GRAPE Group for Research in APplied Economics

GRAPE Working Paper #81

A market-design response to the European energy crisis

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FAME | GRAPE, 2023

Foundation of Admirers and Mavens of Economics
Group for Research in Applied Economics

A market-design response to the European energy crisis

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Abstract

Due to surges in gas and electricity prices in Europe, many households will struggle to heat their homes this winter. This paper provides high-level guidance on designing a relief policy in a way that optimally trades off equity and efficiency. We argue that, contrary to conventional economic intuitions, an optimal policy may involve directly controlling prices. Because governments do not have perfect information about households' needs, price controls could improve the targeting of relief through screening out the most vulnerable by offering them discounts for reducing consumption. This could be achieved by "threshold price caps" that lower the price of all energy units below some consumption threshold and price units above the threshold at a higher rate.

Keywords:

equity-efficiency trade-off, market design, price control, energy pricing

JEL Classification

C78, D47, D61, D63, D82

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Acknowledgements

The authors thank Morteza Honarvar, Oleg Itskhoki, Pawel Kordala, Joanna Krysta, Andrea Di Giovan Paolo, Rui Sousa, Alex Teytelboym, Joanna Tyrowicz, and the audience of the ECB research seminar for helpful comments. The authors gratefully acknowledge the support of the Washington Center for Equitable Growth. Additionally, Dworczak gratefully acknowledges the support received under the ERC Starting grant IMD-101040122; Kominers gratefully acknowledges the support of the Ng Fund and the Mathematics in Economics Research Fund of the Harvard Center of Mathematical Sciences and Applications (CMSA).

Published by: FAME | GRAPE
ISSN: 2544-2473

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1 Introduction

Europe is facing an energy crisis. The sanctions imposed on Russia and the Kremlin's retaliation have drastically decreased the continent's natural gas supply and sent its price soaring.[1] Moreover, due to the "marginal" design of EU energy markets, the shock has fed through to electricity prices.[2] As a result, without government intervention, many European households may not be able to heat their homes this winter.

But how should governments help those who struggle with energy bills? First, any relief program will be expensive—in some countries, the costs of relief schemes are estimated to total over 5% of GDP (Sgaravatti et al., 2021). Since budgets are limited, efficiency in directing help to those in greatest need is crucial. Second, such programs need to incentivize energy saving—given hard supply constraints, cuts need to happen somewhere. Last, they must be quickly implementable, and so must rely on tools and data already available. This paper provides high-level guidance on designing a household relief policy for the current crisis as well as future ones.[3]

So far, countries have announced diverse plans for relief schemes, many of which involve directly controlling (suppressing) per-unit prices (see Table 1). Such measures go against classical economic principles echoed, for example, by Ari et al. (2022) and *The Economist*.[4] Indeed, conventional economic wisdom recommends addressing distributional concerns through targeted lump-sum transfers.[5] Markets, the classical argument goes, allocate energy to those whose monetary value for it is highest; price caps distort this allocation moving the resource to those willing to pay less which destroys economic surplus. Supporting the vulnerable by giving them cash is therefore preferred, as it provides aid without such distortions.

While based on correct principles, the classical economic argument is incomplete—it implicitly assumes governments have enough information to perfectly target transfers to those most in need. Were that the case, targeted transfers would indeed be the correct response. However, while governments may have some information about households' socioeconomic status (e.g., through past tax returns), they do not generally observe households' detailed financial situation and other relevant factors such as insulation quality and home size.

[1] In late March 2022, gas prices were over five times those in early 2021 (Ari et al., 2022).

[2] In EU energy markets, producers bid according to their costs and the price of electricity is determined by the marginal producer required to meet demand at a given time. When demand is high, this producer is typically a gas plant, and so gas and electricity prices are tightly related (Ari et al., 2022).

[3] In doing so, we abstract away from various related but distinct considerations, such as what is politically feasible, how to increase energy supply, how much priority should be given to households versus businesses, or how to fund the program.

[4] https://www.economist.com/leaders/2022/09/08/how-to-deal-with-europes-energy-crisis

[5] These can be enacted through rebates on energy bills, benefit payments, or direct cash handouts.

