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Gert Peersman, Joris Wauters

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Heterogeneous Household Responses to Energy Price Shocks

Abstract

We use survey evidence on reported spending in hypothetical energy price shock scenarios to study novel features of the price elasticity of energy demand and the marginal propensity to consume (MPC) after paying the energy bill. We find that the price elasticity is significantly larger for price increases than price decreases and diminishes heavily for greater price hikes. The elasticity is also larger for households undertaking major home renovations over the next months, and smaller for families with more appetite to consume. For the MPC, we document greater responses of non-energy consumption when energy prices increase compared to price decreases. MPCs are also larger for households with low income and/or saving buffer, and households reporting their future financial situation is difficult to predict. Finally, we show that targeted price subsidies on energy for Belgian low-income households are much more effective in supporting non-energy consumption than the general VAT reduction on energy prices.

JEL-Codes: D120, E210, H310, Q410, Q430.

Keywords: energy demand, marginal propensity to consume, household heterogeneity.

Gert Peersman
Ghent University / Belgium
gert.peersman@ugent.be

Joris Wauters
National Bank of Belgium
joris.wauters@nbb.be

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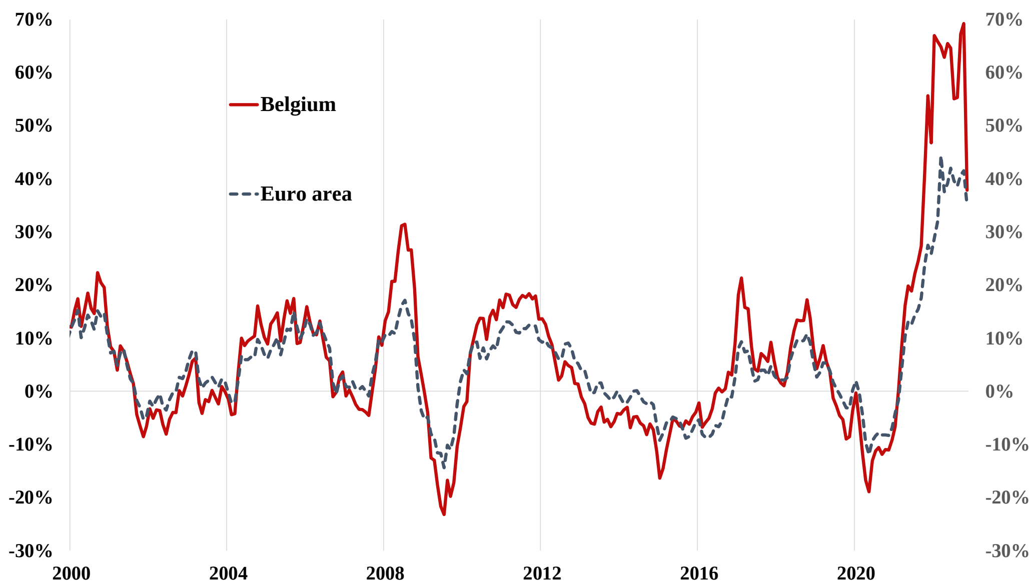
1 Introduction

Energy prices have soared exceptionally in the euro area since mid-2021, particularly in Belgium (Figure 1), which has elicited much debate on the distributional and macroeconomic consequences. In evaluating these effects and designing appropriate income support policies, it is crucial to know how households respond to energy price shocks. The same applies to implementing policies and pricing mechanisms to promote energy efficiency and mitigate climate change. In this paper, we study novel features of households' price elasticity of energy demand and their marginal propensity to consume (MPC) after paying the energy bill. The former is, for example, relevant to measure the impact of changes in energy prices on energy conservation and the disposable income of families after paying the energy bill. The MPC, in turn, determines how households' other types of spending respond to fluctuations in energy prices, which is essential for macroeconomic consequences and stabilization policies.

Figure 1: Growth rate of energy prices



Note: Year-on-year growth rate of HICP-Energy. Sample period: 2000M1-2022M11. Source: ECB Statistical Data Warehouse.

Several recent papers have used survey evidence on reported spending in hypothetical scenarios to estimate MPCs out of unexpected one-time income shocks (Jappelli and Pistaferri, 2014; Bunn et al., 2018; Christelis et al., 2019; Fuster et al., 2020). Reported spending propensities appear similar to revealed-preference estimates based on actual data (Parker and Souleles, 2019). However, they do not require statistical assumptions to identify exogenous shocks and isolate their effects on consumption from other confounding forces. A key advantage of a survey environment is also that it allows for recovering estimates of parameters that are hard to obtain using revealed behavior. For example, surveys allow asking questions about household perceptions and expectations. Moreover, they facilitate the study of nonlinear relationships and heterogeneity across specific population groups.

In this paper, we are the first to use this approach to estimate the price elasticity of energy demand and the MPC after paying the more expensive (or cheaper) energy bill. Since energy is a basic necessity whose prices typically follow a random walk, the MPC can be considered as the spending response to an unanticipated permanent or highly persistent income shock (Gelman et al., 2022). Importantly, our setup allows us to distinguish between the responses at the extensive and intensive margins and to examine nonlinearities and heterogeneity across households, which are all dimensions of these two measures that have largely been unexplored in existing studies.

To this end, we have included additional questions at the end of the monthly consumer survey of the National Bank of Belgium (NBB) in the period May-July 2022. This survey, which is in collaboration with the European Commission, is used to construct Belgian and European consumer confidence and expectations indicators. In these extra questions, households have first been asked for their current monthly energy bill, and were then randomly treated with a hypothetical rise (20€, 50€ or 100€) or fall (-50€) in this bill caused by an energy price shock. Next, households were asked if the price change would induce them to change their monthly energy consumption and, if so, by how much. This data allows us to calculate each household's implicit (contemplated) price elasticity of energy demand. In addition, we have asked whether they would adjust their consumption of other goods and savings, respectively, and by which amounts. Based on these two answers, we construct a household-level measure of the MPC after paying the energy bill.

The four random treatments allow us to examine nonlinearities depending on the sign and magnitude of energy price shocks. To study household heterogeneity, we use the standard survey answers, which represent a rich source of information at the household level. Specifically, we explore heterogeneity according to household income, saving buffer, a new measure of financial uncertainty, expectations about the macroeconomy, appetite to consume, planned home renovations, family size, gender, and age. The main findings are as follows:

1. Households respond much more strongly to scenarios of energy price increases. The reported price elasticity of energy demand—which is on average similar to estimates based on actual expenditures in existing studies—is roughly three times larger for price increases (-0.28) than for price decreases (-0.08). An asymmetric response depending on the sign of the shock is consistent with existing macro evidence for the oil market (e.g., Gately and Huntington, 2002) and suggests that energy demand may be permanently

lower when prices return to pre-crisis levels.

2. The price elasticity crucially depends on the magnitude of the price shift; that is, the elasticity diminishes heavily for larger energy price increases. For example, households report an elasticity of -0.38 when the monthly energy bill at constant consumption would increase by 20€, and -0.19 when the bill would increase by 100€. We find a positive extensive margin effect—a larger share of households would reduce energy consumption as the price shift increases—which is dominated by a negative intensive-margin magnitude effect. That is, conditional on responding, households lower energy consumption more for larger price increases, but much less than proportional to the price shift, resulting in a weaker elasticity. This finding indicates that supply disruptions have greater leverage on energy prices when prices have increased a lot in recent periods.

3. For price increases, the elasticity of energy demand is greater for households that will undertake major home renovations over the next 12 months. These households likely have lower transaction costs to insulate the house or install solar panels. In contrast, the reported price elasticity is significantly lower for households that expect to raise their spending on major purchases of durable goods, which we interpret as appetite or confidence to consume. Against general perceptions, we find no heterogeneity of the elasticity across households according to financial characteristics such as income and saving buffer.

4. For price decreases, we find no relationship between the price elasticity of energy demand and household characteristics.

5. The MPC after paying the energy bill is significantly greater for energy price increases than for price decreases of similar magnitude: 0.59 versus 0.40. On the one hand, in contrast to Gelman et al. (2022)—who estimate MPCs to changes in gasoline prices using transaction data for a large panel of individuals—these values are clearly below one. On the other hand, the asymmetry between price increases and decreases echoes results from studies that document stronger MPCs for negative temporary income shocks (e.g., Bunn et al., 2018; Christelis et al., 2019; Fuster et al., 2020).

6. When the magnitude of energy price increases is greater, more households report that they would accommodate (part) of the decline in disposable income by reducing their savings. As a consequence, the MPC tends to weaken for larger price shocks.

