

Heterogeneous Household Responses to Energy Price Shocks

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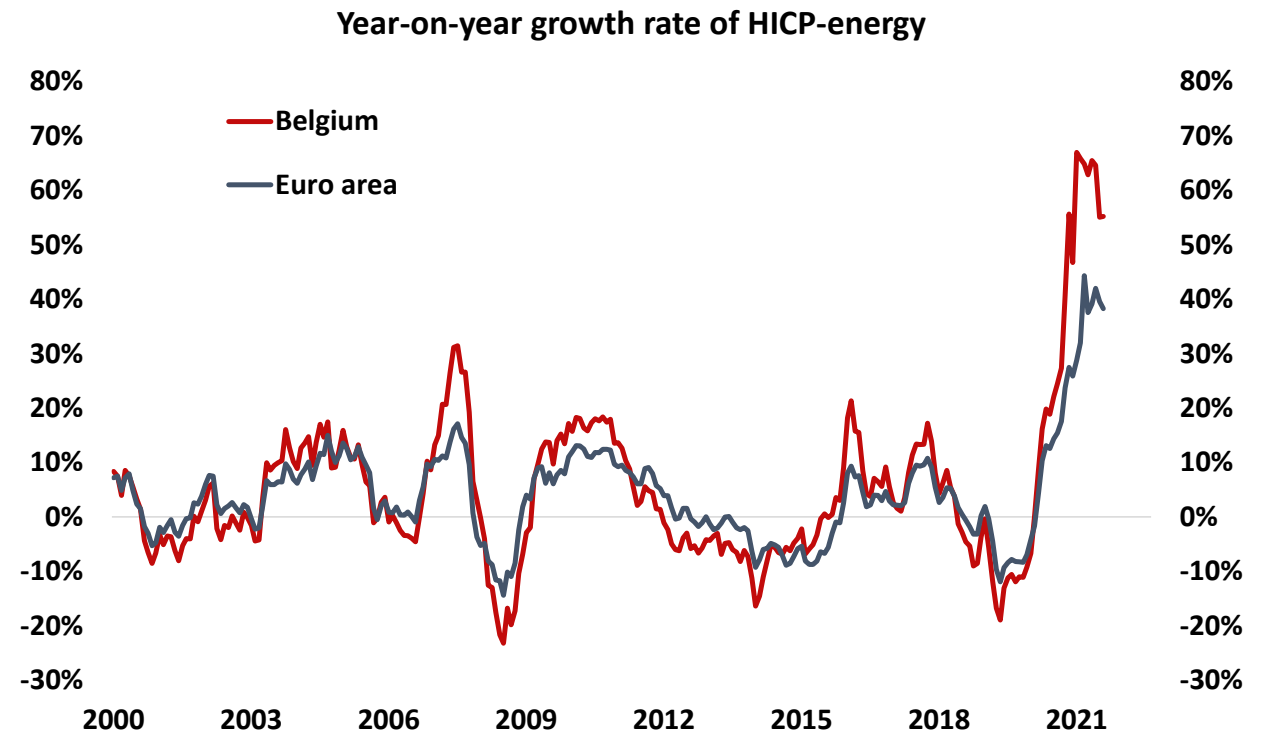
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Motivation

Soaring energy prices since mid-2021, particularly in Belgium, have elicited much debate on the distributional and macroeconomic consequences

- In evaluating these effects and designing appropriate stabilization and 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



This paper

We study (novel) features of households' **price elasticity of energy demand** and their **marginal propensity to consume (MPC) after paying a more expensive (or cheaper) energy bill**

- The price elasticity of energy demand is crucial to measure the impact of changes in energy prices on energy conservation and the disposable income of families after paying the energy bill
- Price elasticity of demand also determines the magnitude of the impact of supply disruptions on prices
- The MPC determines how households' other types of spending respond to fluctuations in energy prices, which is essential for macroeconomic consequences and stabilization policies

Methodology

Several recent studies (e.g., Jappelli and Pistaferri 2020; Fuster *et al.* 2020) have used **survey questions about spending in hypothetical scenarios** to estimate MPCs out of unexpected one-time income shocks

