent.

We have taken considerable care to establish the robustness of our findings in the presence of possibly substantial measurement error, but ultimately the value of the data will depend on their contribution to better empirical understanding of technological change and more discriminating discussion of public policy. To view the empirical contribution of the data from the simplest perspective, consider their potential for improving the quality of research that uses patent counts to measure innovative activity.5 This hne of inquiry has shown, among other results, that industries vary significantly in the average number of patents generated by each dollar of R&D investment.6 Our findings on industry.

4.See, especially, Ariel Pakes，“Patents as Options: Some Estimates of the Value of Holding European Patent Stocks，” Econometrica, vol. 54 (July 1986), pp. 755-84.

5.For a summary of the best of this work, see Zvi Griliches, Ariel Pakes, and Bronwyn H. Hall，“The Value of Patents as Indicators oflnventive Activity ，” working paper 2083 (Cambridge, Mass.: National Bureau of Economic Research, November 1986). For other perspectives on the usefulness of patent data, see the special issue of Research Policy, vol. 16 (August 1987).

F. M. Scherer，“The Propensity to Patent ，” International Journal of Industrial Organization, vol. 1 (March 1983), pp. 107-28; and John Bound and others，“Who Does R&D and Who Patents?” in Zvi Griliches, ed., R&D, Patents and Productivity (University of Chicago Press for National Bureau of Economic Research, 1984), pp. 21-54.

More fundamentally, large and persistent interindustry differences in R&D investment and innovative performance have resisted satisfactory explanation, in part for lack of data that adequately represent the theoretically important concepts of appropriability and technological opportunity. Promising but ultimately unsatisfactory results have been obtained in exploratory work that used crude proxy variables and econometric ingenuity to capture the influence of appropriability and opportunity conditions.7 Our desire to provide a stronger basis for this line of inquiry was a prominent motive for our survey research and helped to shape its design.

Finally, gathering better information on the nature and strength of appropriability is particularly timely in view of the prominence of current debates on the adequacy of laws and institutions to protect intellectual property. One impetus for change has been the need to clarify and perhaps strengthen the system of property rights at various new frontiers of technology. Thus, for example, recent legislation has adapted copy- right law to protect the rights of the creator of new computer software, a new legal framework has been constructed to protect intellectual property embodied in semiconductor chip designs, and important court decisions and administrative actions have shaped the development of a property rights system in biotechnology. 8

Another spur to change has been the need to resolve conflicts between the aims of social regulation and the exercise of intellectual property rights. For example, the Drug Price Competition and Patent Term Restoration Act of 1984 extended patent lives of pharmaceuticals to compensate for regulatory requirements that delay the introduction of new drugs.

7.Richard C. Levin ，“Toward an Empirical Model of Schumpeterian Competition ，” working paper 43 (Yale University, School of Organization and Management, 1981); Richard C. Levin and Peter C. Reiss，“Tests of a Schumpeterian Model of R&D and Market Structure，” in Griliches, ed., R&D, Patents and Productivity, pp. 175-204; and Ariel Pakes and Mark Schankerman ，“An Exploration into the Determinants of Research Intensity ，” in Griliches, ed., R&D, Patents and Productivity, pp. 209-32.

8.See Computer Software Act of 1980; Semiconductor Chip Protection Act of 1984; Diamond v. Chakrabarty, 447 U.S. 305 (1980), holding that plant and animal life is patentable under U.S. patent law; and D. J. Quigg, memorandum of April 7, 1987, explaining the policies of the U.S. Patent and Trademark Office concerning applications to patent life forms.

Intellectual property rights also figure prominently among policy issues milling under the banner of competitiveness. Recent annual reports of the U.S. trade representative have focused on the difficulties U.S. manufacturers encounter in protecting intellectual property rights in foreign markets. The trade bill passed in 1987 by the House of Representatives contains several provisions that increase the scope of protection and the opportunities for relief available to U.S. manufacturers confronted with imports that infringe these rights.9 Proposed antitrust legislation, motivated by a concern that courts have kept inventors from reaping rewards that patent laws are intended to provide, stipulates that patent license agreements and similar contracts relating to use of intellectual property “shall not be deemed illegal per se under any of the antitrust laws." 10

To the extent that all this activity attempts to rectify obvious inade- quacies in existing institutions, the case for reform appears strong and straightforward. It is easy to deplore the blatant copying of innovative integrated circuit designs, the importation of “knock off ' copies of trademarked or patented U.S. products, and the piracy of copyrighted written matter and audio and video cassettes. But reforms may yield unintended consequences. In its simplest form, this concern translates into wariness about Trojan horses: provisions brought into the law by the rhetorical tug of "competitiveness " and "intellectual property " may harbor instruments of protectionism and price fixing. Other potential consequences are subtler but no less important. For example, seemingly uniform adjustments of intellectual property, antitrust, or trade law may affect some industries quite differently than others.

And it should not be taken for granted that more appropriability is better, that better protection necessarily leads to more innovation, which yields better economic performance-higher standards of living, better competitiveness, and soon. Better protection may yield more innovation at the cost of incrementally increasing resources devoted to producing theinnovation: the larger prize may merely encourage duplicative private effort to capture it.11 Alternatively, better protection may induce innovation of the wrong kind, or it may buy the innovation by further delaying access to it on competitive terms.12

9.See H.R. 3, the Omnibus Trade and Competitiveness Reform Act of 1987, which is currently under consideration by a House-Senate conference committee.

10.H.R. 557 and S. 438, 100 Cong., 1 sess.

11.This is the "free access" externality, first emphasized in the context of innovation in Yoram Barze! ，"Optimal Timing of Innovations ，" Review of Economics and Statistics. vol. 50 (1968), pp. 348-55. For a survey of the literature on patent races, see Jennifer Reinganum ，"The Timing of Innovation: Research, Development and Diffusion" in Richard Schmalensee and Robert Willig, ed., Handbook of Industrial Organization (North- Holland, 1988).

The premise that stronger protection will always improve the incentives to innovate is also open to challenge. Unimpeded diffusion of existing technology is immediately beneficial not only for consumers but also for those who would improve that technology. Because technological advance is often an interactive, cumulative process, strong protection of individual achievements may slow the general advance. This would not occur in a hypothetical world without transaction costs, in which efficient contracts to share information would be made. In reality, however, markets for rights to information are subject to major transactional hazards, and strong protection of a key innovation may preclude competitors from making socially beneficial innovations. The semiconductor industry of the 1950s and 1960s provides an excellent example of rapid progress in a cumulative technology that might have been impossible under a regime that strongly protected intellectual property .13

The remainder of this paper discusses our survey instrument, the construction of the sample, and the interpretation of the data, then turns to our findings concerning the effectiveness of patents and other means of appropriating the returns from R&D. The results of related work that employs the survey data to reexamine central questions in the empirical literature on R&D are summarized, and we discuss how our findings might contribute to a more discriminating discussion of patent law, antitrust law, and trade policy.

Questionnaire Design and Survey Methods

The content of our questionnaire was shaped with guidance from the conceptual literature on technological change, empirical literature on the economic impact of the patent system, the work of

Mansfield and his associates on imitation costs, and numerous case studies. 14 The questionnaire was aimed at high-level R&D managers with knowledge of both the relevant technology and market conditions. To check the interpret ability of the questions and the likely validity and reliability of the responses, we pretested the questionnaire with twelve managers representing diverse businesses .15

Richard R. Nelson ,“Assessing Private Enterprise: An Exegesis of Tangled Doctrine ,” Bell Journal of Economics, vol. 12 (Spring 1981), pp. 93-111; and William D. Nordhaus, Invention, Growth, and Welfare: A Theoretical Treatment of Technological Change (MIT Press, 1969).

13.Richard C. Levin,“The Semiconductor Industry ,” in Richard R. Nelson, ed., Government and Technical Progress: A Cross-Industry Analysis (Pergamon Press, 1982), pp. 9-100.

14.Among the sources of ideas for the questions are Paul Allan David, Technical Choice, Innovation and Economic Growth: Essays on Americun and British Experience in the Nineteenth Century (Cambridge University Press, 1975); Richard R. Nelson and Sidney G. Winter,“In Search of Useful Theory of Innovation ,” Research Policy, vol. 6 (Winter 1977), pp. 36-76; Nathan Rosenberg,“Science, Invention and Economic Growth ,” Economic Journal, vol. 84 (March 1974), pp. 90-108; and Devandra Saha!, Patterns of Technological Innovation (AddisonWesley, 1981). For empirical literature on the economic effects of the patent system, see Scherer and others, Patents and the Corporation; and Taylor and Silberston, The Economic Impact of the Patent System. For imitation costs, see Edwin Mansfield, Mark Schwartz, and Samuel Wagner,“Imitation Costs and Patents: An Empirical Study ,” Economic Journal, vol. 91 (December 1981), pp. 907-18.

15. These managers had experience in communications equipment, industrial in organic chemicals, metal cutting machine tools, shoe machinery, household electrical appliances, processed foods, computing equipment, semiconductors, copper smelting and refining, radio and TV sets, and industrial organic chemicals. They were asked to complete the questionnaire for a specific line of business, but to keep in mind the suitability of the questions for other lines of business with which they were familiar. After completing the questionnaire, they were interviewed facetoface or by telephone. Interviews typically lasted one-half hour or more, and each question was discussed to eliminate sources of ambiguity.

To understand how appropriability differs across industries, we asked each respondent to report typical experiences or central tendencies within a particular industry. Respondents were thus treated as informed observers of a line of business rather than as representatives of a single firm, an approach that encouraged cooperation (they were not placed in the position of possibly divulging practices or policies of their own firms), but led inevitably to heterogeneity in the responses within a given industry.

The questionnaire contained four parts. Parts 1 and 2 concerned appropriability; parts 3 and 4 concerned technological opportunity and technological advance. Questions in part 1asked about the effectiveness of alternative means of protecting the competitive advantages of R&D, limits on the effectiveness of patents, and ways of acquiring knowledge of a competitors' technology. Part 2 asked about the cost and time required to imitate innovations of rivals; we distinguished process from product innovations, major from typical, and patented from unpatented.16 Part 3 explored the links between an industry's technology and other sources of technological contribution. We asked about the importance of scientific research in general and university-based research in particular. We also asked about the extent to which inter industry spillovers are an important source of technological opportunity. Part 4 asked some broad questions about the pace and character of techno- logical advance.17 This paper analyzes responses to the questions in parts 1 and 2.18

SAMPLE CONSTRUCTION

As a sampling frame, we used the lines of business defined b the Federal Trade Commission. In the manufacturing sector, these chiefly correspond to four-digit SIC industries, although some are defined as groups of four-digit or even three-digit industries. The FTC lines provide the most disaggregated level at which data on R&D expenditures are available. An additional consideration was that F. M. Scherer' s technology flow matrix, which classifies patents by industry of origin and industry of use, was also constructed at this level of aggregation.19

Ultimately, we received responses from 650 individuals representing 130lines of business, with ten or more responses from eighteen industries and five to nine from twenty-seven industries. The sample was reasonably representative of firms performing R&D, though the exclusion of those without publicly traded securities undoubtedly means that small start-up ventures, important sources of innovation, were under represented. The number of respondents in a line of business was positively correlated with the line's R&D spending, sales volume, and R&D intensity. The number of respondents did not increase in strict proportion to the level of industry R&D or sales, but the rate of response within a line of business was not significantly correlated with industry R&D spending, sales, or R&D intensity. The Appendix presents further details of sample construction.

16.The questions were similar to those in Mansfield, Schwartz, and Wagner ，“Imitation Costs and Patents ，” but covered typical rather than specific innovations. Our industry sample was also broader.

17.One objective was to examine "natural trajectories ” of the sort described in Nelson and Winter，“In Search of Useful Theory ，” p. 56.

18.Data from responses to questions in parts 3 and 4 have been used in Richard C. Levin, Wesley M. Cohen, and David C. Mowery ，“R&D Appropriability, Opportunity, and Market Structure: New Evidence on Some Schumpeterian Hypotheses ，” American Economic Review, vol. 75 (May 1985, Papers and Proceedings, 1984), pp. 20-24; Cohen, Levin, and Mowery ，“Firm Size and R&D Intensity: A Re-examination ，” Journal of Industrial Economics, vol. 35 (June 1987), pp. 543-65; and Richard C. Levin and Peter C. Reiss ，“Cost-Reducing and Demand-Creating R&D with Spillovers” （Stanford University, Graduate School of Business, 1986). See Richard R. Nelson ，“Institutions Supporting Technical Advance in Industry ，” American Economic Review, vol. 76 (May 1986, Papers and Proceedings, 1985), pp. 186-89, for findings on the importance of external sources of technological knowledge.

F. M. Scherer ，“Inter-industry Technology Flows in the United States'，，Research Policy, vol. 11 (August 1982), pp. 227-45.

METHODOLOGICAL ISSUES

Given our interest in identifying differences in the appropriability of R&D, it is reassuring that analysis of variance confirmed the presence of significant inter industry variation in the responses to most questionnaire items.20 There was, however, also substantial intraindustry variation in the responses. There are several potential sources of intraindustry heterogeneity in the responses to any given question. First, the lines of business as defined by the FTC may be objectively heterogeneous in their products and technologies. For example, if two firms classified as manufacturers of industrial inorganic chemicals produce different products using different technologies, they might differ markedly in their perception of the effectiveness of patents or the time required for imitation in their "industry.” To eliminate this source of heterogeneity, we asked respondents to identify two major innovations-a process and a product- within their industries during the past ten to fifteen years. For most industries with ten or more respondents, more than half the respondents agreed on at least one such innovation. We thus believe it unlikely that overly aggregated industry definition was a major source of intraindustry heterogeneity. 21

20.Interindustry differences are significant at the 0.05 level for approximately 60 percent of the questions in parts I and 2 of the questionnaire. Ifa higherlevel ofaggregation is used to measure industry effects, such as the level at which the National Science Foundation reports R&D spending (a hybrid of two- and three- digit level industries), interindustry differences are significant at the 0.05 level for 70 percent of the questions.

21.Heterogeneity, as anthropologists have long insisted，is，however, in the eye of the beholder. One R&D manager, asked to inform us about the air and gas compressor industry, inquired whether we were interested in large, medmm, or small compressors. In his view the technologies were fundamentally different. We asked him to note on his questionnaire where the answers to our questions differed across these size categories. The booklet he returned contained no such notation.

A respondent’ sperception of the central tendencies within an industry may also be affected by his firm’ s policies or strategies. Respondents in the same line of business may thus have different perceptions of the common technological environment that they were asked to characterize. A two-way analysis of variance of the responses on the effectiveness of patents, for example, revealed that both firm and industry effects are statistically significant. A representative multi-industry firm, however, tends to be involved in technologically related industries, and thus what appear to be effects attributable to the firm in the data may simply reflect the correlation in responses from related industries.

The third, and probably most important, source of intraindustry heterogeneity is the inherently subjective nature of the semantic scales used in the survey. Most answers were reported on a seven-point Likert scale. The effectiveness of patents in preventing duplication was, for instance, evaluated on a scale ranging from “not at all effective" to "very effective.” There is no natural or objective anchor for such evaluative ratings. Individuals may perceive the same environment but simply use the scale differently. Some might systematically favor high scores; others might concentrate responses in the center of the scale; still others might frequently use extreme values.

The numerous techniques available to control for differences among respondents in means and variances generally require abandoning one or more dimensions along which the data might be informative. For example, we were interested in interindustry comparisons of answers to a single question; controlling for fixed effects among respondents would vitiate such comparisons, smce we expected a respondent ’s mean score over all questions to depend on his industry. Standardizing the variance of each respondent ’s answers raised similar problems: the distribution of “correct” responses was unknown and it almost certainly differed systematically among industries. Rather than impose an arbitrary standardization, therefore, we examined the results for each group of questions using a variety of techniques and perspectives to assess the robustness of our principal conclusions. There was undeniably much noise in the data, but several important signals were robust to alternative weightings of the observations, alternative partitions of the sample, and the use of alternative summary statistics.22

We sidestepped one methodological difficulty by treating ratings along a seven-point semantic continuum as if they were interval data. The data were, of course, more properly to be regarded as ordinal. It would have been straightforward to treat them as ordinal if we had been interested only in interindustry comparisons ofresponses to a single question. We also sought, however, to make comparisons among questions (for example, are patents more or less effective than secrecy in protecting process innovations from duplication?), and we therefore treated the data as if they were interval.23

One additional methodological concern was whether our level of industry aggregation was appropriate for the problems being studied. The FTC line-of-business level was chosen to facilitate merging the data with disaggregated R&D data and Scherer's classification of patents by industries of origin and use. Our analysis indicated, however, that most of the interesting interindustry distinctions among the 130 lines defined at the FTC level were robust to an aggregation of the data into the 25 industry groups used by the National Science Foundation in its annual survey of R&D spending and employment patterns.

Patents and Other Means of Appropriation

Table 1 shows the pattern of responses, based on a seven-point scale, to questions on the effectiveness of alternative means of capturing and protecting the competitive advantages of new or improved processes and products. The first two columns report the mean response for the entire sample of 650 respondents to each question, as well as the standard error of each estimated mean. These statistics, of course, give equal weight to each respondent and consequently weight each industry in proportion to its number of respondents. The overall pattern across questions, however, is robust to the use of alternative summary statistics, such as the mean of industry means or the median of industry means. This is apparent in columns 3 and 4, which summarize the distribution of industry mean responses to each question. Each pair of numbers represents the range of industry means from the upper bound of the lowest quintile to the lower bound of the highest quintile of industries: 20 percent of the 130 industries had mean responses at or below the bottom of the range indicated for each question, and 20 percent had mean responses at or above the top of the range. Mean responses for the remaining 60 percent (or 78 industries) fell within the reported range.

Table 1. Effectiveness of Alternative Means of Protecting the Competitive Advantages of New or Improved Processes and Products[a]

Method of appropriation	*Overall sample means*		*Distribution of industry means*[b]	
	Processes	*Products*	*Processes*	*Products*
Patents to prevent duplication	3.52 (0.06)	4.33 (0.07)	2.6–4.0[c]	3.0–5.0[c]
Patents to secure royalty income	3.31 (0.06)	3.75 (0.07)	2.3–4.0[c]	2.7–4.8[c]
Secrecy	4.31 (0.07)	3.57 (0.06)	3.3–5.0	2.7–4.1
Lead time	5.11 (0.05)	5.41 (0.05)	4.3–5.9[c]	4.8–6.0[c]
Moving quickly down the learning curve	5.02 (0.05)	5.09 (0.05)	4.5–5.7	4.4–5.8
Sales or service efforts	4.55 (0.07)	5.59 (0.05)	3.7–5.5	5.0–6.1

Source: Authors' calculations.
a. Range: 1 = not at all effective; 7 = very effective. Standard errors in parentheses.
b. From the upper bound of the lowest quintile of industries to the lower bound of the highest quintile.
c. Differences in means significant at the .01 level.

The picture is striking. For new processes (columns 1and 3， patents were generally rated the least effective of the mechanisms of appropriation: only 20 percent of the lines of business surveyed rated process patent effectiveness in excess of 4.0. Eighty percent scored the effectiveness of lead time and learning curve advantages on new processes in excess of 4.3. Secrecy, though not considered as effective as lead time and learning advantages, was still considered more effective than patents m protecting processes.

22.One notable consequence arising from the measurement error in the data was that industry mean responses from lines of business with only one or two respondents tended to be disproportionately located near the extremes of the distribution of mean responses to any given question. Most conclusions based on the full sample of 130 lines, and virtually all those emphasized in this paper, were replicated in the smaller sample of 75 lines that had more than two respondents.

23.We designed the questionnaire to ensure that cross 四 question comparisons would arise naturally in the minds of the respondents. The items were arranged in blocks, with each item in a block rated on the same semantic scale.

Patents for products were typically considered more effective than those for processes, and secrecy was considered less effective in protecting products than processes. Generally, lead time, learning curves, and sales or service efforts were regarded as substantially more effective than patents in protecting products. Eighty percent of the sample businesses rated the effectiveness of sales and service efforts above 5.0, but only 20 percent considered product patents this effective.24

The tendency to regard secrecy as more effective than process patents but less effective than product patents probably reflects the greater ease and desirability of maintaining secrecy about process technology. Firms may sometimes refrain from patenting processes to avoid disclosing either the fact or the details of an innovation.25 But firms have every incentive to advertise the advantages of new or improved products and to get them into the hands of customers, thereby facilitating direct observation of the product and the technology it embodies. Maintaining secrecy about product innovations is thus likely to be both difficult and undesirable.

Respondents also tended to regard patents to prevent duplication as more effective than patents to secure royalty income. This finding was consistent with the view that licensing arrangements 町 e beset with transactional difficulties.

Only 3 of 130 lines of business rated process patents higher than five on a seven-point scale of effectiveness in preventing duplication. Two of these were concrete and primary copper; the other had only a single respondent.26 Only 5 of 130 industries rated product patents to prevent duplication higher than six points. Two of these were singletons; the other three were drugs, pesticides, and industrial organic chemicals. Twenty other lines rated product patents between five and six. Of those with more than two responses, almost all fell neatly into chemical products (including inorganic chemicals, plastic materials, synthetic fibers, synthetic rubber, and glass) or relatively uncomplicated mechanical equipment (air and gas compressors, power-driven hand tools, and oilfield machinery). The only anomalies were roasted coffee and products of steel rolling and finishing mills.

24.This view of the efficacy of sales and service efforts is consistent with the emphasis given to investment in “cospecialized assets" as a means of appropriation in David J. Teece，“Pro 自 ting from Technological Innovation: Implications for Integration, Collaboration, Licensing and Public Policy ，” Research Policy, vol. 15 (December 1986), pp. 285-305.

25.See Ignatius Horstmann, Glenn M. MacDonald, and Alan Slivinski，“Patents as Information Transfer Mechanisms: To Patent or (Maybe) No to Patent ，” Journal of Political Economy, vol. 93 (October 1985), pp. 837-58, for a theoretical treatment of the issue.

26.To preserve confidentiality, we do not identify any industry in which there was only one response. Hereafter, we refer to such cases as singletons.

Table 2 shows additional industry-level detail 一 the mean rating given for the effectiveness of patents in preventing duplication in eighteen industries with ten or more respondents. These industries tend to be much more research-intensive than the sample average, yet the pattern of interindustry variation was similar to that in the full sample. Except for petroleum refining, product patents were considered more effective than process patents. Only four chemical industries (drugs, plastic materials, inorganic chemicals, and organic chemicals) and petroleum refining rated process patent effectiveness higher than four on a seven- point scale, and only these four chemical industries and steel mills rated product patents higher than five.27

The data on these eighteen most heavily sampled industries help to establish the robustness of our conclusion about the limited effectiveness of patents as a means of appropriation. In none did a majority of respondents rate patents-either to prevent duplication or to secure royalty income-as more effective than the most highly rated of the other four means of appropriating returns from new processes, although in drugs and petroleum refining a majority regarded process patents as at least the equal of the most effective alternative mechanism of appropriation. In only one industry, drugs, were product patents regarded by a majority of respondents as strictly more effective than other means of appropriation.28 In three other← organic chemicals, plastic materials, and steel mill products-most respondents rated patents as no less effective than the best alternative.

Table 2. Effectiveness of Process and Product Patents in Industries with Ten or More Survey Responses

	Process patents		*Product patents*	
Industry	*Mean*	*Standard error*	*Mean*	*Standard error*
Pulp, paper, and paperboard	2.6	0.3	3.3	0.4
Cosmetics	2.9	0.3	4.1	0.4
Inorganic chemicals	4.6	0.4	5.2	0.3
Organic chemicals	4.1	0.3	6.1	0.2
Drugs	4.9	0.3	6.5	0.1
Plastic materials	4.6	0.3	5.4	0.3
Plastic products	3.2	0.3	4.9	0.3
Petroleum refining	4.9	0.4	4.3	0.4
Steel mill products	3.5	0.7	5.1	0.6
Pumps and pumping equipment	3.2	0.4	4.4	0.5
Motors, generators, and controls	2.7	0.3	3.5	0.5
Computers	3.3	0.4	3.4	0.4
Communications equipment	3.1	0.3	3.6	0.3
Semiconductors	3.2	0.4	4.5	0.4
Motor vehicle parts	3.7	0.4	4.5	0.4
Aircraft and parts	3.1	0.5	3.8	0.4
Measuring devices	3.6	0.3	3.9	0.3
Medical instruments	3.2	0.4	4.7	0.4
Full sample	3.5	0.06	4.3	0.07

Source: Authors' calculations. Mean score on a scale of 1 to 7.

27.The same pattern appears when the survey data are aggregated up to the level (roughly two and one-half digit) at which the National Science Foundation reports detailed data on the extent and composition of research and development expenditures. Of the twenty-five industries into which the manufacturing sector is divided, only industrial chemicals, drugs, and petroleum refining rated process patents higher than four points, and only industrial chemicals and drugs rated product patents higher than five.

28.Our results were reinforced by Edwin Mansfield 's finding that among the twelve broadly defined industries he studied only in the drug industry were patents considered essential to developing and marketing most inventions. Chemicals was the only other industry that considered patents essential for as many as 30 percent of inventions. See "Patents and Innovation: An Empirical Study，" Management Science, vol. 32 (February 1986), pp. 173-81.

The exclusion from our sample of firms that offered no publicly traded securities may have biased our findings. For small, start-up ventures, patents may be a relatively effective means of appropriating R&D returns, in part because some other means, such as investment in complementary sales and service efforts, may not be feasible. The patents held by a small, technologically oriented firm may be its most marketable asset. Although our respondents were asked to describe the typical experience of firms in their industries, they may well have overlooked aspects of appropriability that are particularly relevant for new firms.

The most probable explanation for the robust finding that patents are particularly effective in chemical industries is that comparatively clear standards can be applied to assess a chemical patent 's validity and to defend against infringement. The uniqueness of a specific molecule is more easily demonstrated than the novelty of, for example, a new component of a complex electrical or mechanical system. Similarly, it is easy to determine whether an allegedly infringing molecule is physically identical to a patented molecule; it is more difficult to determine whether comparable components of two complex systems "do the same work in substantially the same way." To the extent that very simple mechanical inventions approximate molecules in their discreteness and easy differentiability, it is understandable that industries producing such machinery rank just after chemical industries in the perceived effectiveness of patent protection.

The perceived ineffectiveness of patents in most industries raises the question of why firms use them. Further work is needed here, but we offer some speculations informed by the comments of our pretest subjects and by several survey respondents at a conference we held to report preliminary findings. These executives identified two motives for patenting that have little connection with appropriating returns from in- vestment. One is to measure the performance of R&D employees, which is a significant problem because these workers are typically engaged in team production. Legal standards for identifying inventors on a patent application are, however, reasonably rigorous. The second motive is to gain access to certain foreign markets. Some developing countries require, as a condition of entry, that U.S. firms license technology to a host-country firm, and some patents are filed primarily to permit such licensing.29

29.Yet another motive discussed in the literature is to gain strategic advantage in negotiation. In the semiconductor industry, for instance, the cumulative nature of the technology makes it difficult to participate legally without access to the patents of numerous firms. In consequence, there is widespread cross-licensing. Established firms, however, rarely license a new entrant until it has established a significant position in the market. As a defense against infringement suits, a prudent new entrant will establish a patent portfolio of its own, thus compelling established firms to negotiate cross-license agreements. See Eric von Hippel， "Appropriability of Innovation Benefit as a Predictor of the Source of Innovation， " Research Policy, vol. 11 (January 1982), pp. 95-115; and Levin ， "Semicon-ductor Industry ， " pp. 80-81.

Conditions Affecting Appropriability

Thus far we have focused on the overall strength of various mechanisms of appropriation and on inter industry variations in the effectiveness of patents. The patterns of covariation in the responses, however, suggested that interindustry differences in conditions affecting appropriability might be summarized by alimited number of factors. Moreover, the clear indications that patents are effective in only a few industries suggested that it might be fruitful to classify industries into clusters distinguishable by a primary means of appropriation and perhaps by the overall ease of appropriating returns. Such clusters could prove useful in examining links between appropriability conditions and measures of R&D, innovation, and productivity growth.

Correlations among responses to questions on the effectiveness of alternative means of appropriation revealed some interesting patterns. 30 When patents effectively prevent competitors from duplicating processes and products, they tend also to be effective in securing royalty income. But neither form of effectiveness was strongly correlated with the effectiveness of other means of appropriation. For processes, there was a strong connection among three other mechanisms: lead time, learning curve advantages, and secrecy. For products, superior sales and service efforts were strongly linked to lead time and learning advantages, though not to secrecy.

The correlations suggested that the mechanisms of appropriation may be reduced to two dimensions: one associated with the use of patents, the other related to secrecy, lead time, and learning curve advantages. For product innovations, sales and service efforts may be involved in the second of these dimensions. We investigated this possibility by reducing the data to principal components and employing a variety of factor-analytic techniques. Principal factor analysis and several methods of rotation did little to alter the picture presented by the principal components, which are shown in table 3.31

Table 3. Principal Components Analysis of Methods of Appropriation

	Processes and products separately		*Processes and products together*	
Method of appropriation	*Coefficients of 1st principal component*	*Coefficients of 2d principal component*	*Coefficients of 1st principal component*	*Coefficients of 2d principal component*
New Processes				
Patents to prevent duplication	.04	.86	.01	.73
Patents to secure royalties	.12	.86	.08	.78
Secrecy	.59	−.12	.54	.04
Lead time	.84	−.09	.79	−.04
Moving down the learning curve	.84	−.05	.80	−.04
Sales and service efforts	.51	.11	.45	−.06
Cumulative variance explained	.34	.59	n.a.	n.a.
New Products				
Patents to prevent duplication	.06	.87	.06	.73
Patents to secure royalties	.06	.87	.07	.80
Secrecy	.51	.01	.51	.06
Lead time	.84	.00	.79	−.03
Moving down the learning curve	.84	−.07	.82	−.04
Sales and service efforts	.69	−.09	.62	−.11
Cumulative variance explained	.36	.61	.31	.50

Source: Authors' calculations.

30.Simple correlation coefficients were calculated using the individual respondent and industry mean responses as the units of observation. Correlations among industry means for the entire sample of 130 lines of business were qualitatively similar to those obtained when the sample was restricted to those with more than two responses. These and other correlation matrices discussed in this paper are available from the authors upon request.

The first two columns of the table show the weights associated with the first two principal components when the six questions relating to process appropriability are analyzed separately from the six questions relating to product appropriability. The next two columns report the results of a principal components analysis on the entire set of twelve questions. With both approaches, the first principal component gives near-zero weight to the two patent-related methods ofappropriation and heavy weight to the other mechanisms. The weighting is reversed for the second principal component. Thus the first two principal components (and, in the factor analysis, the first two factors) are readily interpreted, respectively, as nonpatent and patent-related dimensions of appropriability. Despite this clear interpretation, the data do not reduce very satisfactorily to just two dimensions. As table 3 indicates, when the process and product questions are analyzed separately, the first two components explain only 60 percent of the variance in the responses to six questions, and when the two sets of questions are combined, two components explain only 50 percent of the variance.

Table 4. Cluster Analysis of Mechanisms of Appropriation

	Cluster		
Method of appropriation	*1*	*2*	*3*
New Processes			
Number of industries	38	67	25
Mean score			
Patents to prevent duplication	3.1	3.0	4.7
Patents to secure royalties	2.9	2.9	4.8
Secrecy	2.8	4.6	4.7
Lead time	4.2	5.4	5.6
Learning curves	4.3	5.3	5.1
Superior sales or service	4.7	4.5	4.9
New Products			
Number of industries	20	68	42
Mean score			
Patents to prevent duplication	3.1	3.8	5.3
Patents to secure royalties	3.2	3.1	5.0
Secrecy	2.6	3.5	4.0
Lead time	4.0	5.6	5.7
Learning curves	4.2	5.3	5.2
Superior sales or service	5.2	5.7	5.6

Source: Authors' calculations.

31.The results reported in table 3 are based on a principal components analysis undertaken at the level of individual responses. An analysis at the level of industry mean responses produced similar results.

Our interpretation that the means of appropriation can be grouped into patent and nonpatent mechanisms was nonetheless reinforced by a cluster analysis that classified industries according to mean responses to the relevant questions. The best clustering results were achieved by dividing the industries into three groups, as shown in table 4. Industries assigned to cluster 1 tended to have relatively low scores for all mechanisms of appropriation. Sales and service effort was the most highly rated mechanism and w 邸 infact, regarded as reasonably effective in capturing returns from new products. Industries in cluster 2 rated lead time and learning curves as relatively effective, but not patents. Secrecy was important in appropriating process returns, and sales and service efforts complemented lead time and learning advantages for products. Only for cluster 3 were product and process patents deemed effective,but still the effectiveness of lead time and learning was no lower than for the industries in cluster 2. Those few industries in which patents were rated as more effective than other mechanisms were all in the third cluster.

The cluster analysis suggested that there was a group of industries in which no appropriation mechanism was particularly effective. As an alternative approach to identifying settings with low appropriability, we considered the maximum score an industry assigned to any of the six mechanisms on the questionnaire. Only 11 of the 130 failed to rate at least one means of appropriating returns from product innovation higher than five on the seven-point scale. The industries in this group with more than two responses were all drawn from the food products and metal- working sectors: milk, meat products, iron and steel foundries, boiler shops, and screw machine products (nuts, bolts, and screws). Many more industries (34 of 130) rated no means of appropriating process returns higher than five. This group contained all the industries (except milk) that ranked low on product appropriability but was otherwise a diverse lot. The heaviest concentration was in fabricated metals and machinery. But several chemical industries were also represented, including the three industries in which product patents were viewed as most effective-organic chemicals, pesticides, and drugs.

The urge to find patterns in the data should not be carried too far. The associations among mechanisms of appropriation revealed by the cor- relation, principal components, and cluster analyses are suggestive, but there is substantial heterogeneity in the underlying data. As noted, the first two principal components, though readily interpretable, explained an unsatisfactory fraction of the overall variance. A similar lack of good fit characterized the cluster analyses of process and product appropriability. Despite the fairly clear interpretation that could be given to each cluster, the variance within the clusters was almost twice that between clusters.

Limitations on Effectiveness of Patents

To understand why patent protection might be weak in some industries, we asked respondents to rate the importance of possible limitations on patent effectiveness. Table 5 summarizes the responses. The ability of competitors to “invent around" both process and product patents was rated higher than five on a seven-point scale of importance by 60 percent of the responding industries. Only one other constraint-the lack of ready patentabihty for new processes-was rated this important by more than 20 percent. Limitations on patents were generally considered more severe for processes than for products, which was consistent with our finding that product patents tend to be mere effective than process patents. In particular, the lack of patentability was more serious for processes than for products, and so was the disclosure of information through patent documents.32

Table 5. Limitations on Effectiveness of Patents for New or Improved Processes and Products[a]

Limitation	Overall sample means		Distribution of industry means[b]	
	Processes	*Products*	*Processes*	*Products*
New processes or products patentable	4.32 (0.07)	3.75 (0.07)	3.6–5.4[c]	2.8–4.8
Patents unlikely to be valid if challenged	4.18 (0.06)	3.92 (0.07)	3.5–5.0[c]	3.0–5.0[c]
Firms do not enforce patents	4.29 (0.06)	3.84 (0.07)	3.5–5.0[c]	3.0–4.8[c]
Competitors legally "invent around" patents	5.49 (0.05)	5.09 (0.06)	4.9–6.0	4.4–5.9[d]
Technology moving so fast that patents are irrelevant	3.40 (0.07)	3.34 (0.07)	2.0–4.3[d]	2.0–4.0[d]
Patent documents disclose too much information	4.19 (0.07)	3.65 (0.07)	3.2–5.0	2.8–4.5[c]
Licensing required by court decisions	2.96 (0.06)	2.79 (0.06)	2.0–3.8	2.0–3.3
Firms participate in cross-licensing agreements with competitors	3.08 (0.06)	2.93 (0.06)	2.2–3.9[d]	2.1–3.9[d]

Source: Authors' calculations.
a. Range: 1 = not an important limitation; 7 = very important limitation. Standard errors in parentheses.
b. From the upper bound of the lowest quintile of industries to the lower bound of the highest quintile.
c. Interindustry differences significant at the .10 level.
d. Interindustry differences significant at the .01 level.

32.Additional evidence of the internal consistency of the survey results was provided by the pattern of negative correlation between responses concerning limitations on patent effectiveness and responses concerning the effectiveness of patents. Using either individual respondents or industry means as the unit of observation, all such correlation coefficients were negative except in the case of compulsory licensing. Most correlations were significant at the .OJ level.

The responses concerning limits on patent effectiveness may illuminate and focus policy discussion. In recent years there has been considerable interest in making patent protection more effective. One initiative has been to make the legal requirements for a valid patent claim less stringent.33 Another has been to vacate court decrees that compel licensing. Our data identified industries in which stringent requirements for patent validity or compulsory licensing were perceived as important limitations on the usefulness of patents in appropriating returns.

Respondents from twenty-two lines of business, mostly in the food processing and fabricated metals sectors, considered the likely inability to withstand challenges io validity as significantly limiting the effectiveness of process patents (scoring the importance higher than five on a seven-point scale); for fourteen of these industries the mean response was six or higher on the scale. This group and the nineteen industries citing invalidity as a constraint on the effectiveness of product patents (again assigning a score higher than five) overlapped considerably. Further investigation would be required to determine just why these two sectors appear to have difficulty establishing valid claims. Perhaps because they are mature industries, opportunities may be limited or novelty may be difficult to achieve or simply difficult to prove.

Compulsory licensing was rarely judged a significant limit on the effectiveness of patents. Only one industry with one respondent rated this constraint higher than five on the scale for products, and only six cited compulsory licensing of process patents as of comparable importance. Two of these industries were not singletons-metal containers and electron tubes. Compulsory licensing decrees were thus perceived as important in only a small subset of the industries that F. M. Scherer indicated were subject to such decrees.34 The overall lack of impact from compulsory licensing requirements was consistent with Scherer's finding that they did not discourage R&D spending.

33.For example, P.L. 98-622, passed in 1984, modified the previous requirement that each coinventor listed in a patent application also had to be a coinventor on every claim of the patent. The new law allows inventors to apply jointly, even though they may not have physically worked together, made the same level of contribution, or contributed individually to the subject matter of each claim. For a thorough discussion, see Patrick Kelley, "Recent Changes in the Patent Law Which Affect Inventorship and the Ownership of Patents," unpublished manuscript (1985).

34.F. M. Scherer, The Economic Effects of Compulsory Patent Licensing (New York University, Graduate School of Business Administration, 1977).

The choice between obtaining a patent and maintaining secrecy may be influenced by the extent to which the disclosures made in the patent document facilitate inventing around the patent. Our data provided some support for this theory. The effectiveness of secrecy was positively correlated with the extent to which disclosures limited the effectiveness of patents. The link was stronger for product patents than for process patents. But patent disclosures represented a substantial limitation on the effectiveness of product patents for only 4 of the 130 industries (scoring as high as six on the scale), and only 16 regarded process disclosures as comparably important. In only one line of business of those with five or more respondents-metal cutting machine tools-did disclosures constrain so substantially the effectiveness of both process and product patents.

Channels of Information Spillover

To the extent that a rival can learn easily about an innovator's technology, the incentive to invest in R&D is attenuated. But to the extent that learning is easy, wasteful duplication or near duplication of R&D effort by rival firms may be avoided. Also, knowledge of an innovator's new technology may complement rival R&D effort by enhancing its productivity. Richard Nelson and Sidney Winter, Michael Spence, and Richard Levin and Peter C. Reiss have developed models that begin to disentangle these offsetting effects, called by Spence the incentive and efficiency effects of interfirm spillovers.35 A sharper characterization of interindustry differences in the nature and strength of the mechanisms by which firms learn about their competitors' technology should advance these modeling efforts.

Table6 summarizes the responses to questions about the effectiveness of alternative ways of learning. There is little difference between the pattern of responses for processes and for products, except that, as one would expect, reverse engineering is markedly more effective in yielding information about product technology. On average, independent R&D was rated as the most effective means of learning about rival technology.36 This may appear to be wasteful duplication, but it need not be. One pretest subject said that R&D effort devoted to determining what a competitor has done may have strong complementarities with a firm own research program in areas not directly imitative of the innovating competitor. Licensing was also rated, on average, an important way of gaining access to a rival's new technology.

Table 6. Effectiveness of Alternative Methods of Learning about New Processes and Products[a]

	Overall sample means		*Distribution of industry means*[b]	
Method of learning	*Processes*	*Products*	*Processes*	*Products*
Licensing technology	4.58 (0.07)	4.62 (0.07)	3.4–5.6[c]	3.5–5.5[c]
Patent disclosures	3.88 (0.05)	4.01 (0.06)	3.0–4.6[c]	3.0–4.8[c]
Publications or technical meetings	4.07 (0.05)	4.07 (0.05)	3.4–4.7	3.3–4.6[d]
Conversations with employees of innovating firm	3.64 (0.06)	3.64 (0.06)	2.9–4.7[d]	2.9–4.5[d]
Hiring R&D employees from innovating firm	4.02 (0.07)	4.08 (0.07)	2.7–5.0[c]	2.8–5.0[c]
Reverse engineering of product	4.07 (0.07)	4.83 (0.06)	3.0–5.0[c]	4.0–5.7[d]
Independent R&D	4.76 (0.06)	5.00 (0.05)	4.0–5.5	4.4–5.6[c]

Source: Authors' calculations.
a. Range: 1 = not at all effective; 7 = very effective. Standard errors in parentheses.
b. From the upper bound of the lowest quintile of industries to the lower bound of the highest quintile.
c. Interindustry differences in means significant at the .01 level.
d. Interindustry differences in means significant at the .05 level.

35.Richard R. Nelson and Sidney G. Winter ,‘' The Schumpeterian Tradeoff Revisited," American Economic Review, vol. 72 (March 1982), pp. 114-32; Michael Spence, "Cost Reduction, Competition, and Industry Performance," Econometrica, vol. 52 (January 1984), pp. 101-21; and Levm and Reiss, "Tests of a Schumpeterian Model, " and "Demand-Creating and Cost-Reducing R&D."

The correlations among individual and industry mean responses show that mechanisms relying on interpersonal communication (publications and technical meetings, informal conversations, and hiring away employees) are strongly intercorrelated. Learning through licensing technology is uncorrelated with nearly all other learning mechanisms except disclosure through patent documents. There are two possible interpretations of this last connection. Potential licensees may learn about the opportunity to license through patent documents, or the documents may prove useful in employing new technology once it is licensed. We cannot tell whether the "announcement" effect or the "complementary information" effect of disclosures predominates. 37

37.Wesley Cohen and Daniel Levinthal have studied the incentives to engage in R&D that is directed toward developing absorptive capacity, the ability to make use of technology developed by others. See "Innovation and Learning: The Two Faces of R&D" (Carnegie- Mellon University, Department of Social and Decision Sciences, March 1987).

The pattern of correlation suggested that there might be three or four clusters of industries, distinguished in turn by an emphasis on learning through licensing, interpersonal channels, and reverse engineering or independent R&D, or both. The results obtained from cluster analysis were not entirely satisfactory. 38 Nonetheless, table 7 presents the results of grouping the lines of business into three clusters on the basis of responses to the questions on channels of spillover.

For both new processes and products, the largest group of industries typically relied on licensing and independent R&D to learn about competitive technology. Interpersonal channels were relatively unim- porta 时， and reverse engineering was important for products. For both processes and products, there was a second cluster of industries in which interpersonal channels of spillover were most important. In the case of learning about new products, only ten industries were classified in this cluster, and in the case oflearning about new processes, other channels- independent R&D and reverse engineering-were nearly as valuable. For processes, a third cluster appeared to find all mechanisms of learning relatively unproductive. For products this group found all mechanisms moderately effective.

Cost and Time Required for Imitation

As part of our investigation we asked respondents to estimate typical costs and time required to duplicate several categories of innovations if they were developed by a competitor. For each category, respondents were asked to identify (within a range) the cost of duplication as a percentage of the innovator's R&D cost. Intervals measured in months or years were used to classify the time required. In light of evidence that there is a time-cost trade-off in certain industries, we asked respondents to estimate the cost and time required "to have a significant impact on the market." 39

Table 7. Cluster Analysis of Channels of Learning

	Cluster		
Learning mechanism	*1*	*2*	*3*
New Processes			
Number of industries	68	43	19
Mean score			
Licensing technology	5.0	4.3	2.5
Patent disclosures	4.0	4.0	3.2
Publications or technical meetings	3.8	4.6	3.9
Conversations with employees of innovating firm	3.2	4.8	3.0
Hiring R&D employees from innovating firm	3.7	5.1	2.4
Reverse engineering of product	3.8	4.6	4.0
Independent R&D	5.0	4.6	4.3
New products			
Number of industries	68	10	52
Mean score			
Licensing technology	4.7	2.5	4.5
Patent disclosures	3.9	2.9	4.3
Publications or technical meetings	3.7	5.1	4.3
Conversations with employees of innovating firm	3.0	4.6	4.5
Hiring R&D employees from innovating firm	3.2	4.4	4.9
Reverse engineering of product	4.7	3.0	5.2
Independent R&D	5.1	3.7	5.0

Source: Authors' calculations.

37.The correlations between the effectiveness of particular learning mechanisms and the effectiveness of alternative methods of appropriation are interesting and internally consistent. In particular, when patent protection is effective, learning tends to take place primarily through licensing and patent disclosures. The effectiveness of patents is essentially uncorrelated with the effectiveness of interpersonal channels of learning and of independent R&D, and it is negatively correlated with the effectiveness of reverse engineering.

38.With three clusters the ratio of variance among clusters to variance within clusters was low, but attempts to find more than three clusters were thwarted by the persistent appearance of clusters containing only one or two lines of business.

39.See Edwin Mansfield, Industrial Research and Technological Innovation: An Econometric Analysis (Norton, 1968), for evidence on the time-cost trade-off.

Tables 8 and 9 show frequency distributions of industry median responses.40 The dispersion of industry medians suggests substantial variations among industries in both the cost and time required to duplicate all categories of innovation. If, however, individual responses to the questions on cost are coded on a six-point interval scale, there is sufficient intraindustry variation to render interindustry differences insignificant at the 0.01 level. Interindustry differences in the time required for duplication are, by contrast, significant at the 0.01 level in every instance except the time required to duplicate a typical patented new process.

Table 8. Cost of Duplicating an Innovation as a Percentage of Innovator's R&D Cost, Frequency Distribution of Median Responses

Type of innovation	*Less than 25 percent*	*26 to 50 percent*	*51 to 75 percent*	*76 to 100 percent*	*More than 100 percent*	*Timely duplication not possible*
New process						
Major patented new process	1	5	19	66	26	10
Major unpatented new process	5	10	55	49	6	2
Typical patented new process	2	15	61	41	6	2
Typical unpatented new process	8	43	58	14	4	0
New product						
Major patented new product	1	4	17	63	30	12
Major unpatented new product	5	13	58	40	7	4
Typical patented new product	2	18	64	32	9	2
Typical unpatented new product	9	58	40	15	5	0

Source: Survey of 127 lines of business.

40.Qualitatively identical results and interpretations are obtained from frequency distributions of individual responses and from the distribution of industry means.

Several conclusions are apparent. First, duplicating major innovations tends to cost more and take longer than duplicating typical innovations. (In a sense, this confirms that respondents correctly interpreted the distinction between typical and major innovations.) Second, for a given category of innovation, the cost and time required to duplicate are distributed very similarly for products and processes. Products tend to be slightly cheaper and quicker to duplicate than processes, though this generalization does not hold for major patented innovations. Finally, patents tend to raise imitation costs and time for each category of innovation. These increases can be regarded as alternative indicators of the relative effectiveness of patents in different industries.

To explore this point further, we coded the individual responses to the imitation costs and time questions on a six-point interval scale, calculated the individual and industry mean increases in costs and time associated with the presence of patents, and correlated these, respectively, with individual and industry mean responses to our questions on the effectiveness of patents in preventing duplication. For each category of innovation, the reported effectiveness of patents was positively correlated with the increase in duplication costs and time associated with patents, although the correlations tended to be stronger for products than for processes. We also found some evidence, at the level of the individual respondent, that patent effectiveness was associated with the absolute level of duplication costs for patented processes and products. We found a much stronger association, however, between reported patent effectiveness and the amount of time required to duplicate both patented process and product innovations.

Table 9. Time Required to Duplicate an Innovation, Frequency Distribution of Median Responses

Type of innovation	*Less than 6 months*	*6 months to 1 year*	*1 to 3 years*	*3 to 5 years*	*More than 5 years*	*Timely duplication not possible*
New process						
Major patented new process	0	4	72	37	9	7
Major unpatented new process	2	20	84	17	2	4
Typical patented new process	0	40	73	13	0	3
Typical unpatented new process	8	66	47	6	1	1
New product						
Major patented new product	2	6	64	40	8	9
Major unpatented new product	3	22	89	12	1	2
Typical patented new product	5	39	72	6	4	3
Typical unpatented new product	18	67	39	4	1	0

Source: Survey of 129 lines of business.

These broad-brush patterns of association conceal some striking anomalies. For particular categories of innovation, at least two and as many as fourteen industries reported that patents actually reduced the costs or time required for duplication. A partial explanation is that a disproportionate number of these industries also reported that disclosure of information through patent documents was a significant limitation on patent effectiveness.

A second anomaly is that, despite the positive correlation between patent effectiveness and the costs of imitating patented products, in several industries patents were relatively ineffective and duplication costs were nonetheless very high, whether or not the innovation was patented. Among these were guided missiles and several types of industrial machinery (food products machinery, electric welding apparatus, and speed changers, drives, and gears). In these instances the relative complexity of the products presumably makes reverse engineering inherently costly despite relatively weak patent protection.

It is interesting to compare our findings with those of Edwin Mansfield, Mark Schwartz, and Samuel Wagner, who studied the effects of patents on imitation costs in three industries.41 They concluded that patents generally raised imitation costs by 30 percentage points in drugs, 20 points in chemicals, and 7 points in electronics. To render our data comparable, we evaluated each respondent 's answer at the mean of the relevant range and computed crude industry average imitation costs for each type of innovation 户 Our results were consistent with those of Mansfield, Schwartz, and Wagner. We found that patents raise imitation costs by 40 percentage points for both major and typical new drugs, by 30 points for major new chemical products, and by 25 points for typical chemical products. In electronics, our results differed somewhat for semiconductors, computers, and communications equipment, but the range was 7 to 15 percentage points for typical products and 7 to 10 for typical products.43

41.Mansfield, Schwartz, and Wagner , "Imitation Costs and Patents."

42.The ranges are shown in the headings of table 8. The fifth and sixth column headings are not readily quantified. To permit the comparison discussed in the text, we assigned these categories the values of 112.5 percent and 137.5 percent, respectively, thereby maintaining a constant spacing of 25 percentage points between each pair of categories.

43.Our results on the time required to duplicate a rival's new products or processes were also roughly consistent with recent findings of Edwin Man field. In all but one of the ten industries he surveyed, the median respondent indicated that six to twelve months usually elapsed before the nature and operation of a new product were known to a firm's rivals. Effective duplication, as we have defined it, should take as long or longer, and table 9 shows that it typically does. The median and modal industries require one to three years to duplicate a major innovation or a typical patented innovation. A typical unpatented innovation, however, is more often duplicated within six to twelve months. See "How Rapidly Does New Industrial Technology Leak Out？"Journal of Industrial Economics, vol. 34 (December 1985), pp. 217-24.

Although the costs and time required for duplication are related to the effectiveness of patents, they do not seem to be linked strongly to any other mechanism of appropriability. In particular, most imitation time and cost measures are uncorrelated with lead time and learning curve advantages, and where such correlations are statistically significant (at the level of the individual respondent), the correlation coefficient is invariably below .15. These results make sense. Lead time and learning advantages may permit appropriation of returns even when duplication is relatively quick and inexpensive. Effective patents, however, presumably require considerable time and expense to be invented around.

Finally, most of our respondents believed only a few firms were capable of duplicating new processes and products. As table 10 shows, the median and modal number of firms judged capable of duplicating a major process or product innovation was three to five. The median and modal number of firms regarded as capable of duplicating a typical process or product innovation was six to ten. The data revealed only the slightest tendency toward a smaller number of capable duplicators for processes than for products.

R&D and Innovation

In this section, we summarize how data derived from our survey have been employed to understand better the sources of interindustry differences in R&D spending and the rate of technological advance. In the first such effort Richard Levin, Wesley Cohen, and David Mowery used several survey-based measures to explain variations in the published Federal Trade Commission data on industry-level R&D spending as a percentage of sales.44 They also sought to explain interindustry differences in the rate at which new processes and new products were introduced during the 1970s, as reported by our survey respondents.45

44.The ratio of company financed R&D to sales (R&D intensity) varies considerably among industries defined at the FTC line-of-business level of aggregation. In the 1976 data used by Levin, Cohen, and Mowery, R&D intensity ranged from 0.08 percent to 8.5 percent; both the mean and standard deviation were 1.7 percent. See "R&D Appropriability, Opportunity, and Market Structure."

45.Respondents were asked to identify, on a seven-point Likert scale ranging from "very slowly" to "very rapidly," the rate at which new processes and products had been introduced in their industries since 1970. Industry mean responses were highly correlated with total factor productivity growth, and the plausibility of the responses was reinforced by the identity of the highest and lowest industries in the sample. Excluding singletons, the lines of business reporting the slowest rates of product introduction were concrete, cement, boiler shops, milk, gypsum, primary copper, grain mill products, and sawmills. Those reporting the most rapid rates of product introduction were electrical equipment for internal combustion engines, radio and TV sets, computers, semiconductors, communications equipment, photographic equipment and supplies, engineering and scientific instruments, and guided missiles. Levin, Cohen, and Mowery used as a dependent variable the average of each industry'sreported rates of process and product introduction.

Table 10. Number of Firms Capable of Duplicating an Innovation, Frequency Distribution of Median Responses

Type of innovation	*None*	*1 or 2*	*3 to 5*	*6 to 10*	*More than 10*
Major new or improved process	2	32	75	18	2
Typical new or improved process	1	7	41	58	22
Major new or improved product	2	25	73	25	4
Typical new or improved product	1	5	33	63	26

Source: Survey of 129 lines of business.

In a subsequent paper, Cohen, Levin, and Mowery studied the extent to which the same survey-based measures explained the powerful industry effects in the confidential FTC data on R&D intensity at the level of the business unit.46

46.Cohen, Levin, and Mowery ，“Firm Size and R&D Intensity.”

The first paper focused on the Schumpeterian hypothesis that R&D intensity and innovation rates are significantly influenced by the level of industry concentration. One common rationale for this hypothesis is that industry concentration enhances the potential for appropriation of R&D returns. A different view is that, in the long run, concentration tends to be a consequence of industry evolution in a regime of abundant technological opportunity and a high degree of uncertainty associated with investment in R&D. Both perspectives suggest that there is no simple, causal relationship between concentration per se and R&D. Concentration may be statistically significant in simple regression specifications because it reflects the influence of the unobserved appropriability and opportunity conditions that directly affect R&D spending and the rate of innovation.

In ordinary least squares and two-stage least squares specifications that included only the four-firm concentration ratio and its square as regressors, Levin, Cohen, and Mowery replicated with the industry-level FTC data the familiar inverted-CT relationship between concentration and R&D intensity, and they found a strong relationship of the same form between concentration and the rate of innovation.47 Adding two- digit industry fixed effects weakened slightly the effect of concentration on R&D, but the innovation-rate equation was unaffected.

The results changed dramatically with the addition of measures of appropriability and technological opportunity derived from the survey.48 Whether or not two-digit industry fixed effects were included, the coefficients on concentration and its square fell by an order of magnitude in the R&D equation, and the effect of concentration was no longer statistically significant at the .05 level in either the R&D intensity or the innovation-rate equation. The vector of survey-based opportunity variables was significant at the .05 level in all specifications, and the opportunity and appropriability variables were jointly significant. The appropriability variables, however, were not individually significant in the R&D equation, although the rate of innovation was positively related to the effectiveness of an industry’s most effective means of appropriation.49

The paper by Cohen, Levin, and Mowery used the disaggregated FTC data at the level of the business unit to investigate the Schumpeterian hypothesis linking size and R&D intensity. The authors found that when either fixed industry effects (at the level of the line of business) or survey- based industry characteristics were taken into account, firm size had a very small and statistically insignificant effect on R&D intensity. The size of the business unit did have a significant effect on the probability of engaging in R&D, but there was no perceptible tendency for R&D intensity to increase with size within the group of R&D performers. Size effects, however, explained only two-tenths of 1 percent of the variance in R&D intensity, while industry effects at the line-of-business level explained half this variance.

47.All coefficients in the R&D and innovation-rate equations were statistically significant at the .OJ level.

48.To represent appropriability conditions, Levin, Cohen, and Mowery used two survey-based measures: the maximum of the mean scores an industry’s respondents assigned to the effectiveness of the six methods of appropriation and the time required to duplicate effectively a patented major product innovation. To represent opportunity conditions, they used a measure of an industry 's closeness to science as well as variables summarizing the importance of four other external sources of knowledge for an industry's technological advance: material suppliers, equipment suppliers, users of the industry 's products, and government agencies and research labs.

49.It may seem anomalous that the effectiveness of appropriation was positively related to innovation but not to R&D, but the relationship was observed at the level of the industry. Better appropriability may discourage R&D directed toward imitation to an extent that more than compensates for its stimulus to innovative R&D. Such a reallocation of effort would be entirely consistent with the observed positive relationship between appropriability and the rate of innovation.

Cohen, Levin, and Mowery found that industry-level measures of appropriability, opportunity, and demand conditions were consistently significant in ordinary least squares, GLS, and Tobit regressions explaining business unit R&D intensity. Moreover, these industry characteristics explained approximately half the variance in R&D intensity explained by fixed industry effects. When attention was focused on those lines for which there were at least three survey respondents, measured industry characteristics explained 56 percent of the variation in R&D intensity among industries. Within particular two-digit industries (chemicals, machinery, and electrical equipment), measured characteristics explained 78 to 86 percent of the variance explained by fixed effects.

The results obtained in the two papers indicated that survey-based measures can contribute substantially to an explanation of interindustry differences in R&D intensity and innovative performance. Measures derived from the survey, despite their imperfections, have also been found useful for various other purposes.50

Remarks on Policy

Our findings suggested some general principles relevant to policies that affect the incentives to engage in innovative activity.

A first principle is that the patent system and related institutions to protect intellectual property should be understood as social structures that improve the appropriability of returns from innovation. They are not the only nor necessarily the primary barriers that prevent general access to what would otherwise be pure public goods. Lead time accrues naturally to the innovator, even in the absence of any deliberate effort to enhance its protective effect. Secrecy, learning advantages, and sales and service efforts can provide additional protection, though they require the innovator's deliberate effort. The survey confirmed that these other means of appropriation are typically more important than the patent system. Hence in examining a proposed adjustment of the patent system or related institutions, it is important to recognize that the incremental effect of the policy change depends on the protection other mechanisms provide.

50.Levin and Reiss have used survey-based measures of appropriability and opportunity in a simultaneous equation model of R&D spending and market structure that builds on their work in "Tests of a Schumpeterian Model." Cohen and Levinthal use survey- based variables in their work on R&D as investment in absorptive capacity; see "Innovation and Learning." lain Cockburn and Zvi Grihches are studying the usefulness of our survey measures in estimating the value of patents from stock market data; see "Industry Effects and Appropriability Measures in the Stock Market's Valuation of R&D and Patents，" American Economic Review (forthcoming, May 1988). Meryl Finkel ，"Overseas Research and Development by U.S. Multinationals: Ownership Structure Decisions" (Ph.D. dissertation, Harvard University, 1986), explored the effect of our appropriability variables on the investment decisions of multinational corporations. Franco Malerba is using the survey data to explain interindustry differences in the extent and effectiveness of learning mechanisms.

The survey results also confirmed substantial interindustry variation in the level of appropriability and in the mechanisms that provide it. From this follows our second major principle, which is that the incremental effects of policy changes should be assessed at the industry level. For example, in the aircraft industry, where other mechanisms provide considerable appropriability, lengthening the life of patents would tend to have little effect on incentives for innovation. In the drug industry the effect of a longer lifetime would matter more.51

Finally, improving the protection of intellectual property is not necessarily socially beneficial. Empirical work has so far indicated a positive cross-sectional relationship between strong appropriability, as measured by variables constructed from our survey, and innovative performance. But the social cost-benefit calculation is not straightforward. Stronger appropriability will not yield more innovation in all contexts and, where it does, innovation may come at excessive cost.

To illustrate how our survey results and general perspective might inform policy discussion, consider the 1987 proposal (S. 438, H.R. 557) that patent license agreements and other contracts relating to the use of intellectual property "shall not be deemed illegal per se under any of the antitrust laws." One consequence would be to eliminate the per se illegality of tie-in arrangements (those in which purchase of one product, the "tying product，" is dependent on purchase of other products) where the tying product is covered by a patent or otherwise protected as intellectual property. 52 Our findings have suggested some issues a court should consider in evaluating such a tying arrangement under the rule of reason.

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51. For a calculation of the impact of the Drug Price Competition and Patent Term Restoration Act of 1984, see Henry Grabowski and John Vernon ，"Longer Patents for Lower Imitation Barriers: The 1984 Drug Act ，"American Economic Review, vol. 76 (May1986, Papers and Proceedings, 1985), pp. 195-98.

When the rule of reason is applied to tying cases, a relevant consideration is the firm' s power in the market for the tying good. Courts have often presumed that intellectual property protection is itself evidence for such power. To the other good reasons for rejecting such a presumption,53 we add that the mere existence of a patent or other legal protection says nothing about its efficacy in a competitive context. As the survey results showed, the effectiveness of protection varies widely among industries. Thus in deciding a case, a court should inquire into the actual competitive significance of intellectual property protection in the particular market.

Suppose, for example, that a pharmaceutical company were to tie hospital sales of supplies or equipment to its sale of a patented drug. Since patent protection of drugs is generally strong and effective, and a drug is often uniquely suited for particular purposes, skepticism about the reasonableness of the tie-in would be in order. The arrangement could not plausibly be regarded as a straightforward means of appropriating returns to which the firm was entitled as owner of the patent. Given the typical effectiveness of drug patents, the price of the drug should suffice for that purpose. There might, of course, be benign explanations for the tie; for example, if the supplies or equipment were complementary to the use of the drug, the arrangement might be explicable as an attempt to control the quality of treatment. But if no such explanation were supported by the evidence, the tie would seem an unreasonable restraint of trade.

52.We focus on this particular consequence of the proposed legislation and set aside two major considerations regarding its merits in its present form. First, without amendment the legislation is likely to undercut severely the per se treatment of price fixing. Second, it might be more appropriate to consider eliminating per se treatment of all tying arrangements rather than just those involving intellectual property. On this point, see the concurring opinion in Jefferson Parish v. Hyde, 466 U.S. 2 (1984).

53.See E. W. Kitch ，“Patents: Monopolies or Property Rights ，” in John Palmer, ed., Research in Law and Economics: The Economics of Patents and Copyrights, vol. 8 (JAi Press, 1986), pp. 31-47; and the associated commentary of F. M. Scherer, p. 51. Digidyne Corp. v. Data General Corp., 743 F. 2d 1336 (9th Cir. 1984) is an example of an application of per se doctrine in a context where the intellectual property (software) does not convincingly convey market power.

By contrast, consider a producer of a patented product in an industry where no mechanism of appropriability functions particularly well- plywood, for example, where patents, secrecy, lead time, and learning advantages are all rated no higher than four on a seven-point scale of effectiveness. In this instance the low level of appropriability in general and the ineffectiveness of patents in particular should weigh against any presumption that a patent confers market power. The patentee in such an industry should be entitled to some scope for ingenuity in constructing arrangements that maximize the return to the patent, provided that these arrangements are not open to antitrust objections on grounds independent of the role played by the patent.

The intellectual property provisions of the Omnibus Trade and Competitiveness Reform Act also serve to illustrate the relevance of the survey results. One provision requires the U.S. trade representative to identify countries that have been particularly insensitive, as a matter of law or de facto policy, to the need for protection of intellectual property and to initiate unfair trade practice (section 301) investigations against them.[54] This provision of the trade bill would complement the administration’s diplomatic efforts to strengthen intellectual property rights throughout the world and particularly in countries that permit firms to copy patented or copyrighted products from the United States.

Since the impact of legal protection of intellectual property depends on the strength of other appropriability mechanisms and varies widely among industries, focused efforts to solve problems in specific markets would be more prudent than a broad attempt to upgrade protection. There is little point in expending diplomatic capital to compel foreign countries to pass or enforce laws that, in most industries, would have minimal impact on the competitive process. By contrast, in those specific industries such as pharmaceuticals — in which patent protection is effective, other means of appropriation are poor substitutes, and foreign governments often restrict, officially or tacitly, the ability of U.S. firms to exploit patents-a more persuasive case could be made for the United States to pressure its trading partners to change their behavior.

54.The trade representative may at his discretion escape this requirement by finding that such an investigation would not be in the national interest.

Appendix: Details of Sample Construction

Our review of the FTC data indicated that several lines of business did not report any R&D activity, and several others were aggregated to prevent violating confidentiality rules. Anticipating difficulty in finding knowledgeable respondents in industries without formal R&D activity, and wishing to avoid industry categories that included technologically disparate products, we eliminated those lines of business from our sampling frame.

The industries eliminated on grounds of heterogeneity were either the FTC's aggregations of technologically disparate industries or those corresponding to SIC industries with four-digit codes ending with 9. Such industries are residual categories within the relevant three-digit groups; their titles usually contain the words "miscellaneous, not elsewhere classified."

Confidentiality requirements prohibited us from using the FTC data as a means of identifying the firms that conduct R&D in each line of business. Instead, we used the Business Week annual R&D survey to identify all publicly traded firms that reported R&D expenses in excess of either 1 percent of sales or $35 million. This constitutes a nearly comprehensive list of private firms performing significant R&D. There were 746 such firms in 1981, when our survey design efforts commenced.

We used the information in Dun and Bradstreet 's Million Dollar Directory to assign each of the Business Week firms to its major lines of business. Dun and Bradstreet 's does not provide a complete list of each lines for each firm, in rough order of sales. Since some firms operate in nonmanufacturing industries, in manufacturing industries absent from our sample, or in two or more industries that fall into only one FTC line of business, we had substantially fewer than 746×6 observations. Within our sample lines of business, we found a total of 1,928 units operated by 688 firms.

A major design problem was how to obtain responses for business units within the same firm. Of our 688 firms, 470 participated in more than one of our sample lines of business. We initially attempted to identify relevant respondents using Industrial Research Laboratories of the United States. But our pretest subjects told us that more than half the people in such a sample were inappropriate. Some had been assigned to the wrong line of business; others had been promoted or had left the relevant division or the firm.

We therefore adopted a two-stage approach in which each firms senior R&D vice president or chief executive officer was asked to furnish the names of employees with the knowledge to complete the questionnaire for specific lines of business. We sent first-round requests to 470 firms representing 1,710 business units. There was attrition of 332 business units from this sample for three reasons: the firm did not do R&D in the specified line of business, the industry definition did not fit any of its activities, or a respondent could not be located. From this adjusted sample frame of 1,378 business units in firms with multiple units, we received names of respondents for 716. We sent questionnaires to each of these potential respondents as well as to representatives of the 218 firms operating in only one line of business. At this stage, there was some further attrition in the sample. Ultimately, we received 650 completed questionnaires from an overall adjusted sample frame of 1,562-an overall response rate of 41.6 percent.

Comments and Discussion

Richard Gilbert: The authors' research program will have lasting value for people interested in R&D markets and markets for intellectual property. They are correct in focusing on appropriability as a key factor in the incentive to undertake R&D. And their findings are generally consistent with those of other studies, for example, those by Christopher Taylor and Z. A. Silberston and Edwin Mansfield, Mark Schwartz,and Samuel Wagner.1 While this consistency may take a bit of the drama out of what Levin and his colleagues have done, the convergence of knowledge on this subject gives us some reason to believe we might be getting to the truth.

One of the authors' main conclusions is that there are very large differences, both among industries and within them, in the effectiveness of various means of appropriating intellectual property and also in the cost of imitation. It is an important result, but one that may cause some consternation. A main function of microeconomic theory is to form testable generalizations about the way the world works. Some of the work implies-at least, in the market for R&D and intellectual property- that such generalizations are extremely risky. We might be inventing a newfield of microeconomic analysis, or ‘′ picoeconomics." Picoeconomics would keep us busy for a long, long time. But if we go down that path, our models will soon become as complicated as the world we are trying to explain.

These particular authors do not seem to want to lead us toward picoeconomics. It is apparent from their follow-up work that they intend to draw some general conclusions about how appropriability varies across industries. Clearly, we would like to know how market structure and capital intensity in different industries influence the degree of appropriation and affect incentives to innovate. But merely adding appropriation as another explanatory variable in these regressions does little good. We really want to know whether there are systematic relations between the degree of appropriation and other observable economic variables.