7. Several household characteristics can explain the heterogeneity of MPCs after paying a more expensive energy bill. First, MPCs are significantly larger for households with low income, low saving buffer, and female respondents. These characteristics also explain the heterogeneity of MPCs to temporary income shocks in existing studies. This finding

is also compatible with Gelman et al. (2022), Känzig (2021), and Battistini et al. (2022), who document a stronger response of non-energy expenditures to energy price shocks for low-income and/or liquidity-constrained households. Furthermore, we show a stronger decline in non-energy consumption for households who report that their future financial situation is difficult to predict, which is our new indicator of financial uncertainty. Finally, households with more appetite to consume appear to have lower MPCs when they experience a fall in disposable income.

8. When the energy bill becomes cheaper, we only find a relatively stronger consumption response for households with lower saving buffers and older households.

To illustrate the relevance for designing appropriate stabilization and income support policies in response to energy price shocks, we use our results to compute the MPCs for four different household profiles. Among other things, these groups differ in their financial vulnerability to energy shocks. Then, we use these profiles to evaluate the effectiveness of two policy measures implemented by the Belgian government in response to the soaring energy prices: a reduction in the VAT on energy prices from 21% to 6% for all households, and targeted social tariffs on electricity and gas for low-income households (acting as a price subsidy).

The results suggest that the reduction in the VAT on energy prices has not been effective in supporting non-energy consumption. For instance, financially secure households have mainly used the rise in disposable income (after paying the energy bill) to increase their savings; that is, the MPC of these households for price decreases is only 0.27. Notably, these (high-income) households receive more financial support from the government than other households when there is a reduction in VAT because they have, on average, higher energy bills. By contrast, the social tariffs on electricity and gas for low-income households have been very effective in stabilizing the non-energy consumption of the financially vulnerable. These households did not experience the substantial price increase shown in Figure 1. If they had, their large MPCs would imply an important reduction in their non-energy consumption expenditures. In particular, the MPCs for these households vary between 0.78 and 0.91. More generally, our results confirm the conjecture that policy measures to stabilize the consequences of soaring energy prices should be targeted at financially vulnerable households. This takeaway is also relevant for the discussions at the EU level to impose price caps on energy prices.

Section 2 explains the survey and the methodology. Section 3 details the series used to explain heterogeneity among households. The estimation results for the price elasticity of demand —including asymmetries, nonlinearities, and household heterogeneity—are shown in section 4. Section 5 discusses the estimation results for the MPC and draws policy implications from a simulation of different household profiles. Finally, section 5 concludes.

2 Methodology

2.1 Consumer Survey

Every month, the NBB consumer survey questions a representative and renewed sample of Belgian households via telephone. The survey is part of the European Commission's Joint Harmonised EU Programme of Consumer Surveys, held monthly in EU member states and used, among others, for constructing consumer confidence indicators. The questions broadly cover the following topics: the general economic situation in Belgium, the personal financial position and attitude towards savings of the household, their intentions regarding purchases of durables, cars, a new house, and major home renovations in the next 12 months. The survey also collects personal characteristics of the consumer, such as age, education, and household income.[1] Overall, the standard survey questions provide a rich source of information at the household level that we will explore in our analyses to explain heterogeneity in price elasticities of energy demand and MPCs in sections 4 and 5.

2.2 Scenario Questions on Energy Price Shocks

In the survey waves of May, June, and July 2022, we included extra questions about spending behavior in hypothetical scenarios related to energy price changes. The questions were asked after all the regular survey questions. We discuss the additional questions in turn and explain in the next subsection how the responses were used for computing the price elasticity of energy demand and the MPC.

The first question is used to know the current monthly energy bill of the household. We limit the analysis to electricity and heating. Most households in Belgium have a joint bill for both sources of energy, and the frequency of this bill is typically monthly. Interviewers were informed that transportation fuels should not be considered.

> ***Question 1:*** *Can you tell me roughly how much your monthly energy bill is today? By energy bill, we mean all the household's monthly expenses for electricity and heating that you pay now.*[2]

We then randomly treat the survey respondent with an energy price shock scenario. Three scenarios for price increases have been included in the May wave of the survey; that is, respectively, a rise in the energy bill by 20€, 50€, or 100€ while holding the volume of consumption

[1] For details on the questionnaire, see https://www.nbb.be/en/statistics/opinion-surveys/methodology. Information on the EU consumer survey can be found at https://economy-finance.ec.europa.eu/economic-forecast-and-surveys/business-and-consumer-surveys_en.

[2] For all survey questions, the response coded by the interviewer could also be "Don't know."

constant. These different amounts will allow us to examine possible nonlinearities depending on the magnitude of the energy price shock. For example, the following question was asked for a rise in the bill by 50€:

> *Suppose that, at constant consumption, your monthly energy bill would increase by 50€ due to an increase in energy prices. What would you do?*[3]

In the June and July waves, we implemented several scenarios corresponding to different policy support measures to reduce the energy bill of households.[4] One of the treatment groups in these waves received a scenario of a reduction in the energy bill (at constant consumption) of 50€ due to a tax cut by the government on energy prices. Since this policy measure represents a fall in energy prices, we include this subgroup in the analysis below to examine possible asymmetries between positive and negative energy price shocks. More precisely, these households were asked the following question:

> *Suppose that the energy price per kilowatt-hour falls due to a tax cut by the government. As a result, your monthly energy bill at constant consumption becomes €50 cheaper. What would you do?*

We follow Fuster et al. (2020) in applying a two-stage structure of questions to provide the answers. Respondents are first asked if they would change their spending (or saving), after which they are asked by what monetary amount they would change their spending (or saving). Compared to only asking for the monetary amount, this approach does not prime the respondents toward a non-zero response. Specifically, to evaluate the response of energy consumption, we first ask the following question:

> ***Question 2A****: Would you consume less, more, or as much energy?*

If the reply was "as much", a zero was automatically imputed for question 2B. If the answer to question 2A was "less" or "more", the respondent was asked the following clarifying question:

> ***Question 2B****: How many euros of energy would you consume [less/more] each month if your energy bill at constant consumption would increase by €50?*[5]

[3]For half of the households, the price increase was further specified as "for a period of one year" (without any information about what happens afterward), and for the other half of households as "for many years". This distinction turned out to be irrelevant (statistically insignificant when explicitly tested in the estimations), which suggests that households consider both scenarios as permanent shocks.

[4]We will discuss this experiment in a follow-up paper, where we compare price policies with income policies.

[5]Using "less" or "more" and the exact amount of euros depends on the reply to Q2A and the treatment group the respondent is in. For price decreases, the question was formulated as follows: *How many euros would you spend more/less on energy if your energy bill at constant consumption was €50 cheaper due to a decrease in the price per kilowatt-hour?*

In section 2.3, we show how this information can be used to calculate the implicit price elasticity of energy demand. The same two-step structure has been used to register the responses of non-energy consumption and savings, which will be used to measure the MPC after paying the energy bill:

> ***Question 3A**: Would you make less, more, or as many other expenses?*
>
> ***Question 3B**: How many euros would you [reduce/increase] your other monthly expenses if your monthly energy bill increases by €50?*
>
> ***Question 4A**: Would you save less, more, equally, or possibly tap into your savings?*
>
> ***Question 4B**: How many euros would you save [less/more] each month if your monthly energy bill increases by €50?*

2.3 Computation of the Price Elasticity and MPC

In the next sections, we will report two types of results. On the one hand, based on the qualitative responses to questions 2A and 3A, it is possible to estimate whether there is a response of energy and non-energy consumption to energy price shocks at the extensive margin, which are dichotomous variables taking values 0 or 1. On the other hand, using the numerical replies to questions 1, 2B, 3B, and 4B, it is possible to compute the household's price elasticity of energy demand and the MPC after paying the energy bill, which will be the dependent variables in linear regression models.