- This paper is the first study that uses this methodology to estimate the **price elasticity of energy demand** and **the MPC after paying a more expensive (or cheaper) energy bill**
 - Since energy prices typically follow a random walk, the MPC can be considered as the response to an **unanticipated permanent or highly persistent income shock** (Gelman *et al.* 2022)
- Our setup allows us to distinguish between the responses at the **extensive and intensive margins** and to examine **nonlinearities** (depending on sign and magnitude) and **heterogeneity across households**, which are all dimensions of these two measures that have largely been unexplored in existing studies

Methodology

Monthly consumer survey of the NBB (in collaboration with the European Commission), which is used to construct consumer confidence and expectations indicators

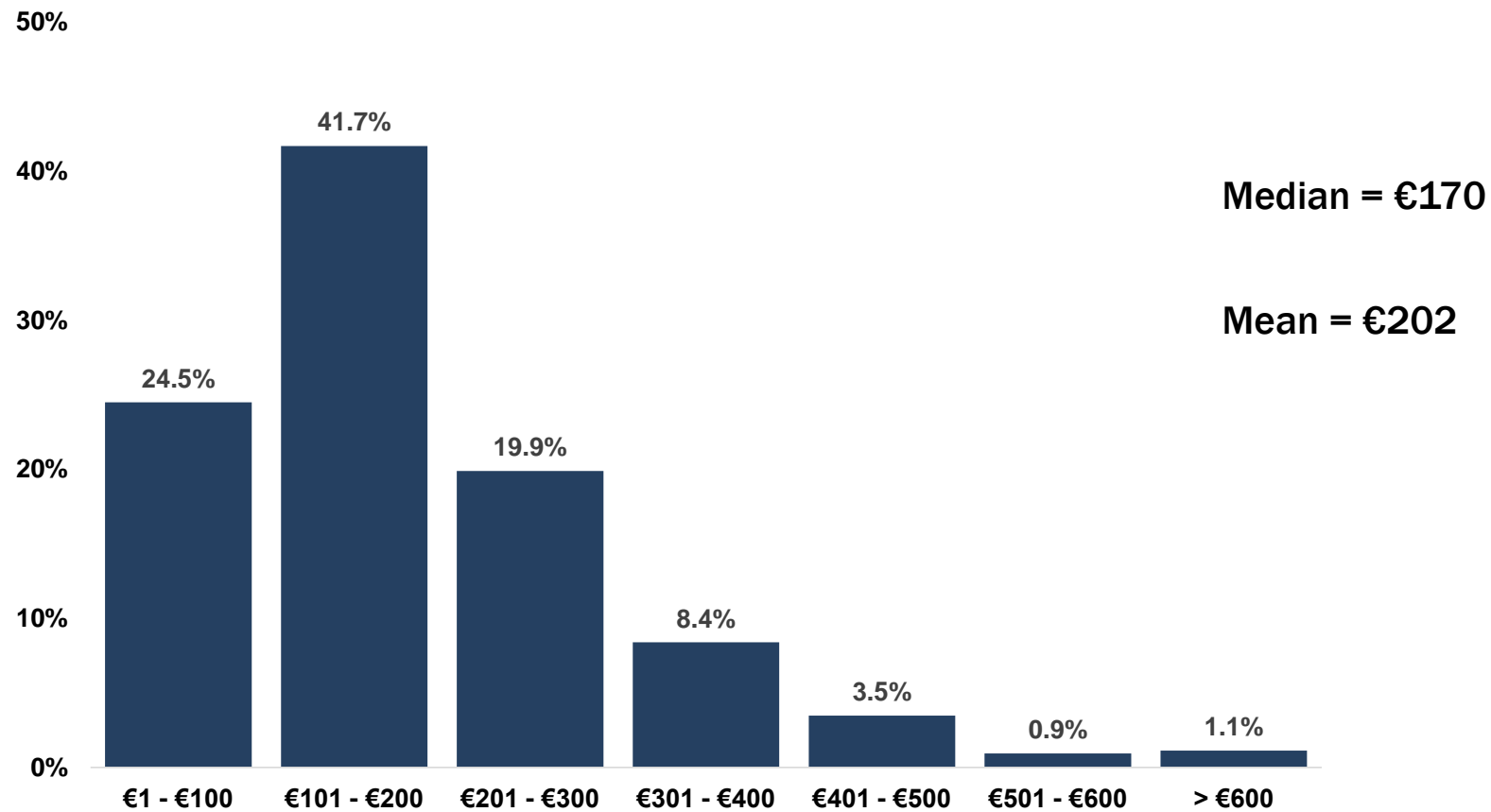
- **Representative renewed sample of ±1850 Belgian households interviewed via telephone**
- **Standard set of questions about household characteristics (e.g., income, age, household composition), financial situation of household, planned major purchases, and expectations about economic activity**
- **May-June-July: extra questions (at the end) about spending in hypothetical energy price shock scenarios**

