To eat or to heat:

are energy bills squeezing people?

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The paper in a nutshell

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Motivation

- Unprecedented increase in energy prices at the beginning of 2021 due to a combination of supply and demand factors, compounded by the Russian invasion of Ukraine;
- uneven effect on households' consumption and expenditure;
- unknown effect on households' financial vulnerability;
- by eating in those households' purchasing power, the price rise ultimately reduces their disposable income and, in turn, could hamper their capability to meet their financial obligations.

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What we do

Research question

Understanding the effects of the energy price shocks on household financial vulnerability using a micro-funded approach.

Procedure, step-by-step

1. estimate price elasticities for energy goods (electricity, natural gas);
2. evaluate the price increase effects on households' financial vulnerability in a **static** microsimulation model, with and without price elasticities;
3. evaluate the price increase effects on households' financial vulnerability in a **dynamic** microsimulation model, accounting for behavioural responses.

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Preview of results

- In the **static** exercise, we limit our focus to households in the year of the last SHIW (2020) and apply the energy price variation for the 2020-22 period.
  1. If households do not re-adjust their consumption choices (**price inelasticity**), the energy expenditure rises proportionally ⇒ marked decrease in disposable income and a consequent increase in financial vulnerability;
  2. If elasticities are considered, **the impact on vulnerability is more muted**.

- In a **dynamic** model with **behavioral responses**, financial vulnerability is broadly the same as in the baseline scenario (i.e. one where the energy price shock is not accounted for).

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Data

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Gas and electricity markets

- until 1999: energy provision in Italy supplied by state-owned enterprises at regulated tariffs;
- from the early-2000s: a process of liberalisation of the internal markets for electricity and gas.

Either **retail** market is divided into two segments:

1. in the regulated market (so-called *Mercato di Maggior Tutela*), the price of the energy components is determined by the Regulatory Authority for Energy, Networks and Environment (ARERA) and quarterly updated;

2. in the free market (*Mercato Libero*), prices of the **energy component** are determined by market rules, and contracts can have different price setting mechanisms and be of variable length.

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Looking for data on energy prices

There is no data on energy prices (or quantity) at the household level. We use alternative data sources:

- regulated tariffs set by the energy regulator (*Mercato di Maggior Tutela*);
- electricity and natural gas components of the price index (NIC) produced by ISTAT;
- semi-yearly, weighted, average cost unit for electricity and natural gas, collected by Eurostat.

We apply the price increase indistinctly to **all of the households**, obtaining an upper bound for their financial vulnerability (stress test).

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Energy price changes

Table: Price variations (2020-2022), by data source

	Electricity			Natural gas		
Data source:	Regulated market	NIC Index	Eurostat	Regulated market	NIC Index	Eurostat
Year	(1)	(2)	(3)	(4)	(5)	(6)
	percentage variations					
2020-22	172	142	46	92	109	47
2020-21	31	15	4	22	21	6
2021-22	108	110	40	57	74	38
	absolute variations					
2020-22	0.31	0.60	0.11	15.8	48.9	10.9
2020-21	0.05	0.29	0.01	3.8	28.2	1.4
2021-22	0.25	0.32	0.10	12.0	20.7	9.4

Notes: Results are in percentage points for cumulated variations, €/kWh for electricity and €/Gj for natural gas in the case of absolute variations.

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Price elasticities of energy demand (1)

- model of household energy demand (Faiella and Lavecchia, 2021) using data on energy expenditure from the HBS, updated;
- focus on groups/strata (i.e. quasi-panel);

$$logQ_{s,t}^z = \lambda_s logQ_{s,t-1}^z + \beta_s logP_t^z + \gamma_s logE_{s,t} + w + s + t + t^2 + \epsilon_{s,t} \quad (1)$$

$Q_{s,t}^z$	fuel z consumed by *stratum s*
P_t^z	average price of fuel z
w, s	seasonal dummies
$E_{s,t}$	expenditure of stratum s
β_s	price elasticity (estimates below)

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Price elasticities of energy demand (2)

