Unequal household vulnerability to high energy prices and the elusive quest for targeted policy support: Evidence from the Netherlands

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Unequal household vulnerability to high energy prices and the elusive quest for targeted policy support: Evidence from the Netherlands

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Abstract

This study aims to inform the political economy debate on the design of targeted policies to support households in high-income countries in coping with (structurally) high energy prices. The effectiveness of policies to shield vulnerable households from high energy costs and limit or offset the increase of energy poverty incidence highly depends on the heterogeneity of the responses to rising energy prices for different household groups. In this study we use microdata to characterize the observed distribution of energy expenditure relative to income, i.e., the energy quote, for all Dutch households. We establish the role of dwelling and household characteristics in determining differences in vulnerability to high energy prices.

We then estimate the energy use response to energy price changes for different household groups and forecast the energy quote distribution under alternative energy price scenarios. This permits to quantify the extent to which differences in vulnerability to high energy prices relate to differences in household and dwelling characteristics and their influence on the energy use response to energy price shocks.

Our analysis reveals that higher income households are rarely vulnerable to high energy prices, irrespective of other household characteristics, whereas the opposite holds for lower income households. Our results suggest that home insulation programs are necessary to eliminate the highest energy quotes but are not sufficient to eliminate energy price vulnerability. This calls for a mix of income-dependent policy measures that increase income and reduce energy costs. In light of our results and the contemporary Dutch policy practice, we discuss various dilemmas and trade-offs involved in designing such policy strategies.

Samenvatting

Inleiding
De sterke schommelingen in energieprijzen sinds 2021 hebben geleid tot politieke aandacht voor de kwetsbaarheid van huishoudens voor stijgende energieprijzen. In Nederland heeft de overheid in 2022 en 2023 verschillende steunmaatregelen getroffen om huishoudens, en met name lage-inkomensgroepen, te beschermen tegen hoge energiekosten. Deze maatregelen waren voornamelijk gericht op huishoudens die reeds in energiearmoede verkeerden, terwijl er veel minder bekend is over de positie van huishoudens die normaal gesproken niet als energiearm worden beschouwd, maar wel kwetsbaar zijn bij hoge energieprijzen.

Dit onderzoek analyseert daarom de energieprijsgevoeligheid van alle Nederlandse huishoudens en in hoeverre inkomensniveaus en woningkenmerken (energetische kwaliteit en huur/koop) invloed hebben op de respons van huishoudens op energieprijsveranderingen. We doen dat aan de hand van de zogeheten energiequote, dat is het percentage van het inkomen dat huishoudens besteden aan energiekosten.

Dit onderzoek is een verdieping van een in juli 2023 gepubliceerd TNO rapport (TNO 2023 P10493) getiteld “De energiekosten van verschillende typen huishoudens in Nederland – een onderscheid naar inkomen, eigendomssituatie en woningkwaliteit” (zie Verschillen in kwetsbaarheid voor hoge energieprijzen vraagt om gericht beleid). Hoofdstuk 4 en 5 van de huidige studie zijn grotendeels nieuw ten opzichte van het eerdere Nederlandstalige TNO rapport.

Methodologie
Het onderzoek maakt gebruik van administratieve microdata van Nederlandse huishoudens, afkomstig van het Centraal Bureau voor de Statistiek (CBS), en beantwoord de volgende vragen:

1. Welke typen huishoudens hebben in ‘normale’ omstandigheden een hoge energiequote?
2. Hoe gevoelig is de energiequote van verschillende huishoudens voor stijgende energieprijzen?

Het eerste deel van het onderzoek (vraag 1) is gebaseerd op data over de periode 2019-2022 voor een sample van 87% van de Nederlandse huishoudens. Dit onderzoek komt grotendeels overeen met genoemde TNO publicatie uit juli 2023 (TNO 2023 P10493). Het tweede deel van het onderzoek (vraag 2) gebruikt data over de periode 2014-2021 voor een sample van 73% van alle Nederlandse huishoudens. In dit tweede deel maken we gebruik van regressieanalyses om de gevoeligheid van verschillende huishoudens op energieprijsveranderingen te kwantificeren.

Belangrijkste resultaten
De analyse toont aan dat de kwetsbaarheid voor hoge energieprijzen sterk varieert tussen verschillende huishoudens:

- **Hoge inkomens zijn zelden kwetsbaar**, ongeacht hun woningkenmerken. Zelfs bij heel hoge energieprijzen blijven hun energiequotes relatief laag.
- **Lage inkomens zijn structureel kwetsbaar**, vooral als hun woning slecht geïsoleerd is. In deze groep heeft een groot deel van de huishoudens een energiequote boven 8% bij hoge energieprijzen, zelfs als de energetische kwaliteit van hun woning goed is.
- **Middeninkomens verschillen sterk in kwetsbaarheid**, waarbij huishoudens met een slechte woningkwaliteit aanzienlijk gevoeliger zijn voor stijgende energiekosten dan huishoudens in goed geïsoleerde woningen.
- **Woningkwaliteit speelt een cruciale rol maar lost niet alles op**: Hoewel een betere woningisolatie de hoogste energiequotes vermindert, blijkt het niet voldoende om energieprijsgevoeligheid volledig te elimineren.

Concreet:
- Afhankelijk van de kwaliteit van de woning, is naar verwachting 1/3 tot 2/3 van de huishoudens met een inkomen tussen het minimum en modaal inkomen kwetsbaar voor hoge energieprijzen.
- Met een 'wat-als berekening' laten we zien hoe het aantal huishoudens met een hoge energiequote bij hoge energieprijzen verandert wanneer huishoudens met een woning van lage energetische kwaliteit een woning met hoge energetische kwaliteit zouden krijgen, terwijl andere huishoudkenmerken (zoals inkomen en woningeigendom) gelijk blijven. Hieruit blijkt:
  - Onder de huishoudens met een laag inkomen zou het aandeel huishoudens met een hoge energiequote dalen met 11% (van ongeveer 90% naar 80%). Deze daling komt overeen met ongeveer 5.000 huishoudens minder (waarvan 4.000 sociale huurders en 1.000 huiseigenaren).
  - Onder huishoudens met een inkomen tussen het minimum en modaal inkomen zou het aandeel huishoudens met een hoge energiequote halveren. Dit komt overeen met ongeveer 33.000 huishoudens minder (waarvan 12.500 sociale huurders, 8.000 particuliere huurders en 12.500 huiseigenaren).

Beleidsimplicaties

Het onderzoek bevestigt dat de meerderheid van de huishoudens niet kwetsbaar is voor hoge energieprijzen, vooral niet bij midden- en hogere inkomens. Lage inkomens daarentegen blijven structureel kwetsbaar, zelfs als hun woningen goed geïsoleerd zijn. Dit onderstreept de noodzaak van een combinatie van inkomensafhankelijke steun en energie-efficiëntiemaatregelen.

Inkomensafhankelijke beleidsmaatregelen zijn nodig om effectief huishoudens te ondersteunen en tegelijkertijd de prikkel om energie te besparen te behouden. Het onderzoek bespreekt verschillende beleidsstrategieën om huishoudens beter te ondersteunen bij stijgende energieprijzen. De auteurs identificeren drie mogelijke beleidsstrategieën:

1. Inkomensondersteuning
   - Dit kan via directe energiecompensatie of inkomensafhankelijke belastingkortingen.
   - Het verhogen van inkomens voor kwetsbare groepen verlaagt de energiequote, maar introduceert beleidsuitdagingen zoals complexe uitvoering en administratieve lasten.
2. **Energieprijsbeleid**
   - Invoering van een inkomensafhankelijke energiebelastingteruggave of een inkomensafhankelijke prijsplafond als verzekering tegen extreme energieprijzen.

   - Beide opties hebben echter implementatieproblemen, met name bij huurders met gedeelde warmteaansluitingen.
3. **Renovatie- en isolatieprogramma's**
   - Een structurele verlaging van energiekosten kan worden gerealiseerd door woningisolatie te verbeteren, met name bij lage inkomens en huurders.
   - Het aandeel energetisch slechte woningen is het hoogst onder koopwoningen, gevolgd door de commerciële huursector en het laagst in de sociale huursector. Echter, omdat huishoudens met lage inkomens zijn geconcentreerd in de sociale huursector zijn meer huurders dan woningeigenaren kwetsbaar voor hoge energieprijzen.
   - De uitvoering van renovatieprogramma's in de huursector verloopt niet snel genoeg om kwetsbaarheid voor hoge energieprijzen op de korte termijn te kunnen opvangen.

De studie concludeert dat, gegeven de verdeling van huishoudens- en woningkenmerken in Nederland, effectief beleid gericht op het verminderen van kwetsbaarheid voor hoge energieprijzen vraagt om een combinatie van energiebeleid en inkomensbeleid. Inkomensbeleid alleen isoleert geen woningen, terwijl energiebeleid alleen niet alle kwetsbaarheid kan wegnemen.

Generieke maatregelen om de kwetsbaarheid van een minderheidsgroep voor hoge energieprijzen te bestrijden, zoals een energiebelastingverlaging voor alle huishoudens, zijn weliswaar relatief eenvoudig te implementeren maar doorgaans inefficiënt, omdat ze ook ten goede komen huishoudens met hoge inkomens die niet kwetsbaar zijn. Dat betekent dat het naar verhouding dure maatregelen zijn om een relatief kleine groep te ondersteunen. Gericht beleid dat zich concentreert op alleen de kwetsbare huishoudens is daarentegen wél efficiënt maar vereist een complexere uitvoering en kan leiden tot beleidsrisico's. Gericht beleid vraagt daarom om beleidsinnovaties, met name in de governance van belastingadministratie, gemeenten en woningcorporaties.