Price Elasticity of Energy Demand. The aim is to compute each household's price elasticity of energy demand:

$$E_d = \frac{(Q_2 - Q_1)/Q_1}{(P_2 - P_1)/P_1} = \frac{\Delta Q_2/Q_1}{\Delta P_2/P_1},$$

where P_i and Q_i denote, respectively, energy prices and quantities in period $i = 1, 2$; that is the period before and after the price shock, respectively. While our questions don't ask directly for energy prices or quantities, they allow for computing E_d. Denote the current monthly energy invoice of the household (response to question 1) as $CURRENT$. Assuming that the invoice does not include a fixed cost component, this invoice can be represented as a function of (pre-treatment) price and quantity as

$$P_1 Q_1 = CURRENT. \tag{1}$$

Now denote the random monthly energy bill shock (20€/50€/100€/-50€) as X, which, at constant consumption, changes the invoice to

$$P_2 Q_1 = CURRENT + X. \tag{2}$$

From equations (1) and (2), the relative price change is then given by

$$\frac{\Delta P_2}{P_1} = \frac{X}{CURRENT}. \tag{3}$$

Next, denote the energy consumption reduction from question 2B as Z (with $Z < 0$ for an increase in consumption). Accounting for the consumer's reaction to the price change leads to the updated spending equation:

$$P_2 Q_2 = CURRENT + X - Z. \tag{4}$$

Combining equations (4) and (2) gives the relative change in energy quantities consumed:

$$\frac{\Delta Q_2}{Q_1} = \frac{-Z}{CURRENT + X}. \tag{5}$$

Putting everything together, the price elasticity of energy demand is obtained as

$$E_d = \frac{\Delta Q_2/Q_1}{\Delta P_2/P_1} = \frac{-Z}{CURRENT + X} \times \frac{CURRENT}{X}, \tag{6}$$

which is typically non-positive: $E_d \leq 0$.

Marginal Propensity to Consume after Paying the Energy Bill. Since we study the response to an energy price shock rather than an income shock, we compute the marginal propensity to consume (MPC) for changes in disposable income *after* paying the energy bill. Notice that the disposable income of households could also be affected by energy price shifts beyond the more expensive (or cheaper) energy bill. Households could, for example, decide to work more hours to compensate for the loss in purchasing power, which also affects disposable income. Moreover, wages are automatically indexed to inflation in Belgium, which is affected by energy price changes. Although the survey does not include a question on the (expected) impact of the shock on the disposable income of households, it is possible to measure the MPC solely based on the other questions.[6] Specifically, denote the consumption reaction

[6] A drawback is that if the consumer reports changing neither consumption nor savings, the MPC cannot be computed. Several households have indeed reported that the rise in energy prices would not affect their non-energy consumption or their savings. Such observations automatically drop for the MPC estimations.

from question 3B as ΔC and the savings reaction from question 4B as ΔS. By definition, the change in disposable income after paying the energy bill corresponds to $\Delta C + \Delta S$, which we use to compute the MPC as

$$MPC = \frac{\Delta C}{\Delta C + \Delta S}. \quad (7)$$

Unlike the price elasticity, the MPC typically lies in the $[0, 1]$ interval.

2.4 Data cleaning

For energy price decreases (June and July waves), we observed quite a large number of counter-intuitive responses. For example, several households reported that if the energy bill decreased by 50€, they would save (and/or consume) 50€ less or reduce energy consumption by 50€. When we had a more careful look at these observations, we found that the suspect cases were systematically linked to some of the interviewers, who likely misinterpreted the intended setup or coding, or did not follow the script of the interview. This problem was confirmed when we listened to several telephone recordings of these interviewers. In addition to a couple of extreme observations that were clearly mistakes, we have therefore decided to remove all the observations linked to these interviewers.[7]

Furthermore, we have winsorized the price elasticity and MPC at the one percent lowest and highest values of the distribution to limit the influence of outliers. As a result, the lower bound of the price elasticity is -2.08, while there are no cases of a positive elasticity (thirteen cases of positive elasticity are winsorized to zero). On the other hand, the MPC is always between zero and one due to the winsorizing of four negative observations and three MPCs larger than one. Overall, this winsorizing does not affect the qualitative results.

3 Characteristics to explore heterogeneity

This section details the series used to explore household heterogeneity and motivates their inclusion in the expanded regressions in sections 4 and 5. Specifically, we use information on household characteristics from the standard consumer survey questions, which were all asked prior to our hypothetical scenario questions. Most questions are qualitative and ask about positive, neutral, or negative perceptions or expectations regarding economic variables. We summarize each such series into a numerical one by following two steps. The first step echoes the method of the European Commission and other institutions to construct so-called

[7]Some responses were about ten times the change in the energy bill—probably referring to annual expenditures. There were also two cases where the price became negative due to the reduction in the energy bill by 50€ at constant prices exceeding current expenditures, which does not allow us to calculate the elasticity.

"balance statistics" from the answers to the qualitative questions by assigning, e.g., +1 to 'very positive', +0.5 to 'positive', 0 to 'neutral', -0.5 to 'negative', and -1 to 'very negative'.[8] As only one response category can be chosen, this implies a single 'score' for each household. In the next step, we standardize the numerical series from step 1. As a result, a unit change in the final numerical series included in the regressions can be interpreted as one standard deviation from the sample mean.[9] We consider the household characteristics discussed below.

Cash on hand. In the literature, income and liquid wealth are considered the most important characteristics to associate with different spending responses of households to economic shocks. The intuition is that consumers with less cash on hand have a lower ability to protect their consumption against income shocks due to credit constraints.[10] Furthermore, Straub (2019) shows that the MPC decreases in the level of permanent income if households have non-homothetic preferences across periods, which captures the idea that rich households save disproportionately more than low-income households. Notice also that poor households spend a larger share of their income on energy, which implies that they are affected differently by energy price shocks in the first place.

Gelman et al. (2022) and Känzig (2021) show that income is indeed an important source of heterogeneity in the MPC to energy price shocks; that is, families with lower income tend to have higher MPCs.[11] Relatedly, Battistini et al. (2022) find that changes in spending on essentials are greater for households in lower income quintiles and those with no positive saving flows when energy expenditures increase. On the other hand, the existing evidence on the relationship between income and the price elasticity of energy demand is mixed. For example, Schulte and Heindl (2017) find that high-income households in Germany respond more to changes in electricity prices than low-income households, while Sun and Ouyang (2016) find the opposite for China. The same opposing findings regarding the role of income have been documented in the literature on gasoline demand (Wadud et al., 2010).

The survey includes a standard question on income but, unfortunately, does not collect information about the balance sheet characteristics of the households, such as liquid assets.

[8] See the user guide at https://ec.europa.eu/info/sites/default/files/bcs_user_guide.pdf.

[9] A linear transformation of a vector θ of numerical scores, e.g., $\theta = (2, 1, 0, -1, -2)'$ into a vector $\beta = a\theta + b$ —where a and b are scalars— results in the same series after standardization when $a > 0$.

[10] This also applies to permanent income shocks. For example, Kaplan and Violante (2010) simulate a life-cycle model with preferences characterized by constant relative risk aversion. They show that the marginal propensity to consume out of a permanent shock increases from 0.77 to 0.93 when consumers are unable to borrow to smooth the shock.

[11] A key finding in the empirical literature on temporary income shocks is that households with low financial resources (cash on hand) have higher MPCs (Jappelli and Pistaferri, 2020). A notable exception is Kueng (2018), who finds that MPCs are increasing with income. He finds that having low financial resources predicts higher MPCs only for lower-income households.

However, the survey includes questions on current and expected savings, which can also be considered as a buffer to absorb shocks. More precisely, we examine the role of the following two variables:

- **Income**: The respondents can choose between four possible categories of total net household income per month; that is <1000€, 1000€-2500€, 2500€-4000€, and >4000€. We construct an income indicator by assigning respectively +1, +2, +3, and +4 to these categories, which is then standardized.
- **Saving buffer**: We construct a measure based on two questions that relate to the household's scope to pay for a more expensive bill by adjusting savings. The first question asks about the current financial situation of the household. To express the saving buffer, we assign +2 for 'We are saving a lot', +1 for 'We are saving a little', 0 for 'We are just managing to make ends meet on our income', -1 for 'We are having to draw on our savings', and -2 for 'We are running into debt'. To these scores, we add those from the second question, which asks how likely the household will save any money over the next 12 months (note that this is the situation in the absence of the energy price shock). We set +2 for 'definitely', +1 for 'yes, possibly', -1 for 'probably not', and -2 for 'definitely not'. After adding both scores, we standardize the series.

Macroeconomic expectations. According to precautionary savings models, households should have lower MPCs when they are more pessimistic about future economic activity and their future financial situation. That is, they prefer to save to be able to accommodate future negative income shocks. To evaluate if expected economic activity affects the response of (non-)energy consumption and saving to energy price shocks, we construct a standardized index based on the question "How do you expect the general economic situation in Belgium to develop over the next 12 months?". Specifically, we apply +2 for 'much better', +1 for 'slightly better', 0 for 'remain the same', -1 for 'slightly worse', and -2 for 'much worse'.