	Short run price elasticities			long run
	LS	stratum-level LS	2SLS	
Electricity	-0.44***	-0.34*	-0.67***	-1.38***
Heating	-0.55***	-0.85**	-0.47***	-1.41***

Notes:* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

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Modelling financial vulnerability

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Definition of financial vulnerable households

The concept of financial vulnerability

A household is defined *financially vulnerable* if its loan instalments to income exceed 30 per cent and its income is below the median of the population (Michelangeli and Pietrunti, 2014).

$$VHH_{i,t} = \begin{cases} 1 & \text{if } L_{i,t}/y_{i,t} > 0.3 \\ & \text{and } y_{i,t}, < median(y_{i,t}) \\ 0 & \text{otherwise} \end{cases} \quad (2)$$

$L_{i,t}$	HH i total loan installment (mortgage and consumer credit)
$y_{i,t}$	HH income gross of financial charges, net of imputed rents
$median(y_{i,t})$	median value of equalized income in the population

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Households' vulnerability in presence of energy price shocks

We consider 3 possible scenarios, based on the source of the energy prices data ($k=1...3$, with 1=regulated market; 2=NIC; 3=Eurostat).

To account for energy price change in the k scenario, ϵ_k, let income y of household i belonging to *stratum s* be modified as follows:

$$y_{i,\tilde{t},\epsilon_k} = y_{i,t} + c_{i,t}(1 - d_{i,t,\epsilon_k}) \qquad (3)$$

$c_{i,t}$ HH consumption

d_{i,t,ϵ_k} adjustment factor equal to the ratio of
            total consumption after and before the change in energy price.

(See Faiella, Lavecchia, Michelangeli and Mistretta, 2022 for an application using the introduction of a carbon tax).

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Dynamic microsimulation model of financial vulnerability

Extension of the models Michelangeli and Pietrunti (2014) and Attinà et al. (2021) to account for consumption dynamics:

$$c_{i,t} = \alpha * (c_{i,t-1} + \Delta_{s,t,t-1}) \tag{4}$$

$\Delta_{s,t,t-1}$ the annual consumption change recorded for
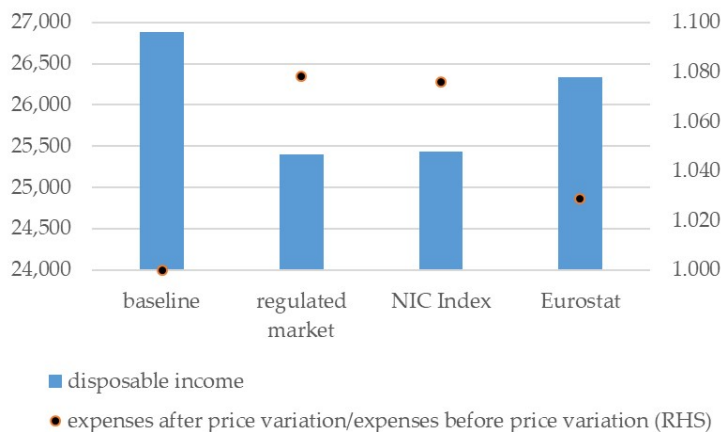   the *stratum*, s, to which household i belongs
α adjustment factor to match aggregate consumption growth

Other projected variables:

- Mortgage installment, based on amortization formula
- Consumer credit installment, exploiting a 3 step approach (participation, total amount, installment)
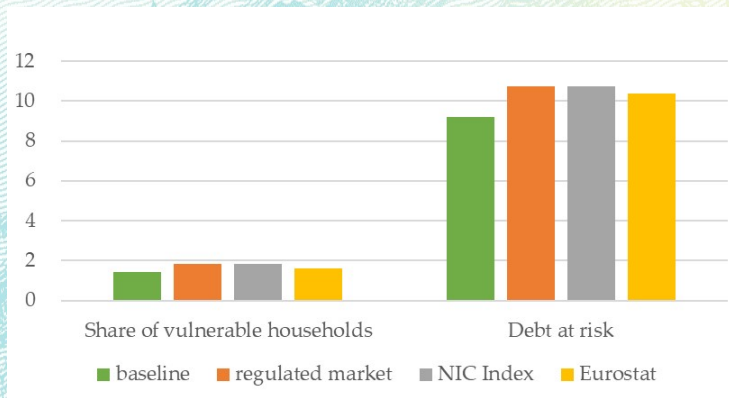- Income differentiated by quartiles

