MARKET POWER ABUSE IN WHOLESALE ELECTRICITY MARKETS

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Overview

In electricity markets, the incentives for producers to drive up the power prices by reducing supply vary from hour to hour. Additionally, because of price hedging, producers regularly have an incentive to depress prices by inflating supply, too. In this study, we estimate the incentives to deviate from competitive behavior for individual generation units in Germany for each hour of the five-year period 2019-2023. Comparing modeled competitive behavior with observed production, we find that deviations from the competitive behavior align well with financial incentives. We find that in situations where it pays out to inflate prices, companies tend to withhold capacity. Our multinomial logit model estimates that a unit is more likely to be withheld, as opposed to no deviation in generation, by 1% for every Euro increase in profitability of withholding one MW. The opposite is also true for hours in which companies benefit financially from lower prices, where we find a 0.3% relative increase in pushing into the market cost-negative capacity, compared to baseline generation, per unit increase in profitability of pushing in capacity. This is evidence of market power abuse at the hourly level that is explained by price-altering incentives.

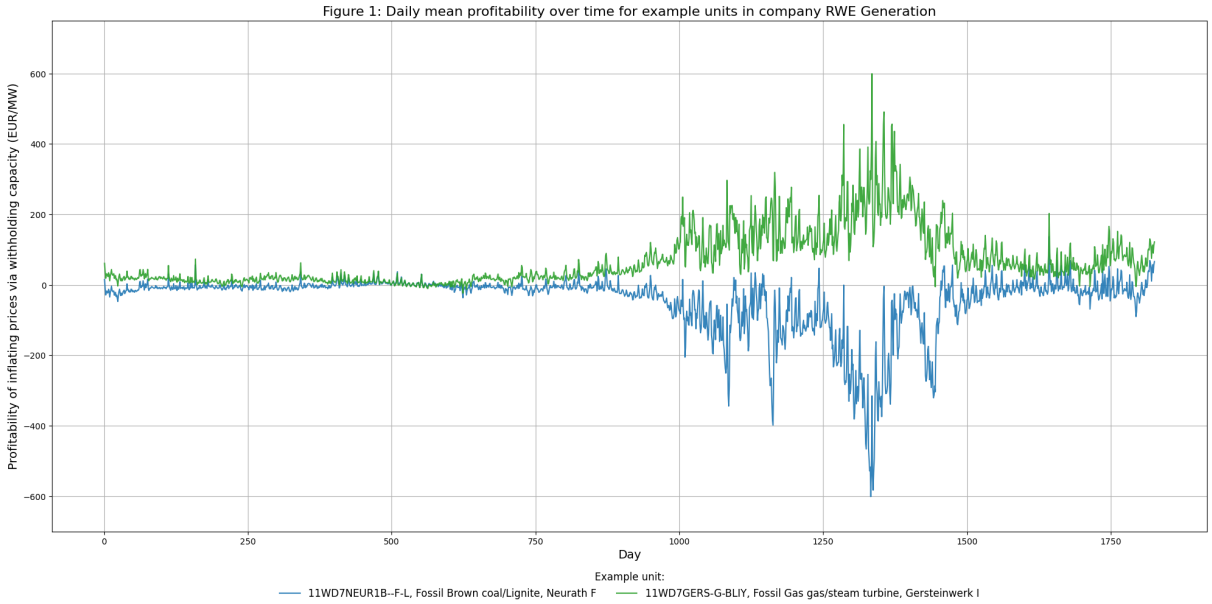
Methods

Withholding analysis by regressing the output gap against factors related to incentives for exercising market power has been suggested as a detection method of much potential. We identify strategically deviating generation by comparing empirical dispatch to a competitive benchmark, which we call competitive dispatch. As economic theory suggests that a competitive supply side is sufficiently determined by marginal costs of production from all available capacity, we construct competitive dispatch with numerical optimization models that solve for profit maximization within monthly planning horizons, for individual generation units at the hourly level, considering their fuel costs, start-up costs, and minimum load constraints. We include all thermal, dispatchable generation units of coal and gas fuel types that are not constrained by ancillary services or the heat market in Germany. We then consider unit availability, based on unavailability reports published by unit owners. We estimate and discretize deviation in empirical generation from competitive dispatch into three categories: negative deviation (suggesting capacity withholding), no significant deviation, and positive deviation (suggesting capacity push-in). We then regress the discretized deviation against indicators of incentives to abuse one's market power – profitability of altering prices by withholding or pushing in one's capacity – in a multinomial logit regression set-up, where the probability of deviation in generation is predicted by profitability of capacity withholding or push-in.