Financial uncertainty. Recent studies have provided evidence supporting theoretical predictions that uncertainty about variables that impact future consumption induces prudent behaviors, including increased precautionary savings and lower consumption levels.[12] Specifically, Ben-David et al. (2018) show that people with more uncertain expectations about personal and macroeconomic outcomes exhibit more precaution in their consumption, credit,

[12]Several macroeconomic studies have documented a negative impact of uncertainty on household expenditures. However, it is unclear whether this is the consequence of expectations about the first or second moments of economic conditions, since most large uncertainty shocks are associated with significant deteriorations in the expected economic outlook (Bloom, 2014). Evidence on the causes and consequences of the second moments is scant, mainly because of a lack of measures of subjective uncertainty (Ben-David et al., 2018).

and investment behaviors. Coibion et al. (2021) find that higher macroeconomic uncertainty reduces the spending of households over the next months, while Dietrich et al. (2022) find that uncertainty about expected GDP leads to higher savings. Noticeably, both studies find little effect of the first moment of expectations on household spending and savings, which suggests that uncertainty is reducing consumption rather than concerns about the expected path of the economy. In the present paper, we are the first to analyze the role of uncertainty in households' responses to economic (energy price) shocks.[13] For example, households might have a higher MPC and/or price elasticity when prices increase in a context of high uncertainty. We measure households' uncertainty about their future financial situation based on a new question recently added to the EU consumer survey (European Commission, 2021). In particular, this question asks how easily the future financial situation of the household can be predicted. Therefore, we set -2 for 'easy to predict', -1 for 'moderately easy to predict', +1 for 'moderately difficult to predict', and +2 for 'difficult to predict', after which we standardize.

Intended consumption. The standard survey also includes questions on expected consumption over the next 12 months. Two of the questions, which we label respectively as "appetite to consume" and "home improvements", might be able to explain the heterogeneity of household responses to energy price shocks:

- **Appetite to consume:** the households are asked, "Compared to the last 12 months, do you expect to spend more or less money on major purchases of durable goods such as furniture and electrical goods over the next 12 months?" We assign 2 for 'much more', 1 for 'a bit more', 0 for 'the same', -1 for 'a bit less', and -2 for 'much less' to construct an indicator for the regressions. This indicator can be considered a proxy for the household's confidence or willingness to consume.[14]

- **Home improvements**: one of the questions asks how likely the household will spend large sums of money on home improvements or renovations over the next 12 months. When the household is (very) likely to engage in home improvements or renovations over the next 12 months, the transaction costs to insulate the house or install solar panels should be lower, facilitating a response to price shifts. In step 1, we assign +3 for 'very likely', +2 for 'fairly likely', +1 for 'not likely', and 0 for 'not likely at all', which is then standardized.[15]

[13] Albuquerque and Green (2022) find that households that are more concerned about their ability to meet their spending commitments in the short term have a higher MPC in response to temporary income shocks, which corresponds to the first moment of expectations.

[14] At the aggregate level, the European Commission uses the sum of this question, two questions on the household's current and future financial situation, and macroeconomic expectations to measure consumer confidence.

[15] In the survey, the households are also asked whether they plan to buy or build a home over the next 12

Other household characteristics. In the regression, we also include the following characteristics that may explain heterogeneity across households.

- **Family size**: Larger families could have a larger price elasticity of energy demand if it's easier for them to reduce energy consumption. They might also have a higher MPC, as this implies lower household income per capita (when controlling for income in the estimations). Jappelli and Pistaferri (2014) find that MPCs to temporary income shocks increase by family size. The survey does not collect the exact number of family members. Instead, it is asked whether the respondent lives together with a partner and/or children. Before standardizing, we construct a measure that equals +1 for someone living alone (i.e., without a partner or children), +2 if the respondent lives alone with dependent children or as a couple without children, and +3 for a couple with children.
- **Gender**: There is mixed evidence on the effect of gender on MPCs to transitory income shocks, with Jappelli and Pistaferri (2014) finding a negative effect for men, and Albuquerque and Green (2022) reporting a positive effect. Intuitively, a gender effect could be linked to lower income or could also be behavioral. In the regressions, we include a dummy variable that indicates if the respondent is female, which is standardized to ensure comparable scaling (and coefficient size) with the other characteristics.
- **Age:** According to the standard life cycle model, young households have lower MPCs since they have a longer horizon. On the other hand, there might be cohort effects in the opposite direction if the younger generation has, for example, a lower discount factor (Jappelli and Pistaferri, 2020). Existing empirical studies for temporary shocks typically find smaller MPCs for older age groups (Jappelli and Pistaferri, 2014; Fagereng et al., 2021). We construct an age indicator by assigning respectively +1, +2, +3 and +4 to the categories '18-29', '30-49', '50-64', '65+', which is then standardized.

4 Price Elasticity of Energy Demand

This section discusses the estimation results for the price elasticity of energy demand (E_d). We first describe the baseline results that test for nonlinearities concerning (i) energy price increases versus price decreases, and (ii) the magnitude of the energy price shock when prices increase. The following subsection expands on the baseline results by including a set of

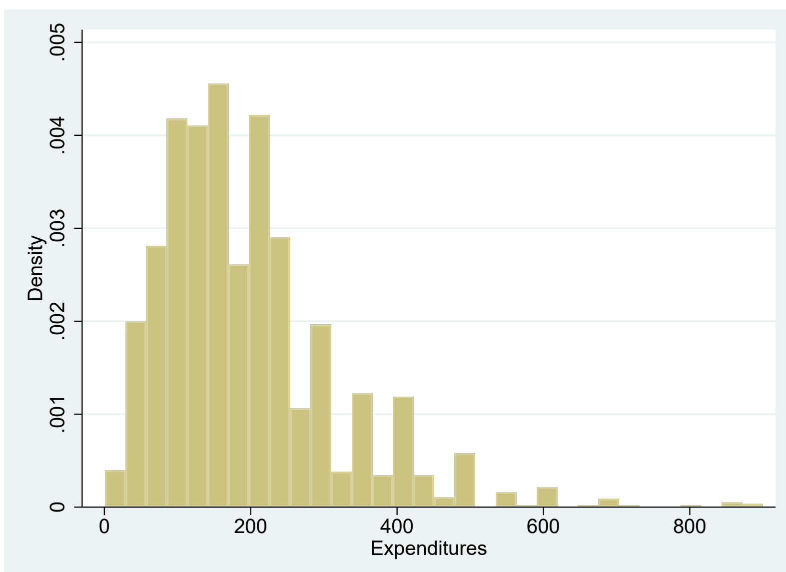
months, which might imply lower transaction costs. However, several caveats apply to this question. First, this home could be a to let or a holiday home. Second, if the household still has to buy the home, they don't know yet whether there will be the possibility to insulate the house or install solar panels. Third, if it is a newly built house, energy efficiency is likely already very high, with little room for improvement. Finally, if the household buys a new house, the current energy bill is not representative to calculate the price elasticity. In fact, when we include this variable in the estimations, it is never significant (results available on request).

household characteristics in the regressions. A caveat to exploring heterogeneity is that the dataset has only a cross-section dimension: a different sample of households is interviewed every month, which makes it impossible to include an individual fixed effect to control for unobserved heterogeneity. However, as shown by Jappelli and Pistaferri (2020) for the MPC out of temporary income shocks, the amount of bias is probably moderate.

4.1 Price Elasticity and the Scenario of the Energy Price Shock

Figure 2 shows the distribution of the monthly energy expenditures across households. The median invoice is 165€, while the sample average is 201€.[16] Hence, on average, the scenarios we consider correspond to energy price increases of roughly 10%, 25%, and 50%, and a decline of approximately 25%. Appendix A.1 shows the relationship between energy expenditures and household characteristics. We document significantly higher energy expenditures for larger families and households with a higher income. There is also a positive relationship with financial uncertainty. On the other hand, women have reported lower energy expenditures.

Figure 2: Distribution of monthly energy expenditures (energy bill)



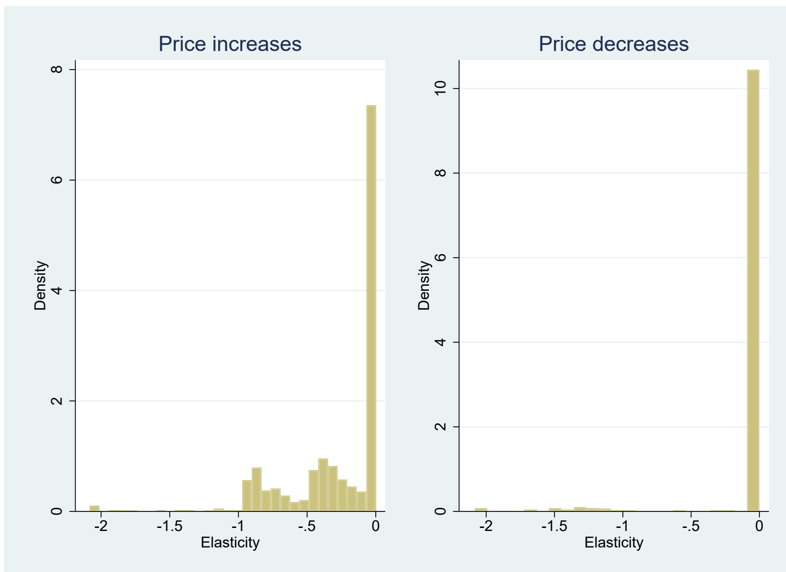
Note: Histogram of monthly energy expenditures in € (question 1).