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1 Introduction

Recent energy price hikes have placed the exposure of households to the upswings of energy markets at the centre of public policy in high-income countries (Guan et al., 2023; Mahler et al. 2023, Menyhert 2022). In this study we profile the exposure of relatively granular groups of the Dutch population to high energy prices, with the aim to inform the political economy debate on the design of targeted policies to support households in coping with (structurally) high energy prices (Ari et al., 2022; Brown, Soni, Lapsa, Southworth, & Cox, 2020; Sovacool, Lipson, & Chard, 2019). To do so, we use unique administrative microdata of Dutch households to establish the role of dwelling and household characteristics in determining (1) which types of Dutch households face high energy quotes (i.e., share of income spent on energy) in 'typical' times, (2) how energy prices affect the energy expenditure of different household groups, and (3) if 'atypically' high energy prices change the incidence of high energy quotes unevenly across household groups.

Following the disruption of Russian gas supply, high energy prices have led most European national and local governments, in recent years, to shield households from high energy costs through a variety of measures, including energy bill compensation schemes, energy tax cuts, social tariffs and price caps (Menyhert, 2022; Sgaravatti, Tagliapietra, & Zachmann, 2021). Also, the Dutch government offered in 2022 and 2023 considerable support to households – especially low-income households – in paying their energy bills. These interventions were by-and-large justified by concerns about the detrimental impacts of high energy prices for households and firms and their potential ripple effects throughout the economy (OECD, 2022). Understandably, during the price peak of 2022 most attention was paid to households suffering from energy poverty – indeed, it is low-income households in poorly insulated homes that struggle the most to meet their energy needs when energy prices are high (Brown, Soni, Doshi, & King, 2020; Bouzarovski & Petrova, 2015; Chai, Ratnasiri, & Wagner, 2021; Legendre & Ricci, 2015; von Platten, 2022). However, these households constitute only a minority of the population, especially in the wealthier European countries (Bouzarovski & Tirado Herrero, 2017). Meanwhile, much less is known about the energy quote of the majority of non-energy poor households. In this study we asses how many of these households, who are not at payment risk under 'typical' energy prices, are nevertheless vulnerable to be in payment risk under high energy prices.

Although the energy price peak of 2022/23 is behind us, given the context of geopolitical uncertainty and an evolving energy transition, (fossil) energy prices in the next decade are likely to be structurally higher and more volatile than in the decade before 2021. This calls for energy and income policies that support the most vulnerable households in a way that maintains price incentives for low-carbon energy consumption and is also sustainable from a public finance perspective. A targeted approach has been advocated for the recent crisis (OECD, 2022), in order to mitigate the risk that well-intentioned (energy) policy measures, such as energy tax breaks or home renovation subsidies, appear to be very inefficient. This is the case because most of the involved government spending benefits households that are not energy poor, or even having (very) high incomes (Nauleau, 2014). Ex-ante understanding of the uneven exposure of different groups of households to energy price shocks is thus a prerequisite for designing targeted policies to support households at risk of high energy prices. In general, however, it holds that the more specific and well-targeted a policy measure is, the more complex its implementation – and thus the greater risks of policy failures. Our analysis therefore explores the nature and size of groups of households that can be identified as due and undue beneficiaries of generic or specific support measures – given their energy housing quality, income and home ownership status.

Methodologically, our analysis consists of two parts. In the first part (Chapter 3), we present a descriptive analysis of the case of the Netherlands by exploring household-level correlations between energetic housing quality, income and ownership status, as well as the energy quote distribution across heterogeneous households, including geographic mapping of potential vulnerability to high energy prices. To this aim we exploit administrative microdata on energy use and household characteristics of Statistics Netherlands (CBS) for the period 2019-2022, covering 87% of Dutch households. In the second part (Sections 4 and 5), we explore how the observed unequal incidence of high energy quotes across household groups is (re-)shaped by the endogenous behavioral response of households to changes in energy prices. For this, we leverage on the panel structure of the data to estimate the elasticity of total energy expenditure (on electricity and gas) to electricity and gas prices, while controlling for time-invariant unobserved characteristics. We do so by using a narrower, but longer, sample of the administrative microdata for the 2014-2021 period, covering 73% of Dutch households. We employ regression analysis to quantify the heterogeneity in the behavioral response to energy price fluctuations across households groups. Subsequently, we use the implied energy price elasticities and four alternative, yet plausible, end-user price scenarios for electricity and gas, to explore whether the observed response heterogeneity ameliorates or exacerbates the heterogeneity in the likelihood of excessive relative energy expenditure across household groups in times of high energy prices. In Section 6 we conclude by drawing key policy lessons from the observed patterns of vulnerability to high energy prices.

Our analysis relates to previous work on (the geography of) energy poverty and house- hold energy consumption in the Netherlands (Dalla Longa, Sweerts, & van der Zwaan, 2021; Mulder, Dalla Longa, & Straver, 2023; Mashhoodi, 2021; Mashhoodi, Stead, & van Timmeren, 2019; Mashhoodi & Bouman, 2023). What sets our analysis apart is the assessment of energy price vulnerability across the entire household distribution and the use of microdata rather than aggregated data at the neighborhood level - most studies on energy vulnerability of households focus on low-income households and either more aggregate or survey based data (e.g., Bardazzi & Pazienza, 2023; Bardazzi, Charlier, Legendre, & Pazienza, 2023; Legendre & Ricci, 2015; Numminen, Kajoskoski, Kaltampanidis, & Jalas, 2024; Simcock et al., 2021). Hence, our paper also relates to the literature on the distributional impacts of energy cost inflation. Although our focus is not on the absolute impact or the effect that it has on other consumption choices of households, we do examine which dwelling and household characteristics drive the uneven distribution of the risk of excessively high energy expenditures, similarly to Bardazzi et al. (2024). Our paper thus contributes to the literature on patterns of energy consumption and its response changes in energy prices. Some of this literature has identified several sources of heterogeneity in household behavior towards energy use. For example, Peersman and Wauters (2024) find that lower income households are more responsive to energy price increases than their high income counterparts, whereas there is no evidence of heterogeneous responses to price declines, and Bardazzi and Pazienza (2020) find that energy use increases with the age of the household head. We contribute to this literature by relying on observational data at the household level, exploiting the interplay between income and energy quality of dwellings across different types of home ownership – the latter obviously being a crucial parameter in designing effective policies. Our analysis thus brings some empirical evidence to the policy debate on the welfare effects of energy (pricing) policies and whether support to households in paying their energy bills indeed should rather take the form of specific energy (pricing) policies or general income support (e.g., Belaid, 2019; Chester, 2014; Hahn & Metcalfe, 2021; Hernandez & Bird, 2010; Norman & Corfe, 2022; Sovacool et al., 2019; Alberini & Umapathi, 2024).

Finally, the results of our study relate to the literature on improving energy efficiency in the built environment. In principle, high energy prices provide a strong incentive to improve energy efficiency of buildings, but in practice households' capabilities in doing so matter a great deal: for example, poverty-related stress and information barriers among low income home-owners and a split-incentive problem for renters undermine the incentivizing potential of energy prices (Charlier, 2015; Maruejols & Young, 2011; Trotta, 2018). Hence, speeding up greening of the housing stock calls for innovative complementary policy measures that maintain price incentives for homeowners while reducing high investment barriers for the renovation of owned and rented dwellings (e.g., Bergman & Foxon, 2020; Kerr & Winskel, 2020).

This report is organized as follows: In Chapter 2 we describe our data and introduce some definitions used throughout our study. Sections 3, 4 and 5 present the core of our analysis and results, focusing, respectively, on the descriptive statistics, the regression analysis and the distribution of energy quotes at different energy prices. We conclude in Section 6 with a discussion on the feasibility of various potential support policies, given our findings regarding heterogeneity in the vulnerability to energy price shocks across different household groups.

2 Data and definitions

As noted before, the first part of our analysis exploits administrative microdata for the years 2019-2022 provided by Statistics Netherlands (CBS) for over 7 million individual households – covering 87% of the over 8 million households in the Netherlands. We distinguish households based on 4 income groups (low, medium-low, medium-high and high), 3 different forms of home ownership status (owner-occupied, social rent and commercial rent) and 3 levels of energetic housing quality (high, low and very low), which results in a total of 36 distinct household groups. for each of these groups, we calculate the group size and average energy quote. As noted, we measure vulnerability to high energy prices in terms of the energy quote, defined as the percentage of household income spent on energy use. Since there is no objective measure to determine when an energy quote is (too) high, we follow the international literature (Heindl & Schüssler, 2015; Moore, 2012) in taking as a rule of thumb that an energy quote above 8% is an indication of financial vulnerability to high energy costs in the longer term. It is to be noted that a high energy quote does not necessarily imply an energy bill affordability risk, since we do not consider other necessary household expenses, such as housing costs, in our calculations (van Middelkoop, van Polen, Holtkamp, & Bonnerman, 2018). Hence, our analysis cannot be interpreted as an analysis of financial vulnerability in general.

We use administrative microdata on income, energetic housing quality, electricity and gas consumption, house area, home ownership status, household size, age of household head and location. We measure income as standardized disposable household income, which means that the disposable income of a household is corrected for the size and composition of a household. Following the standard definition employed in recent energy poverty calculations for the Netherlands, we set our low-income threshold to 130% of the variable INHARMLAG provided in the CBS microdata database. This variable is constructed on the basis of a fixed amount that represents equal purchasing power for all years and all types of households. This amount is based on the social assistance benefit of a single person in 1979, when it was at a high level. Middle-low income lies between the low-income threshold and the median income; middle-high income is an income between the median and twice the median; high income is an income above twice the median income.

