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Measuring competitiveness of the EPEX spot market for electricity

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H I G H L I G H T S

- We investigate the efficiency of the German spot market for electricity.
- We employ a conjectural variations approach and a fundamental market model.
- Peak load hours and base load hours are analyzed separately.
- We find that the market was competitive from 2007 to 2010 for both base and peak hours.
- Policies to promote market transparency in Germany can be regarded as successful.

A R T I C L E I N F O

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The issue of market concentration in electricity markets and resulting possible anti-competitive behavior of producers is a much discussed topic in many countries. We investigate the day-ahead market for electricity at the EPEX, the largest central European market for electricity. To analyze whether generating companies use their market power to influence prices, we use a conjectural variations approach as well as a direct approach to construct marginal costs of electricity production. Given the available data, we cannot reject the hypothesis that there was no systematic abuse of market power by the suppliers of electricity on the EPEX day-ahead spot market for the years 2007–2010. These results are essentially robust when restricting the sample to high load hours, which are generally considered to be the most prone to market manipulation.

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1. Introduction

In the last decades most industrialized countries all over the world have seen a trend towards liberalization of electricity markets. This process was accompanied by discussions on optimal market design and mechanisms to ensure transparency and efficiency of the markets. In the process, in a range of countries doubts were raised on whether the pricing is free of market manipulation by large producers (for example Green and Newbery, 1992; Wolfram, 1999; Borenstein et al., 2002; Fabra and Toro, 2005; Weigt and von Hirschhausen, 2008).

In this paper, we investigate whether the electricity producers use their market power to influence prices to their favor at the European Power Exchange (EPEX), the German/Austrian spot market for electricity. To analyze this issue, we use two independent methods: a conjectural variations approach proposed by Bresnahan (1982), which, to the best knowledge of the authors,

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has not been applied to the German market before, and a fundamental model to compute the marginal prices of electricity generation.

The conjectural variations approach is based on a theoretical model in which firms make their decisions based on conjectures on the reaction of their competitors. From the analysis of the conjectures the degree of market power can be directly deduced. The advantage of this approach is that it lends itself to statistical estimation and the relevant parameters can be identified by using data on prices and quantities. Since our analysis is on an industry level, plant level data is not required. Instead, we use publicly available high frequency data on prices and aggregate demand as well as prices for primary energy for our study. On the basis of this analysis, we find no evidence of the systematic exercise of market power during the observation period 2007–2010. For each of the four years, the parameters estimated from the conjectural variations model correspond to conjectures that fit to a perfectly competitive market. The results are essentially robust when restricting the sample to high load hours, where the incentives for market manipulation are the highest.

To complement the above analysis, we propose a fundamental approach, mimicking the mechanics of an efficient market by

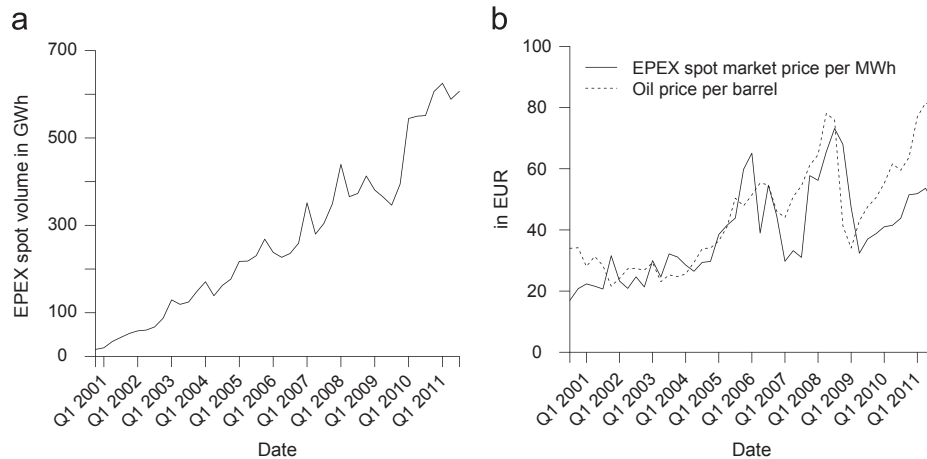


Fig. 1. The evolution of EPEX traded quantities (a), as well as average prices on the EPEX day-ahead spot market from 2007 to 2010 (b).

modeling the marginal costs of production of nuclear, coal, gas, and oil plants and intersecting the resulting merit order with electricity demand minus the production from intermittent sources of electricity. The result serves as an input for the calculation of the optimal operation of storage plants, whose marginal costs are pure opportunity costs. This yields a fictitious competitive price that is compared to the actual market price. To the best knowledge of the authors, this paper is the first that explicitly considers the operations of storages in a fundamental approach to measure market power. Because of scarce data, we apply the fundamental approach only for the year 2010, for which it yields results that are consistent with the conjectural variations approach in the sense that prices are only slightly above the hypothetical marginal costs calculated in the fundamental approach.