Results

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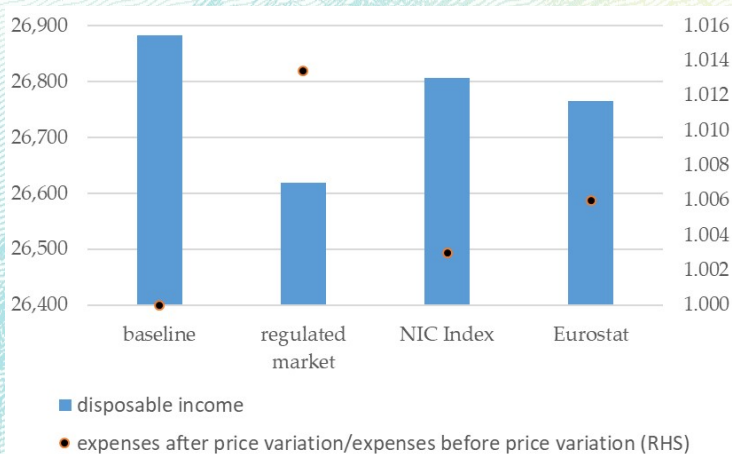
Case 1: Static model, HHs do not re-adjust consumption

Notes: The figure shows household consumption and disposable income average change after the energy price shock. Disposable income is in euros.

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Case 1 (Cont.): Financial vulnerability indicators

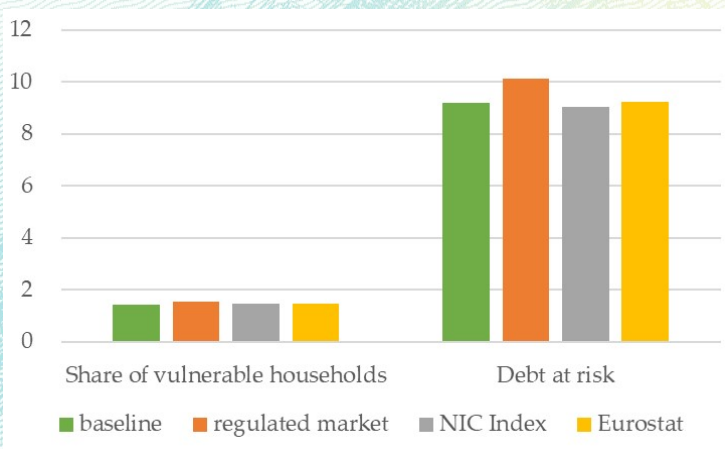*Notes*: The figure reports the share of vulnerable households and their debt (debt at risk). Results are in percentage values.

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Case 2: Static model, HHs readjust consumption

- disposable income
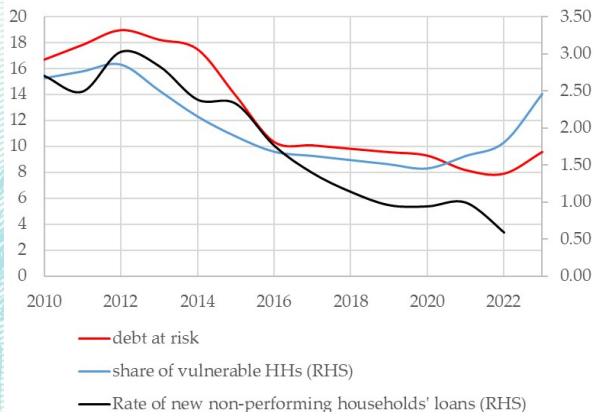- expenses after price variation/expenses before price variation (RHS)

Notes: The figure shows household consumption and disposable income average change after the energy price shock. Disposable income is in euros.