Standard set of questions to explore heterogeneity across households

- Cash on hand: **income** and **saving buffer** of household
- **Macroeconomic expectations** of household
- **Financial uncertainty** of household (new measure!!)
- Intended consumption: more/less durable consumption over next 12 months (**appetite to consume**) and likelihood to engage in major **home improvements or renovations** over the next 12 months
- Family size, gender, and age

Monthly energy expenditures

Question: How much are the household's **monthly expenses for electricity and heating** at the moment?



Price elasticity of energy demand

Question: Suppose that, at constant consumption, your monthly energy bill would increase by $X\text{€}$ due to an increase in energy prices. What would you do?

Note: $X\text{€}$ is random treatment of respectively 20€, 50€, 100€, and -50€

1. Would you consume less, more, or as much energy (compared to situation without the price change)?
 - If answer is less/more: How many (Z) euros of energy would you consume less/more each month if your energy bill at constant consumption increases by $X\text{€}$?
 - Allows us to calculate (contemplated) **price elasticity of energy demand** of the household:

$$\left. \begin{array}{l} P_1 * Q_1 = \text{CURRENT} \\ P_2 * Q_1 = \text{CURRENT} + X \end{array} \right\} \Rightarrow \Delta P/P$$
$$\left. \begin{array}{l} P_2 * Q_1 = \text{CURRENT} + X \\ P_2 * Q_2 = \text{CURRENT} + X - Z \end{array} \right\} \Rightarrow \Delta Q/Q$$

Marginal propensity to consume after paying the energy bill

2. Would you make less, more, or as many other expenses?

— If answer is less/more: By how many euros (ΔC) would you reduce/increase your other expenses each month if your energy bill increases by $X\text{€}$?

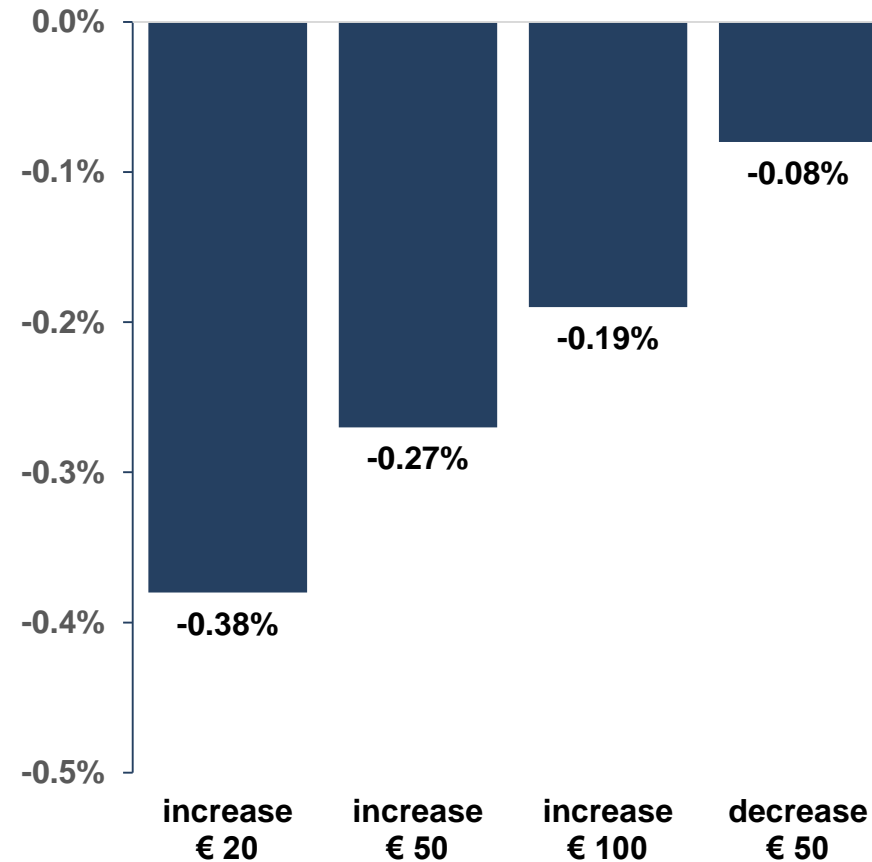
3. Would you save less, more, equally, or possibly tap into your savings?

