VERTICAL INTEGRATION AND RETAIL TARIFF DESIGN IN ELECTRICITY MARKETS

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Overview

Tariff design is crucial for the efficient functioning of the market. This is especially important in industries where demand is highly fluctuating in time, such as the telecommunications, broadband or electricity industry. According to economic theory, the efficient outcome can be achieved when marginal costs equal marginal utility of consumers in every time period. It is therefore clear that real-time pricing (RTP) or time-of-use (TOU) pricing should lead to higher efficiency compared to time-invariant pricing (TIP). In reality, however, RTP is seldomly applied and chosen by end consumers. In this paper, we study the efficiency of different pricing schemes as well as the implications for consumers and producers at the example of the electricity sector. The results can also be transferred to other industries with fluctuating demand over time.

Methods

The liberalization of the electricity sector has led to largely differing vertical relations of the supply structure. A major difference in the analysis of tariff schemes is whether generation and retailing are required to be separated or are allowed to vertically integrate. A primer on the design of RTP in electricity markets has been written by Borenstein and Holland (2005) and has since then been applied with much interest in the scientific community (e.g. Joskow and Tirole (2006), Allcott (2012), Pahle et al (2015)). The model of Borenstein and Holland (2005) builds on an industry structure where generation and retailing are vertically separated.

Our model builds on the analytic formulation by Borenstein and Holland (2005) but focuses on the short-term equilibrium and extend the model in three ways. First, we do not restrict the analysis to regulated retailers but account for the vertical integration of generation and retailing. Second, we extend the model to incorporate the properties of renewable electricity generation, namely time varying costs of electricity generation. Third, we relax the assumption of perfectly competitive markets and derive the resulting tariff for a finite number of players N. Motivated by the recent announcement of the German government to increase energy efficiency, we conduct an illustrative case study on the implications of RTP, TOU and TIP at the example of Germany.

Results

TIP leads to deadweight losses since consumers do not respond to the marginal costs of generation. The deadweight loss depends on the vertical structure of the electricity sector that may be imposed by the regulator. If retailers are not allowed to own generation assets, the second-best outcome cannot be achieved. Furthermore, we find that consumer surplus may be higher under TIP compared to RTP, depending on the demand function of consumers. Therefore consumers may have no incentive to switch to RTP even if it is offered by retailers.

The increased generation from renewable energies leads to an increase of the deadweight loss of TIP compared to RTP. In a case study for Germany, we find that the deadweight loss amounts to about EUR 97.1m (depending on the price responsiveness of consumers). In this case consumer surplus is higher under TIP by 507.5 mio. EUR. Only producers can profit from consumers being on RTP. If renewable generation increases further, it may create an incentive for consumers to switch from TIP to RTP. Furthermore, we find that TOU pricing is only able to achieve a fraction of the efficiency gains that can be achieved under RTP.

Conclusions

Our results have important implications for policy makers, researchers and practitioners in the field of electricity markets. Smart metering and the introduction of real-time or TOU pricing is so far seen as an important instrument for the decarbonization of the electricity sector (FERC (2011), EU Comission (2015)). In this paper, however, we show that the expected efficiency increases may not be achieved if consumers prefer being on TIP

instead of RTP. Nevertheless, the results also show that the importance of RTP increases with the expansion of renewable generation capacities, as deadweight losses can be reduced when consumers are on RTP instead of TIP. As outlined in the paper, the results depend on the characteristics of the demand function of consumers. It is therefore essential to form a better understanding of the demand function in order to optimize the tariff design in the electricity sector.

References

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