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Reforming minute reserve policy in Germany: A step towards efficient markets?

Margarethe Rammerstorfer, Christian Wagner *

Department of Finance and Accounting, Vienna University of Economics and Business, Heilligenstädter Street 46-48, 1190 Vienna, Austria

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ABSTRACT

The present paper provides an empirical assessment of the effects associated with the reorganization of minute reserve markets in Germany. As the aim of the regulator is to assure a competitive market with transparent pricing, we analyze whether the recent policy reform has had an impact on the dynamics of minute reserve prices. Our results show that the level and volatility of positive and negative minute reserve prices decreased substantially. Furthermore, we provide evidence that the degree of integration between reserve and spot markets has increased. Overall, prices reacted to the policy change in a manner that is in line with the regulator's objective. The reform can thus be viewed as a step towards an efficient reserve market.

1. Introduction

The balance between energy supply and demand – and consequently a balanced grid load – at each point in time is a major task of the system operator. Her duty is to estimate beforehand the amount of possible deviations in order to secure sufficient reserve capacities and to avoid imbalances. The effectiveness of balancing management, however, does not only depend on reliable forecasts of energy injections and withdrawals from the grid, but also necessitates an adequately designed market for balancing power.

Since the German market serves as the most important transit market of the continent and has to satisfy the largest demand for energy consumption in Europe, a high level of grid security is indispensable. The German power grid is divided in four power control areas. Before 2001, the transmission system operators and their associated power plants were the only suppliers of tertiary control and ensured the system balance through bilateral contracts between themselves. In 2001, the national Federal Cartel Office prescribed the implementation of separate procurement auctions for each of the four different power control areas, which became effective in 2002. However, in 2006 the German monopoly commission still detected several deficiencies of the market mechanism in their monitoring report (see MC, 2006). In particular, the commission emphasized that the market design failed to ensure market efficiency and that it was not able to prevent collusive behaviour or restrict discriminatory power of the balancing group leaders. As a consequence, the commission arrogated the design of a new legal framework in order to assure competitive and transparent pricing. A corresponding consensual concept was agreed upon on the 29th of August, 2006. Consequently, since the 1st of December, 2006 the transmission network operators participate in a joint tendering procedure for tertiary reserves supported by a web-based platform. With the aim of providing an adequate regulatory environment for an efficient market through stimulating competition and increasing transparency, the new regulatory framework defines an auction design based on merit orders, reduces the minimum bid quantity, limits the extent of self-selling, and sets out disclosure requirements.

The present paper provides an empirical assessment of how the market dynamics of minute reserve prices have changed after the policy reform. In particular, we analyze whether the implementation of the new tendering procedure has had an impact on market prices and their volatility and whether the degree of integration between reserve and spot markets has increased. Previewing our results, we find that the level and volatility of minute reserve prices decreased substantially and that the prices are stronger (co)-integrated with the spot market than before the policy change. This allows for conclusions whether the new market design succeeds in supporting the regulator's objective to assure an efficient market.

The remainder of the paper is organized as follows. Section 2 provides a brief review of the related literature and Section 3 describes the organization of the German minute reserve market. We present our empirical analysis in Sections 4 and 5 concludes.

2. Literature review

Our work is related to the fast growing literature on regulated and liberalized electricity markets. Numerous studies analyze the

* Corresponding author. Tel.: +43 1 31336 4253; fax: +43 1 31336 736.
E-mail addresses: margarethe.rammerstorfer@wu-wien.ac.at (M. Rammerstorfer), christian.wagner@wu-wien.ac.at (C. Wagner).

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impact of market design on price behaviour and the efficiency of electricity markets. For instance, Borenstein et al. (2002, 2008) use the prominent case of California to discuss the impact of market inefficiencies and market power on electricity markets. Other studies that investigate the role of the market design and the success or failure of reforms in a variety of energy markets around the world include Joskow (1997), Dnes et al. (1998), Wolfram (1999a, b), Herguera (2000), Kleit (2001), Angelus (2001), Puller (2007), Woo et al. (2001, 2003), Tishler and Woo (2006), and Sensfuß et al. (2008).