How should governments act in the face of such uncertainty? We argue that—at least in some cases—they should screen out households that are most in need by offering them discounts for reducing consumption. This could be done by capping prices for energy units up to a usage threshold determined by household's observable characteristics, and charging a higher marginal price for units above it.[6] If the thresholds are set correctly, the most vulnerable households would be able to cut consumption to levels at which the discount applies. Meanwhile, wealthier households—not willing to reduce consumption—would pay higher prices, effectively cross-subsidizing the vulnerable. Thus, contrary to "economic orthodoxy," an optimal relief scheme may rely on direct price control.

2 Framework

Our policy prescriptions draw upon the *inequality-aware market design* framework we introduced in prior work (Akbarpour ® Dworczak ® Kominers (2021)).[7] A market designer chooses a policy for allocating a scarce resource (here, energy) in a way that optimally trades off equity and efficiency.[8] On one hand, the designer wants to allocate the resource to maximize economic surplus, i.e., to those willing to pay most for it. This *efficient* outcome could be achieved by letting the market allocate the resource. On the other hand, the designer wants to direct the resource towards agents who need it most, regardless of how much they can pay; that is, she wants an *equitable* allocation. While our subsequent arguments are not sensitive to the particular weights given to these two objectives, we assume that the designer cares somewhat strongly about equity—if she did not, the free-market mechanism would be optimal.

Our framework puts only the most basic restrictions on possible policies. In particular, we require that the policy neither exceeds a designated budget, nor allocates more resources than available. As a result, the framework accommodates a vast range of mechanisms. In particular, it nests policies proposed by European governments (a selection of which is reviewed in Table 1)[9] and hence lets us compare them to the optimal policy.

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[6] Importantly, we consider *price caps* and not *subsidies*. Given the inelastic supply of energy, subsidizing consumers without forcing providers to restrict prices would simply increase the market-clearing price.

[7] This work builds on earlier key contributions of Weitzman (1977), Condorelli (2013), and Dworczak ® Kominers ® Akbarpour (2021).

[8] Formally, the market designer maximizes a social welfare function.

[9] See https://www.bruegel.org/dataset/national-policies-shield-consumers-rising-energy-prices for details.

3 Policy prescriptions

As foreshadowed, if governments had perfect information about households' vulnerability and need, the solution would be straightforward: first, offer households direct cash transfers tailored to their circumstances; second, sell the resource on the open market. This would avoid the equity-efficiency trade-off—transfers provide buying power to those in need, and then markets allocate the resources efficiently.[10]

However, such detailed data is typically not available in practice. Moreover, in the short run governments may not be able to collect and verify all the personal information that perfect targeting would require. Relief program designs must therefore rely on what governments know already, which may include information on income, family size, or employment status. But some relevant variables will remain hidden—such as a household's precise financial situation (e.g., increased loan payments due to interest rate hikes), its reliance on particular energy sources, or factors that make reducing energy consumption infeasible (e.g., low-quality housing insulation).

A premise throughout our analysis is that—all else equal—wealthier households will be willing to pay more for energy. This is natural given that energy is an essential good, and wealthier households have a higher *ability* to pay. We also assume that direct cash transfers can be made to households frictionlessly; we later comment on what changes when this is not the case.

3.1 Uniform price caps are never optimal

Our first insight is that price caps that apply *irrespective* of total household consumption *cannot* be optimal. The reason for this is that uniform price caps disproportionately benefit households that consume large amounts of energy—and, as noted above, those households are more likely to be wealthy. Thus, uniform price caps not only distort efficiency but are actually *regressive*. As the opponents of price caps point out, the government would do better by simply taking any available budget and redistributing it via cash transfers.

3.2 Price caps for low consumption may be optimal

Many price cap systems proposed in practice condition prices on the household's consumption. We will focus on a subset of such schemes—"threshold price caps"—that cap the price of all energy units below some consumption threshold and price those above it at a high rate.

[10] The formal version of this statement is known as the Second Theorem of Welfare Economics (see, e.g., Mas-Colell et al. (1995)).