To define energetic housing quality, we use the new CBS indicator 'Low Energy Quality' (LEQ). More specifically, the indicator distinguishes three energy quality categories: LEQ-0, approximately equivalent to the best energy efficiency labels A to C; LEQ-1, approximately equivalent to the medium energy efficiency labels D and E; and LEQ-2, approximately equivalent to the poorest energy efficiency labels F and G. The LEQ indicator essentially is the equivalent of a predicted energy label for the entire housing stock, derived by CBS in a three-step procedure. First, a regression analysis is used that exploits variation in household characteristics (such as household composition) and dwelling features (such as size, type and construction year) in order to identify the relationship between dwelling characteristics and the amount of energy consumption by a household. Second, the regression results are used to calculate an estimated average energy amount for each dwelling, assuming a hypothetical standard occupancy (e.g. 2 persons with average income) and area of 100 m2, to control for the impact of household characteristics. Third, the energy efficiency category LEQ is determined by com- paring the predicted energy consumption of a dwelling against the LEQ threshold. According to this threshold, a house qualifies as LEQ when the average predicted energy bill is higher than the median energy bill of all houses in the Netherlands in 2019, controlling for dwelling characteristics (such as house type, energy label or year of construction) and floor size. In this study the three CBS levels LEQ-0, LEQ-1 and LEQ-2 are labeled, respectively, as High, Low and Very Low energetic housing quality.

Table 2.1 provides a short summary of the distribution of households among income groups and levels of energetic housing quality. From this table it can be seen that low-income households make up for about 15% of all households in our sample, the middle income groups together account for nearly 80% and the highest income group for about 5% of the sample households. It follows naturally that, in absolute terms, homes with the lowest energetic quality are to be mostly found among middle-income households; but, remarkably enough, in relative terms, high-income households most often live in homes with the lowest energetic quality while the opposite is true for low-income households. We further elaborate upon this in Chapter 3. In terms of homeowner status, Table 2.1 shows that about 60% of the homes are owner-occupied, 30% is social rent and 10% commercial rent. Logically, low income households are concentrated in the social housing sector, higher incomes mostly own their home. However, the group home- owners also includes a substantial number of mid-lower income households (about 1.1 million, 16% of total) plus a smaller but not negligible number of low-income households (about 141 thousand, 2% of total). A similar number of low-income households' rents in the commercial rental sector. As we will show in our analysis, it is especially these substantial minorities outside the dominant division of high-income and owner-occupied versus low-income and social rent that play an important role in designing effective policies in the context of the distribution of energy vulnerability across households.

Table 2.1: Distribution of energetic housing quality and ownership status across income groups.

Number (%) of households					
Income groups:	Low income	Mid-low income	Mid-high income	High income	TOTAL
Energetic quality					
High	686,248 (9.8%)	1,288,369 (18.3%)	1,602,487 (22.8%)	177,564 (2.5%)	3,754,668 (53.4%)
Low	336,380 (4.8%)	792,030 (11.3%)	971,676 (13.8%)	92,824 (1.3%)	2,192,910 (31.2%)
Very Low	75,252 (1.1%)	332,903 (4.7%)	571,323 (8.1%)	102,829 (1.5%)	1,082,307 (15.4%)
TOTAL	1,097,880 (15.6%)	2,413,302 (34.3%)	3,145,486 (44.7%)	373,217 (5.3%)	7,029,885 (100.0%)
Ownership					
Owner-occupied	141,787 (2.0%)	1,134,856 (16.1%)	2,627,663 (37.4%)	341,772 (4.9%)	4,246,078 (60.4%)
Commercial rent	144,284 (2.1%)	294,255 (4.2%)	258,743 (3.7%)	25,182 (0.4%)	722,464 (10.3%)
Social rent	808,859 (11.5%)	978,060 (13.9%)	253,558 (3.6%)	5,718 (0.1%)	2,046,195 (29.1%)
Unknown	2,950 (0.04%)	6,131 (0.1%)	5,522 (0.1%)	545 (0.01%)	15,148 (0.2%)
TOTAL	1,097,880 (15.6%)	2,413,302 (34.3%)	3,145,486 (44.7%)	373,217 (5.3%)	7,029,885 (100.0%)

Data: CBS, based on own calculations

We calculate energy costs at the household level (used to define the energy quote) as the sum of gas and electricity expenditures, calculated as the product of aggregate (national) average consumer prices and individual household energy consumption levels. The energy usage data in this study corresponds to the actual yearly, non-temperature corrected, use of gas (GJ) and electricity (kWh) as collected by CBS from energy network operators. Because CBS does not yet provide individual (average or marginal) electricity and gas prices paid by each household, we impute the price of electricity and gas by using aggregate (national) average prices - in a similar fashion to Alberini, Gans, and Velez-Lopez (2011). Using aggregate average prices alleviates the endogeneity of individual prices due to simultaneity (Bardazzi & Pazienza, 2020). From the household perspective aggregate average prices are exogenous, whereas household- level prices, when utilities apply block-pricing schemes as in the Netherlands, are function of the household's own electricity and gas usage.[1]

The average prices of electricity and gas as published by CBS are computed from data originating in energy companies, where the total electricity/gas expenditure is divided by the total amount electricity/gas used by households.[2] Figure 2.1 depicts these average end-user prices for gas and electricity from 2014 to the first half of 2023

Data: CBS, based on own calculations.

Figure 2.1: Gas and electricity price from 2014 to 2023 in EUR/kWh. *2023 data only based on the first half year.

Figure 2.1 presents the average gas and electricity price faced by households between 2014 and 2023. These data suggest a lagged response in average residential use prices relative to whole- sale prices. While wholesale gas and electricity prices in the Netherlands increased significantly in 2022, average electricity prices remained relatively low in the same year and raised sharply in the following year. This is in part due the stickiness in average prices induced by fixed-energy contracts. In addition to this, the response of end-user average prices to wholesale prices was partly subdued by the temporary reduction of the VAT on energy (from 21% to 9%).

[1] Nonetheless, a potential disadvantage of using aggregate average prices, rather than the exact price paid by households, is the endogeneity caused by measurement error (Alberini et al., 2011; Alberini & Filippini, 2011; Miller & Alberini, 2016). Alberini et al. (2011) find little evidence of biased estimates due to measurement error when using aggregate average prices to estimate (short run) demand elasticities of electricity and gas

[2] CBS provides data of average prices differentiated by usage group; we use the average prices for the modal us-age group. This corresponds to households with a yearly use between 20 to 200 GJ for gas, and to households us-ing 2.5 to 5 MWh per year for electricity. Data available at: https://www.cbs.nl/nl-nl/cijfers/detail/81309NED

3 Descriptive analysis

In this section we document the correlations between energetic housing quality, income and home ownership status in the Netherlands, followed by computing the observed distribution of the energy quote across the 36 household groups. We start our analysis with the observation that, over the last few years, it has proven difficult in practice to develop an effective policy mix for targeted support to low-income households with low energetic housing quality in the Netherlands. The essential reason for this is a remarkably weak correlation between income and energetic housing quality, as illustrated in Figure 3.1. Contrary to public perception, relatively many (very) high-income households live in reasonably to poorly insulated dwellings (including those from the popular 1930s and monumental dwellings in historical city centers and provincial towns), while most of the households with the lowest incomes rent in the social housing sector and the majority of these dwellings features a good energy quality.

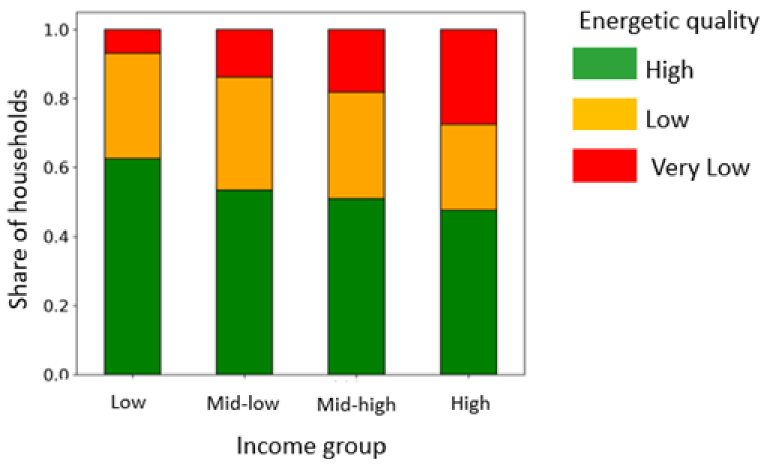
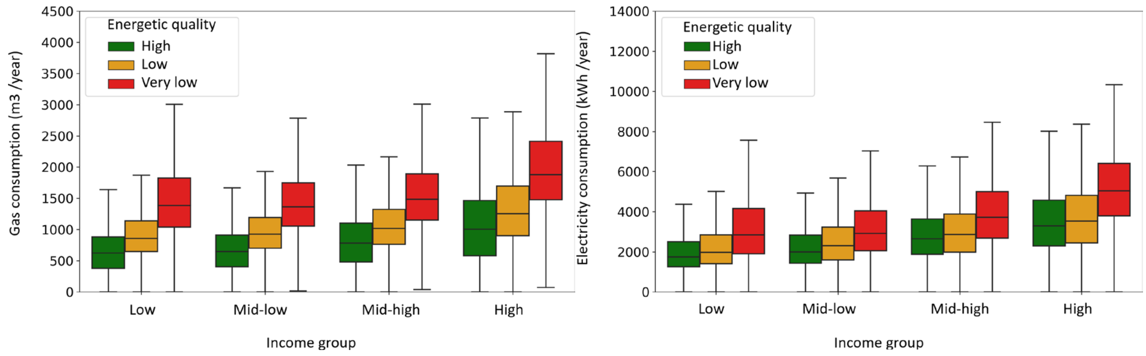


Figure 3.1: Percentage distribution of energetic housing quality levels across income groups.

This observation has important policy implications, as it means that there is not much overlap between the target groups of social policies aimed at affordability of energy costs (low- income households) and energy policies aimed at accelerated home retrofitting (households in poorly insulated homes). Currently, existing income-neutral subsidies for insulating energetically (very) poorly insulated homes fall predominantly on higher incomes while generic low-income support reaches both households in poorly insulated homes and the larger group of households in reasonably to well-insulated homes.

