



Strategic capacity withholding through failures in the German-Austrian electricity market



Julian Bergler^a, Sven Heim^b, Kai Hüschelrath^{b,c,*,1}

^a University of Leipzig, Faculty of Economics and Management Science, Grimmaische Straße 12, D-04109 Leipzig, Germany

^b ZEW Centre for European Economic Research, Competition and Regulation Research Group and MaCCI Mannheim Centre for Competition and Innovation, P.O. Box 10 34 43, D-68034 Mannheim, Germany

^c University of Mannheim, L7, 3-5, D-68131 Mannheim, Germany.

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ABSTRACT

In electricity day-ahead markets organized as uniform price auction, a small reduction in supply in times of high demand can cause substantial increases in price. We use a unique data set of failures of generation capacity in the German-Austrian electricity market to investigate the relationship between electricity spot prices and generation failures. Differentiating between strategic and non-strategic failures, we find a positive impact of prices on non-usable marginal generation capacity for strategic failures only. Our empirical analysis therefore provides evidence for the existence of strategic capacity withholding through failures suggesting further monitoring efforts by public authorities to effectively reduce the likelihood of such abuses of a dominant position.

1. Introduction

Strategic behavior – defined as set of actions a firm takes to influence the market environment so as to increase its profits² – is a common occurrence in markets with a rather small number of firms being able to observe each other's actions. Although strategic behavior is generally expected to lead to prices above marginal costs, only certain forms are considered likely to lead to clear net welfare losses and are thus banned by existing competition laws. Examples include various forms of abuses of a dominant position such as predation, certain rebate schemes or raising rival's costs strategies.

Since the deregulation of significant parts of electricity markets in many countries around the world, operators have been quite innovative in applying various forms of strategic behavior aiming at increasing profits, however, with potentially negative net effects on overall welfare (see generally [Stoft, 2002](#)). An intensively discussed form of such strategic behavior is 'capacity withholding' which makes use of the fact that the supply schedule typically is convex while demand is unresponsive to price signals in the short-term. Hence, whenever demand is high, a small reduction in supply substantially increases the marginal price and – because electricity markets are generally organized as

uniform price auctions – the price all operators receive. By strategically removing a fraction of their operating capacity from the market (e.g., by pretending a sudden failure of a generation unit), multi-unit plant operators expect that the correspondingly higher prices realized for the remaining operating units offset the lost revenues from the (strategically) removed capacity and thus lead to a net increase in profits.

In this context, we use a unique data set of failures of generation capacity in the German-Austrian electricity market to investigate the relationship between electricity spot prices and generation failures. Differentiating between strategic and non-strategic failures, we find a positive impact of prices on non-usable generation capacity for strategic failures of hard coal as well as (partly) gas-fueled plants only. Our empirical results are therefore consistent with existing theoretical research which has identified market price manipulations through (mocked) failures – so called physical capacity withholding – as potentially rational behavior of multi-unit plant operators in electricity markets. From a policy perspective, our findings suggest (further) monitoring efforts by public authorities to effectively reduce the likelihood of such abuses of market power.

The remainder of the paper is structured as follows. The following second section introduces into the theoretical concept of strategic capacity

* Corresponding author at: ZEW Centre for European Economic Research, Competition and Regulation Research Group and MaCCI Mannheim Centre for Competition and Innovation, P.O. Box 10 34 43, D-68034 Mannheim, Germany.

E-mail address: hueschelrath@zew.de (K. Hüschelrath).

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² [Carlton and Perloff \(2000\)](#), pp. 332f.

withholding and reviews empirical evidence from different national electricity markets. The subsequent third section begins with a general characterization for the German-Austrian electricity market in Section 3.1 followed by a more specific discussion on the relevance of strategic capacity withholding in this particular market as part of Section 3.2. Our empirical analysis of a possible relationship between electricity prices and generation failures is presented in the fourth section. While Section 4.1 describes the construction of the data set and discusses the descriptive statistics, Section 4.2 develops our empirical strategy and presents our empirical results. Section 5 concludes the paper.

2. Strategic capacity withholding – theoretical concept and empirical evidence

We first provide an introduction of the theoretical concept of strategic capacity withholding in Section 2.1, followed by a brief review of existing empirical research on this form of strategic behavior in Section 2.2.

2.1. Theoretical concept

The possibility and profitability of strategic behavior is closely tied to certain market- and firm-related preconditions. From a market perspective, the success of strategic behavior crucially depends on how well a certain strategy is taking advantage of, first, general demand- and supply characteristics and, second, the implemented market design (including a possible regulatory oversight). From a firm perspective, a certain degree of market power is usually needed to be able to successfully apply strategic moves.

Electricity as product generally has many characteristics which make an application of various forms of strategic behavior likely. From a market perspective, a lack of real-time pricing and demand side participation leads to inelastic short-term demand for both industrial and residential consumers. From a firm perspective, especially generation markets are often characterized by the presence of few but large multi-unit plant operators which are generally able to successfully implement strategic moves. Typically, their respective generation systems consist of several types of units with some being characterized by low marginal costs but low flexibility (e.g., renewables, nuclear or lignite plants) and some by high marginal costs but higher flexibility in use (e.g., hard coal or gas-fueled plants). While the former are typically covering the base load, i.e., minimum demand, the latter are activated gradually to the degree rising demand makes this necessary. Therefore, the supply curve is typically convex.