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Case 2 (Cont.): Financial vulnerability indicators

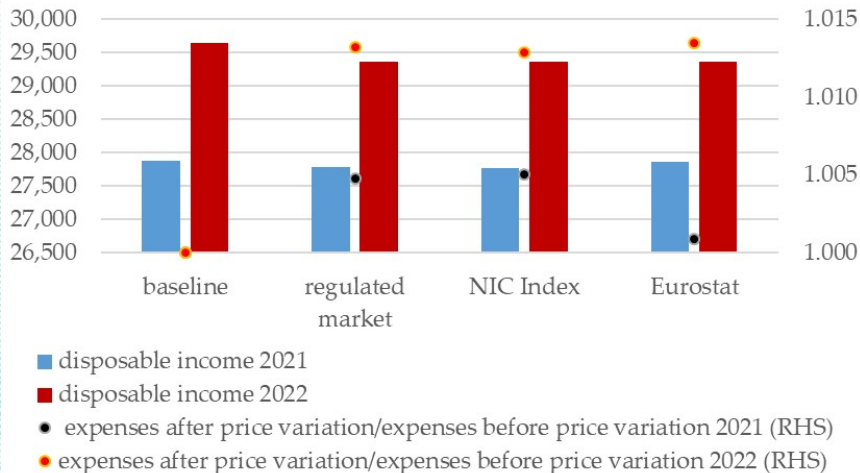*Notes*: The figure reports the share of vulnerable households and their debt (debt at risk). Results are in percentage values.

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Case 3: Dynamic model, baseline

Notes: The figure shows the share of vulnerable households and the debt at risk in the baseline model. The rate of new non-performing loans is defined as the ratio of new non-performing loans on total loans at the beginning of the period and it is calculated as an average of the quarters; it is available until 2022.

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Case 3 (Cont.): Dynamic model, HHs adjust consumption

- disposable income 2021
- disposable income 2022
- expenses after price variation/expenses before price variation 2021 (RHS)
- expenses after price variation/expenses before price variation 2022 (RHS)

Notes: The figure shows how household consumption and disposable income change, on average, after the energy price shock. Disposable income is in euro.

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Case 3 (Cont.): Financial vulnerability indicators

Notes: The figure reports the share of vulnerable households and their debt (debt at risk). Results are in percentage values.

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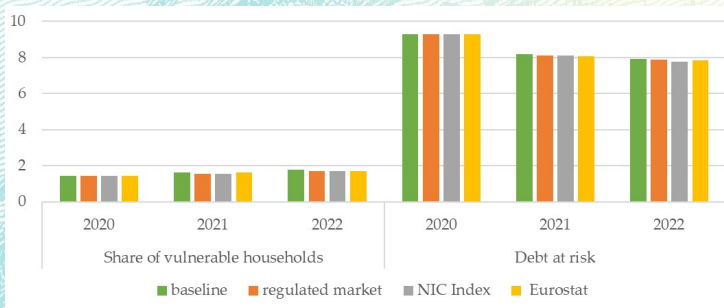
Dynamic model:Projections for 2023

	Expenses after/ Expenses before	Disposable income (euro)	Share of vulnerable HHs (%)	Debt at risk (%)
A. Low energy price variation (2020-21)				
baseline	1.000	30,655	2.47	9.62
regulated mkt	1.005	30,550	2.38	9.58
NIC Index	1.005	30,543	2.39	9.59
Eurostat	1.001	30,636	2.44	9.53
B. High energy price variation (2021-22)				
baseline	1.000	30,655	2.47	9.62
regulated mkt	1.013	30,366	2.42	9.62
NIC Index	1.013	30,368	2.43	9.56
Eurostat	1.014	30,361	2.42	9.60

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Conclusions

- We have developed a microsimulation model to evaluate the impact of the energy price upsurge on households' financial vulnerability;
- Main results: **without** taking into account behavioural responses (i.e. price elasticities), a widespread assumption in the literature, households' financial vulnerability could be abundantly **overestimated**;
- by duly **taking into account** energy demand price elasticities along with the evolution of relevant macro-variables, we show that the change in the share of the vulnerable households and in the debt at risk are **comparable to those in a world without any energy price change**;
- this doesn't come for free: households forgo thermal comfort to keep within the budget constraint.

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