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IS LARGER ALWAYS BETTER? ECONOMICS OF POWER MARKET INTEGRATION

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Overview

Following the idea of a single European market for electricity and gas, the European Union and its Directorate-General for Energy as well as several institutions like ACER or entso-e are currently setting up further steps for integrating the European power markets. On the other hands, several European countries split up their electricity markets during the last years, following increasing internal congestion in the power grid. Currently, Germany is discussing zonal pricing as one way to deal with regional concentration of generation investments (particularly for renewables), causing congestion between northern and southern Germany.

Those two opposing trends raise the question if there is an optimal market size and if yes, which factors determines it. This paper aims to contribute to those questions by regarding several influences within a stylized model. Those factors are particularly volatility of generation and the effects of an increasing volatility due to a higher share of generation from renewable sources, investment incentives arising from a wider regional coverage and related to different network regimes, including the dealing with congestions within a integrated power network and the effects of a mitigated market power in larger markets.

The results show that particularly when investment incentives are taken into account, a larger regional coverage might induce higher costs for network expansion or congestions. Those costs can be higher than the benefits from the market integration. This opens up the question whether one internal European electricity market or several regionally integrated electricity markets might be the best choice. As this paper uses a stylized model, it cannot answer this question directly, but gives important arguments, which should be considered in the ongoing European debate about power market integration.

Methods

I create a stylized model of a power market, regarding both conventional and renewable generation. Without explicitly modelling a market for reserve capacity, I assume that generation and demand are volatile. For simplicity, the assumption is that production from renewables and demand are normally distributed around their mean (what might lead to over- as well as to under-production respectively over- and under-consumption), and that there is a certain probability of an unexpected blackout for each conventional unit. The system operator is seen as obliged to buy additional generation to ensure reliable supply. I regard different market structures: Perfect competition, monopoly and a partial monopoly and in addition a mix dependent on the level of demand (assuming that one generator is essential to meet demand in hours of peak load, giving him market power in those hours).

I start the analysis of market integration by assuming that one or more of these markets are interconnected and run under a common market regime, which is always single marginal pricing. The effects of market integration are analyzed for different scenarios, regarding (1) the different market structures mentioned above, (2) limits in the capacity of interconnectors between the markets, regarding different regimes of congestion management (market splitting, redispatching, expanding the interconnector's capacity) and (3) long-term effects on investments by assuming that generation in one market has lower costs than in others. Of course, those three aspects are combined in different ways, giving multiple scenarios.

Results

The results show that with increasing market integration, the additional benefits from integrating one additional market gets lower. The one major point creating gains from market integration is a lower overall volatility of generation and demand, what means that less reserve generation is needed than it would be for separate markets. As the reduction of volatility is smaller when an additional market is added to an already large market, gains from market integration with regard to volatility become lower. Moreover, the gains are asymmetric, as the larger market area has almost no benefits, while benefits for the added smaller market are high. With regard to volatility, a higher share of renewables leads to additional gains from market integration. This results from the fact that volatility of renewable production is higher than from conventional generation. By this, the effects of reducing overall volatility by increasing the market size and by this reducing the overall needed reserve generation are higher.

The second major positive effect of market integration arises from reduced market power in the scenarios including this aspect. Not surprising, gains here are especially high when the initial market structures in all regarded markets were monopolies, as the system is then moving on over oligopolistic structures to perfect competition.

Including congestion in the scenario reduces gains from market integration. Using market splitting leads to an integrated market during base load, while the markets are run separately for the peak load, re-establishing the original volatility and market power for those hours. Redispatching has similar effects, but opens up an additional opportunity for strategic bidding of power generators, leading to welfare losses. Expanding the capacity of the interconnector leads to an optimal market situation without congestion, but means at the same time higher system costs distributed to the consumers via higher network fees.

A special remark is set on the incentives on investment, when different long run marginal costs are assumed for the different initial markets. It is not surprising that with an integrated market and no congestion – resulting in one single price for the whole area –, investments will be made in the region with the lowest costs. If a limited interconnection capacity is assumed, those investments lead to congestion. Dependent on the congestion regime, the distorting incentives might be lower: In a situation with market splitting and to a smaller extent with redispatching, congestion results in different prices for different regions during congestion hours, with a higher price in the region with higher generation costs. Higher prices in one market leads to higher earnings, inducing to shift investments to this market despite the higher costs. If congestion obliges the system operator to expand the capacity of the interconnection, prices remain identical for the whole integrated market area, but the capacity expansion means that the consumers face higher network fees due to the necessary investments. By this, the costs induced by the investment decisions remain external, while they are internalized with market splitting and to some extend with redispatching.

Conclusions

My results show that market integration has positive effects, but that those effects are getting smaller with increasing market size. On the other hand, increasing market size might lead to distorting incentives on investment, moving investments to areas with lower costs and by this inducing congestion. This congestion might lead to higher overall system costs due to the necessary expansion of grid capacity or redispatching measures (and, not considered in my paper, from increasing network losses). In the opposite direction, an increasing share of renewables, inducing higher volatility of generation, means higher benefits from market integration. Summing those effects up, there is a point where benefits from market integration become smaller than the costs induced particularly by investment incentives.

If one transfers those results to the ongoing debate about European power market integration, the best solution might not be one internal electricity market for the whole EU, but multiple regional integrated markets. (like they exist currently for example with North-West European (NWE) market coupling – although the model presented in this paper does not allow to conclude that the area currently covered by NWE market coupling is the optimal market size). Considering the situation in Europe with significantly different costs of generation mainly due to different costs of carriage for fossil fuels and different potentials of renewables (resulting in higher generation by identical costs for the installation) for different regions, the European energy policy should turn its attention more intensely on the investment incentives induced by market integration. This does not mean that there should be an end of further market integration (particularly for regional market integration), but it should have consequences on market rules, congestion management and for moving from regional integrated markets to one single market. For deciding about all those points, European energy policy should take into account that market integration does not only create benefits, but induces costs, which should be weighed against each other.