— If answer is less/more: How many euros (ΔS) would you save less/more each month if your energy bill increases by $X\text{€}$?

➤ (intended) **marginal propensity to consume** after paying the energy bill can be calculated based on both answers:

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

Price elasticity and the scenario of the energy price shock



- Note: based on regressions that control for the standardized size of the current energy bill and dummy variable for each scenario; differences are statistically significant ($p < 0.01$)

Price elasticity – Heterogeneity across households

Price increases

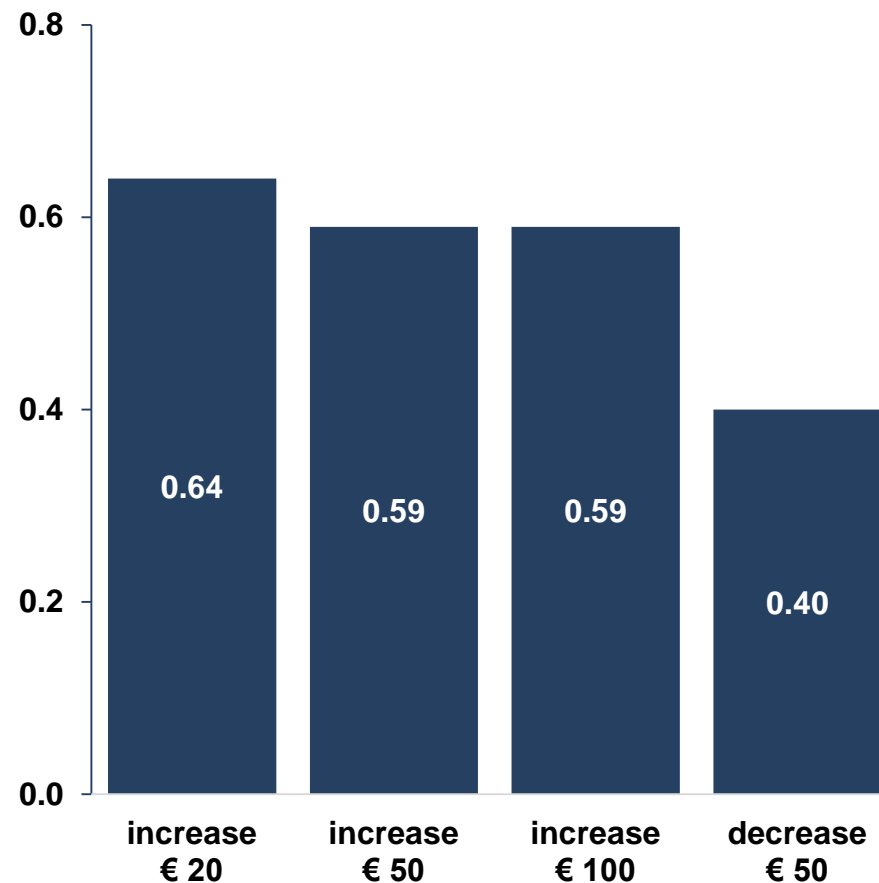
- Elasticity does not depend on income, saving buffer, macro expectations, financial uncertainty, family size, gender, age, or current energy bill
- Greater price elasticity for households that will (very) likely undertake major **home improvements or renovations** over the next 12 months
- Weaker elasticity for families with more **appetite to consume** (indicate that they will increase major purchases of durable goods such as furniture and electrical goods compared to previous year)

Price decreases

- No differences across households

MPC and the scenario of the energy price shock

The **average MPC is 0.52**, which contrasts with Gelman *et al.* (2022), who find an MPC for gasoline price shocks using transaction data of individuals in the US that is close to one. On the other hand, the reported MPCs are higher than those typically obtained for transitory shocks (e.g., Fuster *et al.* 2020)