The price elasticity of energy demand varies substantially across households (Figure 3). Overall, 64% of households report an elasticity of zero, and less than 4% have an elasticity

[16] 81% of the respondents know how much they spend monthly on energy, which is relatively high. Unfortunately, we are unable to calculate the price elasticity for the other households. Note also that the average invoices are statistically not significantly different across the waves.

below minus one. The average price elasticity is -0.22, which appears realistic. Specifically, a meta-analysis by Labandeira et al. (2017) based on 428 papers provided between 1990 and 2016 finds that the trimmed mean (median) short-term price elasticity of energy demand across studies is -0.19 (-0.14), while the mean (median) estimate of the long-term elasticity is -0.52 (-0.43). The corresponding standard deviations in the trimmed sample are 0.17 and 0.39. Even though energy price shocks can be considered as permanent, we have no information about the horizon households have in mind for the reported responses of energy expenditures. In any case, the implied elasticities are similar to existing estimates based on actual data.

Figure 3: Distribution of the price elasticity of energy demand



Note: Histograms of the computed price elasticities of energy demand using the responses to questions 1 and 2. The left(right)-hand side panel shows elasticities to energy price increases (decreases).

Several studies have shown a larger response of energy demand to price increases compared to price cuts at the macroeconomic level (e.g., Gately and Huntington 2002; De Schryder and Peersman 2015; Liddle and Sadorsky 2020; İçen and Yerdelen Tatoğlu 2021). The underlying idea is that higher prices induce more investment in energy-efficient equipment and retrofitting of existing capital, such as greater insulation, which is irreversible when prices fall. We confirm this asymmetry at the individual household level. As can be observed in Figure 3, there is a clear difference between energy price increases and decreases. Half of the households have a price elasticity of zero for energy price increases, compared to 94% when prices decline.

Table 1: Price elasticity and the scenario of energy price shock

	Price elasticity	Extensive margin (likelihood of response)	Intensive margin (elasticity ∣ elasticity ≠ 0)
	(1)	(2)	(3)
↑ bill 20€ (dummy)	-0.38***	0.46***	-0.84***
	(0.03)	(0.03)	(0.03)
↑ bill 50€ (dummy)	-0.27***	0.51***	-0.52***
	(0.02)	(0.02)	(0.02)
↑ bill 100€ (dummy)	-0.19***	0.53***	-0.35***
	(0.01)	(0.02)	(0.01)
↓ bill 50€ (dummy)	-0.08***	0.06***	-1.29***
	(0.02)	(0.01)	(0.09)
Current energy bill	-0.04*	0.01	-0.14***
× dummy ↑ prices	(0.03)	(0.02)	(0.02)
Current energy bill	0.02	-0.01	0.14
× dummy ↓ prices	(0.02)	(0.02)	(0.14)
Difference ↓50€ vs ↑50€	0.19***	-0.44***	-0.77***
	(0.02)	(0.03)	(0.09)
Difference ↑100€ vs ↑20€	0.19***	0.08**	0.49***
	(0.03)	(0.04)	(0.04)
Observations	1753	1753	637

Note: Column (1) shows the price elasticity under different treatments for the energy bill change. In column (2), the extensive margin is measured using a dummy dependent variable that equals one if the respondent changes energy consumption. The intensive margin is measured in column (3) by conditioning on non-zero responses. All regressions apply OLS. Robust standard errors in parentheses. Significance as * p<0.10 , ** p<0.05, *** p<0.01.

Table 1 shows the quantitative effects of this asymmetry, as well as possible nonlinearities depending on the magnitude of the energy price shock. In column (1), we regress the elasticities on a set of dummy variables that capture the sign and magnitude of the change in the energy bill (i.e., 20€, 50€, 100€, and -50€) while controlling for the (standardized) size of the energy bill of each household. Notice that the implicit price change of an individual household is the ratio of the rise or fall in the energy bill in euros and the current energy bill of each household (i.e., equation 3 derived in section 2.3). Hence, by controlling for the size of the energy bill, the dummy variables can be interpreted as price changes.[17] As can be

[17]In Appendix A.2, we show scatterplots between these implicit price changes and the price elasticity.

observed in the table, the price elasticity of energy demand is about three times larger when the energy bill increases by 50€ (-0.27) compared to an equivalent reduction in the bill (-0.08). The difference between both is statistically significant, which is documented in the lower part of the table, and the consequence of the much larger response at the extensive margin to energy price increases. The asymmetric price elasticity suggests that energy demand will be permanently lower when prices would return to pre-crisis levels.

Column (1) of Table 1 further reveals that the price elasticity is highly nonlinear for price increases. Specifically, when the energy bill increases by 20€, the price elasticity is -0.38. However, when the energy bill increases by 50€ or 100€, the price elasticity turns out to be respectively -0.27 and -0.19, which implies that the elasticity is lower (less negative) for households treated with a greater rise in the energy bill. Thus, the elasticity diminishes for larger energy price shifts. The magnitude of this nonlinearity is economically important and statistically significant.[18] Finally, it also appears that the elasticity is somewhat larger (p-value 0.09) when (standardized) current energy expenditures are higher.

Next, we distinguish between the intensive and extensive margins of the price elasticity, which is a dimension of energy demand that has not been explored in the literature so far. The results are reported in columns (2) and (3) of Table 1. Column (2) shows regression results where the dependent variable is a dummy variable that equals 1 when the household reports that it would adjust its energy consumption in response to the price shock (i.e., the qualitative response to question 2A).[19] As we increase the size of the price shift, a significantly larger fraction of the households indicate that they would reduce their energy consumption. Specifically, the probability of a response is 46% when the bill rises by 20€ and 53% for a 100€ bill increase. This can be labeled as a positive extensive-margin magnitude effect of the price shift. However, as shown in column (3), there is a much weaker response for larger price shifts when we limit the sample to those households that effectively adjust their energy consumption. This negative intensive-margin magnitude effect dominates the extensive-margin effect and explains why we find an overall weakening of the elasticity for larger price shocks. Intuitively, when prices increase by, let's say, 10 percent, a fraction of the households will lower the heating temperature by one degree Celsius. When prices increase by 50 percent, more households will lower the heating, but by less than five degrees.[20] This finding indicates that supply disruptions have greater leverage on energy prices when prices have increased a lot recently.

[18]In addition to the difference between the 20€ and 100€ scenarios shown in the table, the price elasticity is also statistically significantly different between the 20€ and 50€ scenarios and the 50€ and 100€ scenarios.

[19]For ease of interpretation, we have conducted linear regressions. Conclusions are, however, the same for logistic regressions.

[20]When we use the implicit responses of the volume of energy as the dependent variable, which can be calculated based on equation 5, we find a stronger decline for larger price shifts, but this is less than proportional to the price shift. The same applies when we use the reported response of energy expenditures in euros as the dependent variable (results available on request).

4.2 Heterogeneity of the Price Elasticity of Energy Demand

Table 2 expands the baseline results by including the household characteristics. Columns (1) and (2) report linear regression results of the price elasticity on household characteristics, the (standardized) energy bill, treatment group dummies, and a constant. Columns (3) and (4) explore the extensive margin of energy consumption, showing results of logistic regressions with a dummy dependent variable that indicates whether the household intends to consume less (more) energy under an energy price increase (decrease) scenario. Logistic regression coefficients are shown as marginal effects on the probability scale (evaluated at covariate means) to facilitate interpretation.

The elasticity is significantly stronger for households reporting to (very) likely do home improvements or renovations over the next 12 months. Holding all other variables equal, a unit increase in this standardized variable strengthens the price elasticity by -0.03. This suggests that lower transaction costs—for example, to install solar panels or insulate the house—allow for a stronger reduction of energy consumption when energy prices increase.

We find an opposite effect for the appetite to consume, as the elasticity is significantly smaller for households that expect to spend more on major purchases of durables such as furniture and electrical goods compared to the past 12 months. This effect can be interpreted as a high degree of consumer confidence (or willingness to consume) at the household level.