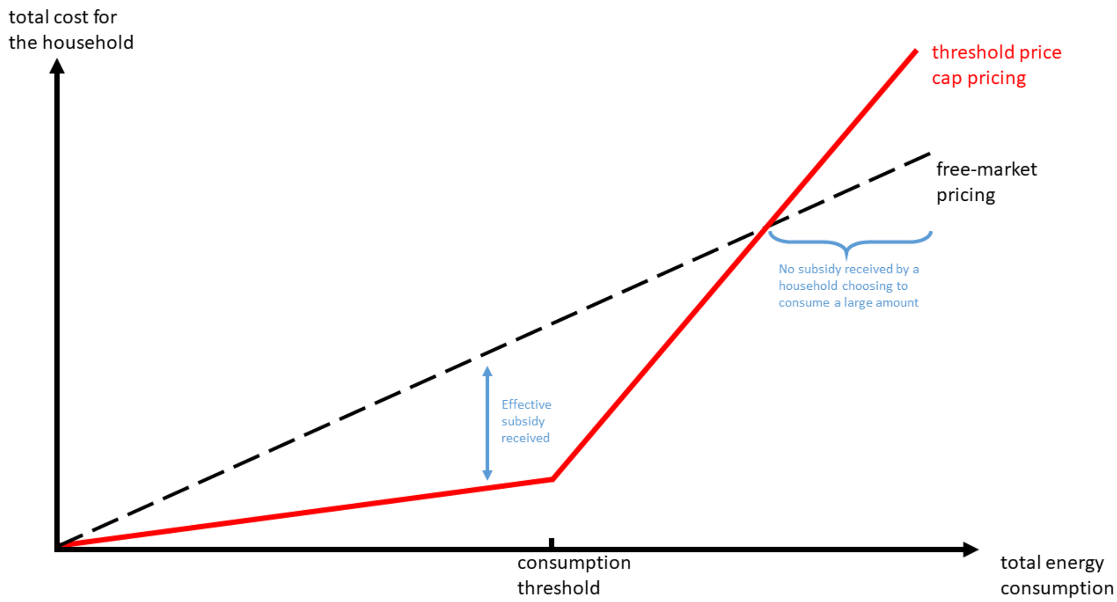

Figure 3.1: A heuristic illustration of the threshold price cap policy

Such mechanisms are easier to calibrate and implement in practice than ones with multiple thresholds and marginal price levels. However, it still makes sense to allow the threshold and the per-unit prices to depend on any information available to the government. In fact, we show that price caps are optimal if the government has enough information to properly set the consumption thresholds.

Any price cap distorts market prices, and hence creates some inefficiency. However, the inefficiency can be justified if the policy improves equity sufficiently. To see why this could be the case, consider households who have *identical observable features* (and hence face the same threshold) but differ in their vulnerability to energy price increases. If the thresholds are set appropriately, poorer households will limit their energy consumption to units with capped prices, while richer ones will not, as they would be willing to pay to avoid the inconvenience of reducing consumption. Therefore, the poorer household pays the capped price for all the units it consumes, but the richer one pays a high price for some share of its consumption.

Contrast the threshold price cap policy with an undistorted market allocation with lump-sum transfers (see Figure 3.1). Under the undistorted allocation, both households pay the same market price for every unit (and get an identical handout). However, in an appropriately calibrated threshold regime, below-threshold prices would be lower than the market rate and above-threshold prices would be higher than the market rate. As a result, the subsidy induced by the price cap would be targeted to the poorer household. Moreover, the richer one may end up actually paying *more in total* than it would absent the cap.[11]

In this way, using price caps to induce self-selection adds another 'layer' of targeting support—apart from adjusting policy based on observable household characteristics, the allocation can now also depend on information revealed by consumption behavior.

But how should we think about the necessary trade-off with efficiency? If the *residual statistical correlation between wealth and willingness to pay for electricity* (after conditioning on observable features) is sufficiently strong, the household's decision of whether to consume above or below the threshold is highly informative of their level of need. In those cases, the benefit from such self-selection-based targeting is more likely to outweigh the inefficiency from price distortions.[12]

Thus, the key question becomes: Is wealth the main factor determining household's decision to exceed the consumption threshold? This depends on whether the government has enough data to correctly calibrate the thresholds. To see what could go wrong, suppose that all households face the same usage threshold. While richer households will consume expensive units above the threshold, some vulnerable households might be forced to do so too. For example, a family living in an energy-inefficient house might be poor but unable to substantially limit their energy consumption; a household that invested in electric heating might find it difficult to decrease electricity usage; large families may not be able to decrease consumption below what would be comfortable for a single-person household. Our final insight, therefore, is that *the optimality of price caps crucially depends on whether the government can observe these confounding factors and mitigate them by adjusting the thresholds*. For instance, if family size is observed, a higher threshold should apply to larger families; if the government has data on the energy efficiency of housing, a higher threshold should apply to those whose houses are harder to keep warm. If most of these circumstances can be accounted for, then *wealth becomes the primary driver of the household's decision to consume below or above the threshold*, and the correlation between consumption decisions and "true need" is likely to be sufficiently strong. In that case, the threshold price cap policy improves targeting and hence equity.