1.Christopher T. Taylor and Z. A. Silberston, The Economic Impact of the Patent System: A Study of the British Experience (Cambridge University Press, 1973); and Edwin Mansfield, Mark Schwartz, and Samuel Wagner，“Imitation Costs and Patents: An Empirical Study，” Economic Journal, vol. 91 (December 1981), pp. 907-18.

With regard to methodology, I suggest using a weighting scheme based on the amount of R&D a firm does and, perhaps, the number of patents it has produced. The purpose would be to weight responses according to the quality of the information. Some industries seem not to have performed any R&D for twenty years. Although it is important to know why these firms have not been active, their responses should be a ‘justed to reflect the information they possess. Also, I suggest that in their survey work the authors include a definition of R&D. That is not a trivial task because there is much variation in what is called research and development.

I would have liked the survey to address more directly some of the theoretical issues in the economics of R&D. Various models in the R&D literature have different implications for the simultaneous determination of R&D intensity and market structure. For example, models such as that of Partha Dasgupta and Joseph Stiglitz imply that the current rate of R&D spending should be independent of cumulative R&D expenditures by a firm or the rivals of the firm.2 This is a consequence of the constant-hazard rate model. Other researchers such as Drew Fudenberg and his colleagues imply that past R&D is crucial to current and future R&D expenditures.3 The dynamic implications of these models are very different. The preemption-type models also suggest that a history of successful R&D gives a firm a technological advantage that provides some protection from future R&D competition and tends to increase concentration in a market.

2.Partha Dasgupta and Joseph E. Stiglitz，“Uncertainty, Industrial Structure, and the Speed of R&D ，” Bell Journal of Economics, vol. 11 (Spring 1980), pp. 1-28.

3.Drew Fudenberg and others，“Preemption, Leapfrogging and Competition in Patent Races ，” European Economic Review, vol. 22 (June 1983), pp. 3-31.

I would be interested in knowing if the survey could have elicited some kind of response about the way R&D success alters the competitive environment of the firms and, conversely, how the competitive environment influences R&D spending. The questions in which the investigators ask how many firms are viable competitors with a given firm and how many could replicate its R&D bear on this question. It is interesting that the number of serious rivals for each firm was small, somewhere between three and six.

There is an empirical problem with surveys of the relationship between competition and R&D. If R&D really does have an effect on entry and competition, then the sample is necessarily biased. There are potential competitors who were not represented in the sample because the firms failed. How one accounts for the failures and puts them back in the sample is a difficult empirical problem.

In terms of patent policy, the diversity and effectiveness of patent protection across industries raises an obvious and interesting question. How should patent policy deal with the large differences in the values of patents among various industries? The authors point to the example of the semiconductor industry and suggest that the industry need not be any worse off as a consequence of the limited patent protection it has received. But one might also question whether the performance of the pharmaceuticals industry might have been improved if patent protection had been circumscribed to some extent.

I have experimented with a very simple model of optimal patent life with limited appropriability. It is basically a Nordhaus-type model with entry and spillovers.4 It shows that the optimal patent life is not af unction of the size of the innovation, so one does not have to worry that there 町 e big innovations in some industries and small innovations in others. The optimal patent life does, however, depend on elasticities of R&D and its benefits and costs. It also depends on the degree of appropriability, and there is the intuitive answer that the optimal life is inversely related to the extent of private appropriation of the social value of the invention. This result suggests that we need either more protection in semiconductors or less protection in the patent drug industry.

The authors' survey provides a basis for contrasting patents with other approaches to protect intellectual property. A patent is a peculiar policy instrument. It represents an unnatural barrier to market entry that is erected to facilitate private appropriation. The survey suggests that other factors may be more important as a means of appropriation, and that other unnatural barriers might be more effective in stimulating R&D. As an extreme example (which I am not proposing), a tax on capital could arguably make entry more difficult and therefore stimulate R&D. It would be useful to do a survey of the effectiveness of different laws governing rights for intellectual property in different countries in an industry such as pharmaceuticals, which is one of the few in which patents really do seem to matter.

4.See WilliamD. Nordhaus,Invention, Growth，and Welfare:A Theoretical Treatment of Technological Change (MIT Press, 1969).

The survey results suggest that patents are important as a barrier to entry in the semiconductor industry not because they protect an individual innovation or invention but because they provide a hurdle for potential entrants, who have to acquire a package of marketable processes and products that they can cross-license to other firms. While this seems an inappropriate or at least unintended outcome of the patent grant, it might well be that by increasing ordinary barriers to entry in the semiconductor industry, the returns to research and development would be enhanced. This is another illustration of the Schumpeterian hypothesis and the tensions between strong enforcement of the antitrust laws and the desire to provide a stable platform for encouraging investment in R&D. If these observations with regard to the semiconductor industry generalize to other markets, they provide a starting point for further reexamination of the antitrust laws in the context of industrial R&D policy.

Thus this survey has raised some very interesting questions. Now we have to get on with their resolution. Thanks to this project, we have some of the data we need for the job.

Zvi Griliches: We should be grateful to Richard Levin and his associates for providing us with a new and detailed glimpse into a subject that is both very important and also lacking in good data. Far too little fresh economics data is collected, and we all have much to learn from the effort of this endeavor. That I am going to quarrel with some of the authors' assessments does not diminish in my eyes the basic value of this enterprise.

The authors have collected a large set of responses from many individuals located in different industries. This multipurpose survey will have many uses as we learn more about the responses and how to interpret them. I will focus on how these answers can help us learn which industries find patents an effective mechanism for appropriating returns from innovative effort, which ones do not, and whether mechanisms are available instead of or in addition to patents.

“Conditions of appropriability" determine the returns from a given innovative effort and hence the incentive to engage in it. One would expect that in industries in which appropriability is easy, there would be more innovative effort, higher returns, and a faster rate of technological progress. Such conditions may not be a fixed, unchanging characteristic of an industry, however. As more inventive effort is pursued, projects may become less easily appropriable, information may be leaked, and conditions may actually equalize among industries. The problem here is the same as in most empirical research programs: What is exogeneous and what is endogenous?

There are two generic problems with using the responses from such a survey: Are the responses comparable among individuals and do they reflect real differences among industries? Given the use of a scale of one to seven, I remain unsure about whether one person ’ s response of five is equivalent to another’s of four or six. Most questions do not have an objective anchor and could, therefore, differ greatly in the meanings attached to them by different respondents. This may account for the large dispersion in responses to most questions even within the same industry. It also leads to the difficulty of deciding whether the responses reflect real differences across industries or just random fluctuations among individuals.

There is a surprising amount of variability within industries in responses to the same question. Some questions, such as those on the effectiveness of patents, are reasonably objective and seem to have a variance among industries. Other questions, such as whether secrecy is effective, do not seem to be particularly industry-specific and do not discriminate well among industries. Questions about lead time, secrecy, sales effort, and service quality are really questions about different ways of succeeding, not about properties of an industry. It is well to have a long lead time or to achieve secrecy, but how is that to be accomplished? These are not characteristics over which either the firm or the policy- makers have clear control. Patents are at least a somewhat better defined instrument, and we have some ideas about how the patent system could be tinkered with.

Table 1. Analysis of Variance of Differences among Industries in Responses to Questions on the Effectiveness of Different Appropriability Mechanisms

	Individual response[a]		*Aggregated industry response*[b]	
Question	*Processes*	*Products*	*Processes*	*Products*
Patents to prevent duplication	1.9	2.8	3.4	5.5
Patents to secure royalties	1.6	1.4	2.4	2.3
Secrecy	1.2	1.2	1.3	1.3
Lead time	1.7	1.6	2.2	2.5
Quickly down the learning curve	1.0	1.0	.9	1.2
Superior sales or service	1.2	.9	.7	.9
Average of questions 1 and 2	2.1		4.8	
Average of questions 3 through 6	1.1		1.6	

Source: Authors' calculations.
a. Covers 541 responses for 130 industries; approximate .05 significance level is 1.3.
b. Covers 620 responses for 24 industries; approximate .05 significance level is 1.6.

Table 1 presents my analysis of variance results for some of the responses derived from the Yale survey. (I am grateful to Levin for providing me with the original survey data.) It shows that there is more variance among industries in the responses to questions on the effectiveness of patents, especially for products, and very little variance in the other questions on conditions for appropriability, especially for process innovations. Process innovations are clearly less industry-specific and so is the importance of superior sales and service efforts.

Another way of seeing this problem is to look at the authors' table 6, which shows that for many of the nonpatent mechanisms the cross- correlation among methods of appropriation is lower at the aggregated industry level than at the level of the individual response. If industrial classification mattered, one would expect higher correlations for the aggregated variables.1 This point is illustrated by a very simple model. Assume that two questions effectively measure the same thing. Then a variance components model for responses to these questions would be

$$y_{qij} = m_i + a_j + e_{qij},$$

where m_i is the "true" industry effect perceived by all individuals, a_j is

1.Y. Grunfeld and Zvi Griliches, "Is Aggregation Necessarily Bad? "Review of Economics and Statistics, vol. 42 (February 1960), pp. 1-13.

the individual deviation from the average respondent independent of the industry he is in, and eqij is the random response error associated with the particular question q and individual ij. Taking these effects as independent from each other, and assuming that the first component does not average out as one aggregates within industries but that the other ones do in proportion to the average number of respondents per industry, gives us a little model that can be fit to the observed variances and covariances at the micro and macro industry levels. The following material shows the relevant numbers for two pairs of questions: whether product patents are effective against duplication and in securing royalty income, and whether moving quickly down the learning curve and superior sales and service efforts are effective in protecting the compet- itive advantage of new products. The two-question expected variancecovariance matrix is

$$\begin{array}{cc} \textit{Individual level} & \textit{Industry level} \\ \begin{bmatrix} \sigma_m^2 + \sigma_a^2 + \sigma_1^2 & \sigma_m^2 + \sigma_a^2 \\ \cdots & \sigma_m^2 + \sigma_a^2 + \sigma_2^2 \end{bmatrix} & \begin{bmatrix} \sigma_m^2 + \dfrac{(\sigma_A^2 + \sigma_1^2)}{N_i} & \sigma_m^2 + \sigma_A^2/N_i \\ \cdots & \sigma_m^2 + \dfrac{(\sigma_A^2 + \sigma_2^2)}{N_i} \end{bmatrix} \end{array}$$

where m_i is the "true" industry effect perceived by all individuals, a_j is the individual deviation from the average respondent independent of the

	Product patents IB1	*Effective IB2*	*Learning curve IB5*	*Secrecy IB6*
Individual	2.860	1.435	1.810	.803
(N = 643)	. . .	2.748	. . .	1.662
Industry	.618	.384	.148	.013
(N = 24)	. . .	.376	. . .	.075
Implied estimates				
($\bar{N}$ = 27)				
σ_A^2	1.09		.820	
σ_m^2	.34		<0	

The numbers imply that the common variance between industries accounts for about one-eighth of the variance at the level of the individual response and more than half at the aggregated industry level. For the two other questions the implied "true" variance between industries is negative. (For the patents question the correlation rises from .51 at the level of the individual respondent to .80 for averages at the NSF industry level, while for the two appropriability questions the numbers go from .46to .12, implying that such averaging attenuates rather than strengthens the relationship between the responses to such questions.) In short, while these questions might be interesting, they do not seem to be able to pick out significant differences among industries. Coming quickly down the learning curve and providing superior services are about equally effective.

Do the results of this survey help us explain other phenomena besides the relationship between answers to different sets of related questions within the survey? Looking at the responses to the questions evaluating patents and other appropriability mechanisms, the evidence appears to be mixed. Levin, Cohen, and Mowery did not find the appropriability variables significant in explaining differences among industries in R&D intensity, even in the absence of industry dummies.[2] In a forthcoming paper Iain Cockburn and Zvi Griliches use the Yale survey responses, aggregated to fifty-five industries at approximately a 3-digit SIC level, to see whether the stock market values the accumulated patents and the current R&D policy of a firm more or less in industries where the appropriability conditions are better in some sense.3 Table 2 reproduces typical results from this study. Patent effectiveness measures help in some sense. The equations seem to imply that both accumulated past patents and cuηent R&D moves are valued more by the market when patent protection is effective. Other appropriability measures do not help. But neither set of measures does better than just an interaction with ten higher-level (2-digit) industries dummies. The greater detail available in the Yale survey appears to be counterbalanced by the (inevitably?) greater imprecision of these measures at the detailed industry level. So there is something there but not as much as might be wished. But we should be thankful for there is hope that a more detailed study of these and other responses in this survey will help us understand our world better. In particular, the information on the differential connectedness of science in different industries is very intriguing and may be of help in future analyses of the contribution of science to technological advance.

2.Richard C. Levin, Wesley M. Cohen, and David C. Mowery ，“R&D Appropriability, Opportunity, and Market Structure: New Evidence on Some Schumpeterian Hypotheses ，′ ’ American Economic Review, vol. 75 (May 1985, Papers and Proceedings, 1984), p. 23.

3.lain Cockburn and Zvi Griliches，“Industry Effects and Appropriability Measures in the Stock Market’s Valuation of R&D and Patents，” working paper 2465 (National Bureau of Economic Research, December 1987).

Table 2. Stock Market's Valuation of R&D and Patents, 722 U.S. Manufacturing Corporations, 1980[a]

Variables	*Coefficients*						
	(1)	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*	*(7)*
SP/A[b]	.165	.380	.107	.249	.360	.077	.199
	(.100)	(.171)	(.167)	(.155)	(.170)	(.183)	(.161)
K/A[c]	. . .	. . .	.932	.335	. . .	.898	.342
			(.201)	(.178)		(.224)	(.175)
NR[d]	. . .	. . .	. . .	11.96	. . .	. . .	12.24
				(1.37)			(1.38)
PPP[e]	. . .	.034	.019	.019	.035	.023	.019
		(.024)	(.024)	(.023)	(.024)	(.025)	(.024)
PPP · (*SP/A*)	. . .	.236	.075	.098	.267	.115	.164
		(.116)	(.110)	(.101)	(.133)	(.142)	(.128)
PPP · (*K/A*)	. . .	. . .	.365	. . .	. . .	.432	. . .
			(.130)			(.172)	
PPP · *NR*	. . .	. . .	. . .	2.788	. . .	. . .	2.60
				(1.231)			(1.39)
NPP[f]	. . .	. . .	. . .	. . .	.039	.100	.054
					(.079)	(.089)	(.075)
NPP · (*SP/A*)	. . .	. . .	. . .	. . .	.127	.174	.290
					(.388)	(.432)	(.293)
NPP · (*K/A*)	. . .	. . .	. . .	. . .	. . .	.263	. . .
						(.636)	
NPP • *NR*	. . .	. . .	. . .	. . .	. . .	. . .	−1.89
							(4.77)
$\bar{R}^2$	.166	.172	.200	.310	.170	.198	.309

Source: Adapted from Iain Cockburn and Zvi Griliches, "Industry Effects and Appropriability Measures in the Stock Market's Valuation of R&D and Patents," working paper 2465 (National Bureau of Economic Research, December 1987), tables 3b and 5.

a. Dependent variable is log Q (market value divided by replacement value). All equations contain also ten 2-digit SIC industry dummy variables and a logarithm of total assets variable whose coefficient is small but consistently significant, on the order of −.03 (.01).

b. Stock of patents (30 percent depreciation rate) divided by total net assets.

c. Cumulated R&D "capital" stock (15 percent depreciation rate) divided by total net assets.

d. Net R&D investment divided by net assets (R − .15K)/A.

e. Sum of responses to "patents provide protection against duplication" questions for both process and product innovations. Averages at a fifty-five industries (approximately 3.5 digit level) aggregation.

f. Average of responses to all other "effectiveness of nonpatent appropriability mechanisms" questions.

General Discussion

Richard Levin agreed with Zvi Griliches that the appropriability variables could not discriminate effectively among more than about ten industry groupings, but he suggested that this may b a good thing, especially in light of Richard Gilbert’s concern that studies such as this amount to“picoeconomics，” from which no generalizations can be drawn. Sidney Winter noted that the results suggest there may be a relatively short list of variables to consider in an analysis of appropriability and incentives for R&D, and that ten industry groupings may provide all the information needed. In other dimensions, a finer division may be important. For example, Levm pointed out that, relative to questions on lead time, learning curves, and duplication costs, the questions on patent effectiveness discriminate better, as do the questions on learning and information spillover and those on duplication time.

Moreover, he added, aprincipal conclusion, that patents do not matter very much except in the chemical industries and in semiconductors, comes through regardless of problems with questions about other mechanisms of appropriation. In these two industries, the meaning and role of patent protection is different. Chemical products are easy to patent because the structure of the molecule of each product is unique, but patents are easy to invent around because it is often possible to create a discrete but structurally similar product with similar properties. With semiconductors, however, the innovation process is cumulative, with each invention built very distinctly on the previous one. The innovation provided by one firm makes the product invented by another firm more valuable. So the role patents play is to define the property rights (usually through the licensing process) so that the proceeds of this cumulative process can be shared and innovation can be encouraged.

Griliches also raised questions about whether the variables measured in this study are appropriately regarded as exogenous. Sales and service effort, for example, is a choice variable for the firms, and hence effectiveness should be endogenous. Likewise, lead time should be thought of as an outcome of the technology race, rather than an exogenous condition of it. Winter pointed out that even the distinction of product and process may be somewhat endogenous in the sense that firms take intoconsideration the importance of secrecy and the possibility of reverse engineering in designing their products. Firms often work to make their high-technology products inaccessible to reverse engineering, he noted, which tends to make these products more like processes from the standpoint of appropriability.

Several participants seemed concerned about problems of measure- ment and scaling biases in the data. Levin responded that various techniques, such as weighting the responses by the inverse of the variances or standard deviations of the individual responses, were tried to correct for these biases. The principal findings were robust to efforts to stretch or squeeze the distribution of responses, he noted, but it was unclear what such “corrections" mean since no one knows what the true distribution should be.

Joseph Farrell took issue with Gilbert’s argument that it is not particularly interesting or helpful to worry about the determinants of R&D in industries that do not perform R&D. In fact, he suggested, it would be very useful to know why some industries seem to do so little research while others do so much. Gilbert agreed, but argued that it was still important to assign some sort of weights to individual responses to particular questions, based on the respondent ’s experience with those issues. Martin Baily argued that weighting the responses by how much R&D the responding firms do would be inappropriate, however, since the amount of R&D is what the authors are trying to explain.

Richard Schmalensee suggested that some of the within-industry variance in the responses about sales and service and other mechanisms of appropriation may be due to the fact that the R&D executives who responded to the questionnaire are less knowledgeable about what happens to the product after it leaves their jurisdiction in the organization.

Responding to a question from Paul Joskow, Levin said if he were doing the survey over again, he would want to do more pretesting. For example, the authors might have picked up on the issue of intraindustry variance earlier if they had pretested multiple respondents from the same industry. Or they might have learned ways to restructure questions to discriminate more carefully between exogenous and endogenous factors.

Robert Litan noted that one implication of the study for trade policy is that issues of intellectual property rights should be dealt with industry by industry. This is, in effect, how section 301 of the Trade Act already works, he added. The section provides a procedure for pursuing complaints about unfair trade practices abroad, but these complaints must be brought product by product. Litan also suggested that mechanisms of appropriating returns from R&D might vary between large and small firms. Levin agreed, but noted that the sampling procedure surveyed only publicly held firms, so that start-up ventures were com- pletely excluded. Patents may be much more important for a start-up company because they provide something tangible to sell if the firm tries to sell out later.

Source: Brookings Papers on Economic Activity, Vol. 1987, No. 3, pp. 783-831.

Innovation in China

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Abstract: Innovation has been increasingly recognized as a critical force in national economic growth not only in developed countries, but also in emerging countries such as China and India. This paper provides a critical review of the literature related to China's innovation capability. First, I evaluate the current status of China's innovation capability as measured not only by the level of human capital and output of academic research but also by patents, products, and services that directly benefit economic growth. I then review the development pathway of China's national innovation system since the economic reforms, including policies, the role of the government, and the engagement of different actors in the national innovation system. Following that, I examine theories and empirical evidence that help to explain the evolution of China's innovation capability. Finally, using China's experience, I analyze the relationship between innovation capability and economic development and highlight how the uneven spatial distribution of innovation capability may affect China's regional economic development.

Keywords: China, Innovation, Regions, Systems of innovation

1. Introduction

China has a long history of pursuing innovation and technological advancement. It is well known that the 'Middle Kingdom' produced the 'four great' inventions: the compass, gunpowder, papermaking, and printing. This ambition for technological supremacy has continued throughout the Maoist Era (1949–1978) and the reform period (1978–present). Though plagued by wars and poverty and under extreme difficulties due to an embargo by western nations, China conducted its first successful atomic bomb test in its northwestern desert in 1964. In recent decades, there have been significant achievements in biotechnology, astronautics and information technology, including: (1) together with four other countries at the forefront of genomic research (the USA, Japan, Germany, and France), China participated in the Human Genome working draft in 2001; (2) China became the third nation to launch a man into space in 2003, following Russia and the U.S.; and (3) China became the third country with supercomputing ability in 2004 and had the fastest supercomputers in the world in 2010 and 2013.

Nevertheless, there is a substantial difference between the pursuit of technological advancement from an historic perspective and the recent launch of an economic development strategy based on innovation. On November 8, 2012, in a report delivered by President Hu Jintao in the 18th National Congress Party, China announced that it would transition into an "innovation-driven economy." Thirty-five years of reform dramatically lifted China out of poverty and positioned the country as the second largest world economy in 2010. However, the growth model it used, which has converted the country into the world's largest factory, producing everything from clothing to electronics, has relied heavily on investments, exports, and a huge low-cost labor force. Currently, China is ready to shift to the next stage, through an economy mainly driven by technological advancement, to address the slow down of its past growth model. Improvements in innovation capability, especially in its industrial sectors, are considered essential to China's sustainable economic growth in the future. Similar to the rest of the world, the importance of innovation to economic growth in China means that innovation should not be treated as merely an element in an economic residual, but rather as a key issue that policy makers should consider as making a positive influence (McCann and Oxley, 2012; Yu *et al.*, 2013).

Against the announcement of China's new economic development strategies driven by innovation are "believer's claims that China is out-innovating the West" and "doubter's claims that China is lagging on the innovation front" (Steinfeld, 2010, p. 34). The common perception is that China's rise in innovation capability poses a threat to U.S. leadership in science and technology.[1]

To unveil the myth of "innovation in China" and its impact on the rest of the world, it is essential to answer the following set of questions: What is the current status of innovation capability in China? How did China improve its innovation capability over the past 35 years? Has any theoretical proposition related to innovation found a resonance in the Chinese context? Further, what can we learn from China's experience, and what are the implications for other emerging countries? In this paper, I address some of the above questions by providing a critical review of innovation in China and related literature. First, I evaluate the current status of China's innovation capability through both the input and output indicators of China's innovation system, such as R&D personnel, R&D expenditure, patents, high-tech and service exports, and scientific and technical journal articles. Further, I underline the contribution of technological progress visavis labor and capital to China's economic development, indicated by annual GDP growth. I then review China's development of innovation since the economic reform and identify major factors that may explain its evolution, relying on theoretic frameworks of (1) systems of innovation (SI), (2) external linkages, such as global value chains, global production networks, overseas returnees, and R&D globalization, and (3) the dynamics of latecomers' catch-ups. Finally, I review the uneven spatial distribution of innovation capability and analyze possible causes for the inequality, as well as the emerging research in regional innovation systems.

2. Measuring Innovation in China

Innovation capability can be assessed using the input and output measures of the innovation system. The input measures are usually represented by indicators such as the amount of R&D investment and the number of researchers in R&D, whereas output measures are reflected by indicators such as patents, high-tech/service exports, and academic output like scientific and technical journal paper publication. This section will present the evaluation of innovation capability based on these commonly used indicators. It should be noted that one has to exercise caution when using the above-mentioned indicators or any other indicator as an accurate assessment of innovation capability, especially when comparing China's indicators with those of other countries. First, while there are useful guidelines that can make measurements of innovation indicators comparable between most developed countries, such as the OECD countries, China has not been a part of the collective process and thus it is difficult to compare China's indicators with others. Many countries in the OECD have adopted the principles of the Oslo Manual to collect innovation data. Currently, all member states of the European Union (EU) and some candidate countries for the EU[2] have used the community innovation survey (CIS) to standardize their models of innovation surveys (Lopez-Bassols, 2011). Other countries, such as China, Japan, Korea, and Russia, have adopted innovation surveys close to the CIS, but with some adaptations (Lopez-Bassols, 2011; Hong *et al.*, 2012). Although CIS indicators are growing in use, they are still less widely used than the R&D statistics, due to concerns about quality, policy relevance, and international comparability outside of the EU (Lopez-Bassols, 2011). Second, innovation-related data are territory-based and national data does not actually reflect China's innovation due to foreign individuals' and organizations' activities in China, as well as the innovation of Chinese individuals and organizations outside of China (Altenburg *et al*., 2008).

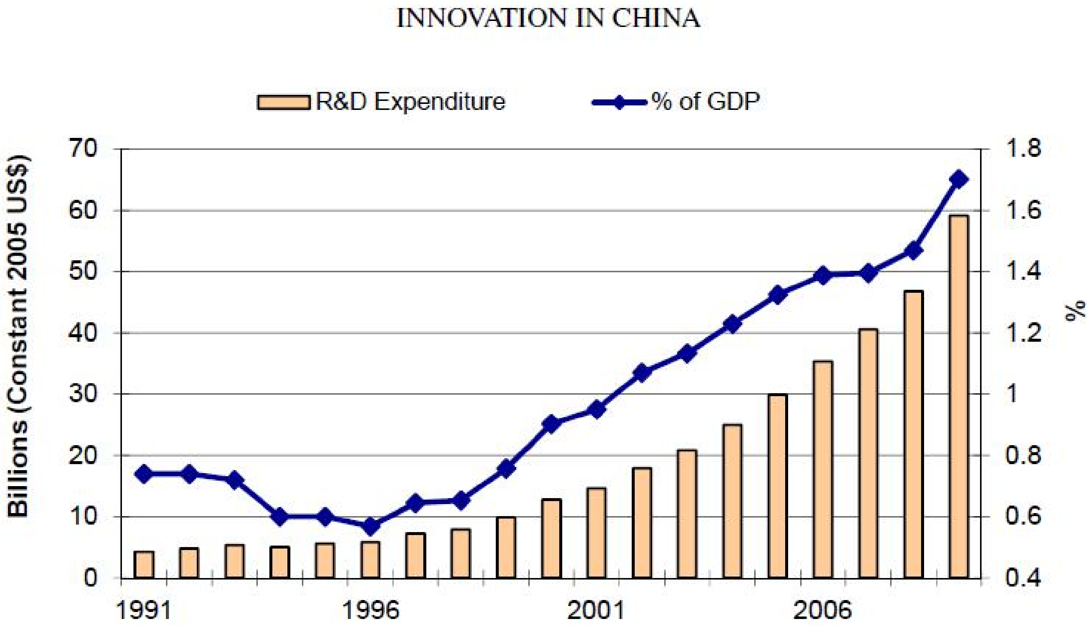

Figure 1. China's R&D Expenditure and Its Percentage of GDP, 1991–2009.

Note: Expenditures for research and development are "current and capital expenditures (both public and private) on creative work undertaken systematically to increase knowledge, including knowledge of humanity, culture, and society, and the use of knowledge for new applications. R&D covers basic research, applied research, and experimental development" (World Bank, 2013, explanation of the definition of Research and development expenditure [% of GDP]).

Source: Figure created by the author based on data from World Development Indicator (World Bank, 2013).

2.1 Input Indicators

2.1.1 R&D Expenditure

R&D expenditure is considered one of the most important elements in improving the innovation capacity of nations as well as firms (Audretsch and Feldman, 2004). Data analysis on OECD countries such as USA, UK, Japan, France, Italy and Germany, shows that R&D expenditure stimulates innovation and enhances total factor productivity (TFP) (Goto and Suzuki 1989; Hall, 1993; Hall and Mairesse, 1995; Harhoff, 1998; Wakelin, 2001; Griffith *et al*., 2004; Lang, 2009). A positive and significant relationship has also been found between the R&D expenditure of a firm and its productivity (Griliches and Mairesse, 1984; Griliches, 1986, 1998; Romer 1986, 1990; Lucas, 1988).

Since the mid-1990s, China has invested heavily in R&D and has gradually increased R&D expenditure as a percentage of GDP from around 0.6% in 1996 to 1.7% in 2009 (Figure 1). It is worth noting that the "Decision on Accelerating S&T Development" announced by the state council in 1995 set the ambitious goal of increasing spending on R&D to 1.5% of GDP by 2000, resulting in China's R&D expenditure as a percentage of GDP after 1995 growing at a much faster pace than in previous years and reaching 1.7% in 2009 (Fan, 2011b). This percentage is still behind that of the OECD countries that, in general, spend on average 2–3% of GDP on R&D. However, considering that China's R&D expenditure increased even faster than its economy, which grew at a remarkable rate of around 10% in the 1990s and 2000s, its R&D expenditure was certainly impressive. The R&D figure expanded from US$4.2 billion in 1991 to US$59 billion in 2009, a 14-fold increase in the space of 18 years. In fact, before China overtook Japan as the second largest economy measured by GDP in 2010, China surpassed Japan to became the second largest nation in R&D expenditure in 2006 (OECD, 2006).

Table 1. Researchers in R&D in China, India, Japan, and the United States.

	Researchers in R&D (per million people)			Total researchers in R&D		
Country	*1996*	*2000*	*2007*	*1996*	*2000*	*2007*
China	447	548	1,077	544,163	691,518	1,419,507
India	152	110	136	147,897	114,656	153,075
Japan	4,946	5,151	5,409	622,044	653,494	691,101
United States	4,254	4,579	4,673	1,159,966	1,292,053	1,407,716

Note: U.S. 1996's figures are 1997's figures. India 2007's figures are 2005's figures.

According to the World Bank, Researchers in R&D are "professionals engaged in the conception or creation of new knowledge, products, processes, methods or systems and in the management of the projects concerned. Postgraduate PhD students (ISCED97 level 6) engaged in R&D are included" (World Bank, 2013, explanation on the definition of Researchers in R&D).

Source: Compiled by the author based on the data from World Development Indicator (World Bank, 2013).

2.1.2 R&D Personnel

The number of researchers in R&D reflects the level of human capital for innovation capability and is an important indicator. A comparison of China's data with that of the United States and Japan indicates that the country has improved in this dimension as well (Table 1). The number of researchers in R&D more than doubled, growing from 447 per million in 1996 to 1077 per million in 2007, making China's level around 20% of that of the USA and Japan. However, due to its large population size, when comparing the absolute numbers, China became the leader in terms of the number of total researchers in R&D, slightly surpassing the USA, and more than double that of Japan. In fact, the rich reserve of R&D human resources is one of the major reasons that multinational corporations (MNCs) have chosen to locate their corporate research centers in China. MNCs grew their R&D centers in China fivefold from 2003 to 2007, with 750 foreign R&D centers in China in 2007 (Walsh, 2007), including work to tailor products to the needs of the Chinese market as well as basic R&D (Sun *et al*., 2008).

2.2 Output Indicators

2.2.1 Patents

Despite skepticism, the number of patents granted has been accepted as the most appropriate output measure for innovation capability (Mansfield, 1986; Basberg, 1987; Griliches, 1990; Hagedoorn and

Cloodt, 2003). Different indices, such as those tracking R&D inputs, patent counts, paper citations and new product announcements, can all be used as an indicator for output measure of innovation capability. This paper follows Audretsch and Feldman (2004) and uses patent data as the main proxy of output measure of innovation capability. Hagedoorn and Cloodt (2003) found that statistical overlap between various innovativeness indicators is substantial and that any of these indicators, including patents, may be used to measure innovation capability.

Although China adopted modern patent law less than three decades ago in 1984, the number of patents granted to Chinese inventors, in China and worldwide, has been growing exponentially (Figure 2). In 2012, China's State Intellectual Property Office (SIPO) granted 1.26 million patents, a 31% increase over the number granted in 2011 and more than any other patent office in the world. Further, almost 80% of China's patents were awarded to domestic applicants in 2012, while fewer than 50% of all U.S. patents went to U.S. citizens (Neumeyer, 2013).

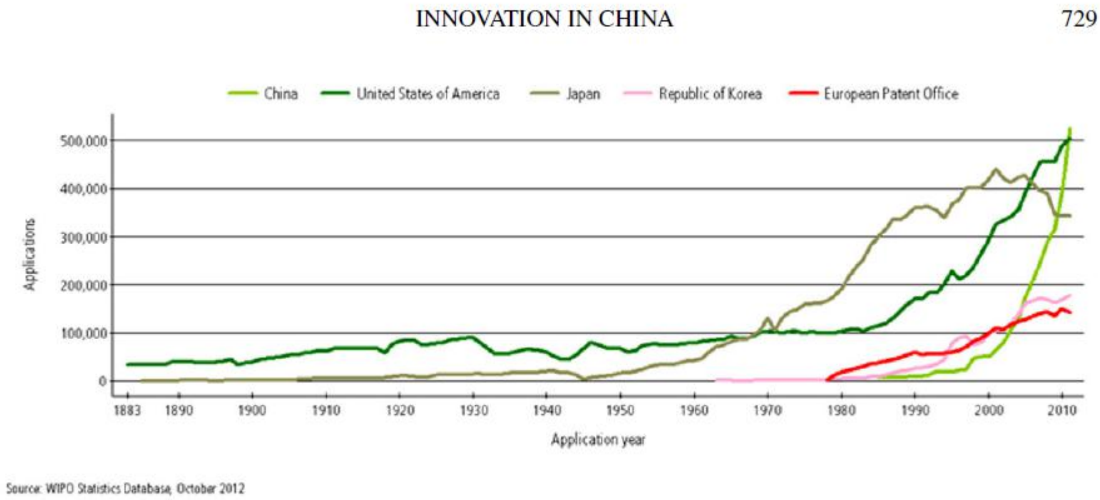

Figure 2. Trend in Invention Patent Application for Top Five Offices.

Source: Neumeyer (2013, Figure 1).

Table 2. U.S. Patents Granted to Asian Inventors, 1970–2013.

	Total	1970–1979	1980–1989	1990–1999	2000–2009	2010–2013
Taiwan	141,431	57	2,613	22,507	72,365	43,889
S. Korea	127,786	10	646	15,306	58,024	53,800
Hong Kong	11,753	123	886	2,688	5,855	2,201
Singapore	9,967	11	102	957	5,166	3,731
China	37,688	2	178	900	13,219	23,389
India	15,068	81	166	679	5,529	8,613

Note: For 2013, the issue dates are from January 1 to October 30, 2013.
Source: Compiled by the author based on the USPTO Patent Collection Database, website: http://patft.uspto.gov/

Worldwide, China has been catching up rapidly in the intellectual property (IP) arena, as illustrated by the decadal data on patents granted by the United States Patent and Trademark Office (USPTO) (Table 2). Compared with other leading Asian inventors excluding Japan, China's progress is hard to dismiss. Although it was behind Hong Kong and Singapore in the 1990s, China's total number of granted patents from USPTO was more than the sum of those two economies in the 2000s. Further, in the past three years (2010–October 2013), China has substantially increased the number of granted patents, by almost doubling its figures from the 1990s, significantly improving its position vis-a`-vis other emerging Asian innovation centers, namely Taiwan and Korea. In 2012, China was listed as No. 9 worldwide in terms of patent applications to the USPTO, trailing after the USA, Japan, Germany, Korea, Taiwan, Canada, the UK and France. However, applications from Chinese inventors increased by 41% over 2011, more than twice the rate of increase of any of those countries (Neumeyer, 2013). In 2012, with 782 U.S. patents granted, a Chinese company, Hong Fu Jin Precision Industry Corp., also become one of top 50 U.S. patent recipients for the first time.

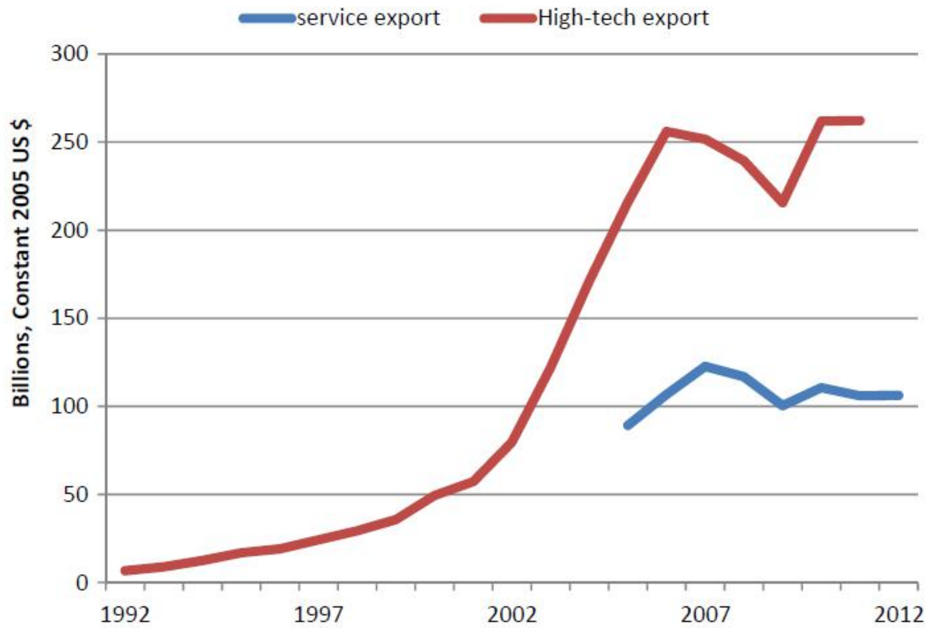

Figure 3. China's High-Tech Exports and Service Exports, 1992–2012.

Source: Figure created by the author based on data from World Development Indicator (World Bank, 2013).

2.2.2 High-Tech and Service Export

As its economy has grown, China has also increased the sophistication of its export files, growing particularly in the volume of high-tech and service exports (Figure 3). High-tech exports have gathered momentum and have experienced exponential growth since 2002, whereas the service export area has experienced steady growth since the early 2000s. This evolution pattern is similar to that of the OECD countries (Rodrik, 2006; Schott, 2008; Lai and Li, 2013). However, due to the debate on whether or not growth in high-tech exports can truly reflect improvements in innovation capacity, this paper suggests that readers use this indicator as a complementary reference for China's innovation system. Chinese high-tech exports have been considered as low technology products from high-tech industries (Blustein, 1997) or as the result of the "processing trade": contract manufacturing in China of goods designed elsewhere (Feenstra and Wei, 2010). In contrast to this negative view, some researchers have emphasized that China has gradually increased the skill content and sophistication of its exports in recent years due to ongoing improvement in human capital and government policies, especially those on tax-favored high-tech zones (Amiti and Freund, 2010; Wang and Wei, 2010; Berger and Martin, 2013).

2.2.3 Scientific and Technical Journal Articles

The number of scientific and engineering articles can be used as another output indicator to illustrate the efficiency of the innovation system, especially the more basic and fundamental aspects of innovation. This indicator refers to journal articles published in the following science and technology fields: physics, biology, chemistry, mathematics, clinical medicine, biomedical research, engineering and technology, and earth and space sciences, in journals classified by the Institute for Scientific Information's Science Citation Index (SCI) and the Social Sciences Citation Index (SSCI) (World Bank, 2013). Starting with only 1100 journal articles in 1981, China surpassed Japan and had around 74,000 scientific and technical journal articles, over a third of that of the USA (208,600), by 2009 (Figure 4).

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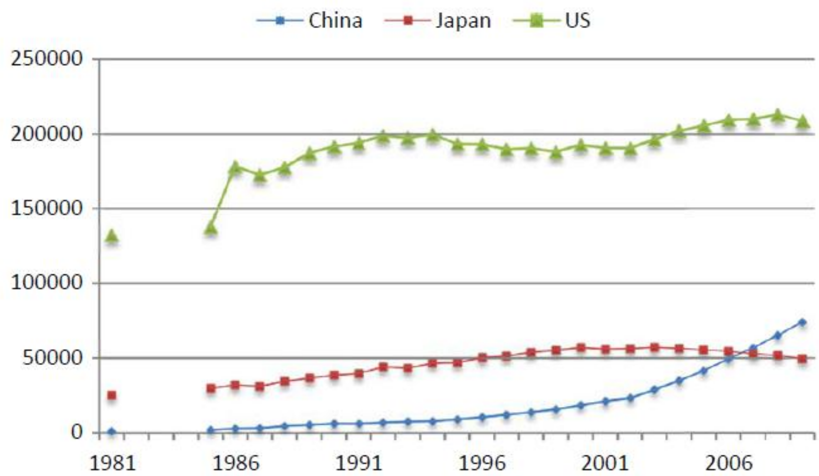

Figure 4. Scientific and Technical Journal Articles Published by China, Japan, and the USA, 1981–2009.

Source: Figure created by the author based on data from World Development Indicator (World Bank, 2013).

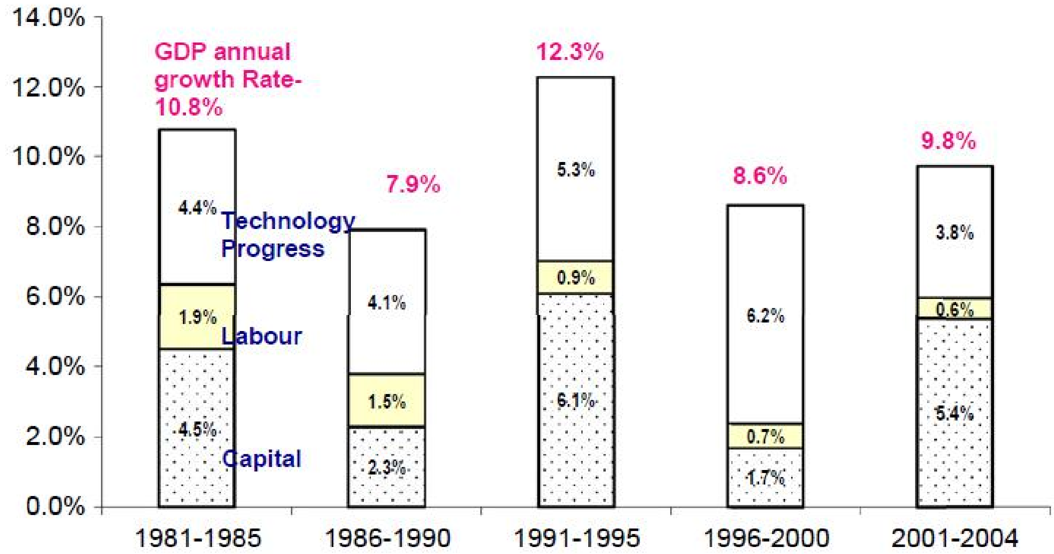

Figure 5. Contribution of Technological Progress to Economic Growth in China, 1981–2004.

Source: Adapted from Fan (2011a, p. 53).

Finally, through a decomposition analysis, one can assess how much innovation capability actually contributed to the economic development of China (Fan, 2011a) (Figure 5). As GDP growth can be decomposed into the contributions of capital, labor, and technology, the share of technology can be measured by TFP growth (Fan and Watanabe, 2006). The decomposition reveals that technology has significantly influenced China's economic development since the 1980s. It is interesting to note that while capital fluctuated in its contribution to GDP growth in different periods, technological progress made a relatively steady contribution. While at the beginning of the reform era (1981–1985), capital was the leading factor for growth, followed closely by technology, technological progress leaped forward and became the leading growth factor over the next five years (1986–1990) with capital some distance behind. In the 1990s and the early 2000s, technological progress consistently contributed to GDP growth at 4–6% annually, while capital displayed a very unstable pattern, fluctuating from 6.1% (1991–1995) to 1.7% (1996–2000), to 5.4% (2001–2004), reflecting the influences of large injections of capital and the outbreak of the Asian financial crisis.

3. Developing Innovation Capability: The Chinese Way

3.1 The System Approach

Since Freeman first officially used the term "national system of innovation" (NSI) in his work to analyze technology policy and economic performance in Japan in 1987 (Freeman, 1987), the "SI" approach and its three perspectives, NSI, sectoral system of innovation (SSI), and regional system of innovation (RSI), have been developed and adopted by many researchers as conceptual frameworks to analyze innovation in different contexts (for example, NSI: Freeman, 1987, 1995; Lundvall, 1992; Nelson, 1993; SSI: Breschi and Malerba, 1997; Malerba, 2002, 2004, 2005; Geels, 2004; Malerba and Mani, 2009; RSI: Cooke *et al.*, 1997; Braczyk *et al.*, 1998; Cooke, 2001; Asheim and Isaksen, 2002). As it emphasizes that innovation is to "produce new knowledge or combine existing elements of knowledge in new ways" (Edquist, 2005, p. 184), the "SI" approach distinguishes itself from other approaches that consider technological change and innovation as exogenous (Edquist, 2005).

Due to its holistic and evolutionary perspectives, encompassing product and process innovation, an emphasis on interdependency and nonlinearity, and the role of institutions, the SI approach has also been used by a number of researchers to analyze innovation in China, particularly the evolution of its NSI (Xue, 1997; Gu, 1999; Liu and White, 2001; Fan and Watanabe, 2006; Motohashi and Yun, 2007; Altenburg *et al.*, 2008).[3] Prior to the 1980s, China had a NSI similar to other central planning economies such as the Soviet Union and India, characterized by the complete separation of research activities, education, and manufacturing activities in public research institutes (PRIs), universities, and state-owned enterprises (SOEs), respectively (Xue, 1997). Since the economic reform, the Chinese government has started to actively transform the Soviet model, especially by emphasizing colocating research and manufacturing. The government has used both carrots and sticks to pull and push the R&D institutes to adapt the market environment and to conduct R&D that has industrial implications. For instance, while it reduced institutional funding for PRIs in order to push the PRIs to conduct more market-oriented R&D through industries and universities (Liu and White, 2001), it also offered financial incentives to commercialize R&D results, especially through the Torch Program, a national science and technology program specifically targeting high-tech industrialization, launched in 1988. The government also performed an organizational transformation by advocating mergers of some R&D institutes with enterprises in 1987 and reforming established R&D institutes into entities with economic functions, such as production and consultancy centers, from the 1990s. (Gu, 1999; Fan and Watanabe, 2006; Fan, 2011a).

Up to now, Liu and White's (2001) analysis of China's NIS remains the most comprehensive of its kind. They identified five fundamental activities in an innovation system, which extend beyond the R&D system and include inputs to research activity and the use of research outputs. The activities are: "(1) research (basic, developmental, engineering), (2) implementation (manufacturing), (3) end-use (customers of the product or process outputs), (4) linkage (bringing together complementary knowledge), and (5) education" (Liu and White, 2001, p. 1,094). They also coined the term "primary actors," referring to organizations that perform one of the five above-mentioned fundamental activities. Applying this updated framework, they concluded that China's NIS in the transition era had two distinguishing characteristics: the inclusion of new actors for each of the fundamental activities and diversification of the activities of the primary actors. Here, I update their summary of the five fundamental activities in the NSI with some new developments that have occurred in the 2000s.

In the transition era, the most fundamental activity, R&D, has had a significant transformation in both nature and distribution. While the original primary actors, i.e., PRIs, are still among the main actors performing R&D, they were given strong financial incentives to conduct applied research. However, a large amount of direct funding for basic research, particularly in "strategic" high-tech industries such as information technology and biotechnology, is available through national programs such as 863 and 973 (explained in more detail later in this section). The distribution of R&D activities has been extended through colocating R&D and implementation (manufacturing), by either adding in-house R&D to enterprises or inserting the commercial component into research institutes (Liu and White, 2001). Further, new players such as R&D centers for MNCs (Sun *et al*., 2008), new technology enterprises (Zhou, 2008), and high-tech firms started by overseas returnees (Saxenian, 2002, 2006; Zweig *et al*., 2006), have entered the scene, while domestic companies started to tap global R&D resources by setting up their R&D units in global hot spots of high-tech development (Fan, 2011b). The business sector quickly rose to become a major contributor to national R&D, with large- and medium-sized enterprises spending RMB 44 billion in 2001, an increase of RMB 14 billion from the 1995 level and accounting for 42% of the national total (Fan and Watanabe, 2006). According to R&D Magazine, in 2004, R&D spending by the industry sector accounted for 61.2% of the national total.

In implementation (manufacturing) activities, many new actors have joined SOEs to become primary actors, including MNCs, joint ventures, township and village enterprises (TVEs), and private companies. In responding to the incentives and freedom to pursue more revenue-generating activities, primary actors in other activities, especially universities and PRIs, have diversified into manufacturing (Gu, 1999), usually in the form of spin-off ventures. For end-use activities, there is a significant increase in individual and industrial consumers as actors, providing incentives for companies to conduct market-oriented innovation. It is worth mentioning that China's end users, either individuals or organizations, have become more sophisticated as the country's economy has expanded. By understanding, the needs of the end users better and being willing to customize R&D for those end users, some Chinese companies, such as Huawei and ZTE in the telecommunication sector (Fan, 2006a, 2011b), have established competitive advantages compared to the MNCs.

In educational activities, while universities are still the main primary actors, they have extended their activities into R&D and manufacturing. China has rapidly scaled up its higher education sector by expanding existing universities through increased admission and establishing more higher educational institutions, and this has led to1h enterprises were located in high-tech parks (Fan, 2011) where they enjoy various benefits for innovation-related activities. For instance, in Zhongguancun Science Park, China's Silicon Valley, benefits for innovation include: (1) a tax cut of up to 15% for key companies in the creative industries, (2) reduction of personal income tax for investors in high-tech R&D to further boost the venture capital sector to aid more tech startups, (3) tax benefits for company income generated by patent transfers, and (4) waiver of the enterprise tax on patents sold at less than 5 million yuan ($820,000) or half the rate of the enterprise tax for higher values.[4]

Although the system approach is very helpful in understanding the internal structure and the evolution of innovation for a specific country/region, it has been criticized for lacking consideration of relationships with key actors outside of the system and for poor understanding of the dynamics of the innovation system, i.e., how structures of interaction develop and change over time (Humphrey and Schmitz, 2002; Bell, 2006). To address these weaknesses, researchers have proposed integrating transborder linkages into the territorially bounded innovation system and analyzing the catch-up in innovation capability, taking into account the changes in technological regimes and the global economic environment (Altenburg *et al.*, 2008; Fan, 2011b). In the following sections, I will focus on analyzing China's innovation along these two dimensions.

3.2 Global Linkages

3.2.1 Interfirm Linkages

Global linkages, especially those describing relationships between firms, are mostly derived from the literature of interfirm networks, which are considered crucial to fostering innovation inside firms as well as at the regional level. Firms can increase the efficiency of their R&D as interfirm networks allow businesses to leverage their capacity and gain access to external resources, thus reducing the risk and cost of R&D (Hagedoorn and Schakenraad, 1994; Mowery *et al.*, 1996; Ahuja, 2000; Stuart, 2000). Global linkages forged by firms from developing countries are considered particularly helpful for technological upgrading because of the limited resources of local companies in developing countries. The global value chain (GVC) (Humphrey and Schmitz, 2002, 2004; Schmitz, 2004; Gereffi *et al.*, 2005; Sturgeon *et al.*, 2008) and global production network (GPN) (Dicken *et al.*, 2001; Ernst and Kim, 2002; Henderson *et al.*, 2002; Coe *et al.*, 2004; Coe *et al.*, 2008; Yeung, 2009) are two approaches that have emphasized how firms from foreign countries have been instrumental in transferring technology, particularly tacit knowledge, to local companies (Sun and Zhou, 2011). However, several studies have indicated that interfirm networks have limited impact on innovation capability, reflected either by the number of patents (Stuart, 2000), or the novelty or impact of the products (Kotabe and Swan, 1995).

It is widely acknowledged that China's economic development has closely been associated with its incorporation into the GVC or global production network (Enright *et al.*, 2005; Zhou 2008; Lin *et al.*, 2013). But what are the exact impacts of these linkages on firms' innovation capabilities? Altenburg *et al.* (2008) suggested that the opportunity to improve the innovation capabilities of local firms depends on the types of linkages forged and the power constellations within their global partners. For instance, in a captive chain, capability (knowledge-using) that goes with the lead firms' interests will be facilitated and encouraged, whereas capability directed against the interests of the lead firms (knowledge-creating) will have less chance to thrive and may even be discouraged. It is also suggested that while working with lead firms provides access to advanced technology, new design, and process, domestic linkages can be more conducive to the development of innovation capability as there is more opportunity to work with domestic consumers on design, marketing, and branding (Mitsuhashi, 2006; Navas-Aleman,´ 2006). Based on a large-scale survey of more than 1000 ICT companies in China, Sun and Zhou (2011) made interesting findings in terms of the impacts of global linkages on innovation in domestic companies compared to the impacts of domestic linkages.

First, many Chinese firms (more than half of the surveyed firms) did not have any interfirm linkages, with either domestic or foreign companies. Second, while positive impacts of interfirm linkages on firms' innovation were found, global linkages offered more benefit than domestic linkages, and firms that had both global and domestic linkages benefitted the most. Third, while more intense global linkages led to higher impacts on innovation in local firms, more intense domestic linkages caused overembeddedness and had a negative impact on firms' innovation. Finally, Chinese firms' internal characteristics and local/regional settings also affected linkages, such as: (1) internal R&D did not seem to enhance the positive impact of interfirm technological linkage on firms' innovation; (2) ownership of firms did not seem to have any impact on innovativeness or the use of interfirm linkages for innovation; and (3) the positive impact of technological linkages on innovation in firms remained the same regardless of the types of industrial hubs involved (Sun and Zhou, 2011).

3.2.2 Global Networks of Professionals and Returnees

In addition to global linkages in the interfirm network sphere, other linkages, such as global networks of professionals, have increasingly gained attention in explaining the improvement in China's innovation capability, especially after the publication of Saxenian's (2006) work on the development of Bangalore's software and China's computer industry through entrepreneurs, engineers, and scientists who originally came from China but gained substantial work experience in the USA.

In fact, China has a significant advantage in tapping into the global networks of Chinese professionals in the high-tech sector, due to the large number of Chinese students being sent to study in western countries since the economic reforms (Zweig *et al.*, 2004, 2006; Zweig, 2006; Simon and Cao, 2009). Between 1978 and 2013, more than one million Chinese went abroad for study and research (Cao, 2004; MOE, 2013) and the number has been exploding in recent years. The annual number of students who went overseas has risen nearly twenty times, from 20,000 in the late 1990s to nearly 400,000 in recent years (Wang *et al.*, 2009; MOE, 2013). The Chinese government has realized the value of this talent pool and has attempted to entice overseas talent to return to China, in the hope of repeating Taiwan's success story in the electronics industry (Li *et al.*, 2004; Fan and Watanabe, 2006). The government has initiated quite a few programs, from central government level such as the "1000 Talents Programs" and the "1000 Young Talents Program," to local governments, such as Nanjing's "321 Program," Wuxi's "530 Program," and Shenzhen's "Peacock Program." Attracting talent has become a critical task for China and other countries to develop innovative economies (Simon and Cao, 2009; Florida, 2010; Beaverstock and Hall, 2012).

Despite a plethora of literature on returnees, there are some gaps that need to be addressed to improve our understanding of how global professional networks and overseas returnees have contributed to the improvement of the innovation capability of the home countries, such as the strategies and performances of returnee companies vis-a`-vis home-grown companies, the specific global linkages that can have significant impact on innovation in returnee companies, and regional (subnational) variations in terms of locating and growing returnee companies. More studies on returnee entrepreneurs and companies that are founded or managed by returnees (returnee companies) are expected to fulfill this need in the near future (Altenburg *et al.*, 2008; Solimano, 2008).

3.2.3 R&D Globalization

Along with forging interfirm linkages with global partners, domestic Chinese firms have also started to use R&D globalization as a proactive approach to tap into the resources that global hotspots of innovation have to offer. Examining the locations, purposes, and patterns of R&D globalization has offered important insights concerning innovation by latecomers.

R&D globalization has increasingly been used to improve firms' innovation capability, boost foreign market share, attract talent, and reduce R&D cost (Niosi, 1999; Reddy, 2000; UNCTAD, 2005; Fan, 2011b). Two types of foreign R&D units should be differentiated: home-base-augmenting (HBA) and home-base-exploiting (HBE) units (Kuemmerle, 1997, 1999a, 1999b). While HBA is established "to augment firm-specific capabilities if this mode of augmenting firms' knowledge base offers higher payoffs than licensing in" (Kuemmerle, 1999a, p. 184), HBE units are set up to "exploit firm-specific capabilities if this mode of exploitation offers higher pay-off than licensing out" (Kuemmerle, 1999a, p. 184). The eclectic "ownership-location-internalization" (OLI) theory (Dunning, 1981, 1988) and the internationalization process (IP) theory (Johanson and Vahlue, 1977) are also useful to explain the locations and motivations of R&D by foreign MNCs in China and the R&D globalization of Chinese MNCs as latecomers.

The findings on Chinese firms in the telecom equipment sector indicate that although Chinese firms do not differ from established firms in terms of locations of HBA and HBE R&D units, they differ in the order and pace of development. In contrast to the IP theory, their R&D globalization has progressed simultaneously with, and even ahead of, their globalization of markets and manufacturing. These differences confirm that the R&D globalization of latecomers is not so much about exploiting the existing "ownership" advantages, like the established multinationals, but, rather, to tap into resources and markets that would otherwise be unavailable (Buckley *et al.*, 2007; Li, 2007; Luo and Tung, 2007; Niosi and Tschang, 2009). Further, as these units are particularly attractive to local skilled personnel who originally came from China, the global R&D units represent another way to tap into the global network of Chinese professionals (Fan, 2011b).

3.3 Dynamics of Catching Up of Latecomers

Latecomers, in comparison with first movers, are challenged with many disadvantages in developing their innovation capability, such as technological leadership of incumbent firms, preemption of assets, and high buyer switching costs (Lieberman and Montgomery, 1988, 1998; Kardes and Kalyanaram, 1992), but are also blessed with advantages because enhanced information and free-rider effects can save them money and time due to information spillover and learning from the experiences of first movers. Meanwhile, changes in market or consumer tastes and technological regimes, in combination with the resources, people and organization committed by first movers to meet earlier market and technology requirements, can disadvantage first movers and offer opportunities for latecomers to catch up (Richardson, 1996; Cho *et al.*, 1998; Lieberman and Montgomery, 1998). Among the literature on catching-up and technological upgrading strategies of latecomers (e.g., Hobday, 1995; Leonard-Barton, 1995), one can apply Kim's technology learning framework (Kim, 1997) to understand how China catches up in different sectors as a latecomer (Fan, 2011b) and highlight the differences between China and the earlier latecomers such as Japan and the newly industrialized economies (NIEs).

Kim (1997) observed that the technological trajectory of catch-up countries, such as Korea, is in the reverse direction to that of advanced countries. While technology development in advanced countries goes through stages of emergence, consolidation, and maturity, firms in catching-up countries move from imitation, i.e., acquiring, assimilating, and improving mature technologies from advanced countries, to innovation, i.e., eventually accumulating indigenous innovative capability and generating emerging technologies (Kim, 1997). Firms in catching-up countries can rely on three main groups of resources for technological learning: the international community, the domestic community, and in-house efforts.

However, compared to the NIEs, Chinese companies, such as those in the telecom-equipment industry, demonstrated marked differences from their peers in NIEs when they started to catch up (Fan, 2011b; Yu and Li-Hua, 2011; Gao, 2014), mainly due to the changing tradability of knowledge or technological regimes (Altenburg *et al.*, 2008) and the global economic environment. For instance, while Korean firms initially relied heavily on foreign sources for their catching-up in the automotive, electronics, and semiconductor industries, Chinese firms chose to conduct in-house R&D on switch technology, due to the high cost and unavailability of the existing technology, their lack of understanding of foreign markets and technology, and MNEs' interest in China's market. Further, situated in a dynamic technological regime and a much more integrated global economic environment, in order to compensate for their limited access to global resources, Chinese telecom firms were able to adopt some global technology strategies such as joint collaboration, participation in industrial standards (Gao, 2014), and R&D globalization at a much earlier stage of their catch-up than the Korean firms (Gao *et al.*, 2007; Fan, 2011b).

4. Regional Inequality in Innovation and Regional Innovation System

In stark contrast with the well-researched economic inequality literature, only a few studies, such as those of Li (2009), Liu and White (2001), Sun (2000, 2003), and Fan *et al.* (2012), have assessed regional inequality in innovation capability and its drivers in China. Using a primary index, a top-five index, a top-10 index and coefficients of variation to indicate spatial patterns of innovation, Sun (2000) found that patents in China were highly clustered in the east–coastal region and the inland provinces, although the degree of spatial concentration declined from 1985 to 1995. When other indicators of innovation, such as new product sales and R&D spending were used, the spatial concentration was found to be on the rise in the 1990s (Sun, 2003).

Using patent numbers from 1985 to 1995, Liu and White (2001) found that economic activity and innovation inputs (i.e., R&D funding and personnel) led to differences in the innovation performance of regions. Also using patent data from 1998 to 2003, Li (2009) illustrated that government support, share of R&D performed by universities and research institutes, and the regional industry-specific innovation environment were significant determinants of innovation efficiency. Li emphasized that the innovation efficiency between regions becomes more disparate when innovation modes are transformed from being university and research institute dominant to being firm dominant.

Fan *et al.* (2012) found that east–central–west interregional inequality increased over time from 1995 to 2006, whereas interprovincial inequality showed a V-pattern until 2003. Using a recently developed decomposition framework, they identified the major factors driving innovation inequality as population, economic development, R&D, location, and openness. The aggravated innovation inequality reflects the growth of China's innovation centers in the eastern region and their admission into the global innovation networks. For instance, 60% of the foreign R&D laboratories in China are located in Beijing, 18% in Shanghai, and 6% in Shenzhen (Yuan, 2005). The fact that R&D is a major factor driving inequality suggests that the efficiency of R&D investment improved in certain regions during the period 1995–2006. Finally, geographic location and openness affect innovation inequality primarily through the coupled evolution of innovation capability and economic development, resulting in first-mover advantages in provinces of the eastern region (Fan *et al.*, 2012).

Worldwide, cities have become the focused locations for economic development and policy intervention (Petrella, 1995; Scott, 2000), facilitated by neoliberal globalization (Harvey, 2005) and the revolution in information and communication technology (ICT) (Castells, 2000–2003). Innovation in the emerging innovative city-regions in China is an exciting field, deserving of more research. For instance, although possessing only 3.2% of the nation's population, Beijing, Shanghai, Shenzhen, and Xian together generated 11% of GDP, 30% of exports, and 24% of the foreign direct investment (FDI) in China. Further, these four city-regions occupy leading positions in the development of high-tech industries, such as ICT and biomedical industries, and they differ in their paths for developing innovation capabilities in these industries. Beijing leads in R&D capacity and is the largest base of China's high-tech industries, as it topped other cities in revenue and number of employees in high-tech parks in 2009. Depending little on foreign capital or markets, Beijing's ICT industry features a large number of small- and medium-sized domestic companies focused on software and computer services (Zhou, 2008). Shanghai possesses strong manufacturing capacity in the ICT and biotech industries, especially in the integrated circuit (IC) and biomedical sectors, with the largest, most complete, and technologically advanced IC industrial cluster in China. Most of Shanghai's high-tech manufacturing capacity comes from large SOEs and MNCs, with little contribution from nongovernmental firms due to an unsupportive institutional environment for them (Breznitz and Murphree, 2011). Shenzhen developed itself from a small fishing village in 1978 to the third largest high-tech industrialization base in China within three decades, featuring mostly domestic firms actively involved in indigenous innovation (Zhou *et al.*, 2011). Accessible venture capital from Hong Kong, the completeness of the ICT industrial value chain, and active private entrepreneurship have been cited as the basis of the prosperity of domestic high-tech firms in Shenzhen (Breznitz and Murphree, 2011). Xi'an is the fourth leading city-region in high-tech industrialization in China. While it has mainly relied on SOEs and MNCs (Segal, 2003), in recent years, the government has begun to give more support to the innovation activities of nongovernmental domestic companies.

A number of recent studies have examined industrial and technological development in China's city-regions and how regional systems have interacted with the national system (Segal, 2003; Walcott, 2003; Huang, 2008; Zhou, 2008; Breznitz and Murphree, 2011; Zhou *et al.*, 2011). By studying nongovernmental firms in Beijing, Shanghai, Guangzhou, and Xi'an, Segal (2003) noted regional variations in technological dynamism and argued that different local states accounted for these differences. He further identified the local government of Beijing as the most effective state for the development of nongovernmental firms among the four city-regions. However, his research did not touch upon interactions between MNCs and local firms (Zhou *et al.*, 2011), or the globalization of firms in these city-regions. Walcott (2003) explored the role of policies in developing science and technology parks in Beijing, Shanghai-Suzhou, Shenzhen-Dongwan, and Xi'an. She emphasized that the main differences in policies lay in those promoting MNCs versus those encouraging ties to local research entities. Her work focused on administrative policies and did not examine the technological catching-up of domestic firms through external linkages. Breznitz and Murphree (2011) also investigated the divergent regional systems in Beijing, Shanghai, and Peal-river Delta and how the inherent "structured uncertainty" in China's national and local political systems has contributed to the variations. They argued that these different systems combine to form a unique national system that uses the logic of value creation—focusing on second-generation product and process innovation through specialization in certain production and service stages, enabled by fragmentation of global production and services.

Nevertheless, they gave little attention to how successful local firms have actively sought global resources, for instance, through R&D globalization, to improve their innovation capabilities to go beyond second-generation innovation.

More academic research is necessary to address these critical gaps related to the innovation capability of China's emerging city-regions. In this respect, several approaches mentioned by McCann and Oxley (2012) can be considered as appropriate methods to further decode the mystery of innovation and regional development, such as developing conceptual frameworks to analyze the differences between regional and local innovation systems (Crescenzi and Rodr´ıguez-Pose, 2012), computing a composite index to measure the regional degree of exposure to external knowledge sources, thus indicating a region's potential capacity to access nonlocal items of knowledge (Moreno and Miguelez,´ 2012), and hierarchical or multilevel modeling of under-used firm-level datasets (van Oort *et al.*, 2012).

5. Conclusion

This paper offers a comprehensive and critical review of innovation in China in the postreform era. China's recent progress in innovation capability after the launch of its economic reforms is certainly impressive, illustrated by the dramatic improvement in input and output indicators of innovation systems such as R&D personnel, R&D expenditure, patents, high-tech and service export, and scientific and technical journal articles. Nevertheless, although improvement in quantity is always the first step in any catch-up scheme, the quality of many indicators has been questioned.

The analysis of China's development of innovation can have implications for others when applying three major theoretic frameworks: (1) system of innovation, (2) global linkages, such as GVCs, global production networks, overseas returnees, and R&D globalization, and (3) the dynamics of latecomers' catch-up processes. While China's evolution of its national innovation system has been the fundamental approach to unleashing the creativity of the "middle kingdom" in postreform years, various global linkages, enabled by the transformation of technological regimes and the global economic environment, have considerably affected China's progress towards becoming a technological superpower. However, we are in need of a better assessment of the impact of these global linkages, i.e., whether these linkages augment or undermine indigenous innovation capability and how. One interesting area that deserves further analysis is how global networks of Chinese professionals and returnees have affected this process. Moreover, being a latecomer, China's catch-up exhibits differences from its predecessors from the NIEs, such as choosing to conduct in-house R&D at an early stage but opting for a much more globally integrated approach later on, as illustrated by the telecom equipment manufacturers. More research would be welcomed in this area to provide policy recommendations for other latecomer countries or regions.

With the rise of emerging nations and the improved innovation capabilities of China and India in particular, one thing is certain: "the long-held monopoly of the west with respect to innovation will be over."[5] After decades of reform, China, along with India, is close to competing on an equal footing with leading OECD countries, such as the USA, Japan, and Germany. In addition to issues at the national level, the uneven spatial distribution of innovation capability of China needs to be taken seriously by the Chinese government, as the increased disparity in innovation capability may significantly affect China's regional economic development in today's knowledge economy. Just like its economic reform, transitioning from "made in China" to "innovated in China" can be a tough national journey with numerous opportunities and challenges unfolding along the way. China may also discover a proper model for its "innovation-driven economy" by learning from the experiences of its various city-regions in experimenting with distinct development pathways for technological upgrading.

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Notes

1.East-West Center. 2011. China not an immediate threat to U.S. technology leadership, exp ert tells the review commission. Available at http://www.eastwestcenter.org/news-center/east-west-w ire/china-not-an-immediate-threat-to-us-tech-leadership-expert-tells-review-commission, accessed on Oct. 30, 2013.

2.As of May 2014, there are five candidate countries for the EU: The former Yugoslav Re public of Macedonia, Iceland, Montenegro, Serbia, and Turkey.

3.In this section, I will focus on NSI and address RSI in Part 4.

4.China Watch. 2013. Tax benefits to fuel innovation, growth. Available at http://chinawatch. washingtonpost.com/2013/11/tax-benefits-to-fuel-innovation-growth.php accessed on Mar. 5, 2014.