The design of many (wholesale) electricity markets allows producers two main possibilities to trade their product: ‘long- and medium-term’ or ‘short-term’. The typically largest part of expected demand is traded via long- and medium-term contracts ‘over-the-counter’ from several years to months prior to supply. Short-term contracts come into play when actual demand can be estimated more precisely. These contracts are then typically traded at a power exchange, the so-called spot market for electricity. Subdivided further into the day-ahead market and intraday trading, the former aims at optimizing liquidity in the market while the latter ensures the possibility to react to specific incidences closer to real-time.

Focusing on ‘short-term’ day-ahead markets in the remainder of this section, the majority of these markets are organized as uniform-price auction or last-price auction (see Newbery (1995)), i.e., market participants submit their bids and asks and the operating counterparty sets a clearing price that all participants receive or pay, respectively. This market design implies that buyers who bid more than the clearing price have to pay less than they actually would. By the same logic, suppliers that offered their output for less than the clearing price experience a profit³ (see Cramton and Stoft (2007)).

³ As a consequence, in an electricity market environment, operators of power plants fueled with low-cost resources experience profits (stimulating further investments in these types of production technologies; see Cramton and Stoft (2007)).

As uniform price auctions are established at most power exchanges all over the world,⁴ there is a large amount of academic literature analyzing electricity markets with uniform-price auctions⁵ in general and ‘suspicious’ developments such as unexpected temporary price rises in particular (see, e.g., Kwoka and Sabodash, 2011). These developments raised concerns about the abuse of market power – first and foremost with respect to forms of collusive behavior but also with respect to applications of particular unilateral strategies including abusive capacity withholding.

Generally, the capacity withholding strategy makes use of the particular characteristics of electricity markets in general and uniform-price auctions in particular. Given the inelastic demand and applying uniform-price auctions, all operators receive the same price (per unit of output) which is determined by the costs of the marginal plant that is just needed to satisfy demand. In such an environment a small reduction in supply causes large price increases whenever demand intersect with the supply curve at a sufficiently steep part. By strategically removing a fraction of their operating capacity from the market, operators expect that the correspondingly higher prices realized for the remaining operating units offset the lost revenues from the (strategically) removed capacity. Eventually, capacity withholding is expected to lead to higher profits for the multi-unit plant operators at the expense of a reduced consumer surplus. Although the deadweight loss is expected to be small or even non-existent due to the low demand elasticity, efficiency losses are nevertheless created by a suboptimal use of the existing generation systems with baseload units being replaced (for strategic reasons) by a less efficient marginal technology.

Although the idea behind a capacity withholding strategy is straightforward, its successful practical implementation is tied to certain conditions. First, capacity withholding by definition demands a multi-unit operator as only the existence of multiple units provides the possibility that the (additional) revenues generated by the still operating units surpasses the lost revenue from the withheld units. Second, in addition to multiple units, a certain market share (or market power, respectively) is sometimes mentioned as additional precondition for a successful application of capacity withholding strategies. However, although there are no serious doubts that the attractiveness of such a strategy increases with the number and size of plants of a certain operator – leading to a decrease in the minimal price that is needed to profitably apply a withholding strategy – the general method can also be successfully applied by smaller multi-unit plant operators units without a significant overall market share (see, e.g. Cabral, 2002; Dechenaux and Kovenock, 2007; Kwoka and Sabodash, 2011; or Fogelberg and Lazarczyk, 2014).

Turning from the general concept to the implementation of the capacity withholding strategy, the academic literature distinguishes between ‘economic withholding’ and ‘physical withholding’ (see Joskow and Kahn (2002)). Economic withholding – also known as hockey stick bidding – refers to a strategy where a supplier offers part of its capacity at an extremely high price thus moving it to the very right of the supply curve. Consequently, a part of the overall supply curve would shift to the left causing the desired price increase of a capacity withholding strategy. Although theoretically sound and workable, economic withholding faces the key challenge that it is relatively easy to detect by market surveillance authorities, e.g., by comparing the respective bid

⁴ The UK is the most prominent exemption where the New Electricity Trading Arrangements (NETA) in 2001 introduced the pay-as-bid auction as allocation mechanism. A key driver for this market design reform in England and Wales was the belief of the British regulatory authority in charge, OFGEM, that uniform auctions are more subject to strategic manipulation by large traders than pay-as-bid auctions (see, e.g., Evans and Green, 2003). From an academic perspective, on the surface, such a market design would indeed eliminate the profitability of strategic capacity withholding as power plants do not profit from a spontaneous unavailability of another power plant. However, as shown by Kahn et al. (2001) or Heim and Götz (2013), withholding strategies are also possible in pay-as-bid auctions under certain market conditions.

⁵ Another reason is that uniform price auctions offer advantageous properties for algebraic analysis compared to pay-as-bid auctions.

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