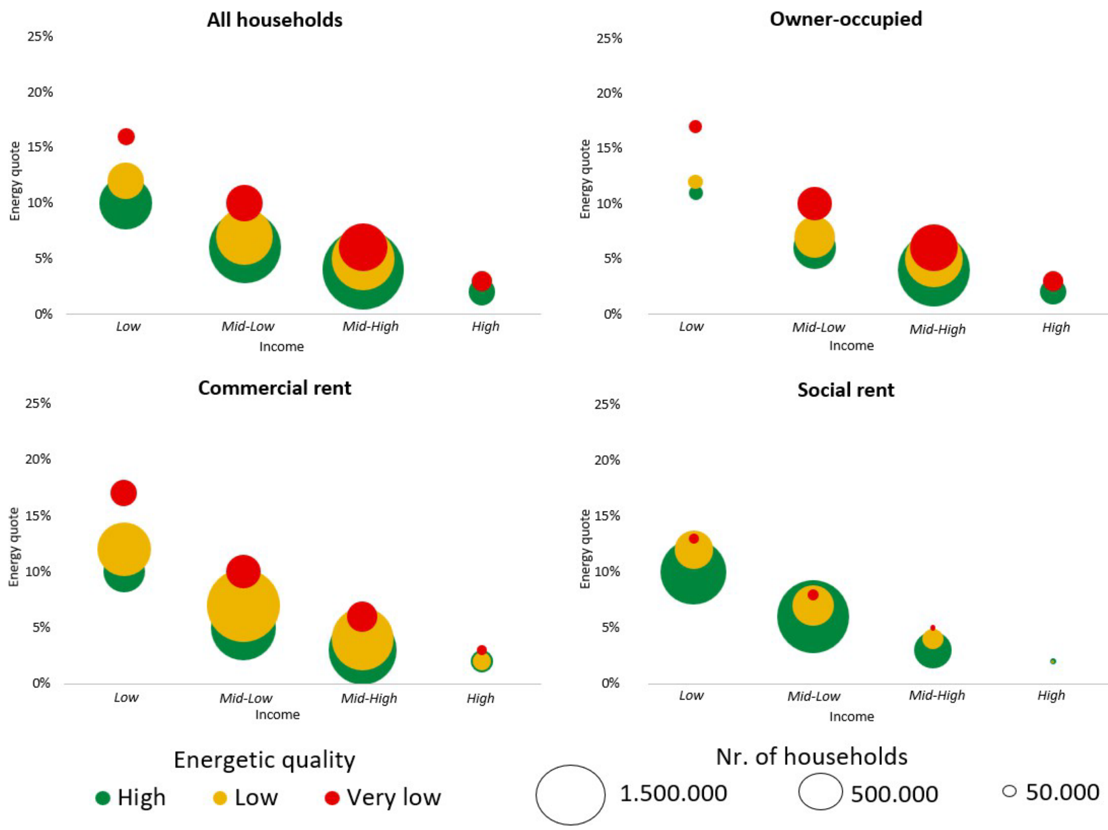
The data also show that, after controlling for energetic housing quality, energy consumption hardly differs between income groups; see Figure 3.2. Thus, energy consumption is mainly determined by the energetic housing quality and not by income. This observation first underlines the importance of home energy efficiency. In addition, it means that energy tariff differentiation as function of energy consumption levels – including a social tariff for 'basic consumption' – does not seem to be an effective way to target support at financially vulnerable households. The implicit assumption motivating such a tariff differentiation is that poorer households consume less energy than richer households, but this is not supported by the data; only the highest income group (which is relatively small in size) consumes on average relatively much energy. It follows that also a tax cut on 'basic energy consumption', as envisaged by the Dutch government, is more generic than targeted to low-income households and thus also benefits to a significant extent medium-high income households.



Data: CBS, based on own calculations

Figure 3.2: Distribution of gas (left) and electricity (right) consumption by income group and energy housing quality level.

Differences in home ownership status matter. Our data show that more renters than homeowners are vulnerable to high energy prices, but that both the number and share of poorly insulated homes is far higher in owner-occupied dwellings than in the rental sector. In this section we break these generic findings further down to assess the distribution of energy quotes across our 36 household groups. We summarize the results in Figure 3.3, in which we show the median energy quote for each household group, distinguishing our four income levels and three home energy efficiency levels for each of the three ownership types.



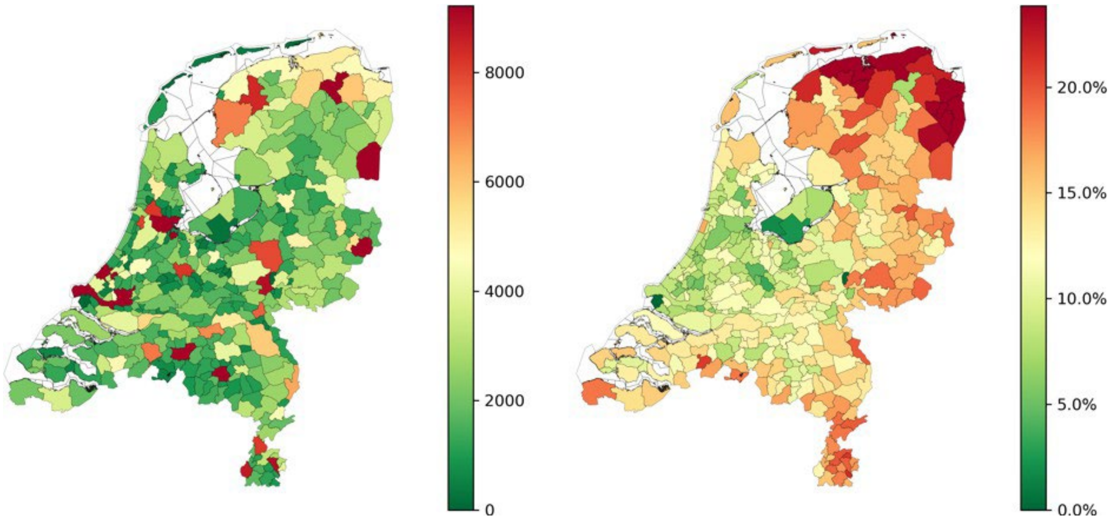
Data: CBS, based on own calculations

Figure 3.3: Distribution of energy quote (at the 'middle' energy price) by income group, energetic housing quality and home ownership status, where the size of the circles represents the size of this group of households.

First of all, Figure 3.3 clearly shows that energy quotes obviously fall with higher income levels. Second, and more important, the figure shows that the highest median energy quote (17%) is to be found among households in the lowest income and energetic housing quality category in commercially rented and owner-occupied dwellings. The size of this group is, however, relatively small: about 60 thousand (less than 1% of total) of which approximately two-thirds in owner-occupied dwellings. Larger groups with still a relatively high median energy quote of around 10% include households in the social rental sector with a high energetic housing quality but a very low income (almost 600 thousand households, 8.5% of total), and homeowners with a mid-low income in a dwelling with a very low energetic housing quality (almost 300 thousand households, 4% of total). The largest group of households with a very low energetic housing quality faces a median energy quote of around 6%, and consist mainly of homeowners with a mid-high income (about 550 thousands, 7.7% of total).

The main explanation behind these different observations is that low incomes are concentrated in the social housing sector and higher incomes are merely homeowners while the energetic housing quality of social housing dwellings are comparatively much better than that of owner-occupied homes. More specifically, about 25% of dwellings in the social housing sector is of (very) low energetic housing quality against 57% of commercially rented dwellings and 55% of owner-occupied housing. Thus, most households in social housing with a high energy quote owe this high quote to their (very) low income rather than to the low energetic quality of their house. There is, however, a minority group of households in the social housing sector that have a very low income and a house with a very low energetic quality; these households face the highest energy quotes of all households and constitute the core of the energy poverty problem in the Netherlands (Mulder, Dalla Longa, & Straver, 2021; Mulder et al., 2023). As noted, however, while they probably suffer from very high costs – with a median energy quote of 17% and no capabilities to improve their situation – the size of this group is relatively small. Only 1.7% of all social housing in our dataset is comprised of homes with very low energetic housing quality (approximately energy label F and G); this adds up to 35 thousand houses approximately, of which about 15 thousand are occupied by households with incomes below the low-income threshold. While the share of homes with very low energetic housing quality is much higher in the commercial rental sector (11%) and especially among the group of homeowners (23%) – in absolute numbers most homes with very low energetic housing quality in the Netherlands are owner-occupied – the majority of the households in these sectors enjoy relatively high incomes, implying relatively low energy quotes. The commercial rental sector still deserves separate mention, because although it is true that fewer low-income households rent in the commercial than the social housing sector, this is offset by the fact that the majority of lower-income households in the commercial rental sector rents a home with (very) low energetic housing quality - in total, this concerns about 275 households.

We conclude our descriptive analysis by providing in Figure 3.4 an overview of the spatial distribution of vulnerable households across the Netherlands, at the municipality level. We selected households with an income below the median, living in a home with low or very low energetic housing quality, and having an energy quote above 8%. The maps in Figure 3.4 present the number (left panels) and the share (right panels) of these households in all municipalities in the Netherlands. Appendix A divides these maps into three types of ownership (owner- occupied, social rent, commercial rent).



Data: CBS, based on own calculations

Figure 3.4: Number (left) and shares (right) of vulnerable households in each municipality in the Netherlands.

In absolute numbers (left panels), the largest cities host the majority of vulnerable households, for all ownership types. For the owner-occupied group, however, relatively high numbers are also found in the north-east of the country and in other rural municipalities.

In relative terms (right panels), the most vulnerable municipalities are observed in the north, east and south of the Netherlands, i.e. in the peripheral (largely rural) regions away from the main urban area. This is especially true for the owner-occupied dwellings (in which the highest shares of vulnerable households are found) and the commercially rented dwellings, while vulnerable households in social housing are somewhat more evenly distributed across the country.