Our analysis reveals that threshold price caps are optimal when governments have an *intermediate* amount of information. If the designer had perfect information, lump-sum transfers would be optimal in line with classical economic arguments. With no information, lump-sum transfers would also likely be preferred as price caps could fail to achieve the desired targeting effect. But if governments have enough data for a calibration of the thresholds

[11]It is worth noting that, due to the increase in prices, wealthy households would still have incentives to cut usage relative to previous years.

[12]Of course, how high the correlation has to be depends on the relative weights the government puts on equity and efficiency. The precise condition can be found in Akbarpour ® Dworczak ® Kominers (2021).

that accounts for the biggest confounding factors, then endogenous consumption decisions can (imperfectly, but nevertheless optimally) substitute the missing data with screening, helping government uncover who is really in need.

3.3 What if cash payments are costly?

So far, we have been assuming that the government can freely make cash transfers to households. But countries lacking effective bureaucracies for distributing direct transfers might be unable to implement such a program quickly. Others might only be able to give cash handouts as income tax reductions, which causes delays. In such cases, every dollar of government money amounts to less than a dollar's worth of benefit for households.

When cash transfers are costly, it might be optimal to provide the support in-kind—the government could allocate electricity allowances to vulnerable households and then pay electricity providers for serving them. Just like before, those in-kind transfers should be allocated based on observable characteristics and self-selection. In particular, an optimal policy would identify need by requiring households receiving aid to limit overall usage.

4 Conclusions

While conventional economic arguments suggest eschewing price controls in favor of targeted transfers to the vulnerable, we argue this approach has shortcomings when households' need is not perfectly observable to the government. Our main insight is that, in this case, carefully designed price controls could actually be the optimal policy. These price controls should be implemented as a threshold price cap—the price the household faces should be capped for all consumed units below a threshold. This policy is optimal if the government has sufficient information to adequately adjust consumption thresholds to households' characteristics, so that wealth becomes the primary determinant of the household's decision to consume below or above the threshold. Conditional on observables, thresholds should be set so that consuming below them is an inconvenience but still meets a household's basic needs. Our proposed policy preserves incentives to save energy overall—poorer households reduce consumption to units covered by the subsidy; meanwhile, richer ones face a high price for marginal units.

References

Akbarpour, M., ⓡ P. Dworczak, ⓡ S. D. Kominers (2021): "Redistributive Allocation Mechanisms," Northwestern University Working Paper.

Ari, A., N. Arregui, S. Black, O. Celasun, D. Iakova, A. Mineshima, V. Mylonas, I. Parry, I. Teodoru, and K. Zhunussova (2022): "Surging energy prices in Europe in the aftermath of the war: How to support the vulnerable and speed up the transition away from fossil fuels," IMF Working Paper.

Condorelli, D. (2013): "Market and non-market mechanisms for the optimal allocation of scarce resources," Games and Economic Behavior, 82, 582–591.

Dworczak, P. ⓡ S. D. Kominers ⓡ M. Akbarpour (2021): "Redistribution through markets," Econometrica, 89, 1665–1698.

Mas-Colell, A., M. D. Whinston, and J. R. Green (1995): Microeconomic theory, Oxford University Press.

Sgaravatti, G., S. Tagliapietra, and G. Zachmann (2021): "National policies to shield consumers from rising energy prices," Bruegel Datasets, 4 November.

Weitzman, M. L. (1977): "Is the price system or rationing more effective in getting a commodity to those who need it most?" Bell Journal of Economics, 8, 517–524.

Country	**Transfers**	**Uniform price caps**	**Threshold price caps**	**Examples of observables policies conditioned on**
Austria	✓		✓	Employment status (e.g. self-employed, pensioner), income, number of children
Czech Republic	✓	✓		Reliance on electricity/gas (e.g. for heating, cooking)
Denmark	✓	✓		Reception of other benefits (e.g. disability, senior)
Germany	✓		✓	Student status, employment status, number of children
Poland	✓		✓	Income, type of heating, number of people in household
UK	✓	✓		Income, pentioners, disabilities

Table 1: Examples of Policy Responses Based on Sgaravatti et al., 2021. (Our classification does not treat VAT reductions as price controls. For Denmark, the household can choose to freeze its energy price if the per-unit price exceeds a threshold. However, the ability to freeze is not conditioned on total consumption.)