MPC – Heterogeneity across households

Price increases

- Significantly higher MPCs for **low-income** households and households with **lower saving buffer**
- Higher MPC for households that are more **uncertain about their future financial situation**
- Lower MPC for households that have more **appetite to consume**
- Higher MPC for **female** household heads
- Other characteristics are insignificant (macro expectations, home renovations, age, and family size)

MPC – Heterogeneity across households

Price decreases

- Significantly higher MPCs for households with **lower saving buffer**
- MPC increases with **age**
- Other characteristics are insignificant

Economic relevance and policy implications

We evaluate the effectiveness of **two policy measures** implemented by the Belgian government in response to the soaring energy prices

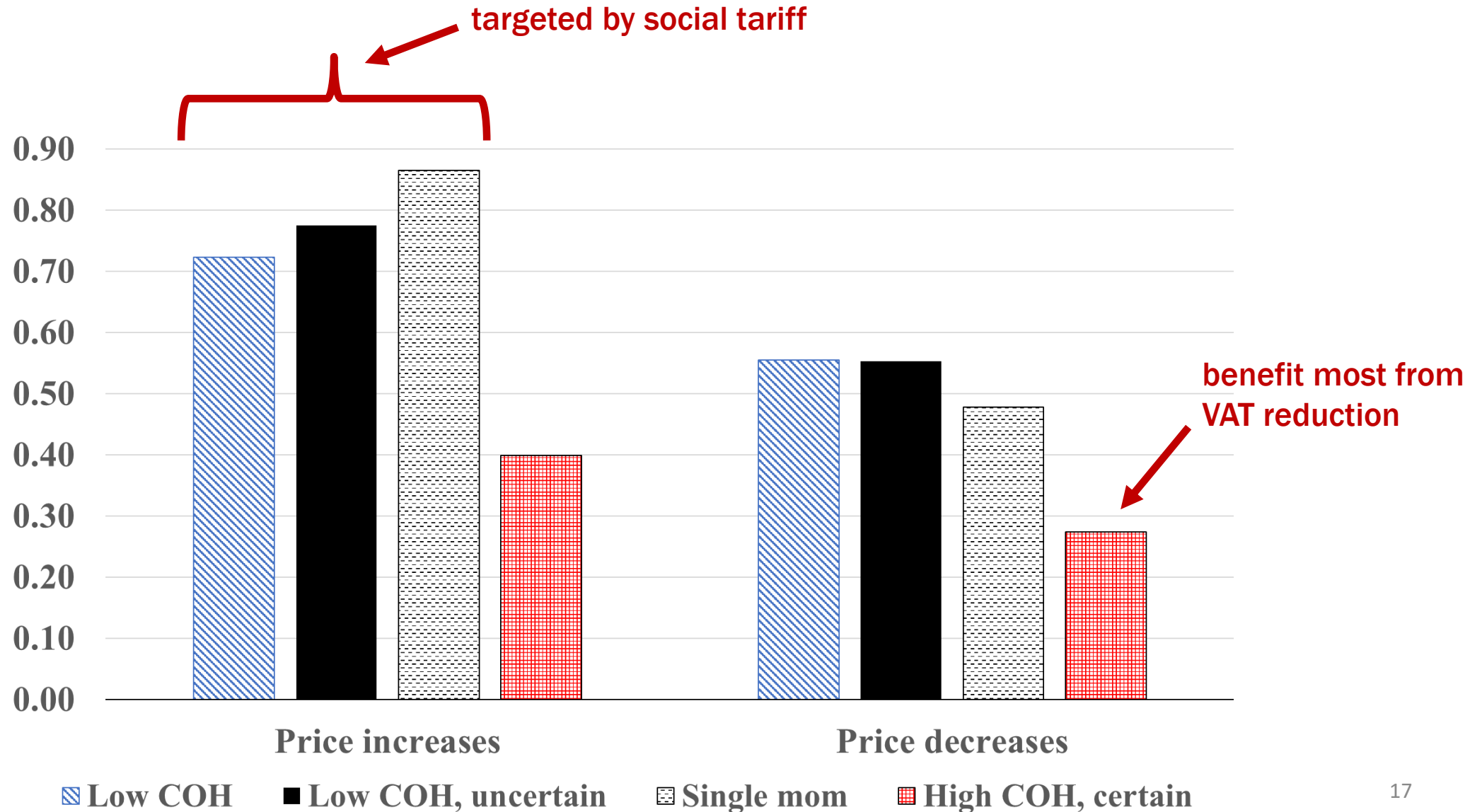
- The **social tariff** and the extension of the eligibility criteria from May 2021 onwards (from $\pm 10\%$ of households to $\pm 20\%$ of households)
 - System that limits monthly price increases: these households experienced a considerably more subdued price increase than other households
- **VAT reduction** on gas and electricity from 21% to 6% for all households, which was around the same time of the survey