4 Regression analysis

In this section, we complement the preceding analysis by assessing how the incidence of high energy quotes across different household groups is shaped by changes in energy prices. To this end, we empirically study whether different household groups face an uneven exposure to excessive energy expenditure when energy prices increase. We focus on the direct impact of energy prices on the energy quote of households, that is the effect of prices on energy expenditure.[3] Via a higher energy expenditure required per unit of energy consumed, high energy prices can increase the likelihood that households face a high energy quote, i.e., devote a substantial share of their income to energy expenses. Yet, this likelihood does not necessarily increase evenly for all households. The uneven exposure to a high energy quote in case of high energy prices can be due both to pre-existing differences in relative level of energy expenditure for a given energy price, and to differences in the behavioural response to an increase in energy prices Peersman and Wauters (2024).

We use econometric analysis to quantify if and to what extent households adjust their energy usage patterns in response to changes in energy prices, how this ultimately impacts their energy expenditure, and if this response to prices is different across household groups. We then use this to determine whether potential energy price surges have differential impact on incidence of high energy quotes for different household groups. We conduct the econometric analysis at the household-year level, with houses (and their characteristics) being matched to households on a yearly basis. As noted before, in order to estimate the impact of energy prices on energy usage, we rely on a narrower sample of the administrative microdata than we used in Chapter 3; this allows us to better exploit the time variation in energy prices over a longer period, namely 2014-2021.

Extending the time dimension requires using an alternative variable to measure the energetic quality of houses, as the LEQ indicator of energy efficiency performance that we used in the descriptive analysis is only available from 2019 onwards. Instead, and staying as close as possible to the LEQ, the three categories of energy quality (high, low and very low) are imputed based on the energy labels data from the Netherlands Enterprise Agency (*Rijksdienst voor Ondernemend Nederland - RVO*).[4] In line with the LEQ, we assign the category 'high' to houses with an energy label C or better; 'low' corresponds to houses with energy label D and E; and, 'very low' to houses with an energy label worse than E. For our econometric analysis we select a subsample of the total household's population for which energy labels are consistently available in all years between 2014 and 2021. This results in a sub-sample of the administrative data in this period, covering 5.9 million distinct households, with a total of 21.9 million household-year observations, corresponding to around 35% of all potential records. This longer sub-sample results in an unbalanced panel since energy labels are not available for all houses in the Netherlands for the entire period analysis. For instance, energy labels are only mandatory when selling a house and for newly built houses. Nonetheless, energy labels are not a time-invariant characteristic as, for example, the energetic housing quality faced by a household is set to change in the data if households move or update the energy label of their houses.

[3] Asides from this direct impact, higher energy prices can affect households indirectly via the ensuing increase in prices of other goods and services as well as the potential decline in household income due to declining firm profits and labor demand

[4] Energy labels for residential buildings in the Netherlands run down from A++++ to G. See https://www.rvo.nl/sites/default/files/2020/08/infographic-vernieuwd-energielabel-woningen-en-gebouwen-nta-8800.pdf

Our regression analysis includes controls for individual household- and house characteristics, including household size, age of the head of the household, house area and home ownership status. Table 4.1 presents the summary statistics for the main variables of interest in the period of analysis.

Table 4.1: Descriptive statistics of the used variables.

Variable	N	Mean	Std.Dev	25th percentile	50th percentile	75th percentile
Disposable income (EUR)	21,972,593	36,590	41,495	20,114.0	28,630	46,170
Household size (number of people)	21,972,593	2	1	1	2	3
House area (m^2)	21,972,593	100	121	74	93	115
Age of household head (years)	21,972,593	54	18	38	53	68
Electricity use (kWh)	21,972,593	2414	1340	1470	2130	3054
Gas use (kWh)	21,972,593	11,142.1	5,866	7,230	10,270	13,970

Data: CBS, based on own calculations

Using data on energy use at the household level and average yearly prices for the Netherlands we estimate the electricity and gas demand elasticities based on the following regression equation

$$\tilde{y}_{i,t} = \beta_g \tilde{p}_{g,t} + \beta_e \tilde{p}_{e,t} + X_{i,t}\Gamma_h + \lambda_i + \lambda_m + \varepsilon_{i,t},$$

where $\tilde{y}_{i,t}$ corresponds to the, log of, electricity use or gas use by household i in year t; $\tilde{p}_{g,t}$, $\tilde{p}_{e,t}$ represent the, log of, average consumer gas and electricity prices in year t, respectively. $X_{i,t}$ is a vector of controls, and λ_i and λ_m denote the set of fixed-effects at household and municipality level. Household fixed effects control for unobserved, time-invariant, household and municipality characteristics limiting the potential for omitted variable bias.

Following the contextual evidence for the Netherlands, the demand equation is esti-mated separately for different household groups. Thus, we effectively estimate group-specific β_g and β_e. These household groups are defined based on income, home ownership status, and energetic housing quality. Based on their, time-variant, characteristics households are classified into a group on a year-by-year basis.

In addition to the demand elasticity we estimate the elasticity of total (electricity and gas) expenditure to electricity and gas prices. For this, we use the same log-log specification as for the demand elasticities, but the left hand side variable $y_{i,t}$ is the (log of) total expenditure in electricity and gas by household i in year t. Total expenditure is calculated based on the observed electricity and gas use and the average electricity and gas prices.

As with the demand estimations, the expenditure elasticities are determined separately for each household group h. Effectively, we allow for the β_g and β_e coefficients to differ across household groups. In total, the combination of 4 income groups, 3 home ownership types, and 3 levels of energetic quality, results in 36 household groups h. We can achieve this level of granular heterogeneity and precisely identify differences in price-responses by leveraging the richness of the dataset. This heterogeneity analysis based on household characteristics enables us to assess whether the unequal incidence of high energy quotes across household groups relates to their uneven responses to changes in energy prices.

In order to obtain a benchmark for the household-type specific estimates, we start by estimating average price elasticities of energy demand and expenditure. The results from these estimations are presented in Table 4.2, where we include 4 model specifications that differ in the type of control variables used and the subdivision of the sample in subgroups. Model 1 corresponds to the OLS estimation for the whole sample without any control variable nor fixed effects, while in Model 2 we include household-level and municipality-level fixed effects. Model 3 includes household and municipality fixed effects, as well as a set of time-variant characteristics (i.e., the controls $X_{i,t}$) previously identified in the literature as relevant determinants of energy demand patterns: the level of disposable income, age of the household head, household size, area of the house, heating degree days at the municipal level, and the non-energy CPI to control for the prices of other goods and services (Peersman & Wauters, 2024). In addition to this, Model 4 includes household-level dummies associated to the characteristics used to classify households in groups.

Table 4.2: Effect of energy prices on energy use and expenditures.

	Model 1			Model 2			Model 3			Model 4		
Dependent variable:	Electricity use	Gas use	Energy expenditure	Electricity use	Gas use	Energy expenditure	Electricity use	Gas use	Energy expenditure	Electricity use	Gas use	Energy expenditure
Electricity price	-0.124	-0.205	0.118	-0.044	-0.129	0.193	-0.133	-0.04	0.215	-0.135	-0.038	0.215
Gas price	0.063	-0.176	0.624	-0.171	-0.329	0.446	0.022	-0.287	0.509	0.028	-0.267	0.525
Low income										-0.052	-0.048	-0.045
Mid-high income										-0.028	-0.028	-0.027
Mid-low income										-0.041	-0.04	-0.038
Privately rented dummy										-0.109	-0.113	-0.109
Rented via Corporation dummy										-0.186	-0.223	-0.208
Household Fixed Effects				Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Municipality Fixed Effects				Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Controls							Yes	Yes	Yes	Yes	Yes	Yes

Data: CBS, based on own calculations.

These estimations provide us with (short-run) own-price elasticities of electricity and gas use that are in line with previous results in the literature[5]. Specifically, as in the previous literature, we find relatively inelastic demands of electricity and gas. Our results indicate that a 10% increase in the price of electricity induces, on average, a 1.3% reduction in the use of electricity and a similar increase in the price of gas would lead to less than 3% reduction in gas use. These inelastic responses amount to a positive relationship between prices and energy expenditure, with the direct effect of (higher) energy prices dominating over the indirect (lower) energy use response in determining the total impact of prices on expenditure.

In addition to this, the results from Model 4 indicate that there are significant differences in the level of energy consumption, and consequently of expenditure, across household income groups and by home ownership status. Yet, these level differences may in part be capturing differences in the response of households to changes in prices. Household groups with more inelastic demand may spend relatively more on energy. As this response is potentially heterogeneous across household groups, it may exacerbate (or mitigate) the excessive energy expenditure of some household groups relative to others: when energy prices increase, households with more inelastic demand will see their expenditure increase relative to the expenditure of households with more elastic demand.

To uncover whether different household groups respond differently to changes in prices, we then estimate Model 4 separately for each of the 36 household groups. The resulting own-price elasticities per household type are depicted in Figure 4.1, while in Figure 4.2 we present the elasticities of total energy (electricity and gas) expenditure to the price of electricity and gas, respectively. Both figures show point estimates with corresponding 95% confidence intervals.

