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THE EFFECTS OF MARKET DESIGN ON SUPPLY SECURITY IN IMPERFECT POWER MARKETS

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OVERVIEW

During the 1990's most industrialized countries deregulated their electricity sectors. Although this re-organization introduced a more decentralized approach to supply security, energy regulators have always been debating the extent to which liberalized power markets actually can constitute a secure supply of energy. This regulatory debate over supply security resulted in a variety of different market designs across power systems.

At the same time, nearly all power markets face market power. However, the relation between market power and supply security, and how market design affects this relation, is unexplored. Surprisingly, while a huge strand of literature deals with market power in power markets, most contributions on supply security focus on competitive markets. This paper tries to attack this missing link and explores the effects of market design on supply security in imperfect power markets. It analyses the two main competing power market design tracks: the energy-only market and the capacity market design.

Previous contributions to the relation of market design and supply security led to ambiguous conclusions. Hogan (2005) argues in favor of energy-only markets. He states that claims in favor of capacity mechanisms rather lay out the proposition that pure energy-only markets are not politically feasible. Also Oren (2000) finds that capacity mechanisms are the least desirable tool to enhance power market reliability. On the contrary, Cramton and Stoft (2005) promote the capacity market design. Besser et al. (2002) find that capacity markets lower peak-time prices and decrease price and reliability risks for consumers. Joskow and Tirole (2007) derive outcomes of competitive power markets that feature aspects of both market designs. Creti and Fabra (2007) explicitly model capacity markets and focus on the monopoly and the competitive case.

METHODS

This paper introduces dominant firm behavior into the literature on supply security and to this end employs an analytical framework that relies on a duopoly auction setup by Fabra et al. (2006). Technically, the attention lies on the effects of market design on equilibrium outcomes in generation capacities, market prices and blackout probabilities, while long run investment decisions are neglected.

First, I present a simple duopoly model for energy-only markets and derive energy prices, equilibrium capacities and blackout probabilities. Then, I add capacity mechanisms and examine the distortion of capacity mechanisms on the energy market equilibrium.

RESULTS

Main findings are that for a range of asymmetric firm sizes, energy-only markets can cover the full support of stochastic energy demand and hence can secure energy supply at all times, technical outages neglected. However, if firms are sufficiently similar in size, capacity withholding becomes attractive and may lead to blackouts.

When regulators implement capacity mechanisms, energy prices decrease together with blackout probabilities. However, this requires that capacity is priced above marginal costs. Hence, when firms can behave strategically, consumers have to 'buy supply security' from

dominant firms. Furthermore, price volatility cannot be decreased by reliability markets. Instead, a sufficient level of contracted capacities increases the volatility of energy prices. Another surprising result is that system security is independent of the price cap for energy, since capacity withholding only depends on each competitor's offered generation capacity.

CONCLUSIONS

This paper studies the effects of market design on supply security in imperfect power markets. The findings suggest that energy-only markets can ensure sufficient available peak capacity only for very asymmetric firm sizes. When firms become similar in generation capacities, each firm likes to withhold capacity and free-ride on its competitor's role to satisfy residual demand and to secure continuous trade on balanced power networks.

When regulators implement capacity mechanisms such as SO reserve procurement or capacity obligations, available peak capacity increases as long as capacity prices are above marginal costs. In that case, capacity mechanisms lower blackout probabilities and the energy price level, but increase energy price volatility.

Energy price caps and capacity mechanisms can mitigate market power in the energy market, but at high costs for available peak capacity. In conclusion, the choice of market design depends on regulatory preference for supply security, that is, on how much costs for secure supply shall be spent and on how much regulators are willing to administer capacity mechanisms and distort energy price signals in the long run.

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