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Research Brief

Rational Rationing: A Price-Control Mechanism for a Persistent Supply Shock

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The 2021 Texas power crisis, caused by a series of winter storms, led to prices that were 100 times higher than anything considered normal. The conflict in Ukraine threatens to disrupt supplies of gas, oil, and electricity in Europe, leading to a chilling prospect that a "Texan Storm" type of event could last for, not just weeks, but months. We propose and empirically quantify a price-control mechanism for an efficient demand adjustment in such a persistent crisis.

Administratively set price caps are part of the standard design in electricity (wholesale) markets, with the purpose of restoring the equilibrium through rationing in rare situations in which the supply fails to meet the demand. Such caps are typically high, $9,000/MWh during the Texas power crisis, and intended to bind only in short-lasting events such as production or transmission outages. Once the glitch is resolved, the market is expected to return to the status quo ante. For example, both private and industrial consumers' technology choices or longer-term contracts based on the prevailing spot price can remain unaltered.

The shock due to the conflict in Ukraine is different: Supplies are not expected to return back to normal soon, the shock is persistent. In contrast to a one-time anomaly, the demand is expected to adjust but with a delay as not all consumers respond to prices in real time – the short-term demand is sticky in electricity markets. Due to the stickiness, there is a misallocation in the market that cannot be immediately resolved. We show that the efficient intervention corrects for the misallocation by introducing an aggregate "demand response" through rationing not only when the market fails to clear but whenever the market price exceeds the social value of consumption. In our quantification, the efficient policy implements a temporary price cap well below the administrative price caps currently in place.

A persistent shock means persistent over-consumption by the sticky consumers. The optimal policy regulates the price of consumption at a level that trades off the surplus from non-sticky (i.e., price-responsive) vs. sticky parts of the demand, together with a rationing protocol to implement the price cap. This non-market mechanism has the same general motivation as, e.g., in Joskow & Tirole (2007), i.e., a market imperfection, but there is an important difference: We introduce the price-control mechanism for all parties in the market. The approach seems unavoidable, e.g., in exchanges where trading takes place with a uniform price without powers to ration consumers individually. In such a situation, we find that the optimal price cap needs to be time-varying, responding to changes in market demand. In particular, the cap starts binding in response to a persistent supply shock, rises to a higher level as the demand adjusts to the shock, and finally stops binding when the demand has adjusted. In this sense, the cap is temporary.

We calculate the social value of rationing using basic price theory. We illustrate it in a specific context, the Nordic market for wholesale electricity. The supply and demand bids to the exchange contain information on the social value of rationing, and they form the basis for calculating the optimal price cap, hour by hour. The bids indicate how the demand changes in response to the shock which is essential for the optimal adjustment of the price cap. In any given hour, if the clearing price rises above the optimal price cap, the mechanism implements the cap by an elimination procedure for the demand bids to obtain the required rationing. We quantify the mechanism using the actual bids in 2019-2022 as data.

We find a number of strong predictions for the optimal intervention. First, in a persistent supply crises, the optimal price cap is only a fraction of the actual harmonized EU price cap. The rudimentary reason for the difference is that the harmonized price cap pays no attention to the welfare gains from a demand response achieved through rationing. The mechanism has no bearing on market clearing in normal times; it gains traction only after the onset of the supply crises in winter 2021-2022. Second, the rationed quantities are minuscule in relation to total volumes in the market suggesting that executing the physical rationing in regions that participate in trading should not be a major hurdle. Third, the intervention has strong distributional implications; a small demand reduction leads to a large price drop. In our stress tests, the policy leads to transfers from producers to consumers measured in billions of euros over a short period of time, although it should be borne in mind that our theory is justified by efficiency and not by redistribution objectives. Finally, the mechanism can be adopted without reforming the market clearing rules in place.

References

Joskow, P., & Tirole, J. (2007) "Reliability and competitive electricity markets." The RAND Journal of Economics, 38(1), 60–84.

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