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Entrepreneurship, Innovation and Institutions

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INTRODUCTION

In a context of increasing international competition and ageing populations, many Western governments feel the urge to stimulate innovation in order to secure long-term wealth creation. This means that next to the traditional economic criteria of efficiency and equity, innovation is now a more central criterion for economic policy. Innovation is also seen as a tool to move nations through economic crises more quickly and position the nations to have a stronger economy as crises ease. Economic crises may also yield an opportunity to turn destruction into the creative destruction of innovation. Several policy instruments are considered in innovation policy, ranging from investments in public R&D, subsidizing private R&D and cooperation for innovation, to stimulating entrepreneurship. The latter area is receiving increasing attention in innovation policy. The popularity of a policy instrument is not necessarily an indication of consensus about its effectiveness, or clarity about its content. Entrepreneurship is a fuzzy concept that is used in a confusing way not only in policy, but in academia as well. The same is true for innovation. Nevertheless, there are multiple arguments that innovation is a key mechanism through which entrepreneurs drive economic growth (see, e.g., Audretsch et al., 2006; Baumol, 2002; Landes, 1998; Rosenberg and Birdzell,1986).

In this chapter we provide a definition of entrepreneurship in the context of innovation, and discuss its role within a cycle of innovation. This cycle of innovation reflects the growth of knowledge in society: innovation is based on the knowledge base of a society and expands this innate knowledge base (cf. Nooteboom, 2000; Metcalfe, 2002). Increasing the set of future economic choices seems to be a reasonable policy in a context of radical uncertainty (Moreau, 2004, p. 866):

One of the main roles of public policy is indeed to minimise the risks of technological or behavioural lock-in by maintaining some diversity among the characteristics of market participants and thus in the economic trajectories followed. The central policy problem becomes that of increasing the probability and the profitability of experimental behaviour. Thus the attention of the evolutionary policy-maker shifts away from efficiency towards creativity. Nelson and Winter (1982) underline that when the neoclassical hypothesis of a given opportunity set is elaxed, the role of the state becomes to discover and to extend this opportunity set rather than to choose among this set to maximise a hypothetical social welfare function.

Different types of innovation along the cycle of innovation are realized with different forms of entrepreneurship, which are constrained or enabled by different legal institutions. One of the key roles of governments is to design, change or destroy institutions in order to improve societal welfare. Governments typically have the authority to do this. We explicitly take the destruction of institutions into account, because (a) it is often much harder to abolish institutions than to create them, and (b) ‘inefficient economic institutions are the rule, not the exception’ (North, 1990a, p. 191). The question is what governments should do in the context of innovation policy. Here, social scientists can make a contribution by providing insight into what entrepreneurship and innovation are (theories about these phenomena), and how institutions affect them in reality (empirical evidence about their effects). This requires social scientists to be engaged scholars (cf. Van der Ven, 2007) and to provide new policy options as an honest broker between the academic world and the policy world (Pielke, 2007). With respect to institutions, the demand for social science knowledge is derived from the demand for institutional change (Ruttan, 2006; 2008). Advances in social science could then be useful in policy practice. The key question of this chapter is: how can policy best enable innovation-based entrepreneurship? The answer is derived from looking at both theoretical tenets and empirical evidence using an institutional design perspective, which aims at providing arguments for the design, change and/or destruction of institutions, given the goals of the governments. This perspective is closely linked to the new institutional economics (North, 1990b; Williamson, 2000) and mechanism design theory (Cramton, 2008; Myerson, 2008; Ruttan, 2008).

Traditionally economics deals principally with institutions in a minimal form, e.g. The necessity of institutions that secure property rights for markets to work. New approaches recognize that different institutions are appropriate in different circumstances, and deal with the positive and normative aspects of institutional diversity (cf. Djankov et al., 2003). According to the institutional economic approach to entrepreneurship, the rules of the game (institutions) that specify the relative payoffs to different entrepreneurial activities play a key role in determining whether entrepreneurship is allocated in productive or unproductive ways (Baumol, 1990; cf. Murphy et al., 1991).

From a policy perspective the issue at stake is how to design an innovation policy that targets but does not attempt to predetermine the outcomes of industrial development (as was the case with state investment planning in targeted industrial policies). This kind of innovation policy design falls between the targeted industrial policies that are (to some extent) determined by special interest groups on the one extreme, and general economic policies (like fiscal incentives for innovation investments and public investments in education and research) at the other. Targeted industrial policies are a reflection of a belief in the ability to optimally plan the allocation of resources in society. This is at odds with the fundamentally uncertain and unpredictable nature of innovation. The latter characteristics do not preclude any role for government, however. The role of government is to design institutions that enable the creativity that facilitates innovation, ultimately supporting economic progress (cf. McCloskey, 1997). From an institutional design perspective, social science knowledge can play an important role in the rational design of institutional reform and institutional innovation. This chapter starts with a discussion of the nature of entrepreneurship and its relation to innovation. The next section provides a conceptual elaboration of innovation along a cycle in which exploration and exploration follow upon each other: this goes beyond the Schumpeterian notion of the innovation process that runs from exploration to exploitation only. We place the roles of entrepreneurship in innovation policy within this cycle of innovation. After these conceptual investigations of entrepreneurship and innovation, institutions move centre stage. In this final section we provide overview of some (empirically tested) institutions that enable or restrain particular types of entrepreneurship. Examples of these institutions are intellectual property rights and the Small Business Innovation Research programme (for new technology-based firms), employment protection (for high-growth start-ups) and non-compete covenants (for spin-offs).

ENTREPRENEURSHIP AND INNOVATION

What is meant by entrepreneurship and how does it relate to innovation? Entrepreneurship and innovation are fuzzy concepts with multiple meanings. Innovation and entrepreneurship are often regarded as overlapping concepts. This can be traced back to the definition entrepreneurship put forward by Schumpeter (1934, p. 74), who defines entrepreneurs as individuals carrying out new combinations (i.e. innovations). Schumpeter distinguishes four roles in the process of innovation: the inventor, who invents a new idea; the entrepreneur, who commercializes this new idea; the capitalist, who provides the financial resources to the entrepreneur (and bears the risk of the innovation project); and the manager, who takes care of the routine day-to-day corporate management. These roles are usually filled by different individuals (see, e.g., Kenney, 1986). The literature on entrepreneurship recognizes a variety of entrepreneurial roles in economic change, all implicitly carrying with them an economically positive connotation. However, if entrepreneurs are defined to be persons who are ingenious and creative in finding ways that add to their own wealth, power and prestige (Baumol, 1990), then it is expected that not all activities will deliver a productive contribution to society (cf. Murphy et al., 1991). There are various of other reasons why many entrepreneurs do not directly contribute to an increase in national income: some entrepreneurship is more adequately characterized as a non-profit-seeking activity (cf. Benz, 2006). Greater independence and self-fulfilment are more often mentioned as important motivations to become self-employed than increasing earning power (EOS Gallup, 2004). Empirical studies show that (on average) entry into self-employment has a negative effect on the monetary income of individuals (Hamilton, 2000; Parker, 2004). Being an entrepreneur may be rewarding because it entails substantial non-monetary benefits, like greater autonomy, broader skill utilization, and the possibility to pursue one's own ideas; i.e. more freedom (cf. Sen, 1999). These wide-ranging effects of entrepreneurship are reflected in the various aims of entrepreneurship policy, ranging from employment growth (lowering unemployment), flexibility of the economy, innovativeness of the economy, individual development, emancipation of females, and integration of ethnic minorities into host societies.

There are dozens of definitions of entrepreneurship (Hebert and Link, 1989; Thurik and Van Dijk, 1998). There is certainly no one answer to the question of what the phenomenon of entrepreneurship 'truly' is. Rather than looking for any essentialist, 'really true' definition of entrepreneurship, we prefer to study different forms and functions of entrepreneurship. Taking all entrepreneurship definitions together, they broadly reflect two relatively distinct (but partly overlapping) phenomena (cf. Davidsson, 2004). The first of those is the phenomenon that some people, rather than working for somebody else under an employment contract, strike out on their own and become self-employed.

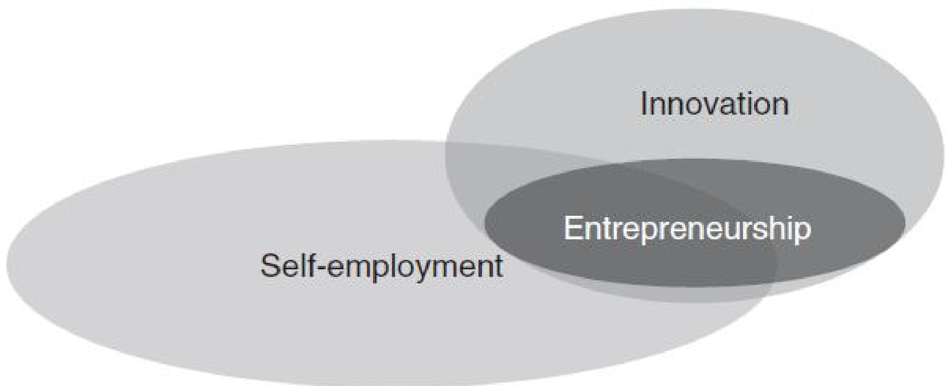

Figure 26.1 Entrepreneurship, innovation and self-employment

This involves some element of innovation at start-up, and some degree of innovativeness is needed to survive. However, innovation is not central to this phenomenon. The second phenomenon involves the development and renewal of any society, market, economy or organization based on micro-level actors who have the initiative and perseverance to make change happen. Here, 'entrepreneurship' means the creation of new economic activities and organizations ('Schumpeterian entrepreneurship') as well as the transformation of existing ones ('corporate entrepreneurship').

In the context of this chapter we focus on this second phenomenon, 'entrepreneurship'. Some self-employed are innovative but most are not, and it is innovation that we are interested in. In order to narrow down the discussion, we propose a working definition of entrepreneurship as 'the introduction of new economic activity by an individual that leads to change in the marketplace' (cf. Davidsson, 2004). Change in the marketplace generally entails new kinds of value for users, or new ways to provide or deliver existing values. This means that we exclude some other interpretations of entrepreneurship (as non-innovative self-employment) and parts of the innovation phenomenon (see Figure 26.1). For example, we exclude non-market activities such as not-for-rofit endeavours, changes in contract (e.g. from employee to self-employed) and internal, administrative or organizational changes that do not appreciably affect markets, but include intrapreneurship that is driven by individual action and changes the marketplace. We also exclude mere contemplation of new ideas or introduction of fatally flawed ones that do not change the market (directly or indirectly, via learning mechanisms). We thus do not include novelty and creativity in all domains of human behaviour in our concept of entrepreneurship.

Consistent with our definition of entrepreneurship as the introduction of new economic activity by an individual that leads to change in the marketplace, we can formulate several necessary conditions for entrepreneurship (cf. Shane, 2003, pp. 6 – 8): existence of entrepreneurial opportunities (environmental changes: technological, political/regulatory, social/demographic); difference between people (in their willingness and ability to perceive and act upon an opportunity); risk bearing: does demand exist? Can the entrepreneur compete with others? Can the value chain be created? etc.; organizing (realizing the opportunity); either creating a firm, adapting a firm, or using the market mechanism (e.g. licensing); innovation: recombination of resources into a new form that is by implication not a perfect imitation of what has been done before, and thus involves a change in the marketplace.

Entrepreneurial Opportunities

Because the range of options and the consequences of exploring new ideas are unknown, entrepreneurial decisions cannot be made through an optimization process in which mechanical calculations are made in response to a given set of alternatives (Baumol, 1993). People must be able to identify new means – ends relationships that are generated by a given change in order to discover entrepreneurial opportunities. Even if a person possesses the prior information necessary to discover an opportunity, he or she may fail to do so because of an inability to see new means – ends relationships. Unfortunately, visualizing these relationships is difficult. History is rife with examples in which inventors failed to see commercial opportunities (new means – ends relationships) that resulted from the invention of important technologies – from the telegraph to the laser.

Every entrepreneur who starts a new business has ideas. The real challenge is to discover an opportunity that is more than just a simple idea. These opportunities can be radical (Schumpeterian) or incremental (Kirznerian). Entrepreneurial opportunities may originate from changes in the environment. These can be technological, social, demographic, political or regulatory changes, but also general shocks to the economy (cf. Shane, 2003). First, technological change, often based on progress in the research base of society (e.g. biomedical knowledge, or nanotechnology), is a prime source of entrepreneurial opportunities for new technology-based firms. Together social and demographic changes can be quantitative changes, such as ageing population that offers new opportunities for entrepreneurs. It may also involve more qualitative changes: changing preferences or wants, for example reflected in the increase in the creative industries that satisfy new wants, or in the trend towards health and nutrition with its resulting demand for the supply of diet and organic food. In that sense people's necessities are few but their wants are endless. Finally, political and regulatory changes, such as deregulation, privatization and liberalization, open up opportunities for entrepreneurship. Examples of privatization as sources of entrepreneurial opportunities are the outsourcing of municipal services and the privatization of the health-care market, which have provided opportunities for high-growth start-ups.

Until now, we have largely left the definition and the discussion about the nature of innovation implicit. We deal with explicitly it in the next section.

CYCLE OF INNOVATION

Innovation is about the development of new knowledge introduced to the economy. This means that it starts with the cognition of the actors involved. This cognition is constructed from interactions of practices (see Nooteboom, 2000, 2008). Based on this insight, we arrive at an innovation process as a cycle or spiral of idea generation followed by development, commercialization, market penetration, diffusion, consolidation and differentiation, which lead to the beginning of invention. Thus this cycle of innovation goes beyond (neo-) Schumpeterian theory, which includes only the notion of invention as new combinations, and the subsequent commercialization and production (Schumpeter, 1934). Where new combinations come from in invention is left unexplained. We see innovation as a cumulative process with discontinuities: today's innovation stands on the shoulders of yesterday's innovation, to paraphrase Merton (1993). Innovation is highly cumulative – building on earlier inventions, development and applications – but also discontinuous in its creative destruction. This nature of innovation – and growth of knowledge more generally – explains why the economy is never in equilibrium (Metcalfe, 2002). The cycle of innovation explains how exploitation and exploration succeed each other and emerge from each other (see Figure 26.2).

The proposal of a cycle of discovery (Nooteboom, 2000) was originally inspired by the work of Piaget on the development of intelligence in children.4 Here it is applied at the level of firms, products and technologies within economies. How can such a shift of the level of analysis be justified? The claim here is that the cycle goes beyond empirical phenomena of child development. It represents a more general 'logic' of composition and break-up on the basis of experience, in an alternation of reducing variety of content, in the move towards consolidation (the upper half of Figure 26.2), an opening up of variety of context, in generalization (the lower half of Figure 26.2), which leads on to a renewed opening of content, in novel combinations. A basic idea of the cycle is that application of existing knowledge and competence in novel contexts (e.g. new applications of theory and technology, new markets for existing products, new jobs for people), called 'generalization', leads to 'differentiation' of existing practice for the sake of adaptation to the new selection environment. The new selection environment offers room to deviate from the previously consolidated institutions that resulted from a previous innovation. In adapting a product or practice to new conditions, one first taps into earlier experience about how things might be done differently, based on experience from earlier rounds of innovation. If differentiation does not suffice in order to survive, or to profit from newly emerging opportunities, a further step is to allow oneself to be inspired by foreign practices encountered in the new environment, which appear successful or promising where one's own practice seems to fail. This leads to experiments with combinations of known elements from existing practice and new elements from unfamiliar, local practices, called 'reciprocation'. This yields hybrid practices. The history of technology offers many examples of the importance of hybrids in the development of radical innovations (Mokyr, 1990). The significance of hybrids is that they allow one to explore the potential of novel elements without immediately surrendering the basic logic, structure, design principles or architecture of established practice. The problem with hybrids is that they yield inefficiencies and inconsistencies in the system ('spaghetti'), with overlaps, redundancies, misfits and 'work-arounds' to resolve them. That leads to more radical, architectural change, in Schumpeterian 'novel combinations'. The period of hybridization gives insight into the elements one would most like to preserve, given their performance in the hybrid, and the logic and architectural directions in which one might go in the future. Here, at this stage, small changes in design principles or basic logic can yield drastic changes in the functioning of the whole. At the same time, the inefficiencies and contradictions of hybrids also form a stumbling block: they may be seen as evidence of failure and lack of perspective for the innovation. Progress then depends on the perseverance of the entrepreneur or inventor. Also, the inefficiencies of reciprocation and hybridization are difficult to sustain under the pressures of competition. This frequently leads to failure – because problems do indeed prove to be insurmountable or ongoing efforts and uncertainty cannot be sustained – but occasionally it leads to a breakthrough. The cyclical process of innovation indicates how one can set out in exploration along a path of exploitation. Crucial for the process, in the stages of generalization and reciprocation, is the opening to novel contexts, with new challenges and opportunities, and openness in the form of curiosity and attention to unfamiliar practices and perspectives, and the willingness and opportunity to engage in experiments, and tolerance of the problems with hybrids. The cycle is illustrated in Figure 26.2.

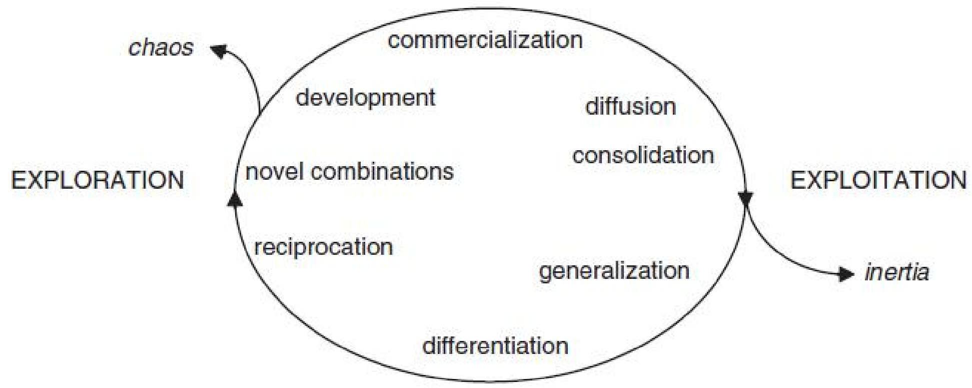

Figure 26.2 Cycle of innovation

So far, the discussion of the cycle concerns the bottom half of Figure 26.2, in the transition from exploitation to exploration, which is relatively new in the innovation literature. The top half of Figure 26.2 is more consistent with established innovation theory. Along the top half, in the emergence of a new idea or practice, in a novel combination, there is search for technical feasibility and commercial viability5 of a new technology6 or product and its optimal configuration, in the emergence of what in the innovation literature is called the 'dominant design' (Utterback, 1994; Geroski, 2003). This leads to what is called 'consolidation'. In that process, if a breakthrough of an innovation succeeds, it faces the need to replace old practices: in Schumpeterian terms, 'creative destruction'. Here, one runs into the problem that existing institutions, in the form of standards and regulations (technical, safety, commercial, fiscal, legal, administrative), market structures (distribution channels, installation, maintenance, repair), schooling and training, as well as established commercial positions, which form the existing selection environment, can block entry and change. In other words, in order to break through, innovation requires institutional change. As a result, due to institutional barriers, radical innovations can often break through only later, and initially can succeed only where they can be fitted into the prevailing order of existing institutions and market structures. They need to prove their worth and their potential more extensively before obstacles can be cleared. It is a well-known phenomenon that innovations initially do not find their application where their potential is highest but where the obstacles are lowest.

Hence openness of markets for new product entry, with a critical attitude towards established interests and institutions, is an issue for innovation policy. One policy implication is that enabling entrepreneurs goes beyond helping them to find their way through the thickets of rules and regulations. It also requires gathering insights as to how obstacles may be changed to accommodate the shifts of innovation.

In the movement towards consolidation, goals, means and causal relationships between them become clear. As uncertainty decreases and familiarity with the novelty increases among potential users, demand increases, new producers jump into the emerging market, and price competition intensifies. Pressure on price creates pressure towards efficiency, on the basis of process innovation (by large firms: see Falck, 2009). For pressures towards efficiency, standard economic analysis applies. Market mechanisms are needed to ensure optimal allocation of scarce resources (allocative efficiency) to known goals and means. In the drive towards efficiency, opportunities are taken to increase productive efficiency, by increase of scale, enabled by growing demand, which leads to concentration and the 'shake-out' of less efficient producers. Here, usually in competition policy, mechanisms are oriented towards removing barriers to entry (see Audretsch et al., 2001).

The fall of profits, in the transition from product innovation to process innovation during consolidation, yields an argument for trying to be a leader in the early stage of innovation, because thereby one captures the high profits of early partial monopoly before imitation sets in (cf. Schumpeter, 1942). As a follower, one enters at the stage of consolidation, where users profit from lower prices, but high profits have eroded. Furthermore, early leaders may construct entry barriers to followers. As the history of capitalism has shown, only an extremely small percentage of all start-ups make it to the position of industry leader (e.g. Microsoft, Apple, Cisco and Dell in ICT industries).

Ongoing progress throughout the cycle is by no means guaranteed. The cycle is not to be seen as a logically necessary sequence but as a heuristic that generally works. In trying novel combinations, one may get caught in ongoing uncertainty and chaos (see Figure 26.2), unable to settle the inconsistencies between new goals, means and connecting causalities. Prototypes, may continually fail to become viable, either technically or commercially. Rival designs, prototypes or technical standards may continue to compete for a long time, and for the duration potential users are hesitant to commit themselves. After consolidation, one may get caught in inertia (see Figure 26.2), particularly if there are no opportunities or incentives to escape to new contexts of application, or barriers to novel conditions being imposed from outside. In consolidation, institutions shift to accommodate the innovation, and once that has happened there are often strong pressures towards 'isomorphism' (DiMaggio and Powell, 1983), with strong pressures to conform, by 'coercion, mimesis (imitation) or normative pressures'. Vested economic interests protect existing institutions with installed bases of both tangible and intangible investments, existing competencies and efficiencies (accumulated in learning by doing), as well as market positions. Therefore innovation requires openness to novel contexts of application, e.g. global markets, or new users or suppliers, as arenas for exploration and sources of novel challenges. Stages of the cycle may be skipped, in a leap to novel combinations without much intervening differentiation or reciprocation. The process may not proceed beyond any given stage. For example, differentiation, as a step in exploitation, may not proceed to reciprocation and novel combinations.

Note that progress along the cycle is full of stress and potential conflict. In order to survive in novel contexts, innovators need to adapt their existing practices. In novel combinations, innovators encounter stress in trying to have their innovation accepted, and established practices encounter the stress of creative destruction.

The cycle of innovation provides the dynamic basis for the systemic view of innovation and innovation policy, in which innovation policy is concerned with stimulating and matching the knowledge-producing elements (exploration) and knowledge-exploiting elements (exploitation) of an economy. The cycle of innovation operates, more or less perfectly, depending on institutional conditions that inhibit or enhance the componentprocesses of generalization (opening up to new contexts); differentiation (deviation from established practice to survive in the new context); reciprocation (opening up to contributions from unfamiliar ideas or practices); experimentation with hybrids and new principles, interpretive schemes or architectures; convergence to a dominant design; and institutional change to accommodate the novelty. Innovation policy is not about the determining the content of innovation, but about enabling innovation processes. Crucial in this policy is the opening to new contexts with new challenges and opportunities, opening to collaboration for the exploration of novel combinations, opening in the form of curiosity and attention to foreign practices, and the preparedness to engage in experiments with elements from those and with surprising hybrids.

Entrepreneurship in the Innovation Cycle

It is customary to distinguish between equilibrium-breaking, Schumpeterian entrepreneurship that yields 'creative destruction', and 'Kirznerian' entrepreneurship (Kirzner, 1973), which finds new market niches for existing or adapted products, in a process of what economists call 'arbitrage', and thereby tends towards equilibrium. We can recognize this in the cycle of innovation: the movement towards consolidation can perhaps be seen as equilibration, and the movement away from it as disequilibration. Instead of two kinds of entrepreneurship, we can identify a larger range of types, all along the cycle of innovation. Thus there are entrepreneurs who make a new idea technically feasible, commercially feasible, productively efficient (e.g. Henry Ford in the automobile industry), eliminate entry barriers, carry it into new markets or applications, differentiate it, bring in new elements, in hybrids, or bring together elements from different practices in new architectures and thereby produce new concepts.

Note that in the step of generalization the actor who takes an existing product or practice into a new context is not necessarily an existing producer or practitioner. It may be an outside entrepreneur or user stepping in, or an employee spinning off from an existing firm, adopting the product or practice with his own specific experience and perspective. This, however, may already happen prior to consolidation, so that exploration may set in when exploitation has not yet settled down. Entrepreneurs adopting the innovation will inevitably, and not necessarily deliberately, colour their use of it according to their perspective, and seeing that the product is on its way to widespread diffusion and consolidation, with an erosion of profit, may already differentiate it deliberately. What we are saying here is that disequilibration may take place even during equilibration, which seems to make nonsense of the very notion of equilibration. Why would entrepreneurs move towards equilibrium if they know that it will erode profits?

INSTITUTIONS ENABLING/CONSTRAININGENTREPRENEURSHIP

The economy would be in chaos without institutions,8 one might even argue that economics – production, distribution and consumption – would not exist without institutions. Institutions are the rules that constrain behaviour – and in that way often reduce uncertainty, and transaction costs in particular, and enable (inter)actions. The most basic institutions that enable capitalist economies are property rights and the rule of law. In this paper we focus on how entrepreneurship, specified along the cycle of innovation, is enabled and constrained by institutions. A key question is which (formal) institutions governments should design to enable entrepreneurship, i.e. the introduction of new economic activity by an individual that leads to change in the marketplace. In practice, institutions are often not the product of intentional design,9 and are often the outcome of a political process in which the interests of many stakeholders have to be satisfied. However, that does not mean that there is no scope for institutional design.10

The relationship between institutions and entrepreneurship seems paradoxical, as the former reduces uncertainty in order to enable behaviour (North, 1990b), while the latter involves judgement under uncertainty (Knight, 1921; Casson, 2003). This paradox is resolved by distinguishing different types of uncertainty (cf. Milliken, 1987; Van Waarden, 2001). For example, financial institutions are necessary to let financial markets work, so that entrepreneurs can acquire capital for investments with uncertain future returns. The latter uncertainties relate to whether the new product is technically viable, commercially viable, and whether the firm will not be outcompeted by rivals, while the former institutions for example reduce the uncertainties related to the value of money and creditworthiness of firms. Furthermore, institutions may also constrain the making of constraints and enable escape from constraints, creating uncertainty by keeping avenues towards innovation open, as in competition policy, or other elimination of entry barriers, which create the uncertainty of novel entry into markets.

The question of which institutions governments should design to enable entrepreneurship is not about more or less state or market, since markets require institutions that often only states can construct; it is about how the state can enable entrepreneurs to change the market. This also means that it might have to design institutions that constrain vested interests, or to abolish institutions that serve vested interests, in order to let entrepreneurs flourish.

In order to focus our discussion of how institutions affect entrepreneurship, we shall discuss particular types of entrepreneurship that according to the literature have relatively strong positive effects on economic growth: new technology-based firms, spin-offs, and high-growth start-ups. Spin-offs and new technology-based firms are likely to be better indicators of exploitation of unused ideas than the general population of new firms, while they may also be involved in the exploration of ideas that have emerged out of the former exploitation of knowledge. High-growth start-ups are even stronger indicators of successful exploitation on a relatively large scale.

Table 26.1 Types of entrepreneurship and legal institutions

Type of entrepreneurship	Position at the cycle of innovation	Legal institutions	Enabling/constraining effects
New technology-based firms	Novel combinations	Intellectual property rights	Markets for technology
New technology-based firms	Novel combinations – development – commercialization	Small Business Innovation Research (SBIR) programme	Sourcing of radical small firms innovations; commercialization of public research
Spin-off firms	Generalization, differentiation	Non-compete covenants (labour market)	Exploitation of ideas
High-growth start-ups	Commercialization – generalization	Employment protection (labour market)	Reallocation of labour

New Technology-based Firms and Patents

Entrepreneurs wanting to develop new technologies and introduce them to the market face Arrow's disclosure problem (Arrow, 1962): the value of a new technology to any one buyer may be decreasing in the number of other potential buyers who have been able to evaluate the new technology due to information leakages in the valuation process (value rivalry). There is thus a risk of expropriation of the 'rights' to use this new technology of the inventor if this invention has not been registered and protected by patent rights. The enforcement of patents or licensing agreements acts as an entry barrier that significantly reduces the potential for user reproducibility. Patent rights explicitly prevent would-be buyers from using the idea for commercial gain without the permission of the technology seller. The legal institution that solved this disclosure problem is the protection of intellectual property rights via patents (see Gans and Stern, 2009). New firms that specialize in the development of new technologies can thus claim the property rights of the inventions involved and gain from trading the use rights of this invention with licensing on a market for technology (cf. Arora et al., 2001). The availability of intellectual property protection by patents has been instrumental in the rise of the number of new firms in knowledge-intensive sectors like biotech and R&D services.

New Technology-based Firms and SBIR

The Small Business Innovation Research (SBIR) programme is a public procurement programme aimed to subcontract socially relevant (i.e. fulfilling a public need) innovative research to small businesses. The programme's central goals are (1) meeting federal research needs with small business and (2) fostering commercialization of federally funded research (Cooper, 2003). The US Congress enacted the SBIR programme in the early 1980s as a response to the loss of US competitiveness in global markets, especially in the face of the 'Japanese threat' (see Audretsch, 2003). The birth of the SBIR programme was the result of lobbying activities by the National Science Foundation (NSF) and the Small Business Administration (SBA) (Obermayer, 2009). There was no clear design, but the programme was constructed and evolved through a trial-and- error process taking into account both the political and administrative viability of the programme. The US regulation underpinning the SBIR programme requires that 2.5 per cent of all federal government agency external R&D budgets be distributed to small innovative businesses. Each year the SBIR programme makes more than 4000 awards to US small businesses, amounting to over $2 billion in value (Connell, 2006). The SBIR consists of three phases: feasibility, development and commercialization. Phase I is oriented towards determining the scientific and technical merit (technological creativity) along with the feasibility (economic creativity) of a proposed research idea. A Phase I award (typically around $100 000) provides an opportunity for a small business to establish the feasibility and technical merit of a proposed innovation. This is a step generally ignored by private venture capital. Phase II awards are more selectively aimed at developing new technologies and products, which involves about 50 per cent of the phase I award winners, and delivers up to $750 000. Phase III awards are funded from mainstream (i.e. non-SB IR budgets), and add probably again as much as Phase I and II in total to overall R&D expenditure on SBIR projects (Connell, 2006). These Phase III projects also bring small businesses the opportunity to win valuable sole supplier contracts with federal agencies. Some of the most innovative US companies, like Genzyme, Amgen, and Genentech – all three university spin-offs – as well as Apple Computer, Compaq, Intel and Qualcomm received early-stage SBIR finance. Lerner (1999) shows that SBIR-funded firms enjoyed substantially greater employment and sales growth than other similar firms. It is not just the size of the subsidy that is important for the recipients: these awards also have an important certification function, increasing the trustworthiness of the recipients (Lerner, 1999; cf. Toole and Turvey, 2009). This implies that the programme's project review and selection process identifies the quality of projects and firms, so that information asymmetries are reduced that are normally an important cause of the failure of financial markets to provide investment capital to these projects and firms.

From an innovation policy point of view, the SBIR programme has the general purpose of stimulating technological innovation, and the more specific purpose to tap into the pool of innovative potential of small businesses to meet federal R&D needs on the one hand, and to increase private sector commercialization of inventions derived from federal R&D; i.e. to stimulate novel combinations, technology development and commercialization in the innovation cycle. The evolutionary design of the programme facilitates maximum experimentation, with minimal financial losses per experiment. The programme also reduces the inherent uncertainty involved in technological innovation concerning the functionality of the technology, the ability to produce new technology-based products, and the demand for the new product. In combination with providing 'venture capital' for product development, the SBIR programme reduces multiple barriers to technological innovation that are said to be especially harmful for new and small technology-based firms (cf. Hall, 2002).

The programme reduces the typical large-firm bias in public procurement. Public procurement in general, and innovation procurement in particular, favours large firms for logical reasons: due to accountability of these larger and often long-established parties, and the relatively low transaction costs for government procurement to a small set o large established firms. Procurement to a large set of small and new firms incurs more search costs, contract costs and control costs. This problem is even more severe when the 'product' subcontracted involves high uncertainties and many intangible assets, as is the case with subcontracting of innovative research. However, the downside of subcontracting to large established firms is that relatively incremental innovations will be sourced, due to the small variety of potential innovations, and the relative inert nature of larger, long-established firms. The problem then is how to source more radical forms of innovation, and solving the two (capital and product) market problems for new tech-based firms. The SB IR programme turned out to be an institutional change that solved these problems.

Spin-offs and Non-compete Agreements

Spin-off firms are a specific form of employee mobility, in which employees leave their former employer to pursue opportunities in their newly created and owner-managed legal entity. These entrepreneurs introduce ideas from their prior work experience to new contexts (generalization), and sometimes substantially differentiate these ideas in order to adapt to new selection environments (differentiation). A number of studies show that one particular legal constraint on employee mobility – employee non-compete agreements13 – lowers the ability of employees to move from one firm to another (Gilson, 1999; Fallick et al., 2006; Marx et al., 2009). These employee non-compete agreements are intended to help firms protect their investments in human capital, intellectual property14 and relationships: firms can increase their productivity by training their workers, by developing new products and processes, as well as by building valuable relationships with customers and suppliers (see Franco and Mitchell, 2008). These non-compete agreements may also reflect the vested interests of incumbents that want to restrict the possibility of employees striking out on their own, and exploiting their knowledge outside the former employer. In this respect, employee non-compete agreements may be a constraint on the creation of spin-off firms, which has been confirmed by several studies (Stuart and Sorenson, 2003; Samila and Sorenson, 2009).

High-growth Start-ups and Employment Protection

Labour market regulations leading to large hiring and firing costs are negatively associated with new firm formation (Van Stel et al., 2007). This finding might reflect different mechanisms: relatively high opportunity costs for employees to become self-employed, constraints on the flexibility of highly uncertain innovative start-ups, orpotential problems with attracting personnel for a growing new venture.

There is some empirical evidence for all three mechanisms: Robson (2003) found that stricter employment protection legislation in OECD countries reduces self-employment; Bosma et al. (2009b) found that the probability of individuals in European countries to start an innovative firm is negatively related to the strictness of employment protection, and Bosma et al. (2009a) found the same relation for the probability to start a new firm with high growth expectations. See Henrekson and Johansson (2009) for an extensive discussion of the effects of labour market institutions on the prevalence of high-growth firms.

An overview of the reviewed institutions and their place along the innovation cycle is shown in Figure 26.3.

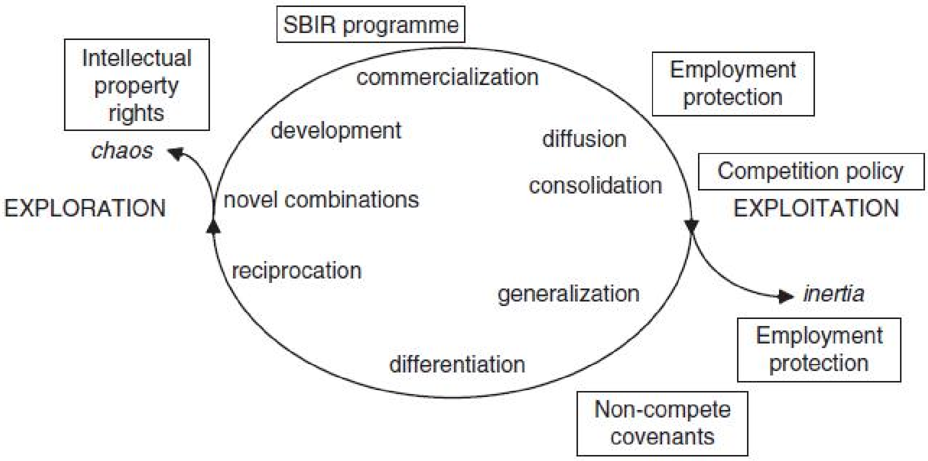

Figure 26.3 Institutions along the cycle of innovation

CONCLUSIONS

In this chapter we provide a definition of entrepreneurship in the context of innovation, and discuss its role in a cycle of innovation. This cycle of innovation reflects the growth of knowledge in society: innovation is founded on the knowledge base of a society and xpands this knowledge base. Different types of innovation along the cycle of innovation are realized with different forms of entrepreneurship, which are constrained or enabled by different institutions. One of the key roles of governments is to design, change or destroy institutions in order to improve welfare in society. The key question of this chapter is: how can policy best enable innovation-based entrepreneurship? We take an institutional design perspective, which aims to provide arguments for the design, change and/or destruction of institutions, given the goals of government. This is illustrated by how four different formal institutions enable or constrain different types of entrepreneurship through the innovation cycle. These illustrations also show that it is not fruitful to see these institutions as either designed or as evolving spontaneously: the selection and consequential design and creation of institutions is both intended and unintended, which means that institutional learning becomes crucial.

The translation of scientific insights into the world of policy practice has several caveats. First, the success of institutional design in the context of innovation policy remains uncertain due to unforeseen interdependencies and unintended side-effects. Bringing the nuances and contingencies in the effects of institutional change centre stage might constrain the adoption of these insights into the world of policy practice. However, this should not be a licence for the exclusive use of slogans and sound-bites in the policy debate. The message should be simple enough to be communicated to a broad non-scientific audience, but should have enough causal depth and contextual sensitivity to avoid harmful translations of academic insight.

The second caveat concerns the dangers of evidence-based policy. Evidence-based in social sciences means building on academic publications in social science fields. In contrast to, for example, the research field of medicine, replication research is not greatly valued in social sciences (cf. Davidsson, 2004, ch. 9; Evanschitzky et al., 2007). There is a tendency to publish success studies, thus undersampling failures or zero-effect outcomes (cf. Denrell, 2003). This means that the social science knowledge base on the effects of institutions on entrepreneurship and innovation more broadly is not likely to be an unbiased pool of insights for the design of institutions. In order to become a reliable pool of insights, social sciences should become more like the medical sciences and emphasize replication studies (over time and different contexts), and engage as scholars with the actors involved in order to uncover the ways in which institutions affect their behaviour (cf. Van de Ven, 2007).

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Intrapreneurship Versus Entrepreneurship in Eigh and Low Income Countries

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INTRODUCTION

Cross-country comparative studies on independent new businesses (Arenius and Minniti 2005, Bowen and De Clercq 2008, Koellinger 2008, Stephan and Uhlaner 2010, Terjesen et al. 2013, Wennekers et al. 2005) and studies on new business development within existing organizations (Pinchot 1985, Kanter 1988, Lumpkin and Dess 1996, Kuratko 2007) have developed along separate paths in business and management studies.

Entrepreneurial behaviour within existing firms (intrapreneurship) has remained beyond the bounds of empirical research on national variations in entrepreneurship, because comparable data on intrapreneurship has not been available until now. This means that the study of the effects of the national environment on the individual level trade-off between new business creation and intrapreneurship has been off the map of academic research. This lack of insight into intrapreneurship at the national level creates the risk of reaching conclusions on the prevalence and causes of entrepreneurship that are based only on a limited part of this phenomenon. It might also lead to misplaced interpretations about the effect of national level economic development and institutions on entrepreneurship, and to ill-guided policy recommendations regarding entrepreneurship.

This chapter provides some first cross-national evidence on the preva-lence of intrapreneurship, based on a unique empirical investigation in which eleven countries across a wide range of economic development levels participated. It makes two distinct contributions to the literature. Firstly it provides international comparative research on intrapreneur-ship in high and low income countries, making it possible to explore the effect of the macro context (in particular, levels of economic development) on the prevalence and nature of intrapreneurship. Secondly the chapter also explores the relationship between these two types of entrepreneurial behaviour at the individual level.

We first briefly discuss the nature, process and scope of intrapreneur-ship, combining insights from two strands of literature on employee behaviour inside existing organizations, i.e. proactiveness and innovative work behaviour with insights from the literature on early- stage entrepre-neurial activity. Subsequently we discuss possible micro and macro level relationships. Next, after discussing the questionnaire and the sample, we present the empirical results of this first cross-national study into intrapreneurship. The chapter concludes with a discussion of these first results, an exploration of other possible underlying mechanisms and some suggestions for future research.

DELINEATING INTRAPRENEURSHIP

Intrapreneurship refers to initiatives by employees in organizations to undertake new business activities. Although intrapreneurship is related to corporate entrepreneurship, these concepts differ in the following sense (Antoncic and Hisrich 2003, Sharma and Chrisman 1999). Corporate entrepreneurship is usually defined at the level of organizations and refers to a top-down process, i.e. a management strategy to foster workforce initiatives and efforts to innovate and develop new business. Intrapreneurship relates to the individual level and is about bottom-up, proactive work-related initiatives of individual employees.

Intrapreneurship is a special type of entrepreneurship and thus shares many key behavioural characteristics with this comprehensive concept, such as taking initiative, pursuit of opportunity, elements of newness and some degree of risk taking (Crant 2000, Kanter 1988, Lumpkin 2007, Parker and Collins 2010, Pinchot 1985). At the same time intra-preneurship also belongs to the domain of employee behaviour and thus faces specific limitations that a corporate hierarchy and an intra-organizational context may impose on individual initiative, as well as specific means of support that an existing business may offer to an intrapreneur.

Pinchot (1987) refers to intrapreneurs as 'dreamers that do'. Accordingly it is possible to distinguish between two phases of intrapreneurship, which may be called 'vision and imagination' and 'preparation and emerging exploitation'. Analytically this distinction formalizes the sequential nature of the various intrapreneurial activities.1 Empirically, it helps in assem-bling relevant items for measuring intrapreneurship. In practice these stages may overlap and occur in cycles, as the perception of an opportunity sometimes follows various preparatory activities such as product design or networking (see Gartner and Carter 2003).

The large conceptual diversity in the literature with respect to the relevant scope of entrepreneurial behaviour also reflects on any intra-preneurship concept. A first approach is pursuit of entrepreneurial opportunity (Shane, 2003). This includes developing a new product or service, a new geographical market or a new production process in the widest sense. This view encompasses both the Kirznerian and the Schumpeterian perspective of entrepreneurial opportunities (Shane 2003: 35). A second view may be labelled new entry (Lumpkin and Dess 1996). New entry includes entering new markets with new products, entering established markets with new products or entering new markets with established goods or services. Finally, new organization creation (Gartner 1989) offers a behavioural view of entrepreneurship as the process by which new organizations are created. Following this specific view intrapreneurship should always be linked to some sort of internal start-up (such as establishing a joint venture, a new subsidiary, a new outlet or a new business unit).

We prefer the first approach, i.e. pursuit of opportunity, as this encom-passes most individual level pursuit of new business activities. Other schol-ars have limited intrapreneurship to new organization creation (Parker 2011, Martiarena 2013 with 'engaged intrapreneurship').

MICRO LEVEL RELATIONSHIPS:BRIEF REVIEW OF THE LITERATURE

There might be good grounds to expect intrapreneurship to induce sub-sequent independent entrepreneurship at the micro level: intrapreneurs might to a large extent share various entrepreneurial behaviours with independent entrepreneurs, such as innovativeness, proactivity and risk taking (De Jong et al. 2013). Independent entrepreneurs and intrapreneurs both recognize and pursue opportunities for new value creation, they only differ with respect to their mode of organizing (Stevenson and Jarillo 1990, Krueger 2000, Shane 2003). There are, however, several recent empirical studies (based on data from high income countries) that have revealed clear differences between (the drivers of) independent entrepreneurship and intrapreneurship.

Douglas and Fitzsimmons (2013) compared the drivers of entrepre-neurial intentions with the drivers of intrapreneurial intentions (based on a sample of MBA students in Australia, China, India, and Thailand). They found that self-efficacy (an individual's confidence in his or her ability to perform entrepreneurial tasks) is related to both entrepreneurial and intrapreneurial intentions. Attitudes to income, ownership, and autonomy relate only (and positively) to entrepreneurial intentions, whereas risk tol-erance relates only (and negatively) to intrapreneurial intentions. Age and previous self-employment were positively related to entrepreneurial inten-tions, but not to intrapreneurial intentions. Prior income and education did not seem to be related to entrepreneurial intentions and intrapreneur-ial intentions, with the exception of a negative relation between doctoral education and intrapreneurial intentions.

Douglas and Fitzsimmons (2013) also conclude that independent entre-preneurship and intrapreneurship are viewed as distinctly separate career options.

Parker (2011) revealed the differences between nascent intrapreneurs and nascent entrepreneurs (based on US data from the Panel Study of Entrepreneurial Dynamics, PSED): nascent entrepreneurs tend to leverage their general human capital and social ties to organize ventures which sell directly to consumers, whereas nascent intrapreneurs disproportionately commercialize new opportunities (resulting in unique products) which sell to other businesses. Nascent intrapreneurs are more likely to be male than nascent entrepreneurs. In contrast to nascent intrapreneurs, nascent entrepreneurs seem to respond positively to stimuli emanating from entrepreneurial parents and other entrepreneurial role models in their communities.

Martiarena (2013) compared intrapreneurs with independent entrepre-neurs and with other employees (based on data from the Spanish Global Entrepreneurship Monitor, GEM).2 She found that a higher fear of failure and age increase the probability of becoming an intrapreneur over an independent entrepreneur, whereas income, perceived start-up skills and opportunity recognition decrease the probability of becoming an intra-preneur over an independent entrepreneur. Gender and general human capital do not seem to affect the probability of becoming an intrapreneur over an independent entrepreneur. In this Spanish study intrapreneurs seem to be much more similar to other employees than to independent entrepreneurs.

Given the variety of empirical definitions of intrapreneurship3 (and variety of country settings), it is difficult to derive general conclusions. The studies revealed distinct differences between independent entrepreneur-ship and intrapreneurship (e.g. with respect to previous self-employment, entrepreneurial role models, risk attitude, and product innovation), but also conflicting findings with respect to the entrepreneurial skills, income, age, and general human capital.

MACRO LEVEL RELATIONSHIPS:SOME CONJECTURES

Entrepreneurship is a widely present aspect of human action, but its manifestations depend upon many factors. At the macro level these deter-minants include the level of economic development and the institutional environment (Baumol 1990, Boettke and Coyne 2003). This wider macro context encompasses an array of institutions including property rights, the rule of law, employment regulation and the educational system. To a large extent these institutions are related to the level of economic develop-ment, and accordingly the level of economic development may influence individual choices towards types of entrepreneurial behaviour.

Specifically, we conjecture the following underlying causal mechanisms related to the level of economic development. First, we expect that due to the relatively high share of adults formally employed in multi-person organizations in high income countries (OECD 2009), intrapreneur-ship will be more prevalent in high income countries than in low income countries. Additionally, a lower share of the primary sector and a higher presence of larger firms in countries with a higher level of economic devel-opment (Ghoshal et al. 1999) will have a negative effect on the prevalence of independent entrepreneurship in an economy. This effect is partly due to an entry deterring influence of large firm presence (Choi and Phan 2006) and is also related to large firms paying more stable wages than small firms (Parker 2009). A second possible mechanism underlying the patterns of intrapreneurship and independent entrepreneurship at the macro level is the level of education in an economy. Given a significant positive correla-tion of higher education with a newly developed measure of intrapreneur-ial behaviour (De Jong et al. 2013), it appears that the presence of highly educated workers is likely to increase the probability of intrapreneurship in a country. With respect to independent entrepreneurship, a meta study by Van der Sluis et al. (2005) concludes that the impact of education on being self-employed is negative in developing countries and insignificant in industrialized countries. A third mechanism is the well-known positive effect of increasing per capita income on the opportunity cost of inde-pendent entrepreneurship (Lucas 1978). With rising real wages, 'marginal' entrepreneurs will increasingly opt for a wage job. It seems likely that this mechanism will also have a positive effect on intrapreneurship (also see Bosma 2009: 175).

In addition, apart from the level of economic development, specific institutions may also influence the prevalence of intrapreneurship and independent entrepreneurship at the macro level. In particular, a high level of employment protection will add to the opportunity cost of independent entrepreneurship. The institutional environment may also include relevant cultural aspects, such as the cultural appreciation for independence and autonomy.

RESEARCH DESIGN

This investigation was carried out as a special theme study in the frame-work of the Global Entrepreneurship Monitor (GEM), which annually surveys at least 2,000 adults per participating country regarding their attitudes towards entrepreneurship and their entrepreneurial intentions, activities and aspirations (see Reynolds et al. 2005 for a detailed descrip-tion of the GEM methodology). In 2008 eleven countries participated in an exploratory study of intrapreneurship using a set of specific ques-tions targeted at all employees – excluding those already identified as owner-managers of running businesses – aged between 18–64 years in the GEM samples. This also created the opportunity to compare intrapre-neurs with nascent entrepreneurs and owner-managers of a new business4 at both the macro and the micro level.

In this special theme study intrapreneurship was operationalized as employees developing new business activities for their employer, includ-ing establishing a new outlet or subsidiary and launching new products or product-market combinations. This approach is in the range between the 'pursuit of opportunity' and the 'new entry' views discussed previously. It is definitely wider than new organization creation. On the other hand, it excludes employee initiatives that aim mainly to optimize internal work processes. Next, we distinguish between two phases in the intrapreneurial process, i.e. idea development for new business activities, and prepara-tion and (emerging) exploitation of these new activities. For the role of intrapreneurs in each of these phases we distinguish between leading and supporting roles.

Based on these elements we conceive a broad and a narrow definition of intrapreneurship. According to our broad definition intrapreneurs are employees who, in the past two years, have been actively involved in and have had a leading role in at least one of these phases. According to our narrow definition intrapreneurs have a leading role in both phases of the intrapreneurial process. See the scheme in Figure 6.1 for a clarification.

Subsequently, all intrapreneurs that fitted our narrow definition were asked some further questions about their 'most significant new business activity' in the past two years. First, there were some questions concern-ing various aspects of the intrapreneurial process, including whether the new business activity was the intrapreneur's own initiative, whether he/she had to overcome internal resistance and whether he/she personally had to take risks to become involved in the new activity. Secondly, they were also asked whether the new business activity involves a new product or service. Finally, as the intrapreneurship questionnaire was part of GEM's Adult Population Survey (APS) as a whole, it was possible to link all these results to other relevant characteristics of the intrapreneurs, including their per-ceptions and attitudes as well as their intentions to start a business of their own within the next three years.

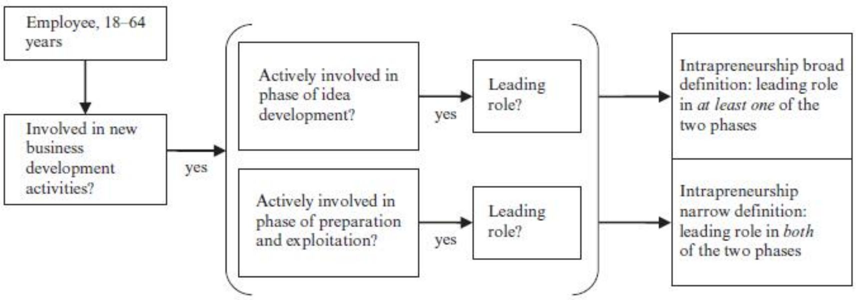


Figure 6.1 Broad and narrow definitions of intrapreneurship used in this study

Table 6.1 presents some characteristics of the eleven countries that participated in the GEM survey on intrapreneurship. These include GDP per capita and population size. The levels of GDP per capita range from $7,500 (Ecuador) to $55,200 (Norway). We used GDP per capita levels to distinguish four high income countries (incomes between roughly $25,000 and $55,000) and seven low income countries (incomes between roughly $7,500 and $18,000). Our subsample of low income countries thus does not include the poorest countries with income levels below $7,500. As might be expected, the low income countries have relatively low (formal) employment rates in comparison with the high income countries. This is probably due to the large informal economies in low income countries. The two outliers in these groups are Latvia with a relatively high employ-ment rate in the sample (73 per cent), and the Republic of Korea with a relatively low employment rate (55 per cent).

Table 6.1 Characteristics of GEM countries participating in intrapreneurship investigation

Countries	GDP per capita ($)	Population size (× 1,000)	Sample size adult population 18–64 years	Number of employees in sample	Employees as % of adult population
Low income countries:					
Brazil	10,300	191,900	2,000	1,162	58
Chile	14,700	16,400	1,828	1,124	61
Ecuador	7,500	13,900	2,142	557	26
Iran	12,400	65,900	3,119	1,146	37
Latvia	17,800	2,400	2,011	1,477	73
Peru	8,600	29,000	1,990	1,189	60
Uruguay	12,700	3,500	1,645	1,104	67
High income countries:					
Korea Republic	26,300	48,400	2,000	1,102	55
Netherlands	40,400	16,600	2,534	2,024	80
Norway	55,200	4,600	1,614	1,241	77
Spain*	30,800	40,500	2,597*	2,000	77*

Note: * Spain selected a random sample of employees within a much larger sample of adults. The corresponding number of the adult population 18–64 years is an estimate based on the reported employment rate of 77% (obtained from IMD (2008) *The World Competitiveness Yearbook* and US Bureau of the Census, International Database (IDB)).

Source: Global Entrepreneurship Monitor 2008.

THE PREVALENCE OF INTRAPRENEURSHIP

Table 6.2 presents the main results regarding the prevalence of intrapre-neurship across countries according to our narrow and broad definition, both as percentage of the number of employees and as percentage of the adult population between 18 and 64 years of age.A first observation is that intrapreneurship, as defined in this study, is not a very widespread phenomenon.On average, fewer than 5 per cent of employees are intrapreneurs,even according to our broad definition.In addition, its incidence in the adult population is,on average, lower than that of owner-managers of young firms, as can be seen from Figure 6.2.

Table 6.2 Prevalence of intrapreneurship

	Intrapreneurship narrow definition in		Intrapreneurship broad definition in	
	% employees	% adult population	% employees	% adult population
Low income countries:				
Brazil	1.1	0.7	1.5	0.9
Chile	3.4	2.2	5.2	3.5
Ecuador	1.0	0.3	2.1	0.6
Iran	0.6	0.1	1.2	1.4
Latvia	1.1	0.8	1.8	1.3
Peru	1.6	1.0	3.2	1.9
Uruguay	1.9	1.3	4.5	3.0
Unweighted average	1.5	0.9	2.8	1.8
High income countries:				
Korea Republic	1.2	0.7	2.0	1.1
Netherlands	3.5	2.7	7.2	5.5
Norway	4.2	3.2	7.4	5.7
Spain	2.0	1.5	3.4	2.6
Unweighted average	2.7	2.0	5.0	3.7
Total unweighted average	1.9	1.3	3.5	2.4

Source: Global Entrepreneurship Monitor 2008.

A second observation is that intrapreneurs seem to be more prevalent in high income countries as compared to low income countries. This pattern is the reverse of that for early-stage entrepreneurial activity, which is more abundant in low income countries (again see Figure 6.2).

Finally, additional analysis suggests that the size class of the organi-zation does not differentiate the intrapreneurship rates in high income countries: the rate is about 3 per cent for all three size classes. In low income countries intrapreneurship seems to be underrepresented in small organizations and relatively prominent in (the very small number of) large organizations.

THE NATURE OF INTRAPRENEURSHIP

Table 6.3 highlights characteristics of the most significant new business activity in which intrapreneurs, as defined according to our narrow defini-tion, have been involved during the past two years. The first column shows that in 50 per cent of the cases, these intrapreneurs became involved in developing the new business idea, acting on their own initiative rather than because they were asked to do so by their manager or another colleague. The incidence of own initiative is, on average, higher in high income countries than in low income countries. This suggests that relatively low levels of autonomy as a cultural trait in low income countries (as shown in Figure 6.3) affect both the prevalence and the nature of intrapreneurship in these countries. The second column shows that, on average, about 50 per cent of all intrapreneurs have had to overcome some kind of internal resistance in developing the new business activity. This element deserves further scrutiny in future studies.

Table 6.3 Some characteristics of intrapreneurship (narrow definition) in eleven countries, as percentage of the total number of intrapreneurs

	% own initiative	% overcoming internal resistance	% taking any risks personally	% new good or service
Low income countries:				
Peru	71	71	71	50
Brazil	36	45	27	45
Chile	39	25	66	71
Iran	50	53	86	71
Latvia	57	57	43	71
Ecuador	25	75	67	33
Uruguay	40	50	40	40
Unweighted average	45	53	53	52
High income countries:				
Netherlands	60	56	30	58
Spain	73	40	18	28
Norway	48	48	28	65
Korea Republic	50	50	25	N/A
Unweighted average	58	49	25	38
Total unweighted average	50	51	42	46

Source: Global Entrepreneurship Monitor 2008.

In addition, risk taking is a well-known core characteristic of entrepre-neurship. The third column makes it apparent that, on average across the eleven participating countries, about one-third of intrapreneurs report having taken personal risks by becoming involved in the new business activity. Risks included loss of status, damage to career, loss of employ-ment and loss of own money invested in new activity. The incidence of per-sonal risk taking appears to be much lower in high income countries than in low income countries. This suggests that intrapreneurship is a more daunting activity in low income countries than in high income countries.

Subsequently, it was found that about half of the intrapreneurs devel-oped new business activities involving a good or service that was new to the intrapreneur's organization. The innovativeness of these activities shows no clear difference between high and low income countries.

Finally, it was found that intrapreneurs have clearly higher job growth expectations for their new business activity than independent entrepre-neurs have for their own new business, suggesting higher aspiration levels of intrapreneurs and/or better access to resources for achieving growth. For more details see Bosma et al. (2010, 2011).

EXPLORING INDIVIDUAL LEVEL RELATIONSHIPS

To gain a better understanding of some of the abovementioned character-istics of intrapreneurship in relation to owner-managers of new firms, we performed a multinomial logistic regression, for low and high countries separately, using a set of often-used, basic demographic determinants of entrepreneurship (see Table 6.4).[7] The reference group in the multinomial logistic regression is that part of the workforce (aged 18–64) that has not been involved in any type of entrepreneurship. This means that all coef-ficients in the table – as well as those highlighted below – should be inter-preted as effects *relative* to not being involved in entrepreneurship *at all*, which has the highest probability, witness the negative intercepts for both manifestations of entrepreneurship. Gender (female) is positively linked to independent entrepreneurship in low income countries, but not to intrapre-neurship. In contrast, gender (female) is negatively related to both intrapre-neurship and independent entrepreneurship in high income countries. Age above 25 years seems to be negatively related to independent entrepreneur-ship in low income countries and positively to intrapreneurship in high income countries. The effect of higher household income is positive in both types of countries, with the exception of independent entrepreneurship in high income countries. Higher educational attainment is positively linked to intrapreneurship, but linked negatively to independent entrepreneurship in low income countries, while in high income countries it hardly has any effect.

Our analyses thus reveal that the country context, more in particular the level of development (as measured with per capita income levels), conditions the micro level relations with intrapreneurship and independ-ent entrepreneurship to a large degree: age and education are negatively related to independent entrepreneurship in low income countries, but not in high income countries; age is positively related to intrapreneurship in high income countries, but not in low income countries. High house-hold income is positively related to intrapreneurship and independent entrepreneurship in both types of countries.

Table 6.4 Multinomial logistic regression: determinants of intrapreneurs and owner-managers of new firms, by country group

	Low income countries		High income countries	
	Intrapreneurs	Owner-managers new firms	Intrapreneurs	Owner-managers new firms
Gender: female	−0.21 (0.21)	0.25 (0.08) **	−0.97 (0.19) **	−0.85 (0.15) **
Age category				
18–24 years	(ref)	(ref)	(ref)	(ref)
25–34 years	0.63 (0.38)	−0.27 (0.11) *	2.05 (1.02) *	0.17 (0.32)
35–44 years	0.48 (0.39)	−0.29 (0.12) *	1.75 (1.02) 1	−0.04 (0.32)
45–54 years	0.66 (0.39) 1	−0.59 (0.13) **	2.44 (1.01) *	−0.06 (0.32)
55–64 years	0.28 (0.49)	−0.71 (0.16) **	1.74 (1.04) 1	−0.62 (0.38)
Household income				
Lowest tertile	(ref)	(ref)	(ref)	(ref)
Middle tertile	−0.01 (0.33)	0.05 (0.10)	0.36 (0.28)	−0.28 (0.20)
Highest tertile	0.91 (0.31) **	0.49 (0.11)	0.90 (0.26) **	0.28 (0.18)
Educational attainment				
No secondary degr.	(ref)	(ref)	(ref)	(ref)
Secondary degree	0.48 (0.37)	−0.42 (0.10) *	−0.04 (0.23)	0.33 (0.21)
Post secondary	0.55 (0.38)	−1.09 (0.13) **	−0.06 (0.33)	−0.16 (0.32)
Graduate exp.	0.79 (0.37) *	−0.78 (0.12) *	−0.21 (0.22)	0.64 (0.20) **
Intercept	−5.23 (0.48) **	−1.29 (0.11) **	−5.42 (1.03) **	−2.76 (0.35) **

Notes:

1 $p \leq 0.10$, * $p \leq 0.05$, ** $p \leq 0.01$.

Reference category dependent variable: part of the workforce that is *not* involved in any manifestation of entrepreneurial activity (nor in the past).

* Model fit: Nagelkerke R^2: 0.260, McFadden: 0.109. All variables entered pass the likelihood ratio test comparing the full model and the reduced model.

Analysis excludes Spain as this sample does not allow for comparisons with nascent entrepreneur and owner-managers in new/established firms.

INTRAPRENEURS AND THEIR ENTREPRENEURIAL PERCEPTIONS AND INTENTIONS

Table 6.5 shows that perceptions of entrepreneurship differ between indi-vidual intrapreneurs and other employees. This observation is especially reflected in the very high levels of self-perceived entrepreneurial skill (94 per cent) and perceived opportunity (50 per cent) of intrapreneurs in low income countries, even higher than the already high levels for other employees. In high income countries, intrapreneurs do not seem to differ significantly from other employees when it comes to recognizing opportu-nities to start a business or the fear of failure preventing them from start-ing. They do, however, more often believe to have the required skills to start and more often know someone who recently started a business.

Table 6.5 Entrepreneurial perceptions and intentions, intrapreneurs versus other employees

	Low income countries		High income countries	
	% of intra-preneurs	% of other employees	% of intra-preneurs	% of other employees
You personally know an entrepreneur who recently started a business	*59*	*46*	*54*	*33*
You have the required skills and knowledge to start a business	*94*	*60*	*62*	*44*
There are good opportunities for starting a business in the area where you live	*50*	*35*	33	25
Fear of failure would not prevent you from starting a business	*76*	*65*	65	56
Entrepreneurial intentions (excl. nascent entrepreneurs)	*37*	*25*	13	6
Nascent entrepreneurship	*12.4*	*7.4*	5.1	1.7

Note: Numbers in italics denote significant differences between intrapreneurs and other employed ($p < 0.05$).

Source: Global Entrepreneurship Monitor 2008.

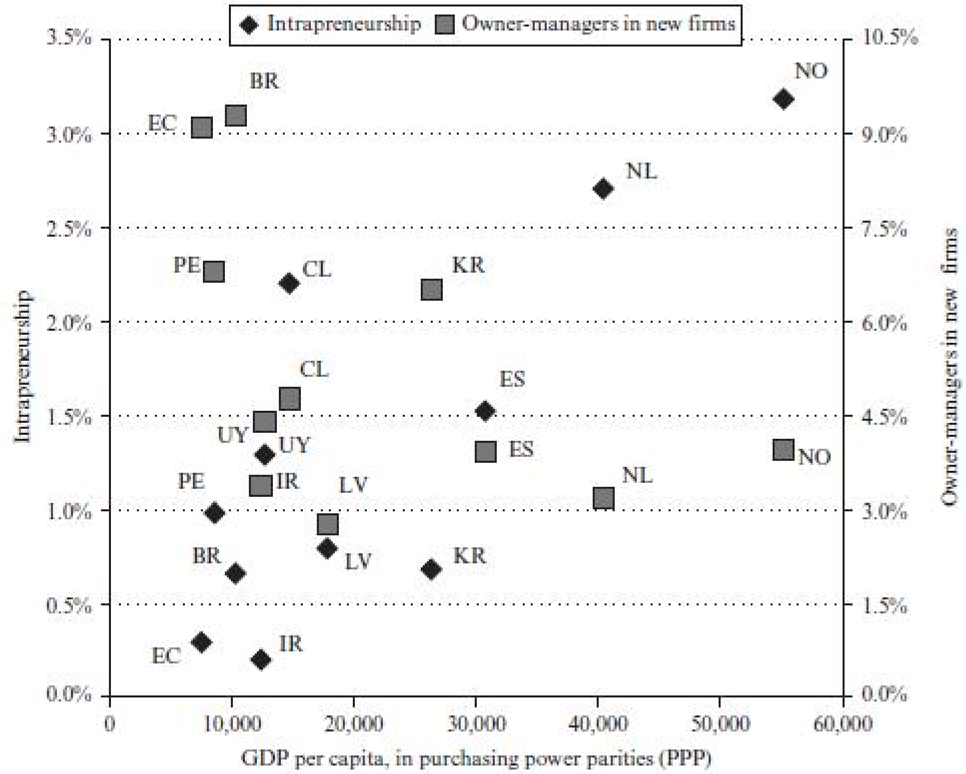
Previous studies tend to analyse intrapreneurship and independent entrepreneurship as different career options (Douglas and Fitzsimmons 2013). While some entrepreneurial employees deliberately opt for intra-preneurship instead of independent entrepreneurship in order to limit their risks, it also seems likely that intrapreneurship can be a step-ping stone towards founding one’s own business. Indeed, as shown in Table 6.5, the incidence of nascent entrepreneurship, as well as that of intended entrepreneurship, is higher for intrapreneurs than for other employees in both low and high income countries. This suggests that at the micro level intrapreneurship may be a substitute for independent entrepreneurship in the short term, but may induce independent entrepre-neurship in the longer term, and/or is to a large extent driven by the same underlying factors.

EXPLORING NATIONAL LEVEL RELATIONSHIPS

Figure 6.2 explores the possible relationship between the national level incidence of intrapreneurship according to our narrow definition and the level of economic development as measured by GDP per capita. The scatter plot suggests a positive relationship between income levels and intrapreneurship at the macro level. As suggested previously in this chapter, this may be caused by the relatively high share of adults employed in multi-person organizations in high income countries, as well as by rela-tively high levels of employee autonomy in these countries. Obviously a far larger sample including higher income countries with varying institutional frameworks (Bowen and De Clercq 2008; Stam et al. 2010) will be needed for a more conclusive analysis.

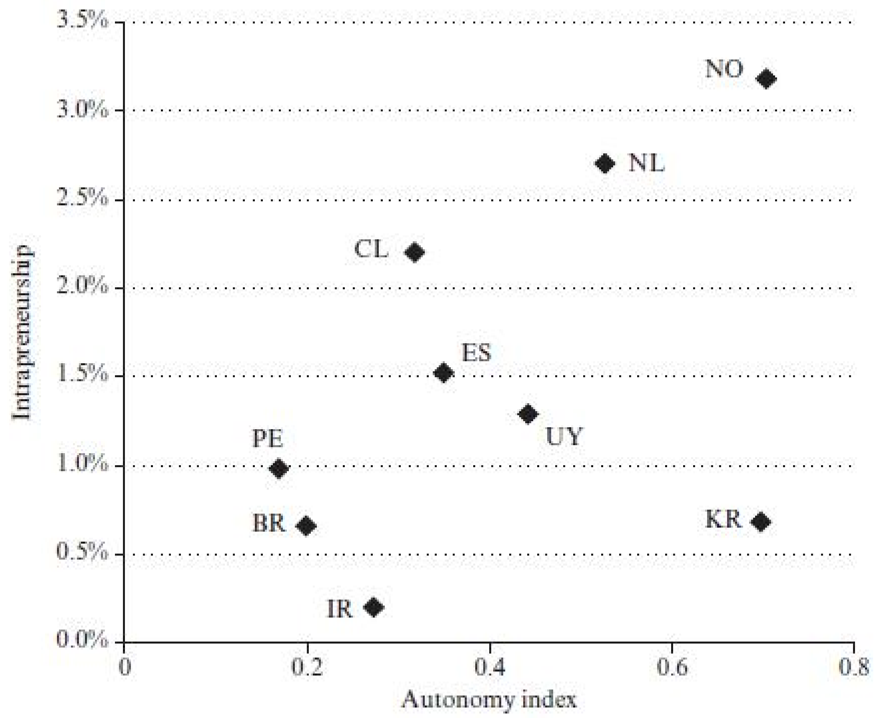
Figure 6.2 also plots the prevalence of independent owner-managers of new businesses. The resulting scatter plot reflects the well-known nega-tive empirical relationship between independent entrepreneurship and the level of economic development (see for example Yamada 1996; Bosma et al. 2012: 22). Accordingly, the figure thus also suggests that across a wide range of levels of economic development, intrapreneurship and independent entrepreneurship may be negative correlates at the macro level. However, *given* the level of economic development, the prevalence of intrapreneurship and independent entrepreneurship might also depend on specific institutions. Some first empirical support for this conjecture is presented in Figure 6.3, which suggests a positive relationship between intrapreneurship and a national culture embodying a high appreciation of individual autonomy (with an outlier position for the Republic of Korea).