Column (3) provides a consistent message on the extensive margin. A marginal increase in home improvements raises the probability of energy savings behavior by 0.04; for the appetite to consume, we find a negative effect of -0.05. In contrast to the price elasticity, the extensive margin increases significantly for larger families and female respondents. All other characteristics are statistically insignificant. For income and the saving buffer, this is somewhat surprising since there is a general perception that households with low cash on hand are forced to lower energy consumption when prices increase due to liquidity constraints, which is less the case for high-income families.

For energy price decreases, column (2) shows no relationship between the price elasticity and household characteristics. The same holds for the extensive margin results in column (4). Notice that the price elasticity contains only a small share of non-zero values (6%) for price decreases, which might be the reason why we cannot explain its variation with the household characteristics data.

Table 2: Heterogeneity of the price elasticity of energy demand

	Price elasticity		Extensive margin	
	↑ Prices	↓ Prices	↑ Prices	↓ Prices
	(1)	(2)	(3)	(4)
Income	0.02	0.00	-0.03	-0.01
	(0.02)	(0.02)	(0.02)	(0.01)
Saving buffer	-0.00	0.02	0.00	-0.02
	(0.01)	(0.02)	(0.02)	(0.01)
Macro expectations	-0.01	0.01	-0.01	-0.00
	(0.01)	(0.02)	(0.01)	(0.01)
Financial uncertainty	0.00	-0.01	0.01	0.01
	(0.01)	(0.02)	(0.02)	(0.01)
Appetite to consume	0.03**	0.03	-0.05***	-0.00
	(0.01)	(0.02)	(0.02)	(0.01)
Home improvements	-0.03***	0.01	0.04**	-0.01
	(0.01)	(0.01)	(0.02)	(0.01)
Family size	-0.02	0.01	0.05***	0.00
	(0.02)	(0.02)	(0.02)	(0.01)
Female	-0.00	0.01	0.04**	-0.00
	(0.01)	(0.02)	(0.02)	(0.01)
Age	0.01	0.01	-0.02	0.00
	(0.01)	(0.02)	(0.02)	(0.01)
Current energy bill	-0.04	0.01	0.00	-0.00
	(0.03)	(0.02)	(0.02)	(0.02)
↑ bill 50€ (dummy)	0.11***		0.05	
	(0.03)		(0.04)	
↑ bill 100€ (dummy)	0.19***		0.09**	
	(0.03)		(0.04)	
Constant	-0.39***	-0.09***		
	(0.03)	(0.02)		
Observations	1146	537	1146	537

Note: Columns (1) and (2) show linear regressions of the price elasticity on household characteristics and the treatments for the energy bill. Columns (3) and (4) report marginal effects (at covariate means) from logistic regressions which use a dependent variable that equals one if the respondent changes energy consumption. Robust standard errors in parentheses. Significance as * p<0.10 , ** p<0.05, *** p<0.01.

5 Marginal Propensity to Consume

Similarly to the previous section, we first discuss the baseline regression results for the MPC, followed by the expanded regressions that account for household characteristics. In addition, we provide a numerical illustration of the policy implications of household heterogeneity.

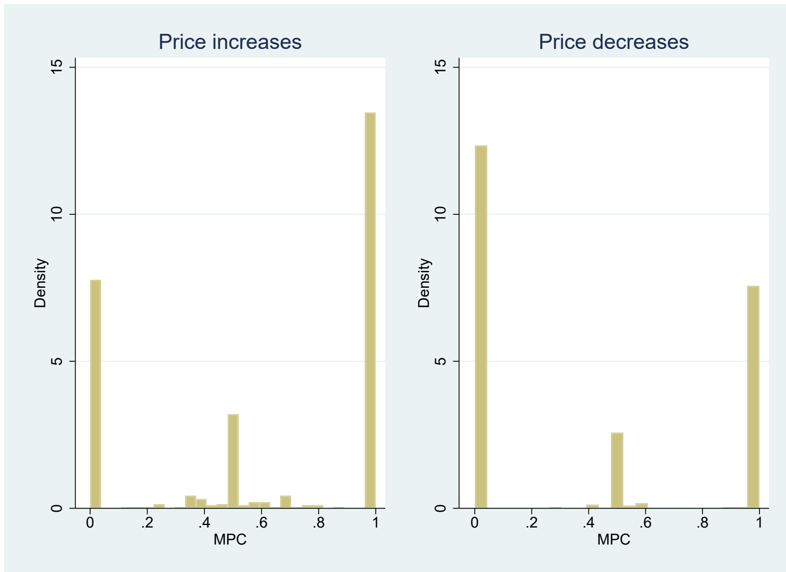
5.1 MPC and the Scenario of the Energy Price Shock

The MPC is interpreted here as the reaction of consumption expenditures to a permanent change in disposable income *after* paying the energy bill (Gelman et al., 2022). When households report a zero response for both non-energy consumption and savings ($\Delta C = \Delta S = 0$), it is not possible to compute their MPC. These respondents suggest that they assume or believe that their disposable income after paying the energy bill would be unaffected by the shock. This is possible, for example, when these households fully accommodate the price shock by adjusting energy consumption. This is also possible when they decide to cover the rise (fall) in the energy bill by working more (less) hours, or when income increases (decreases) proportionally to changes in the energy bill. Notice that Belgium is one of the few countries where wages are automatically adjusted to changes in consumer prices (including electricity and heating prices), which implies that this is feasible.

It appears that the number of such observations depends on the magnitude and sign of the energy price shock. In particular, 31% of the households report a zero response for both non-energy consumption and saving when the energy bill increase by 20€. For increases in the bill by 100€, this is only 21%. This statistically significant difference can partly be explained in two ways. First, there's the larger price elasticity of energy demand for small changes in energy prices that we have documented in section 4.1, which implies that disposable income after paying the energy bill is much less (or not) affected by the shock. Second, households seem to presume that smaller shocks can or will be accommodated by changes in disposable income. On the other hand, 9% of the respondents report no response of consumption and saving when the energy bill decreases by 50€, which is mainly the consequence of the lower price elasticity of energy demand when prices decrease.

Figure 4 shows the distribution of MPCs for price increases and decreases. There is ample heterogeneity across households. Overall, 39% report an MPC of zero, and the average MPC is 0.52. This average contrasts with Gelman et al. (2022), who find an MPC for gasoline price shocks using transaction data for a panel of individuals that is close to one. Instead, we obtain a value that is significantly below one, indicating that households partly absorb the shock by adjusting their savings. On the other hand, the reported MPCs are higher than those typically obtained in the literature for transitory shocks (e.g., Fuster et al., 2020).

Figure 4: Distribution of the Marginal Propensity to Consume



Note: Histograms of the computed MPCs following energy price increases (left-hand side panel) and price decreases (right-hand side panel).

In Table 3, we examine the same nonlinearities as in section 4.1. Again, there is a difference between price increases, which imply a decline in disposable income after paying the energy bill, and price decreases (where disposable income rises). For the subgroup with price increases that raise the energy bill at constant consumption by 50€, the average MPC is 0.59. For similar decreases in the energy bill, the average MPC is lower at 0.40. The table's bottom part shows that the difference is statistically highly significant (p-value<0.001). This finding of a higher MPC for price increases is consistent with existing studies on temporary income shocks, which have documented an asymmetry in the form of stronger reactions to negative income shocks.[21] The reason for this asymmetry is the reported response at the extensive margin. Specifically, as documented in column (2) of Table 3, a significantly lower share of households note that they would adjust non-energy consumption when energy prices decrease. The opposite applies to the responses of saving (column 3). At the intensive margin, in contrast, the magnitude of the response is statistically not different between positive and negative changes in disposable income after paying the energy bill.

Several effects are worth mentioning concerning nonlinearities depending on the magnitude of the energy price shock. As described above, more households suppose that disposable

[21] See, for example, Bunn et al. (2018), Christelis et al. (2019), and Fuster et al. (2020). Several mechanisms from the theoretical literature can explain an asymmetric response to positive and negative temporary income shocks, such as liquidity constraints, precautionary savings, and loss aversion.

