Quantifying The Worst Case Impact Of INC-DEC Gaming On A Redispatch Market

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Overview

Electricity markets in Europe are organized in a zonal configuration and therefore require congestion management. Not least the growing role of demand side flexibility has led to the advent of so called flexibility markets and calls for implementing market based redispatch (cf. Article 12 in [1]). This in turn has lead to a renewed interest of regulators, grid operators and utilities alike in the possibility of gaming these markets by bidding strategically. One of the possible ways to game a redispatch market is called increase-decrease (INC-DEC) gaming, where market participants anticipate better prices in the redispatching market and see these prices as opportunity costs. They then adjust their bids in the (zonal) spot markets to reflect these opportunity costs and therefore no longer bid according to marginal costs. This leads to undesirable effects such as worsening of congestions and higher congestion costs even if no single actor has market power. While the possibility for this type of gaming is well known (cf. e.g. [2]) and has led some to explicitly advise against market based redispatch (cf. [3]), no numerical analysis has yet been undertaken to quantify the effects of INC-DEC gaming in the current CWE market configuration. There are many unknowns and possibly mitigating factors to consider when talking about the practical implications of INC-DEC gaming. Firstly, uncertainties and risk aversion impact the ability of market participants to effectively game the system, as neither the zonal market outcome nor the anticipated redispatch market outcome are known in advance. Secondly, there are benefits to consider when moving from a cost based redispatch system to a market based redispatch system, such as easier inclusion of demand side flexibilities, which do not have clear marginal costs and therefore do not lend themselves easily to cost based remuneration. To pave the way for quantifying the actual practical impact of this type of gaming, in this paper we calculate a worst case scenario. In this scenario, every market participant can perfectly anticipate the results of a redispatch market and can therefore adjust its bids in the zonal market accordingly. This scenario represents the worst possible standalone impact of INC-DEC gaming, disregarding additional factors such as abuse of market power. From this point, further assumptions can be integrated, such as the inclusion of uncertainties and risk aversion. Preliminary results show that the theoretical worst case impact of INC-DEC gaming results in extra payments to generators under 1 % (about 180 m€ per year) compared to zonal clearing and market based redispatch without this type of unwanted behavior.

Methods

To quantify the worst case effects of INC-DEC gaming we utilize a model of the extended Central Western Europe electriticy market (CWE plus Switzerland), with a representation of the flow-based market coupling mechanism and a subsequent redispatching mechanism (cf. [4]). In order to clear a zonal market, so called flow-based parameters have to be calculated, namely generation shift keys (GSKs) and remaining available margins (RAMs). In practice, these parameters are calculated by the TSOs utilizing a *base case*, the expected market outcome for the hour in question. To simulate this base case, we first calculate a nodal optimal power flow (OPF) of the system, from which a first set of flow based parameters is derived. A first zonal clearing is performed with these parameters in order to serve as the simulated expected market outcome (which is used as the base case). From this zonal base case the “real” set of flow-based parameters is derived, which serve as input into the “real” zonal clearing. From this market outcome, redispatch is performed in order to achieve a feasible solution considering the physical grid constraints (which are not adequately represented in the zonal problem).

The solution from the redispatching represents (1) cost based redispatch, if generator costs are used to calculate system costs or (2) market based redispatch without strategic behavior by the participants, if clearing prices are used to calculate system costs. From this solution a (3)rd possibility is modelled: perfect anticipation of the redispatch market by market participants. In this case, market participants anticipate the results of the redispatch market, including the resulting prices, as opportunity costs. They then consider these opportunity costs already in zonal market as shown by [2], and adjust their bids accordingly. This type of strategic bidding behaviour is called increase-decrease (INC-DEC) gaming. We model this behaviour by performing a first calculation run (including redispatch) to get the prices on a redispatch market. We then adjust the cost curves of generators according to these prices, as if they (correctly) anticipated them on the redispatching market. With these adjusted cost curves, a new zonal clearing is performed. This represents the zonal clearing with strategic bidding by the market participants, anticipating the following redispatching market. In the next and last stage, redispatch with the original cost curves is performed. The original cost curves are used because this represents the last step of the process and market participants no longer stand to gain anything by deviating from their marginal costs in their bids. By comparing prices and produced quantities in both simulation runs, the worst case effects of INC-DEC gaming can be established.

Results

Preliminary results show that payments to generators increase by about 0.6 % in the worst case scenario compared to the scenario without unwanted behavior by generators (zonal clearing costs and redispatching costs taken together). This represents a yearly amount of ~178 million Euros. Of this amount, 8 million Euros result from the zonal market clearing and 170 million Euros result from higher payments in the redispatching process. Additionally results show that while in most hours the market with anticipation results in higher payments to generators, in 40 % of calculated hours total payments to generators actually decrease. Payments by loads after zonal clearing are on average 10ct/MWh cheaper in the gaming scenario. Distributing the extra costs from additional payments to generators in the redispatching process evenly across every produced MWh (for example in the form of grid fees) results in extra fees of 18ct/MWh compared to the no-gaming scenario. Total extra payments to generators therefore result in an average surcharge of 8ct/MWh when gaming is considered. Redispatched volume increases significantly when considering gaming, increasing from 60 TWh of positive redispatch to 89 TWh, an increase of 48 %. Further analysis will show how the origin of extra payments to generators are distributed, e.g. by country / bidding zone and how the extra profits are distributed among generators (e.g. by country / bidding zone and type of generator).

Conclusions

The growing (expected) role of demand side actors in congestion management has led to an uptake of research in flexibility markets and calls for implementation of marked based redispatch on a European level. At the same time, worries have grown that these market based mechanisms could be abused, for example by INC-DEC gaming. Our results show that while these worries should not be overstated (payments to generators in the zonal clearing and redispatching increase only by 0.6 % in the gaming scenario), further research should be done on the effects of drastically increasing redispatched volumes apart from immediate financial aspects, e.g. the operational burden for grid operators, who have the task to secure a grid where the zonal market no longer holds the same predictive power as before (because of gaming). Building on the preliminary results, additional effects such as the interplay between market power and INC-DEC gaming and the impact of uncertainty about prices on the redispatching market should be studied. Further study could also be done on the losers of INC-DEC gaming: Generators may lose revenue because INC-DEC gaming leads to different zonal prices.

We conclude that while the worst case effect of INC-DEC gaming is not insignificant, care should be taken not to overstate the impact. Our results represent the worst case assumptions, where every generator has perfect foresight into future prices and therefor no uncertainty exists. As the costs and consequences of possible alternatives, such as variable grid fees, are by no means certain, market based redispatch as a future congestion management tool should not be rejected out of hand.

References

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