The implications might be far-reaching. Given a ‘supply of entrepre-neurial talent’, it might depend on various contextual determinants, i.e. the institutional framework (e.g. employment protection) and manage-ment styles within organizations (possibly related to national culture), whether entrepreneurial individuals pursue their aspirations within a business or choose to start up for themselves. We will pursue this line of reasoning in the next section.



Source: Global Entrepreneurship Monitor 2008 and IMF World Economic Outlook Database (October 2008 edition)

Figure 6.2 Intrapreneurs and owner-managers of new firms as a percentage of the adult population (18–64 years of age) versus GDP per capita



Note: Ecuador and Latvia excluded due to missing data for autonomy.

Source: Global Entrepreneurship Monitor 2008 and World Value Surveys, fifth wave (2005–2008).

Figure 6.3 Intrapreneurship and autonomy at the country leve

DISCUSSION

The relationship between intrapreneurship and independent entrepre-neurship at the micro level differs from this relationship at the macro level. At the micro level intrapreneurship may induce subsequent inde-pendent entrepreneurship, while at the macro level intrapreneurship may to some extent be negatively correlated with independent entrepreneur-ship. This paradox can be explained by considering the underlying mech-anisms, especially those related to the level of economic development. First, the level of economic development has a positive effect on the presence of larger firms (Ghoshal et al. 1999), which has a negative effect on the prevalence of independent entrepreneurship in an economy (Choi and Phan 2006, Parker 2009). At the same time the related incidence of multi- person firms as well as supposedly higher levels of autonomy of employees in higher income countries lead to higher rates of intra-preneurship. A second mechanism underlying some degree of possible substitution between intrapreneurship and independent entrepreneur-ship at the macro level is the well-known positive effect of economic development (per capita income) on the opportunity cost of independ-ent entrepreneurship (Lucas 1978). Due to rising real wages, 'marginal' entrepreneurs will increasingly opt for a wage job. It seems likely that this mechanism will also have a positive effect on intrapreneurship (also see Bosma 2009: 175).

Finally, apart from the level of economic development, specific institu-tions may also lead to some degree of substitution between intrapreneur-ship and independent entrepreneurship. An example regarding the role of (appreciation of) individual autonomy at the macro level was presented in Figure

6.3. Autonomy at the micro level may however not be related to intrapreneurship (Douglas and Fitzsimmons 2013): on average individu-als with a high need for autonomy may be more likely to start their own business than to pursue an opportunity for their employer. However, at the macro level, individuals are more likely to pursue opportuni-ties within established organizations in countries in which (employee) autonomy is highly valued than in countries in which autonomy is not valued. In the latter situation, relatively many entrepreneurially oriented individuals might leave their employer to set up their own firm, because they have not been granted sufficient autonomy (cf. Baum et al. 1993). Labour market institutions may also be of influence. For example, a high level of employment protection may add to the opportunity cost of inde-pendent entrepreneurship. The same holds for the degree to which social security favours employees. When the opportunity cost of independent entrepreneurship are high, entrepreneurial employees with safe jobs in existing firms will think twice before moving to a risky new business venture and may prefer to pursue entrepreneurial opportunities as part of their job. For some first empirical support for this conjecture, see Bosma et al. (2013).

If culture and institutions do indeed influence the prevalence of inde-pendent entrepreneurship and intrapreneurship at the macro level, various patterns seem possible for countries with the same level of economic devel-opment. In some countries these two types of entrepreneurship might be substitutes, while in others they might be complements. Such patterns are a subject for future research based on a larger sample of countries with diverging cultural and institutional profiles.

CONCLUSIONS

This chapter presented some results of a novel international study into entrepreneurial employee behaviour, also known as intrapreneurship. Here intrapreneurship was defined as employees developing new business activities for their employer, including establishing a new outlet or subsidi-ary and launching new products or product-market combinations.

This chapter makes two distinct contributions to the literature. First, it provides international comparative research on intrapreneurship in low and high income countries. Second, it offers insight into the relation-ship between independent entrepreneurship and intrapreneurship at the individual level as well as the national level.

A first conclusion is that intrapreneurship, as defined in this chapter, is not a very widespread phenomenon. On average, less than 5 per cent of employees are intrapreneurs and, in addition, its incidence in the adult population is on average significantly lower than that of early-stage entrepreneurial activity.

Secondly, the relationship between independent entrepreneurship and intrapreneurship was explored at the micro (individual) level as well as at the macro (national) level. We found that at the individual level, intrapre-neurs are much more likely to have the intention to start a new independ-ent business than other employees, suggesting that intrapreneurs have more resemblance with entrepreneurs than other employees.

Thirdly, however, there is a negative correlation between intrapre-neurship and early-stage entrepreneurial activity at the macro level. One explanation is the diverging effect of per capita income on intrapreneur-ship (positive effect) and on early-stage entrepreneurial activity (negative effect). The prevalence of intrapreneurship is about twice as high in high income countries as in low income countries. This is probably related to a combination of a relatively high share of adults employed in multi-person organizations in high income countries, and higher levels of autonomy for employees in these countries.

Finally, underlying personal characteristics may explain the shared entrepreneurial intentions and aspirations of intrapreneurs and independ-ent entrepreneurs. The dominant mode of pursuing entrepreneurial aspi-rations, however, is likely to depend on the level of economic development and on national institutions.

NOTES

1. This resembles the sequence of the three entrepreneurial processes (opportunity recogni-tion, evaluation, and exploitation) that are seen as the key characteristics of the domain of entrepreneurship studies by Shane and Venkataraman (2000).
2. Martiarena (2013) uses a much more inclusive definition of intrapreneurship than we do in this study: according to Martiarena (2013) 5.7 per cent of the Spanish employees can be characterized as intrapreneurs (people involved in new business activities at their employer's organization), while our much more strict definitions lead to a percentage of respectively 2.0 and 3.4 per cent (see Table 6.2). This difference in definition is likely to explain the somewhat diverging outcomes of these studies, i.e. a much more selective group of intrapreneurs is more likely to resemble the group of independent entrepre-neurs, than a more inclusive group of intrapreneurs.
3. Parker defines intrapreneurship as new organization creation, while Martiarena distin-guishes between intrapreneurs and engaged intrapreneurs.
4. In the GEM studies, nascent entrepreneurs are individuals who are actively involved in setting up a business they will own or co-own, while this business has not paid salaries, wages, or any other payments to the owners for more than three months. Owner-managers of a new business are individuals who currently, alone or with others, own and manage an operating business that has paid salaries, wages or other payments to the owners for more than three months, but not more than 42 months.
5. In high income countries rates equal 2.7 for small organizations with fewer than 10 employees, 3.0 for organizations with 10–249 employees and 2.7 for large organizations with 250 or more employees. The corresponding estimates for low income countries are 0.9, 2.2 and 2.7 respectively. Organizations (private and public) with more than 250 employees are more prevalent in high income countries than in low income countries. The percentage of intrapreneurship in large organizations in high income countries may have been negatively influenced by the dominance of public sector organizations in this size segment.
6. In general, intrapreneurship seems to involve new products more often than independent entrepreneurship (Bosma et al. 2010, Parker 2011).

7. Household income is divided in tertiles for each country. This implies that the income categories are relative to the country's phase of economic development and are not heavily correlated with national levels of GDP.

8.This is in line with Van der Sluis et al. (2005), who found in their meta study that the impact of education on being self-employed is negative in developing countries (but insignificant in industrialized countries). However, our findings are in contrast with those of Parker (2011), who found general human capital to be more associated with entrepreneurship than with intrapreneurship. This, however, was based on a United States sample only, and with a more narrow definition of intrapreneurship restricting it to new venture creation. Grilo and Thurik (2008) also find a positive impact of educa-tion on entrepreneurship, but with a sample of the total adult population (in European countries and the US), while we take a sample of only the workforce into account for our multinomial logistic regression.

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Organizations as Fonts of Entrepreneurship

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Abstract: Most entrepreneurs emanate from established organizations, yet systematic theorizing about the ways in which organizations shape the entrepreneurial process has only recently begun to emerge. We provide a framework for organizing this emerging literature. We focus on four different metaphors in the literature for how organizations matter in the entrepreneurial process and suggest promising avenues for future research.

Keywords: entrepreneurship, organizational theory, careers

Introduction

Organizations beget organizations. Although tales of successful entrepreneurs emerging from college dormitories capture the popular imagination, the vast majority of entrepreneurs enter into entrepreneurship from employment in established firms. Precise data are difficult to come by, but estimates suggest that at least 9 in 10 entrepreneurs work for established employers before launching their ventures. For example, in a study of Silicon Valley start-ups, Burton et al. (2002) were able to identify (from publicly available data) prior employers for all but 7% of the founding team members. Thus at least 93% of the founders were employed before becoming entrepreneurs. Similarly, Gompers et al. (2005) were able to identify a prior employer for approximately 90% of venture capitalfunded entrepreneurs in 1999.

In light of this fact, it is natural to expect that our understanding of the entrepreneurial process would be informed by the vast literature on organizations and organizational processes. Yet until recently, there has been a rather distinct separation between the literature on entrepreneurship and the literature on organizations. For example, consider the literature on turnover. Although a key concern of this literature was to understand how workplace conditions influence turnover processes (e.g., Mowday et al. 1982), turnover was viewed largely from the perspective of the originating organization. Even though a portion of turnover events involves entrepreneurial activity, theories of turnover generally do not focus on explaining why some people leave to become entrepreneurs whereas others leave for other jobs. Similarly, much of the focus of the entrepreneurship literature was on understanding the entrepreneur or what makes some individuals more likely to become entrepreneurs. In particular, much of the focus was on the dispositional and biographical features of individuals that make them more likely to launch a new venture. Although elements of social context played a role in these explanations, they were generally very broad features of the economic and social environment or more tightly focused elements such as family background and personal networks.

This division between the study of organizations and the study of entrepreneurship was unfortunate, because entry into entrepreneurship is to a large extent an organizational process (Freeman 1986). By this we mean something very straightforward: in the vast majority of cases, the decision to launch a new venture (or indeed, the decision not to) is made while a person is employed by an existing organization. This does not, of course, mean that the organization plays a large role in shaping the entrepreneurial decision in all cases; a job may just be a job that pays the bills until long-held entrepreneurial ambitions can be realized. Yet such a view would seem inconsistent with much of what we have learned from the literature on organizational behavior on how the structures, composition, and policies and practices of organizations shape individual preferences and beliefs, access to information and opportunities, and creativity and risk taking. Working people spend a large portion of their waking hours in formal organizations, and these organizations shape their experiences in a multitude of ways that they have little control over. It thus seems natural to bring our understanding of these processes to bear on our understanding of entrepreneurship.

Fortunately, in recent years we have seen a convergence in the research interests of organizations and entrepreneurship scholars. In particular, there has been a growth in research that examines the interface between existing organizations (viewed primarily as places of employment) and entrepreneurship, and that seeks to understand how the workplace shapes entrepreneurial activity and outcomes. Our goal in this paper is to provide an initial review of this still-nascent literature. We have not sought to conduct an exhaustive searchof the literature and do not claim to be comprehensive. Rather, our aim is to provide an initial framework for organizing research on how the workplace shapes entrepreneurial activity. As will become apparent, scholars have taken up the relationship between the workplace and entrepreneurship with different goals in mind; as a consequence, this nascent area of research can appear to lack coherence, which may stand in the way of progress. We hope that our review will help clarify the major areas of focus and identify issues for future research.

We begin by providing a framework for organizing the literature according to the types of entrepreneurial outcomes studied and the nature of the theoretical mechanisms invoked. We then use papers from the literature to illustrate this framework and to identify continuing puzzles and unresolved issues for future research.

Mapping the Relationship Between Employment and Entrepreneurship

As might be expected when considering research that stands at the intersection of multiple literatures, much confusion can arise from a lack of clarity about basic definitional issues. In considering what has been written about the workplace and entrepreneurship, perhaps the central point of definitional divergence between scholars lies in their conceptual definitions of entrepreneurship. This is a more general characteristic of the entrepreneurship literature, which has not reached consensus on how entrepreneurship should be defined. We do not hope to resolve this issue, and in fact, we are skeptical that it can be resolved. Instead, we merely seek to identify the diversity of approaches.

It is useful, in this respect, to distinguish between two different motivations for being interested in entrepreneurship as a form of economic activity. One motivation lies in the conceptual distinction between entrepreneurship and paid or dependent employment; in other words, this is entrepreneurship viewed primarily as a labor market status. Often this falls under the heading “self-employment.” Scholars who focus on this sense of entrepreneurship are interested in why people choose to (or are forced to) launch their own ventures as opposed to working for others. This puzzle is particularly intriguing given evidence that the returns to entrepreneurial activity are, for most who try it, far from lucrative (Hamilton 2000, Shane 2007). But it is also of interest because the whole range of entrepreneurial activity (ranging from the sole, self-employed contractor to the founder of a high-growth venture) is in the aggregate an important component of economic activity and growth.

Some scholars are more interested in understanding entrepreneurship as a source of value creation and economic growth. In this second view, entrepreneurship is interesting because it is the motor of the process of creative destruction and change in advanced capitalist economies (Schumpeter 1950). It is through entrepreneurial activity, broadly defined, that change and renewal happen in organizations and markets. Much of this conceptualization of entrepreneurship therefore emphasizes its innovative and creative aspects: Where do new products and technologies come from? What are the factors that encourage the emergence of new firms with revolutionary, market-transforming products? One interesting feature of this focus is that entrepreneurship does not, strictly speaking, have to imply selfemployment or the creation of new ventures. Indeed, Schumpeter's supposition concerning the evolution of capitalism was that large firms would excel at this form of entrepreneurial creativity, thanks to their ability to invest in research and development, etc. For individuals, this form of "intrapreneurship" may take the form of initiating new projects or divisions in an established firm.

Figure 1 cross-classifies these two meanings of entrepreneurship to arrive at a clearer understanding of the different types of outcomes (and implicit comparisons) that are prevalent in the study of the workplace and entrepreneurship. Although it is relatively uncontroversial to treat the labor market dimension as dichotomous (but see Folta et al. 2010), the degree of creativity and value creation involved in an entrepreneurial act varies more continuously. For simplicity, however, we treat it as a high–low dichotomy.[1]

The lower left quadrant of Figure 1 signifies the absence of entrepreneurship; this is the case of continued conventional paid employment where people do the jobs that they have been assigned to do. For most individuals, this is where their careers start, and indeed for many people, their entire working careers are spent in a series of jobs in this quadrant. The upper left quadrant of Figure 1, by contrast, encompasses forms of entrepreneurial activity that are low in innovation and growth potential, but where the worker is self-employed. Allowing for a range of value creation in the ventures, examples in this cell include independent contractors, freelance workers, self-employed professionals and craftsmen, as well as proprietors of small businesses. In the lower right cell of Figure 1, we find cases of individuals who actively contribute to innovation and the process of creative destruction, but do so while maintaining their employment. Although these individuals create new products or processes, they do not assume full risk and responsibility for them. This form of entrepreneurial activity may be labeled "intrapreneurship" or "spin-offs," with the latter term perhaps best reserved for the creation of distinct organizations in which the parent company retains ownership. It is worth noting that what falls in this quadrant can be generally thought of as innovation and change by existing organizations. Finally, the upper right quadrant of Figure 1 covers cases that involve both a transition from employment to self-employment and the discovery of an innovative value creation opportunity. This covers to a large extent the forms of "entrepreneurship" that are the focus of popular attention, as well as the types of entrepreneurial activity of interest to business school students, venture capitalists, and the like, who dream of being involved in the next Google or Facebook.

Figure 1 Types of Entrepreneurial Transition

	Innovation and novelty	
Labor market status	Low	High
Self-employment	Independent contractor Small business proprietor	Venture-backed start-ups Spin-outs
Dependent employment	Conventional employment	Intrapreneurship

An important reason for highlighting the two distinct dimensions in Figure 1 is that it makes apparent some of the challenges that students of entrepreneurship can create for themselves. This is particularly the case in developing theories to account for outcomes in the upper right corner of Figure 1. Here, we need to explain the intersection and potential interaction of two processes: not only why some people are more likely to discover innovative entrepreneurial opportunities but also which of those people are more likely to pursue those opportunities by launching their own independent venture. Although it is not hard to understand why students of entrepreneurship would want to solve this problem—who would not want to be able to predict who is going to launch the next eBay?—this may be too difficult a challenge, given the current state of theory.

Instead, it may be more productive to think of the two different dimensions as different objects of theorizing. Put simply, it seems unlikely that there is a perfect overlap between the set of theoretical processes that account for changes in employment status and the set of processes that account for the likelihood that individuals will identify the next game-changing innovation. Moreover, even if one recognizes that different "main effects" may be at play, there is no guarantee that they combine in a simple additive manner. Thus when thinking about how existing workplaces may influence the entrepreneurial process, it seems most useful to focus clearly on one chosen dimension. This suggests that theory development in this area will most likely be fruitful to the extent that authors are clear about what aspects of the entrepreneurial process they are trying to explain.

Metaphors for the Relationship Between Existing Firms and Entrepreneurship

We organize our discussion of existing approaches to the relationship between work environments and entrepreneurship in terms of four basic metaphors for how established firms matter in the entrepreneurial process. These basic metaphors are as follows: The organization as fonts of knowledge and skills; The organization as fonts of beliefs and values; The organization as fonts of social capital ; The organization as fonts of opportunities We discuss each of these in turn.

The Organization as Fonts of Knowledge and Skills

The most common conceptualization of why the workplace might matter in the entrepreneurial process rests on the idea that the organization is an arena for learning. Thus existing organizations are thought to matter because they shape (directly or indirectly) the skills and knowledge that people bring to the table in the entrepreneurial process and thereby influence the likelihood that those people will become and/or succeed as entrepreneurs. In this sense, existing firms are viewed as potential training grounds for future entrepreneurs. This learning can be along both of the dimensions identified in Figure 1; in other words, existing organizations may teach their employees what they need in order to make the transition to self-employment, and/or they may give them the knowledge needed to launch new products and processes.

One approach in this vein is to emphasize how organizations shape the development of entrepreneurial abilities, where entrepreneurial abilities are thought of as the skills needed to make an independent venture viable. This approach focuses on the determinants of the propensity to leave paid employment for selfemployment. The basic logic of this viewpoint is perhaps most clearly articulated in Lazear's (2005) jack-of-alltrades theory of entrepreneurship. Lazear posits that successful entrepreneurship requires the mastery of a wide range of functional areas, such as marketing, sales, manufacturing, etc. Lazear argues that individuals who have a breadth of functional skills have greater entrepreneurial ability: their expected value for a given entrepreneurial opportunity is greater than for individuals who have specialized in a particular functional area. This prediction rests on the assumption, then, that individuals recognize and assess the relevance of their career experiences when evaluating entrepreneurial opportunities.

Employers are important in this kind of story because they determine the extent to which individuals can acquire the breadth of skills needed for entrepreneurship in the jack-of-all-trades story. Organizational structure plays a central role here; the extent to which jobs and roles are broadly versus narrowly defined affects the ability of their incumbents to acquire a wide range of skills. Because organizational size is a major driver of such role differentiation, skill development may be one reason why individuals from small firms are more likely to become entrepreneurs (Sørensen 2007); likewise, it may explain why entrepreneurs from small firms perform better (Sørensen and Phillips 2011). In addition to role differentiation, other firm policies play a role as well; for example, job rotation, cross-training, and cross-functional teams may all increase the exposure of employees to a wider range of functional skills.

Whereas a jack-of-all-trades argument emphasizes an indirect mechanism through which the workplace shapes entrepreneurship, firms may also be arenas for learning about the entrepreneurial process from others. Thus it may be in the workplace, from coworkers and others, that individuals learn how to organize and mobilize the resources necessary for the launch of a new venture. Gompers et al. (2005, p. 612), for example, argue that in entrepreneurial firms, employees can "learn from their co-workers about what it takes to start a new firm." Nanda and Sørensen (2010) show that the presence of former entrepreneurs among one's colleagues increases the rate of entrepreneurship, and they argue that this reflects, in part, an informal training process whereby former entrepreneurs shed light on the entrepreneurial process.

A challenge for skill-based explanations for entrepreneurial entry decisions lies in the fact that entrepreneurial skills are difficult to measure and, indeed, to conceptualize clearly. If we observe that people who have worked in a wider variety of functional roles are more likely to become entrepreneurs, this may indeed be because they have developed greater entrepreneurial abilities. Likewise, the association between exposure to former entrepreneurs and subsequent entry may be due to learning about entrepreneurship. But other explanations are possible. For example, it may be that fixed dispositions cause people to change jobs more frequently because they never like their boss or assigned tasks; this eventually causes them to launch their own venture, creating a spurious association between career experiences and entrepreneurship. Therefore, in the absence of a clear specification of "what it takes" to be an entrepreneur, these types of learning accounts of the entrepreneurial entry decision are on shaky empirical ground. Progress can be made through a clearer conceptual specification of the rather abstract notion of entrepreneurial abilities, along with a stronger empirical validation. We need stronger claims about what it is people learn and how that learning is relevant to the entrepreneurial decision.

A different view of the entrepreneurial learning that goes on in existing organizations focuses not on how it shapes the choice between self-employment and dependent employment, but on how what is learned in existing organizations shapes the new ventures themselves. In this perspective, organizations are consequential for entrepreneurship because they are the places where individuals discover the ideas or innovations around which they build their entrepreneurial ventures, or learn the practices and policies that they implement in their new ventures.

A substantial literature explores the role of "pre-entry knowledge" on entrepreneurial outcomes (e.g., Helfat and Lieberman 2002, Carroll et al. 1996, Klepper 2001, Klepper and Sleeper 2005, Agarwal et al.

2004, Dencker et al. 2009). These studies take the decision to leave paid employment for granted and focus on qualitative differences in the experience and knowledge that the founders bring to the venture. A general theme in this literature is that entrants perform better to the extent that there is greater similarity between the resources and capabilities required for success in the origin and destination industries (Helfat and Lieberman 2002). Whereas much of this literature has focused on industry differences, perhaps more relevant for current purposes is the growing literature on "spin-outs" in an industry, i.e., new ventures that are founded by former employees of industry incumbents (Klepper 2001, Klepper and Sleeper 2005, Agarwal et al. 2004).

The dominant view of spin-outs is that they are a form of knowledge diffusion though employee mobility (Franco and Filson 2006) because they "exploit knowledge their founders acquire from their employers" (Klepper and Sleeper 2005, p. 1292). In his interviews with founders of successful entrepreneurial ventures, Bhidé (2000) finds that the large majority of the founders claimed to have had the idea for their venture while working for their prior employer. Consistent with this, in a study of the laser industry, Klepper and Sleeper (2005) show that the large majority of spin-outs in this industry initially produce a type of laser that the parent company had produced. Moreover, they show that more successful firms—which they interpret to be due to superior knowledge—have higher spin-out rates. Klepper (2001) and Agarwal et al. (2004) argue that there is an association between the quality of the parent company and the quality of the spin-outs, as measured by survival rates.

This may suggest that the most successful entrepreneurs come from the most successful parent firms; however, care must be taken in interpreting the mechanisms behind these associations. In particular, it is not clear whether the better outcomes for entrepreneurs from higher-quality firms can be attributed to their access to better ideas and innovations at the parent firms. Beyond the issue of whether people working for firms of different quality are equally skilled, one must be careful not to assume that the opportunity costs of entrepreneurship are the same across firms. The most successful firms may be the most attractive to work for, either because their success generates pecuniary benefits or because they are simply exciting places to work. By contrast, a long career with a straggling competitor may be less appealing. Employees of successful firms may therefore have a higher threshold for entry into entrepreneurship. The expected value of observed spin-outs will therefore increase with the quality or success of the parent firm because of its increasingly stringent threshold, not because of the quality of the knowledge generated in the parent firm.

Damon Phillips used his organizational genealogy framework to develop an alternative way of conceptualizing the transmission of knowledge from parent firms to the ventures founded by their former employees. Using law firms as an empirical context, Phillips (2002, 2005) argues that much of what prospective entrepreneurs learn from their employers is how to run an organization. In other words, Phillips focuses on the transmission of organizational routines. Unlike decisions about which products to sell or which markets to serve, many organizational founders spend little time consciously reflecting on how to structure organizational routines. Phillips shows that this often means that the new ventures behave in ways similar to their parent firms. This in turn has consequences on competition and the ability of the new firms to grow (Phillips 2002, Sørensen 1999). One advantage of this approach is that it is less ambiguous evidence of learning from the parent organization, because it is unlikely that organizational routines are related in a systematic way to the opportunity costs of entrepreneurship.

The Organization as Fonts of Beliefs and Values

Organizations are not simply places where people acquire skills and encounter ideas and information. They also set the tone. Through formal and informal socialization processes, organizations shape individual values and aspirations. In this way, organizational processes may influence the entrepreneurial decision-making process— in particular, the decision to leave the firm to launch a new venture. It is commonly argued, for example, that people become entrepreneurs because they have a taste for autonomy (Hamilton 2000, Benz 2009), because they have different attitudes toward risk (McClelland 1961), or because they possess a broader set of entrepreneurial job values and aspirations (Halaby 2003). Although these attitudes and values are often viewed as being innate dispositional characteristics, they may also be usefully viewed as arising from social interactions in the workplace.

Work in this area is limited. Drawing on the literature on peer social influence processes, Nanda and Sørensen (2010) argue that coworkers define an important normative environment, based on their own beliefs and experiences, that shapes entry into entrepreneurship. They argue that peers may play an important role in shaping the motivation to leave paid employment to become an entrepreneur. For example, contact with former entrepreneurs in the workplace may demystify the entrepreneurial process, changing beliefs about the nature of entrepreneurship. Furthermore, such contact may help individuals construct a vision of a viable alternative to paid employment and may help develop or accelerate the adoption of entrepreneurial job values.

In addition to peer influences, workplaces may socialize their employees for entrepreneurship through their formal and informal practices. We do not know of work that explores this connection systematically, but such work can identify potentially fruitful areas of intersection. There are natural linkages here, for example, to the extensive literature on the organizational determinants of creativity and innovation (Amabile 1996). Consider the fact that some firms are hotbeds of new ventures whereas others are not (Burton et al. 2002). Although this may, in part, reflect differences in the ability of firms to retain the new ideas generated by their employees, it also undoubtedly can be traced to elements of organizational structure and culture that have been shown to influence individual creativity.

Turning to the decision to leave paid employment, variations within and across firms in the delegation of authority and in the autonomy granted to employees in different roles may play a role in developing the attitudes conducive to entrepreneurial activity. The paucity of research on this topic means that it is not clear whether greater autonomy within the workplace should increase or decrease rates of entrepreneurship; for example, does greater autonomy strengthen or weaken the taste for autonomy? On the one hand, it is commonly asserted that entrepreneurs left their previous former employer in order to have greater autonomy; this seems to imply that the problem with the previous employer was that workers were overly controlled and monitored. On the other hand, the evidence demonstrates that rates of entrepreneurship are lower in more bureaucratic firms (Sørensen 2007). Because one of the hallmarks of bureaucracy is monitoring and control, this suggests that a negative reaction to such practices may not play an important role.

Corporate cultures and the firm's normative environment may also play an important role in stimulating entrepreneurship, although these influences have yet to be fully explored. The potential effects of corporate culture on entrepreneurship can be thought of usefully in terms of two key dimensions of the cultures: their content and their strength. The content of a culture refers to the dominant norms and values in the workplace, which may directly or indirectly shape attitudes toward entrepreneurship or the ability to identify entrepreneurial opportunities. For example, Stuart and Ding (2006) argue that transitions to entrepreneurship among university scientists are influenced by the dominant norms in the university and profession and, in particular, the stigma attached to entrepreneurship. Traditionally, the community of academic scientists associated the pursuit of private science (in the form of entrepreneurial activity) as a betrayal of the core values of science. Stuart and Ding (2006) argue, however, that these norms have changed over time such that the pursuit of entrepreneurial opportunities has become more accepted within leading universities. Cultural norms and values may also shape capabilities for innovation and assumptions about the proper way to pursue such innovations (e.g., inside or outside the firm). Thus Saxenian's (1994) comparison of Silicon Valley and Route 128 suggests that part of the reason for the greater dynamism in Silicon Valley lies in the culture of Valley firms, which she claims were less bureaucratic, command-and-control environments than the dominant firms in Massachusetts.

Corporate cultures may also influence entrepreneurship through their strength, or the extent of agreement about and commitment to core norms and values. For example, Sørensen (2002) suggests that strong corporate cultures encourage exploitation in organizational learning processes, as the lack of diversity in worldviews and assumptions within the firm leave little room for novel thinking. This suggests the possibility that employees of strong-culture firms are less likely to generate innovative entrepreneurial ideas (although they may be more likely to leave if they have the ideas and they are blocked; see "Organizations as Fonts of Opportunities" below). Likewise, the higher levels of organizational attachment generated by strong-culture environments may create a situation where innovations are more likely to be exploited within the boundaries of the existing organizations than through the launch of a new venture. Part of what successfully innovative companies like 3M and Johnson & Johnson do is to use strong cultures (along with other organizational policies) to simultaneously stimulate innovation and maximize the probability that the firm will capture those innovations internally. In this sense, strong cultures may represent a solution to the incentive problems identified by economists as a reason why people leave paid employment for entrepreneurship when they have new ideas (Anton and Yao 1995, Hellmann 2007).

The Organization as Fonts of Social Capital

A central claim in the study of entrepreneurship is that social networks and social capital play an important role in the entrepreneurial process (e.g., Stuart and Sorenson 2005). Social ties to others structure the flow of information and hence affect access to opportunities for innovation and creativity (Burt 2004). The trust required to mobilize resources for uncertain new ventures often resides in the pattern of social relationships, thus enabling the transition from paid employment to entrepreneurship. Likewise, reputation generated through patterns of affiliation plays an important part in the entrepreneurial process by facilitating access to exchange partners. Employers may shape individual social capital in two ways that are relevant to entrepreneurial activity. First, the workplace is a source of interpersonal connections that can either help facilitate entrepreneurial entry or the identification of growth opportunities. Second, affiliation with an employer is a source of reputational capital that may help a person mobilize resources to transition to an independent venture.

The workplace is one of the central arenas of social life in modern society; people in the labor force spend a large proportion of their working hours in the workplace, interacting with a potentially wide range of individuals. These connections are important because—unlike friendship ties—they are not fully voluntary. Your job makes you interact with a lot of people because you have to, not because you want to. It also may expose you to interaction partners you may not otherwise have been able to meet; in this way, the employer facilitates and structures social contact. This fact suggests the methodological advantages of studying workplace influences on entrepreneurial networks, because one might be less concerned (than in the case of friendship or discussion ties) that the observed ties were chosen with entrepreneurial goals in mind (Nanda and Sørensen 2010). However, it also suggests an important place for theorizing about how the workplace affects entrepreneurship through its impact on individual social networks (Romanelli and Schoonhoven 2001). These effects may be relevant both in terms of the ability of individuals to mobilize the resources needed to launch a new venture and of being in the right place at the right time to identify promising, value-creating opportunities.

Employer identities also constitute a form of social capital that is relevant to the entrepreneurial process. In other words, who your employer is says something about you: it may serve as a marker of differences in ability (witness how academics are assessed by their university affiliations), or it may signal qualitative differences in skills, beliefs, and attitudes. In 2011, the benefit of having worked for Google is presumably that it tells people that you are smart and creative; the cost of having worked for an aging industrial giant is presumably that it signals the opposite. These assessments influence the entrepreneurial process, particularly in terms of the ability of individuals to mobilize the resources needed to launch a new venture. Along these lines, Burton et al. (2002), in a study of new ventures in Silicon Valley, show that ventures launched by employees from "entrepreneurially prominent" employers (i.e., employers that have been the source of many entrepreneurial ventures) are more likely to pursue innovative ideas and more likely to secure external financing. They argue that this reflects the reputational consequences of employer affiliation, because affiliation with prominent firms helps reduce the perceived uncertainty of innovative ventures.

The Organization as Fonts of Opportunities

Our final view of the role of organizations in the entrepreneurial process focuses on the organization as an opportunity structure. This perspective is most germane to the question of understanding why people leave paid employment to become entrepreneurs. The central insight is that organizations encourage or discourage entrepreneurship in proportion to the extent to which they provide opportunities to their employees. In other words, the main driver of entrepreneurship is the (relative) absence of opportunities. This suggests a different perspective on how established organizations matter for entrepreneurship. When we consider the workplace as an arena for learning, socialization or social capital formation, we focus on mechanisms whereby features of the workplace drive changes in individual characteristics. A view of the workplace as an opportunity structure, by contrast, does not trace the effects of the workplace to any changes in individuals; rather, the workplace matters because it shapes the structure of the choices the employee with an entrepreneurial idea faces. In this sense, this type of explanation is situational. This is an important theoretical distinction, in particular for our understanding of how careers of attachment to different firms might matter. In the situational view, what matters for driving entrepreneurship is the structure of choices at a particular moment. In approaches that emphasize individual change, by contrast, history matters. Two people working for the same firm, with the same entrepreneurial idea, may have different risks of becoming entrepreneurs if they have been exposed to different work conditions.

In perhaps the earliest articulation of this situational view, John Freeman (1986, p. 50) famously noted that organizations are sources of entrepreneurial ventures, in part, because they "create frustration, political disruption and lost opportunity" for those individuals inside the firm attempting to pursue new ideas. This view rests in large part on the assumption that established organizations, and in particular large, bureaucratic incumbents, resist or are unable to pursue new ventures. In the face of this inertia, employees with entrepreneurial ideas and the willingness to pursue them are forced to pursue them outside the boundaries of the firm.

This expectation echoes the widespread argument in organizational research that firms are slow to change and respond to new opportunities (e.g., Hannan and Freeman 1984). Thus firms with high levels of routinization and role specialization should be less likely to pursue their employees' entrepreneurial ideas. For example, a formal division of labor with specialized roles can make decision making more cumbersome, particularly regarding nonroutine issues. Resistance to entrepreneurial proposals may be greater if the task demands of the new venture do not correspond well to the established role structure in the firm. Furthermore, as the firm moves toward the exploitation of successful routines, its willingness and ability to invest in exploring alternatives declines (March 1991). Routinization makes it more difficult for organizations to incorporate and react to nonstandard forms of information, including possible entrepreneurial opportunities (Cyert and March 1992, Nelson and Winter 1982). Thus even when entrepreneurial opportunities are identified, established firms may be unlikely to pursue them if the opportunities are surrounded by great uncertainty about the likelihood of success and if they require highly uncertain investments in new organizational capabilities (Henderson 1993).

The fact that established firms generate new ventures because they do not take advantage of innovations discovered by their employees is often viewed as a failure on the part of those organizations. However, it should be recognized that it may in many cases be quite rational for the established firm to pass on entrepreneurial opportunities, as when pursuing them would distract the firm from exploiting its core competencies, for example. One should also be careful to draw inferences from the very successful ventures that can be traced back to established firms (Bhidé 2000, Hiltzik 1999). Typically, we do not know about the many entrepreneurial opportunities that the firm turned down and that ultimately failed.

A more formal approach to the idea that the organization can stimulate entrepreneurial activity through its responses to employee innovation can be found in economic models analyzing the incentive and contracting issues surrounding innovation and entrepreneurship in firms. Anton and Yao (1995), for example, focus on the difficulties firms have in preventing entrepreneurial exit, conditional on the employee discovering an innovation. They analyze a situation where an employee makes a private discovery and must decide whether to reveal that discovery to her employer, who then must decide whether to pursue the idea. The dilemma in their model arises from the absence of enforceable property rights in the idea, which means that once revealed, neither party can prevent the other from exploiting the idea. Gromb and Scharfstein (2002) analyze the tradeoff between intrapreneurship and entrepreneurship from the firm's perspective. They note that intrapreneurship (i.e., funding employee initiatives) allows for learning about the skills and abilities of their employees, but it creates weaker incentives compared with entrepreneurship because workers may know that they will be redeployed if their venture fails. This suggests that firms will pass on intrapreneurship opportunities when the need for strong incentives outweighs the informational benefits of the internal labor market, either because of the nature of the project or because the external labor market is rich in appropriately skilled managers.

Whereas these papers treat the arrival of entrepreneurial opportunities as exogenous to the incentive system, Hellmann (2007) tackles the broader issue of how incentive design affects both the discovery of new ideas and whether these will be pursued within the firm. In Hellman's model, a key trade-off for the firm in designing incentives is how to balance the desire for a focus on established competencies and the development of firmspecific skills with a desire for the discovery of new ideas (March 1991). The key issue, then, is the firm's responsiveness to new ideas, and not, for example, the extent to which the organizational structure is formalized. Hellmann shows that employees leaving to pursue entrepreneurial ideas discovered at the firm may reflect an optimal policy by the firm designed to promote a greater focus on established competencies. (The cost for the firm, though, is that in equilibrium, employees will not generate innovations.)

A broader view of the impact of organizations as opportunity structures can be gained by considering in a more general way how organizations structure career opportunities. Central to this conceptualization is the recognition that spells of entrepreneurship are surprisingly common features of many careers and that transitions to entrepreneurship therefore share much in common with other career transitions, particularly between jobs in paid employment. This logic suggests that moves into entrepreneurship should, like moves between paid jobs, be understood as components of an attainment process: people pursue entrepreneurial opportunities because they seem like the best way to get ahead (Sørensen and Sharkey 2010). From this perspective, then, the central issue in understanding why people become entrepreneurs is understanding what makes it seem attractive relative to other career opportunities.

Organizations play a central role in defining the opportunity structures that workers face in the labor market (Baron and Bielby 1980). One of the important ways in which organizations can shape entrepreneurship, then, is by changing the attractiveness of entrepreneurial opportunities relative to other forms of mobility. At its simplest, we can imagine that being at the bottom of a well-defined job ladder should lower the appeal of entrepreneurship, because leaving to pursue an (uncertain) entrepreneurial venture implies incurring the opportunity cost of not being able to progress up the ladder. By contrast, if one reaches the point where advancement opportunities in paid employment dwindle, entrepreneurship begins to look relatively more attractive as a means of advancement.

Sørensen and Sharkey (2010) formalize this intuition by developing a simple model of the mobility process in which increased rates of entrepreneurship result from people getting "stuck" in (organizational) opportunity structures. The central insight of their model is that in situations where employers reward people whose skills and abilities are well matched to the firm's needs, a good match can be a double-edged sword, depending on the firm's opportunity structure. On the one hand, a good match implies higher wages and better advancement opportunities within the firm. Yet the rate of external offers declines in the quality of the match (Jovanovic 1979), leading to lower rates of interfirm mobility. Sørensen and Sharkey (2010) demonstrate that this leads to the somewhat counterintuitive conclusion that, holding constant the attainment level, the odds of choosing entrepreneurship are increasing in the quality of the person–firm match. Moreover, they show that the characteristics of the opportunity structure, such as the height of the job ladder and degree of inequality, interact with match quality in affecting entry into entrepreneurship. In particular, rates of entrepreneurship are higher when workers have good matches with structures that have limited opportunities. Sørensen and Sharkey (2010) show how this model accounts for a number of wellknown empirical regularities, including the relationship between firm size and entrepreneurship (Sørensen 2007).

Conclusion

In this paper, we have offered a simple framework for organizing the emerging literature on the role of organizations in generating entrepreneurship. We have not attempted to provide a comprehensive survey of work done in this area; rather, we have sought to identify, through our four metaphors, broad differences in the classes of theoretical mechanisms that have been invoked to explain the impact of established employers on the entrepreneurial process. In addition, our highly schematic consideration of the definition of entrepreneurship in Figure 1 is meant to highlight the importance of being clear about the object of study in developing work in this area.

Our reading of this young literature suggests two imbalances, one primarily theoretical and one primarily methodological. Theoretically, the dominant approach to conceptualizing the relationship between the workplace and people's entrepreneurial activity has been to focus on the ways in which workplaces change people to make them more likely to become entrepreneurs. This can be because the workplace facilitates the acquisition of entrepreneurially relevant skills, changes career aspirations, or changes job values. This emphasis on entrepreneurship as the outcome of a personal development process is consistent with a tendency in much entrepreneurship research to understand entrepreneurs as distinctive types of individuals; with this perspective, it is natural to focus on what experiences generate these unique characteristics.

However, there is a different, less developed approach to conceptualizing the relationship between the workplace and entrepreneurship. This is the perspective characterizing the work that views organizations as fonts of opportunities and has to do with understanding the workplace as a structural context that shapes the parameters involved in career decision making. Thus it may be that different workplaces generate entrepreneurs at different rates because they differ in the extent to which they expose individuals to entrepreneurial opportunities or because differences in incentives and opportunity structures make entrepreneurship more attractive in some settings than in others. In this view, work environments do not have to induce any changes in individual characteristics; rather, they shape behavior by shaping the structure of opportunities. Developing this type of structural approach more fully would be a promising direction for future research.

The second, more methodological, imbalance we note is in the nature of the evidence. For understandable reasons, papers on the linkage between workplace characteristics and entrepreneurship rely on observational data of various sorts. Yet such observational data pose inferential challenges that are arguably quite severe when trying to develop and test theories about how established firms shape entrepreneurship. As Elfenbein et al. (2010) phrase it, the issue is one of treatment effects versus selection effects (cf. Sørensen 2007). Theories of the impact of workplace characteristics on entrepreneurship are theories of treatment effects: claims that firms change individual preferences or skills, or that firms change the choices individuals make. Yet many of the empirical associations between firms and entrepreneurial outcomes may arise through sorting and selection processes. The study of workplace effects is particularly complicated because they are subject to selections both on the front end and the back end, so to speak. On the front end—that is, at the point of hire—sorting processes in the labor market mean that there may be unmeasured compositional differences between firms that are related to entrepreneurial outcomes. Workers with a predilection for entrepreneurial activity, for example, may choose to work for firms with certain characteristics, leading to the mistaken conclusion that those characteristics play a causal role in encouraging entrepreneurship. On the back end—that is, at the point of exit from the firm—firms also shape the threshold for entrepreneurial entry, or how attractive an opportunity must seem in order for an individual to pursue it. In short, firms and their policies define the opportunity costs of entrepreneurship. Unmeasured variation in these opportunity costs is a plausible alternative explanation for many accounts of the relationship between firm characteristics and entrepreneurial entry rates and outcomes.

Despite these imbalances, we are confident that the literature on organizations and entrepreneurship will flourish over the coming years. Organizations are fonts of entrepreneurship; the vast majority of entrepreneurs have careers of prior paid employment. The simple fact that such transitions are so prevalent is reason enough for scholars to devote their attention to how existing organizations affect the entrepreneurial process. Better yet, this area is both conceptually rich and largely unexplored. As a consequence, the opportunities for theoretical advancement are plentiful.

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Endnotes

There is a difficult question here, which we elide, with respect to how (or when) one defines entrepreneurial outcomes along the value creation dimension. In particular, it is not a priori clear whether one should focus on intentions (i.e., the entrepreneur believes that this is going to be a big thing) or outcomes. In principle, it seems unsatisfying to focus on the outcomes because that is confounded with postentry performance; in practice, however, it is often difficult to avoid it because measuring the creativity or innovation of entrepreneurial intentions at the point of entry is very difficult. 2We use the term "font" here not to denote a typeface, although that may be its most common current usage. Rather, we use it in the sense of a "well" or "fountain."

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Knowledge and Entrepreneurial Employees: a Country-level Analysis

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Abstract: According to the knowledge spillover theory of entrepreneurship, knowledge created endogenously results in knowledge spillovers, which allow independent entrepreneurs to identify and exploit opportunities (Acs et al. in Small Bus Econ 32(1):15–30, 2009). The knowledge spillover theory of entrepreneurship ignores entrepreneurial activities of employees within established organizations. This ignorance is largely empirical, because there has been no large-scale study on the prevalence and nature of entrepreneurial employee activities. This article presents the outcomes of the first large-scale international study of entrepreneurial employee activities. In multiple advanced capitalist economies, entrepreneurial employee activity is more prevalent than independent entrepreneurial activity. Innovation indicators are positively correlated with the prevalence of entrepreneurial employee activities, but are not or even negatively correlated with the prevalence of independent entrepreneurial activities.

Keywords: Entrepreneurial employees; Knowledge spillover theory of entrepreneurship; Independent entrepreneurship; Innovation; GEM

1.Introduction

Where do entrepreneurial opportunities come from and in which organizational setting are they recognized and pursued? Investments in knowledge are seen as a key source of entrepreneurial opportunities. This has been studied on the individual level (Shane 2000), the firm level (Cohen and Levinthal 1989), the regional level (Audretsch and Lehmann 2005), and the national level (Acs et al. 2009; Braunerhjelm et al. 2010). Most entrepreneurship studies on innovation emphasize the role of new firms and independent entrepreneurs (Shane 2000; Shane and Stuart 2002; Hellmann 2007; Stam and Wennberg 2009; Qian and Acs 2013). This is largely the legacy of Schumpeter (1934; also known as Schumpeter Mark I) in which the independent entrepreneur as innovator turns new ideas into commercial products. In recent theorizing on knowledge spillovers and entrepreneurship (Au- dretsch et al. 2006; Audretsch and Keilbach 2007; Acs et al. 2009; Braunerhjelm et al. 2010), the role of the (independent) entrepreneur is to commercialize the new ideas that are developed in established organizations, but exploited in newly created independent firms. The Schumpeter Mark I legacy and the knowledge spillover theory of entrepreneurship ignore entrepreneurial activities of employees within established organizations. This ignorance has two roots. The first one is empirical, because there has been no large-scale study on the prevalence and nature of entrepreneurial employee activities. There have been many studies on corporate entrepreneurship, but these never involve large-scale adult population surveys, which simultaneously compare the prevalence of both independent entrepreneurship and entrepreneurial employee activity, in a large set of countries. The second root of ignorance is conceptual, in the sense that entrepreneurship has predominantly been seen as either individual-level organization creation activity (Gartner 1985; Gartner and Carter 2003) or as a firm-level characteristic (Teece 2007; Wiklund and Shepherd 2003; even in studies on corporate entrepreneur- ship, such as Zahra and Covin 1995; Ahuja and Lampert 2001), but not as an individual-level activity within an established organization that can be com- pared to independent entrepreneurship. Many corporate entrepreneurship studies deal with venturing activities that are initiated by the top management of an organization, not with venturing activities that emerge bottom up by entrepreneurial employees.

The key question in this article is whether innovation indicators are more related to independent entrepreneurship or entrepreneurial employee activities on the national level. The purpose of this study is to reveal and explain why knowledge is related to entrepreneurial employee activity on the national level, to complement the knowledge spillover theory of entrepreneurship with its focus on independent entrepreneurship as the mechanism to turn new ideas into new business activity. In order to answer the key question, a new measure of entrepreneurial employee activity on the national level is introduced. This enables an analysis of the prevalence of entrepreneurial employee activity in a large set of developed economies. This measure provides insight into entrepreneurial activity on the national level of aggregation, but is based on individual-level responses, doing justice to the choices made by individuals about how they would like to pursue the opportunity that they have discovered (Hayek 1937). This article presents the outcomes of the first large-scale international study into entrepreneurial employee activities. If this is a marginal phenomenon there is no need to further inquire into entrepreneurial employee activities. How- ever, we find, quite in contrast, that entrepreneurial employee activity is more prevalent than independent entrepreneurial activity in multiple advanced capitalist economies.

Still, this would not be such a noteworthy finding if this entrepreneurial employee activity would just be an extended version of independent entrepreneurship, i.e., if its characteristics would not substantially differ, especially with respect to the innovative nature of the phenomenon. It is tested whether knowledge at the national level is more related to independent entrepreneurial activity or to entrepreneurial employee activity. This would provide further evidence on the relevance of entrepreneurial activities within established organizations and show why the intra-organizational dimension has been a very important area neglected in the debates on entrepreneurship and innovation in general, and the knowledge spillover theory of entrepreneurship in particular. The innovation indicators turn out to be positively correlated with the prevalence of entrepreneurial employee activities, and are not or even negatively correlated to the prevalence of independent entrepreneurial activities.

These findings are highly relevant for public policy. Most policy attention until now has been focused on stimulating individuals to become independent entrepreneurs. However, if entrepreneurial employee activity is as prevalent as independent entrepreneurial activity and if it is even more strongly related to innovation, public policy should more explicitly take into account entrepreneurial employee activity as a possible conduit for knowledge to be turned in economic value. Investments in innovation in established organizations might as well be the source of opportunity recognition and pursuit by entrepreneurial employees.

2.Knowledge, Entrepreneurship, and Innovation

The founding father of the economics of innovation, Joseph Schumpeter, is well known for his two models of innovation. The first, also known as Schumpeter Mark I (Schumpeter 1934), emphasizes the role of new entrants that introduce innovation into the market. This has provided the starting point for a long tradition in the economics of entrepreneurship, in which entrepreneurs are seen as the individuals that create new firms in order to exploit opportunities for innovation. In the second model, also known as Schumpeter Mark II (Schumpeter 1942), innovation is the result of R&D investments of large incumbents. This R&D is performed by groups of employees, with interchangeable individuals, so without a distinctive role for the individual entrepreneur (see also more recent interpretations in Nelson and Winter 1982; Baumol 2002). In empirical terms, Schumpeter Mark I is measured with data on new (innovative) entrants in the economy, while Schumpeter Mark II is measured with data on R&D and/or the most straightforward output indicator of R&D, namely patents. In international comparisons on innovation, this comes down to measuring new firm formation or rates of (new) independent entrepreneurship, and the level of R&D investments and/or the rate of patenting.

These two Schumpeterian models of innovation and theorizing on economic growth, e.g., by Lucas (1988), Romer (1990) and Aghion and Howitt (1992), are brought together in the so-called knowledge spillover theory of entrepreneurship (Audretsch et al. 2006; Audretsch and Keilbach 2007; Acs et al. 2009). According to this theory, knowledge created in an incumbent organization is an important source of entrepreneurial opportunities. Not all this knowledge is perceived to be valuable by the incumbent, and by commercializing knowledge that otherwise would remain uncommercialized through the start-up of a new venture, independent entrepreneurship serves as a conduit of knowledge spillovers. According to the theory of knowledge spillover entrepreneurship, a context with more knowledge will generate more entrepreneurial opportunities. In contrast, a context with less knowledge will generate fewer entrepreneurial opportunities. We thus expect the level of new independent entrepreneurship to be positively related to the level of knowledge investments, activities, and outputs in a country.

However, this assumes that entrepreneurial activity is most likely to be activity by independent entrepreneurs. Most studies on entrepreneurship, knowledge, and innovation indeed only use independent entrepreneurship as an empirical indicator of entrepreneurship (see, e.g., Shane 2000; Shane and Stuart 2002; Stam and Wennberg 2009; Qian and Acs 2013). There are many reasons to also consider entrepreneurial activity within existing organizations next to entrepreneurship embodied in new organizations (see Sørensen and Fassiotto 2011; Stam et al. 2012). There might be many knowledge investments in established organizations that lead to the recognition and pursuit of entrepreneurial opportunities by employees of these very same organizations. Two mechanisms make entrepreneurial employee activity more likely than independent entrepreneurship. First, highly educated entrepreneurial employees in established organizations are more likely to recognize opportunities because of their own high levels of absorptive capacity. Second, entrepreneurial employees are more likely to pursue opportunities for innovation because of their access to a larger knowledge base and to more complementary assets within their employer organization, which are needed to exploit these new ideas on a sufficiently large scale (cf. Teece 1987). Independent entrepreneurs in contrast often have a more limited knowledge base and set of complementary assets. So we expect the level of entrepreneurial employee activity to be positively related to the level of knowledge investments, activities, and outputs in a country.

3.Data and Empirics

3.1 Dependent Variables

The dependent variables are all based on the 2011 data collection of the Global Entrepreneurship

Monitor (see GEM 2012). The Global Entrepreneurship Monitor (GEM) assesses entrepreneurial activity at the national collection through telephone surveys of a randomly selected adult sample. These surveys include a minimum number of 2,000 respondents in each participating country as to their attitudes toward entrepreneurship, their participation in entrepreneurial activity, and their entrepreneurial aspiration. See Reynolds et al. (2005) for a detailed description of the GEM methodology.

The GEM normally focuses on independent entrepreneurship, and its central measure is the so-called Total Entrepreneurial Activity (TEA) rate. The TEA rate reflects the percentage of the adult population (aged 18–64 years) that is actively preparing to set up an independent business (nascent entrepreneurs) or currently owns an independent business that is less than 42 months old (owner-managers of new businesses). More in particular, a nascent entrepreneur is an individual who is currently actively involved in setting up a business he/she will own or co-own; this business has not paid salaries, wages, or any other payments to the owners for more than 3 months. An owner-manager of a new business refers to an individual who currently, alone or with others, owns and manages an operating business that has paid salaries, wages, or other payments to the owners for more than 3 months, but not more than 42 months. We also used a subset of the TEA rate, which reflects independent entrepreneurship activities that have a relatively strong emphasis on the pursuit of innovation opportunities, namely independent entrepreneurial activity that involves new products (TEA_NEWPRO). TEA_NEWPRO reflects the percentage of the adult population involved in entrepreneurial activities that deliver products or services that are regarded as new and unfamiliar by their (potential) customers.

Entrepreneurial employee activity (EEA) is a completely new measure of entrepreneurship. The data for this new measure were collected through a special theme study on entrepreneurial employee activity in the framework of the Global Entrepreneur- ship Monitor in 2011. Fifty-two countries participated in this study on entrepreneurial employee activity using a set of specific questions targeted at all employees- excluding those already identified as owner-managers of businesses—aged between 18–64 years in the GEM samples (Bosma et al. 2012). This cumulates into a total of over 140,000 respondents, of which more than 70,000 are employees, of the GEM Adult Population Survey. A particular advantage of this methodology is the opportunity to compare entrepreneurial employee activity with 'regular' entrepreneurial activity (i.e., individuals who own and manage a business, or expect to own the business they are setting up) at both the macro and micro level.

Regarding the scope of entrepreneurial employee activity, GEM operationalized entrepreneurial employee activity as employees developing new business activities for their employer, including establishing a new outlet or subsidiary and launching new products or product-market combinations. Two phases are distinguished in the entrepreneurial process (comparable with the phases in TEA): idea development for new business activities and preparation and (emerging) exploitation of these new activities. For the role of entrepreneurial employees in each of these phases, we distinguish between leading and supporting roles. Based on these elements GEM distinguishes between employees who, in the past 3 years, have been actively involved in and have had a leading role in at least one of these phases and who are also currently involved in entrepreneurial employee activity. All employees participating in the GEM Adult Population Survey could be classified in terms of their involvement in entrepreneurial employee activity. Accordingly, the EEA rate measures the prevalence (in the population of 18–64 years) of employees who, in the past 3 years, have been actively involved in the development of new activities for their main employer, had a leading role in at least one phase of the entrepreneurial process, and are also currently involved in the development of such new activities.The differences (locus of entrepreneurial activity) andsimilarities (phases in the entrepreneurial process) between EEA and TEA are represented in Fig.

		Phases in the entrepreneurial process:	
		Recognition of an entrepreneurial opportunity	**Pursuit of an entrepreneurial opportunity**
Locus of entrepreneurial activity:	**With an independent business**	TEA: Nascent entrepreneurship	TEA: Owner-manager of new business
	Within an established organization	EEA: Employee leading idea development for new business activities	EEA: Employee leading the exploitation of new business activities

Fig. 1 Different types of entrepreneurial activity

This approach to entrepreneurial employee activity is in many ways comparable to the measure of independent early stage entrepreneurial activity, albeit within the context of established organizations. In practice, entrepreneurial employee activity can occur in many different functions within organizations: employees developing new products (in a new business development function), launching new products or launching existing products in new markets (in a marketing function), setting up a new branch (in a HRM function), introducing new technologies, or outsourcing the production to external organizations (in an operations function) (see Bosma et al. 2010). The difference with 'regular' R&D and marketing work is that only new business activities initiated by the individual employee are included in entrepreneurial employee activity, and this individual should be in a leading role in the recognition of the opportunity or the pursuit of the opportunity, emphasizing proactiveness, which has been acknowledged as a key element of entrepreneurial behavior (Crant 2000; Frese and Fay 2001; Parker and Collins 2010). In a similar vein, EEA does not include corporate venturing activities by employees that are initiated by the top management of an organization. This however does not rule out that aggregate measures, e.g., of R&D and marketing, partly overlap with aggregate measures of entrepreneurial employee activity, since R&D workers might take the initiative to develop a new product and marketing workers might take the initiative to exploit new markets.

3.2 Independent Variables

In this study, we regard innovation indicators as precursors of entrepreneurial activity and thus treat them here as independent variables. In practice, this distinction might not always hold as entrepreneurial activity might be more simultaneously related to innovation, for example, when entrepreneurial employees are funded by the R&D budget of their employer or when their entrepreneurial activity also results in patents during the process. R&D and the resulting patents might however also be the raw material (inventions) that entrepreneurial employees or independent entrepreneurs use as input for their new business activities. We used the most general national- level indicators of innovation, namely gross expenditure on R&D investments (as percentage of GDP), patents (per resident), (percentage of the population with) tertiary education, and knowledge-intensive employment (as percentage of total employment). Table shows the source (year) of the innovation indicators. There is a time lag between the innovation indicators (measured in 2007–2009) and the entrepreneurship indicators (measured in 2011), taking into account that it may take several years for the innovation indicators to affect the entrepreneurship indicators.

Table 1 Innovation indicators

Innovation indicator	Description	Source (year)
EXPRD–gross expenditure on R&D (% of GDP)	Total domestic intramural spending on R&D as a percentage of GDP	UNESCO Institute for Statistics (2007) http://stats.uis.unesco.org
KNOEMP–employment in knowledge-intensive services (% of workforce)	Sum of people in categories 'professional, technical and related workers; administrative and managerial workers; clerical and related workers' and 'legislators, senior officials and managers; professionals; technicians and associate professionals', as a percentage of total people employed	International Labour Organization, LABORSTA Database of Labor Statistics (2008) http://laborsta.ilo.org
PCTPAT–patent applications filed at national office (per billion GDP, 2005 PPP$)	Number of patent applications filed by residents at the national patent office	World intellectual Property Organization, WIPO Statistics Database (2009) http://www.wipo.int/ipstats
TEREDU–Tertiary school enrollment (% gross)	Ratio of tertiary enrollment, regardless of age, to the population of the age group that officially corresponds to the tertiary level of education	UNESCO Institute for Statistics (2008) http://stats.uis.unesco.org

4.Results

We analyze a subsample of the total set of countries that is taken into account in the Global Entrepreneur- ship Monitor: this subsample of 25 countries includes all OECD countries in the total GEM sample, which allows us to take into account all innovation indicators, and a relatively homogenous set of countries with respect to the level of economic development.[6] In Table 2 we show the descriptive statistics and correlations between the country-level variables. Two sets of variables are highly positively correlated: the two TEA measures and the four innovation indicators. The most striking correlations are the strongly positive correlations between EEA and all four innovation indicators. In contrast, the TEA measures are negatively (but mostly not statistically significantly) related to innovation. This discon firms our expectation that the level of new independent entrepreneurship is positvely related to the level of knowledge investments, activities, and outputs in a country–and confirms our expectation that the level of entrepreneurial employee activity is positively related to the level of knowledge investments, activities, and outputs in a country.

When we focus on two of the key drivers of economic growth—R&D and education (see, e.g., Helpman 2004)—and visually inspect the data (see Fig. 2, 3), a clear pattern arises: a positive correlation of tertiary education and R&D with EEA, and a negative correlation of tertiary education and R&D with TEA. The values of the innovation indicators are rather equally distributed. Several outliers with respect to entrepreneurial activity rates stand out: Chile with a TEA rate of 23.7 percent, Sweden with an EEA rate of 13.5 percent, and Turkey, Mexico, and Greece with very low EEA rates (respectively 0.6, 0.8, and 1.3 percent).

If we take a more country-specific approach and focus on the countries that are innovation leaders, how do these countries rank on EEA and TEA? Out of the 25 countries we analyzed, four countries ranked in the top three of the innovation indicators at least two times: Finland, Japan, Sweden, and Switzerland. These countries have also been classified as innovation leaders in prior OECD, World Economic Forum, Global Innovation Index, and Innovation Barometer studies. All four of these countries rank relatively low on the TEA index, but two out of four (Finland and Sweden; both ranking very high on R&D and patents) perform very well on the EEA index as well.

Table 2 Descriptive statistics and correlation matrix

	Min	Max	Mean	SD	1	2	3	4	5	6	7
1. EEA	0.60	13.50	4.22	2.93	1						
2. TEA	3.70	23.70	8.24	4.08	−0.307	1					
3. TEA_NEWPRO	1.90	21.30	4.35	3.87	−0.250	0.928***	1				
4. EXPRD	0.37	3.84	1.95	1.07	0.621***	−0.502*	−0.463*	1			
5. KNOEMP	18.44	47.20	36.74	8.09	0.649***	−0.366†	−0.288	0.502*	1		
6. PCTPAT	0.14	11.73	3.49	3.55	0.531**	−0.395†	−0.331	0.879***	0.515**	1	
7. TEREDU	13	44	28.48	9.16	0.480*	−0.254	−0.241	0.749***	0.514**	0.660***	1

Correlation significant at the *** 0.001 level, ** 0.01 level, * 0.05 level, and † 0.10 level

Fig. 2 Tertiary education and entrepreneurial activity

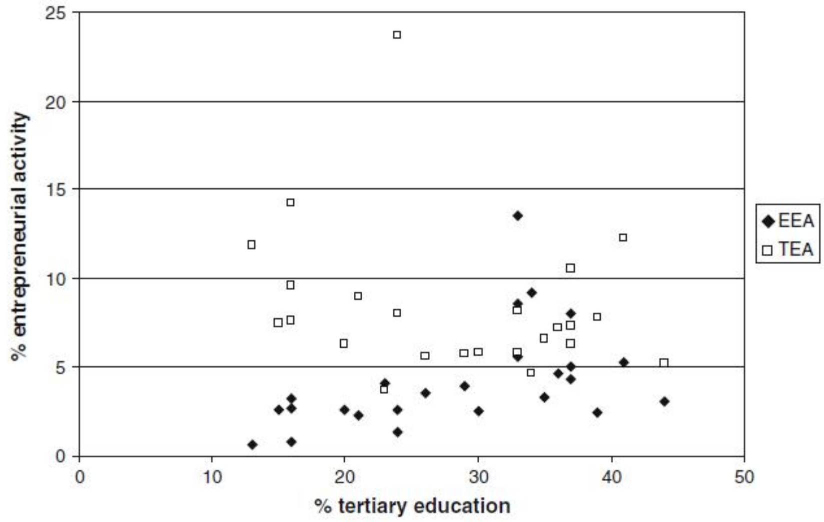

Fig. 3 R&D and entrepreneurial activity

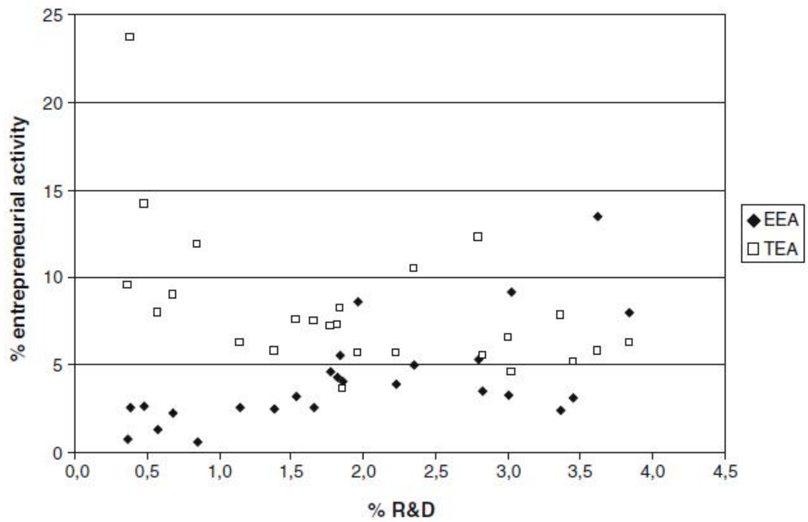

Table 3 Regression results

	TEA	TEA_NEWPRO	EEA
EXPRD	−3.402	−3.405	1.811
	(1.655)*	(1.629)*	(0.970)*
KNOEMP	−0.124	−0.080	0.179
	(0.111)	(0.110)	(0.065)**
PCTPAT	0.327	0.426	−0.188
	(0.449)	(0.442)	(0.263)
TEREDU	0.158	0.124	−0.039
	(0.127)	(0.125)	(0.074)
Constant	13.793	8.904	−4.140
	(3.987)**	(3.924)**	(2.338)*
R^2	0.336	0.285	0.556

Standard errors are in parentheses

Asterisks indicate the significance level where * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

We also performed a linear regression to discover which of the innovation indicators is most strongly related to TEA, TEA_NEWPRO, and EEA, controlling for the other innovation indicators. The results are shown in Table This reveals that especially R&D is strongly related to both types of entrepreneurial activity, albeit in completely contrasting ways: negatively related with TEA and positively related with EEA. Employment in knowledge-intensive services is only positively related to EEA, while patents and educational level seem to become insignificant once the effects of other innovation indicators are controlled for.

5.Discussion

The results of the very first large-scale international analysis of the relation between knowledge and two types of entrepreneurship—independent new entrepreneurship and entrepreneurial employee activity— show some very clear patterns, disconfirming the received wisdom that independent new entrepreneur- ship is highly related to the level of knowledge investments, activities, and outputs in a country, and in other (public and private) organizations than independent entrepreneurs, with on average lower levels of education (see Bosma et al. 2010) and less access to complementary assets. We will discuss our findings on the macro and micro levels, and finally discuss their relation to high-impact entrepreneurship and radical innovation.

5.1 Macro level

There has been no empirical study on the country-level relations between knowledge and entrepreneurship in incumbent organizations, what we label here as entrepreneurial employee activity. Our findings suggest that on average, knowledge investments, activities, and outputs in a country are more related to entrepreneurial employee activity than to independent entrepreneurship in developed economies. The implications of our analyses are primarily relevant for developed countries and not for developing countries. However, we expect our results to be even stronger when developing countries are included in the analyses, because these countries on average perform rather poorly on the traditional innovation indicators, and have high independent entrepreneurship rates and low intrapreneurship rates (see Bosma et al. 2010; 2012).

5.2 Micro level

Correlations do not necessarily indicate causalities. We should be very careful with making inferences about causal relations and should also provide proper micro foundations. On the micro level, the relation between innovation and entrepreneurship in incumbent organizations is not a completely novel insight: the classical work by Edith Penrose (1959) already emphasized the entrepreneurial function of individual managers in incumbent organizations, which comprised the recognition and pursuit of productive opportunities. Also more recent work on intrapreneur- ship emphasizes the importance of entrepreneurial activity within incumbent organizations (Lumpkin 2007; Parker 2011). Our findings on the macro level confirm recent findings on the micro level, which reveal that intrapreneurship involves new products more often than independent entrepreneurship (Bosma et al. 2010; Parker 2011). However, these empirical findings do not provide much insight into the relevant organizational and institutional mechanisms that explain why certain opportunities are recognized and pursued in established organizations or with new independent firms.

It is an empirical question to what extent incumbent firms efficiently exploit knowledge flows. The original formulation of the knowledge spillover theory of entrepreneurship also leaves this option open: ‘‘(t)he more efficiently incumbents exploit knowledge flows, the smaller the effect of new knowledge on entrepreneurship’’ (Acs et al. 2009, p. 17). Acs et al. (2009) suggest that this efficiency can be measured with the number of patents per capita, a measure that can also be seen as an indicator of general knowledge production (the way this variable is treated in this article). They indeed find a statistically significant negative relation between patents per capita and their measure of entrepreneurship (share of self-employed as a percentage of the labor force). In contrast to our findings, their results show a positive relation between knowledge stock (also measured with R&D expenses) and independent entrepreneurship. Further research should show whether these contrasting findings are contingent on the time period, set of countries, and/or type of data (longitudinal or cross-sectional).

5.3 High-impact entrepreneurship and radical innovation

From an empirical point of view, it has been suggested that many individuals that start new independent businesses are only marginally innovative and do not apply novel (scientific and technological) knowledge at all in their commercial offerings (Santarelli and Vivarelli 2007). Most of these founders of new independent businesses might fill small niches of product markets that have not yet been served adequately by large incumbents (Penrose 1959) or adapt goods and services to local contexts (Kirzner 1973). These entrepreneurs make a living with these activities and might even be relatively happy with this (Benz and Frey 2008; Lange 2012). Entrepreneurial employees not only have to make a living with their activities, or become happy themselves, but have to convince their colleagues and superiors that investing resources in their ideas is really worthwhile. Their ventures need to have much more potential impact than the average independent new business. This is confirmed by the previous finding that entrepreneurial employees have high expectations of their new business much more often than independent entrepreneurs (Bosma et al. 2010). They can also have more impact, because they have better access to complementary assets within their employer’s organization (Teece

1987), which are needed to exploit these new ideas on a sufficiently large scale.

