BIDDING UNDER A PRICE CAP
EVIDENCE FROM AN ELECTRICITY MARKET EXPERIMENT

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Overview

Price-cap regulation is a well spread phenomenon even in electricity markets. The fact that price spikes are heavily debated in the media is perhaps one of the main reasons for price-cap regulation. There is a clear trade-off between price spikes and price caps. Policymakers have always stressed the importance of creating incentives for adequate investment in electricity generation yet also require low, non-volatile prices. Price cap is a regulatory tool used to achieve the latter of these objectives, however, it may curtail adequate investment levels.
The purpose of this paper is to analyse the efficiency properties of price caps for the wholesale power market.
Despite the extensive use of price-cap regulation in the electricity sector, the literature on this topic is scarce.
The theoretical approach has mainly focused on the strategic behaviour of the generators in the wholesale electricity market (For a recent overview see Genc and Reynolds, 2011 or Frutos and Fabra, 2012). The majority of these studies assume a market reserve price and does not discuss whether or not a price cap impacts upon market efficiency. As far as we aware there is no empirical study on this issue for the electricity market (the difficulty to obtain such data may explain the absence of an empirical study).
Electricity market design has been studied using the experimental approach but we are aware of only two studies on price-cap schemes. These studies focus primarily on how price caps differ according to the generators, (Kiesling and Wilson, 2007) and on non-binding price caps, (Vossler et al., 2009).
Unlike the previous studies, this paper considers different price cap levels, which are applicable to all market participants. We investigate the effect of price caps in the context of uniform-price auctions where the subjects choose their capacities and subsequently compete in prices.

Methods

We test the efficiency properties of price caps on wholesale power markets using the experimental method. Several real world features of the electricity market inspire the experimental design.

In our setup four subjects playing the role of generators interact in repeated multi-unit auctions competing on the supply side. The demand is perfectly inelastic and volatile. Subjects have to make two types of decisions. Initially, they have to decide how much capacity to make available to the market. Then they submit repeatedly multi-step supply functions, i.e. schedules of quantities and prices specifying how much they are willing to supply for a given price. They cannot offer their units above a maximum price, exogenously given in the experiment. On the other hand there is no obligation to produce at full capacity.

Subjects participate in different treatments with different price caps and demand levels. Moreover the participants were students but also professionals working in the electricity industry.

Results

We found that price cap regulation has an impact not only on market prices but also on market performance. Imposing a higher price cap leads to, not surprisningly, an increase in market price and in market capacity. Because of the higher market capacity, a relatively high price cap improves allocative efficiency (i.e. energy supply security) but reduces productive efficiency (costs are not minimized).
Interestingly, price cap for similar market conditions is reached more often when price cap is relatively low.
In order to better understand how changing the price cap affects bidding price behaviour, we have constructed a "representative" bidding curve for each treatment. The fact that each generator may become pivotal – each generator's capacity is required to meet the demand – turns out to be crucial for the effect of a price cap regulation. We found a negative relationship between bidders' pivotal power and competitive behaviour (see Brandts et al., 2013). More interestingly, the price cap level only matters for the bidders with large pivotal power. When price cap

is relatively low, bidders with high pivotal power tend to behave more aggressively than when price cap is relatively high.

Conclusions

This paper contributes to the general debate on the security of electricity supply, which has been taking place ever since the wave of deregulation of electricity sectors. We used experimental methods to investigate the relationship between prices, market power and capacity investments in electricity markets with inelastic demand. One main finding is that an increase in price cap does not fully translate into a one to one increase in market prices. This is largely due to large bidders being more competitive when the price cap is relatively high.

This last result may have an interesting implication for the price-cap regulation. It should be possible to design an "optimal" price-cap regulation that would induce "reasonable" market prices and levels of energy supply security. The exact formula for such a price-cap regulation remains to be studied.

References

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