Both of the approaches used to detect market power are of statistical nature. We therefore are not able to detect instances of market manipulation that occur very infrequently and have only a negligible effect on average prices. However, we believe that the misuse of market power only becomes a policy problem, if it significantly influences the cost of electricity for the end consumers. For this to happen, prices have to be distorted upwards in a large number of hours or there have to be hours with extremely high prices. Such a deviation from competitive behavior would be detected by the methods applied in this paper. Moreover, an in-depth analysis of single hours would require very detailed data on plant dispatch, bids, and detailed technical specifications of single plants. Unfortunately, this data is not publicly available for the German market.

We start our exposition with a short history of the joint German/Austrian electricity market and the ongoing debate about the alleged anti-competitive behavior of generation companies. In Germany, deregulation of the electricity market was introduced in 1998. In 2000, the Leipzig Power Exchange and the European Energy Exchange (EEX) were founded. Two years later the two German power exchanges merged under the name EEX. In 2009, the EEX spot market joined with the French exchange PowerNext to form the EPEX. The Austrian market was fully liberalized in 2001. Although there exists an Austrian power exchange, the relevant day-ahead spot market for electricity in Austria is the EPEX. In the remainder of the paper, we disregard the history of name changes and will refer to the spot market as the EPEX.

The founding of the German power exchanges clearly was a success in terms of traded quantities as Fig. 1, Panel (a) shows. While in 2005 only 10% of the demand for electricity was traded on the EPEX day-ahead markets (see Growitsch and Nepal, 2009), the importance of the exchange increased in the recent years.

In 2011, there were 174 EPEX spot market participants listed and registered for auctions in the German/Austrian market, about half of which are from Germany/Austria. The price for electricity is determined in a single price, closed bid auction for every hour of the next day which takes place at 12 p.m., seven days a week, year-round, including statutory holidays. Allowed prices range between –3000 EUR/MWh and 3000 EUR/MWh. Since the interconnection between the different areas of the EPEX market zone is usually sufficient to avoid congestion, there is no need for zonal or nodal pricing and the prices found in the day-ahead auctions are valid for the whole market zone. This even holds in the rare case of congestion where the resulting costs of re-dispatch are charged via network fees.

In the first year after liberalization, electricity prices on the exchange were rather low and it seemed that the liberalization was a success also from a consumer's perspective (see Bower et al., 2001). However, in the subsequent years EPEX spot prices rose sharply (see Fig. 1, Panel (b)), triggering a public and political debate which was further boosted by an increasing market concentration as 30 small electricity producers merged into four large producers within a short period (see Lise et al., 2006). In 2009, the four biggest German energy producers Energie Baden-Württemberg AG (EnBW), E.ON AG (E.ON), Rheinisch-Westfälisches Elektrizitätswerk AG (RWE), and Vattenfall Europe AG (Vattenfall) owned 80% of production capacities and supplied 82% of electricity into the German power grid (Bundeskartellamt, 2011). Power producers counter accusations of price manipulations by claiming that higher electricity prices are caused by higher prices for primary energy. The development of the oil prices depicted in Fig. 1, Panel (b) partially supports this statement.

The debate on whether high wholesale electricity prices are connected to higher input prices or to strategic withholding of capacities by the four big players is not resolved up to this day and is still discussed in academia, politics, and in the public. The European Commission (EC) and the German federal cartel office (GFCO) picked up the topic and, based on the sector inquiry issued by the EC and London Economics, concluded that at least in some hours the market outcomes were poor in the years 2003–2005 (European Commission, 2007; London Economics, 2007). As a result and to address the EC's concern about profitable withholding of generation capacity by E.ON, one of the leading German electricity producers, the company had to divest about 5000 MW generation capacity. In contrast to E.ON, RWE and Vattenfall did not make any commitments (Bundeskartellamt, 2011). The legal proceedings against E.ON, RWE, and Vattenfall were suspended in 2008 due to the lack of conclusive evidence. In the year 2009, the GFCO initiated another sector inquiry, analyzing wholesale

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