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The role of expectations for market design – on structural regulatory uncertainty in electricity markets

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The need for decarbonization of the electricity system, together with structural changes in electricity demand and generation costs, is driving significant investment in new and upgraded electricity transmission and generation capacity. Transmission and generation investment projects have long lead times and lifespans, and are therefore subject to significant levels of risk and uncertainty. Existing methods used to plan transmission and generation capacity under uncertainty focus almost exclusively on parametric uncertainties – uncertainty about particular parameters of future electricity systems, such as demand levels or generation costs. In reality, there are also many structural uncertainties. This includes uncertainty about future market design. Compared to parametric uncertainties, this uncertainty about future market rules and structures is much harder to model.

This paper is a first attempt to consider the effect of structural regulatory uncertainty on investment in and operation of electricity markets. In particular, we consider the effect of uncertainty about the configuration of bidding zones. Historically, many European markets have bidding zones that correspond to national borders – within each country, electricity prices are uniform, with no spatial differentiation. In several markets, there are proposals to increase the number of bidding zones, allowing for more spatial differences in electricity prices to reflect some of the congestion costs in the transmission system. This, at least theoretically, increases market efficiency. However, it is currently also a major source of structural regulatory uncertainty.

We use a stylized multi-level optimization model to analyse the effects of this uncertainty. Even though we apply this model to a simple two-bus network, it is highly complex and difficult to solve directly. However, by exploiting the mathematical structure of the model, we are able to simplify and decompose the model in order to solve it. Our analysis yields various insights.

First, our qualitative results show that a perceived positive probability of zonal reconfiguration affects the location and technology of generation capacity, as well as the level of transmission capacity. Second, some of the welfare gain from a switch to a more efficient market design might already be realized before the actual implementation, if market participants anticipate the market design change. Market participants' beliefs about future bidding zones should therefore not be ignored in the discussion on bidding zone topology. Welfare gains increase with higher expectations of a switch to a more efficient system. Third, we observe that in case of regulatory uncertainty risk is not distributed equally between market participants: in general, generators with high investment costs carry the risk of investing the wrong quantity and in the wrong locations, while generators with lower investment costs are not affected negatively by uncertainty.

When considering implementing a change to a more efficient market design, policy makers should be aware of the fact that part of the welfare gains might already have been realized due to a period of uncertainty preceding the actual implementation. At the same time, deliberately inducing uncertainty cannot be used as a policy tool by the regulators in the long run, as expectations and realizations cannot indefinitely diverge.

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