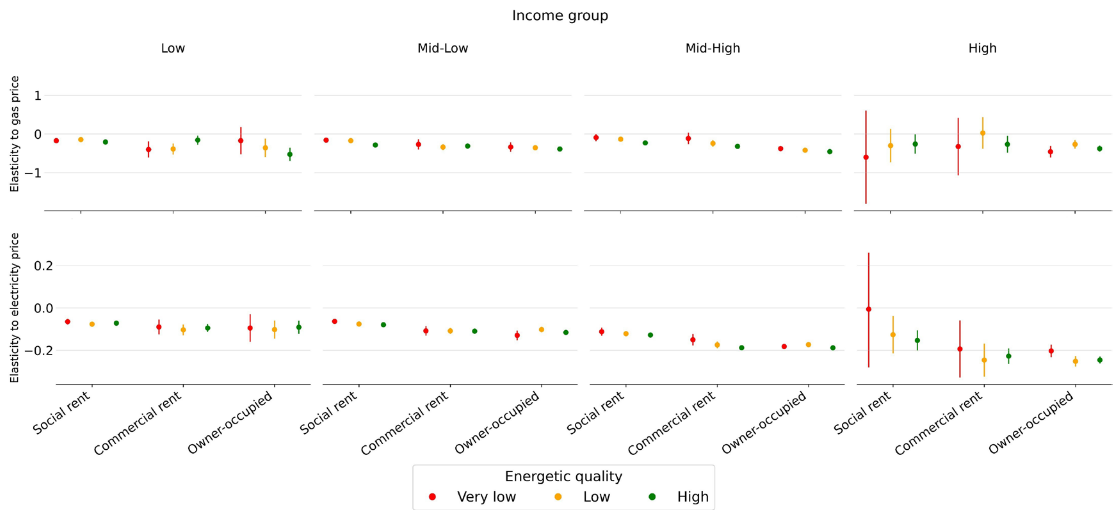


Figure 4.1: Elasticity of gas use (top) and electricity use (bottom) with respect to own price shown as Point estimates with 95% confidence intervals.

[5] See findings for the short-run elasticities for the residential use of these two energy sources in the meta-analysis by Labandeira, Labeaga, and López-Otero (2017)

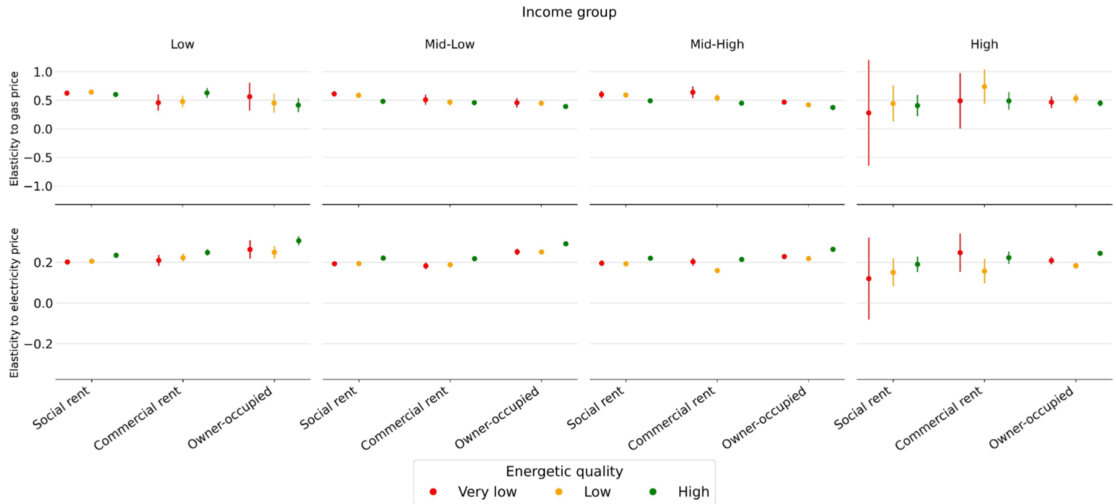


Figure 4.2: Elasticity of energy expenditure with respect to gas (top) and electricity (bottom) price shown as point estimates with 95% confidence intervals.

Our results for the demand elasticities reveal significantly different patterns across household groups (see Figure 4.1). Characteristics associated to high median energy quotes in the preceding analysis, lower income, being home-owner or commercial renter, and living in a low energetic quality houses, tend to be associated to more inelastic demands of gas and electricity with respect to own prices. Consistently with the inelasticity of demand we find a positive elasticity of energy expenditure to prices across household groups, as shown in Figure 4.2. Increases in electricity or gas prices are more strongly associated to increases in energy expenditure for low income households (given other characteristics) and thus are likely to exacerbate differences in high energy quote incidence across income groups. Among the lower income groups (Mid-low and Low), lower energetic housing quality and living in a rental home strengthen the positive impact of gas prices on total energy expenditure (top panel in Figure 4.2). For these lower income households, there is little difference in the elasticity of electricity prices on expenditure by energetic quality, given the other characteristics of the household group (bottom panel in Figure 4.2).

Overall, we find that different household groups have distinct energy use responses to changes in energy prices. In particular, groups with relatively high energy quotes (e.g., lower income households with very low energetic housing quality) tend to react less to energy price changes and thus, upon a simultaneous increase in electricity and gas prices, will see a stronger increase in their energy expenditure in case of higher energy prices. Subsequently, we explore how, given these uneven responses, changes in energy prices affect the energy quote distribution, and specifically the incidence of a high energy quote across household groups.

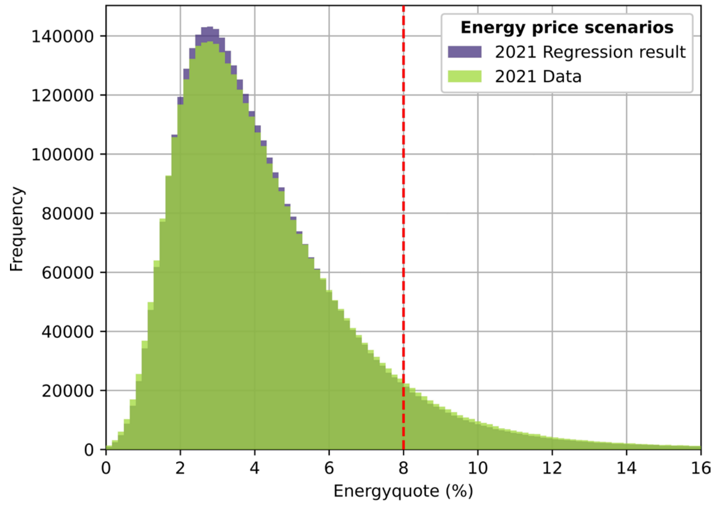
5 Distribution of energy quotes at different energy prices

Starting from the, household-group-specific, expenditure elasticities estimated in the preceding section we project the distribution of energy quotes for all households in the Netherlands under four energy price scenarios. To this aim, from the estimation of the energy expenditure equation, we compute the predicted energy expenditure and the corresponding energy quote EˆQ, as a function of electricity and gas prices

$$\hat{E}Q\,i,h,t\left(P_e,P_g\right)=\frac{\hat{y}_{i,h,t}\left(P_e,P_g\right)}{income_{i,t}}$$

where $\hat{y}_{i,h,t}\left(P_e,P_g\right)$ corresponds to the estimated energy household-level energy expenditure, for household i in group h, as a function of electricity and gas prices. The income level in the denominator, household group, and all the explanatory variables used for the estimation of $\hat{y}_{i,h,t}$, except prices, are set at their observed household-level values in t = 2021.

Next, using the household-type specific characteristics, we calculate the energy bill and the energy quote for given energy prices. To obtain the predicted energy expenditure, re- quired for energy quote estimates, the estimated household-level fixed effects are computed as household-level average residuals between observed and estimated (log of) expenditure. More- over we assume a 'naive' estimation of y in levels where no additional correction for the non-zero difference between expected value of exp $\left(\hat{y}_{h,e,t}+\varepsilon\right)|\chi$ and of exp$\left(\hat{y}_{h,e,t}\right)|\chi$ is applied. These two assumptions may induce some (systematic) bias in the estimated energy quote distribution. To get insight into the quality of estimation we compare the distribution of the estimated energy quote distribution under the 2021 prices to the distribution of the observed energy quotes in 2021. Figure 5.1 shows that these two distributions largely overlap, and that our estimation procedure does not lead to an evident sign of an under- /over- estimate of the energy quote.



Data: CBS, based on own calculations

Figure 5.1: Energy quote distribution.

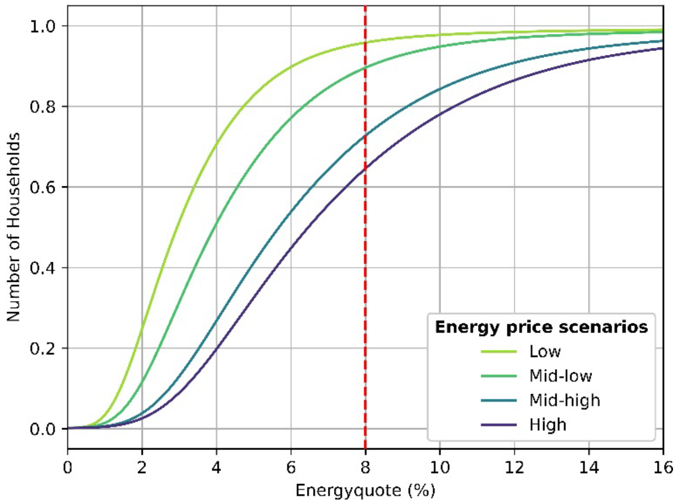
Price scenarios To examine the impact of price changes on the incidence in high energy quotes, we estimate the energy quote of each household under four different price scenarios: low, mid-low, mid-high and high. Due to the importance of gas in electricity generation, and gas prices for the formation of electricity prices, our price scenarios assume co-movement in electricity and gas prices. Historical prices are used to reflect realistic minimum and maximum prices. In the low scenario the price of gas is set to the annual average price level of 2015 and in the high scenario it is set to the average level of the first half of 2023. For electricity, the price levels of 2022 and the first half of 2023 are taken for the low and high price scenario, respectively. We then split the range between the low and high prices in equal parts, and set the two mid-level price scenarios to 0.25 and 0.75 of the range (see Table 5.1).

Table 5.1: Gas and electricity price scenarios.