However, radical high-impact innovations will not come from the ‘average’ independent entrepreneur and will probably also not be realized by the ‘average’ entrepreneurial employee. Radical high-impact innovations are likely to be recognized by employees (or other members, like students) of knowledge-intensive organizations that are not able (e.g., universities) or willing (e.g., large companies) to pursue those high- risk activities (see Hellmann 2007; Klepper 2007; Klepper and Thompson 2010). In the end, it may be a very small subset of entrepreneurial employees that leave their employer to found a spin off firm in order to pursue a high-risk, (potentially) high-gain opportunity and an even smaller subset of this group that is successful in realizing these high impact opportunities. These are independent entrepreneurs turned entrepreneurial employees. In practice, these (potentially) high-impact independent ventures might be acquired by established organizations, stimulating entrepreneurship within their boundaries or killing these ventures if the acquiring firm is insufficiently entrepreneurial. This interpretation does justice to the original formulation of the knowledge spillover theory of entrepreneurship, which stated that ‘‘(s)tart-ups with access to entrepreneurial talent and intratemporal spillovers from the stock of knowledge are more likely to engage in radical innovation leading to new industries or replacing existing products’’ (Acs et al. 2009, p. 16). However, neither their empirical test nor ours is able to pick the proper empirical indicator for this type of radical innovation and the actors involved in pursuing such high-risk, high-gain opportunities.

6. Conclusions

In this study we presented the results of the first large- scale international study into knowledge and the relation with two types of entrepreneurship: independent new entrepreneurship and entrepreneurial employee activity. We expected positive relations of knowledge with both types of entrepreneurship on the country level. Our key findings disconfirm the expected positive relation among the level of knowledge investments, activities, and outputs in a country on the one hand and the level of new independent entrepreneurship on the other. The level of entrepreneurial employee activity was revealed to be positively related to the level of knowledge investments, activities, and outputs in a country. These findings turn most current research on the relation between entrepreneurship and knowledge on its head and reveal that when we talk about knowledge, innovation, and entrepreneurship, we should be talking predominantly about knowledge, innovation, and entrepreneurial employee activity.

This has profound implications for research in that the omission of entrepreneurial employee activity has been a major shortcoming for international studies on entrepreneurship (see Marcotte 2013 for a recent review), not only because entrepreneurial employee activity is equally prevalent as independent new entrepreneurship in many developed economies, but also because entrepreneurial employee activity is much more strongly related to knowledge than independent new entrepreneurship. It also redirects attention from the narrow version of the knowledge spillover theory of entrepreneurship to the original ‘broad’ version of the knowledge spillover theory of entrepreneurship (Acs et al. 2009), in which the knowledge exploitation efficiency of incumbents is one of the central variables. This includes the possibility that societies with high levels of investment in knowledge and human capital have relatively many organizations that fuel entrepreneurial activity of their employees and do not trigger independent new entrepreneurship on a large scale. An interesting avenue for future research would be to disentangle the effects of private and public R&D on the prevalence of (innovative) independent entrepreneurship and entrepreneurial employee activity. One would expect a stronger relation between private R&D and entrepreneurial employee activity than between public R&D and entrepreneurial employee activity (cf. Acs et al. 1994).

Our findings also have substantial implications for entrepreneurship and innovation policy, which used to focus on independent new entrepreneurship as a driver of innovation—mainly derived from the Schumpeter Mark I heritage—and that tended to stimulate R&D as a source of routinized innovation—mainly derived from the Schumpeter Mark II heritage. This study reveals that a significant relation exists between investments in new knowledge and human capital and entrepreneurial employee activity, which neither reflects Schumpeter Mark I nor Schumpeter Mark II inspired twentieth-century innovation policy. It redirects attention to creating the institutional context and organizational conditions that enable productive entrepreneurial employee activity in the twenty-first century. The last century has seen an enormous increase in individual rights in most countries (Ac- emoglu 2012) and an increase in the knowledge intensity of their economic activities (Thurik et al. 2013). Combined, this means that firms are increasingly communities in which individuals share and create knowledge (Kogut and Zander 1992). Firms should be seen as value-creating institutions that inspire and enable individual initiative (Ghoshal and Bartlett 1997), and public policy should create, adopt, and abolish institutions in order to enable productive entrepreneurship in society (Stam and Nooteboom 2011). Two examples of public policy that might foster entrepreneurial activity by employees are first stimulating the provision of entrepreneurship courses that do not narrowly focus on independent entrepreneurship as the only mode of opportunity pursuit and second abolishing non-compete agreements. The latter policy intervention could cut both ways: employers would be more inclined to invest in their employees in order to retain them, and employees who want to pursue radical innovations that might cannibalize their employer's product markets cannot be withheld, enabling high-risk, high-gain opportunities to be pursued by spin offs.

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1.With some exceptions, such as Hornsby et al. (2002) on corporate entrepreneurship activities of middle managers, Parker (2011) on individuals starting a new venture for an employer, and Martiarena (2013), which is based on data from one country (Spain) of our research sample.

2.The exception being the literature on dispersed corporate entrepreneurship (e.g., Birkinshaw 1997; Belousova and Gailly 2013).

3.Previous large-scale research on entrepreneurial employee activity (Bosma et al. 2010) has shown that higher educated individuals are more likely to be intrapreneurs than lower educated individuals, and that lower educated individuals are more likely to be independent entrepreneurs than higher educated individuals. This has been confirmed in follow-up research by Bosma et al. (2012). Research on intrapreneurship has shown that higher educated employees are more likely to be involved in intrapreneurship than lower educated employees (Stam et al. 2012, chapter 3). So both within society and within organizations, education seems to be positively correlated to entrepreneurial employee activity.

4.This is a much more narrow definition than that of Martiarena (2013), which includes all employees that have been involved in the development of new business activities for their employer, irrespective of whether they had a leading role in this.

5.As Morris et al. (1994, p. 84) mention, entrepreneurial employee activity is unlikely to be a completely individual exercise: 'The key is to balance the need for individual initiative with the spirit of cooperation and group ownership of innova- tion. This balance occurs over the entrepreneurial process, not all at once, and as micro-level innovation evolves into macro- level organizational change. Individuals are needed to provide the vision, unwavering commitment, and internal salesmanship without which nothing would be accomplished. But as the process unfolds, the entrepreneur requires teams of people with unique skills and resources' (cf. Bartlett and Ghoshal 1997).

6.The 25 countries are: Australia, Belgium, Chile, Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, Ireland, Japan, Korea (Rep.), Mexico, The Netherlands, Poland, Portugal, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey, UK, and USA.

7.Given that the dependent variables are positive, we also ran Tobit regressions as a robustness check. This delivered the same outcomes. We also performed a linear regression with new technology based TEA: this type of independent entrepreneurship is not (statistically significantly) related to the innovation indicators. Results are available upon request.

Source: Springer Science+Business Media, New York, 2013.

Ambitious Entrepreneurship, High-growth Firms, and Macroeconomic Growth

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1 Introduction

Although entrepreneurship has long been considered a crucial mechanism of economic development (Schumpeter 1934; Landes 1998; Baumol 2002; Audretsch et al. 2006), empirical studies on the role of entrepreneurship in economic growth show mixed evidence (Stam 2008; Parker 2009). This is not surprising given the heterogeneity characterizing both the kinds of entre- preneurship and the economic contexts in which economic growth takes place. In addition, issues concerning the measurement of entrepreneurship (Wennekers and Thurik 1999) and reversed causality (Thurik et al. 2008; Parker 2009) also exist. Heterogeneity, both at the micro and macro level has thus far rarely been taken into account. This, in turn, limits our understanding of the specific role of entrepreneurship in economic growth. Important questions in this respect are: "How does the role of entrepreneurship differ between high-income and low-income countries?" and "What kinds of entrepreneurship are most crucial for economic growth?" The objective of this chapter is to provide insight about the relationship between different types of entrepreneurship and economic growth, and into its possible difference between low and high-income countries.

We investigate four research questions. First, we examine whether the relationship between entrepreneurship and macroeconomic growth differs between high and low-income countries. Second, we look at whether ambitious entrepreneurship plays a different role in achieving economic growth compared to entrepreneurship in general. Third, we investigate the relation- ship between the prevalence of established high-growth firms and macroeconomic growth. Finally, we examine the relationship between the prevalence of ambitious entrepreneurship (consisting of entrepreneurs expecting to grow their firm considerably) and the prevalence of established high-growth firms (firms that have actually realized high growth rates). To investigate these issues, we use data from the Global Entrepreneurship Monitor (GEM) project for ambitious entrepreneurship, and from EIM's International Benchmark Entrepreneurship database for high-growth firms. We take into account the relationship between (ambitious) entrepreneurship and macroeconomic growth in four subsequent data waves. Thus, the analyses presented in this chapter are more comprehensive than previous studies in this field (Van Stel et al. 2005; Wong et al. 2005; Stam et al. 2009; Valliere and Peterson 2009).

In addition, we take into account realized firm growth measures, in order to perform a robustness check over intended entrepreneurial (growth) activities. Our evidence shows that once we control for the share of ambitious entrepreneurs, the overall positive effect of entrepreneurship on macroeconomic growth disappears. Growth-oriented entrepreneurship seems to contribute heavily to macroeconomic growth in both low- and high-income countries. In low-income countries, the overall positive effect of entrepreneurship on macroeconomic growth does not disappear after introducing the share of ambitious entrepreneurs into the statistical model. In contrast to ambitious entrepreneurship, established high-growth firms do not seem to contribute to macroeconomic growth. These established high-growth firms seem to flourish in countries with high levels of entrepreneurship in general, while there appears to be no connection between the rate of high-growth firms and the share of ambitious entrepreneurs. In the final section of this chapter, we summarize and discuss our findings.

2 Related Literature and Hypotheses

Entrepreneurship has been identified as one of the four production factors in the aggregate production function (Audretsch and Keilbach 2004; Audretsch et al. 2006). It is the factor that creates wealth by combining other production factors in new ways (Audretsch 2007). Entrepreneurs experiment with new combinations whose outcomes are uncertain, but alternative variations need to be considered to find out which ones will improve (economic) life (Rosen- berg and Birdzell 1986). Key elements in this regard are the creation and introduction of new products and processes, and a selection process used to test their value in a way that assures their rapid adoption or rejection. Ambi- tious entrepreneurs whose aim is to create, introduce and/or diffuse these innovations on a large scale are important players in this game.

Entrepreneurship unlocks economic development only if a proper institutional setting is in place (Baumol 1990; Powell 2008; Boettke and Coyne 2003). The latter, in turn, includes both formal and informal institutions (North 1990;Boettke and Coyne 2009). Clear property rights are an essential formal institution with regard to welfare-enhancing entrepreneurship. Unclear property rights, for example, are a stronger constraint on investments in transition countries than capital market rigidities (Johnson et al. 2000), and their absence is an even more severe problem in developing countries (De Soto 1989). To give a specific example, private firms with more than seven workers were not even allowed to operate legally in China until 1988 (Dorn 2008: 301). It may be argued that capital, labor, technology, and entrepreneurship are the sources of economic development, while institutions are its fundamental cause (Acemoglu et al. 2004). Without the proper institutions in place, it would be hard for entrepreneurs to invest in promising new combinations. Encouraging entrepreneurs to invest in their domestic economy is one of the best ways to stimulate growth in poor countries (Rodrik 2007: 44–50).

In this context, investments refer to innovation (e.g. employing new technology, producing new products, searching for new markets, etc.) and expanding capacity. These investments trigger a combination of capital investment and technological change. Many low-income countries are faced with a situation in which, although local investments by entrepreneurs could be a way out of poverty and into prosperity, due to an insufficiently developed institutional infrastructure, individuals will either not start investing in promising new combi- nations or, when they start doing so, face too many hurdles. Without promising start-ups, foreign direct investments may be the only way out (Blomstrom and Kokko 1996). In advanced capitalist economies, innovation and structural change take place through the combined efforts of small (independent inventors) and large innovative (organized research and development) firms, which complement each other in changing the economy (Nooteboom 1994; Baumol 2002) and which play different roles throughout the business cycle (Koellinger and Thurik 2009). In developing countries, large firms are very scarce and small firms have to be the prime movers in the process of structural change.

In contrast to high-income countries, entrepreneurship in low-income countries is driven significantly by necessity (Reynolds et al. 2001; Bosma et al. 2008; Naudé 2010). Many entrepreneurs in these economies do not start a firm because they want to be independent or increase their income as compared to being employed; they start out of necessity because they have no better way to make a living. This is somewhat reflected in the finding that in low-income countries self-employed people are less happy than employees, while the opposite is true in high-income countries (Blanchflower and Oswald 1998; Graham 2005). These entrepreneurs are not likely to be involved in a process of opportunity discovery and their actions are not likely to have an effect on the restructuring and diversification of low-income economies (Ro- drik 2007: 110). From the theoretical and empirical evidence reviewed so far, we derive a set of testable hypotheses aimed at improving our understanding of the relationship between entrepreneurial activity and growth.

Hypothesis 1: Entrepreneurship in general is a more important determi- nant of macroeconomic growth in high-income countries than in low-income countries.

We expect that the level of ambitious entrepreneurship in a country is a more relevant driver of economic growth than the most frequently used indicators of entrepreneurship such as self-employment and new firm forma- tion. Entrepreneurs aspiring to produce new products, make their company grow, or engage in export-related activities are expected to contribute more to economic growth than their less ambitious counterparts (Bellu and Sherman 1995; Kolvereid and Bullvag 1996; Wiklund and Shepherd 2003). Thus,

Hypothesis 2: Ambitious entrepreneurship is a more important determi- nant of macroeconomic growth than entrepreneurship in general.

Looking at nascent entrepreneurship and young businesses may reveal more about stated preferences regarding entrepreneurial behavior and employment growth than about surviving in a competitive environment and creating substan- tial growth, that is a revealed preference for growth. In response to this argument, we analyze the effect of realized firm growth on economic growth. Thus,

Hypothesis 3: The prevalence of high-growth firms is positively related to macroeconomic growth.

In addition, we expect established high-growth firms to be related to nascent entrepreneurship and young businesses, with the latter providing a pool of potential high-growth firms and serving as an indicator of competitive pres- sure, which forces less efficient incumbents to vacate the market and other incumbents to step up their performance (Thurik and Wennekers 2004; Bosma et al. 2010). As a result, the quality of the firm population in the industry improves, which in turn leads to an improved aggregate performance (Fritsch and Mueller 2004). These effects may be stronger when ambitious entre- preneurship is considered compared to entrepreneurship in general. Thus,

Hypothesis 4: Entrepreneurship in general is positively related to the prevalence of established high-growth firms.

Hypothesis 5: Ambitious entrepreneurship has a stronger positive rela- tionship to the prevalence of established high-growth firms than entre- preneurship in general.

3 Data and Sources

We use data from a sample of countries participating in the Global Entrepreneurship Monitor (GEM) project between 2002–5 complemented by data from the International Monetary Fund (IMF) and EIM as described below.

For growth of gross domestic product (GDP) (ΔGDP) we use a four-year average of real GDP growth. Real GDP growth rates are taken from the IMF World Economic Outlook database of the International Monetary Fund, version April 2008. The lag structures imply that the estimation sample of GDP growth is 2005–8. This is appropriate since the sample for early-stage entrepreneurship is for 2002–5. To limit the potential impact of reversed causality, we include lagged GDP growth as an additional explanatory variable. The lagged GDP growth variable refers to the four years prior to the measurement period of the dependent variable. When growth expectations for a national economy are good, more entrepreneurs may expect to watch their business grow in years to come. Hence, there may also be a (reversed) effect of economic growth on (ambitious) entrepreneurship.

Total early-stage entrepreneurial activity (TEA) is defined as the percentage of adult individuals who are either actively involved in starting a new venture or are the owners/managers of a business that is less than 42 months old. Data on TEA are taken from the GEM adult population survey (see Reynolds et al. (2005) for details).Ambitious entrepreneurship (Ambitious) is defined as a subset of TEA, specifically, the share of entrepreneurs within TEA who expect their firm to grow with at least six employees within five years.[1] These data are also taken from the GEM adult population survey.

Data for established high-growth firms (High-growth) are taken from EIM's International Benchmark Entrepreneurship database. EIM has constructed a comprehensive set of harmonized data for the rate of established high-growth firms across several (developed) countries which, however, exclude NACE sectors A, B and J (agriculture, fishery, and financial and other services). The rate of high-growth firms is defined as the share of incumbent firms realizing sixty percent growth or more over a period of three years (from t-3 to t). We use two variants: growth in terms of turnover and growth in terms of employment. Firms that realize fast turnover growth may not realize fast employment growth and vice versa. Importantly, when we computed the rate of high- growth firms, we only included firms with between 50 and 1,000 employees at the start of the observation period. This implies that small firms growing sixty percent or more while employing just a few employees are not included. Most studies on GDP growth include the initial level of income in their analysis and find it to be significant (see Abramovitz (1986) on the conditional convergence effect hypothesis). Thus, we use data from the IMF World Economic Outlook database (version April 2008) and include GDP per capita expressed in (thousands of) purchasing power parities per international dollar. This is our measure of per capita income (GDPC).

Finally, we include a Growth Competitiveness Index (GCI). Data on the GCI are taken from various versions of The Global Competitiveness Report. The GCI consists of three main factors assessing a country's potential for economic growth. The three factors are the quality of the macroeconomic environment, the state of the public institutions, and the level of technology. For further details about this index, see McArthur and Sachs (2002).

As an illustration of the data at hand, we report descriptive statistics for our entrepreneurship variables for the most recent year in our sample (2005) in Table 10.1.

4 Models

It is generally accepted that the level of entrepreneurial activity differs across countries (Blanchflower et al. 2001; Djankov et al. 2002; Grilo and Thurik 2008; Wennekers 2006). Studies exploring these differences often focus on the incidence of new firm registration or self-employment, which may not be reliable indicators when applied to transition countries and developing countries with significant informal economies. For these reasons we use total early-stage entrepreneurial activity (TEA) which is a more accurate measure of the entrepreneurial propensity of a nation.

As mentioned earlier, in this chapter, we investigate four topics. First, we look at whether the relationship between entrepreneurship and macroeconomic growth is different for high-income and low-income countries. Second, we examine whether ambitious entrepreneurship plays a different role in achieving economic growth compared to entrepreneurship in general. Third, we investigate the relationship between the prevalence of established high- growth firms and macroeconomic growth. Fourth, we examine the relation- ship between the rate of ambitious entrepreneurship and the rate of established high-growth firms.

The first part of our empirical analysis deals with the first two research questions. We build on Van Stel et al. (2005), who investigated whether TEA influences GDP growth in a cross-section of thirty-six countries participating in GEM in 2002 and found that, although that is the case, the influence depends on the level of per capita income. In particular, they found the contribution to economic growth to be stronger in high-income countries han in low-income countries, and argued that this may be related to higher human capital levels of entrepreneurs in those countries. In this chapter, we perform a similar regression analysis but, instead of using data on a cross- section of countries for a given year, we use an unbalanced panel data set for thirty-seven countries over the years 2002–5 (see Table 10.1).

Also, inaddition to the general TEA index, we use the share of ambitious entrepreneurs within TEA as an independent variable to test whether the impact of ambitious entrepreneurs is higher than that of non-ambitious entrepreneurs. We also investigate whether these effects are different for high-income as compared to low-income countries.[5] In the second part of our empirical analysis, we investigate the relationship between the rate of high-growth firms and subsequent macroeconomic growth (our third research question), which al- lows us to perform a robustness check over intended entrepreneurial (growth) activities. In the third part, we investigate the link between the rate of high- growth firms and the rate of ambitious entrepreneurship. Below, we present the models used in this chapter.

Table 10.1. Entrepreneurship rates (TEA) in 2005

Country		TEA	Share ambitious entrepreneurs	Rate of high-growth firms based on Turnover	Rate of high-growth firms based on Employment
High-income	Australia	10.9	0.45	–	–
	Belgium	3.9	0.41	11.7	5.6
	Canada	9.3	0.55	–	–
	Denmark	4.8	0.30	16.9	11.6
	Finland	5.0	0.35	17.3	8.8
	France	5.4	0.32	12.3	6.8
	Germany	5.4	0.50	10.6	7.8
	Hungary	1.9	0.16	–	–
	Iceland	10.7	0.74	–	–
	Ireland	9.8	0.31	24.3	–
	Italy	4.9	0.20	16.3	13.2
	Japan	2.2	0.51	6.8	2.0
	Netherlands	4.4	0.40	11.0	7.5
	New Zealand	17.6	0.43	–	–
	Norway	9.2	0.26	–	–
	Singapore	7.2	0.42	–	–
	Slovenia	4.4	0.56	–	–
	Spain	5.7	0.25	23.5	23.5
	Sweden	4.0	0.31	17.7	17.7
	Switzerland	6.1	0.28	–	–
	United Kingdom	6.2	0.52	19.8	10.9
	United States	12.4	0.49	38.4	20.1
Low-income	Argentina	9.5	0.59	–	–
	Brazil	11.3	0.55	–	–
	Chile	11.1	0.64	–	–
	China	13.7	0.89	–	–
	Croatia	6.1	0.43	–	–
	Mexico	5.9	0.19	–	–
	South Africa	5.1	0.45	–	–
	Thailand	20.7	0.31	–	–
Mean		7.8	0.43	17.4	11.3
Standard deviation		4.4	0.16	8.1	6.3

Note: Data regarding TEA and ambitious entrepreneurial activity refer to 2005, while data regarding the rate of high-growth firms refer to the period 2002–5.

Sources: GEM and EIM.

Model 1

In our first model, we investigate whether (ambitious) entrepreneurship may be considered a determinant of economic growth, alongside other well-known determinants that are captured in the Growth Competitiveness Index (GCI) published by the World Economic Forum. As both entrepreneurship and the factors underlying the GCI are assumed to be structural characteristics of an economy, we want to explain economic growth in the medium term rather than in the short-term. As a dependent variable, we use average annual growth over a period of four years following the year for which we measure TEA. In line with Van Stel et al. (2005), we also use (the log of) initial income level of countries to correct for catch-up effects, and lagged growth of GDP to correct for reversed causality effects, as additional control variables.[6]

We allow for different effects in high-income compared to low-income countries (including transition countries). TEA rates may reflect different types of entrepreneurs in countries with different development levels, imply- ing a different impact on growth. This is tested using separate TEA variables for different groups of countries (high-income versus low-income). Our first model is represented by Equation 1:

$$\begin{aligned}\Delta GDP_{i(t-(t-3))} = a + b_1\ TEA^{high-income}{}_{i,(t-3)} + c_1 TEA^{low-income}{}_{i,(t-3)} \\ + b_2\ Ambitious^{high-income}{}_{i,(t-3)} + c_2 Ambitious^{low-income}{}_{i,t-3} \\ + d\log(GDPC_{i,t-3}) + e\ GCI_{i,t-3} + f\Delta GDP_{i,((t-4)-(t-7))} + \varepsilon_{it} \qquad (1)\end{aligned}$$

where △GDP is the annual real growth rate of GDP (this variable is averaged over a four year period), TEA the total early-stage entrepreneurial activity index, Ambitious the share of ambitious entrepreneurs (those expecting to employ six or more people within five years), GDPC per capita income, and GCI the Growth Competitiveness Index.

Hypothesis 1, which states a more positive effect of entrepreneurship in general for high-income countries, is supported if coefficient b1 would be larger than coefficient c1. Furthermore, Hypothesis 2, which states that ambitious entrepreneurs contribute more to national economic growth than entrepreneurs in general, is supported if b2 and c2 are greater than zero.

Model 2

In our second model, we test whether the rate of high-growth firms has a positive effect on subsequent macroeconomic growth. The data involved relate only to high-income countries. We use data on two rates of established high-growth firms, one referring to turnover growth and the other to employment growth. We use the same control variables as in Equation 1. Model 2 reads as follows:

$$\begin{aligned}\Delta GDP_{i,(t-(t-3))} = a + b\ High\text{-}growth_{i,((t-3)-(t-6))} + c\ \log(GDPC_{i,t-3}) \qquad (2) \\ + d\ GCI_{i,t-3} + e\Delta GDP_{i,((t-4)-(t-7))} + \varepsilon_{it}\end{aligned}$$

where High-growth is the rate of high-growth firms (firms growing by at least sixty percent in a three year period).

Hypothesis 3, which states that the rate of high-growth firms is positively related to macroeconomic growth, is supported if coefficient b is greater than zero.

Model 3

As mentioned above, in our third model we test whether a relationship exists between the number of (ambitious) entrepreneurs and the number of high- growth firms in a given country. Model 3 is:

$$High\text{-}growth_{i,(t-(t-3))} = a + b\ TEA_{i,t} + c\ Ambitious_{i,t} + d\ \log(GDPC_{i,t-3}) + e\ GCI_{i,t-3} + \varepsilon_{it} \quad (3)$$

Hypotheses 4 and 5, which state that (ambitious) entrepreneurship is positively related to the rate of high-growth firms, are supported if coefficients b and c are greater than zero, respectively. Note that we measure TEA in period t. Although this is not ideal in terms of establishing a causal relationship, if using t-3 we would lose too many observations to estimate the model. As a result, we are unable to establish a causal relationship, but merely a conditional correlation.

5 Results

Results for Model 1 (Equation 1) are presented in Table 10.2. Our estimation sample is 2005–8. This corresponds to an unbalanced panel of 119 observations of countries participating in GEM in the years 2002–5 (note the three year lag in Equation 1). Because the aim of our model is to explain country variations in economic growth rates, we do not include country dummies in our model. On the other hand, we do include year dummies to correct for worldwide cyclical variations in economic growth rates.

Model variant 1 in Table 10.2 presents the estimation results when only the control variables are included. Per capita income has an expected negative effect that is consistent with the conditional convergence effect (Abramovitz 1986). Remarkably, the Growth Competitiveness Index (GCI) is not significant. The impact of lagged growth is significantly positive, suggesting a considerable degree of path dependency. In the second model variant, TEA is added and its effect is significantly positive at the ten percent level. Next, we add the share of ambitious entrepreneurship to the model. Here, its effect is strongly positive. In the fourth model variant, the effects of TEA and the share of ambitious entrepreneurs are allowed to be different for high-income and low-income countries. Likelihood ratio tests reveal that, when comparing model variant 4 to either model variant 2 or 3, model variant 4 significantly outperforms models 2 and 3 at the five percent level.[7] Hence, we conclude that the relationship between entrepreneurship and macroeconomic growth is indeed different for high-income and low-income countries. In particular, we see that entrepreneurship in general (TEA) has no significant impact in high-income countries, while it has a significantly positive impact in low- income countries. This is remarkable, since Van Stel et al. (2005) and Stam et al. (2009) found an opposite pattern. They use a cross-section of countries for a single year, while we use data regarding four years. One explanation is that the effect was different in the period 2003–5 when compared to 2002. Another explanation is that the estimated effect of TEA on subsequent economic growth is robust enough to examine different time periods. Hypothesis 1 is not supported.

Table 10.2. Explaining economic growth from TEA rate and share of ambitious entrepreneurs

	Model 1	Model 2	Model 3	Model 4
Constant	20.3***	17.3***	15.5***	4.8
	(8.6)	(9.8)	(9.2)	(1.1)
TEA		0.073*	0.064	
		(1.7)	(1.6)	
TEA high-income countries				0.01
				(0.1)
TEA low-income countries				0.13**
				(2.3)
Share ambitious entrepreneurs			2.2***	
			(3.3)	
Share ambitious entrepreneurs, high-income countries				2.1***
				(3.3)
Share ambitious entrepreneurs, low-income countries				3.2***
				(2.8)
log (GDPC)	−1.7***	−1.4***	−1.3***	−0.3
	(6.0)	(5.1)	(4.7)	(0.6)
GCI	−0.075	−0.23	−0.28	−0.2
	(0.2)	(0.7)	(0.8)	(0.5)
lagged GDP growth	0.29**	0.30***	0.28**	0.35***
	(2.3)	(2.8)	(2.6)	(3.4)
R^2	0.426	0.445	0.469	0.495
adjusted R^2	0.395	0.410	0.430	0.448
loglikelihood	−218.7	−216.7	−214.1	−211.1
N	119	119	119	119

Absolute heteroskedasticity-consistent *t*-values are between brackets. Year dummies included but not reported.
* Significant at 0.10 level
** Significant at 0.05 level
*** Significant at 0.01 level

With regard to Hypothesis 2, we see that, both for high-income and for low- income countries the share of ambitious entrepreneurship significantly con- tributes to economic growth, over and beyond the effect of entrepreneurship in general. Hypothesis 2 is supported. To a certain extent, this is at odds with Valliere and Peterson (2009), who identified a positive effect of ambitious entrepreneurship in high-income countries, but no effect in low-income countries. The absence of an effect in the latter group of countries may be explained by the fact that they did not include India and China in their sample, two low-income countries that seem to drive the relationship between ambitious entrepreneurship and economic growth in low-income countries in the study of Stam et al. (2009).

Table 10.3 shows the results of the estimations of Model 2 (Equation 2) about the effect of the growth of established firms on macroeconomic growth. Model variants 1 and 2 refer to turnover growth, while variants 3 and 4 refer to employment growth. As the data we use refers to high-growth firms in high-income countries only, the results presented in Tables 10.3 and 10.4 also relate to high-income countries only.

Table 10.3. Explaining economic growth from rates of high (realized) growth firms

	Model 1	Model 2	Model 3	Model 4
Constant	17.1***	8.2	19.0***	22.0***
	(4.8)	(0.8)	(5.1)	(2.9)
Rate of high-growth firms, in terms of turnover	−0.003	0.077***		
	(0.2)	(3.1)		
Rate of high-growth firms, in terms of employment			−0.001	0.009
			(0.1)	(0.3)
log (GDPC)	−2.0***	−0.85	−2.2***	−2.5***
	(5.1)	(0.8)	(5.4)	(2.8)
GCI	0.88***	0.36	0.96***	1.2***
	(6.2)	(0.9)	(5.9)	(3.6)
lagged GDP growth	0.66***		0.59***	
	(13.7)		(7.0)	
R^2	0.830	0.273	0.771	0.299
adjusted R^2	0.803	0.176	0.732	0.199
loglikelihood	−33.0	−70.8	−30.8	−58.2
N	52	52	49	49

Absolute heteroskedasticity-consistent *t*-values are between brackets. Year dummies included but not reported.
* Significant at 0.10 level
** Significant at 0.05 level
*** Significant at 0.01 level

Although the effect of the rate of high-growth firms (turnover) is not significant in model variant 1, it turns out to correlate strongly with lagged GDP growth. When we remove the latter variable, there is a strong positive relationship between the rate of high-growth firms and subsequent macroeconomic growth. The different outcomes in Model 1 and 2 can be interpreted in at least two ways. On the one hand, although it does not provide evidence of a causal effect (in a Granger sense), there is a strong conditional correlation between the rate of high-growth firms (in terms of turnover) and GDP growth in the subsequent period. This suggests that high-growth firms play an important role in achieving macroeconomic growth. On the other hand, a reverse causality in which GDP growth drives the growth of established firms may be more relevant. Interestingly, we find no effect of high-growth firms in terms of employment, even after removing the lagged growth variable. Perhaps fast growing firms in terms of employment have smaller productivity growth compared to fast growing firms in terms of turnover. This would suggest that their impact on macroeconomic growth is smaller (or even zero, accord- ing to Table 10.3). Table 10.3 provides hardly any support for Hypothesis 3.

Finally, Table 10.4 presents the results of Model 3 (Equation 3), where we investigate whether (ambitious) entrepreneurship is related to the share of high-growth firms among incumbents (note again that realized high growth is measured among firms with 50–1,000 employees). Because we only find a positive relationship with GDP growth for the rate of high-growth firms in terms of turnover, Table 10.4 focuses on this group of firms. The main result is that there is a strong statistical association between TEA and the rate of high- growth firms, with a t-value of no less than eight. By contrast, we do not find an additional effect for the share of ambitious entrepreneurs. These results support Hypothesis 4 but not Hypothesis 5.

Table 10.4. Explaining rates of high (realized) turnover growth firms from TEA

	Model 1	Model 2
Constant	132.2***	135.3***
	(3.2)	(3.1)
TEA	2.5***	2.6***
	(8.1)	(8.0)
Share ambitious entrepreneurs		−5.8
		(0.9)
log (GDPC)	−13.1***	−13.3***
	(3.2)	(3.0)
GCI	1.3	1.5
	(1.1)	(1.3)
R^2	0.714	0.718
adjusted R^2	0.674	0.671
loglikelihood	−139.2	−138.8
N	50	50

Absolute heteroskedasticity-consistent *t*-values are between brackets. Year dummies included but not reported.
* Significant at 0.10 level
** Significant at 0.05 level
*** Significant at 0.01 level

Table 10.4. Explaining rates of high (realized) turnover growth firms from TEA

	Model 1	Model 2
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		(0.9)
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	(3.2)	(3.0)
GCI	1.3	1.5
	(1.1)	(1.3)
R^2	0.714	0.718
adjusted R^2	0.674	0.671
loglikelihood	−139.2	−138.8
N	50	50

Absolute heteroskedasticity-consistent *t*-values are between brackets. Year dummies included but not reported.
* Significant at 0.10 level
** Significant at 0.05 level
*** Significant at 0.01 level

These results indicate that it is entrepreneurship in general, rather than specif- ically ambitious entrepreneurship, which is positively associated with the prev- alence of established high-growth firms, suggesting that all different types of new firms contribute to a process of variety and selection, from which a number of high-growth firms eventually emerges. The strong positive relationship between TEA and the prevalence of established high-growth firms is illustrated by Figure 10.1, which plots the fifty observations used in Table 10.4.

6 Discussion

In general, ambitious entrepreneurship has a stronger impact on economic growth than overall entrepreneurial activity in a given country, as was expected. In contrast to expectations, however, our findings suggest that the relationship between ambitious entrepreneurship and macroeconomic growth is stronger in low-income countries than in high-income countries. Established firms with considerable growth (either in turnover or employment) do not seem to be connected to economic growth. These established high-growth firms seem to flourish in countries with high levels of entrepreneurship in general, while there appears to be no relationship between the share of ambitious entrepreneurs and the rate of high-growth firms.

The ambiguous findings on the relationship between

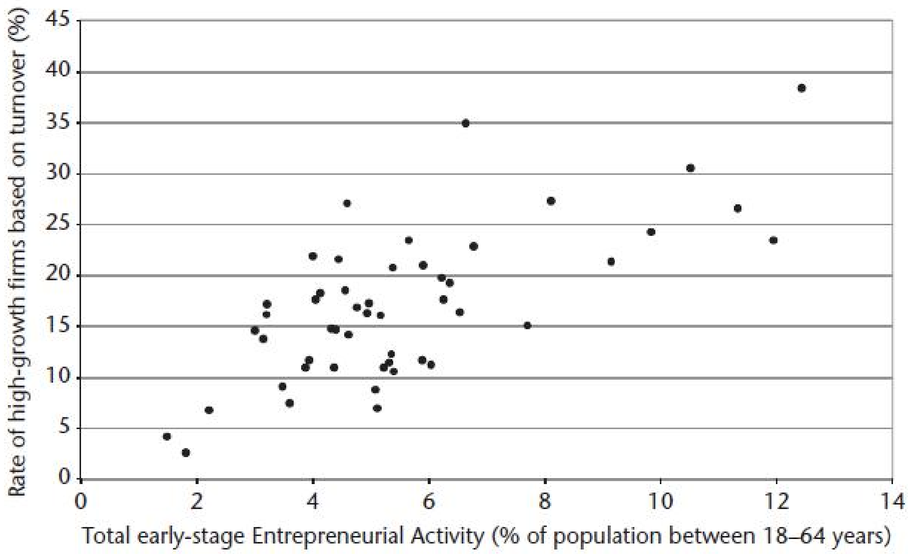

Figure 10.1 Relationship between TEA and rate of high-growth firms (turnover)
Sources: GEM and EIM.

Entrepreneurship and economic growth in low-income countries may reflect the complexity involved in the underlying institutional dimension, which affects the prevalence (Hessels et al. 2008) as well as the effects of the different types of entrepreneurship in different ways. We expected that, in low-income countries, an insufficiently developed institutional framework would reduce growth intentions and curtail entrepreneurial growth. Possibly, the selection of low-income countries in the GEM dataset only contains relatively well- developed economies, which makes it harder to analyze the effects of insufficiently developed institutional frameworks. This calls for more research that takes into account specific types of institutions and their dynamics over time in order to uncover the role of different types of entrepreneurship in economic growth in low-income countries (Naudé 2010).

Largely confirming prior findings (Wong et al. 2005; Stam et al. 2009; Valliere and Peterson 2009), we also find that ambitious entrepreneurship has a positive effect on subsequent macroeconomic growth. Ambitious entrepreneurship seems to be an important vehicle when it comes to creating new value and it is likely to stimulate the creation of genuinely new jobs. An interesting issue for further research would be to examine in which industries most of these ambitious entrepreneurs can be found. It is often implied that young and small high-growth firms are most likely to be found in young and growing industries (Davidsson and Delmar 2006; Acs et al. 2008), but this needs to be investigated in large-scale empirical research.

The positive effect of established high-growth firms on macroeconomic growth often assumed is not confirmed by our results. At first, this goes against the intuition that these firms are important drivers of employment growth, innovation, productivity growth and, ultimately, economic growth (OECD 2006; EIM 2006). However, when we reflect on the nature of firm growth, this outcome is less surprising. Most studies on firm growth do not draw a distinction between organic and acquired growth. The few studies that have made this distinction indicate that young and small firms predominantly grow organically, while old and large firms most often grow through acquisition (Davidsson and Delmar 2006; Deschryvere 2008). Davidsson and Delmar (2006) argue that this implies that young and small firms create the lion's share of genuinely new jobs. Acquired growth involves a reallocation or even an overall decline of employ- ment (when acquired firms and/or the acquiring firm are restructured) and, as a result, is less important in terms of macroeconomic growth than organic growth. Given that established high-growth firms are relatively large and old, most of their growth is probably realized through acquisitions, with hardly any effect on the overall growth of the economy. In addition, mergers and acquisitions are pro-cyclical in nature, that is they are driven by GDP growth (Maksimovic and Philips 2001; Bhattacharjee et al. 2009), and most of them erode the value of the acquiring firm (Haleblian et al. 2009).

Finally, we investigated the relationship between the rate of ambitious entrepreneurs (entrepreneurs expecting to grow their firm) and the rate of high-growth firms (firms that have actually realized high growth rates). We find that it is entrepreneurship in general, rather than specifically ambitious entrepreneurship, which is positively associated with the rate of high-growth firms. More research is needed to identify the mechanism underlying this relationship.

To sum up, the aim of this chapter was to test the relationships between ambitious entrepreneurship, high-growth firms and macroeconomic growth, and to provide insight into the links between the microeconomic phenomena of entrepreneurial activities and firm growth and macroeconomic growth. Our study can be seen in the light of other studies that link the effect of micro- economic dynamics to macroeconomic dynamics (Baumol 2002; Metcalfe 2004; Eliasson et al. 2004).8 To explain aggregate income growth, we need to understand entry, innovation, and growth at the micro level, and to gain insight into how competition and learning provide the link between the micro level and the macro level. It has often been too easily assumed—especially in policy documents and debates—that firm entry and growth are driven by innovation. However, empirical research has shown that only a minority of all entrants introduces new processes or products into the economy (Stam and Wennberg 2009) and that firm growth is often a statistical artifact of merging prior separated legal entities (i.e. acquired growth): most entrants and large growing firms do not create new value in society. Our study suggests that high levels of overall entry and firm growth do not automatically lead to macroeco- nomic growth.

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1 Unfortunately, multicollinearity problems prevent us from dividing ambitious entrepreneurship into entrepreneurs who expect a growth between 6 and 19 people and entrepreneurs who expect a growth of at least 20 people.

2 For more details see EIM (2008, 2009a, and 2009b). The data can be downloaded at www.entrepreneurship-sme.eu

3 Due to the unbalanced nature of our panel dataset, Table 10.1 does not contain all countries included in the sample. The additional countries (for which we do not have data for all years) are: Hong Kong, India, Israel, Poland, Korea, Russia, and Taiwan

4 The distinction between high and low-income countries is based on the World Bank 2002 classification: the lower-income category includes "low-income economies," "lower-middle- income economies," and "upper-middle-income economies," while the higher-income category includes "high-income economies."

5 This first part of our analysis is an update of Stam et al. (2009) who used GEM data for 2002 only. Similar analyses focusing on the importance of entrepreneurs' export orientation and on entrepreneurial diversity (in terms of age, education, and gender) can be found in Hessels and Van Stel (2008) and Verheul and Van Stel (2007), respectively.

6 When growth expectations for the national economy are good, more entrepreneurs mayexpect to see their business grow in years to come. Hence, there may also be a (reversed) effect of economic growth on (ambitious) entrepreneurship. To limit the potential impact of reversed causality, we include lagged GDP growth as an additional explanatory variable. We also measure TEA rates in the year (t) preceding the period over which the dependent variable is measured (t–(t+3)). Of course, we realize that the possibility of reversed effects cannot be ruled out completely.

7 Comparing model variants 2 and 4 requires using three degrees of freedom for the critical value of the null distribution, while comparing model variants 3 and 4 requires using two degrees of freedom.

8 Parker (2009: chapter 11) provides a survey of various theories of venture growth and their link to industry dynamics (the intermediate level between the micro and the macro economy).

Source:http://www.ices-study.org/WhatIsEnterpreneurship/Research/(knowledge%20web)%20ambitious%20entrepreneurship,%20high-growth%20firms%20and%20macroeconomic%20growth.pdf

Entrepreneurial Ecosystems

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1. Introduction

In recent years the fields of entrepreneurship studies, economic geography, urban economics, and the economics of entrepreneurship have moved closer to each other through research on the context of entrepreneurship (Ucbasaran et al., 2001; Welter, 2011; Zahra et al., 2014), the growing recognition that not all types of entrepreneurship are equally important for economic growth (Henrekson & Sanandaji 2014; Stam et al., 2009; 2011; Wong et al. 2005), and the increasing interest in the entrepreneurial actor within urban and regional economics (Acs & Armington, 2004; Feldman, 2001; Glaeser et al., 2010). These developments have culminated in an emerging entrepreneurial ecosystem approach that explicitly focuses on how urban and regional contexts affect ambitious entrepreneurship. In this chapter we will review and discuss this emergent entrepreneurial ecosystem approach. We define entrepreneurial ecosystems as *a set of interdependent actors and factors coordinated in such a way that they enable productive entrepreneurship within a particular territory*. We see productive entrepreneurship (Baumol 1990) as an outcome of successful ambitious entrepreneurship. Ambitious entrepreneurs are individuals exploring opportunities to discover and evaluate new goods and services and exploit them in order to add as much value as possible (Stam et al., 2012). That means more than just 'being your own boss' or 'pursuing self-fulfilment' through business ownership, ambitious entrepreneurs attach importance to the performance and success of their ventures and seek to quickly scale up (Stam et al., 2012). In practice ambitious entrepreneurs are more likely to achieve substantial firm growth, innovation or internationalization than the 'average' entrepreneur.

Though recent interest in entrepreneurial ecosystems amongst academic researchers is driven by its popularity with policymakers and entrepreneurs, it is part of a larger trend in entrepreneurship studies. The fundamental ideas behind entrepreneurial ecosystems were first developed in the 1980s and 1990s as part of a shift in entrepreneurship studies away from individualistic, personality-based research towards a broader perspective that incorporated the role of social, cultural, and economic forces in the entrepreneurship process (Dodd & Anderson 2007). This was part of a wider movement away from conceptions of the entrepreneur as a solitary Schumpeterian 'economic superman' and towards a more nuanced view of entrepreneurship as a social process embedded in broader contexts (Nijkamp 2003; Steyaert & Katz 2004). In particular, the place that entrepreneurship takes within is seen as having a crucial impact over the entire entrepreneurship process, from the ability and willingness of nascent entrepreneurs to start a firm to their ability to find venture capital and eventually structure an exit from the firm. Works by Pennings (1982), Dubini (1989), Van de Ven (1993) and Bahrami and Evans (1995) developed the concept of an 'entrepreneurial environment' or ecosystem in order to explain the influence regional economic and social factors have over the entrepreneurship process.

Building on previous movements that decentered the individual entrepreneur as the sole locus of value creation, the new contextual turn emphasizes the importance of situating the entrepreneurial phenomenon in a broader field that incorporates temporal, spatial, social, organizational, and market dimensions of context (Zahra, 2007; Zahra et al. 2014). While the past decade has seen entrepreneurship researchers become more sensitive to some contexts such as location, too often context is "taken for granted, its influence underappreciated or…controlled away" (Welter, 2011 p. 173-174). That is, previous work in entrepreneurship has tended to attempt to eliminate the role of context in order to produce generalizable models of entrepreneurial activity when instead context should be the specific focus of investigation. A context such as location should not be treated as a simple control variable or proxy; a deeper examination of how the cultural, social, political, and economic structures and processes associated with a place influence all aspects of the entrepreneurial journey is required. A context like location is not a cause of particular entrepreneurial practices but rather reflects a much more complex influence on entrepreneurship (Johannisson, 2011).

The purpose of this chapter is to critically investigate the emerging literature on entrepreneurial ecosystems. Current work on ecosystems is underdeveloped, focusing more on superficial generalizations based on successful case studies such as Silicon Valley or Boulder, Colorado rather than on rigorous social science research. The next section provides a review of the multiple definitions of ecosystems found within the literature. Next, we discuss the relationships between ecosystems and allied concepts such as industrial districts, clusters, and innovation systems. The chapter concludes by discussing an integrative model that connects the functional attributes of entrepreneurial ecosystems with welfare outcomes.

2. The Entrepreneurial Ecosystem Defined

The concept of entrepreneurial ecosystems has gained popularity in recent years due to mainstream business books such as Feld's (2012) Startup Communities and work by Isenberg (2010) in the Harvard Business Review. These works have popularized the idea amongst entrepreneurial leaders and policymakers that a place's community and culture can have a significant impact on the entrepreneurship process. But despite its popularity, there is not yet a widely shared definition of entrepreneurial ecosystems amongst researchers or practitioners. The first component of the term is entrepreneurial: a process in which opportunities for creating new goods and services are explored, evaluated and exploited (Schumpeter, 1934; Shane & Venkatamaran, 2000). The entrepreneurial ecosystem approach often narrows this entrepreneurship down to 'high-growth start-ups', claiming that this type of entrepreneurship is an important source of innovation, productivity growth, and employment (World Economic Forum, 2013; Mason and Brown, 2014). Empirically, this claim seems too exclusive: networks of innovative start-ups or entrepreneurial employees can also be forms of productive entrepreneurship (Baumol, 1990) and in that way the source of earlier mentioned welfare outcomes. But it is clear that the entrepreneurial ecosystem approach does not by definition include the traditional statistical indicators of entrepreneurship, such as 'self-employment' or 'small businesses' into entrepreneurship. This distinction between the traditional measures of entrepreneurship and the conceptually more adequate measures of entrepreneurship such as innovative and growth-oriented entrepreneurship, is increasingly emphasized in the entrepreneurship literature (Shane, 2009; Stam et al., 2012; Mason & Brown, 2013; Henrekson & Sanandaji, 2014).

The second component of the term is ecosystem. The biological interpretation of this concept in which the interaction of living organisms with their physical environment is at the centre is obviously not to be taken too literally. Rather, the entrepreneurial ecosystem approach emphasizes that entrepreneurship takes place in a community of interdependent actors (cf. Freeman & Audia, 2006). In particular the literature on entrepreneurial ecosystems focuses on the role of the (social) context in allowing or restricting entrepreneurship and in that sense is closely connected to other recent 'systems of entrepreneurship' or systemic entrepreneurship research approaches (Neck et al., 2004; Sternberg, 2007; Ylinenpää, 2009; Acs et al., 2014), which often aim to bridge the innovation system approach and entrepreneurship studies. Unlike previous uses of the term 'ecosystem' in the management literature such as by Moore (1993) and Iansiti and Levien (2004) that focus on the organization of a single industry or value chain, entrepreneurial ecosystems are an inherently geographic perspective. That is to say, entrepreneurial ecosystems focus on the cultures, institutions, and networks that build up within a region over time rather than the emergence of order within global markets.

Entrepreneurial activity, as an output of the entrepreneurial ecosystem, is considered the process by which individuals create opportunities for innovation. This innovation will eventually lead to new value in society and this is therefore the ultimate outcome of an entrepreneurial ecosystem while entrepreneurial activity is a more intermediary output of the system. This entrepreneurial activity has many manifestations, such as innovative start-ups, high-growth start-ups, and entrepreneurial employees (Stam, 2014). Especially entrepreneurial employees seem to be of great importance for new value creation in developed economies like Europe (Bosma et al., 2012; Stam, 2013; Bosma et al., 2014). The term productive entrepreneurship refers to "any entrepreneurial activity that contributes directly or indirectly to net output of the economy or to the capacity to produce additional output" (Baumol, 1993 p. 30); which we interpret it as entrepreneurial activity that creates aggregate welfare increases. Productive entrepreneurship might also include failed enterprises that have provided a fertile breeding ground for subsequent ventures or inspired them, creating net social value ('catalyst ventures': Davidsson, 2005). Technically speaking this means that the total (social) value created by entrepreneurial activity should be more than the sum of the (private) value created for the individual entrepreneurs (leaving distributional issues aside).

While work on entrepreneurial ecosystems is still in its infancy there are already several empirical studies showing how a rich entrepreneurial ecosystem enables entrepreneurship and subsequent value creation at the regional level (Fritsch, 2013; Tsvetkova, 2015). For example, Mack and Mayer (2015) explore how early entrepreneurial successes in Phoenix, Arizona has contributed to a persistently strong entrepreneurial ecosystem based on visible success stories, a strong entrepreneurial culture, and supportive public policies. Similarly, Spigel's (2015) study of entrepreneurial ecosystems in Waterloo and Calgary, Canada suggests that while ecosystems can have different structures and origins, their success lies in their ability to create a cohesive social and economic system that supports the creation and growth of new ventures. Other work on regions such as Boston (Saxenian, 1994), Silicon Valley (Kenney and Patton, 2005), Washington D.C (Feldman, 2001) and Kyoto (Aoyama, 2009) — even if not using the precise term 'entrepreneurial ecosystem'— described how interlocking historically produced, place-based elements created the conditions for long-term entrepreneurial success. Works such as Acs et al. (2014) have employed large scale quantitative methods, rather than qualitative case studies, to identify strong entrepreneurial ecosystems and show the different underlying local factors associated with high levels of innovative entrepreneurship.

3. Predecessors to The Entrepreneurial Ecosystem approach

What the entrepreneurial ecosystem approach has in common with other established concepts - such as industrial districts, clusters, and innovation systems – is the focus on the external business environment: that there are forces beyond the boundaries of an organization but within those of a region that can contribute to a firm's overall competitiveness (see table 1). The industrial district approach emphasizes the local division of labour of an industry (Marshall, 1920) and the interaction between the community of people and a population of firms within a socio-territorial entity (Becattini, 1990) in order to be successful on international markets. The cluster approach focuses on ‘geographic concentrations of interconnected companies, specialised suppliers, service providers, firms in related industries, and associated institutions (…) in particular fields that compete but also co-operate’ (Porter, 1998: 197). Regional innovation systems (RIS) refer to the networks and institutions linking knowledge producing hubs such as universities and public research labs within a region and innovative firms. These linkages allow knowledge to spill over between different organizations, increasing a region’s overall innovativeness (Cooke et al. 1997). Entrepreneurs play a key role in RIS by combining together technical and market knowledge to identify new opportunities and technologies (Cooke, 2001).

Table 1. Comparison with industrial district, cluster, and innovation system literature

	Key actors	**Key concepts**	**Input into Entrepreneurial**	**Key outcome**	**Key references**	**Key references**
Marshallian industrial	SMEs	Labor market pooling; specialized	Talent (labor market pooling), intermediate services	Regional economic growth (productivi	Marshall 1890; Krugman 1991; Markusen 1996	-
Italianate	SMEs; local	Flexible specialization, interfirm	Networks between entrepreneurs	Regional economic growth	Piore & Sabel 1984; Becattini	Johannisson et al. 1994;
Cluster	Innovative firms	Factor conditions; demand conditions; related and	Talent, finance, knowledge, physical infrastructure (factor	National / regional competitiveness (productiv	Porter 1990; 1998	Rocha 2004; Rocha & Sternberg 2005;
Innovatio	Innovative	Networks, inter-	Knowledge, finance, formal	Innovation	Freeman 1987; Lundvall	Sternberg 2007;

The entrepreneurial ecosystem approach differs from industrial district, cluster, and innovation system approaches by the fact that the entrepreneur, rather than the firm, is the focal point of analysis. The entrepreneurial ecosystem approach thus begins with the entrepreneurial individual instead of the company but also emphasizes the role of the social and economic context surrounding the entrepreneurial process. Most cluster studies focus on firms and industries, including their dynamics (Frenken et al. 2015). As opposed to the clusters, district, and innovation systems literature, the focus of ecosystems research is placed firmly on the entrepreneur and the startup rather than larger, more established firms or slower growing SMEs. The high-growth startups that make up the basis of entrepreneurial ecosystems are not necessary included in all cluster and industrial district models (Markusen, 1996). While frameworks of industrial districts, clusters, and innovation systems do include a role for entrepreneurs (e.g. Henry & Pinch 2000; Cooke 2007; Ylinepää 2009), the focus is not specifically on them but rather the role of entrepreneurs and startups within larger systems of value creation and innovation. As a result, these existing approaches often see startups as smaller versions of larger, international firms rather than as unique organizational entities with different (and often more constrained) capabilities and resources.

Beyond this, the role of knowledge differs between ecosystems and allied concepts like clusters and innovation systems. Within traditional models knowledge refers to the technical know- how necessary to develop new products and technologies and the market knowledge necessary to know which new products will succeed in the marketplace. This knowledge is key in ecosystems, but ecosystems approaches also highlight a new type of knowledge: knowledge about the entrepreneurship process itself. This includes knowledge about the challenges facing entrepreneurs as they scale, how to design business plans and pitch ideas to angel investors and venture capitalists, and how to overcome the liability of newness when working with potential clients and suppliers. Thus, the mentoring and networking between entrepreneurs are critical to sharing entrepreneurial knowledge within an ecosystem (Lafuente et al. 2007).

Another significant contrast with other concepts is that the entrepreneurial ecosystem approach not only sees entrepreneurship as a result of the system, but also sees the importance of entrepreneurs as central players (leaders) in the creation of the system and in keeping the system healthy (Feldman, 2014). This "privatization" of entrepreneurship policy diminishes the role of the state compared with previous policy approaches. However, this does not remove its role but rather shifts it to that of a 'feeder' of the ecosystem than as a 'leader' (Feld, 2012). Entrepreneurs with a long-term commitment to the ecosystem are often best positioned to recognize the opportunities and restrictions of the ecosystem and to deal with them together with other 'feeders' of the ecosystem (such as professional service providers and the financial infrastructure). These successful businesspeople and philanthropists can act as 'dealmakers,' using their own social networks and capital to improve the entrepreneurial environment of their home region (Feldman and Zoller, 2014). However, the government retains an important role as a 'feeder' who acts to create a conducive economic and social environment for entrepreneurship, for example in adjusting laws and regulations or providing training and educational opportunities. Market failures and system failures are not necessarily rationales for government intervention: even here, entrepreneurs can find opportunities, for example by reducing information asymmetry and organizing collective action to create public goods.

As illustrated in Table 2, there are significant differences between entrepreneurial ecosystems and allied concepts such as industrial districts, clusters, and innovation systems. This does not mean that work on ecosystems cannot draw on the decades of research underlying these concepts, but that the findings from this work must be reinterpreted through the agent-centred approach that is at the heart of the entrepreneurial ecosystem approach.

4. Attributes of Successful Entrepreneurial Ecosystems

The recent popular literature on entrepreneurial ecosystems is directly aimed at the key stakeholders of the ecosystem, mainly entrepreneurial leaders and policymakers rather than an academic audience. The recent entrepreneurial ecosystem literature provides several lists of factors which are deemed to be important for the success of an entrepreneurial ecosystem. Naturally, entrepreneurs (being visible and connected) are considered to be the heart of a successful ecosystem, but successful entrepreneurial ecosystems have multiple attributes (Feld, 2012: 186-187). Next to the key role of entrepreneurs themselves (in leading the development of the ecosystem and as mentors or advisors) the nine attributes by Feld (2012) emphasize the interaction between the players in the ecosystem (with high network density, many connecting events, and large companies collaborating with local start-ups) and access to all kind of relevant resources (talent, services, capital), with an enabling role of government at the background.

An important input is a broad, deep talent pool of employees in all sectors and areas of expertise. This includes both technical workers as well as more business-oriented workers such as salespeople, marketers, and business development professionals. Universities are an excellent resource for start-up talent and should be well connected to the community. Next to human capital, financial capital is key: a strong, dense, and supportive community of VCs, business angels, seed investors, and other forms of financing should be available, visible, and accessible across sectors, demographics, and geography. A successful ecosystem necessitates leadership, consisting of a strong group of entrepreneurs who are visible, accessible and committed to the region being a great place to start and grow a company. It also requires many well-respected mentors and advisors giving back across all stages, sectors, demographics, and geographies as well as a solid presence of effective and well-integrated accelerators and incubators (i.e. intermediaries). In addition, professional services (legal, accounting, real estate, insurance, consulting) that specialize in the unique needs of startups and appropriately priced (such as offering equity-for-service arrangements). For an ecosystem to be successful, large established organizations should also be supportive. This includes large anchor firms, which should create specific departments and programs to encourage cooperation with high- growth start-ups, and it also includes strong government support for and understanding of start-ups toeconomic growth. Additionally, supportive policies should be in place covering economic development, tax, and investment vehicles. Another prerequisite is a large number of events for entrepreneurs and community to connect and engage, with highly visible and authentic participants (e.g. meet-ups, pitch days, startup weekends, boot camps, hackatons, and competitions). Finally, a thriving ecosystems is said to depend on a deep, well-connected community of start-ups and entrepreneurs along with engaged and visible investors, advisors, mentors and supporters (indicated by high network density). Optimally, these people and organizations cut across sectors and demographics. Everyone must be willing to give back to his community.

Table 2. Differences and similarities between entrepreneurial ecosystems and related concepts

Approach	Industrial District, Cluster, Innovation System	Entrepreneurial Ecosystem
Main focus	Main focus is on economic and social structures of a place that influence overall innovation and firm competitiveness. In many cases, little distinction made between (fast growing) startups and other types of	Startups explicitly at centre of ecosystem. Seen as distinct from established large firms and (lower-growth) SMEs in terms of conceptual development and policy formation.
Role of knowledge	Focus on knowledge as source of new technological and market insights. Knowledge from multiple sources is recombined to increase firm competitiveness. Knowledge spillovers from universities and other large research intensive organizations	In addition to market and technical knowledge, entrepreneurial knowledge is crucial. Knowledge about the entrepreneurship process is shared between entrepreneurs and mentors through informal social networks, entrepreneurship
Locus of action	Private firms and state is primary locus of action in building and maintaining industrial district/cluster/innovation system. Little room for individual agency in their creation.	Entrepreneur is the core actor in building and sustaining the ecosystem. While state and other sources might support ecosystem through public investment, entrepreneurs retain agency to develop and lead the

Isenberg (2010) also discusses the concept of the entrepreneurial ecosystem. He notes that there is no exact formula for the creation of such an ecosystem but that (public) leaders should follow nine principles when building an entrepreneurial ecosystem. These principles first emphasize the role of local conditions and bottom-up processes: (1) stop emulating Silicon Valley; (2) shape the ecosystem around local conditions; (3) engage the private sector from the start; (4) stress the roots of new ventures; (5) don't over engineer clusters; help them grow organically. Second, they emphasize ambitious entrepreneurship: (6) favor the high potentials; (7) get a big win on the board. And third, focus on institutions: (8) tackle cultural change head-on; (9) reform legal, bureaucratic, and regulatory frameworks). These principles are claimed to lead to 'venture creation', the 'creation of an ecosystem', and a 'vibrant business sector' (Isenberg, 2010). It is unclear how the causal mechanisms work to realize these different results. Even though this might be a practitioner's point of view, the emphasis on the role of local conditions and bottom-up processes is largely in line with recent academic work on regional innovation and growth (cf. Boschma & Martin, 2010; Cooke et al. 2011), while the focus on ambitious entrepreneurship and institutions is also a key feature of recent entrepreneurship research (Henrekson & Johansson, 2009; Stam et al. 2012).

Based on this, Isenberg (2011) formulates six distinct domains of the ecosystem: policy, finance, culture, support, human capital and markets. This largely overlaps with the previously mentioned attributes and the eight pillars distinguished by the World Economic Forum (2013, p.6-7) for a successful ecosystem, each with a number of components. These pillars also focus on the presence of key factors (resources) like human capital, finance, and services; the actors involved in this (talent, investors, mentors / advisors, entrepreneurial peers); the formal ('government & regulatory framework') and informal institutions ('cultural support') enabling entrepreneurship; and finally, access to customers in domestic and foreign markets.

The listed attributes, principles, and pillars show that the entrepreneurial ecosystem approach contains a shift of traditional economic thinking about businesses, and especially on markets and market failure, to a new economic view on people, networks and institutions. The common denominator appears to be the fact that entrepreneurs create new value, organized by a wide variety of governance modes, enabled and confined within a specific institutional context. This does not mean that companies and markets (and market failure) are irrelevant. But markets and companies are governance modes which, like all other forms of governance, will always be imperfect. Moreover, entrepreneurship is often about companies and markets "in the making", and not about situations that come close to a 'fully efficient market equilibrium', as in the ideal of the market failure approach.

Drawing on these studies, Spigel (2015: 2) defines entrepreneurial ecosystems as "combinations of social, political, economic, and cultural elements within a region that support the development and growth of innovative startups and encourage nascent entrepreneurs and other actors to take the risks of starting, funding, and otherwise assisting high-risk ventures". He groups these attributes into three categories - cultural, social, and material - that explain the level of entrepreneurial activity as the output of entrepreneurial ecosystems: cultural attributes (supportive culture and histories of entrepreneurship), social attributes (worker talent, investment capital, networks, mentors and role models), and material attributes (policy and governance, universities, support services, physical infrastructure, open markets). Importantly, these categories of attributes are not isolated from one another but are created and reproduced through their interrelationships. For example, networking programs sponsored by a regional government (a material attribute) depends on the pre-existence of existing knowledge sharing networks within the region to build on (a social attribute), which in turn requires the effort of business networking and knowledge sharing to be legitimized within the local culture (cultural attribute). But while the operation of the program depends on these social and cultural attributes, it also strengthens and reproduces them by helping to create new successful new ventures who see networking with other entrepreneurs as a normal business activity. This relationship is illustrated in Figure 1.

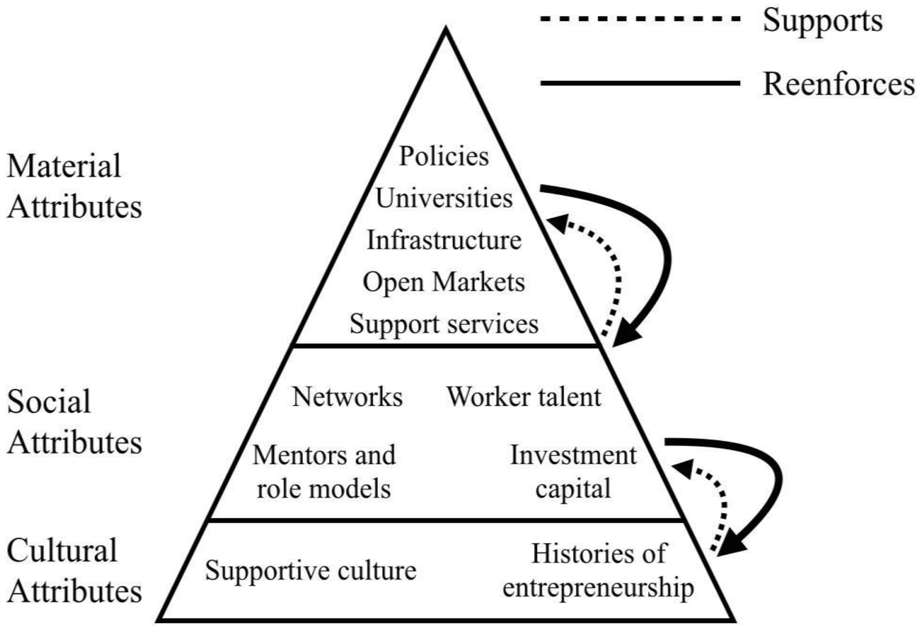

Figure 1. Relationships between attributes within entrepreneurial ecosystems (Spigel, 2015)

5. Shortcomings of The Entrepreneurial Ecosystem Approach

The mere popularity of the entrepreneurial ecosystem approach is no guarantee of its profundity. Seductive though the entrepreneurial ecosystem concept is, there is much about it that is problematic and the rush to employ the entrepreneurial ecosystem approach has run ahead of answering many fundamental conceptual, theoretical and empirical questions. The phenomenon at first appears rather tautological: entrepreneurial ecosystems are systems that produce successful entrepreneurship, and where there is a lot of successful entrepreneurship there is apparently a good entrepreneurial ecosystem. Such tautological reasoning ultimately offers little insight for research or public policy. Secondly, the approach as yet provides only long laundry lists of relevant factors without a clear reasoning of cause and effect nor how they are tied to specific place-based histories. These factors do provide some focus but they offer no consistent explanation of their coherence or their interdependent effects on entrepreneurship - and, ultimately, on aggregate welfare. And third, it is not clear which level of analysis this approach is targeting. Geographically, it could be a city, a region or a country. It can also be other systems less strictly defined in space, such as sectors or corporations, that create opportunities for firm creation and growth.

Such approaches do not offer sufficient explanations for economic outcomes and has not been clearly demarcated. Nor do they provide useful insights into the fundamental causes of the entrepreneurial ecosystems. The World Economic Forum (2013) study, for example, concludes that access to markets, human capital and finance are most important for the growth of entrepreneurial companies. But these can best be seen as superficial perquisites, not as the fundamental causes for the success of ecosystems - for human resources and finance are, after all, largely dependent on the underlying institutions regarding education and financial markets (Acemoglu et al., 2005). For an adequate explanation we must distinguish between the necessary and contingent conditions of an ecosystem and clearly define the role of the government and other public organizations. This has not yet been accomplished. The question remains: how do entrepreneurial ecosystems perform with the different forms of entrepreneurship (as output) and in terms of aggregate welfare effects (as final outcome)? After more elaboration, the tautology will probably disappear. Constructive synthesis of on

the one hand the previously mentioned elements of the entrepreneurial ecosystem approach, and on the other hand the insights from the existing empirical studies on entrepreneurship and (regional) economic development (Stam and Bosma, 2015a; Fritsch, 2013) could provide a better framework for policy.

The question of the level at which entrepreneurial ecosystem operate has not been answered yet. This would depend on the spatial scale on which the elements are achieved, on the one hand, and how they are limited, on the other hand. For most system elements it seems possible to demarcate them at a regional (sub-national) level (e.g. regional labour markets), while the conditions can be designed on both regional and national level (e.g. national laws and regulations) (cf. Stam and Bosma, 2015b). In addition, entrepreneurs of high-growth firms and especially entrepreneurial employees in large established firms could act as ecosystem connectors on a global scale, connecting distinct regional entrepreneurial ecosystems in their role as knowledge integrators (Sternberg, 2007; Malecki, 2011).

6. An Entrepreneurial Ecosystem Model

In response to these critiques we have developed a new entrepreneurial ecosystem model, as shown in Figure 2. The new model includes insights from the previous literature (i.e. the aspects that have been deemed important elements of entrepreneurial ecosystems), but most importantly it provides more causal depth with four ontological layers (framework conditions, systemic conditions, outputs, and outcomes), including the upward and downward causation, and intra-layer causal relations. Upward causation reveals how the fundamental causes of new value creation are mediated by intermediate causes, while downward causation shows how outcomes and outputs of the system over time also feed back into the system conditions. Intra-layer causal relations refer to the interaction of the different elements within the ecosystem, and how the different outputs and outcomes of the ecosystem might interact.

The elements of the entrepreneurial ecosystem that can be distinguished are framework conditions and systemic conditions. Both are summarized in Figure 2. The framework conditions include the social (informal and formal institutions) and the physical conditions enabling or constraining human interaction. In addition, access to a more or less exogenous demand for new goods and services is also of great importance. This access to buyers of goods and services, however, is likely to be more related to the relative position of the ecosystem than its internal conditions (in contrast to for example the important role of 'home demand' in Porter's [1990] cluster approach). These conditions might be regarded as the fundamental causes of value creation in the entrepreneurial ecosystem. However, in order to fully understand how these fundamental causes lead to this outcome, we first need to gain insight into how systemic conditions lead to entrepreneurial activity.