Table 3: MPC after paying the energy bill

	MPC	Extensive margin		Intensive margin
		$\Delta C \neq 0 \mid \Delta Y_d \neq 0$	$\Delta S \neq 0 \mid \Delta Y_d \neq 0$	$(MPC \mid MPC \neq 0)$
	(1)	(2)	(3)	(4)
↑ bill 20€ (dummy)	0.64***	0.72***	0.42***	0.88***
	(0.03)	(0.03)	(0.03)	(0.02)
↑ bill 50€ (dummy)	0.59***	0.71***	0.51***	0.84***
	(0.03)	(0.03)	(0.03)	(0.02)
↑ bill 100€ (dummy)	0.59***	0.71***	0.52***	0.83***
	(0.03)	(0.03)	(0.03)	(0.02)
↓ bill 50€ (dummy)	0.40***	0.46***	0.67***	0.86***
	(0.02)	(0.02)	(0.02)	(0.01)
Difference ↓50€ vs ↑50€	-0.19***	-0.25***	0.16***	0.02
	(0.03)	(0.04)	(0.04)	(0.02)
Difference ↑100€ vs ↑20€	-0.06	-0.01	0.10**	-0.05**
	(0.04)	(0.04)	(0.05)	(0.02)
Observations	1300	1300	1300	792

Note: Column (1) shows the marginal propensity to consume (MPC) under different treatments for the energy bill change. In column (2), the extensive margin is measured using a dummy dependent variable that equals one if the respondent changes energy consumption. In column (3), the dependent dummy variable measures a change in savings. All regressions apply OLS. Robust standard errors in parentheses. Significance as * p<0.10 , ** p<0.05, *** p<0.01.

income after paying the energy bill (Y_d) will be affected by greater price increases, which requires a response of non-energy consumption and/or saving in the first place. Second, among those that suppose a change in disposable income after paying the bill, the response of consumption at the extensive margin appears to be the same for all three scenarios of price increases. As shown in column (2) of Table 3, this share is roughly 70%. On the other hand, column (3) reveals an extensive-margin magnitude effect of saving. In particular, a larger share of households reports that they would save less (or dissave) when we increase the shock size from 20€ to 50€ and 100€. Finally, at the intensive margin, there is a significant decrease in the MPC with the magnitude of the price shift. The combination of the weaker intensive margin and the stronger extensive margin of saving implies a decline in the MPC; that is, the overall MPCs for increases in the bill by 20€, 50€, and 100€ are 0.64, 0.59, and 0.59, respectively, although the differences are statistically not significant (column 1 of Table 3).

5.2 Heterogeneity of the Marginal Propensity to Consume

Table 4 explores the heterogeneity of the MPC using household characteristics under energy price increases and decreases in columns (1) and (2), respectively. Recall that energy price increases (decreases) correspond to a decline (increase) in disposable income after paying the energy bill. Columns (3) and (4) examine the extensive margin using logistic regressions. The dependent variables are dummy variables indicating the intention to consume, respectively, 'Less' and 'More' other non-energy goods. We include two additional columns for the extensive margin response of saving. In column (5), the dependent variable equals one if the respondent intends to save less, whereas column (6) measures the intention to save more.

We find several links between household characteristics and the MPC. Specifically, the MPC tends to be significantly higher for households with low income, a low saving buffer, and a weak appetite to consume. The MPC is also higher for households reporting higher financial uncertainty and women. The economic relevance of these characteristics will be illustrated in section 5.3. By contrast, we find no significant effects for a household's macroeconomic expectations, intention to spend on home improvements, family size, and age. Accordingly, it appears that uncertainty is affecting consumption rather than the expected path of the economy, which is a finding consistent with Coibion et al. (2021) and Dietrich et al. (2022).

The statistically significant drivers of the MPC are also significant for the extensive margin shown in column 3; that is, they explain the intention to reduce consumption under energy price increases. The marginal effect for home improvements is now also statistically significant at the 95% level. Yet, in contrast with the price elasticity, its effect is negative. Hence, families intending to spend on home renovations expect to absorb energy price increases by reducing their energy expenditures rather than their non-energy consumption.

Turning to the extensive margin for the savings response (column 5), we find that people with a higher income and saving buffer are more likely to absorb the reduction in disposable income (after paying the energy bill) by reducing their savings. The coefficient for females is significant, large, and negative. In combination with the results shown in column (3), we find that women would rather reduce their consumption than their savings following a reduction in disposable income due to an increase in the energy bill.

In sum, for price increases, we confirm existing studies that find significantly larger MPCs for households with low cash on hand and female respondents. However, we show that MPCs are also greater for households who report that their future financial situation is difficult to predict. In contrast, households with more appetite to consume have lower MPCs when they experience a fall in disposable income after paying the energy bill.

Table 4: Heterogeneity of the MPC

	MPC		Extensive margin			
			Consumption		Saving	
	↑ Prices	↓ Prices	↑ Prices	↓ Prices	↑ Prices	↓ Prices
	(1)	(2)	(3)	(4)	(5)	(6)
Income	-0.04**	0.02	-0.04*	0.04	0.04*	0.00
	(0.02)	(0.02)	(0.02)	(0.03)	(0.03)	(0.03)
Saving buffer	-0.06***	-0.11***	-0.05**	-0.11***	0.05**	0.11***
	(0.02)	(0.02)	(0.02)	(0.03)	(0.02)	(0.03)
Macro expectations	0.01	0.03	0.00	0.04*	-0.02	-0.01
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
Financial uncertainty	0.03**	-0.00	0.06***	-0.01	-0.03	-0.00
	(0.02)	(0.02)	(0.02)	(0.03)	(0.02)	(0.02)
Appetite to consume	-0.04***	0.03	-0.06***	0.02	0.03	-0.03
	(0.02)	(0.02)	(0.02)	(0.03)	(0.02)	(0.02)
Home improvements	-0.03	-0.02	-0.04**	-0.02	0.02	0.02
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
Family size	0.03	-0.02	0.03	-0.03	-0.03	0.01
	(0.02)	(0.02)	(0.02)	(0.03)	(0.02)	(0.02)
Female	0.06***	-0.00	0.08***	-0.00	-0.04**	0.00
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
Age	-0.02	0.04**	-0.01	0.02	-0.01	-0.07***
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
↑ bill 50€ (dummy)	-0.04		-0.00		0.07	
	(0.04)		(0.04)		(0.05)	
↑ bill 100€ (dummy)	-0.02		0.03		0.07	
	(0.04)		(0.04)		(0.05)	
Constant	0.62***	0.41***				
	(0.03)	(0.02)				
Observations	737	517	737	517	737	517

Note: Columns (1) and (2) show linear regressions of the marginal propensity to consume (MPC) on household characteristics and the treatments for the energy bill. Columns (3) to (6) report marginal effects (at covariate means) from logistic regressions. In columns (3) and (4), the dummy dependent variable equals one if the respondent changes non-energy consumption. In columns (5) and (6), the dependent dummy variable measures a change in savings. Robust standard errors in parentheses. Significance as * p<0.10 , ** p<0.05, *** p<0.01.

When the energy bill becomes cheaper, household characteristics matter less for explaining heterogeneity in the MPC. Overall, this is consistent with existing studies that examine asymmetries of MPCs depending on the sign of transitory income shock. Specifically, several recent studies find that the MPC declines with cash on hand under windfall losses, while there's little to no relation between the MPC and household resources under windfall gains (Bunn et al., 2018; Christelis et al., 2019; Fuster et al., 2020). For income, we confirm this asymmetric relationship. We also find that the influence of financial uncertainty, the appetite to consume, and the gender of the respondent vanishes for energy price decreases. However, as can be observed in column (2), the saving buffer remains significant under price decreases as well; that is, the MPCs to cheaper energy bills are relatively larger for households with lower saving buffers. Furthermore, we find a positive effect for age under price decreases, which correspond to standard life cycle model predictions for income increases, as younger age cohorts have a longer horizon to smooth their consumption (Christelis et al., 2019).

5.3 Economic Relevance and Policy Implications of Heterogeneity

The surge in energy prices documented in Figure 1 has prompted several countries to provide financial support to households. For example, the Belgian government decided to lower the VAT on energy from 21% to 6%, which was around the same time of the survey (i.e., in March and April 2022 for electricity and gas, respectively). Moreover, Belgium has a social tariff on electricity and gas, which is a tariff targeted at low-income households that is considerably lower than market prices in periods of price increases. In essence, it is a system that limits monthly price increases for these households.[22] In normal times, about 10% of households have such a tariff. However, the government decided to extend the eligibility criteria from May 2021 onward. As a consequence, roughly 20% of the households benefit from the lower tariff at the time of the survey.

To what extent does household heterogeneity matter for such policy measures? To answer this question, this subsection illustrates the impact of household heterogeneity on household spending (and saving) following energy price shocks, and draws implications for policy design. We define four household profiles and compute their corresponding MPCs using the results from Table 4. The profiles are the following:

1. **Low cash on hand (COH)**: This first group captures households in a financially vulnerable position, as measured by the income and saving buffer series. Since the lowest categories for these series feature relatively few observations, we select the second weakest category for each series.

[22]For example, between January 2021 and January 2022, the social tariff increased by 24% for gas and 23% for electricity. However, market prices increased by, respectively, 183% and 81% over the same period.