Price scenarios	Gas price (EUR/kWh)	Electricity price (EUR/kWh)
Low	0.077	0.105
Mid-low	0.120	0.144
Mid-high	0.205	0.221
High	0.247	0.47

Data: CBS, based on own calculations

We compute the distribution of the estimated energy quote for all households in the Netherlands based on the 2021 sample. Figure 5.2 shows the cumulative distributions of the estimated energy quote under each of the four price scenarios. A price increase not only shifts the position of the energy quote distribution to the right, as households increase their energy expenditure, but it also changes the shape of the distribution. Under higher energy prices the dispersion of the energy quote increases. Both the shift and the reshaping result in a larger fraction of the overall population facing a high energy quote. The reshaping of the distribution in part corresponds to the heterogeneous response in energy use to energy prices. In our analysis, where income is taken as exogenous, the energy quote by construction has an elasticity to energy prices equal to the elasticity of energy expenditure to prices (ln EQ = ln Expenditure +ln Income). Thus, the uneven response of expenditure to energy prices across household groups, creates a (relative) repositioning of households along the energy quote distribution when prices increase.



Data: CBS, based on own calculations.

Figure 5.2: Observed and Estimated EQ cumulative distribution (2021).

Risk of high EQ To more precisely assess this differential repositioning of households along the energy quote distribution we explore how the incidence of a high energy quote changes for the different household groups. That is, for each household group we calculate the share of households that face a high energy quote (> 8%) under different price scenarios and compared to the observed incidence of a high energy quote in 2021.

Table 5.2: Fraction of households with high EQ. Data: CBS, based on own calculations.

					Price scenarios			
Property Group	Income Group	Energetic housing quality	N	2021 Data	Low	Mid-low	Mid-high	High
Owner-occupied	high	high	115,117	0.1%	-	0.1%	0.6%	1.1%
		low	36,314	0.2%	0.0%	0.2%	1.4%	2.7%
		very low	24,340	0.3%	0.1%	0.4%	2.1%	3.6%
	mid-high	high	775,327	0.6%	0.1%	0.6%	3.2%	5.5%
		low	243,211	1.4%	0.4%	1.5%	6.9%	11.3%
		very low	129,752	2.7%	0.8%	3.0%	13.0%	20.4%
	mid-low	high	198,866	5.3%	1.7%	5.7%	20.4%	29.6%
		low	79,799	10.1%	3.8%	11.1%	33.8%	45.9%
		very low	42,103	19.0%	8.5%	20.9%	48.6%	60.4%
	low	high	28,759	50.3%	37.0%	52.6%	73.9%	80.3%
		low	14,334	58.2%	44.9%	60.8%	79.9%	85.1%
		very low	9,793	69.2%	54.4%	72.1%	86.9%	90.1%
Commercial rent	high	high	10,744	-	-	-	0.3%	0.6%
		low	3,794	-	-	-	1.1%	2.5%
		very low	2,024	-	-	-	1.7%	2.7%
	mid-high	high	105,674	0.6%	0.2%	0.7%	3.0%	5.0%
		low	41,903	1.4%	0.4%	1.7%	8.0%	13.0%
		very low	21,973	2.9%	0.8%	3.8%	17.8%	27.8%
	mid-low	high	91,890	5.1%	1.6%	5.5%	20.6%	29.9%
		low	45,865	10.0%	3.6%	11.2%	35.5%	48.2%
		very low	26,079	17.4%	7.4%	19.9%	48.8%	60.3%
	low	high	51,134	40.0%	25.7%	44.3%	75.2%	83.4%
		low	30,220	50.5%	35.4%	54.2%	79.5%	85.0%
		very low	19,560	56.6%	41.4%	59.3%	80.5%	85.3%
Social rent	high	high	4,685	-	-	-	-	-
		low	1,255	-	-	-	-	-
		very low	285	-	-	-	-	-
	mid-high	high	196,064	0.1%	0.0%	0.1%	1.9%	4.3%
		low	55,253	0.4%	0.0%	0.4%	6.3%	12.9%
		very low	10,936	0.9%	-	1.0%	10.4%	19.1%
	mid-low	high	643,273	4.0%	0.6%	4.0%	22.9%	34.9%

					Price scenarios			
Property Group	Income Group	Energetic housing quality	N	2021 Data	Low	Mid-low	Mid-high	High
		low	184,403	8.3%	1.3%	9.7%	45.9%	62.1%
		very low	36,056	12.9%	2.6%	15.6%	56.8%	71.4%
	low	high	519,037	25.6%	9.7%	29.1%	68.3%	79.0%
		low	176,972	36.6%	14.7%	42.7%	81.8%	88.8%
		very low	37,363	44.8%	20.8%	51.1%	84.7%	90.2%

Note: Some values are hidden (-) because of privacy related rules.

The estimated share of households with a high energy quote per household group are presented in Table 5.2. These results showcase the remarkable differences in vulnerability to high energy prices across household groups. For the high-income group, even under the highest price scenario the incidence of a high energy quote is marginal. For Mid-low income households between 1/3 to 2/3 households would face a high energy quote under high energy prices. Whereas for low-income households the highest energy price results in an incidence of a high energy quote in excess of 80% across home ownership types and energetic housing quality groups.

Relative to the 2021 data the high energy price scenario dissipates the differences in the high energy quote incidence across ownership types for low-income households, particularly between owners and social renters. For these two especially vulnerable groups, energetic housing quality plays a substantial role in reducing the impact of high prices. Specifically, shifting the energetic housing quality from very bad to good reduces the incidence of a high energy quote under the high price scenario by 11% (from 90% to 80%).

This reduction in the incidence of a high energy quote under high prices associated to the energetic housing quality is even more salient for the Mid-low income group. For this group, shifting energetic housing quality from very bad to good cuts in half the incidence of a high energy quote. The importance of the energetic quality as a determinant of the heterogenous exposure to high prices among Mid-low income households appears to explain the relatively high median energy quote that we find in the descriptive analysis for households in this income group in low energetic quality houses.

As a means to quantify how much of a difference energetic quality makes in terms of mitigating the impact of high energy prices we perform a counterfactual-type back-of-the-envelope calculation. Specifically, we calculate how the number of households facing a high energy quote under high energy prices change, given other household characteristics (i.e., in- come and home ownership status), households in low energetic quality houses would have high energetic quality houses, and thus faced the incidence of high energy quote of this group in- stead. If Low income households in homes with very low energetic housing quality were to have a high energy energetic quality house, approximately 5 thousand (4 thousand social renters and 1 thousand owners) less households would have a high energy quote under high energy prices. A similar calculation for the Mid-low income households results in 33 thousand (12.5 thousand social renters, 8 thousand commercial renters, and 12.5 thousand owners) less households facing a high energy quote under high energy prices.

6 Discussion and conclusion

Like in most other European countries, during the energy price peak in 2022, the Dutch government offered support to households in paying their energy bills. Because of political pressure for speed and ease of implementation, in the Netherlands the support measures took shape mainly through a lower energy tax for all households plus various energy allowances, including an income-neutral allowance for all households. Meanwhile, the Dutch government is looking for ways to phase out generic compensation measures in favour of measures targeted at specifically vulnerable groups of households, given the obvious disadvantages of generic measures – they i) are not structurally sustainable from a public finance perspective, ii) offer support to house- holds that do not need it, and iii) can undermine the incentive for households to adopt energy saving technologies such as home insulation and solar panels. To overcome these drawbacks, there are roughly three policy paths that governments can choose: income support, energy price policy and home renovation (retrofit) programs. In this study we showed the extent to which these three policy paths may help to provide targeted support to households vulnerable to high energy prices.

We found that the majority of households is not vulnerable to high energy prices; this is especially true for the medium-high incomes, even if they have a poorly insulated home. The opposite is true for lower incomes: they are often vulnerable to high energy prices, especially - but certainly not exclusively - in case their house is of low energetic quality. These findings are in line with the conclusions of recent Dutch policy studies by, respectively, the Netherlands Bureau of Economic Policy Analysis (CPB) and the Dutch Central Bank (DNB) that lower incomes are structurally vulnerable to higher living costs (van Hoenselaar, Eijsink, & Rupert, 2023; Schulenberg & Vlekke, 2022). Moreover, we found that almost no correlation exists in the Netherlands between energetic housing quality and income. This means that financial sup- port to low-income households in paying their energy bills (regardless of their energetic housing quality) disproportionally benefits households in reasonably well insulated homes – and is there- fore a form of income policy rather than energy policy. Conversely, income-neutral subsidies for insulating low-energy houses largely benefit higher-income homeowners in poorly insulated houses (REFERENCE). Hence, our analysis shows that supporting households in adapting to structurally higher energy prices primarily calls for income-dependent policy measures that reduce the high energy quote of a subgroup of lower-income households. This is particularly relevant if one considers that lower-income households also appear to be relatively unresponsive to high energy prices (as highlighted by our results on the price elasticity of energy use), and thus with higher prices they see their energy bill increase relatively faster.

Generally speaking, the required support can be achieved by increasing their income or reducing their energy costs. Energy costs can be reduced by increasing the energetic quality of poorly insulated homes, which (especially for low-income households) leads to lower energy quotes and moderates the increase in the incidence of high energy quotes in case of higher energy prices. We find, however, that while increasing energetic housing quality is a necessary condition to shield all lower-income households from vulnerability to high energy prices, it is also an insufficient condition. The data show that, while energy quotes of lower-income household with high energetic housing quality are indeed substantially lower than those of lower-income household with low energetic housing quality, they are still relatively high, and the large majority of households in the lower income group would face a high energy quote in case of high energy prices. That said, home retrofitting evidently still is a good strategy from a social cost perspective: a one-off investment in targeted home renovation means that less annual income support is needed to compensate for extreme income effects of a relatively small group. Recently, social housing associations in the Netherlands have been subject to performance agreements to improve the energetic quality of their housing stock. The most important agreement is that houses with the lowest energetic quality (e.g. energy labels E, F, and G) need to be phased out by 2028 at the latest. Additionally, since January 1st, 2023, the costs of improving housing sustainability for incumbent tenants can no longer be passed on in a rent increase. In addition, substantial extra energy efficiency investments in the commercial rental sector are warranted, given the relatively low energetic housing quality of this part of the housing stock. To this aim, the Dutch government plans to impose legal requirements for commercially rented dwellings, including the requirement that all commercially rented dwellings have at least energy label D by 2030, but this is yet undecided. Per 2024, however, renters are helped by an (additional) rent reduction that is imposed for rental homes with energy labels E, F and G (via the allocation of points in the housing rating system). Per April 2023 owners of commercially rented dwellings are helped by having been granted access to existing subsidy arrangements for energy efficiency improvements. Recent years have shown, however, that despite high energy prices, the pace of home retrofitting in the social rental sector in the Netherlands is hardly increasing. Given the relatively autonomous institutional status of social housing, the Dutch government has very limited control over their renovation strategies. A lack of coordination among both individual social housing associations and commercial landlords, meanwhile, hinders the industrialization of housing renovation, despite the fact that such an innovative approach to housing renovation would enable economies of scale, and thus both cost savings and a faster pace of home retrofitting.