Economic relevance and policy implications

We construct **four household profiles** to evaluate the economic relevance of household heterogeneity and the effectiveness of both policy measures

1. Low cash on hand: households with low income and low saving buffer
2. Low cash on hand and financially uncertain: similar to first group, but also highest degree of uncertainty about their future finances
3. Single mom in financial distress: similar to second group, but also female, in age category of 30-49, and being a single mother with children
4. High cash on hand and saving buffer, as well as future finances that are easy to predict

MPCs of four different types of households



Conclusions

Price elasticity of energy demand is greater for price increases compared to price decreases, but tends to weaken for larger price increases

- Standard characteristics cannot explain heterogeneity across households for price decreases
- For price increases, price elasticity is greater when household will likely undertake major home renovations over the next months and smaller for families with more appetite to consume

MPCs are larger for price increases than price decreases, and slightly lower for larger price shocks

- Depend on income, saving buffer, financial uncertainty, and appetite to consume for price increases
- For price decreases, MPCs are smaller for households with a greater saving buffer and younger families

Targeted price subsidies are much more effective in supporting non-energy consumption than VAT reductions

Price elasticity and the scenario of the energy price shock

	Price elasticity	Extensive margin	Intensive margin
↑ bill 20€ (dummy)	-0.38***	0.46***	-0.84***
↑ bill 50€ (dummy)	-0.27***	0.51***	-0.52***
↑ bill 100€ (dummy)	-0.19***	0.53***	-0.35***
↓ bill 50€ (dummy)	-0.08***	0.06***	-1.29***
Difference ↓ 50€ vs ↑ 50€	0.19***	-0.44***	-0.77***
Difference ↑ 100€ vs ↑ 20€	0.19***	0.08**	0.49***

➤ Regressions also control for the standardized size of the current energy bill (interacted with dummies for price increases and decreases) => dummies in table can be interpreted as price changes

➤ * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Price elasticity – Heterogeneity across households

	Price elasticity		Extensive margin	
	↑ Prices	↓ Prices	↑ Prices	↓ Prices
Income	0.02	0.00	-0.03	-0.01
Saving buffer	-0.00	0.02	0.00	-0.02
Macro expectations	-0.01	0.01	-0.01	-0.00
Financial uncertainty	0.00	-0.01	0.01	0.01
Appetite to consume	0.03**	0.03	-0.05***	-0.00
Home improvements	-0.03***	0.01	0.04**	-0.01
Family size	-0.02	0.01	0.05***	0.00
Female	-0.00	0.01	0.04**	-0.00
Age	0.01	0.01	-0.02	0.00

MPC and the scenario of the energy price shock

	MPC	Extensive margin		Intensive margin
		Consumption	Savings	
↑ bill 20€ (dummy)	0.64***	0.72***	0.42***	0.88***
↑ bill 50€ (dummy)	0.59***	0.71***	0.51***	0.84***
↑ bill 100€ (dummy)	0.59***	0.71***	0.52***	0.83***
↓ bill 50€ (dummy)	0.40***	0.46***	0.67***	0.86***
Difference ↓ 50€ vs ↑ 50€	-0.19***	-0.25***	0.16***	0.02
Difference ↑ 100€ vs ↑ 20€	-0.06	-0.01	0.10**	-0.05**

MPC – Heterogeneity across households

	MPC	
	↑ Prices	↓ Prices
Income	-0.04**	0.02
Saving buffer	-0.06***	-0.11***
Macro expectations	0.01	0.03
Financial uncertainty	0.03**	-0.00
Appetite to consume	-0.04***	0.03
Home improvements	-0.03	-0.02
Family size	0.03	-0.02
Female	0.06***	-0.00
Age	-0.02	0.04**