We measure profitability of withholding or pushing in one's capacity with three components: slope of market supply, company forward position, and unit contribution margin. The profitability of withholding one MW of each unit is calculated as the potential profit of withholding less opportunity cost, denoted below:

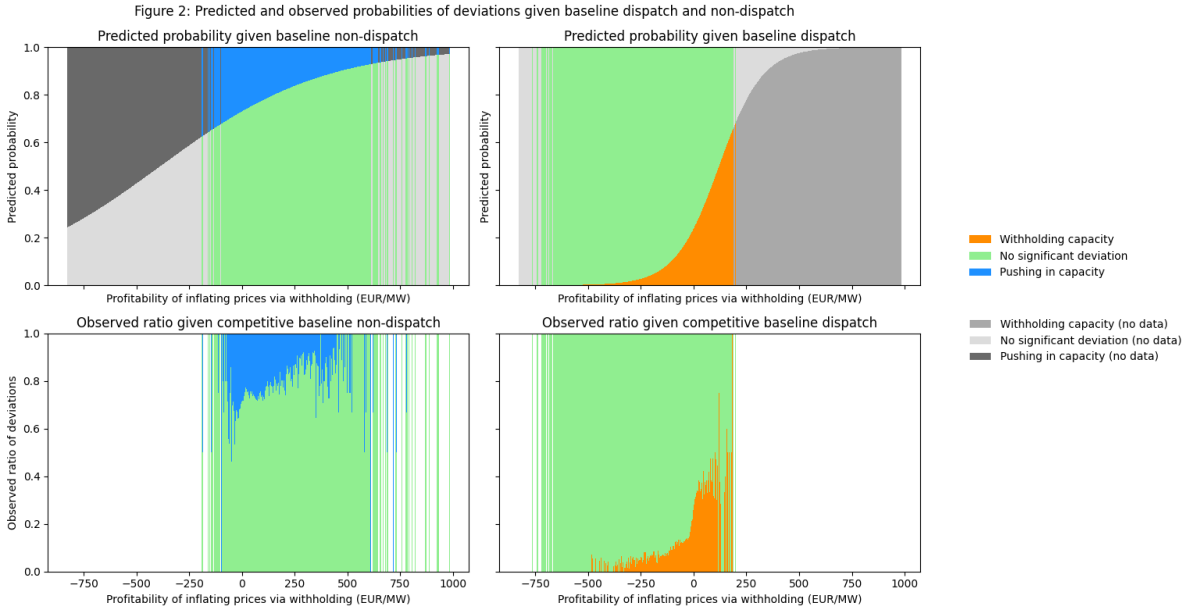
$$P_{ij,t} = S_t * FP_{j,t} - M_{ij,t}$$

where P stands for profitability of capacity withholding, S for slope, FP for forward position, M for margin, i for unit index, j for company index, t for hourly time-step index. For each hour, we consider the potential profit of withholding to be the product of the EUR/MWh increase in market price per MW capacity withheld (the slope of supply) and the MWh quantity of generation output under-hedged by the company (the forward position), which it is incentivised to sell on the market. Correspondingly, the opportunity cost of withholding a MW capacity for each unit is the Euro amount that MW could have earned for its output in the market, namely, the difference between market price and marginal cost of production, which is unit margin. It is important to note that the profitability of pushing in one's capacity is the exact opposite of that of withholding the same capacity: an increase in the profitability of withholding is a decrease in the profitability of pushing in to the same extent. Daily mean profitability of withholding over the entire sample period is shown below for two example units owned by RWE Generation, largest player in the German wholesale electricity market, in Figure 1.



Results

Over the five-year period and across all relevant units of coal and gas fuel types in the German wholesale electricity market, we observe two trends simultaneously. First and more notably, we find a significant and positive increase in unit probability of withholding capacity rather than no deviation in generation, by 1.0% per unit increase in profitability of inflating prices via withholding. This is shown by Figure 2 in the top right panel. Second, the top left panel shows our finding that unit positive deviation in generation is negatively associated with the same profitability of withholding, with a 0.3% decrease in probability of pushing in rather than no deviation per unit increase in profitability of withholding. This equates to an increase in unit probability of being pushed in per unit increase in profitability of depressing prices via pushing in capacity, to the same extent. The bottom panels in Figure 2 show observed data that corroborates the model estimates on top. Besides findings on the market level, we also find technology-specific, company-specific, and unit-specific results, which we discuss in detail in the paper.



Conclusions

Market power abuse is typically difficult to pin down in electricity markets, due to its volatile nature hour by hour. We provide a measure of profitability of abusing one's market power at the hourly level and explain unit deviation in generation with variations in price-altering incentives between hours. For thermal, dispatchable generation units in the German wholesale market, we find significant association between its profitability of depressing prices via pushing in capacity and its deviation in the positive direction, as well as its profitability of inflating prices via withholding capacity and its deviation in the negative direction.