Alternatively, another policy strategy to reduce the energy quote of lower income households is to design an income-dependent energy tax refund, regardless of energetic housing quality. While this option is still being considered, its implementation is complex: it requires linking income data to energy use data and sharing income data with commercial energy companies – which is legislatively complex. Another way to accomplish the same goal is the introduction of a direct energy allowance, directed at low-income households. In 2022 and 2023 this was in place, as low-income households were twice entitled to a one-off payment ('energy allowance') distributed by municipalities. This scheme has greatly mitigated the increase in energy poverty Mulder et al. (2023) but involved a high administrative burden for municipalities. The Dutch government does not want to structurally introduce such an allowance as part of the existing system of allowances for rent, childcare and health care costs of households with a lower income. Since there was a major scandal with childcare allowances, the government is politically motivated to abolish such allowances for subgroups of households altogether. In addition to this, the effectiveness of this approach may be curtailed if it further reduces the energy usage response to high energy prices of the already relatively unresponsive groups.

Yet another strategy is an income-dependent price cap as insurance against extreme energy prices. This approach could be justified on the basis that an increase in energy prices significantly increases the incidence of high energy quotes for the lower-income groups, whereas for the high-income group energy prices make little difference in terms of high energy quote incidence. Nevertheless, the Dutch government does not appear keen on exploring this option, partly in view of implementation problems that are foreseen for households with a communal heat connection. Finally, replacing income with “poor energy housing quality” as a criterion for targeted subsidies that differentiate between households also proves difficult: both energy labels and the LEQ energy housing quality indicator, as used in this study, do not provide legal certainty because they are based on expert judgment and modelling, respectively.

In conclusion, the so far largely elusive quest for targeted policies to structurally support vulnerable households in adapting to (structurally) higher energy prices in the Netherlands illustrates the importance of institutional innovations - particularly in the tax administration, central government, municipalities and social housing associations - in achieving a just energy transition that leaves no one behind.

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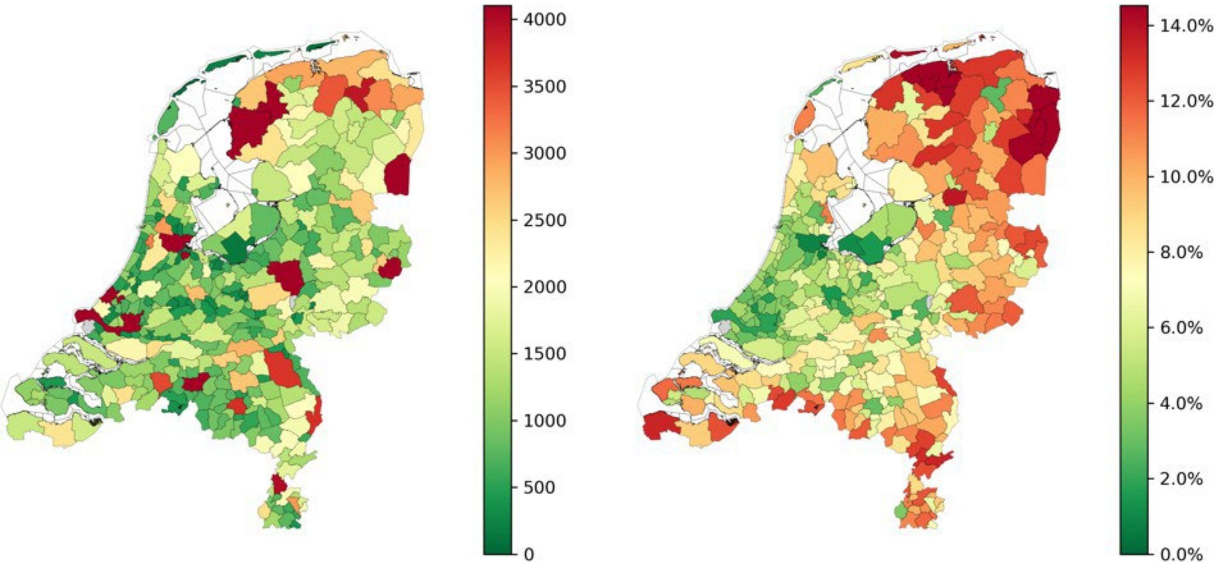
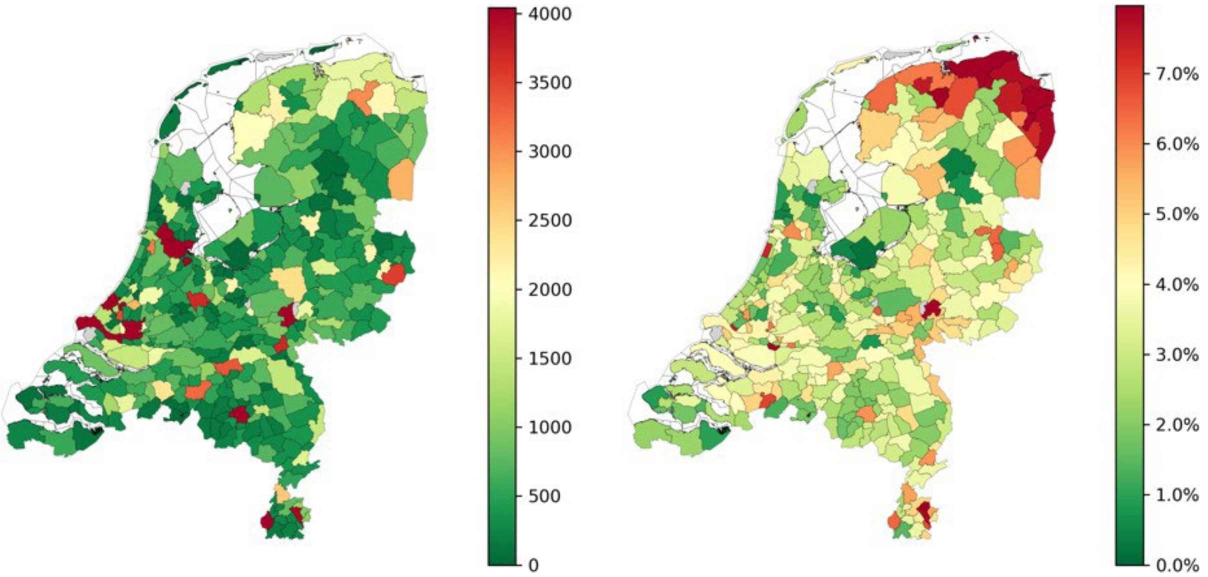
Appendix A

Vulnerable households per household group



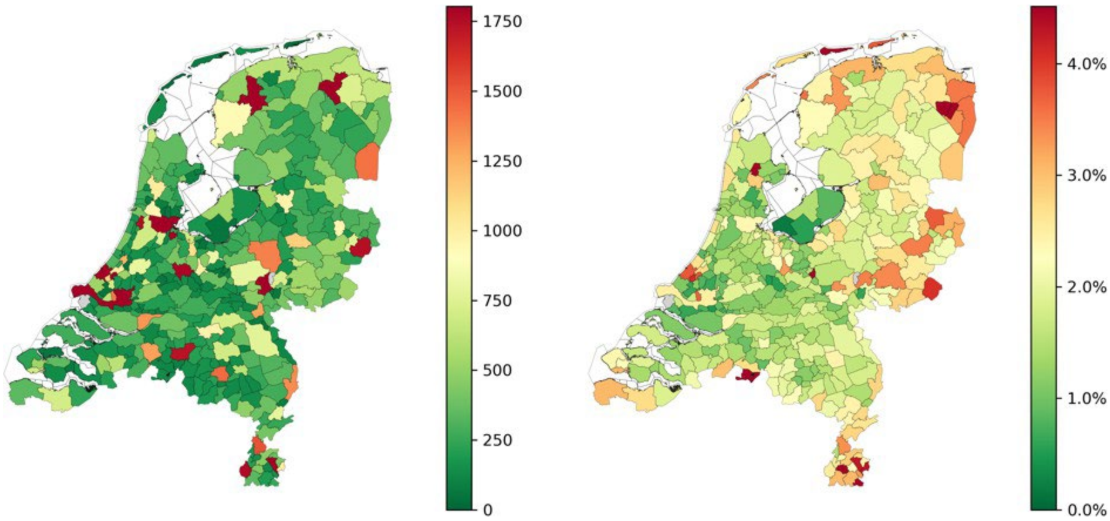
Data: CBS, based on own calculations.

Figure A.1: Number (left) and shares (right) of vulnerable households in each municipality in the Netherlands (only owner-occupied).



Data: CBS, based on own calculations.

Figure A.2: Number (left) and shares (right) of vulnerable households in each municipality in the Netherlands (only social rent).



Data: CBS, based on own calculations.

Figure A.3: Number (left) and shares (right) of vulnerable households in each municipality in the Netherlands (only commercial rent).

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