Systemic conditions are the heart of the ecosystem: networks of entrepreneurs, leadership, finance, talent, knowledge, and support services. The presence of these elements and the interaction between them are crucial for the success of the ecosystem. Networks of entrepreneurs provide an information flow, enabling an effective distribution of labour and capital. Leadership provides direction and role models for the entrepreneurial ecosystem. This leadership is critical in building and maintaining a healthy ecosystem. This involves a set of 'visible' entrepreneurial leaders who are committed to the region. Access to financing — preferably provided by investors with entrepreneurial knowledge — is crucial for investments in uncertain entrepreneurial projects with a long-term horizon (see e.g. Kerr & Nanda 2009). But perhaps the most important element of an effective entrepreneurial ecosystem is the presence of a diverse and skilled group of workers ('talent': see e.g. Acs & Armington, 2004; Lee et al., 2004; Qian et al. 2013). An important source of opportunities for entrepreneurship can be found in knowledge, from both public and private organizations (see e.g. Audretsch & Lehmann, 2005). Finally, the supply of support services by a variety of intermediaries can substantially lower entry barriers for new entrepreneurial projects, and reduce the time to market of innovations (see e.g. Zhang & Li, 2010).

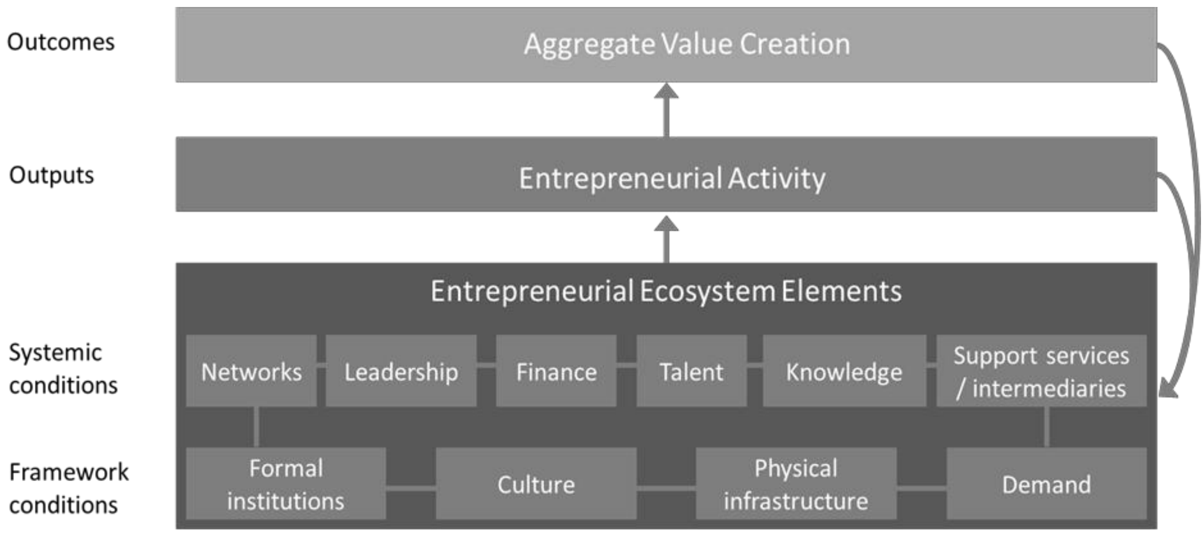

Figure 2. Key elements, outputs and outcomes of the entrepreneurial ecosystem (based on: Stam 2015)

7. Conclusions and Policy Implications

The concept of entrepreneurial ecosystems is very attracting to regional policymakers and leaders. The idea that a certain mixture of public policy options, social attitudes, and financing can catalyse long-lasting entrepreneurial and innovation activity is a seductive promise to leaders looking to create a foundation for more sustainable growth. Authors like Feld (2012) are quick to point out that examples like Silicon Valley are not replicable. The growth of places like Silicon Valley are tied directly into particular events (e.g. the founding of Stanford University with an explicitly industrial orientation), historical trends (the US government shifting defence research away from the east coast in the 1930s and 1940s, the emergence of the venture capital industry in the 1950s and 1960s), and the existence of a long-lasting culture that encourages risk taking, rebellion, and innovation throughout the place (Saxenian, 1994; Lécuyer, 2006; Kenney, 2011). Taking one aspect of this complex ecosystem, such as an effective university technology transfer office, will not replicate the other factors, actors, and institutions that make it up.

However, other cases of successful ecosystems offer more reasonable approaches for policymakers. Spigel's (2015) discussion of Waterloo, Ontario is an instructive example of how a mid-sized city can develop a strong and supportive entrepreneurial ecosystem. The city was historically an industrial economy, but the establishment of the University of Waterloo in the 1950s helped move the region towards a more advanced, knowledge-based economy. Crucially, the university has had an applied, industry-focused research orientation from its founding. As the university emerged as a world leading centre for computer science and electrical engineering research, entrepreneurial faculty and students were attracted to the university and the region. This pool of highly skilled workers was instrumental to the creation and growth of Research in Motion, maker of the Blackberry smartphone as well as numerous other smaller high-tech startups. While the region has a highly effective entrepreneurship support organization, its role is secondary to the strong networks of entrepreneurs, mentors, financers. These networks help new entrepreneurs learn the formal and informal skills associated with being a high-tech entrepreneur and help knowledge about new markets, technologies, and opportunities to flow through the region. This helps to reproduce and strengthen the region's overall cultural orientation towards entrepreneurship, ensuring that it survives the recent decline of local anchor firms like Research in Motion. This effective ecosystem was not created overnight nor through a purposeful effort by the state or an individual. Rather, numerous actors and factors have contributed to creating an ecosystem that supports innovative, high-growth entrepreneurship which in turn has helped the region avoid the decline and population loss that commonly afflicts old industrial regions in the new knowledge-based economy.

The entrepreneurial ecosystem approach intuitively evokes recognition and acknowledgement among public and private stakeholders of regional economies. A critical review reveals that many insights of decades of research into entrepreneurship and regional development in the past can be used as input to the new approach. It might even be said that the entrepreneurial ecosystem approach contains no new separate insights. However, the entrepreneurial ecosystem approach provides a framework for integration of insights from the academic literature on regional entrepreneurship and the approach includes several valuable novel contributions to our understanding of the entrepreneurship process and its impact on regional economic development. First, the system approach builds up from the level of the entrepreneur in order to better understand the context of the entrepreneurship. Such a system approach also centres on the weakest link that mostly limits the performance of the entrepreneurial ecosystem (Acs et al., 2014). A second novel contribution is the prominent place given to the entrepreneurs themselves to build the entrepreneurial ecosystem and keep it healthy, fed by the other stakeholders relevant to the ecosystem. Although causal relations within the system and the effects on entrepreneurship and value creation have not yet been studied sufficiently, the entrepreneurial ecosystem approach offers valuable elements for an improved understanding of the performance of regional economies. The approach emphasizes interdependencies within the entrepreneurship context, and it provides a bottom-up analysis of the performance of regional economies, without fixating on individual entrepreneurs.

The approach also feeds the shift in entrepreneurship policy from a focus on the quantity to a focus on the quality of entrepreneurship. In line with Thurik et al. (2013), the next shift would be from ‘entrepreneurship policy’ to policy for an ‘entrepreneurial economy’, i.e. an entrepreneurial ecosystem. So policy will not be about maximizing a certain indicator of entrepreneurship, but about creating a context, a system, in which productive entrepreneurship can flourish. This shift also necessitates a shift in thinking about the rationales for policy. The economic policy perspective has been reduced to examining the extent to which markets function optimally, in order to reach the maximum (allocative) efficiency. Or, in policy language: is this a case of market failure? The textbook rationales for government intervention are externalities, abuse of market power, public goods, and asymmetric information. Markets are an important mode of governance in economic systems. In the context of innovation and entrepreneurship, the failure of that mode of governance may also be a reason for government intervention (see e.g. Jacobs and Theeuwes, 2005). Public policy based on insights of the industrial district and cluster approaches also uses the market failure rationale for public policy interventions, such as externalities arising from knowledge spillovers or coordination failures due to information asymmetries. This mode of governance, however, also has substantial constraints for innovation and entrepreneurship policies (Nooteboom & Stam, 2008). Market failure plays a role, but not everything in the innovation system can be reduced to market contexts: the non- market interaction is seen not only as market failure, but often as a necessity for the realization of innovations (Teece, 1992). For innovation and knowledge sharing in general, especially non-codified knowledge, informal interaction is of great importance. Cooperation makes it possible to exchange much more knowledge than can be specified contractually. This was the reason to create a wider framework for this type of policies: the innovation system approach. The focus of this approach is the so-called system failure: the lack of sufficient elements in the innovation system (e.g. certain types of financing or knowledge), or a non-optimal interaction between these elements (e.g. between companies and knowledge institutes). An innovation system works well if there is a sufficient variety of organizations that fulfil the required functions in such an innovation system, and as a result create an optimal interaction between these elements. The innovation system approach not only examines at markets, but also, and especially, organizations and their interaction, and not only through market transactions, but also otherwise. However, in the innovation system approach, the role of entrepreneurs remains a black box, as does the market failure approach, for that matter. This makes the entrepreneurial ecosystem approach more desirable, as it appears to be able to solve the shortcomings of the market failure approach and the system failure approach, and seems better applicable to policies for an entrepreneurial economy.

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Innovation, the Economy, and Policy

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1 Introduction

Innovation has been essential for economic growth in the last centuries (Mokyr 1990; Baumol 2004). In western economies, the importance of innovation for economic growth has become more pressing given ageing populations, global competition, increasing product variety, and shortening product life cycles. Innovation is also needed to solve problems in society such as those concerning climate change, health, and congestion. Innovation also has intrinsic value as a manifestation of creativity. In this volume the focus is on the economic significance of innovation, and on its conditions, in innovation systems. The aim is to provide an analytical basis for innovation policy, primarily that of governments.

While macroeconomic analyses show the importance and the effect of innovation for productivity and growth, as will be investigated in chapter 2, and show effects of macro-level factors such as labour markets, they give little insight into the underlying processes of innovation. As a result, innovation policy is still very much a matter of improvisation and trial and error. In this book we aim to improve insight into the micro level of individual agents and corporate agents (organisations) and their interactions, in the generation, utilisation, and diffusion of ideas, products, and processes. As noted by Lundvall and Borras (2005: 614): "Innovation policy calls for 'opening the black box' of the innovation process, understanding it as a social and complex process". The aim of this volume is to contribute to that. Another reason for a focus on the micro level of the economy is that this volume is oriented towards the national government, and increasingly macro-economic policy has shifted to the supra-national level of the EU.

Hence the title: micro-foundations for innovation policy. This does not mean that we discount the value of macro policies (for example concerning taxes, labour, and social security): these indeed present vital conditions for innovation and economic growth. However, they have already been analysed to a large extent in other studies, are commonly recognised as important elements of economic policy, and we have little to add on that score. We take a complementary, relatively new perspective of 'innovation systems', that takes into account interactions between a variety of agents, various dimensions of innovation (going far beyond science and technology), and a variety of economic and institutional conditions. The analysis applies to innovation systems in general, with special attention to the Netherlands.

The main line in our policy approach is a trade-off between arguments against and in favour of policy interventions. One reason for restraint in making policy interventions derives from the insight gained from Austrian economics that knowledge is diverse and is distributed throughout society, and that government should mobilise that knowledge rather than impose its own. A second reason, derivedfrom an evolutionary perspective, is that innovation is highly unpredictable and full of surprises that government should not aim to outguess, and is a system phenomenon, with complex interactions that produce partly unintended consequences. On the other hand, there are market and system failures in innovation that government should address. The question then is how to do this while respecting unpredictability and the variety and distribution of knowledge, and taking into account government failures. This yields a policy perspective that keeps the innovation process as open as possible. Open in four ways. Openness to uncertainty in the innovation process, as opposed to determining the innovation trajectory exante. Openness for collaboration at a sufficient ‘cognitive distance’, as opposed to cooperation with equals in knowledge. Openness for new entrants, as opposed to coalitions of incumbents. Openness to the world outside the own region or country and outside established industries, as opposed to inward-looking, parochial innovation policy. Such a policy would strengthen the position of the Netherlands as an open knowledge economy, in multiple respects. Introductory chapter we discuss the meaning of innovation, its economic significance, and the roots and development of innovation policy.

After a brief introductory section, the second section concerns the key notions of novelty and creativity, and definitions of innovation. In the next section we give an inventory of dimensions and measures of innovation. The fourth section concerns the role of innovation in the economy, in the context of globalisation. This includes the necessary openness of innovation to global markets. In the fifth section we consider the position that innovation cannot be left to markets, and what perspective of markets we can then take. We contrast ‘mainstream’ economic views with views derived from Austrian and evolutionary economics, which have led to the ‘innovation systems’ view that is now current in many policy debates. We specify what we make of these perspectives for our own approach. In the sixth section we provide a historical view on innovation policies. A final section outlines the further contents of this book.

2 Novelty, Creativity, and Innovation

Innovation denotes both an activity and its outcome. In its outcome, it is a novel function or a novel way of performing an existing function. This is wider than new goods, services, and processes in market sectors, and includes innovation in the public sector. In its process, innovation denotes invention, the creation of innovations, and their diffusion. A key element of innovation is novelty; literally innovation means to introduce a novelty. In the current debates around innovation, its meaning is largely reduced to the economic domain, and the dominant interpretation is innovation as the successful exploitation of new ideas. In this view, the creation of new ideas precedes innovation. Before we zoom in on the economic aspects of innovation, we first explore the general meaning of innovation.

It is debatable whether sheer novelty is possible at all: paraphrasing the biblical Preacher (Ecclesiastes 1:9) and the economist Schumpeter “there is nothing new under the sun, only new combinations”. Of course, new ideas do not arise from a cognitive vacuum, but are somehow constructed , from ideas and experience adopted, constructed, and accumulated along a path of life. This is further discussed in chapter 3. The term ‘combination’ carries a connotation that appears to underestimate the cognitive transformation or emergence involved in idea generation. That is creation. Creativity is making a connection between or combining two elements that have not previously been connected or combined (Feinstein 2006: 31). This connects with Schumpeter’s view of innovation as novel combinations. Cognitive psychologist Sternberg (1996: 375) defines creativity as “the process of producing something that is both original and worthwhile”. Two central elements are thus novelty (originality) and value (worthwhile). Creativity includes the process of finding a novelty and then transforming findings into observable products (Schweizer 2004). Does the condition, universally recognised to apply to innovation, that the novelty has direct value for, and is appreciated by others than the creator, also apply to creativity? We don’t think so. It is widely recognised and documented (see e.g., Mokyr 1990) in science, technology, and art that new ideas often find a useful application and acceptance only later, sometimes much later.

> Examples abound. In mathematics, consider non-Euclidean geometry. It was later taken up in physics, but prior to that it was appreciated as an intriguing and consistent system of new axioms and theorems. In technology there is the classic example of Marie Curie's discovery of radioactivity, later to be applied to X-ray photography, for example. In art the French impressionists were at first ridiculed and scandalized, and were barred from museums and galleries. Yet the impressionists did value each other's work and later met with huge popularity.

Would it make sense to say that those ideas become creative only then, when they were more widely applied or appreciated, long after they were produced? If value is a criterion for creativity, value to whom, and to how many? There is a double subjectivity here. First, whether someone identifies something as a novelty depends to a large extent on his prior knowledge. Second, when this novelty is turned into an innovation, its performance and value depends on the subjective judgment of its selectors. Some people may value an idea because they like it for itself, or because it inspires the further development of ideas, without any application beyond that. Creativity may have mostly or even exclusively intrinsic value to the creator. A scientist or artist who produces 'l'art pour l'art' is not thereby barred from creativity. Both the recognition one may get from innovative accomplishment and the intrinsic value underlying creation contribute to the flourishing of people. So, we propose to allow for creativity to include novelty even when it has no identifiable value beyond intrinsic value to the creator.

This issue is more than an idle, innocuous semantic squabble. By looking only at value in application or use, in innovation policy, one runs the risk of neglecting invention and discovery. While innovation may usefully be defined as applied and accepted new ideas, there is no innovation without the underlying idea generation, prior to application. Therefore, innovation policy should be oriented not only toward innovation but also toward underlying creativity (as defined here). The relation between idea creation (exploration) and application (exploitation) is analysed in chapter 3.

According to the definition of innovation given above, innovative performance depends on social judgement of others. In the case of technological creativity, innovative performance depends on 'peer reviewed' journals, patent bureaus, but also specific prizes (e.g., of national science foundations and Nobel Prize commit- tees). Innovativeness in the arts is assessed for example by publishers and arts foundations that provide grants and prizes. Economic creativity – entrepreneur- ship – is rewarded by the market, i.e., customers that pay more for the products than the costs of the sum of its inputs: from a company perspective this involves value creation (sales) and capture (profits).

"The current discussion on the so-called 'knowledge paradox' can be translated as a lack of economic creativity following on technological creativity: 'In the end the translation and transformation of knowledge into concrete products and services leads to productivity and welfare in a broad sense. In essence it is about the utilization, in a competitive environment, of opportunities that markets and newly developed knowledge offer. Innovation and entrepreneurship'" (Innovation Platform 2006: 17).

Innovation is mostly seen as primarily of economic value and purpose. However, it is widely recognised that regardless of economic growth innovation is also of value in solving societal problems, and has cultural value and intrinsic value for the flourishing of people, in activities of creation and selfrealisation. From a more utopian perspective, innovation is seen as a means for world peace and ecological preservation. These dimensions of value are not necessarily separate. Solving societal problems may well go together with the furthering of economic growth. As argued in chapter 4, university research may contribute to both culture and economy. In chapter 9 it will be argued that creative teams in organisations, which further innovation, are conditioned at minimum by certain dimensions of the quality of labour, such as intrinsic motivation and autonomy.

Until now we have discussed innovation, creativity, and novelty in general terms. The current public debate on innovation is however much narrower in focus, in that it largely focuses on the economic aspects of innovation, as a 'solution' for economic 'problems' such as increasing global competition and ageing populations. The macroeconomic significance of innovation is further analysed in chapter 2. Here we discuss the position of innovation in economic structure and processes. First we specify the dimensions, the further 'ins and outs' of innovation.

3 Dimensions and Measures of Innovation

The foundational definition of innovation as new combinations was provided by Joseph Schumpeter (1934: 74). The carrying out of new combinations can take several forms: (1) the introduction of a new good or quality thereof, (2) the introduction of a new method of production, (3) the opening of a new market, (4) the conquest of a new source of supply of new materials or parts, or (5) the carrying out of the new organisation of any industry. In contrast to the often-used narrow definition of innovation as technological change, Schumpeter also recognised innovation as organisational change.

Economically, innovations can be 'smaller or larger', in terms of the volume of sales involved, number of producers and users, the degree to which it is creatively destructive of existing assets and competencies, with all the implications for the destruction of capital, employment, and the restructuring of markets, industries, and institutions (such as technical, administrative and educational standards, legal rules, etc.). A well-known distinction is that between 'radical' or path-breaking, or 'paradigm-switching' innovation and 'incremental' innovation along a 'techno- logical trajectory' (Dosi 1982, 1984). Radical innovation tends to have wider repercussions, yielding more creative destruction, involving larger volumes of sales and numbers of consumers and producers, and more markets and industries.

The so-called shifts in techno-economic paradigms (Dosi 1984; Freeman and Louca 2002) reflect the emergence and diffusion of new general-purpose technologies (gpts) like the steam engine, the combustion engine, nuclear power, electricity, and information and communication technologies. The emergence, diffusion, and adoption of these gpts is said to initially lower productivity levels and economic growth (due to problems of integration and restructuring), but in the longer term to improve productivity levels and ultimately economic growth (see chapter 2). Technological innovation is often seen as the major motor of economic growth (Mokyr 1990). Some authors however are quite critical of the assumed relationship between the invention of gpts and national economic growth. According to Edgerton (2007) most economic growth does not take place in countries that heavily invest in the invention of new technologies, but takes place in countries that adopt, adapt, and copy new technologies. The fact that prosperous countries spend relatively much money on research and development (r&d) is in this light seen as an effect of wealth, not a cause. Other gpts, such as nuclear power, are far from driving economic growth, in contrast perhaps to their geopolitical influence. Some very important innovations are not based on spectacular technological inventions. A striking example in this respect is the introduction of the shipping container, which has led to major cost-reductions in transportation, and enabled for example the rise of China as a low-cost producer country (Levinson 2006).

The distinction between incremental and radical innovation is related to the distinction between “first and second order change” (Bateson 1972), “single and double loop” learning (Argyris and Schön 1978), and “exploitation and exploration” (March 1991), which denote change and learning within established basic principles or logics, and changes of such principles and logics. A big difference is that these concepts are relative to the level of analysis, while the notion of radical innovation is more absolute, related to the world economy. A new way of performing a small task within a firm may deviate from established logic or design principles and would thus be exploratory; on the level of an entire industry its impact may be small and it would hardly be called a radical innovation.

Generally, a distinction is made between invention/discovery, innovation, and adoption/diffusion. Innovations can be new to a person, an organisation, a market or industry, a country or the world. Such distinctions are made, for example, in the EU Community Innovation Survey (cis). When the definition includes novelty only for a given individual or organisation it overlaps with the notion of adoption. There may be arguments for such a broad definition, in the analysis of intra-organisational conditions and consequences of adoption, which may entail organisational innovation. This happens in chapter 9 of this volume, for example. However, in general we use the term innovation to denote some- thing new for others than only the producer or adopter of an innovation.

There are stages in innovation processes, from idea creation and knowledge sourcing via development and testing, in exploration; to application (with new products or processes); improvement; diffusion; and differentiation (exploitation). As one progresses along these stages, uncertainty mostly decreases. This used to be seen as a linear process, in one direction. Later, it was recognised that there are feedback loops. In particular, experience with testing and application yield adaptation, differentiation, extension, and inspiration for new ideas, so that the process is circular rather than linear (Kline and Rosenberg 1986). How that process works is of course of crucial importance and will be analysed in chapter 3.

Empirical measures of innovation relate to different aspects of innovation, different stages of the innovation process, and different conditions for innovation. The development of innovation indicators reflects the development of policy (to be discussed later). First efforts, in science policy (S), concentrated on indicators of science related to r&d. The fundamental shortcoming of this is that it concerns invention rather than its use in innovation. While r&d may provide an input, innovation also requires prototype development, testing, design, organisation, marketing, and distribution. Those, in turn, require collaboration with customers, suppliers, distributors, and others. Later, attention included some output indicators concerning technology and its production and use, in a shift to science and technology policy (st). Most recently, in the development of innovation policy – including science, technology, and innovation (sti) – the arsenal of indicators has been widened considerably, with plans to include not only product and process innovation, but also marketing innovation (including design) and organisational innovation (including knowledge management, the organisation of collaboration, and even measures of social capital), as reported in the third version of the Oslo Manual (oecd 2005, 2007).

In other words, there has been a growing recognition of the non-technological aspects of innovation. Also, in addition to r&d another input is adoption, and we require measures of diffusion. Gault (2007: 16) reports that 41 percent of innovative firms in the Community Innovation Survey (cis) innovate by adopting technology from other organisations. The present repertoire of indicators can be ordered as concerning inputs, process (e.g., linkages), outputs, and impacts. They are summarised in table 1.1.The categorisation in terms of inputs, process, outputs, and impacts is somewhat problematic in the non-linear, recursive view of innovation where inputs may also be outputs and vice versa. Skill, for example, is both an input and an output.

The indicators hardly correlate (cf. Kleinknecht et al. 2002), which suggests their 23complementary nature. Some of the improved impact indicators still carry problems. An innovation that is new to a firm can be due to internal development but also due to simple purchase of new technology from a supplier, in the form of machinery or instruments (Arundel 2007). An innovation may be new to the market of a firm not because the firm is very innovative but because that market is backward. Some indicators are still lacking. Impacts from innovation take time, can be indirect, and, in part, are difficult to trace (such as cultural effects or the wide repercussions of creative destruction). We still lack indicators of institutional effects that may enhance or obstruct innovation. Ultimately, of course, the question is not what the merit is of individual indicators, but how they can be used to measure the impact of policy. That requires an often difficult matching of different databases. Generally, to evaluate the impact of a policy measure, one needs to determine 'additionality': what effects do the measure generate that would not have been generated without it. In principle, what one needs for that is longitudinal data over a sufficiently long period to trace effects, both for firms that participate in the programme and for firms that do not participate but are similar in other respects. That can and has been done, but only rarely.

In spite of the recent rhetoric against focusing on r&d and against the linear model of innovation, old practices still dominate the actual use of indicators (Hawkins 2007). There are three reasons for this. First, r&d as input and patents as output are more easily measured than many other, modern indicators (see Kleinknecht et al. 2002). Second and third, there are path-dependencies in both policy – with an ongoing focus on r&d – and in research, with an ongoing focus on familiar measurements of productivity and of impacts of r&d (Arundel 2007). In policy, r&d allows more grip for government than many other factors, such as collaboration. The ongoing one-sided preoccupation with r&d is also reflected in the EU's Lisbon and Barcelona agendas.

Table 1.1 Empirical Measures of Innovation

Inputs	Skill or educational levels of employees or entrepreneurs Science and engineering graduates R&D (formal and informal, internal and external to a firm) Innovation expenditures Use of ICT (hard- and software) Use of licences Purchase of machinery, instruments Information from trade fairs, conferences, press etc. High-tech industries Creative class and industries Risk capital, particularly seed capital
Process: linkages, marketing, organisation, strategy	Linkages with knowledge institutes

	Alliances, networks, chains of innovation, social capital
	Marketing, customer relations, design
	Supplier relations, co-makership
	Organisation, knowledge management
	Communicative skills
Outputs	Patents (in US, EU or elsewhere; applied for or obtained)
	Publications
	Graduates from education
	Licences sold
	Trademarks
	Prototypes
Impacts	Citations (of publications, patents)
	Renewal of goods or services due to development or application of new (to a firm) or recent technologies (adoption)
	Renewal not necessarily based on technological knowledge (e.g. management, marketing or organisational renewal), 'social' innovation
	Number or percentage of turnover of goods or services new to the firm / country / industry
	Improved processes, reduced costs
	Profit, market share growth
	New market entry
	High quality employment

A narrow focus on technological innovation and on innovation inputs, such as r&d spending and science and engineering graduates, could be especially misleading for innovation policy in small open economies like the Netherlands.

First, although the Netherlands may be lagging behind with respect to such things as the number of science and engineering graduates, business r&d expenditures, and high-tech manufacturing (see chapter 2), it may be leading the indicators on creative class, patents, and new designs, which may reveal more about the particular nature of the Netherlands economy than about the 'innovation gap' that it should bridge. Second, for a small open economy it might be more effective to improve the international networks and the absorptive capacity of the actors in the national economy than to aim at shifting the technology frontier (Weterings et al. 2006; Nahuis and Van de Ven 1999).

Within one week the following two headlines were published in the same Dutch newspaper (Trouw): "Innovation in the Netherlands lags behind neighbouring countries" (July 10, 2007) "Multinationals lead the Netherlands to a third place on the European innovation list" (July 16, 2007). These headlines may be puzzling to many: is the glass half full or half empty, or are we talking about different glasses? The latter seems to be the case: The Netherlands is lagging behind mainly in private r&d expenditures and in entrepreneurship, while it has been the third most productive patent applicant in Europe (after Germany and just behind France). This shows that innovation is a process with many phases and a concept with many faces that can thus be measured in multiple ways.

4 Innovation and the Economy

The construction of new combinations is seen as a driving force of economic welfare. However, much that counts as innovation has dubious added value.

> Two leading shaving equipment manufacturers – Gillette and Wilkinson Sword – spend billions of dollars on R&D to develop ever more advanced shavers. Has the evolution from one-bladed razors to eight-bladed razors really delivered a societal benefit that covers all these R&D investments? According to free-market ideologists, the answer is yes, because these two firms still seem to be profitable. According to Gillette, the key is to "provide benefits people think are worth paying for". However, one might wonder whether all the energy and creativity of all the thousands of talented highly qualified researchers could be allocated to more productive activities.

Innovation can also lead to the ruin of culture and nature. As Schumpeter already recognized, there is also 'creative destruction' involved in innovation: new knowledge, technologies, markets, firms, and employment make old ones obsolescent, and adjustments in demand and supply can be very painful.

> In the earlier example of digital cameras, there was creative destruction of the production and use of chemical films and their processing, and hence of corresponding manufacture and retailing. There were wide repercussions for the media, publishers, advertising, design and artists. It led to cameras in mobile telephones that turn passers by into potential news photographers, who may have to shift their profession.

Radical innovations are generic in the sense that they generate waves of related and subsequent innovations, which enhance their application; and incremental innovations that widen their application, make improvements, and differentiate them into varieties. While radical innovations are the most dramatic, incremental innovations are by far more frequent, and in their accumulation have the greatest impact. Indeed, it is through incremental innovations that radical innovations have most of their economic impact. Here, the distinction between minor innovation and the diffusion of a major innovation becomes blurred. One might envisage this as a pyramid, with radical innovations at the top, which fan out into a broad basis of applications and incremental innovations. Incremental innovations, being in the majority, mostly require limited creation of new knowledge, and hence limited r&d, building on existing knowledge, and entail minor variations upon an existing theme, with adjustments in styling, branding, distribution, added services, etc. Thus, it is a misconception that all innovation requires r&d and a linkage to knowledge institutes. However, such linkages are required in the diffusion of new knowledge and technology, and for the inspiration of new knowledge. Even radical innovation is not necessarily based on r&d and new scientific knowledge, particularly if it is an innovation in organisation, marketing, or distribution.

> An example is self-service, which has revolutionized retailing, not only in the type of service offered, but also in creating the opportunity for an enormous increase of scale, in large self-service stores. From retailing it spilled over to wholesaling, cafés, restaurants, and even hotels.

As a result, when complaints are made concerning lack of r&d, lack of application of knowledge generated by universities, and lack of connections between university and industry, the question is how much one would expect is needed and useful. What is the benchmark?

While economic value is not a precondition for all innovation, innovation is needed for economic reasons, also for developed Western nations, if they want to maintain their prosperity in the face of changing conditions in the global economy. As will be shown in chapter 2, total factor growth in the eu has slowed down, as a result of, among other things, slow down of the increase of the volume of the working population and of the volume of capital. In fact, due to an increase in age, the share of working people in the population is declining. A major determinant of total factor productivity is innovation, and for ongoing growth that will have to increase, in order to compensate for lack of growth of the volumes of labour and capital. This line of argument is further developed in chapter 2. There is a shift of growth to emerging nations (e.g., China, India), which offer lower wages and are bridging their gap in development. This is not necessarily a threat. There might even be a net benefit from this aspect of globalisation for the Nether- lands, due to lower prices of goods produced in lower-wage countries, opportunities for exports to emerging markets, and opportunities for the Netherlands to function as a gateway into Europe for imports from emerging economies (Suykerand De Groot 2006). However, development is accompanied by structural change, where for a number of industries activities are shifting to emerging economies. Opportunities for innovation should be grasped to fill the gaps.

With globalisation, industrial value chains are increasingly fragmented or 'splintered', with different links of chains being distributed across the globe (Gereffi 1999; Dicken 2003). The front end of the chain, in r&d and design, may still remain in a developed country, while production takes place elsewhere, after which marketing, distribution, and user support may again be located at 'home', to a greater or smaller extent. Thus, it is out of date to think in terms of domestic versus foreign industries, and one should think in terms of segments of industries that need to be connected to other segments, across the globe. Nowadays, this fragmentation of value chains applies not only to manufacturing but also to services, in what has been called the "second unbundling" (Went 2007). Even some provision of distribution hubs , a traditional specialty of the Netherlands, has now been outsourced to China (Wright 2007).

There may no longer be a future for a full-fledged motor car industry in the Netherlands, but there may still be a future for a cluster of parts, say the 'front end' of a car, or its carriage and suspension system, provided it is well connected to, say, the German car industry. In the formerly extensive Dutch textile industry, most production has been outsourced to low wage countries, but fashion and design (Amsterdam) and logistics (Rotterdam) are still in the Netherlands.

This has an important policy implication: when instituting a programme for developing economic activity, there is a tendency to frame it in national terms, if only because in the eu a single nation is limited in what it can arrange in subsidised programmes across different eu nations. This bias towards national activities carries a risk of tying the initiative to the country while the opposite should occur: a loosening of local ties to connect local activities to parts of fragmented value chains that are located abroad. This is one of the reasons why we will argue for more openness to the world in national innovation policy.

We can no longer assume that all high value-added activities, such as r&d, will remain in developed countries. The arguments are familiar: there are hosts of engineers and other well-educated workers entering the global economy in less developed countries. What, then, will not easily dissipate to emerging economies? What may help us to survive is the condition, increasingly recognised in recent economic thought, that innovation is a network phenomenon, arising from interaction between a variety of firms, knowledge institutes, and public authorities, together fashionably and pompously labeled as 'the triple helix', embedded in local conditions of infrastructure and institutions, which cannot so easily shift to other locations, and may not easily be imitated. This is one reason for current policy attention to 'regional innovation systems' and 'local clusters'.

> According to Meeus and Faber (2006: 67), in the Netherlands more than 90% of innovations are achieved with contributions from external parties. In much research over many years (see e.g., Wever and Stam 1999, Pittaway et al. 2004), it has been shown that firms maintain relationships first of all with customers, suppliers, and even competitors, more than with public and private knowledge institutes. Before this is taken as evidence for some kind of failure in the knowledge system, recall that much of the large volume of incremental innovation hardly requires new scientific knowledge.

Conceptually, a reason for attention to collaboration is the increasing recognition that innovation requires learning by interaction (Lundvall 1988, Nooteboom 2000). It is not quite clear, however, why, precisely, that is the case. It is clear that it has something to do with variety as a source of Schumpeterian 'novel combinations', but it is not clear how that works, cognitively and socially. Analysing that is one of the objectives of this volume. Conceptual analysis of collaboration for innovation is given, in particular, in chapter 3, which looks at the more cognitive aspects, and chapter 7, which looks at the governance of collaboration. Analysis of inter-organisational networks and regional clusters or innovation systems is given in chapters 10 and 11. The focus on knowledge and learning, developed in chapter 3, connects this volume to the 'Lisbon strategy' to make the eu the most dynamic and competitive knowledge-based economy in the world by 2010, and to the aim of the Innovation Platform to make the Netherlands one of the five leading knowledge economies of the world.

5 What Markets?

Before turning to innovation policy, the question for many is why we need policy in the first place. Why wouldn't markets work for innovation? Arguments for innovation policy usually arise from market failures. But what are those? And are there also other failures? Here we take the view from institutional economics that there is co-evolution of markets and institutions: markets require institu- tions – as has been shown in the difficult transition of former communist economies to market economies – and market processes shift and create institutions.

Market Failures

In traditional economic versions of innovation policy, the main orientation is one of laissez faire. The market should be allowed to do its work of achieving optimal allocative efficiency, with incentives from competition, and the focus of policy is on the reduction of barriers to firm entry, growth, and exit, in competition policy. The changes brought about by innovation can require adjustments by policymakers. Their prime task is to restore an optimal market structure. In such a perspec- tive, results of technological change are supposed to be known, as antitrust authorities intend to impose a specific (optimal) state of affairs. The only ration- ale for state intervention is market failures, such as those connected with 'public goods', characterised by non-rivalry (one's use does not exclude another's use) and non-excludability of use, and external (dis)economies, such as pollution.

Public goods are goods for which an increase in one person's consumption does not reduce its availability for others ('more for you means no less for me'). Exam- ples of public goods are national defence, monuments, street lighting, light-houses, or radio and television broadcasts. In addition to these most often 'national public goods', there are also public goods whose benefits extend beyond national boundaries, such as peace, the environment, biodiversity, health, scien- tific and technical knowledge, financial stability, and shared technical standards (see Acocella 2005).

In particular, a problem for innovation lies in possible non-appropriability of rewards for innovation, due to spillover of the results to imitators, which yields an argument to postpone competition by protection of property rights. In tradi- tional economics innovation is generally seen as the introduction of new more efficient production technologies. Firms are assumed to immediately obtain gains associated with the new technology once they have decided to implement it. As a consequence, the only motive to innovate lies in the perspective of benefiting from a monopoly rent that is at least transitory.

Within the traditional economics framework, "the best way to understand market failure is first to understand market success, the ability of a collection of idealised competitive markets to achieve an equilibrium allocation of resources which is Pareto optimal" (Ledyard 1989: 185). This particular definition of market success and hence of market failure is nothing but a reading of the first fundamental theorem of welfare, according to which: "if there are enough markets, if all consumers and producers behave competitively, and if an equilibrium exists, then the allocation of resources in that equilibrium will be Pareto optimal" (ibid.). Therefore, "market failure, the inefficient allocation of resources with markets, can occur if there are too few markets, non-competitive behaviour, or non-existence problems" (ibid.). The main objective of public policy in this perspective is to realize optimal (static) efficiency: optimal allocation of given resources.

Often failure in financial markets is assumed when it is hard for certain innova- tors to acquire capital for investments. However, lack of private financing might well be the effect of rational choices: private financers perceive the market prospects of certain innovations to be too limited due to obstacles to commer-cialisation. Another frequently used argument in favour of policy (i.e., public investments in r&d) is underinvestment in private r&d due to limited appropri- ability of the returns to r&d. A conventional argument in market failure reason- ing is that knowledge is a semi-public good. Because of the problem of non- appropriability, government should take action to overcome underinvestment in new knowledge through the provision of r&d subsidies or the establishment of property rights. An example of government intervention is the support of new technology-based firms, which is assumed to stimulate r&d investments and to improve public returns on a longer term when new technology is developed and commercialised in many new applications and sectors of the economy (see chapter 5).

These conventional market failure arguments provide a basis for public interven- tion in innovation policy. It is based on a linear model of innovation that focuses on r&d infrastructure and technology transfer, as if these will automatically lead to innovation. Sometimes targeted industrial policy is introduced, based on the assumption of market failure, in that public intervention stimulates economic growth not otherwise likely to occur. A standard argument in this line of reason- ing is that knowledge is characterised by increasing returns to scale. For that reason, investments in public r&d, technology transfer, and education are expected to foster economic growth (Hall 1994). These increasing returns might even give rise to selective government intervention, for example through subsi- dies for industries characterised by this ‘imperfect competition’. With this inter- vention government can ensure that a larger part of the supposed ‘excess returns’ is earned by domestic firms. The basic idea underlying such a strategic trade or industrial policy (Krugman 1987) is that in the presence of increasing returns and imperfect competition, firms in some industries may be able to earn excessive returns, and that a country can ensure that the firms earning these excess returns are domestic rather than foreign. This kind of policy could easily lead to ‘locational tournaments’ in which national governments compete with each other in a zero sum game to attract foreign direct investment.

Markets for Discovery

Most people, also those outside mainstream economics, would agree that it is important that “markets are open, that they facilitate and create incentives to challenge established positions and that they eliminate activities which are no longer viable in the prevailing environment” (Metcalfe and Ramlogan 2005: 230). Stimulating innovative entrants (outsiders) to compete with (obsolete) incum- bents (Boone and Van Damme 2004, Aghion et al. 2006), or ‘backing the chal- lengers’ is a key policy instrument (Jacobs and Theeuwes 2004).1 While markets may fail by undersupply of innovation, policymakers may also fail. They are susceptible to mistakes (due to information problems) and may be prone to capture by private interests (Olson 1965). Some authors have argued that govern- ment policy fails, giving rise to ‘deadweight’ and ‘substitution’ effects (Jacobs and Theeuwes 2004a, 194; Santarelli and Vivarelli 2002). Deadweight effects occur when the beneficiary of an innovation subsidy is a firm which would have started or innovated in any case. In other words, there is a lack of ‘additionality’ of public funding. See for innovation Irwin and Klenow (1994), Wallsten (2000), Cornet and Van de Ven (2004)2; and for new firm formation: Santarelli and Vivarelli (2002). Substitution effects lead to more distortions, since the subsidy is not only a social waste but also implies the substitution of potentially more efficient new firms or innovation projects by less efficient ones. In the presence of a publicly funded – incentive, the firm adjusts its own capacity not on the basis of either passive or active learning in a market, but as a consequence of the artificial support brought about by the subsidy received. See for innovation Niosi (1995); and for new firm formation Maggioni et al. (1999), Santarelli and Vivarelli (2002).

Outside mainstream economics, however, there is a notion of a market as a ‘discovery process’ rather than as an efficient mechanism for allocation of scarce resources to given goals. This notion goes back to Austrian economics, in particular Hayek (1945).3 Knowledge is differentiated and distributed in society. In chap- ter 3 we will use the notion of ‘cognitive distance’ between people. New economic knowledge is best discovered by actors in a competitive process. In this view, centralisation is inferior to a market system because the central actor attempts to make decisions on the national economy despite inferior information. Because the market system relies on the efficient exploitation of bits and pieces of information held by different actors dispersed over society, a decentralised market system can make most decisions better than a centralised one. As a result, in a decentralised market society, people can make decisions about the exploitation of innovation on the basis of idiosyncratic information gathered through their life course (Shane 2000). Why would policymakers be better informed about making the right choice than professionals in the marketplace and people with access to local knowledge?

What sets this Austrian approach apart from the traditional one, is that it regards uncertainty and information asymmetry as fundamental to the process of innovation. Entrepreneurs make conjectures about new combinations that are uncertain – that is, one cannot know (or even calculate the probability) ex ante whether these conjectures will be correct (Knight 1921). Several types of uncertainty can be distinguished: for example technical, market, and competition (Shane 2004: 205). The entrepreneur does not know in advance if the good or service he is producing will work, and, if so, if it can be produced at a cost less than the price at which it will be sold (technical uncertainty). The entrepreneur also does not know if demand will exist for the product, and, if so, if customers will adopt in large enough volumes, quickly enough, and at a high enough price, to make the effort profitable (market uncertainty). Finally, the entrepreneur does not know if she will be able to appropriate the profits from the exploitation of the opportunity or if they will dissipate to competitors. This uncertainty will only be resolved with entrance into the market (Rosenberg and Birdzell 1986: 257-258), hence the description of the market as a discovery process.

Consistent with this aspect of the Austrian view, but going beyond it, is the more recent approach inspired by evolutionary economics and institutional economics. Evolution is driven by processes of variety generation, selection, and transmission of what survives selection. Here, innovation is conceived of as a process of research, learning, and selection, which results in the appearance of new productive options that bring about a modification of the environment itself. The notion of selection points to the – often forgotten – function of competition in economic growth that it eliminates obsolete forms of economic activity, burying the economically dead (the 'destruction' part of Schumpeter's creative destruction). This function is not to be taken for granted: consider the difficulty often experienced by policymakers in getting rid of programs that are obsolete or that have simply failed. Thus defined, innovation is a sequential process, which takes (and can change) form, content, and direction at each successive step of its implementation. Firms do not know ex ante whether it is profitable to innovate.

> "Indeed the answer to this question for any single firm depends on the choices made by other firms, and reality does not contain any provisions for firms to test their policies before adopting them. Thus there is little reason to expect equilibrium policy configurations to arise. Only the course of events over time will determine and reveal what strategies are the better ones" (Nelson and Winter 1982: 286).

This approach takes the radical uncertainty of innovation seriously, which pulls the rug out from under rational choice analysis and analysis in terms of equilibria. The efficient operation of markets is limited by the uncertainty of conditions and outcomes of innovation, limited insights in demand and supply, transaction costs, and the endogenous change of preferences.

Transaction costs are costs of contact (search, evaluation, distribution), contract (negotiation, agreements, contracts) and control (monitoring, haggling, litigation). Internet and related technologies (credit cards, bar codes, electronic tracking and tracing, database management, intelligent software agents) have drastically reduced such costs and have enabled novel and transformed relationships between producers, suppliers and customers. That is an important part of the technological background of globalization, in particular the 'splintering' and fragmentation of value chains across the globe.

While there may be forces that tend towards equilibrium, in the diffusion of innovations, equilibria are never approached due to ongoing change. Under the radical uncertainty of innovation, and consequent lack of foresight, one needs the view of an evolutionary process where a variety of trial and error is submitted to a selection environment of markets and institutions. One of the reasons equilibria are not reached is that the selection environment co-evolves with innovations: innovations affect the institutions upon which selection is based. In such evolution one can get locked into path-dependencies. Institutional set- ups limit and enable evolutionary processes, and this varies across countries and regions. In other words: history and context matter. A policy that is effective in one setting of time and place may not be so in another. Universally valid instruments of policy are an illusion.

The evolutionary perspective recognises the possibility of system failures4 that may obstruct the processes of variety generation, selection, and transmission, which need to be tackled by policy. This deviates from the more radical laissez faire view of Hayek. In this context, coordination among the firms is not only "highly beneficial to the economy" (Baumol 2001: 727), but a necessary condition for innovative investment to be carried out. Practices usually perceived as anti- competitive can be tolerated by antitrust authorities, at least so long as they do not lead to actual market failures. In order to gain (dynamic) efficiency (innovative choice), coordination among firms may be required (market imperfections), but should not lead to abusive market power that would block innovative initiatives. From this perspective, innovative choice consists not so much in the choice between given alternatives (whether based on complete or incomplete information) as in a search for coordination. What matters is no longer the 'rationality' of the choice between known alternatives. It is the 'viability' of the process through which a different alternative is brought about: a viability that depends on how coordination problems are dealt with step by step. In this light, competition is not only aimed at equalising supply and demand in a given market and technological environment, but "has also to adapt both structure and technology to the fresh opportunities created by expanding markets" (Richardson 1975: 353).

The evolutionary perspective, and its connections to theory of knowledge and learning, will be further discussed in chapter 3.

Variety and Effects of Scale

The importance of variety for innovation has implications for arguments of scale. There is a persistent inclination to think that large scale is efficient. In innovation policy this leads to arguments for 'focus' and 'mass' in research and development by concentrating efforts in a given discipline or field of research or in a single large institute or university, research programme, or project. And indeed, there are several valid arguments of economy of scale. For example, some areas of research require expensive instruments or installations, or specialised support and collaboration, whose cost can be justified only when they are used on a sufficiently large scale (in terms of number of researchers, students, or patients).

Thus, there are good arguments for collaboration, in joint use of facilities, between the three technical universities in the Netherlands, for example. However, there are also diseconomies of scale, as the Dutch have learned from their experience of increased concentration and scale of education and health care provision, which came at a large cost. To some extent the advantages of scale may be utilised without incurring disadvantages, by having decentralised, highly autonomous operational units that share resources for support, such as housing, administrative support, ict services, recreational and catering facilities, and libraries.

As we will argue in more detail in the chapter on entrepreneurship (chapter 5), many small, independent units allow for more variety of experimentation, at a lower cost of failure per unit, which is bound to be frequent in innovation, since the units are small. This yields more innovative output at lower cost of failure than concentration in a large effort in a single large unit. Large scale can lead to coordination failures, loss of motivation and, in particular, loss of variety.

> If there are n people, then there are n(n-1)/2 possible direct links between them. If everybody talks to everybody, communication explodes, with the square of n, together with its costs, confusion, interpretive distortion of information, and delay, which crowd out effective work. This is a potential problem particularly, perhaps, in the Netherlands, with its deliberative tradition of the 'polder model'. The classic solution is to institute a hierarchy, with communication only between successive levels in the pyramid. Hierarchy entails delay and cumulative distortion and reduction of information, which isolates the decision making apex of the pyramid, resulting in inappropriate strategy, and frustrates the base which forms the front of the organization, and the main source of information needed for improvement and innovation, from contacts with customers, suppliers and technology. Decoupling of the system into separate, autonomous, specialized units that are nevertheless mutually dependent yields a problem of obstacles for coordination, novel combinations and diffusion between them.

Upon closer inspection, in the policy debate arguments of scale often turn out not to be proper arguments of scale, defined as more of the same, but arguments of scope, defined as configuring different, complementary activities. This can be closer to objectives of innovation than scale, in allowing for variety of insights and a potential for 'novel combinations'. It is not always clear when an argument is a bad argument of scale or a valid argument of scope. Note however, concerning arguments of scope, that in science the tapping of variety and the crafting of novel combinations occurs in the process of scientists moving around the world to conferences and seminars, and following it up with joint research, or participating in, say, an eu r&d programme. They do not necessarily have to be co-located for longer periods of time. However, it can be a good idea to institute a substantial research institute or university with a variety of specialisations within a discipline, or a variety of disciplines that yield perspectives for novel combinations, and attract the best talent in the world for each of the parts. An important argument may then be that this helps to attract the best talent, and contributes to what we will later (in chapter 3) call a 'knowledge ecology'. On the other hand, it is generally not a good idea to concentrate all efforts in a given field or specialisation in a single location. It may be an excellent idea to set up an elite institute for finance in Amsterdam, but not to concentrate all finance departments at a single university.

Discrepancies and Agreement

Between mainstream economics and the Hayekian/evolutionary view there are not only deep-level discrepancies but also surface-level agreements. In the Hayekian/evolutionary view, the stuff out of which 'market failures' are made from the perspective of mainstream economics – such as asymmetric information, radical uncertainty, cumulative knowledge, path dependence, lack of equilibrium, and rigidities – are from an evolutionary perspective the stuff from which markets and innovation are made.

In view of differentiated and distributed knowledge it is nonsensical to assume that prices carry all the information needed for markets to work. Prices do not tell producers how technology works, nor what different qualities of products different consumers want. Prices do not tell users how products fit into their particular needs and user practices, and what the switching costs between different products are. Transaction costs, such as search costs, are not imperfections that one can tag onto an otherwise perfect market, but are endemic, part of how markets work. Markets require coordination to deal with differentiated and dispersed knowledge and transaction costs. Those are not market imperfections but part of markets, and the basis for discovery. Also, product differentiation is not an exception but the rule.

> Gasoline in itself is as homogeneous as a product can get. Yet it is differentiated by means of logos and colour schemes of gas stations, projecting different images of being sportive, 'green', science based, etc., and with discount, bonus and gift schemes, loyalty cards, goods sold at gasoline stations, etc.
>
> As argued by Anderson (2006), Internet and related technologies have enormously expanded opportunities for product differentiation. Much market thinking is still oriented towards the idea that only large volume sales are efficient, in view of the per unit cost of packaging, transportation, advertising, shelf space in shops, and search by consumers. However, since Internet started to dramatically reduce or even eliminate those costs, enormous opportunities have opened up to radically differentiate products, since very small volumes of sales now become economically feasible, opening up very small market niches. This 'fattens the tail' of the distribution of sales: very small volumes of demand that previously could not be served now can be.

What mainstream economists call rigidities to some extent are not only unavoidable but indispensable for markets to work. One example is that markets need communication and communication needs a certain stability of meanings, whereby new meanings tend to be ignored. Similarly, for technology to work one needs technical standards and those also need sufficient stability. In other words, to some extent efficiency requires orthodoxy. Interactions in markets require a certain reliability of behavioural expectations, on the basis of rules or norms of conduct. That entails rigidity. More generally, institutions, defined as enabling conditions for action, can work only if they cannot instantly be changed by that action. But enabling conditions are inevitably also limiting conditions. Hence institutions inevitably yield rigidities. Another example is that in many cases, investment for productivity and innovation require investments that are specific, i.e., that cannot (efficiently) be employed for alternative uses, and require a certain stability of activity to recoup the investment, or else they will not be made, thus sacrificing opportunities for productivity and innovation. In other words, they cause switching costs and when it is costly to switch one needs some stability, i.e., rigidity.

Furthermore, in the new perspective intense price competition can eliminate the slack in resources and time that are needed for exploration and coordination required for innovation. There should not be excessive competition that hampers the viability of the process of change. This will be discussed in more detail in chapter 3. In sum, what in mainstream economics are seen as virtues of market mechanisms are seen here as possible obstacles, and what are seen there as obstacles for markets, are here seen as features of their functioning.

> "the imperfections identified in the market failure approach, therefore, can be viewed in a different perspective, as integral and necessary aspects of the production and the dissemination of knowledge in a market economy" (Metcalfe 1998: 114).

Now we are facing a puzzle. On the one hand this perspective says that what mainstream economics sees as imperfections of markets are not imperfections but the very stuff markets are made of. The crux of markets is not optimal allocation given perfect information, but the utilisation of profit opportunities from imperfect information and differences in knowledge and competence. It also says that markets can be too perfect, in the sense that extreme price competition can eliminate conditions for innovation. On the other hand, it agrees with the old view that markets are needed and that some market failures can obstruct innovation. The paradox can be resolved.

First, in the new view the notion of public goods and services still applies. If knowledge is dispersed, asymmetrical, and cumulative, yielding limited absorptive capacity, this means, in effect, that it does not spill over so easily. This means that it becomes more excludable, and its returns become more appropriable, so that the market failure concerning knowledge as a public good has less force, and less policy may be needed, in that respect. In other words, limitations of market operation through rigidity in the form of imperfect spillover limits market failure that discourages investment in knowledge. However, there can still be spillovers to a greater or lesser extent, and appropriability of innovation can still be a probem.

Second, in the new view one can still maintain that markets function better than central planning (see Hayek 1945). The reason may be different – based on the idea of dispersed knowledge, rather than optimal allocation – but the conclusion is still the same. In other words, the coordination required should be left as much as possible to decentralised actors that have the local knowledge.

Third, one may still agree that competition is needed. Here again, the reason may be different, based on the idea of selection in an evolutionary process, to select from the many trials and errors that emerge from a diversity of views and knowledge, rather than efficient allocation of scarce resources, but again the conclusion is still the same. One can still agree that entry barriers that obstruct entry of innovators and 'challengers' are to be prevented or lowered. Not so much to increase efficiency of allocation, but to give room for innovation. In evolutionary terms: to open up the selection environment.

Fourth, one may still agree that while certain rigidities are inevitable and indeed enable markets, they can become excessive. We should look for optimal or temporary, and hence 'flexible' rigidities (Dore 1986) that provide the basis for investment for productivity and innovation while not eliminating variety generation and selection, maintaining openness to new ideas, products, processes and institutions. This issue of how to combine rigidity and flexibility, which is a manifestation of the ancient problem of stability and change, will re-appear later in this book, in chapter 3, as the problem of combining exploration and exploitation. It is arguably the most fundamental issue in innovation policy and research.

6 Innovation Policy

Science and technology policies emerged in the mid-twentieth century, triggered by the challenges of World War ii and the subsequent Cold War (e.g., the space race) (Lundvall and Borras 2005). These policies were focused upon universities, research institutions, technological institutes, and r&d laboratories (see Bush 1945). In subsequent technology policy, emerging in the 1960s, attention was widened from knowledge institutes to sectors of the economy using and producing technologies, and linkages between them and knowledge institutes. A classic issue that is still with us, is to what extent universities should produce knowledge for industry or remain autonomous. In some eu countries technology policy has led to the promotion of industrial complexes, connecting public users and segments of industries, and 'national champions' in selected industries. Later, such industrial policies were seen to evoke too much public involvement in private interests and to detract too much from market mechanisms. Since the 1990s, policy was further widened to include additional actors in the 'innovation system' such as, in particular, entrepreneurs, but also users, and the public with its perceptions of technology. Also, policy opened up to non-technological aspects of innovation – such as design, marketing, and organisation – and innovation in and by services. According to Lundvall and Borras (2005: 612):

"The major reason for innovation policy becoming more broadly used as a concept was the slow down in economic growth around 1970 and the persistence of sluggish growth as compared to the first post-war decades. The reasons for the slow-down in the growth in 'total factor productivity' were, and still are, not well understood but there was a feeling that it had to do with a lack of capability to exploit technological opportunities".

In the Netherlands in the 1950s policy was oriented towards reduction of unemployment and regional backwardness, for the sake of equity (Raspe and Van Oort 2007). In the 1960s policy was more oriented towards growth potential, but in the 1970s, during an economic slump, policy again became more defensive, protecting firms and regions. In the 1980s, based on a report from the Nether- lands' Scientific Council for Government Policy (wrr 1980), policy became more offensive again, orienting itself towards 'picking winners' in new growth areas, focusing on technological change, and innovation, in 'arrowhead' sectors. In the 1990s the strategy shifted, with more attention given to knowledge, networks and clusters, in the transition from an industrial to a knowledge economy, with a role for the government as a broker in relationships. More recently, attention has shifted from picking winners, with the recognition that it is at odds with the unpredictability of future success, as indicated by an evolutionary perspective, to 'backing winners' that have demonstrated their viability in market success (awt 2003).

Radical, path-breaking innovation is rare, and most innovative activity lies in incremental innovation, diffusion, and imitation. A key question that is asked in policy is where we should choose to lead, creating radical innovation, and where to follow. Should we 'pick winners' or 'back winners', or are both choices problematic? If radical, path-breaking, paradigm-switching innovations are indeed

rare, relative to incremental innovation, diffusion, and imitation, one should expect a small country like the Netherlands to be a leader, in the sense of creating those radical innovations, only in few cases, compared to a mass of imitations and improvements. Why would one want to be a leader rather than a follower in the first place? In early stages of innovation, which carry an emphasis on product innovation, profits are higher, allowing for higher real wages, while in later stages competition increases, there is a shift to process innovation, and prices fall (Free- man and Perez 1988). As a follower one benefits only from the latter, while as a leader one benefits from both. This issue is taken up further in chapter 3. There may be other advantages to being a leader, such as being able to set a technical standard that fits established assets and competencies, while as a follower one may have to accept a less congenial standard.

Given that one cannot be a leader everywhere, where, then, should one choose to be a leader and where a follower? Is such a choice possible, or is leadership an emergent phenomenon that cannot be planned? We note that also followers need to build and maintain absorptive capacity, needed to implement what leaders have created. In other words, even as a follower one would still need to have a basis of knowledge and skill, in research and education, which is sufficiently broad not to miss out on opportunities to be a follower, and sufficiently deep to be a fast follower. Nevertheless, the question remains where to be a leader and where a follower.

> Note that the requirement to develop absorptive capacity, in order to be a follower, yields an argument for the policy of protecting an economy from world trade until it has built up absorptive capacity, because otherwise it will loose out on both leadership and followership. Here, absorptive capacity includes not only cognitive capabilities, based on education and research, but also physical and institutional infrastructure, health care, basic industries supporting transport and communication, and a variety of business services needed, among other things, to reduce transaction costs. After World War II this build-up occurred in Europe with the aid of the Marshall Plan. China and India are growing now, and are developing from followers into leaders, after many years of protective policies to build up a basis of absorptive capacity.

Here, a perceived urge arises for policymakers to make a choice, on the basis of expected unique strengths in the future ('picking winners'), or to enhance strengths that have been proven in the market ('backing winners'). As noted above, the former approach was taken, in the Netherlands, in the 1980s, with a choice of 'arrowhead' sectors, and the latter policy is taken now, with the choice of 'key areas'. Picking winners is now recognised as going against the unpredictability of future success, emphasised by an evolutionary perspective. But for backing winners the question is why they should be backed if they are winners. If they have been proven in the market, surely this means that they are generating profits for their own expansion. We will pick up the issue of targeted industrial policy again in chapter 12.

Whither innovation policy?

The Austrian and evolutionary views have yielded a perspective of 'innovation systems'. Originally this was a purely descriptive, analytical category: innovation arises from interactions, of both competition and collaboration, between a multiplicity of individual and corporate actors, in science, industry, and government, and interest groups, conditioned by historically and regionally or nationally specific institutions (shared habits, norms, routines, established practices, rules, and laws). Innovation requires not only science, technology, and entrepreneurship, but also finance, education, training, and a variety of institutions concerning property rights, standards, competition, and disclosure. Next to these supply factors, advanced users are also of the utmost importance. Organisation, within and between organisations, conditioned by institutions, plays a central role. Innovation is conditioned by institutions but also causes institutional change. For recent summaries of the system view, see Borras (2003) and

Chaminade and Edquist (2006). The system view has been adopted by many innovation scholars, the oecd, and in the Netherlands by the Dutch Advisory Council for Science and Technology (awt) and, more recently, by the Innovation Platform instituted by the Netherlands government in 2004. One policy implication of the system view is that policy should be based on an 'integral perspective', taking into account diverse actors, institutions, and linkages between them (Edquist 1997; awt 2003, 2007).

Systemic coherence of factors arises on the level of the entire innovation system, but also in parts of it. Take finance. Venture capital is needed to supply capital for entrepreneurial ventures that banks are too risk averse to supply. Even venture capital mostly fails to provide 'seed capital' at the early start of new ventures. For this one has to fall back on friends, family or 'business angels', who themselves are mostly successful entrepreneurs who have cashed in on their own successful ventures. They are not in the position to coach firms along the full trajectory of development, and require venture capital to take over or pitch in after the early start. Venture capitalists, in turn, want to exit after the venture has proven itself, and require stock markets to capitalize successful ventures, or private equity funds or firms that acquire them. Venture capitalists need to acquire their funds from institutional investors (pension funds, insurance companies), banks and private investors. Thus there is whole supply chain of finance. All the contracting involved requires appropriate legal forms and services. Hellman (2000) reports that in the US the SBIC programme, instituted to help private markets to supply capital to new entrepreneurial firms, played an important role in getting the venture capital business under way. Thus there is a whole web of firms and institutions that makes the finance subsystem work. It is an important part of innovation policy to make it work.

Innovation is a distributed phenomenon, even from the single firm's viewpoint. As a matter of fact, most innovations are the result of new forms of coordination among several firms and institutions rather than of the independent actions of single dominant innovating firms. In this light, particularly important is how the innovating firms acquire, accumulate, and develop knowledge other than scientific and technical knowledge which is material to innovation, (namely) knowledge about the specific characteristics of customers and markets, which in turn has wider connections to knowledge about economic, social, and regulatory changes (Metcalfe 2000). Such coordination among firms and institutions in the innovation process is a core element of the innovation system literature, with its core assumption that a number of organisations (such as research institutes, educational facilities, and financial organisations) provide complementary inputs essential to the innovation process (Edquist 1997).

The distributed, network nature of innovation is particularly pronounced in services, which often perform a linkage function, and in the increasing intertwining of manufacturing and services, in the combination of technology, design, marketing, distribution, organisation, the involvement of users and suppliers, and learning by interaction. In the past we were inclined to see innovation as technology, and a given technology as being related to a given industry, so that innovation policy is prone to be given the form of industrial policy. Now, we see innovation as a phenomenon of chains and networks that run, in principle, criss- cross through all industries. This has important implications for policy, in particular the debate on 'key areas', which will be taken up in chapter 12.

Metcalfe (2003) argues that (innovation) system failure should be taken as a starting point for policy intervention, instead of conventional policy, which is preoccupied with market failure and optimal policy. Again, this is not to say that the relevance of market failures for underpinning innovation policy is denied. On the contrary, poor access to information, for instance, should be tackled by policy intervention, but it requires additional policy actions to be effective. The objective of innovation policy is to encourage and facilitate the generation, application, and diffusion of new ideas. The government might directly intervene, through the supply of r&d, education, and capital that match the need of local firms, andwhich increase the absorptive capacity5 and innovative capability of firms. Public policy can also stimulate the effective transfer of knowledge through various mechanisms, such as spin-off dynamics, labour mobility, and collaborative networks (see chapter 11).

For innovation, there are system failures of many kinds. One is the condition of inconsistencies between different parts of a system innovation, or clashes of interest and stalemates among multiple stakeholders involved. Examples are given in chapter 6. System failures also include institutions that often were func- tional in previous stages of development but now hinder radical innovation.
Examples are distribution channels, forms of organisation, standards, physical infrastructure, educational structures and programmes, political views, social practices, modes of thought, and ways of looking at the world, which developed to suit earlier changes of technology, products, tastes, and styles. Strong forces of social legitimation enforce conformity to established views and practices. In evolutionary terms, the selection environment, with its market structures and institutions, in due course moulds itself to suit successful breakthrough innovations that have diffused, and then can form a powerful obstruction for the next radical innovation. In other words, there is co-evolution between markets and institutions. Systemic coherence between different elements of the selection environment obstruct piecemeal deviations.

A problem for policy is that often market and system failures are case-specific, and are difficult to cover with a generic, one-size–fits-all policy. For example, when an innovation is competence-destroying, or when it does not fit the installed base of assets of powerful incumbents, the conservative force of established interests is clearly greater than when such conditions are not present. Some innovations entail more externalities, and thus require more government intervention, than others. Some innovations require more change of standards, educational systems, distribution channels, or forms of organisations than others. When price elasticity is low, established firms are less inclined to go for cost-reducing innovations, since they will yield few extra sales, whereas new entrants that can gain market share are more motivated to enter with the newest technology (Langlois and Robertson 2005), so that there is more need to make room for entrants.

Thus, there are good arguments against laissez faire, and in favour of specific policy interventions. However, in time, among some innovation scholars the innovation system perspective has developed from a purely descriptive category to a normative one, with ambitions not only to eliminate system failures but also to design and govern the system. Recognition of systemic coherence developed into ambitions for systematic design. While we accept that system failures occur, and government should address them, we are very wary of top-down system designs. The perspective of innovation systems is still very general and little-developed in terms of the causalities involved in the processes of interaction between the various actors, as is recognized in the literature (Borras 2003, Chaminade and Edquist 2006). It is a frame of a painting that mostly still has to be painted. It might even be said that the innovation systems approach is a rather vague frame- work within which to speculate on some possible relationships between hypothetical actors at a vaguely specified level of abstraction, and that it consequently has only very limited utility for guiding innovation policy; theory has even been led by policy, not the preferred other way around (see for example Lovering 1999; Hers and Nahuis 2004).

7 Outline of the Book

We proceed with a macroeconomic analysis of innovation as a source of productivity, and we confirm the idea that we need to delve further into the micro-level (chapter 2). For that, we start with an analysis of knowledge and learning (chapters 3 and 4), and proceed with an analysis of entrepreneurship (chapter 5), obstacles to innovation (chapter 6), institutional conditions for trust to support learning by interaction (chapter 7), forms of organisation (chapter 8), conditions or innovation within organisations (chapter 9), network structure as organisa-tion between organisations (chapter 10), and properties of regional systems of innovation (chapter 11).

Each chapter ends with implications for policy. These policy implications are primarily for public policy, but secondarily also for policies of firms and other organisations in the private and public sector. The latter implications, oriented towards industry, are still relevant for public policy with a view to the diffusion of best practices, which applies to organisational innovation no less than to technological ones. The final chapter integrates the insights from the preceding chapters and discusses policy implications.

The occasion for the production of this volume was a study on innovation policy produced for the Dutch government, and thus has a Dutch orientation and flavour, both in the selection of illustrative cases and in the reference to existing innovation policy. However, the analysis of micro-foundations, and types of policy are, we expect, more generic and also of interest to policymaking elsewhere.

In a little more detail, the further content of thos volume is as follows:

In chapter 2, Gerard de Vries presents a macroeconomic diagnosis of the Nether- lands, in comparison with other eu countries and the us. As is customary in macroeconomics, the core of this is an analysis of total factor productivity and an attempt to understand its development. The conclusion is threefold. First, the declining growth of total factor productivity indicates the need for enhanced innovation. Second, there are some indications that the Netherlands could perform better in a number of relevant dimensions of innovation. Third, apart from this broad diagnosis, macroeconomic analysis does not help us much further in the design of innovation policies, and for that we must proceed further into micro-foundations, in the analysis of processes of interaction between relevant agents, in the innovation system.

In chapter 3, Bart Nooteboom discusses, criticises, and extends the evolutionary perspective of innovation. While that perspective is very useful, and yields some important policy implications, it is also limited in that it does not provide a theory of discovery or invention. To compensate for this, he brings in elements from theories of cognition that underpin learning as a process of interaction.

The need and difficulty of combining exploration and exploitation is identified as a key and pervasive issue. A model is applied of how exploration and exploitation may build upon each other, in a 'cycle of discovery'. Insight into processes of innovation by interaction are further developed by means of the notion of 'optimal cognitive distance'. The chapter ends with a call for an innovation policy that is open in four dimensions: open with respect to collaboration, with open communication; open for surprises and changes of direction during innovation projects; open to new players ('challengers'); and open to global linkages.

In chapter 4, Gerrit Kronjee and Bart Nooteboom discuss the creation and application of knowledge, in particular the role of universities, science policy, and the relations between university and industry.

They discuss the necessary openness of innovation to variety and surprise in r&d. They argue that while efforts to apply scientific knowledge, and to indicate priority themes for research are valid, autonomy of fundamental university research should be preserved. There is a natural division of labour between universities and institutes of higher vocational education, with the latter focusing more on applied research, and they should obtain the means and the authority to do so. Institutes of higher vocational education are a natural ally for knowledge for smaller low-tech firms. For the interaction between university and large firms and high-tech small firms ideas are proposed to further activities of exploration between them, in a 'thirdspace' of activities, to support industry in activities of exploration and for universities to test their ideas and to gain inspiration for fundamental research.

In chapter 5, Erik Stam discusses the nature of entrepreneurship and its relation to innovation. He addresses the necessary openness of innovation to outsiders and challengers. An overview is given of theory and empirical research on the effects of entrepreneurship on innovation and economic growth in oecd countries. An in-depth study is made of entrepreneurship and innovation in the Netherlands from an international and historical perspective. This study shows that the annual number of new firms has increased spectacularly (almost tripled) during the period 1987-2006. However, the study shows more weaknesses than strengths with regards to entrepreneurship. First, a large part of the new firms seem to be self-employed individuals who continue with the same activities (mainly in the construction and services sectors) they they had executed as employee before. This is not likely to improve the (product) innovativeness of the economy. Second, on average small- and medium-sized enterprises (smes) have become less and not more innovative in the last decade (1999-2007).

