Welfare Implications of Capacity Markets in the Electricity Sector

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1. OVERVIEW

Motivated by the current debate and being aware that the economic literature is non-abundant and limited in scope, the present paper explores the implications of capacity markets in the electricity sector in terms of consumers' welfare. For that purpose, we propose a theoretical model with cost heterogeneous firms, for which price and quantity equilibria are obtained both with and without a price cap in the wholesale spot market. The consequences for the consumers are assessed using three different and complementary measures: consumer surplus, probability of blackout due to insufficient generation capacity and price risk. We conclude that the introduction of a capacity market serves as a insurance mechanism for the consumers, since it is able to reduce extreme events, i.e. it reduces probability of blackouts as well as spikes in electricity prices, at the cost of reducing on average the ex-ante consumer surplus.

2. METHODOLOGY

The aim of the present study is to provide a formal model that can be used to study capacity markets and their impact on the welfare of consumers. For that purpose we proceed as follows: first, as Tishler et al. (2008) do, we propose a two-stage game environment in which two kinds of electricity generators –a base load and a peak load– invest in capacity in the first stage (before demand is realized) and then compete in a wholesale spot market to produce and sell electricity to consumers.

Applying backward induction, we first deal with the second stage. Building on the seminal work by Fabra et al. (2006), we propose a uniform price auction as the mechanism to allocate electricity in the spot market. In the first stage, electricity generators solve for the equilibrium investment in capacity by considering the expected profits we assess in the second stage. Then, using the equilibrium we find, we analyze the consumers' welfare. We focus on three main consequences for them: consumer surplus, blackout probability and price risk. In subsequent steps, we introduce into our model a price cap in the wholesale market and then a capacity market. The latter establishes an equilibrium compensation mechanism. Again, we analyze the consequences of both measures in terms of consumers' welfare and compare them with the benchmark scenario in which both are absent.

3. RESULTS

Our main findings are as follows. First of all, in line with Joskow and Tirole (2007), we casts doubt on the potential benefits of the introduction of price caps. In fact, our model indicates that their introduction leads to less investment in capacity, which implies greater probability of blackout for consumers. In addition to that, the implementation a price ceiling unambiguously reduces the consumer surplus in comparison to the benchmark case in which no price cap is present. The only welfare gain is in term of price volatility: they are able to reduce the risk of price spikes for consumers.

Second, provided that the price cap is present in the wholesale spot market, we analyze the implications of introducing a capacity market. Putting aside the question of whether the capacity compensation should be allocated using one mechanism or another –e.g. via auction or via bilateral trading– which is out of the scope of the paper, we price this compensation in equilibrium, to conclude that a capacity market serves as an insurance mechanism for the consumers. In other words, the introduction of a capacity compensation mechanism increases the amount of investment and mitigates some of the harm associated with the price cap while enhancing the

risk reducing benefits. Typically the regulator imposes a target installed capacity to be achieved, which is set equal to guarantee a supply of at least the peak demand plus a reserve margin. The capacity market reduces the blackout probability and decreases the price spikes risk relative to the market without a price cap. It does so, however, at the cost of reducing the consumer surplus.

Under some circumstances –for instance, if the Value of Lost Load (VOLL) is very high– the introduction of a capacity markets also improves the consumer surplus in addition to reducing price volatility and reducing power outages likelihood. Thus, in under these circumstances, the capacity market leads to a Pareto improvement in the electricity sector.

4. CONCLUSIONS

The special features inherent in the power industry have required a high level of attention from market regulators all around the world. Perhaps due in part to these difficulties the industry was essentially controlled by the public sector before the nineties,. The liberalization pattern that has prevailed since that period has proved to be a real challenge for these regulators. They have struggled to balance the tradeoff between allowing *bona fide* market freedom while regulating the idiosyncratic factors that are inherent to the electricity sector and that could potentially lead to market power and, thus, to a worse scenario for the consumers.

Among the recent measures implemented in the restructured and liberalized electricity sectors, it seems that having a price cap is widely accepted. By contrast, the introduction of capacity markets is still controversial. In fact, while several countries and regions have implemented some form of capacity compensation mechanism –for instance, PJM, Colombia and Italy– some others have not implemented them yet –for instance, NEM and Alberta. Thus, whether capacity markets are beneficial for consumers or not is a question of current debate. That debate has been especially intense in countries like Germany and regions like Texas, which are considering their introduction.

Throughout the paper, we study the implications for consumers of the implementation of price caps together with capacity compensation mechanisms. For that purpose, we have proposed a theoretical model with cost heterogeneous electricity generators that invest in capacity to produce and sell electricity in a wholesale spot market once they have built their facilities. Our findings show that in a price capped market a capacity market is able to reduce both the blackout probability and the price volatility for the consumers, at the cost of making them to pay a higher price on average –i.e. at the cost of reducing their average consumer surplus.

5. REFERENCES

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