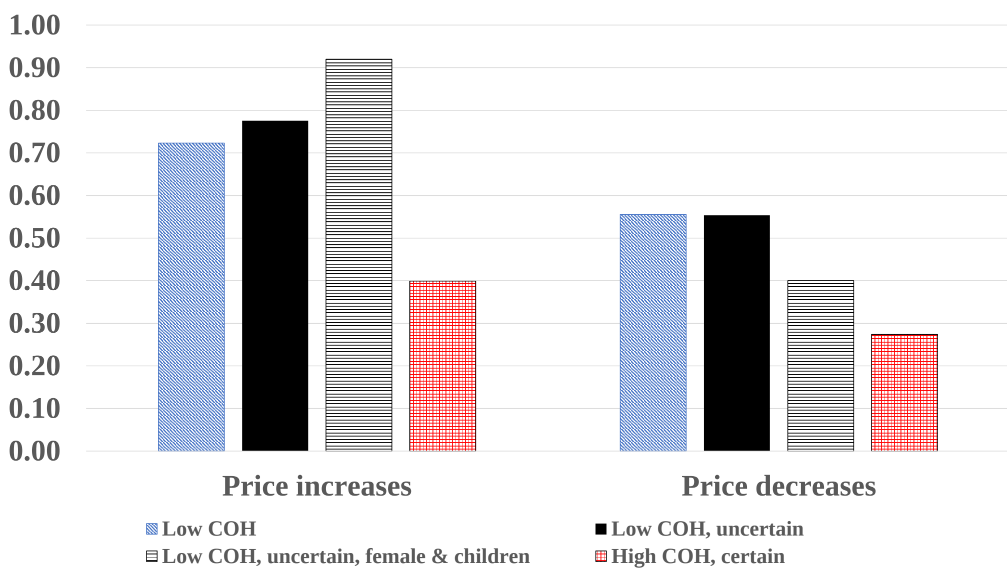
2. **Low COH, uncertain**: This group is similar to the previous one regarding cash on hand but also features the highest degree of uncertainty about their future finances.

3. **Low COH, uncertain, female & children**: This profile builds on the characteristics of the second group, with the additional features of being a young family (age category 18-29) with children and a female household head.

4. **High COH, certain**: This group is the opposite of the second group. Its members are in the highest income and saving buffer categories and consider their future finances easy to predict.

When building the profiles, we set other (and unspecified) household characteristics at their de-meaned zero values. For price increases, we consider the average situation between 20€, 50€, and 100€ energy bill increases.

Figure 5: MPCs for different household profiles



Note: The figure shows the MPCs for different profile types. See text for their definitions.

Figure 5 shows that the MPCs feature remarkable heterogeneity. Under price increases, the MPC is relatively high at 0.72 for the first group with low cash on hand. The MPC continues to increase as we add features of financial distress for the second and third groups. For the latter group of young families with children and a female household head, the MPC attains 0.91. By contrast, for the financially secure group, the MPC drops to 0.40—about half the MPC for the second group (0.78). This economically important difference suggests that financially secure households mainly respond to unfavorable shifts in disposable income by changing their savings rather than their consumption. As can be observed in the figure, the MPCs are lower for all groups when energy prices decrease. Again, the fourth group of financially secure households features the smallest MPC at a value of 0.27, which is about half the size of the MPC of the first group (0.56).

Taken together, these results have several policy implications. First, according to our estimates, households have responded very differently to the recent surge in energy prices. Specifically, financially vulnerable households have mainly reduced their non-energy consumption to pay for the more expensive energy bill. In contrast, financially secure households have mainly reduced their savings to cover the bill. Hence, to stabilize the macroeconomic consequences, policies should be targeted at financially vulnerable households.

Second, the relatively low MPC for price decreases implies that the macroeconomic stimulus of lowering the Belgian VAT on energy prices has been meager. For instance, our results indicate that financially secure households have mainly used the rise in disposable income (after paying the energy bill) to increase their savings. Notably, these households receive more financial support from the government than other households when there is a reduction in VAT because they have, on average, higher energy bills. Finally, the existence and the extension of the social tariffs on electricity and gas in Belgium have been very effective in stabilizing the non-energy consumption of financially vulnerable households because they did not experience the strong price increase shown in Figure 1. If they had, the large MPCs of these households would imply a strong reduction in non-energy consumption expenditures.

6 Conclusions

The recent surge in energy prices has led Europe into an energy crisis. Consequently, there is ample debate on its distributional and macroeconomic consequences, and on appropriate policy measures to support households. In evaluating these effects and designing stabilization and income support policies, it is crucial to understand how households respond to energy price shocks.

This paper contributes to this debate by jointly studying features of households' price elasticity of energy demand and their marginal propensity to consume (MPC) after paying the energy bill. We implement survey experiments with various energy price shock scenarios at the end of the National Bank of Belgium's consumer survey. Our questions ask about the household's monthly energy bill and measure how they change their energy consumption, non-energy consumption, and savings behavior due to the price shock. Based on these responses, we derive household-level measures of the price elasticity of energy demand and the MPC after paying the energy bill. We explore the drivers of household heterogeneity in these measures using the standard survey questions on household characteristics and expectations.

We document several nonlinearities depending on the sign and magnitude of the energy price shock, including at the extensive and intensive margins. First, the price elasticity and MPC tend to be significantly stronger under price increases than under price decreases. Second, the price elasticity weakens for larger energy price shifts. This weakening is due to a negative intensive-margin magnitude effect dominating a positive extensive margin effect.

We also find that several household characteristics can explain the heterogeneity in the price elasticity and MPC across households. For price increases, the elasticity of energy demand appears to be significantly larger for households that will likely undertake major home renovations over the next months, and smaller for families with more appetite to consume. In contrast, MPCs depend on the households' income, saving buffer, financial uncertainty, appetite to consume, and gender of the respondent. Yet household characteristics hardly matter when energy prices decline; we only find smaller MPCs for households with a greater saving buffer and younger families.

Finally, we construct four household profiles that differ, among others, in their financial vulnerability and discuss the implications of their elasticities and MPCs for two recently taken policy measures in Belgium. First, a reduction in the VAT on energy prices from 21% to 6%; second, an extension of social tariffs on electricity and gas for a broader group of low-income households (acting as a price subsidy). On the one hand, due to the low MPCs for energy price decreases, the reduction of Belgian VAT on energy prices delivered only a modest macroeconomic stimulus. For instance, financially secure households have mainly used the rise in disposable income (after paying the energy bill) to increase their savings.

By contrast, our results suggest that the extension of the social tariffs on electricity and gas in Belgium for a broader group of low-income households has been effective in stabilizing the non-energy consumption of the financially vulnerable. These households only partially experienced the substantial recent price increases. If they had, their large MPCs would imply an important reduction in their non-energy consumption expenditure. This takeaway is also relevant given the ongoing discussions at the EU level to impose price caps on energy prices.

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Appendix

A.1 Explaining the Monthly Energy Bill

As referred to in section 4.1, Table 5 shows the results from a linear regression explaining the monthly invoice using household characteristics. Energy expenditures are significantly higher (p-value < 1%) when the household has a higher income and a larger family (partner and/or children). Financial uncertainty and Female are significant at the 10% threshold, with the former having a positive association with the energy bill and the latter a negative one.

Table 5: Explaining the monthly energy bill

	Energy invoice
Income	30.79***
	(6.34)
Saving buffer	-7.60
	(4.91)
Macro expectations	-1.07
	(4.49)
Financial uncertainty	9.75*
	(5.26)
Appetite to consume	-6.41
	(5.82)
Home improvements	5.56
	(3.90)
Family size	17.55***
	(6.83)
Female	-7.68*
	(4.19)
Age	-3.82
	(5.45)
Constant	201.09***
	(4.56)
Observations	1683

Note: Robust standard errors in parentheses. Significance as * p<0.10 , ** p<0.05, *** p<0.01.

A.2 Implicit Price Changes and the Price Elasticity

In our setup, the implicit (relative) energy price change is the ratio of the nominal rise or fall in the energy bill (i.e., 50€, 100€ or -50€) and the current energy bill of each household (i.e., equation 3 derived in section 2.3). Figure 6 shows the relationship between the computed price elasticity and the relative price change of all households. For price decreases, there are only 33 non-zero observations for the price elasticity, which does not allow us to derive strong conclusions. For price increases, however, there is clearly a negative relationship: the price elasticity tends to be lower for large energy price shifts.

Figure 6: Price elasticity and magnitude of the price shift

Note: Scatterplots of the price elasticities of energy demand and the percentage points price change. The left(right)-hand side panel shows the relationship for energy price increases (decreases).