The percentage of innovative smes is much lower than the eu average. Third, the Netherlands are lagging behind internationally with respect to ambitious entrepreneurship. The low number of ambitious entrepreneurship seems to be especially worrying, as such entrepreneurship is a strong driver of national economic growth. The chapter continues with the role of entrepreneurship in innovation policy. Several specific types of entrepreneurship – technology start- ups, spin-offs and corporate venturing, and high growth start-ups – are considered.

In chapter 6, Leo van der Geest and Lars Heuts discuss four Dutch cases in which innovation ran up against obstacles, and the policy implications. Thus, like chapter 5, this chapter addresses the issue of openness of systems and institutions to novelty. The cases are: energy from windmills and other alternative sources, an electronic patient dossier, a 'whisper' coach, and energy neutral houses. These cases give insightful examples of obstacles to innovation in general, and of system failures in particular, where there are several stakeholders that each have excellent reasons not to make the move they would need to make in order to set the system going. Later, in chapter 12, this results in the ideas of a 'deblocking brigade' and an 'ombudsman for entrepreneurs'. The deblocking brigade should help to unblock difficult stalemates among stakeholders in ways that only the government can do. An ombudsman for entrepreneurs should help entrepreneurs through the density of rules and regulations, and monitor complaints against obstacles from inconsistent or excessively complex institutional arrangements, and against obstacles from vested interests.

In chapter 7, Bart Nooteboom considers the governance of collaboration for innovation, within and between organisations, in particular the meaning, dimen- sions, conditions, and limits of trust. He addresses the openness of innovation to collaboration, within and between firms, and the corresponding need for open communication. He considers the role of government in facilitating trust and collaboration, and the implications of governance for the structure of networks and regional 'clusters'. One conclusion is that a mentality of excessive control has developed, in both public and private organisations, for the sake of ‘accountabil- ity’, that is detrimental to trust and excessively risk-averse, de-motivating, and constrains discretion of professional judgement as well as innovation. Another conclusion is that while in the emerging network economy there is a growing demand for go-betweens to facilitate collaboration, government should be careful in assuming that role.The development of a new branch of commercial serv- ices is to be preferred. Yet another conclusion is that policy should switch from a rhetoric of maximum flexibility of relationships, in labour and corporate gover- nance, to a perspective of optimal flexibility that allows for minimum stability of relations to evoke investments in mutual understanding and trust.

In chapter 8, Bart Nooteboom and Robert Went discuss an important aspect of ‘social innovation’, in particular the relation between innovation and organisation. They further develop the issue of openness of innovation with respect to relation- ships within and between organisations. They look at both organisation for inno- vation and innovation of organisation. They consider conditions for work, forms of organisation to meet the central challenge of combining exploration and ex- ploitation, platforms for serving customers, the role of users in innovation, and ‘open source communities’. They also look at the scope that this, in particular the notion of platforms, yields for innovation in government services. Much of this is enabled by ict and Internet. They see a large and largely untapped potential for im- provement of quality and increase of productivity. This untapped potential might explain the lag in productivity behind the us, identified in chapter 2. In policy to promote social innovation one should beware that also the urgency and relative ease of exploitation tends to crowd out attention and resources for exploration.

In chapter 9, Neil Anderson and Rosina Gasteiger give a survey of the applied psychology literature on organisational conditions for creative teams. They address the openness of innovation with respect to collaboration and labour within organisations. For example, they look at the role of things such as work stress, autonomy, intrinsic motivation, trust, and type of leadership. This indicates that key dimensions of high quality of labour favour innovation, which yields scope for a coalition between employers and employees. A policy implica- tion of this is that labour should be closely involved in innovation policy, in both firms’ and public policy.

In chapter 10, Marius Meeus, Leon Oerlemans, and Patrick Kenis discuss inter- organisational networks for innovation. They address the issue of openness of innovation to collaboration between organisations, and the trade-off between openness and closure. They summarise the literature on relevant dimensions of network structure and their effects on innovation. They then try to trace what instruments of innovation policy affect which of the relevant dimensions of network structure. One conclusion is that few instruments appear to impact those dimensions, which opens possibilities for further design of policy.

In chapter 11, Ron Boschma discusses the evolutionary view in economic geogra- phy, and in particular the role of ‘related variety’ in regional growth. Among other things, he addresses the necessary openness of agglomerations to outside linkages, with other agglomerations, and to entry and exit of actors. He concludes that regional innovation policy needs to account for the region-specific context because it provides opportunities but also sets limits to what can be achieved by public policy. In doing so, it should neither apply ‘one-size-fits-all’ policies nor adopt ‘picking-the-winner’ policies. Instead of copying best practice models or selecting winners, policy should take the history of each region as a basic starting point, and identify regional potentials and bottlenecks accordingly. To avoid regional lock-in, it is crucial that public policy is open to newcomers and new policy experiments.

In chapter 12, Bart Nooteboom and Erik Stam give an integrated survey of conclusions. Innovation policy should take into account the radical uncertainty of innovation, and the impossibility to predict and plan success. It should tap into the variety of ideas and initiatives in society. This is not, however, a traditional laissez faire policy.. Policy should condition, enable, and stimulate sources of variety, in ideas and ventures, remove obstacles, and coordinate where necessary. In addition to traditional arguments of market failure there are also system fail- ures that require intervention. But in intervention we should take into account government failures. These principles and the four dimensions of openness are used to discuss policy implications. In particular, the following major issues are addressed:

How can we manage the combination and tension between exploitation and exploration, and stability and change, in research and in the relations between university and industry, in the organisation of firms and government, and in inter-organisational collaboration and networks?

Can we determine where, in innovation, a country should be a leader and where a follower. What are the merits and drawbacks of the current policy of 'backing winners'? Can such choices be made while maintaining openness to outsiders and challengers?

How can we further improve openness for entrepreneurs, and deal with obstacles, in market and system failures? How can this be done while taking into account government failures?

How can we provide openness for surprise in innovation projects and processes? In government-funded projects and programmes, can we switch from ex ante safeguards that lock away innovation to ex post accountability that allows for changes of direction?

How can we organise openness for collaboration and communication, in alliances and networks? What is the role, and what are the limits of trust? How to combine trust and transparency? What are the effects of network structure?

How can we combine the strengths of the local with the need for openness to the non-local and the global, in organisations, networks, regions, and coun- tries?

Notes

It is not clear, however, what defines 'the challengers': are these all new firm entrants, also including foreign direct investments, or only new firms that have reached a substantial size and are really able to challenge incumbents?

However, evaluations of the Dutch wbso program (r&d subsidies) found that this triggered additional private investments of 2 to 94 percent (Brouwer et al. 2002; De Jong and Verhoeven 2007).

We adopt only part of Hayek's perspective: the heterogeneity, dispersion and local nature of knowledge. We do not adopt Hayek's view of laissez faire. What Hayek neglects is the social, interactive nature of knowledge, and the resulting importance of interaction, which encounters obstacles and system and institu- tional failures that often require government action.

The oecd (1998: 102) has defined 'systemic failures' as mismatches between the components of an innovation system. More specifically, it refers to a situation in which organisations, institutions, or interactions between elements of the innovation system are inappropriate or missing (Edquist 2001).

As noted earlier, investment in education/human capital might be necessary to improve the absorptive capacity of firms, in order to use new technologies in the production process (Bovenberg and Theeuwes 2004). A lack of investments in education can be seen as institutional failure, instead of market failure (Boven- berg and Theeuwes 2004).

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Collaboration, Trust, and the Structure of Relationships

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Introduction

The literature on 'open innovation' and the analysis in chapter 3 recommend collaboration between organisations as a source of innovation. Dutch and eu innovation policy, on all spatial levels (regional, national, supra-national), have caught on to the trend of 'open innovation', in the stimulation and even organisation of collaboration, networks, and local 'clusters'. However, collaboration is often risky and difficult, and frequently fails. So, we need to consider the governance of collaborative relationships.

This, I propose, entails a shift in the notion of governance. Traditionally, concepts of governance have been oriented towards control. The World Bank defined governance as the way in which power is exercised, the undp defined it as the exercise of economic, political, and administrative authority, and the oecd defined it as the use of political authority and exercise of control (Weiss 2000). In a world of relationships and networks for collaboration, approaches of implicitly or explicitly unilateral control, authority and power are no longer adequate, because there is no central authority or controller. The economic perspective of 'principal-agent' relationships and the business perspective of 'marketing warfare' have become counterproductive. In relationships of collaboration, players are each others' agents as well as principals. Operation in markets is not warfare but alliance management. Governance in networks must be multilateral, in equilibration of power or dependence, somehow. If we can still talk of control, it must be mutual control.

It is routinely recognised that collaboration requires trust. Especially in innovation, uncertainty is too large to allow for complete contractual control. The uncertainty of innovation makes it difficult to foresee what needs to be contracted for (tasks, rights, duties, penalties, responsibilities, goals, competencies), the novel opportunities that will require a change of direction, the pressures that may tempt people to renege on commitments, and the avenues avail- able to conduct such escape. Beyond technical uncertainty for contracting, there is the more fundamental uncertainty in exploration, or in 'interpretation' as Lester & Piore (2004) called it, that goals, means, and their causal connections and resource requirements are not yet known, so that the actors involved must take the time to deal with ambiguity, and to iterate between goals and means, without knowing where they will wind up. Here, one must resist inclinations or pressures to go for the quick fix of doing what is known, arguable, and measurable. Acceptance and utilisation of such uncertainty in the form of ambiguity of goals and means requires trust.

However, while there is widespread recognition of the importance of trust for innovation, it remains unclear what the meaning, conditions, and limits of trust are. Trust is a complex notion that has caused much misunderstanding and confusion. What do we mean by trust, what is the basis for it, and what are its limits? What is the relationship between trust and incentives? The unravelling of trust requires some space, in this book, since an understanding of trust is needed for insight into collaboration within organisations, which forms the micro-level structure of innovation systems (analysed in chapters 8 and 9), and in collabora tion between organisations, in networks and clusters, which forms the meso- level structure of innovation systems (analysed in chapters 10 and 11). Conditions for building trust depend on network structure.

The analysis in this chapter has implications for policy, in particular the issues of whether and how government should pick economic activities and design or facilitate their configuration. There are several different aspects to these issues, which are not all taken up in this chapter. Here, we focus on the role of brokerage in building trust between actors: is this a role for government?

Trust in whom and what?

First, what is the object of trust: to what sorts of things does trust apply? We can trust objects, but trust becomes more complex when we trust things that have intentionality, such as people, organisations, institutions, and socioeconomic systems, in 'behavioural trust'. In collaboration between organisations people need to trust the people they are dealing with, as well as their organisations, and relevant institutions, such as legal systems, that regulate ownership, contracts, etc. If we trust our personal contacts, but they do not enjoy the support of their superiors or associates, such trust is not very reliable. Vice versa, we can trust an organisation, perhaps because of its reputation, but if its trusted policies are not reliably executed by its personnel, such trust is also not very reliable. In the case of small firms one may go a long way with trust in the owner-entrepreneur, but in larger organisations we should be able to trust the people, the organisation, and the relations between them. Those relations depend on the positions, roles, and functions of people, organisational procedures, and organisational culture. Commercial organisations may come under commercial pressures to renege on commitments. Public organisations can be benevolent and have integrity, but their conduct depends on politics, which can be volatile. Civil servants with high personal integrity can be institutionally unreliable. In government there are many horizontal, vertical, and lateral connections relevant for trust.

The next question is in what, i.e., what aspect of conduct, we can trust. We can have trust in competence, i.e., the ability to act according to agreements and expectations. We can also have trust in intentions, i.e., the will to act 'properly', with attention, commitment, and benevolence (no opportunism, no cheating, no free riding). The distinction between competence and intentional trust is important. When something goes wrong because of lack in competence, we react differently from when something goes wrong because of opportunism, or because of neglect or lack of care. In the first case we can invest in an improve- ment of competence |(e.g., by training, advice, and help) while in the second case we may tighten a contract. We can trust competence but not intentions, and vice versa. If it concerns a partner in collaboration, we should be able to trust both competence and intentions. If it is an adversary, and we do not trust his intentions, we hope he is not very competent. Trust suffers from 'causal ambiguity': if something goes wrong we often do not know the cause, or even what exactly went wrong. It may be due to a mishap or accident, a shortfall of competence, lack of attention or commitment, or opportunism. This causal ambiguity has serious consequences for dealing with trust, and in particular for the openness needed for trust.

Trust and Control

What is the difference between trust and control? Can we speak of trust when reliable behaviour is enforced by contract or hierarchy? And if it is based on mate- rial incentives such as profit? If we take trust broadly as the expectation that, for whatever reason, 'things will be all right', despite risks of dependence, then control is part of trust. Is this what we mean by trust, or can we speak of trust only when control no longer applies? Are people trustworthy not because they are forced or rewarded, but because they choose on the basis of the intrinsic motivation of ethics or solidarity? Then trust is to be defined as the expectation that 'things will be all right' even if the partner has both the opportunity and an incentive to cheat. Trust then entails that we do not assume that partner will defect as soon as he sees a more profitable opportunity ('exit'), but that he will give us a chance to jointly improve the relationship ('voice'). To avoid confusion, I (Nooteboom 2002) proposed to speak of 'trust' and 'trust- worthiness' only beyond control, and to employ the terms 'reliance' and 'reliability' when there is also or is only control. In other words, reliance can be based on trust, control, or a combination of the two.

Trust may be based on psychological mechanisms that move people to trust or distrust others (causes of trust), and on a rational assessment of trustworthiness (reasons for trust). Even while trust is often based on information (one has good reasons to trust), there is never certainty concerning future conduct. This uncertainty needs to be bridged by a 'leap in the dark' and willingness to extend the benefit of the doubt. It is very fruitful to employ insights from social psychology into the non- or partly rational motives and decision heuristics that lie behind trust and trustworthiness (Nooteboom 2002), but in the following we focus on the rational reasons why people may be reliable. A survey is given in table 7.1 In the two columns of the table reasons for reliability are categorised on two levels: within a relationship (micro) and in the institutional environment of the relation- ship (macro). A distinction is made between control and trust.

One form of control is opportunity control. Here action space is constrained, either by legal contracts (macro) or by hierarchy (micro). Another form of control is incentive control, where actions are elicited by rewards. Within a relationship this can be due to dependence: when a partner is more dependent he is more inclined to take my interest to heart. This can be due to the unique value that I offer to him, or due to his relation-specific investment in the relationship. The latter notion, derived from transaction cost economics, suggests that the investment has (full) value only in the specific relationship, and when the relationship breaks an investment has to be made anew in another relationship, which entails switching costs. Also taken from transaction cost economics, the partner may also be dependent because I own a hostage from him: something that he values but that I do not, which I can destroy without hesitation when the partner defects. This can take the form of a minority shareholding that may be sold in the hostile takeover of the partner. Mostly, it concerns commercially sensitive information that can be surrendered to a competitor of the partner. Another form of incentive control is reputation. That also is a matter of self-interest: the partner behaves well, because bad behaviour not only jeopardises the focal relationship, but also the development of fruitful relationships with others.

Trust and trustworthiness need to begin where control ends, or control begins where trust ends. Trustworthiness can be the result of established codes of conduct, based on widely shared norms and values or habits. Within a relation- ship trust can be based on values and routines or empathy developed in the course of a relationship. Empathy is the ability to put oneself in the shoes of a partner to gain insight into his needs, views, expectations, fears, and his strong and weak points. This can lead on to identification, i.e., the experience of a shared destiny and a merging of needs and goals. For fruitful collaboration, identification is often not needed, and empathy may suffice. Trust and trustworthiness can also emerge from sheer routinisation, where things are taken for granted because nothing ever went seriously wrong. In identification and routinisation trust can go too far, where flexibility disappears and opportunities for innovation are missed.

Trust and control are both complements and substitutes. With more trust less control is needed. But since both trust and control have their limits the one may be needed where the other ends. Contracts should not be so strict, extensive, or adversarial that the basis for trust is destroyed. Trust can both precede and follow contracts (Klein Woolthuis et al. 2005). Excessive and strict contracting tends to obstruct the development of trust, but limited contracting can set a relationship going, and when trust grows contractual slack can increase. Without some prior trust one may not want to take the trouble and risk of crafting a contract.

A certain balance of dependence is generally desirable. Unbalanced dependence is not hopeless but it is more difficult to sustain. There is no need for balance in every single determinant of reliability, and imbalance in one may be offset by counterbalance elsewhere. If one partner is more dependent due to a greater share in specific investments, balance may be achieved by redistributing their owner- ship, or by offsetting the imbalance with another instrument, such as a hostage.

As discussed above, third parties or go-betweens can play important roles in the management of collaboration. A policy question is who plays such roles: (local) governments or private go-betweens in commercial business services? They can offer arbitration or intermediation in conflicts, but there are more potential roles to play. There is one aspect that merits special attention. As noted earlier, trust suffers from causal ambiguity: when something goes wrong it is often not clear what caused it. One can draw the wrong conclusion that the cause was opportunism, because that is what one fears most, while in fact there was merely an accident. But how can one know? When detected, opportunism may be masked as an error. A go-between may disambiguate the situation, explaining what really happened, eliminating misunderstandings, and side-stepping emotions due to fear and suspicion – which yield a vicious circle of mistrust that may escalate beyond repair – and propose remedial actions. Go-betweens can also contribute to an efficiënt and reliable reputation system by filtering just from unjust accusations of opportunism or incompetence and broadcasting the results. Go- betweens may be found at banks, trade or professional organisations, knowledge transfer agencies, or might be lawyers or private consultants.

There are limits to trust. While reliance can go beyond control, to include trust, the room for trust depends on pressures of survival. When a manager is pressured to catch any profit he can or else the firm will go down, his loyalty will likely lie more with his firm than with external partners, and he may be forced to renege on agreements with them.

In chapter 3 we quoted the proposition from Lester and Piore (2004) that competition can eliminate the conditions and resources needed for the 'interpretation' that is part of exploration. Here we see a specific aspect of that: pressures of competition can eliminate the trustworthiness needed for innovation.
Conditions and the role of government.

As indicated, there are various ways to manage relational risk for the sake of innovation. None of them is universally the best way, and a proper mix should be found to fit the circumstances. Table 7.1 offers a basis to find such a mix, where one must take care that different instruments complement and do not operate against each other. If appropriate external institutions (legal system, reputation mechanisms, shared norms and values of conduct) are lacking, the basis must be sought within relationships. If there is no basis for trust, one can only fall back on control.

Contracts make no sense in countries where there is no adequate legal basis, or where the police or judiciary are incompetent or corrupt. Contracts also make no sense if one cannot reliably monitor contract compliance, as may be the case in highly specialised professional work that does not yield a deliverable that can be judged. Reputation mechanisms are not automatic, and reliable go-betweens may not be available. If economic or political volatility is so high as to discourage a longer-term perspective in the development of trust, or pressures of survival are so harsh as to preclude solidarity, the only option may be to fall back on family, friends, or the clan, limiting the perspective for prosperity by division of labour, long-term investment and innovation from cognitive distance. There lies some of the tragedy of underdeveloped countries.

Thus, a primary task for government is to maintain an adequate institutional basis for trust and control (Nooteboom 2000). That is an important location factor, particularly for innovation. With a weak institutional basis for ethics and empathy, one will have to expend more on legal control and control by incentives, with corresponding monitoring. That is costly and bad for innovation.

While a certain amount of flexibility of relationships, in labour, ownership, and inter-organisational relationships, is needed for innovation, present market rhetoric that pleads for maximum flexibility goes too far. Relationships require a certain amount of investment in mutual understanding, intellectually and morally, to cross the cognitive distance that is beneficial for innovation (see chap- ter 3), and to invest in the building of trust. Such investments tend to be relation- specific, and by the logic of transaction cost economics this entails that relation- ships must be expected to last sufficiently long to recoup such investment. Hence we should aim for optimal, not maximal flexibility: long enough to warrant specific relational investment, but not so long as to produce rigidities.

Do governmental agencies have a task in the building or support of relationships for innovation? In present Dutch policy concerning 'key areas' (sleutelgebieden) the assumption is that such a role of government is indeed needed. Concerning the policy of key areas, there is much more to be discussed, and we will turn to these issues later, in chapter 12. Here we focus on the potential role for government as a go-between in building trust. As indicated in chapter 1, in the discussion of system failures in innovation, we can see reasons for that, and government may then use table 7.1 for an analysis of the situation and a choice of instruments. However, we also have reservations. In particular, governments should ask themselves if they are the appropriate actors to play the role of go- between. They should be aware of the dangers, which can also be seen from the table. Governmental agencies are more vulnerable to loss of reputation than most firms. Earlier we indicated that there are many connections between layers and chains of government, where distrust can spill over from one part to another (we took the chain of justice for an example). Also, actions, pronouncements and mistakes can be used as hostages, for blackmail, with the threat to publicise them unless demands are met. Government itself is more constrained than private actors in such naming and shaming. The government must be wary in building trust on the basis of personalised empathy and identification, in view of the risk of real or apparent corruption. In view of democratic accountability and transparency, governments must exercise more openness, which they cannot reserve only for preferred partners.

The possibilities are larger and the risks smaller for local/regional authorities than for central ones. At the central government level, distrust spills over more widely. Local government has better access to knowledge of local, historically grown specificities and peculiarities, and is better embedded in local reputation mechanisms. It can more easily offer a wider, integrated whole of subsidies, permits, location, housing, and facilities of schooling and training. The down- side, of course, is that precisely because of these conditions there is a larger risk of clientism or even corruption. All the more reason for central government to stay aloof and maintain supervision of decent local government.

Let us reconsider the case of Italy. The institutional shortcomings that left the need to fall back on network relationships opened up the opportunity for the mafia to move in, and for public servants and politicians to move in, in a mix of public and private relationships that easily evoke corruption. Anthony Pagden (1988) gave an analysis of the breakdown of trust in the kingdom of Naples in the 17th and 18th century, when it belonged to the Habsburg empire of the Spanish king Carlos and later Philips ii. The Spaniards opted for a cheap way to suppress the country from a distance, by breaking down the social structure and the culture of trust. In the Netherlands they had learned that sheer military suppression is costly and does not suffice, and that for control from a distance the institutions of a society must be broken down, in a strategy of divide and rule. The nobility was divided by creating a new, upstart nobility that owed its position to the Spanish masters. These were given the task of collecting exorbitant taxes, of which they could keep a large share for them- selves provided that it be spent on idle, economically useless and politically harmless activities such as duelling and the defense of personal honour. This destroyed trust in the nobility as defenders and personification of order and reliability. The critical role of the intelligentsia was destroyed by a relaxation of academic standards. Universities were obliged to continue the teaching of Aristotelian logic "because it never accounted for anything". Excessive attention to religious ceremony was required. Academic requirements for the legal degree were lowered, and the degree was also awarded as a token of honour to the upper class, which contributed to the undermining of the legal system. Arbitrary and unpredictable exceptions to legal rules were granted. Through the oversupply of incompetent lawyers their price was lowered, yielding an excess of worthless and inconclusive litigation. Social ties were replaced by mutual suspicion, and people were thrown back on themselves or close family. Trade became a game of mutual cheating. Exchange was reduced to immediate quid pro quo, without credit or investment. Gambetta (1988) showed how this breakdown of institutions as a basis for trust in the kingdom of Naples, which included Sicily, allowed In view of the difficult capability of competent support as a go-between, and the risks for government, both local and central, it is recommended to stimulate the emergence of commercial services of go-betweens, who may compete in the art of the go-betweenit. Some existing 'knowledge intensive business services', such as consultants in engineering, marketing, and finance are orienting themselves to this emerging market, but there are opportunities for new services that are more dedicated to the issues involved. The availability of reliable go-betweens contributes to the attractiveness of a country or region.

Transparency and Trust

As discussed in chapter 3, in innovation one should not try to do everything oneself, and one should utilise collaborative relationships with others, in 'open innovation'. That requires openness of communication, and many firms struggle with that, from fear that others will hi-jack knowledge in order to compete. As a result, in negotiation people are wary of openness. However, good negotiation is looking for the solution of problems for the partner that mean much to him and cost you little. If the partner acts in the same way, everyone benefits.

In teaching, health care, and other professional work there are increasing complaints of an excess of control that eliminates motivation and the room for action that are needed especially for innovation. Hence there is a call for less control and more trust. At the same time, people demand transparency, to enable trust, but what is the difference between transparency and control? If one demands or imposes transparency that is proof of distrust. But can one trust without transparency? Trust and transparency are both needed, and they both require and enable each other, but neither can be imposed: they must be earned. This requires 'voice' rather than 'exit' (Hirschman 1970). In voice one expresses one's weaknesses and fears, expecting others to react constructively, with the commitment to jointly solve problems. Only when that fails persistently one falls back on exit: one walks out, fires personnel, sells shares or a business, or forces a cabinet crisis. There are several reasons for voluntary transparency, but a condition is that the partner responds constructively.

One must give room to a partner to contribute his creativity and competence. One needs the partner because he knows or masters something that you do not. Then is is odd to pretend that you can tell him what precisely he must do, and that you can reliably monitor and assess his actions. Monitoring and control are limited by cognitive distance, which, as argued in chapter 3, is needed for innovation. That applies to firms as well as professional work in education and health care. Partners should be open in terms of what they want and expect, and in terms of what concerns or worries them: what dangers or risks they see, if only because otherwise the partners cannot know what they can do to help.

Within teams, in firms, or in inter-firm collaboration, openness requires 'psychological safety' (Edmonson 1999), i.e., the confidence that in reporting an error one will not be made a fool of in public. Further conditions for innovation in teams within organisations are discussed by Anderson and Gasteiger, in chap- ter 9. For instance, they report that "leader-member-exchange (lmx)" in terms of supervisor support, in relationships characterised by mutual trust and respect, is positively related to creative and innovative behaviour (Harrison et al. 2006).

In collaboration between firms, a danger that is often seen is that in openness you may surrender commercially sensitive information with which the partner can become a competitor, or which via the partner can reach a competitor, so that one cannot 'appropriate' the rewards for innovation. That danger may be real, but in innovation is often smaller than people are inclined to think. The issue there is not whether sensitive information reaches a competitor, but whether he can absorb it, i.e., understand and implement it in his organisation, given his knowledge, assets, and competencies, and whether he can achieve that so fast that competition is still effective. If by that time the knowledge involved is already superseded, there is no risk.

Nevertheless, in collaboration one is vulnerable to mishaps, mistakes, lack of dedication, and opportunism. As indicated earlier, that yields causal ambiguity: one does not know which is at work. And when something goes wrong people may all too readily jump to the conclusion that opportunism is at play, especially when the possible loss is large or when one has little self-confidence. In the 'Calimero syndrome' the weak or dependent are overly sensitive to risks and threats, and see bad will wherever something goes wrong. Given all this, openness is the best strategy. It is in one's own interest, when something is seen to go wrong, someone has not paid attention, or falls short in competence, to report this to the partner and to help to preempt the problem or solve it in an early stage. It is difficult to admit error, but in trying to hide one's failures one jeopardises one's own interests. When you don't report it, you are suspected of bad will when later the problem appears anyway, as it usually does. If it was an error and not bad will, why didn't you report it when something could still be done about it? Mistrust, once rooted, is difficult to eradicate. Trustworthiness must be shown time and again; untrustworthiness can appear from a single action. Hence the saying that 'trust comes on foot and departs on horseback'. Also, by remaining silent one robs oneself of the opportunity to learn, with the help of the partner, and that is what counts in innovation. If one doesn't like that, then one should not start a partnership for innovation.

Openness cannot be imposed, and must be earned by a constructive response to reports of error. Such reports are valuable, in order to repair the error and to prevent a repeat, in a shared effort, with pooled resources. If, on the contrary, an error report is used to impose guilt and punishment, then transparency will disappear, and we fall back on straightjackets of control that smother the movement and motivation of innovation.

Trust and transparency require empathy: the ability to imagine oneself in the position and perspective of the other, and to look at one's own actions from there: how would one interpret them, and how would one feel and respond? Empathy increases the ability to collaborate, in crossing cognitive distance. It aids insight into how to help the partner. It also reduces causal ambiguity: one can better see what is at play when something goes wrong. One can better foresee forced failures: how would one act if one were under the same pressures? Earlier we noted that trust has its limits due to pressures of survival. One may be forced to renege on commitments. However, one has the option to be open about that as well, warning the partner in time, and explaining one's predicament.

Earlier, we noted that the Netherlands has a tradition of deliberation, as part of political and organisational culture. Hence, one might expect that the Dutch are better at this game of openness, transparency, and trust. To some extent that may be the case, but like everybody else the Dutch are caught in the momentum of 'accountability' on the basis of strict and measurable performance on 'deliverables', in order to ensure control, which comes at the expense of risk taking, of room for professional discretion and experimentation, and of openness, which are all needed for innovation. This drive towards accountability by strict performance measurement is accentuated by considerations of efficiency, in that limited resources and time preclude the more time-consuming judgement of less-easily measured forms of quality.

In its subsidy programmes for innovation, in particular the 'Framework Programme' (fp) for collaborative research between research organisations and firms, the eu appears to be caught in an upward cycle of control that is becoming tighter, in the sequence of the fifth to the sixth and now the seventh fp. Earlier on, in fp5, eu programme managers were personally involved in the progress of projects. This allowed them to informally assess progress and problems, employing tacit knowledge, and to judge proposals for changes of direction as they emerged. Increasingly, they are being pulled out, and control has become more distant, and as a result more codified, explicit, and detailed, in the form of criteria, rules, and regulations. This has the adverse effect of increasing transaction costs, which is problematic especially for smaller firms, and reducing the flexibility needed to allow for the openness to surprises and unpredictable twists and turns that are characteristic for innovation.

Trust and network structure

The structure of networks has effects on innovation in two ways: on the compe-ence side (learning) and on the governance side (managing relational risk) (Nooteboom 2004). On the competence side, the number, diversity, density, centrality, and strength of ties have effects on the diversity and accessibility of network nodes as sources of information, and on the flexibility of making and breaking relationships between them. On the governance side, they affect conditions for trust and control, such as monitoring, reputation mechanisms, bonding, and coalition formation to constrain conduct.

On the competence side, Granovetter (1973) and Burt (1992, 2000) argued that dense and strong ties are bad for innovation, and more distant, weak, and less- dense ties generate the higher level of variety that is needed for innovation. This is related to the notion of structural holes, discussed in chapter 3. Bridging a structural hole taps into variety for innovation, but in dense networks there are no promising holes left. Dense and strong ties keep players from moving out and new players from moving in. Dense ties also yield redundancy: If you are connected to A and to B who are also mutually connected, one of the ties is redundant. If you only had a tie to A you could reach B through A. Since ties are costly to set up and maintain, this is more efficient. From the analysis of cognitive distance it follows that ties that are strong in the sense of durable and exclusive will in due course reduce cognitive distance and the dynamic potential of the ties. However, note that less exclusiveness yields greater density of ties. Gilsing and Nooteboom (2005), argued that in exploration, where knowledge is embryonic, density is needed for agents to complement their absorptive capacity (in the collaboration with A you also use B to help you understand A), and in order to 'hedge bets' concerning the availability of partners. If in exploration there is much volatility of entry and exit, you cannot count on partners yielding access to other partners, since intermediary partners may soon drop out, so that one must also have one's own, direct access to other partners. This also increases density.

Furthermore, in exploration the cost of maintaining a relationship is often less, and in any case in exploration cost matters less (than in exploitation), so that the cost of redundant relations matters less. An environment of multifarious interactions, in business and recreation, in 'local buzz', contributes to the utilisation of diversity on the basis of planned and unplanned encounters (Bathelt et al. 2004).

On the 'governance' side of relationships, Coleman (1988) argued that strong and dense ties enhance control and bonding. Strong ties, in the sense of high frequency and intensity, and long duration, yield shared experience, which reduce cognitive distance, and enable the development of empathy and identification.i Multifarious personal encounters, in sufficiently dense networks, can be indispensable for building trust, particularly in the more personal foundations of trust, such as empathy and identification. Business trustworthiness may be assessed in part by how people treat a waiter during a business lunch. Second, local 'buzz' may be needed for reputation mechanisms. Third, reliable, locally embedded go-betweens may help to forge and manage collaboration – in the bridging of cognitive distance and in the management of relational risks – and this is supported in a milieu that is rich in diverse and frequent interaction. To generate and utilise local buzz, opportunities for collaboration, and reputation mechanisms, networks in local clusters tend to be fairly dense, with many ties between actors. Ties also tend to be fairly strong, with frequent interaction, and investments in mutual understanding and trust. As indicated earlier, the building of mutual understanding and affinity, to cross cognitive distance and to build and maintain trust, requires investments that are to some extent specific to the relationship. In local networks an investment in a relationship will sooner have value in another local relationship, i.e., will be less specific, which encourages such investments. In so far as the investment is still specific its utilisation requires some continuity of the relationship or frequent interaction, which are both more easily achieved at a small distance.

These arguments confirm the value of agglomerations with fairly dense and strong ties between actors that offer related variety, at sufficient but not too large cognitive distance. However, earlier (chapter 3), from the cycle of discovery, we indicated the need for connections between local clusters and clusters elsewhere in the world: an outside avenue is needed for the processes of differentiation and reciprocation that yield exploration. Earlier, we also indicated that a lengthy and exclusive relationship can yield too large a decrease of cognitive distance, whereby its innovative potential dissipates. Then one needs either 'channels' out of the agglomeration, a lively entry and exit of new players, or a combination of the two, in order to replenish the variety of inspiration and insight, based on a variety of experience, and thereby maintain cognitive distance.

In other words, agglomerations should be open, with outside connections, domestically and internationally, to other agglomerations, and should promote entry and exit of firms. Concerning entry and exit, Knoben (2006) showed that for automation services the relocation of firms has a positive effect, especially in the longer term, on the innovativeness of firms.

Concerning external linkages, similar arguments were given earlier by others (Asheim and Isaksen 2002, Boschma and Lambooy 2002, Oinas and Malecki 2002). Here, we wonder whether perhaps universities can provide the connecting nodes of small worlds, connecting regional innovation systems to similar systems elsewhere in the world (Benneworth et al. 2006 Kitagawa 2005). Universities are geared to access such internationally dispersed communities. Combining the arguments for and against agglomerations with dense and strong ties, we arrive at a theoretical argument for what is called 'small worlds', illustrated in figure 7.1. There, different local networks with high density and strength of ties are mutually connected by less dense and weaker ties. The strong and dense local ties enable the utilisation of opportunities for novel combinations in related variety, flexible reconfigurations of ties, high joint absorptive capacity, and support governance by reputation, go-betweens, and trust building. On the other hand potential weakness due to lock-in, too much stability of ties, shrinking cognitive distance, and reduced variety, are compensated by much entry and exit of players and the weaker and less dense ties to other communities that extend the scope of variety and maintain cognitive distance.

In the development of small world structures we see a reflection of the phenomenon that the economic significance of the national level declines and that of the global and regional levels increases. That does not say that there is no role left for the national level. Perhaps its crucial role is to see to it that the connections between the regional and the global are indeed made. As an agglomeration increases to a larger size and diversity of activities, it can remain innovative longer without connections to outside agglomerations, although one may expect that it may then break up into a set of smaller agglomerations. In a small country, like the Netherlands, agglomerations will be smaller than for example in the us or China, and therefore especially in a small country the need for outside connections is great.

The analysis has implications for the dynamics of clusters or networks (Noote- boom 2006). As discussed earlier, in the early stage of exploration one would expect a relatively high need for local embedding, in strong and dense ties. Later, one would expect a certain amount of disembedding, to utilise the potential of emerging innovations in distant markets, and to achieve access to novel sources of novelty to replenish local variety and restore cognitive distance. This raises considerable complications for a policy for local clusters and regional innovation systems. Are policymakers able to correctly identify the stage of development that a local cluster is in, and are they able to implement policy on time, before development has reached the next stage, where the policy may be counter- productive? One may wind up furthering local embedding by the time that disembedding is needed.

In sum, we see a trade-off between central and local/regional government in the promotion of innovative clusters. Local/regional government is superior in its local knowledge and governance of embeddedness and related issues of infra- structure of various kinds – traffic, zoning, housing, education, and training – that have an impact on knowledge ecologies. They can intervene faster to ensure that intervention is in tune with the stages of development. However, local/regional government may get too entangled in local embeddedness, which may yield clientism or even corruption. There is a danger that an agglomeration might become disconnected from other agglomerations, cutting off access to sources of new knowledge, to complementary resources, and to distant markets. Local or regional authorities may try to keep firms locked into their regions or municipalities, thus obstructing healthy relocations. Central government has a role to monitor developments and to ensure outside linkages and disembedding where needed.

Conclusions

For collaboration, trust is needed, especially in exploration, where high uncertainty limits the scope for contracts and monitoring of contract compliance. To eliminate misunderstandings concerning the notion of trust it is useful to distinguish between reliance and trust. Reliance includes control, by contractual enforcement or hierarchy, and by incentives of dependence, reputation, and hostages. Trust goes beyond control, in norms and values of ethical conduct, and in routinised conduct and personalised empathy and identification. However, trust has its limits, which depend on pressures of survival. Intense price competition reduces the scope for trust, and hence is part of the overall obstacle that competition may present to exploratory activities.

Trust, openness, and voluntary transparency based on trust that openness will be met constructively, in a culture of ‘voice’, are needed to give professional work the autonomy and room that it needs to exercise the discretion of professional judgement, and the space needed for the experimentation of innovation. This requires a transformation of the current drive towards accountability on the basis of the strict measurement of ‘deliverables’ (even where the latter cannot be clearly specified), which can be detrimental to more difficult to measure dimensions of quality. This connects with earlier propositions, in chapter 3, concerning the inherent unpredictability, variety, and risk of innovation (particularly of exploration) that need to be accepted for innovation to take place. The connection between innovation and organisation, including the issue of accountability and performance measurement, particularly in the public sector, is further discussed in chapter 8.

Concerning the structure of networks for innovation, there are arguments in favour of dense and fairly strong ties, based upon considerations of both competence (learning) and governance (trust and control). However, such networks carry the danger of getting locked into insufficient variety, cognitive distance that is too short, and insufficient flexibility. To repair for that, and to complement local dense and strong ties, weaker and sparser ties to other, outside networks are needed, to yield a ‘small world’ structure. This yields a call for ‘open agglomeration’, i.e., an agglomeration that is open to outside ties, and to the entry and exit of players. This connects with our general call for an open innovation policy in chapter 3. Perhaps universities can play a role in providing such connections to outside sources of knowledge and expertise.

In current Dutch innovation policy, central government, having recognised the importance of collaboration for innovation, in its policy for ‘key areas’ goes quite far toward getting involved in crafting collaborative relationships between firms and knowledge institutes. Arguments for local embedding of such collaborative structures suggests that local authorities, with knowledge of local specificities and attuned to local reputation mechanisms, seem to be in a better position to do that. Also, local authorities are likely to be faster in identifying the stage of development that a local cluster is in, and faster in implementing a policy of embedding or disembedding that is appropriate to that stage of development. In view of the complexities of collaboration and of the relational risks and complexities of managing reliance and trust, the question is whether govermental agencies are equipped for this task, and whether they might become too involved, with risks of being taken hostage by private interests. Preferably, an increase in private sector go-betweens will occur to fulfill the emerging demand for go-betweens in the emerging network economy. If government does have to play the role, at least temporarily, local government appears to be better equipped.

On the other hand, the close involvement of local/regional government in local dense and strong ties carries a risk of clientism or even corruption. All the more reason for central goverenment to step back and concentrate on preventing that. Local/regional government may neglect or be unable to craft the outside linkages needed for open agglomeration, and may be tempted to try and keep firms from moving out when that is best for innovation. Central government has a role to ensure openness and outside connections. The role of networks is further analysed in chapter 10, and regional innovation systems are further analysed in chapter 11.

On the national level, we might consider opportunities for the Netherlands to develop into a ‘knowledge ecology’ for connecting exploration and exploitation on a global scale. We refer to the notion of a knowledge ecology from chapter 3, as a system where exploration and exploitation build upon each other, in a ‘cycle of discovery’. The Netherlands has traditionally functioned as a place for trading, combining, and distributing goods, as a ‘portal to Europe’, with the Rotterdam harbor and the commercial and financial hub of Amsterdam. The question now is whether in the future this may be extended to include more ‘trade’ in knowledge. Other countries might find, in the Neterlands, not only logistical access but also knowledge of knowledge and technology, and of supply and demand, for access to Europe.

The Netherlands might function as a place for meetings, of shorter or longer duration, between explorers and exploiters of knowledge of many kinds: scientists (keeing in mind the Netherlands’ international reputation in the fields of agriculture, food, flowers, astronomy, and some fields of engineering, e.g., water management), producers and users of technology, designers and artists, traders and businesspeople, politicians, diplomats, and lawyers (e.g., the International Court of Justice, located in the Hague), security (with Interpol, also in the Hague), and certain areas of publishing. To support such a system, we would need a variety of supporting services, in law, finance, transport, distribution, conferencing, communications, translation, publishing, accommodation and housing, with attractive spatial, recreational, and cultural environments, and, hopefully, a renaissance of traditional openness to other cultures, as a ‘hub of buzz’. Hopefully, the Netherlands might be a place where trust is built; a place where identity matters little and processes of identification take place (wrr 2007). Perhaps the Dutch can again, even more extensively than in the past,
assume the many roles available for ‘go-betweens’ to help other people cross their cognitive distances.

Notes

In figure 7.1, the thickness of a connecting line represents the strength of the tie, with a number of dimensions: the scope or ‘multiplexity’ of the content of the tie, the volume of business or communication involved, duration, frequency of inter- action, specific investment in understanding and trust, and personal bonding.

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Regional Innovation Policy

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Introduction

Why some regions grow more than other regions is a key question in economic geography. Up until the late 1980s, neo-classical economic approaches argued that technology is a key determinant of regional growth. However, these approaches treated technology as an exogenous factor, leaving the geography of innovation unexplained. Inspired by Schumpeter, economic geographers took the lead in criticising this view. Since the early 1980s, they have focused attention on the explanation of the geography of innovation: some regions are more capable of developing and implementing innovations, and region-specific characteristics (including institutions) may be underlying forces. This led to the claim that regions are drivers of innovation and growth. During the last decades, new concepts like industrial districts (Becattini 1987), clusters (Porter 1990), innovative milieux (Camagni 1991), regional innovation systems (Cooke 2001), and learning regions (Asheim 1996) have been launched to incorporate this view.

Many of these concepts have drawn inspiration from evolutionary economics (Nelson and Winter 1982; Dosi et al. 1988; Boschma et al. 2002). In a nutshell, an evolutionary approach argues that "the explanation to why something exists intimately rests on how it became what it is" (Dosi 1997: 1531). The objective of this chapter is to outline how evolutionary economics may provide inputs for regional innovation policy. This is not an easy task, since distinctive strands of thought in evolutionary economics hold opposing views on policy. For example, the neo-Schumpeterian approach (associated with Nelson and Winter, among others) advocates an active role for policy makers, while the Austrian approach (such as Hayek) does not (Wegner and Pelikan 2003). Complexity thinking in evolutionary economics takes a policy view that is again very different. Notwithstanding these different views, we will outline some policy recommendations that incorporate recent thinking in evolutionary economic geography (Boschma and Lambooy 1999).

This chapter is structured as follows. A brief and selective literature review is given in section 2, providing a theoretical and empirical background for the remaining part, which addresses policy implications. In section 3, we claim that system failures should be taken as the point of departure to underpin regional innovation policy. In section 4, we discuss how history should be taken seriously in regional innovation policy. What is essential to recognise is that history deter- mines not only the policy options that are at hand in regions, but also the probable outcomes of regional innovation policy. Building on these insights, in section 5 we sketch some policy options that may direct regional economies into new directions while building on related variety. In particular, we direct attention to various mechanisms through which knowledge transfer may be encouraged at the regional level. Section 6 draws the main conclusions.

Variety and Regional Development

Our starting point is a fundamental departure from how conventional neo-classical economics treats knowledge. Knowledge is not a public good that is characterised by diminishing returns to scale. On the contrary, knowledge evolves: it is not reduced when it is used, but it accumulates through processes of learning-by- doing (Arrow 1962). This cumulative and irreversible nature of knowledge development is embodied in individuals (skills) and in firms (competences): they develop different cognitive capacities over time. Due to its tacit and cumulative nature, knowledge is actor-specific and difficult, if not impossible, to copy or imitate by other actors. As a result, variety in an economy is the rule, and knowledge accumulation at the level of individuals and firms is its prime mover.

Variety in economic space

Consequently, an economy consists of numerous pieces of knowledge that are formed as time goes by. To start with, an evolutionary approach to economic geography focuses on the question of how these pieces of knowledge are spatially distributed over time. If one observes the world, it is undeniable that knowledge, knowledge creation, and innovation (i.e., the economic exploitation of new knowledge, as embodied in new products, machines, and organisation techniques) are unevenly distributed over space. This is shown in multiple ways.

To start with, one can observe a high degree of variety in the most urbanised regions. Following Adam Smith, a huge market size enables firms to specialise in activities they can do best, enhancing their productivity levels. As a result, the economies of urbanised regions are characterised by a sharp division of labour between specialised firms, which sustains urban growth (Pred 1966). Another reason has been proposed by Jacobs (1969) who claimed that diversified urban economies trigger new ideas and innovations. Co-location of many different individuals, firms, and sectors enhances knowledge exchange and the recombination of different pieces of knowledge in novel ways, generating even more variety in major cities.

In addition to such intra-regional variety, knowledge creation tends to concentrate in space, leading to interregional variety of knowledge. Research and development is extremely spatially concentrated, favouring only a small set of regions in the world, and empirical studies show this pattern is quite stable over time (Feldman and Audretsch 1999). Studies have found strong relationships between regional stocks of knowledge (as embodied in university research and private r&d) and performance indicators, such as patent intensity and productivity levels (Anselin, Varga and Acs 2000). However, it is not necessarily the case that places of knowledge creation and places of innovation overlap. When there is little overlap, one speaks of a knowledge paradox. The European paradox is a prime example: while Europe excels in (basic) research (i.e., r&d levels and patenting activity in Europe are quite high), Europe is incapable of exploiting this knowledge economically, turning it into innovations. In fact, the geography of knowledge and innovation may be characterised by a strong spatial division of labour, with some places specialising in knowledge creation, other places turning this new knowledge into innovations (such as new products), and again other places focusing on the manufacturing of the new products.

There are countless examples of regions and countries that specialise in a particular knowledge field, and which continue to do so for a long time. Industries often tend to concentrate in space, as shown by the film industry in Hollywood, the financial sector in the city of London, the American car industry in Detroit, and the cut flower sector in the Dutch Westland region.1 However, spatial variety also occurs within one industry. We already mentioned the fact that the geography of knowledge creation (r&d) does not necessarily overlap with the geography of production of new products within the same industry. For instance, r&d in the Dutch electronics industry is heavily concentrated in the Eindhoven region, while the outputs of the r&d (i.e., new electronic products) are produced else- where. In addition, firms operating in the same industry may look very different in different places (Essletzbichler and Rigby 2005). For example, the French, American, and Indian film industries are very different in terms of organisation, state involvement, and market focus (Lorenzen 2007).

Spatial Variety and Geographical Proximity

So, variety in space is paramount. These observations lend support to the fact that knowledge tends to accumulate at the regional level. We stated previously that knowledge tends to accumulate in individuals and firms. So why in regions? The main reason is that knowledge will spill over to other firms now and then, despite the fact that knowledge is actor-specific and difficult to copy. Knowledge is a non- rival good: its use by one firm does not preclude its use by other firms. This means that not only the firm itself, but other firms may benefit from the accumulation of knowledge and human capital. This may result in increasing returns to scale that is external to the firm (Shaw 1992). Empirical studies show that knowledge spillover effects are often geographically localised. That is, they spill over to neighbouring regions at the most, and spillover effects become weaker the higher the distance from the source of knowledge (Audretsch and Feldman 1996).

This suggests that geographical proximity is a prerequisite for knowledge diffusion and innovation. However, there is reason to believe that this position should be reconsidered. In fact, it could be argued that geographical proximity is neither a necessary nor a sufficient condition for interactive learning and innovation (Boschma 2005a). This happens only when other barriers of knowledge diffusion are overcome, such as cognitive, social, and institutional distance. These other forms of proximity need to be secured between actors in order to make them connected, and to enable effective knowledge transfer. Other forms of proximity may act as a substitute for geographical proximity, because they can help to provide the necessary trust to exchange knowledge without the need for geographical proximity. For instance, social proximity may provide a vehicle to connect agents and enable flows of knowledge over large distances, because these agents share a past as former schoolmates or as former colleagues working for the same organisation (Agarwal et al. 2006). However, having said that, effective knowledge transfer may still often be geographically localised because geographical proximity indirectly impacts on the establishment of the other forms of proximity. In fact, geographical proximity may encourage the creation of trust-based relationships or other institutions that facilitate effective knowledge transfer between local agents (Maskell 2001).

The cognitive dimension has attracted most attention in this respect. There is ample evidence that local access to information (e.g., through the provision of ict infrastructure) is not sufficient. Due to the tacit nature of knowledge, firms can only understand, absorb, and implement external knowledge that is close to their own knowledge base (Cohen and Levinthal 1990). Effective transfer of knowledge requires absorptive capacity of firms and cognitive proximity, that is, firms need to share similar knowledge and expertise to enable effective communication (Nooteboom 2000). In combination with geographical proximity, the need for cognitive proximity may well explain the spatial concentration of tacit knowledge.2 Once a region specialises in a particular knowledge and competence base, this will act as an incentive, offering opportunities to local firms for further improvements in familiar fields of knowledge on the one hand, and as a selection mechanism, discouraging knowledge creation that does not fit into the regional knowledge base on the other hand (Boschma 2004). As a result, the regional accumulation of tacit knowledge provides an intangible asset for local firms that is hard to grasp for non-local firms, because spatial distance forms an insurmountable barrier to the transfer of tacit knowledge (Gertler 2003).

Empirical studies demonstrate that the key mechanisms through which knowledge between organisations is transferred encourages knowledge accumulation at the regional level. One such mechanism is the spinoff process, through which knowledge diffuses effectively between firms. A spinoff firm is a firm that has been established by a founder that was a former employee of an incumbent firm in the same or a related sector. Crucial is that these new entrants do not start from scratch: these new entrepreneurs have acquired relevant knowledge and skills in a incumbent firm which they can exploit further in their new company. Empirical studies systematically show that this type of entrant performs best, that is, they demonstrate the highest survival rates. Quite a number of sectors are characterised by a high degree of spinoff dynamics during their years of formation, and the most successful firms in those emerging industries tend to be spinoff compa- nies (Klepper 2002). Because most spinoffs locate in the immediate vicinity of their parent organisation, this knowledge transfer mechanism contributes to geographically localised knowledge formation.

Another mechanism through which knowledge diffuses is labour mobility. Since labour is the main carrier of knowledge, employees moving from one firm to the other will contribute to the exchange of knowledge. Since labour mobility takes place largely at the local level, this implies this type of knowledge transfer contributes to knowledge formation at the regional level. This is especially true for labour markets that have similar or related economic activities: clusters are characterised by local labour mobility that is higher than elsewhere in an economy (Lindgren and Eriksson 2007). In addition, labour mobility creates linkages between firms through social ties between former colleagues. These social relationships facilitate knowledge flows between organisations (Breschi and Lissoni 2003). Since most of the job moves are intra-regional, these social networks are formed locally, enhancing further knowledge accumulation at the regional level.

Thus, a network is a mechanism of knowledge transfer that favors localised learning between firms. Knowledge effectively circulates in networks, as happens in technological alliances and epistemological communities to an increasing extent (see chapters 7 and 10). Basically, networks are a-spatial constructs. Social connectedness is often considered crucial to explain network configurations, as the formation of inventors' networks on the basis of co-patenting shows (Breschi and Lissoni 2003). But because social proximity is enhanced by geographical proximity, networks are often geographically localised, and so is the process of knowledge creation and diffusion.

Networks may be especially beneficial for activities of exploitation, but they may be less suited to exploration (Nooteboom et al. 2007). As chapter 10 showed, network ties may become too close and inward looking, leading to a reduced awareness of developments outside the network (Uzzi 1997). Firms that are involved in embedded relationships may feel morally obligated to stay loyal to their partners, and thus end up choosing less efficient ways of production. If firms do not connect to new groups of firms now and then, and if their own network is not accessible for new partners, it is difficult to break this situation of cognitive lock-in. This over-embeddedness argument has a geographical connotation. Grabher (1993) argues that firms that focus too much on local relation- ships become less aware of technological and market-related developments outside their region. The establishment of non-local relationships are considered crucial, because they bring new variety into the region (Asheim and Isaksen 2002; Bathelt et al. 2004). However, non-local relations as such do not guarantee effective knowledge transfer either: one needs a certain level of social and cognitive proximity to make effective connections over large distances. So, firms with relationships that are too tight or focus too much on their own region may find it harder to adapt to external changes (Boschma 2005a).

Regional Dynamics

There is, however, more in capitalist economies than just knowledge accumulation taking place at the regional level, and consolidating spatial variety. An evolutionary approach to economic geography focuses on the dynamics of urban and spatial systems in the long run. It does so in terms of what Schumpeter (1942) described as creative destruction. What drives a regional economy is the introduction of new variety (as embodied in for example new products, new firms, and new sectors) in the economic system through entrepreneurial activity, because it must offset the decline in other parts of the economy (Saviotti 1996). So, regional growth is about qualitative change, not quantitative change.

This process of creative destruction does not keep the spatial system in balance. On the contrary, regional dynamics is the rule. New basic variety challenges the core-periphery structure of the spatial system (Boschma and Lambooy 1999). New industries require new knowledge, new types of skills, new institutions, among other things, and the existing spatial structure cannot provide these. This makes it unpredictable where new industries emerge in space, although this may differ from industry to industry. Newly emerging sectors do not necessarily favour leading regions, and they provide opportunities to backward regions to a considerable degree. Economic history bears witness to dramatic changes in the spatial system both at the international and national level (Hall and Preston 1988). In the last two centuries, techno-industrial leadership has shifted from Great Britain to the United States and Germany, and some countries in South-East Asia have recently joined the ranks of leading industrial countries. Countries are subject to similar dynamics: in Great Britain, Belgium, and Germany, the leading industrial regions of the nineteenth century have almost been overrun by a set of newly emerging regions in the south east of England, Flanders, and the south of Germany.

As a consequence, the long-term development of regions depends on their ability to create new variety through entrepreneurship and innovation, in order to compensate for the loss of variety through exits and relocations in other parts of their economy. In other words, it is essential for regions to transform and renew their economic base (Pasinetti 1981; Saviotti and Pyka 2004). One reason for this is that (tacit) knowledge not only accumulates in regions, but it may also become standardised (i.e., explicit and codified) in the long run. Since this codification process encourages knowledge diffusion between regions, the regional knowledge base may lose its unique value to local firms (Maskell and Malmberg 1999).

Related Variety as Source for Regional Innovation

Regions may have several option to restructure their economies (Martin and Sunley 2006). A key option is to diversify into new fields while building on existing regional assets. There is increasing awareness that the long-term development of regions depends on their ability to diversify into new economic applications and new sectors while building on their current knowledge base. It means that regional economies that branch into new directions may be more stable in the long run than those that start from scratch.

One way to establish this is to develop major innovations that are triggered by knowledge spillovers between different sectors in a region (Henderson et al. 1995). However, knowledge will only be exchanged effectively when the cogni- tive distance between sectors is not too large. In other words, sectors need to be related or complementary in terms of competences to enable effective knowledge transfer. To be more precise, some degree of cognitive proximity is required to ensure that effective communication and interactive learning take place, but not too much cognitive proximity, to avoid cognitive lock-in (Nooteboom 2000). It is neither regional diversity (which involves too large cognitive distance) nor regional specialisation per se (resulting in too much cognitive proximity), but regional specialisation in related variety that enhances real innovations. The idea of innovations based on related variety comes close to the Schumpeterian definition of innovation as the recombination of pieces of knowledge in entirely new ways (Levinthal 1998). So, major innovations are more likely to occur when knowledge spills over between sectors, rather than within one sector, but only as long as the sectors are related.

Related variety is linked to the concept of technology system that accounts for strong technological interdependencies across industries (Carlsson and Stankiewicz 1991). Economic history has repeatedly given evidence of a high degree of exchange and feedback of technology across a particular set of industries during a particular period (Boschma 1999). For instance, sectors may be technically connected because they originate from a common technology. The discovery of the technological principles behind synthetic dyestuffs in the nineteenth century is an example: this laid the foundations of a range of new chemical sectors, such as synthetic colours, pharmaceutics, explosives, photography, plastics, and synthetic fibres Major innovations also depend on complementary advances in technology in other industries before they can be fully exploited (Rosenberg 1982). These examples give insights into how related variety enhances knowledge spillovers and sparks of radical innovations, how new growth sectors come into being, and how regional economies branch in new directions.

Another example of how related variety contributes to economic renewal is the post-war experience of the Emilia Romagna region in Italy. For many decades, Emilia Romagna has been endowed with a diffuse knowledge base in engineering. After the Second World War, many new sectors, such as the packaging industry, ceramic tiles, and robotics, emerged out of this pervasive and generic knowledge base one after the other. These new economic applications made the regional economy diversify into new directions. These new sectors not only built and expanded on this extensive regional knowledge base, they also renewed and extended it, further broadening the regional economy of Emilia Romagna.

The economic significance of related variety is also shown through the emergence of new sectors that grow out of old sectors, such as the television industry, which branched out of the radio sector (Klepper and Simons 2000). Because this branching process concerns old sectors giving birth to new sectors, it increases the probability of survival of the new industry. Klepper (2002) demonstrated empirically that prior experience in related industries (like coach and cycle making) increased the life chances of new entrants in the new us automobile sector. This confirms the observation made earlier that the spin-off process is a powerful mechanism that effectively transfers knowledge from one firm to the other. Boschma and Wenting (2007) found evidence that new automobile firms in the uk had a higher survival rate during the first stage of the life cycle of the new industry when the entrepreneur had a background in these related sectors, and when the firm had been founded in a region that was well endowed with these related sectors. So, when diversifying into the new automobile sector, these types of entrants could exploit and benefit from related competences and skills, which improved their life chances significantly, as compared to start-ups lacking those related competences/skills.

Frenken et al. (2007) have more quantitatively assessed the impact of related variety on regional growth in the Netherlands. Making use of the standard sectoral classification, sectors at the five-digit level were defined as related when they shared the same category at a lower level. An outcome was that regions with a high degree of related variety showed the highest employment growth rates in the Netherlands in the period 1996-2002, suggesting the importance of knowledge spillovers across related sectors at the regional level. At the same time, a broad range of unrelated sectors in a region may also be beneficial for regional growth, because unrelated variety spreads risks. When a sector-specific shock occurs, it is unlikely to harm other industries and disturb the regional economy when sectors are unrelated. So, unrelated variety may stabilise regional economies (Essletzbichler 2005).

Before, we pointed out that non-local relationships may be crucial because new variety may be brought into the region through linkages with other regions (Boschma 2004). However, a study on regional growth in Italy, making use of trade data, demonstrated that the inflow of variety of knowledge per se does not affect economic growth in regions: it is not sufficient to attract large flows of extra-regional knowledge (Boschma and Iammarino 2007). The same is true when the extra-regional knowledge is similar to the knowledge base of the region: there is not much to be learned from inflow of knowledge that the region is already familiar with: it does not add to the existing knowledge base of the region, and therefore, does not lead to real innovations and regional growth.

However, a crucial finding of this study was that the more related the knowledge base of the region and its import profile was, the more it contributed to growth in the region. This finding suggests that related variety in extra-regional connec- tions ensures that external knowledge sparks of learning and innovation in situ. Thus, a region benefits especially from extra-regional knowledge when it origi- nates from sectors that are related or close, but not quite similar to the sectors present in the region. In those circumstances, cognitive proximity between the extra-regional knowledge and the knowledge base of the region is not too small (avoiding the learning process of being more of the same), but also not too large (enabling the absorption of the extra-regional knowledge).

The Need For Dynamic Innovation Systems

However, inter-firm knowledge transfers based on proximity and related variety alone will not lead to innovations. Since the 1990s, the innovation system literature claims that the innovation process should be seen as the outcome of interaction between actors within firms, between firms, and between firms and other organisations such as universities, educational facilities, financing organisations, and government agencies (Freeman 1987). So, being innovative is not just a matter of having access to related variety or to local or non-local knowledge, but whether interaction takes place at all these levels.

According to this literature, a number of organisations (such as research institutes, educational facilities, and financial organisations) provides complementary inputs essential to the innovation process (Edquist 1997). In addition to absorptive capacity, a firm can exploit its innovation only when it is for example able to get access to (venture) capital, when it is able to hire workers with the required new skills, or when it can find a new market. In other words, firms need the presence of a critical mass of organisations that can provide these needs. In many peripheral regions, this critical mass is missing, resulting in low innovative performance.

Besides a critical mass, it is crucial that these organisations are connected and form a system. The innovation process requires organisations to connect in order to enable flows of knowledge, capital, and labour. The key issue is that this is far from self-evident in practice, even quite exceptional (Boschma 2004). Capital suppliers are almost by definition reluctant to invest in innovative projects: (radical and more complex) innovations are a risky business with uncertain outcomes, and financial organisations have built up routines in established markets and technologies. Although the number of inter-firm technology alliances is on the increase (Nooteboom et al. 2007), firms tend to be reluctant to share their core competences with others, because there is a serious risk that knowledge will leak to competitors. Public research institutes such as universities often have difficulties in meeting the demands of innovative firms, because of differences in culture and incentive mechanisms (Metcalfe 1994).3 And when innovations require labour with new skills, it may take a long time before the educational system is restructured and new appropriate courses are offered.

In addition to the fact that it is not self-evident that interactions occur between organisations, it is also unlikely that organisations are sufficiently flexible to implement innovations. In reality, almost by nature, organisations are not flexible and responsive, due to routines and path dependency (Nelson and Winter 1982). Thus, regions will reap the benefits from entrepreneurial activities of firms only when the actions of these key organisations are coordinated and form a system of innovation, and when regions have local organisations that respond quickly and smoothly to new developments. This is crucial for the long-term competitiveness of regions: some regions are more capable of making these connections and have more responsive organisations than other regions. This is a key systemic asset of a region that is almost impossible to copy by other regions.

Institutions play a crucial role in this respect (Nelson 1995). Apart from basic institutions like democracy and markets that support entrepreneurship and innovation, institutions also regulate and coordinate actions between organisations (Hodgson 1996). This task is fulfilled by formal institutions (such as laws) and informal institutions (like norms and habits) (Edquist and Johnson 1997). An example of a formal institution is a patent law system that protects inventors for some time while making information public. An example of an informal institution is a culture of shared trust, which is a local capability that supports inter- firm learning (Maskell 1999). Countries and regions accumulate different institutions over time, which is quite similar to the way the regional knowledge base accumulates. They are the outcome of a long history in a specific regional context that cannot easily be copied by public policy in other regions. Like the innovation process itself, institutions have a systemic dimension: they form systems that are territory-specific (Hall and Soskice 2001). At the international level, there are 'exit-based' and 'voice-based' institutional models (Ergas 1984), at the regional level, there are many more. Consequently, regions follow different institutional paths that yield comparable levels of economic development: there is more than one way regions can accomplish economic development.

Because institutions tend to be durable and resistant to change, they not only support but may also constrain new developments. When new institutions are formed and created alongside new economic activities, they fulfill a specific need (Murmann 2003), but once they are established, they may obstruct new develop- ments. Powerful special-interest organisations may take over an economy, slow- ing down the capacity of regions to adopt new technologies and to reallocate resources to new activities (Olson 1982). What matters thus is whether institutions are flexible and responsive to change, in order to avoid regional lock-in (Freeman and Perez 1988): regions need a capacity to upgrade and transform institutions required for the development of new activities. This dynamic capability of organisations and institutions impacts on the long-term competitiveness of regions (Boschma 2004).

Conclusion

In a knowledge economy, regions depend on their ability to develop and apply new knowledge in their economies. Since knowledge tends to accumulate, new knowledge will not diffuse widely between firms and between regions. It requires absorptive capacity and institutions that bring agents together. Both of these intangible assets provide incentives and constraints within which the innovation process takes place. If region-specific, interregional variety may be a persistent feature of economies. Knowledge will spill over more intensively when regions are endowed with related industries that share a common knowledge base. Due to the systemic nature of innovation processes, regions also require a critical mass of organisations that meet the following conditions: (1) they have to be well connected, enabling flows of knowledge, capital, and labour; (2) however these ties should not be too strong, and not too focused on the region, avoiding problems of lock-in; and (3) local organisations and institutions must be flexible and responsive to new circumstances, overcoming inertial tendencies due to habits, routines, and path dependency (Boschma and Lambooy 1999).

System Failures as Basis for Regional Innovation Policy

In this section, we sketch out some policy implications. While it is common to refer to market imperfections as basic underpinnings for public intervention, we will claim that system failures should be taken as the basic rationale for regional innovation policy.

A conventional market failure argument is that knowledge is a semi-public good. Because of the problem of non-appropriability, government should take action to overcome underinvestment in new knowledge through the provision of r&d subsidies or the establishment of property rights. Another standard argument is that knowledge is characterised by increasing returns to scale. For that reason, investments in public r&d, technology transfer and education are expected to foster economic growth (Hall 1994). As such, the government aims to encourage the dissemination of knowledge, through the public provision of infrastructure such as broadband Internet. This is especially relevant for lagging regions and small- and medium-sized firms that lack resources to invest in r&d.

By and large, the market failure argument suffers from two shortcomings. First of all, evolutionary economists argue that market imperfections are not necessarily a problem that needs to be corrected by public intervention. For instance, due to cognitive constraints, knowledge can be excluded from other firms to a greater or lesser extent. Market imperfections, such as knowledge spillovers, knowledge asymmetries, and monopolies can even be considered the real drivers of innovation and economic growth (Bryant 2001). Because knowledge asymmetries limit knowledge transfer, they provide a strong incentive to invest in knowledge creation. What is more, variety acts as a major source for exploration and economic renewal (see chapter 3). Therefore, variety is a key regional asset that needs to be cherished.4 Consequently, public intervention aimed at tackling market imperfections could damage rather than benefit an economy. Secondly, the market failure argument is based too much on a linear model of innovation policy that focuses on r&d infrastructure and technology transfer, as if these automatically lead to innovation in regions. For instance, science and technology policy in the European Union is focused on enhancing r&d, and there is a strong belief that r&d policy will bring benefits to many regions. In reality, r&d-based policy favours only a few regions in Europe, that is, the ones that are already specialised in r&d (Morgan 1997; Simmie 2003). In addition, much of the newly created knowledge is not exploited economically in Europe but leaks away to countries like the us. This means European r&d policy is subsidising the exploitation of knowledge elsewhere. In other words, this linear model of innovation policy based on market failure will lead to poor results, if such policy does not account for the systemic nature of innovation and the importance of absorptive capacity and institutions for knowledge diffusion.

Therefore, we claim that system failures, rather than market failures, should be the starting point for policy intervention (Metcalfe 2003; Asheim et al. 2006). This is not to deny the relevance of market failures for underpinning regional innovation policy in some cases. On the contrary, poor access to information, for instance, should be tackled by policy intervention, but it requires additional policy actions to be effective. So, at best, policy based on market failures needs additional actions to be effective, at worst, it may seriously damage the driving forces of innovation in an economy.

There are three types of system failures that may result in poor innovative performance of firms in regions (Edquist 1997; Bryant 2001; Todtling and Trippl 2005). The first type is more quantitative in nature, instead of relational: there may be crucial parts of the innovation system that are underdeveloped. This so- called 'organisational thinness' refers to the fact that key organisations in innovation systems, such as research institutes, educational facilities, venture capitalists, and specialised suppliers, but also key regulations, are weakly developed. Such a situation of 'organisational thinness' is often found in peripheral regions, due to a lack of critical mass of local demand (Camagni 1995).

The second type of system failure is a purely relational one, of a more qualitative nature. As mentioned in section 2, relationships between organisations in innovation systems are not self-evident, but have to be constructed. As explained in chapter 7, inter-organisational collaboration, for instance, is often risky and frequently fails. When missing or badly managed, knowledge will not be exchanged, inter-firm learning will come to a halt, and investment opportunities will not be realized due to shortages of capital and skilled labour.

The third type of system failure is associated with processes of lock-in. A lack of flexibility in organisations and their relationships may lead to inertia, which undermine the ability of regions to adapt and to renew their economic base. As noticed before, local organisations may be too strongly oriented towards old routines and old specialisations, as the experience of mature industrial regions illustrates (Grabher 1993). Moreover, local organisations may have developed too strongly tied networks, which limit their access to new sources of information, and which makes it difficult to implement changes. It is crucial to under- line that public organisations may be part of such a regional deadlock: public agents may contribute to the formation of closed and inward-looking systems through their policy programs and their direct participation in such networks (Hassink 2005). how to design regional innovation policy?

When building regional innovation policy on system failures, a number of issues call out for clarification. Should policy select and target particular sectors and regions? Should one adopt a 'one-size-fits-all' policy approach? Can policymakers make regional economies develop in new directions, and if so, how? And to what extent should innovation policy be regionally-based? These issues are addressed below.

Targeting Sectors and Regions?

There is often a tendency in policy to select particular sectors and regions a priori as targets at the national level. Policymakers are inclined to support relatively new sectors such as biotech, nanotechnology, or gaming, because these sectors are expected to create jobs in the near future. In a similar way, some regions are identified as innovation hotspots or 'brain ports', because these are considered the drivers of national economic growth in the near future. However, one can question the usefulness and relevance of such a 'picking-the-winner' policy.

First of all, such policy overlooks the fact that it is impossible to predict which will be the new growth regions and sectors of the future. A 'picking-the-winners' policy at the national level is risky, as history shows, because one runs the risk of selecting the wrong regions and sectors. There is little understanding of how regions move into new directions or start up new growth paths (Iammarino and McCann 2006; Martin and Sunley 2006). What has been observed is that new industries are often the result of spontaneous processes, rather than the outcome of orchestrated policy interventions (Lambooy and Boschma 2001; Pack and Saggi 2006). This is not to deny, however, that governments often play a key role, as in Silicon Valley, where huge defensive expenditures by the us government gave the region an enormous boost.

Secondly, 'picking-the-winner' policy often results in picking the same winners by many countries and regions. When all regions are targeting the same sectors (like biotech), it is meanwhile likely that most of these sectors will cluster in only a small number of regions in the world;one can predict that the overwhelming majority of regions will fail to develop these industries, with huge losses of public resources (Boschma 2005b). An exception might be the public support of general purpose technologies (like the Internet): there is no doubt these will have long-term impacts, but it remains uncertain which parts of the economy will be most strongly affected in the next decades, and how.

Thirdly, 'picking-the-winner' policy at the national level denies the fact that, in principle, almost every region has growth potential in the knowledge economy. Growth or innovation potentials of regions can be measured in different ways. Indicators like r&d, creative workers, high-tech industries, and knowledge- intensive services identify different dimensions of the knowledge economy. Each of these indicators will reveal a different spatial pattern, as an empirical study of the Netherlands shows (Raspe et al. 2004). For example, r&d is located more often in the more peripheral parts of the Netherlands, while creative workers are concentrated in the central, urbanized part of the country. If all the maps of each indicator would be put on top of each other, it would be almost impossible to identify regions that lack innovation potential. That is, most of the Dutch regions participate in the knowledge economy in one way or another. Therefore, it would be wrong to exclude many regions from policy intervention from the very start, because it would leave regional potential untouched and unexploited.

Consequently, one should be cautious of focusing innovation policy too narrowly on r&d. As explained before, r&d is only one indicator to measure innovation potential, and it is grounded in a traditional linear model of innovation that simply equates innovation with r&d. In addition, innovation policy based on r&d potential has strong geographical implications. Since r&d activities are concentrated in a small number of affluent regions, r&d-based policy will benefit these leading regions even more (Oughton et al. 2002).

Regional innovation policy based on related variety will avoid the dangers of picking-the-winner' policy, because its objective is to broaden and diversify the regional economic base while building on region-specific resources and extra- regional connections. No particular regions need to be targeted. Each region can be made part of such a policy approach, no matter whether these regions are specialised or diversified, or whether these have a high or low degree of related variety. Nor do specific sectors (low or high tech, creative or not) have to be excluded from such a policy approach. As it aims to bring together activities with possible complementary pieces of knowledge, such policy leaves behind a narrow sectoral perspective. Having said that, there is no doubt that regional policy based on related variety needs focus to be effective: it needs to identify and target region-specific assets and extra-regional linkages that have obtained some critical mass in a region. However, the objective is not to make strong sectors even stronger, but the objective is to enhance interaction and exchange between different activities, in order to support new variety in the region.

No 'one-size-fits-all' policy?

To say that almost each region has innovation potential is not to say that all regions are equal. On the contrary, there is a strong need to account for a variety of innovation potentials between regions, because regions differ in terms of location, human capital, knowledge base, and institutional structure. Italy is a prime example: the north of Italy is strong in science-based organisations with a high r&d intensity, the Third Italy is characterised by industrial districts which consist of small- and medium-sized organisations that have formal and loosely structured relationships, and the south of Italy is characterised by a weak indigenous learning capability and weak networks of organisations due to poor institutional arrangements (Iammarino 2005). Because of such spatial variety, it would be wrong to apply a 'one-size-fits-all' policy, such as copying neo-liberal policies or a best practice like Silicon Valley, which is often the case in regional policy development (Todtling and Trippl 2005).

It would also be wrong to create regional policies from scratch. Effective policy making requires localised action embedded in, and attuned to available resources in regions. To a large extent, it is the regional history that determines available options and probable outcomes of policy (Lambooy and Boschma 2001). It means one should take the knowledge and institutional base in a region as starting point when broadening the region's sector base by stimulating new fields of application that give birth to new sectors. Accordingly, there is a need for differentiated, tailor-made policy strategies that are geared towards specific potentials, and that will focus on tackling specific bottlenecks in regions. In sum, regional policy needs to capitalise on region-specific assets, extending and renewing the economic base, rather than selecting from a portfolio of specific policy models and recipes that owe their success to different environments (Asheim et al. 2006).

'One-size-fits-all' regional policy models do not work in a highly fragmented economy (Cooke and Morgan, 1998). This implies that copying of best practices, as identified by benchmarking studies, are bound to fail, as regional policies aimed at imitating success stories such as those of Silicon Valley have demonstrated (Boschma 2004). Howells (2005) points out that 'best practice policies' are hard to adapt to local situations and difficult to understand and implement.

Moreover, copying of success stories in practice often focuses on the success factors, rather than on the basis of a sound analysis of how public policy contributed to the success of that particular region. This is not to say that regions cannot learn from each other (Hassink and Lagendijk 2001). There may be advantages to best practice policies: they have proven their success elsewhere, they are more or less ready to use, and they may break down closed local networks that serve vested interests (Howells 2005). In other words, there may be disadvantages attached to region-specific policies: these are often unique, so it is not clear whether they will work, and local vested interests may dominate the design of new policy, excluding outsiders and newcomers (Fritsch and Stephan 2005).5 This implies that region-specific policies should be designed in such a way that these potential problems are tackled. This means, for instance, that it might be a good thing to encourage public support of academic spinoffs everywhere, but for this to work it requires different public strategies that are adapted to regional circumstances (Degroof and Roberts 2004).

Policymakers are adapters

The rejection of 'one-size-fits-all' policy is in line with the view that policymakers are not fully informed and omnipotent. Therefore, policymakers have few degrees of freedom (Lambooy and Boschma 2001). As stated before, the trajectories that regions followed in the past, as accumulated in a particular knowledge base and a set of institutions, determine to a large extent the available options and probable outcomes of policy. Regional policy is likely to fail when local strategies deviate from their local context. The more the policy objectives are embedded in the surrounding environment, the larger the potential impact of policy. When adaptation to change is constrained by the spatial system, policy based on related variety may increase the probability of policy success, because it builds on existing structures, while its objective is to broaden or diversify the regional economy in new directions.

Such a policy approach takes a more contextualised view of how policy should intervene in a regional economy. It implies that the degree and nature of policy intervention should be different in different regions because their histories differ. As a consequence, the question of whether governments should intervene in a regional economy should be based on the institutional history of a region and on the type of intervention that better fits a region's situation, rather than being based on theoretical or ideological accounts (Fromhold-Eisebith and Eisebith 2005). In addition, there is general awareness that the state is only one of the actors in a region, although a key player (Kohler-Koch 1998). When taking a systemic innovation policy approach, we claim that governments do not only directly intervene (e.g., through regulations, public research, and education), but also take a role as broker and intermediary to an increasing extent, bringing together actors at the regional level (Cooke and Morgan 1998).

We should account for the fact that policymakers, just as firms, do not optimise, but they adapt (Metcalfe 1994). They operate in a world of uncertainty. In these circumstances, policy failures will occur, just as it is a rule that firms will eventually fail in markets (Ormerod 2005). Because policymakers cannot rely on 'one- size-fits-all' policies, regional innovation policy is necessarily based on trial-and-error, in which policymakers learn and adapt, based on experience (Schwerin and Werker 2003). To stimulate learning, the policy system should be open to newcomers and new ideas, leave room for policy experiments, and a system of constant policy evaluation should be put in place (Wegner 1997).

Regional dimension of regional innovation policy Policymakers in many countries have embraced the view that innovation processes have a regional dimension, and have responded by adding a regional dimension to their innovation policy (Van Geenhuizen and Nijkamp 2006).6 We stated earlier that diversity in regional innovation policy is something that should be encouraged. While it is essential to take the knowledge and institutional base of regions as a starting point, one should be cautious, however, not to overestimate the role of the region as a driver of innovation. This has implications for regional innovation policy.

First of all, knowledge relationships often cross regional boundaries. As noted in section 2, non-local linkages are often found to be crucial for learning and innovation, in order to avoid cognitive lock-in. Amin and Cohendet (1999) claim that non-local networks are crucial for path-breaking innovations, while local learning results in more incremental innovations. For firms, being connected may be as important, or even more so, than simply being co-located (Giuliani and Bell 2005). This means that policy intervention should not focus on the region alone, as if geographical proximity is sufficient for innovation (Boschma 2005a). On the contrary, it should encourage geographical exposure by means of cross-regional knowledge collaboration and inflows of human capital, in order to avoid regional lock-in.

Secondly, policy should take in consideration that knowledge transfer between local firms is not just accomplished by bringing them together. Knowledge does not spill over automatically between firms, even when they are located in the same region. Network analysis demonstrates that the position of firms in knowledge networks depends on their absorptive capacity (Giuliani and Bell 2005). The higher a firm's absorptive capacity, the more it is connected locally, the more central its position in the knowledge network, and the higher its innovative performance. Firms with a high absorptive capacity are also more connected to the world. They may even act as gatekeepers that bring new variety into the region. Whether this external knowledge will diffuse in the region depends on the absorptive capacity of all other firms in the region. This can be stimulated by policy, by enhancing the absorptive capacity of local firms through public research, and by education schemes.

Conclusion

There are good reasons to avoid a 'picking-the-winner' policy that targets only a few sectors or regions. The idea that it is possible to design 'one-size-fits-all' regional policies is no longer valid. The copying of best practices is almost impossible when it comes to intangible regional assets that are the result of long histories. Regions provide opportunities but also set limits to effective growth policies. When policy solutions are built on regional indigenous capacity, the probability of effective policy is likely to increase. To avoid regional lock-in, it is crucial that policy is open to newcomers, to new ideas, and to experimentation.

Policy Options

Now, how can regional innovation policy tackle system failures? There are many policy options one could think of, too many to be mentioned here. Due to a lack of space, only selected policy options will be listed and discussed below.

The objective of regional innovation policy is to encourage and facilitate new ideas and innovation through the creation, diffusion, and exploitation (or commercialisation) of new knowledge. The government might directly intervene, through the supply of r&d, education, and capital that match the need of local firms, and which increase the absorptive capacity and innovative capability of firms. Public policy can also stimulate the effective transfer of knowledge through various mechanisms, such as spinoff dynamics, labour mobility, and collaborative networks.7 Below, we briefly direct attention to these three mechanisms of knowledge transfer, because they tend to take place at the regional level, and they may provide inputs for regional innovation policy based on related variety.

Recent studies have shed light on the importance of spinoff dynamics for knowledge diffusion, entrepreneurship, and regional development (Helfat and Lieber- man 2002). As noted before, spinoffs are new firms that are founded by entrepreneurs that have acquired relevant experience as far as market and/or technical knowledge is concerned. Empirical studies tend to show that spinoff companies often perform better than other types of entrants because they can build on relevant knowledge and experience acquired in parent organisations in the same or related industries (Klepper 2002). Since spinoffs tend to locate near their parents almost as a rule, they may provide a basis for regional innovation policy. Because the spinoff process has played a crucial role in the emergence of many new sectors, it may be seen as a mechanism that makes regional economics diversify into new sectors, while building on knowledge and competences available in existing sectors (Boschma and Wenting 2007). A policy option is to target potential entrepreneurs (not just supporting any new firm), by taking into consideration what kind of knowledge the founder brings into the new firm. Another policy option is to encourage spinoff policies at universities that may contribute to the growth potential of spinoff ventures (Lockett et al. 2005).

Regional innovation policy could also play a role in encouraging labour mobility, because it is a crucial mechanism through which skills and experience are transferred from one local company to the other (Camagni 1991). Since most labour mobility takes place at the regional level, policy promoting labour mobility may enhance knowledge transfer and innovation at the regional level. Since labour mobility may take away the incentive of firms to invest in their personnel, public policy should invest heavily in education and life-long learning at the same time. Aghion et al. (2006) argue that labour markets need to be more flexible in order to smooth the process of creative destruction and lower the costs of such adjust- ments. This again needs to be complemented by a policy of life-long-learning, because it increases the capability of individuals to confront changes and to move from one job to the other.

Another crucial policy measure is to encourage the immigration of skilled labour because it may bring new ideas and knowledge into the region. One way to achieve this is through international exchange programmes for students. Incoming students bring in new talents and skills from abroad, and combine these with new skills that are acquired in higher education institutes in the host country. If the host country is capable of maintaining this group of high-skilled students after graduation (policy can most certainly play a role here), they will contribute to the economy as skilled employees or as founders of new firms. Outgoing students will acquire new skills in research and education institutes abroad, and may return to their home region after a while, where they will exploit their newly acquired skills in an environment they are familiar with (Saxenian 2006). Policy could target those outgoing groups and provide incentives to return to their home region.

Another policy option is to stimulate networks as effective settings through which knowledge circulates and interactive learning takes place. As stated before, policymakers may act as intermediaries or knowledge brokers, or establish policy platforms that facilitate knowledge to spill over and diffuse from sectors to related ones. In doing so, policy should avoid that vested interests of established firms take over and dominate these networks, and deny access to small firms and newcomers. Some have conceived these vested interests as one of the weaknesses of the Innovation Platform, an initiative of the Dutch national government. In a similar vein, competition policy could aim at stimulating the establishment of network alliances between firms in related industries as a way of diversifying regional economies into new but complementary fields of activity.

This type of network policy should acknowledge that knowledge networks frequently cross regional boundaries (Gertler and Levitte 2005; Giuliani 2005). It is crucial that regional innovation policy stimulates extra-regional networks, because it brings new knowledge into the region. Besides new infrastructure development and international exchange programs, a way to accomplish this is to encourage foreign investments. In a study of small European countries, Dachs et al. (2007) found that foreign-owned companies in some European countries tend to show a higher innovation output and higher labour productivity, as compared to domestically-owned companies. What is more, affiliates of foreign multinationals were quite strongly embedded in the national innovation system, may of them even showing a higher propensity to cooperate with domestic partners, as compared to domestically-owned companies.

Universities may also play a crucial role in exploiting inter-regional linkages, because they are extremely well connected to international networks. After their graduation, students will exploit and diffuse this knowledge in the regional econ- omy. Academic spinoff policy and other policy measures may be implemented to ensure that the knowledge of universities will be further exploited economically at the regional level (Feldman and Desrochers 2003). What would be risky though is that public policy specifies in detail which knowledge fields will be targeted (e.g., through the allocation of r&d subsidies). As outlined before, this would mean a 'picking-the-winners' policy that denies the crucial role of variety as a source of novelty.

Conclusions

We have built upon insights drawn from evolutionary economic geography to present some recommendations for effective regional innovation policy. Since knowledge tends to accumulate mainly at the firm level, variety is the rule, and the more diversified a regional economy is, the higher regional growth. However, knowledge may also diffuse between firms, having an additional impact on regional development. If knowledge externalities are geographically bounded, knowledge will also accumulate at the regional level, and the regional economy will benefit as a whole. In addition, knowledge will spill over more intensively when regions are endowed with related industries that share a common knowledge base. This makes regional economies diversify into new directions and start up new growth paths, which are crucial for long-term regional development.

However, knowledge creation and knowledge spillovers alone will not lead to innovation. Regions require a critical mass of organisations that provide necessary inputs to the innovation process, such as knowledge, skills, and capital.

Besides a critical mass, these organisations need to connect and interact, to enable flows of knowledge, capital, and labour. In addition, organisations and institutions need to be flexible and responsive in order to implement change. In reality, almost by nature, organisations and institutions are not, because they suffer from lock-in, due to routines, sunk costs and path dependency.

We have used these insights as key inputs and underpinnings for effective regional innovation policy. Following system failure arguments, public policy has the task of establishing key organisations of innovation systems in regions where these are found to be missing, or public policy has to ensure that these missing inputs to the innovation process will flow into the region. Once available, public intervention should encourage key organisations to connect. For example, firms need to be linked with research institutes and capital suppliers. In addition, public policy can make organisations more flexible and innovative, for instance, by upgrading their routines through the supply of new knowledge and skills.

Finally, regional innovation policy can stimulate the effective transfer of knowledge at the regional level by means of spinoff activity, labour mobility, and networks. Since these mechanisms of knowledge transfer are basically taking place at the regional level, and because they make regions move into new growth paths while building on existing assets, these policy actions put in practice the idea that related variety may contribute to long-term regional development.

To increase the probability of policy success, regional innovation policy needs to account for the region-specific context because it provides opportunities but also sets limits to what can be achieved by public policy. In doing so, it should neither apply 'one-size-fits-all' policies nor adopt 'picking-the-winner' policies. Instead of copying best practice models or selecting winners, policy should take the history of each region as a basic starting point and identify regional potentials and bottlenecks accordingly. To avoid regional lock-in, it is crucial that public policy is open to newcomers and new policy experiments.

Notes

In the late nineteenth century, Marshall (1890) attributed the spatial clustering of industries to specialised labour markets, local access to specialised suppliers and large markets, and the presence of local knowledge spillovers.

The relevance of geographical proximity for knowledge exchange is associated with tacit, as opposed to codified knowledge (Brown and Duguid, 2000). Codified knowledge consists of information that can be written down and, consequently, can be exchanged over long distances. Tacit knowledge is more difficult to express in an explicit form. Tacit knowledge is acquired through experience, demonstration, and practice which require personal interactions. Therefore, geographical proximity is seen as facilitating the transfer of tacit knowledge (Johnson et al. 2002). There is increasing awareness, however, that the need for face-to-face contacts to exchange tacit knowledge does not automatically mean that individuals have to be located close to one another (Rallet and Torre, 2000). In many cases, face-to-face contacts can be arranged on a temporary basis, for example through business travels, conferences, or fairs (Gallaud and Torre, 2005).

Because collaboration between different types of organisations (e.g., between firms and universities) is not self-evident, it tends to take place at a lower spatial scale, as compared to collaborations between similar organisations (e.g., between firms) (Ponds et al. 2007). This suggests that geographical proximity may be helpful in overcoming cultural and other barriers between different types of organisations.

In a study on the Swedish economy, Neffke et al. (2007) found evidence that young industries (in contrast to mature industries) tend to benefit from Jacobs' externalities, that is, they perform best in regions with a high degree of sectoral variety. An additional finding was that the effect of Jacobs' externalities was especially strong and positive when the industry was in the exploration stage, in contrast to the exploitation phase.

There is real danger that the ideal circumstances for regional policy (a specialised region with a few strong players) cause a situation of institutional lock-in, with adverse impacts on regional development in the long run (Cheshire and Gordon, 1996).

It is important to realise that this regionalisation of innovation policy consists of many dimensions: it incorporates objectives, instruments and administration issues of policy, among other things (Fritsch and Stephan, 2005). We view regionalisation of innovation policy in a broad way, covering any policy action that accounts for region-specific features. So, it is not only about cluster promotion, which is now a popular policy objective, but which has also been subject to severe criticism (see Martin and Sunley, 2003).

By contrast, Dosi et al. (2006) claim that the European Union should shift its policy approach from a networking type (emphasis on interactions with local environment) to an actor type of approach (strengthening high quality basic research and the innovative capacity of corporate actors).

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Conclusions for innovation policy: opening in fours

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Introduction

Innovation is needed to sustain economic growth, but the position of the Nether- lands in terms of innovation is not a very good one. It was shown in chapter 2 that in recent years the eu has lagged behind the us in productivity growth, and within the eu the Netherlands takes up a middle position. The Netherlands performs below the eu average in six out of eight indicators of innovativeness. It was shown in chapter 5 that although in recent years the number of new firms has risen rather spectacularly, this can largely be attributed to employees continuing their activities in self-employment for fiscal and 'lifestyle' reasons. On average, small- and medium-sized enterprises (smes) in the Netherlands have become less rather than more innovative in the last decade, and the percentage of innovative smes is much lower than the eu average. Therefore, there is an urgent policy issue: how can innovation be increased? have argued that innovation is a system phenomenon, with multiple types of individual and collective agents, including firms, entrepreneurs, institutes for education and research, policymakers, regulatory agencies, and many types of services and intermediaries, interacting in a variety of ways. Actions and interactions are enabled by institutions and forms of organisation (of firms and between firms), and in turn affect those institutions. In this innovation system institutional logics and dynamics arise that are difficult to manage, and yield unexpected and often adverse effects.

As argued in chapters 1 and 2, for an adequate innovation policy we need an adequate understanding of the micro-level actions and interactions of agents, in competition and collaboration, in idea generation, implementation, and diffusion of innovations. Little is known of the micro-foundations and institutional conditions of innovation policy, and the purpose of this book is to contribute to the further development of that insight and corresponding policy.

In this book we have discussed theories of cognition, learning, and trust (chapters 3 and 7), and we have analysed the following elements of the innovation system: the generation and utilisation of ideas (chapter 4), entrepreneurship (chapter 5 and 6), and the internal (chapters 8 and 9), and the external organisation of innovation (chapters 10 and 11). In this final chapter we summarise the main lines of analysis and we present our conclusions.

We begin with a summary of the conceptual and theoretical perspectives that we have used. We proceed with a critical discussion of targeted industrial policies, and a discussion of market, system, and government failures. This is followed by policy implications regarding different parts of the innovation system: knowledge, entrepreneurship, organisation, networks, and regions.

Perspectives as discussed in chapter 3, in this volume we take a perspective informed by an Austrian, in particular Hayekian, and an evolutionary view of markets, where diversity, local specificity, and idiosyncrasy of knowledge form sources of innovation, in an experimentalist society. This yields a plea to afford autonomy and to create conditions for lower-level actors to experiment with solutions of their own devising within broadly defined areas of public policy. For this, entrepreneurship is crucial, as discussed in chapter 5. We also take an institutionalist view of markets, in which markets and institutions co-evolve in the innovation system. Markets require institutions but also create institutions that may obstruct the emergence of new markets.

An evolutionary perspective yields an appreciation of radical uncertainty and the role of variety, for exploration, and the corresponding role of trial and error, the need for a selection environment of markets and institutions to select among them, and the transmission of success. We add a Hayekian awareness of the distributed nature of knowledge. Together, the two perspectives suggest modesty concerning the ability of governments, especially central government, to 'pick winners', choose the right parties for 'backing winners', and to design innovation trajectories. Yet, it does not leave policy empty-handed. In addition to the traditional market failure arguments for policy interventions in (innovations in) public sectors, one can identify 'system failures' in the processes of idea generation, innovation, and diffusion that governments should address, to enable and facilitate evolutionary processes, without claiming to be able to outguess innovation in the prediction of the outcomes of those processes. The unpredictability of innovation lead to the requirement of openness in the course of innovation processes and their outcomes, to allow for surprises and changes of direction along the way.

However, the evolutionary perspective is in danger of neglecting creativity and invention. The creation of variety, in new ideas, is not as blind as it is in biological evolution, and we need a theory for it. A central issue, analysed in chapter 3, but returning in several if not all other chapters, is how to combine exploration and exploitation, within and between organisations. In learning and innovation, on all levels, of people, teams within organisations, firms, and public policy, there is a tension as well as a mutual dependence between exploitation, or first-order learning, in the application and improvement of new ideas, principles, designs, or logics, and exploration, or second-order learning, in which they are generated. On the one hand the two build upon each other, or emerge from each other, but on the other hand they have different requirements, in terms of mentality, approach, modes of governance, and organisational conditions, and are difficult to combine at the same time and place. We find this tension in firms (between research and development on the one hand and operations and production on the other hand), in the tension between entrepreneurship and management (in the relation between university (exploration) and industry (exploitation)), and in the tension between the design and implementation of policy.

In economic policy, there has been a focus on exploitation to the neglect of exploration, which requires a dynamic perspective. The fundamental duality and tension between exploitation and exploration has to be faced in innovation policy, and its consequences have to be developed and translated into policy measures, in most if not all parts of the innovation system. In chapter 3, we analysed a 'cycle of discovery', as a model for a 'knowledge ecol- ogy'. According to this model, exploration is stimulated by submitting established practice to new challenges, in new contexts of application, to gain fresh insight into its limits, to build motivation to change, and to find inspiration of possible elements and directions of change, as an avenue of discovery. The cyclical nature of learning, with exploration and exploitation building upon each other, yields the requirement of openness of entry for new players, outside entrepreneurs, and inventors. It also requires openness to the world, allowing for connections with outside communities, and for avenues of discovery. In policy making it requires openness to ideas, goals, and experiences of citizens.

As discussed in chapter 3, the Hayekian view of diverse and dispersed knowledge can be connected, going beyond Hayek, with an 'embodied' view of cognition, including perception, interpretation, and evaluation, as based on mental categories that constitute absorptive capacity and are constructed in interaction between people. Here, cognition is both individual and social: an individual construction based on interaction. This yields 'cognitive distance' between people to the extent that they have developed their cognition along different life paths. This yields both a problem, of imperfect understanding, and an opportunity, of new insights. Information needs to be absorbed to become knowledge.

Knowledge is transmitted only imperfectly and with greater or lesser effort. This applies not only to 'tacit knowledge', as widely recognised, but also to codified knowledge, since that can also only be absorbed to the extent that it fits into absorptive capacity. Knowledge absorption, or assimilation into cognitive frame- works, entails transformation, to a greater or lesser extent. Thus learning in the sense of acquiring knowledge to some extent also entails the creation of knowledge. That, by the way, is also why it is difficult to completely separate the creation from the adoption of innovation (in diffusion), since adoption always entails transformation and in that sense is innovative. Absorptive capacity is subject to development: more knowledge enables the absorption of further knowledge. In other words, knowledge is cumulative. For innovation, diversity and cognitive distance are indispensable. The policy implications of this are that formal and informal institutions should be aimed not at eliminating that distance but at the ability to cross it. The benefits of cognitive distance yield an argument that for innovation actors (people, firms) should profit from outside collaboration with others, at optimal cognitive distance. On a fundamental level, that is what lies behind the currently fashionable notion of 'open innovation'.

On the governance side, a crucial theme is that of trust, discussed in chapter 7. As argued above, collaboration is especially necessary for innovation. We need collaboration to profit from cognitive distance, but especially in innovation governance of relationships by contractual and incentive control is problematic, due to the uncertainty of innovation and the novelty of emerging knowledge and competence, which limit contracting, monitoring and the evaluation of competence and performance. Especially in the earlier stages of innovation, i.e., exploration, one does not yet know what the goals, means, causalities between them, and requisite resources will be. In other words: problems are 'untamed'. As a result, relevant stakeholders have to iterate in their collaboration, in the hope of converging on a basis for exploitation. This is difficult to govern by means of contracts, monitoring, and control. But what is trust, how does it work, and what are its limits? Crucial for trust is openness of communication ('voice'), in which one voices concerns, reports one's weaknesses and mistakes, and responds constructively to such openness of partners. To further innovation, but more generally to provide scope for professionalism, we should get away from current tendencies towards excessive control and monitoring of work, and master the art of voice in the building of trust. chapter 7 provided indications on how to do that.

Our key message is that innovation policy should create and maintain openness, in four dimensions: openness to uncertainty in the innovation process; openness for collaboration with others at a fruitful 'cognitive distance'; openness for new entrants; and openness to the world outside. This fourfold openness for innovation stands in contrast to much theory, policy, and practice of innovation, which in many cases locks up innovation in preconceived targets, established players, national programmes, isolated activities, and relationships at arms length that lack collaboration and openness of communication. The different chapters of this book serve to make these dimensions of openness more concrete, and to specify ways to achieve them. Those are summarised in the following sections. First, we proceed with a critical discussion of targeted industrial policies.

Targeted Industrial Policies

In chapter 1 we noted that one should expect radical, path-breaking, paradigm- switching innovations to be rare, particularly in a small country like the Nether- lands. Most innovation will be exploitative, incremental, or imitative. There, in a wide range of application across the economy, invention achieves its greatest economic impact. Clearly, then, a priority for policy is to enable and stimulate entrepreneurship to conduct this wide range of exploitative innovation. That is why, in a later section, we indicate how entrepreneurship may be enhanced, based on the analysis in chapter 5.

The question next is in what areas 'we', as a nation, should choose to be leaders, accepting that we are mostly followers. Here, a temptation arises for policymakers to make a choice in targeted industrial policies, on the basis of expected unique strengths in the future ('picking winners'), or to enhance strengths that have been proven in the market ('backing winners'). The former approach was taken, in the Netherlands, in the 1980s, with a choice of 'arrowhead' sectors, and the latter policy is being pursued now, with the choice of 'key areas'. Picking winners is now recognised as going against the unpredictability of future success. One cannot outguess the evolutionary process, and as much as possible one should leave the errors of choice up to private business, in a wide range of experimentation in diverse directions that occasionally, somewhere will yield unpredictable success. The argument for backing winners is that in proven success errors and misfits have been weeded out. Another argument that is used for backing winners is in fact an old argument of comparative advantage, now applied to areas of knowledge or competence. If we are successful in certain areas this reveals comparative advantage, upon which we should capitalise. However, who says that present success guarantees future success? Again, we cannot outguess evolution. Also, success is often the result of strength developed from challenge and struggle, and may be weakened rather than further strengthened by support. Innovation when cuddled may only survive in an artificial way.

An argument that has also been used for backing winners is an argument of concentration: we cannot afford to spread money and attention around every- where. For the sake of efficiency we have to concentrate it where it is best spent, and that is where quality is highest. In chapter 1 we acknowledged that economies of scale do occur, sometimes, for example in transaction costs, but there are also diseconomies of scale, and moreover any advantages of scale have to be traded off against loss of variety. Spreading experimentation over a variety of many small- scale trials increases the chance of breakthroughs while limiting the losses that arise from failure, compared to fewer bets on larger projects.

Furthermore, the question with backing winners is why they should be backed if they are winners? If they have been proven in the market, they are generating profits for their expansion. Such policy carries the risk of confirming what exists, in established ideas, technologies, and players, rather than stimulating the emergence of novelty generated by outsiders. Backing winners may confirm or even raise obstacles to entry for new challengers. In our view, the priority should lie in keeping the system open to outsiders. This entails prioritising space and incentives for entrepreneurship. Upon closer inspection and debate it turns out that what is in fact intended by the Dutch policy of backing winners, is better labelled as 'mobilising unrealized potential', i.e., eliminating obstacles for the full utilisation of proven strengths.

Of course, government certainly has a task in seeing that potential is realised, for example by breaking down barriers to innovations. Barriers may arise from the lack of appropriate infrastructure, skills, education, technical standards, vested interests, problems of high costs due to initial small scale and lack of learning by doing, and systemic complexities. There may be market or system failures, and then there is an argument, in principle, for government intervention, but those barriers then have to be specified. We consider such barriers in a subsequent section on failures of governments, markets, and systems.

On what basis would government make choices? Part of the problem is that in from industry, and these tend to be offered and taken from established large business (small firms hardly have the staff to spare, for example to participate in such committees). Naturally, their suggestions are coloured by their experience and interests – hen they slide into positions where they can protect their interests, it would be naive to assume that they would not. In particular, in innovation large incumbent firms are tempted to engage in 'preemptive participation'. Here, they do invest in the r&d needed for innovation, if only to have a basis for appropriating innovation if it does break through, but hold back on implementation and breakthrough as long as the innovation would cannibalise existing, sunk investments, when those innovations are incompatible with it. This is not a matter of 'evil plots' but of institutional logic. In the Netherlands, this phenomenon is intensified by the country's peculiar industrial structure, with a hydrocephalus ('waterhead') of a relatively large number of very large firms, in combination with a small number of medium-sized firms, whereby the large firms are likely to exercise a disproportionately large influence on public policy.

There are also policy bandwagon effects. If one targets a particular industry or technology in innovation policy, everyone in that area wants to take part, and on what basis would government refuse them? It is not only a matter of whom to admit but also of whom to exclude. On what basis would government determine that exclusion is justified or unjustified? Moreover, other areas worth their salt would lobby to also be recognised as a key area, or at least a potential one. Which area would not consider itself a potential key area? In this way backing winners might lead to picking winners (or: winners picking governments) again.

Finally, there are obstacles of bureaucracy, in government failures. We will discuss those in more detail later, but here the point is that participation of the government in the funding, facilitation, and monitoring of consortia for innovation entails bureaucratic entanglement, with consequent delays, irritations, and frustrations among business partners. It is naïve to see this as a simple matter of lack of competence, will, or commitment on the part of civil service. It is due, again, to an institutional logic that follows from the need for public spending to be publicly justifiable and accountable, with a division of competencies and authority across different sections and levels of a government department, and in innovation often also across departments, to accommodate novel combinations.

Clearly also, there are sectors of activity where, for classic arguments concerning public goods and externalities, government needs to take the lead, such as health, education, infrastructure, mobility, energy, environment, security, and, increasingly, the provision and control of water. In matters of societal interest with a public goods nature, government should not just back winners but also pick them, even in spite of the inevitable errors in trying to outguess evolution, because private firms do not take the lead. If private firms cannot be tempted to make choices that are liable to mistake, then government must make them.

Next, there is the issue of openness to the world. In particular, do targeted industrial policies satisfy our condition of openness to the world? Or are they in danger of locking innovation up in a country while the priority may lie precisely in linking national activities into globally fragmented value chains, as argued in chapter 1? The latter danger is not unrealistic: in a survey of measures of Dutch innovation policy, in chapter 10, it was shown that of 21 measures only one was explicitly directed at international collaboration (the Innovation Subsidy for Collaborative Projects). It is true that implementation of policies for chosen key
areas does occasionally include measures to make international connections. Typically, this occurs ex post. However, in the basic choice and design of key areas there is the simple point of institutional logic that an eu nation is not inclined to involve organisations from other eu countries in its national innovation

policy, so that the basic design is necessarily nationally oriented, while the choice and design should be taken in an international perspective from the very beginning. In other words, the choice, ex ante, of what to do, and of whom to involve, should be internationally oriented, and not only the choice of how to implement national choices. An example of how national boundaries constrain innovation projects is given below.

Also, if we want to be leaders rather than followers in some areas, then in those areas we should not take a parochial view of excellence and be satisfied with the best that we have at home, but instead we should take a global view, where we build what is best in the world. Innovation policy should beware of policy measures that are nationally oriented and may have the adverse effect of locking innovation up in a country when instead innovation policy should enable international connections.

In sum, utmost caution should be taken in any policy of backing winners. The emphasis should lie on enabling challengers. There may be arguments for lowering obstacles in the realisation of proven innovative potential, but these obstacles should be made explicit as a basis for policy and its design. But what, then, is our answer to the question of where to be leaders and where to be followers in innovation? We maintain that one should exercise restraint in backing winners, except in cases of market or system failures, since in principle winners in markets should reap their own funds for expansion.

Failures of Governments, Markets, and Systems

Government Failures

Before undertaking any government policy for innovation, the customary question, which is still valid, is why government should or should not act? Why do markets fail, in respect of innovation, what other failures may there be in the innovation system, and what are potential government failures? Usually, the analysis starts with market failures and ends with government failures. Let us do it the other way around.

The main government failure, in line with Hayek's ideas, is that government does not have an adequate grasp of the varied – to a greater or lesser extent idiosyncratic and context-specific – local knowledge and insights that are distributed across society. In view of diverse and distributed knowledge, government should be modest about its grasp of what can be done, and should tap into local knowledge rather than impose its own.

Government is vulnerable to being taken hostage by established interests. It needs the knowledge and support of industry in the design of subsidies and other schemes, but design and implementation then inevitably carry the imprint of their interests, as we discussed above. Also, in the discussion of the foundations and limits of trust, in chapter 7, we noted that government is more vulnerable to loss of reputation, and has to be more careful with commitments and openness of information than industrial firms. Since government is more vulnerable to opportunism than business, it should beware of confirming established interests by getting involved in close relationships with industry.

Earlier, we noted that bureaucratic entanglement is inevitable when government becomes involved in programmes or projects for innovation, as a result of the imperative of public accountability. The question is how this can be fulfilled without generating the delays, irritations, and frustrations that result for business partners. Here, the principle comes to mind of an 'account manager', which is already familiar in business: there should be a single point of contact. This account manager carries the responsibility, and is given the authority, of coordinating across departments and across segments and levels within departments. We see this as a basis not only for resolving coordination problems, but also for policy learning. The need for an account manager to coordinate across departments or segments within departments exerts a pressure to take cognisance of inconsistencies or incoherence between regulations, rules, or processes, as a basis for simplifying or revising them. This pressure is greater than when it is left to the outside partners to deal with the problems of bureaucratic entanglement. In this way, the public internalisation of transaction costs may best stimulate their reduction by streamlining and integration. The problem of bureaucratic entangle- ment is exacerbated by the condition, argued in chapter 3, that in innovation, particularly when exploration plays a large role, there should be openness concerning the course of a project, to allow for the surprises and changes of direction that are inherent in innovation. This is at odds with any ex ante specification of 'deliverables' that must be achieved for payment of the subsidy. An alternative then is to attach an official to the process, to monitor progress, discuss and authorise changes of direction, and to assess the value of outcomes that deviate from expectations. This entails a fundamental switch from the authorisation of deliverables that need to be specified up front, to the authorisation of the process as it unfolds, and/or the value of outcomes, ex post. Thus, a public account manager has the task not only of coordinating public contacts, but also of authorising progress and legitimating outcomes.

Earlier we noted the risk of government becoming hostage to private interests, when playing an inside role in collaborative programmes or projects. Now the additional problem is that of temptations of favoritism or outright corruption. Can this problem be resolved? We suggest a solution. Public account management and process authorisation should be accompanied by safeguards of account- ability. This probably requires a supervisory board, to specify boundary conditions and for accountability ex post. Account managers submit verifiable reports according to standards specified by the board, which are scrutinised, integrally or by sampling, ex post. This entails correction of the conduct of account managers, and a basis for learning, in an adjustment of rules and procedures. This increases transaction costs, but it is not clear a priori that total transaction costs, for government and business, increase. They may well decrease, even substantially. That is an issue for further investigation. Crucial here is that the arrangements allow for more openness of innovation.

Market Failures

Knowledge does not suffer as much from the market failure of non-excludability as has been assumed in earlier economic theory, since it cannot always spill over easily, due to cognitive distance and limited absorptive capacity. As discussed in chapter 4, a policy question is to what extent protection of intellectual property (ip) is still needed. We suggest that the degree of ip protection should be weakened – by shortening the period of protection, by raising the originality bar, and by making compulsory licensing and parallel imports easier (Chang 2007: 143).

Where patent protection is still needed, for small, independent innovators there are transaction costs with effects of scale in the acquisition, monitoring, and protection of intellectual property rights. Acquiring a patent is costly, especially for smaller firms and especially the first time when the procedure is unfamiliar, as is the cost of determining if a certain patent already exists, and also the monitoring and fighting of patent infringement. The procedure is also too slow, especially for small firms, who often have to move fast and lack the resources to wait long. There should be a single eu patent, not complicated by language issues, available through a faster process, and a lower price for searching, filing, and renewing a patent, as well as support for small firms in the identification and redress of infringement. This is on the agenda of present innovation policy, but its urgency should again be highlighted.

As indicated above, market failure in the appropriation of rewards from knowledge is not as strong as previously thought, due to cognitive distance and limitations in absorptive capacity. However, the reverse side of that coin is that there are serious market failures in diffusion of innovation. Knowledge ‘transfer’ is a highly misleading term. Firms with limited absorptive capacity cannot easily capture innovative opportunities. Often this creates a problem particularly for smaller and more traditional firms, who for reasons of scale lack specialised expertise. Also, particularly in more traditional smaller firms knowledge is often highly tacit, transmitted via ‘learning by doing’ rather than formal learning. Tacit knowledge is harder to assess by outsiders than codified knowledge, and tends to be self-evident to the bearer of the knowledge, which makes criticism of existing knowledge and practice, and hence adoption of innovations, more problematic.

Lack of absorptive capacity and a high degree of tacit knowledge yield what one might call ‘cognitive’ transaction costs, and these are relatively high for many small firms (Nooteboom 1993). Therefore, there is a good rationale for a subsidised knowledge transfer service to small firms, as offered by the Dutch‘Syntens’ organisation.

As argued in chapter 3, exploration requires time and slack resources to deal with uncertainties of goals, means, causal relations between them, and resources needed, in iterations with relevant stakeholders, and this slack is likely to be eliminated by extreme price competition. This constitutes a newly recognised market failure for innovation. Here, the failure is not that the market does not work, but that it works too well, in the sense that price competition is so intense as to squeeze out resources for exploration. We suspect that this is one of the reasons why industry has cut down, or even abolished, its more fundamental
‘blue sky’ research, and is now falling back on universities for such research.

For collaboration for innovation we argued that, as elaborated in chapter 7, a minimal duration of relationships is needed to make and recoup relation-specific investments in mutual understanding and trust, and that we should strive for optimum, not maximum, flexibility of relationships. This has implications for competition policy. Competition policy should allow for dedicated collaborative relationships, with specific investments needed to utilise cognitive distance, to have an adequate duration, even if this means temporary exclusivity and hence limitation of competition.

Mobility of labour helps innovation, in both the diffusion of new practice and exploration. In particular, innovation is stimulated by movement between exploitation and exploration. However, for labour also the logic applies that a certain stability of a job is needed to elicit the specific investments in mutual understanding and trust that is needed to cross the cognitive distance that is conducive to innovation. The argument extends to the ownership of firms, in issues of corporate governance. There also, ownership should not be so volatile as to discourage specific investment needed to build networks, mutual understand- ing, commitment, and corresponding trust. This means that in relations of work and ownership of firms, we need a corrective to the present discourse of maxi- mum flexibility, aiming for optimal, not maximum flexibility.

System Failures

System failures arise from mismatches between elements of the innovation system. These are many. In the previous section we discussed the institutional logic of ‘pre-emptive participation’. Some system failures go beyond the scope of this book. One of those is lack of adequate education and training to match new ideas or practices. Other system failures have been discussed in various chapters in this book, and conclusions will be presented below. One of those is an apparent lack of connection between the generation of new knowledge, at universities, and its application, in industry, as discussed in chapter 4. A second is lack of finance for entrepreneurship, discussed in chapter 5. A third is lack of adequate anagement and organisation to deal with the need to combine exploration and exploitation, discussed in chapter 8, and to provide conditions for the functioning of creative teams, discussed in chapter 9. These failures, and implications for policy, are discussed in subsequent sections. Another system failure is lack of trust and ability to collaborate, in alliances for innovation, discussed in chapter 7. Another system failure is the reverse, in a sense: lock-in into established interests and positions, discussed partly in chapter 7 and partly in chapter 11.

In our critical discussion of the policy of 'backing winners' we granted that there may be problems of coordination in the collaboration needed to utilize opportunities of novelty, and that this might yield an argument for government intervention. Here we will focus on that issue. Regularly, stakeholders get stuck in stale- mates of manoeuvring for position, in choosing which option to take, which standard to establish, and how to divide influence, costs, risks, and revenues.

In terms of game theory, players can get caught in equilibria of non-cooperation ('prisoner's dilemmas'). Often, players need each other but are also rivals. Examples are technical standards or market structuring. Some solutions are closer to established practice and knowledge of a given player than others. It may be difficult to bring manoeuvring for position to an end. Once equilibrium is found it may be very difficult to find new equilibrium when conditions change. An outside party, like the government, may be required to take steps to solve the dilemma. We have heard this argument for government intervention several times, also from industry. We are sceptical about this. There are conditions where intervention is indeed needed to unlock such lock-ins. This may be a task for government, but there may be alternative intermediaries. And if, for want of adequate intermediaries, there is indeed a need for government to intervene, it may have to be only a short-term 'nudge', after which government can retire, rather than maintain ongoing involvement. As indicated earlier, government can be taken hostage in tugs of influence.

The real issue, it seems to us, is that rather than running to government for help as soon as deadlocks arise, industry should face up to the challenge of developing the capabilities needed for collaboration and network formation, in the new networked knowledge economy. Also, as argued in chapter 7, there are interesting entrepreneurial opportunities in a new branch of business services to provide the roles of go-betweens to facilitate collaboration for innovation. There is consider- able knowledge concerning the issues involved and ways to deal with them, which can be exploited commercially (Nooteboom 2004).

Chapter 6 showed how specific the problems can be, in unique configurations of positions and interests of different stakeholders that are difficult to translate into general regulations. Solutions then need to be case-specific, to be effective and to forestall further accumulation of regulations. There may be a role for a 'deblock- ing brigade'1 that is expert in managing complex relationships and has the author- ity to cut across different areas of departmental and jurisdictional authority, and can be called in when unyielding systemic failures occur. We propose this deblocking brigade partly as an alternative to the targeted industrial policies that we criticised earlier.2 In sum, government should exercise utmost restraint in participating in the configuration, design, planning, and progress of collaboration between private actors. It should stimulate private actors to take their own responsibilities, and to develop their own capabilities in collaboration, and it might stimulate the development of business services that facilitate collaboration. Government should intervene only when obstacles arise that are inveterate to the point that they cannot otherwise be resolved.

Earlier, we discussed government failures, and the de-blocking brigade should be consistent with that analysis. First, clearly officials at the brigade should be masters in the management of collaborative relationships and networks for innovation. Second, the process requires an 'account manager' with sufficient author- ity. This 'account manager' should provide a single point for integrated and consistent access to the public stakeholders involved. Third, when the issue at hand involves a prolonged process of innovation, this official should have the authority to authorise changes of direction in order to maintain openness to innovation. The official should be able, or have the resources, to establish a valid judgement about the quality of the outcome of the process, when it does deviate from expectations. Fourth, to cover the risk of favouritism or even corruption that such a position of power and trust could elicit, the brigade should be subject to a supervisory board that establishes boundary conditions, and to which project managers report for possible correction, ex post. This board would be accountable to parliament, through a minister that has this in her portfolio. The reporting procedure should provide a basis for policy learning.

Generation and Utilisation of Knowledge

Valorisation

In chapter 4, we considered the system failure of the supposed 'knowledge paradox', according to which in the eu in general and the Netherlands in particular scientific performance is fine, but fails to be adequately carried forward into innovation. Presently, in the Netherlands, this problem of utilisation, or 'valorisation' as it is called, carries high priority in innovation policy.

In chapter 4 we noted a perverse effect of forcing universities to ask for a fee for any knowledge they supply to industry. Pricing this knowledge provision is not efficient in view of the transaction costs involved. Furthermore, even from a commercial perspective it is better to allow for an ample threshold of free advice that forms the basis for judging the merits and feasibility of a contract for a more substantial research project.

In the preparation of this book we developed some ideas on how the interaction between university and industry in exploration could possibly be improved, and we tested those ideas in a series of interviews with four universities, a polytechnic, two technical institutes allied with universities, two medium-sized firms (motek and otb), and three large corporations (Unilever, Shell, and Philips).

The main result is that among our respondents the problem of valorisation is not perceived to be quite as large or urgent as it is among policymakers in 'Dutch government. Many forms of collaboration have already been developed. Lessons can be learned from this, improvements can be made, and it may be useful to collect and diffuse the resulting principles, summarised below. The principles that emerged from our own analysis, in chapter 3, plus feedback from the inform- ants, are as follows.

A key principle, in our view, is that the relation between university and industry is not only a one-way process of putting university research to use, in exploitation, but a two-way process in which inspiration is also provided from practice for more fundamental university research, in exploration. Theoretically, this follows from the analysis of the 'cycle of discovery', in chapter 3, in which exploitation and exploration build upon each other. Most respondents acknowledged the validity of this principle.

Another key principle, to ensure exploration, is that meetings between people generate ideas and projects, around a broad theme, rather than that projects are specified beforehand for participants to subscribe to. This is related to the Hayekian principle that innovation projects should tap into the diversity of knowledge and ideas spread around different communities, and the principle that projects should be sufficiently open to allow for surprise and change of direction.

It proved useful also for other reasons to employ the distinction between exploitation and exploration. Exploitation emerges in more or less straightforward contract research, in which industry can specify and contract for desired outcomes. Exploration arises in collaboration between universities and industry to literally explore uncertain but possible developments, in new technologies, areas of application or problems to be investigated. In line with our earlier analysis, in chapter 7, which yielded a recommendation for optimal rather than maximum flexibility, it was recognised that in such collaboration for exploration each actor should take enough time to get to know and understand each other ('speak the same language') and build trust, since in such settings contractual control, for example of property rights, is difficult, cumbersome, unworkable, or even counter-productive. On the other hand, there should be enough turnover of people to maintain variety of ideas and sufficient cognitive distance.

Concerning the issue of intellectual property and 'spillover', respondents noted a growing awareness that a relaxation was in order: to get knowledge one should offer and risk knowledge, in many cases exploration was sufficiently 'precompetitive' not to yield a direct threat, contractual control would not work in early stages of exploration (there isn't yet anything well defined to appropriate), and people simply could not make progress without each others' knowledge. This does not mean that issues of intellectual property have disappeared, but that in early exploration they are less urgent or even do not arise. As one respondent said: patents from early exploration are likely to have elapsed before exploitation is reached.

For some respondents it was fine to conduct exploration more or less ad hoc, with different groups of partners on different occasions. The advantage of this is flexibility. Others were aiming at more durable, 'strategic' relations, as a basis for building understanding and trust. An element of such relations was also the provision of temporary staff and exchange of personnel, for the duration of a project. Some respondents expressed apprehension at too close and extensive an involvement of firms in universities. That may interfere with the independence of universities and their task, generally seen as legitimate and important, to do independent fundamental research, and it may be seen by others (for example, politicians and the public) as appropriation of public institutes by business.

A solution here may be the concept of a 'third space', between university and industry, in the form of an actual institute, with residential facilities, dedicated to their interaction, financed jointly by business and the government, with the express task of enabling and facilitating meetings and joint projects to utilise cognitive distance for the sake of exploration. Such separation from both university and industry may serve to protect the integrity of the university and ensure that the work does not fall back into exploitation induced by commercial pressures. A condition for this to work is that participation by academics is seen as legitimate, and is given a place in the system of performance evaluation. For industry, a condition for this to work is that their staff views participation as a good career move within the firm. A third space could perhaps also function as a platform for entrepreneurial spin-offs. In that case the set-up may also involve venture capitalists. Mostly, the respondents from university and technical institutes claimed that they practised what we suggested, and that something like 'third spaces' already were a reality. We acknowledge that, but not all potential participants seem to be aware of all relevant options, and we believe that the people involved can still learn, mainly from each other.

Valorisation may be less of a problem than is perceived by policymakers. The actors involved, in industry and academia, have developed forms of interaction for both exploitation and exploration, oriented at both application and inspiration of university research. However, options and forms can still be further developed and improved. Government has only a limited role here – to ensure that adequate incentives are in place for university staff to participate in interaction with industry and to disseminate experience in modes of collaboration.

These arrangements are appropriate for large firms and for small firms with adequate absorptive capacity, such as high-tech firms or spin-offs from universities or large firms. However, the limited absorptive capacity of most smes makes Dutch institutes of higher vocational education a more suitable collaboration partner for them than universities. To play this role, institutes of higher voca- tional education should be given the resources to conduct applied research.

Funding University Research

An issue in relation to university research, is to what extent such research should be programmed and rewarded according to societal needs. We do acknowledge the legitimacy to indicate broad areas of public priorities, such as energy, environment, water, health care, and aging. However, in line with our Hayekian perspective, we are wary of bureaucrats in central offices, at ministries, and national science foundations, specifying programmes or projects for which scientists or businesses may then submit tenders. Why should they know better than the totality of differentiated and dispersed knowledge? There is a danger also of fashionable 'hypes' directing research. Ideas should be allowed to arise from below, from the wellsprings of variety. This would also mean that within universities ideas for Ph.D. projects should come more often from Ph.D. Candidates themselves than from their supervisors, as is the rule in the us but occurs in the Netherlands only at some universities. It must be possible to allow for this and still achieve sufficient coherence and connection between projects.

On the basis of a traditional logic of public goods, we propose to back winners in scientific achievement, with awards that yield funds for expansion to proven researchers and research leaders. The merit of such a policy is that it avoids the problem of trying to predict successful new ideas, and provides the means for success to expand where it cannot generate its own profits to do so. As discussed in chapter 4, in the Netherlands we have such awards, notably the 'Spinoza prize'. Note that the award does not yield a higher income to the researcher, but funds to expand his patently excellent line of research. What successful firms get out of profits researchers should get out of awards. The logic of this principle is that in order to avoid the paradox of outguessing evolution, and as a means of extending the scope of success, one gives a reward afterwards for proven success if the research cannot get such a reward from a market. We applaud awards for proven personal excellence, allocated in second-stream funding. In addition to that, however, funding on the basis of prior assessment of the merits of a research proposal is also needed, to allow for newcomers and outsiders, but this is more problematic, in view of the difficulty to predict the value of exploratory research. As argued in chapter 4, here we have a preference for the first stream, in view of the greater variety and richness of local knowledge and perspectives for generating and evaluating proposals.

A further issue is inter-disciplinarity of university research, as discussed in chapter 4. While there are good reasons for disciplinarity, both radical novelty and application often arise across the frontiers of disciplines. However, universities are mostly oriented towards, and organised according to, disciplines. This was noted above as one of the complications in university-industry collaboration. Indeed, one of the reasons for university-industry collaboration, possibly in third spaces, is to stimulate interdisciplinary exploration. In this respect, measures are needed to facilitate inter-disciplinary research, for example with special programmes at the Science Foundation, and measures to recognise and reward interdisciplinary research at universities, in formal assessment systems and Ph.D. programmes.

Entrepreneurship

In view of our evolutionary argument for variety generation, and our plea for openness to surprise and to challengers of the status quo, entrepreneurship is of central importance for innovation. In chapter 5, we distinguished between Schumpeterian entrepreneurship, in breakthrough innovations, and Kirznerian entrepreneurship, in more incremental innovation and 'arbitrage' in filling gaps between supply and demand. The former are needed to produce innovations and the latter to diffuse and fully profit from them. While the second type does not and should not form the focus of innovation policy, it is important for economic. policy more widely, in order to diffuse innovation into all relevant parts of of society and to profit fully from innovation in economic growth. Self-employment may also yield an escape from unemployment. Beyond economics, self- employment has an important societal value as a stabilising political factor, for example as an avenue for emancipation, an escape from discrimination in labour markets, and for social acceptance.

The majority of self-employed people are of the second, Kirznerian type, if innovative at all. That is not surprising: as argued in chapter 1, one should expect only few breakthrough innovations relative to incremental innovation and diffusion. For innovation policy we focus on the more dynamic, Schumpeterian entrepreneurs. Research tries to identify these in new technology-based firms, corporate venturing, spin-offs, and high-growth start-ups. On the basis of recent research it was shown in chapter 5 that notwithstanding a recent increase in the number of self-employed people in the Netherlands, on average small- and medium-sized enterprises (smes) have become less and not more innovative in the last decade (1999-2007), and the percentage of innovative smes is much lower than the eu average. The Netherlands is lagging behind internationally with respect to entrepreneurial activities in general and ambitious entrepreneurship in particular. In view of the importance we attach to entrepreneurship for an open system of innovation this is a serious matter.

Another striking finding is that, counter to received wisdom, there is a relatively low 'fear of failure' in the Netherlands. Since this does not explain lack of innovative entrepreneurship, then what does? It may be lack of ambition. If it is, such a cultural feature is hard to change, certainly in the short term. So, we turn to markets and institutions. In particular, while venture capital has developed in the Netherlands, there is still a perennial problem in the Netherlands, as elsewhere, in the provision of early stage finance ('seed capital'). Here we make a link to the need for major efforts for innovation in public sector activities such as those related to energy, the environment, climate change and water management, ageing and health care, and congestion in transport. Since government will have to make a major investment in research and development in these areas, this might also be used to stimulate and mobilise entrepreneurship. In view of institutional logic that tends to favour larger firms, it would be a good idea to systematically channel public funds for r&d to smaller firms, in imitation of the sbir programme in the us.

Corporate spin-offs are a much more important phenomenon than university spin-offs, both in number and in impact. In chapter 5 we discussed the conditions for corporate spin-offs. The advantage of such spin-offs, from the perspective of combining exploration and exploitation, is that they carry relevant experience from business into new ventures (See chapter 3). Chapter 11 also offered evidence of the importance of spin-offs for innovation. Corporate spin-offs might be stimulated by lowering barriers such as anti-competition clauses. Innovation policy and innovation strategies of large firms should stimulate corporate venturing to a larger extent, for example by showcasing best practices.

In our analysis of interactions between university and industry, in chapters 3 and 4, we noted the danger of too many market pressures within universities. That provided a basis for considering 'third spaces' between university and industry. This notion of a 'third space' also has implications for the development of 'business incubators' at universities. Facilitating the growth of promising university spin-offs by privatised incubators both provides these incubators with more competent staff, and protects the university in its role as producer of public knowledge.

The fragmentation of present innovation policy in the Netherlands, and of schemes and regulations more widely, yields high transaction costs, which weigh more heavily for small firms due to effects of scale in transaction costs (Noote boom 1993). Often, these costs are in the nature of a fixed effort of search, contracting and monitoring compliance, which weigh more heavily on small volumes of business than on large ones. In addition to such familiar types of transaction costs, we noted cognitive transaction costs, related to absorptive capacity and tacit knowledge, which also exhibit an effect of scale. The case studies in chapter 6 illustrated barriers to innovation, in established interests, standards, procedures, coordination failures, and perverse institutional logics, which can obstruct innovation generally but are especially difficult to overcome for small firms.

Organisation

An important part of organisation for innovation lies in the collaboration between firms and other organisations, in open innovation. This has been discussed above, and it reappears in the discussion of networks. Here the focus is more on internal organisation. Public policy has at best an indirect role to play here, for example in the diffusion of best practices in organising innovation, and hence this section is modest in scope. In chapters 8 and 9 we analysed organisational conditions for innovation, and perspectives for organisational innovation, concluding that there are enormous as yet unexploited opportunities. Perhaps this is the cause of the Netherland's apparent lag in total factor productivity relative to the us, which appears to be ahead in this regard.

There are many opportunities to improve the efficiency of exploitation, but the big challenge is how to combine, within an organisation, or to connect, between organisations, exploration and exploitation, in 'ambidextrous organisation'. In chapter 8 we found ways to do this. In chapter 9 we identified conditions for the functioning of creative teams within organisations. The problem, however, is that the more short-term oriented and familiar conditions of exploitation tend to prevail and to squeeze out exploration, which is also more vulnerable to pressures of price competition. This appears to lead to a conservatism in management and organisation that the Netherlands can ill afford.

In chapter 9, we noted that a number of organisational conditions for innovative teams are consistent with dimensions of the quality of labour: intrinsic motivation, autonomy, openness, psychological safety, and inspirational leader- ship. There appears to be an opportunity here for a new alliance between management and labour, to both stimulate innovation and improve the quality of labour.

Related to the combination of exploration and exploitation, but going beyond that, profiting from new opportunities of ict, there are several new forms of platform organisations, in which users can to a greater or lesser extent configure their product, and even contribute to its innovation, and open source communities, where users are the producers. Particularly for government services there are obstacles in present authority relations and in rules of accountability, there are opportunities to make mistakes, and there is low status for 'front-office' workers. There are opportunities to improve innovation, in both quality and speed, not least in government services, by employing the concept of platform organisations, and even, perhaps, of open source communities. For government services, this will require a change of perspective concerning the role and the authority of the 'front office', in suggesting and leading innovation. We have only touched lightly upon the wide issue of innovation in government. The further exploration of opportunities and their exploitation in the innovation of organisation in government services by itself merits further study.

Networks and Regions

We also see conservatism and insufficient learning in the limited ability of public and private organisations to collaborate with other organisations, in open innovation. Too often, organisations engage in the power play of mergers and acquisitions, to maintain hierarchical authority, rather than engage in the more difficult game of collaboration in mutual dependence, where that would be better for innovation. Inter-organisational collaboration yields more flexibility of (re)configuring activities and greater variety and cognitive distance, conducive to innovation. Also, as argued in chapter 7, formal hierarchical authority and control are less appropriate especially for exploration. There is increasing insight into how to manage such relationships, in mastering the art of trust, as discussed in an earlier section.

As discussed in chapter 5, there is complementarity between small and large firms, which should also be taken into account in regional policy. Small firms provide the variety of trial and error needed for experimentalism, and large firms provide a platform for spin-offs of new entrepreneurial firms, a basis for large- scale exploitation (production, distribution) of innovations, and a home for deep specialisation of labour (with a corresponding advanced demand for labour). Also, as argued earlier, large firms are often more interesting partners for universities than small firms, because they generally offer higher levels of knowledge and specialisation, lower transaction costs, and deeper pockets, to engage incollaboration in exploration, possibly in 'third spaces'. For most small firms polytechnics are more natural partners, in view of a smaller cognitive distance.

In chapter 10, a survey was given of features of networks of collaboration for innovation, their effects on innovative performance, and opportunities to gear policy to favourable network variables, such as variety of potential participants, centrality, density, and small world structure, which was also discussed in chap- ter 7. For example, policies to further entrepreneurship contribute to the number and variety of potential participants in networks. As noted in chapter 7, governments have a task in maintaining institutions that support reliability and trust- worthiness of actors.

As discussed in chapters 7 and 10, structure and strength of ties in networks have effects on both competence and governance in networks for innovation. On the one hand, dense and strong ties are needed, especially in exploration, to ensure accessibility to contacts under the volatility of networks, to pool absorptive capacity for understanding sources of knowledge, triangulation for accuracy, and reputation mechanisms, coalition formation and trust building as an alternative to contractual control. On the other hand, strong and dense ties can limit variety and cognitive distance, and can yield cognitive and relational lock-in, thus reducing the variety and flexibility of configuration needed for innovation. A solution to this dilemma lies in 'small world' structures, where local communities with dense and strong ties are complemented with less dense and weaker outside ties to other, similarly structured communities.

The cycle of discovery, discussed in chapter 3, provided the foundations for a call for openness to new contexts, including foreign countries. In chapter 7 we noted that an alternative to external weak and sparse ties is frequent entry and exit of players, to maintain related variety and cognitive distance.

As discussed in chapter 11, in geography there is a notion of 'related variety', concerning activities that on the one hand differ but on the other hand are still similar. The claim is that such related variety contributes most to regional employment. Both more variety and more specialisation yield less growth.

Note the correspondence between the notions of cognitive distance and related variety, where both plea for difference that is enough for potential novelty but not too much to utilise that potential. However, while related variety contributes to innovation, unrelated variety contributes to the spread of risk.

Regionally embedded, diverse, but also related, activities, that are upgraded with processes of localised learning, are less footloose, and do not dissipate as easily to emerging economies (such as China and India) as isolated activities or technologies do. However, there is a danger of locking activities into regional or local 'clusters' that are 'over-embedded', with too high strength and density of ties. The concept of small worlds suggests that there must also be 'channels' that connect an agglomeration with comparable, competing, and complementary agglomerations elsewhere. We call the result an 'open agglomeration'. Here, we wonder whether perhaps universities can provide the connecting nodes of small worlds, connecting regional innovation systems to similar systems elsewhere in the world (cf. Benneworth et al. 2006, Kitagawa 2005). Universities are geared to such access to internationally dispersed communities.

This potential role for universities is to be connected with the idea of 'third spaces' between universities and industry, discussed above. Here, third spaces connect universities with industry, in regional innovation systems, while the universities provide the necessary channels to the world. Local collaboration is probably more geared to exploiting the potential of novel combinations, on the basis of experience and experiments from local related variety, with an interdisciplinary structure and orientation, while the outside, global connections of universities, organised along disciplinary lines, provide a deepening and renovation in specialised areas (Ponds and Van Oort 2006). Universities as connecting nodes, via a third space that connects them to local industry, may also help firms to gain access to new markets of inputs and outputs. That role of providing outside connections is also played by large firms.

In present policy there is an inclination to identify 'best practice' in regional systems, in the form of the configuration of activities and their organisation and governance (the renowned Silicon Valley and Italian industrial districts), and transplant them to one's own environment. This is illusory. As argued in chapter 11, local and regional systems are the historical outcome of the confluence of locally specific and highly path-dependent conditions. The context specificities of these systems are essential for structure and performance and cannot be universalised. Their success must be unraveled in underlying logics, such as those we are trying to set out here. As argued in chapter 11, there is spatial division of labour, with some regions being strong in research, others in innovation, and yet others in production. Different industries tend to concentrate in different regions and within an industry firms may look different in different places. As a result, different regions have potential in different types of activity. It is myopic to focus policy on regions that are strong in r&d, for example, while neglecting potential in application and production. Different indicators, such as r&d, creative workers, and high-tech industries reveal different strengths in different regions, and in the Netherlands it is hardly possible to find a region that is not strong on one or more of these indicators (Raspe et al. 2004).

The argument for regionally embedded policy gains further force when we take in- to account the dynamics of clusters. As discussed in chapter 7, in the early stage of exploration one would expect a relatively high need for local embedding, in strong and dense ties. Later, one would expect a certain amount of disembedding, to utilise the potential of emerging innovations in distant markets, and to achieve access to novel sources of novelty to replenish local variety and restore cognitive distance. This raises considerable complications for a policy for regional clusters and innovation systems. Are policymakers able to correctly identify the stage of development that a local cluster is in, and are they able to implement policy in time, before development has reached the next stage, where the policy may be counter- productive? One may wind up furthering local embedding by the time that disembedding is needed. Regional government seems better informed and better able to act quickly than national government. However, regional/local govern- ment may not be able to break up local structures if they become counterproductive under the creative destruction of radical innovation, illustrated in chapter 11.

In view of local specificity of knowledge, conditions, successes and failures, and the need to choose and implement policies in time to fit the needs of different stages of development, central government should be modest in its ambitions to design regional development, and leave it as much as possible to 'bottom-up' regional initiatives, in the locally specific configuration of relevant variables. Such variables are: related variety, complementarity between large and small firms, collaboration between universities and large firms, and between polytechnics and small firms, spin-off formation, features of network structure, education and training, labour mobility, linkages outside the region ('small worlds'), and inward and outward mobility of firms and people.

National government could then focus on the linkages between regional clusters and other clusters, at home and abroad, the possible role of universities in establishing and maintaining linkages abroad, entry and exit of organisations, establishing safeguards against local or regional clientism and possible corruption, and providing pressure and support to break up regional structures when they become counter-productive under the creative destruction of radical innovation.

There should be a division of labour between central and regional government. This we connect with the notion of experimentalist governance or directly deliberative polyarchy, discussed in chapter 3, where: "… lower level actors … experiment with solutions of their own devising within broadly definedareas of public policy. In return they furnish central or higher-level units with their rich informa-tion regarding their goals as well as the progress they are making..., and agree to respect in theiractions framework rights of democratic procedure and substance… With periodic pooling ofresults... (that) reveals the defects of parochial solutions, and allows the elaboration of standards forcomparing local achievements, exposing poor performers to criticism from within and without,and making of good ones (temporary) models for emulation" (Gerstenberg & Sabel 2002).

And finally, we wonder whether for an overall policy concept we could think of the Netherlands as a 'hub of buzz'; an open knowledge economy or ecology, where as an extension of its traditional function as a portal to Europe, as a hub of streams of goods, it could also function as a hub for meetings of explorers and exploiters of a variety of knowledge. As discussed in chapter 7, this would entail meetings between scientists, producers and users of technology, traders and businesspeople, designers and artists, politicians, diplomats, lawyers, security and police officials, publishers, marketers, and distributors. To support such a hub, we would need a variety of supporting services, in law, finance, transport and distribution, conferencing, education, communication, languages and publishing, accommodation and housing, with attractive spatial, recreational and cultural environments. For all this, we would need a renaissance of traditional openness to other cultures. Hopefully, the Netherlands might be a place where people meet at a fruitful cognitive distance and where trust is built. A place where identity matters little and processes of identification take place (wrr 2007). Perhaps the Dutch can again, and even more widely than in the past, assume the role of 'go-betweens' to help other people cross their cognitive distances.

Notes

We were inspired partly by the establishment, by the Dutch foundation 'Nederland Kennisland', of a ‘Kafka brigade’ to help people who are caught up in institutional tangles.

The Dutch ‘Innovation Platform’ was advertised in terms that suggest that it should have acted as a ‘deblocking brigade’, but in fact it did not quite get around to carrying out that function.

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