Understanding the dynamics of energy prices and their properties is a prerequisite for analyzing the efficiency of electricity markets. While market efficiency traditionally builds on the conjecture that prices are unpredictable, finding predictability alone is not sufficient to conclude that electricity markets are inefficient. Since electricity is non-storable, electricity today and electricity in the future are different assets and predictability does not provide inter-temporal arbitrage opportunities per se. In order to account for this feature, equilibrium models for the pricing of forward contracts have emerged in the literature, see e.g. Bessembinder and Lemmon (2002), Lucia and Schwartz (2002), and Longstaff and Wang (2004).[1] The results of these papers have further implications for trading and risk-management in electricity markets, for instance, for the pricing of power derivatives and their relation to spot prices (see e.g. Lucia and Schwartz, 2002; Shawky et al., 2003) and for trading in multiple markets; see e.g. Woo et al. (2001) who deal with forward pricing and hedging across energy markets. Although traditional no-arbitrage arguments are not applicable for electricity products, the institutional setup may allow for profitable strategies if multiple electricity markets (real-time, forward, etc.) are organized as competing substitutes and prices are predictable but do not comove, see e.g. Quan and Michaels (2001) and Arciniegas et al. (2003). By the same logic, the prices of regional substitutes should comove (after accounting for transaction costs), see e.g. Woo et al. (1997), De Vany and Walls (1999a, b), and Park et al. (2006).

Hence, an assessment of market efficiency can be based on an analysis of whether substitute markets comove. Following the literature, we use cointegration techniques to analyze the success or failure of Germany's reform of minute reserve policy, i.e. whether it has led to a higher integration of the spot day-ahead and the minute reserve market. Our paper can be viewed as an empirical complement to the work of Müller and Rammerstorfer (2008), which provides a theoretical analysis of the reform's potential effects on market prices. Other related work on the German minute reserve market includes Riedel and Weigt (2007) and Wieschhaus and Weigt (2008).

3. The German minute reserve system

At each point in time, the transmission system operator has to assure the matching of total energy demand and supply within the network. As these variables are characterized by substantial time-variation (due to power plant outages, stochastic feed-ins, demand fluctuations, etc.) and limited predictability, maintaining the system balance is not a trivial task. The purpose of the balancing power system is to provide an additional market which meets the needs of the system operators as well as the needs of electricity producers. Imbalances in a transmission network, i.e. the differences between feed-in and withdrawal of energy, can be of positive or negative sign. A positive sign indicates that more energy is produced than consumed which leads to an increase in the frequency of the transmission network. In this case, the network operator has to reduce the frequency by buying negative balancing power. In contrast, a negative sign implies that the network frequency is too low and hence, the balance of the market has to be achieved by acquiring positive balancing power.

In Germany, power imbalances have to be substituted by the balancing group leaders or by the transmission system operators, who have three balancing power instruments at their disposal which differ with respect to their activation mechanisms: primary, secondary, and tertiary reserves. As the aim of the present paper is to analyze the reform of minute reserve policy, we focus on tertiary control; in the following, we may refer synonymously to minute reserves as tertiary control, balancing power, or reserve power.[2,3] In this market, positive and negative minute reserves are auctioned on a daily basis for 6 four-hour time slots of the next day. Buying minute reserve can therefore be viewed as purchasing an option on positive or negative energy which has to be delivered if it is called by the system operator. When the holder of minute reserves calls her claim, she has to pay the working charge and the supplier has to deliver within the next quarter of an hour.[4]

The bid prices offered by the suppliers of minute reserves depend, on the one hand, on costs associated with choking production and ratcheting up the plant, on the other hand, potential opportunity costs have also be accounted for. The latter is relevant since electricity producers may choose to rather participate in the spot market at the European Energy Exchange (EEX), where the Phelix Day-Ahead Baseload (Phelix) can be viewed as kind of a substitute for positive minute reserves. The Phelix is also auctioned on a daily basis for 6 four-hour time slots of the next day, with the spot auction taking place one hour after the minute reserve auction. Hence, in an efficient market, the prices for positive minute reserves should be related to the Phelix. For negative minute reserves, the relationship is less clear, hence the opportunity costs should be lower. Furthermore, as minute reserves only provide an option on the delivery of energy, their prices should be expected to be lower than corresponding spot prices. However, prior to the introduction of the new regulatory framework for tertiary control, minute reserve prices have been substantially higher than spot prices. As a consequence, several market participants criticized the low transparency in pricing and the discriminatory behaviour of the balancing group leaders. In a similar manner, the German monopoly commission emphasized that the market design in place fails to ensure market efficiency and is not able to prevent collusive behaviour; see the monitoring report (MC, 2006). With the objective to assure competitive and transparent pricing, the German regulator reacted to these criticisms by introducing a new tendering procedure for minute

[1] Modelling the volatility of electricity prices is for instance discussed in Goto and Karolyi (2004).

[2] Readers not familiar with the German reserve market and interested in comparing tertiary control in Germany to that in other markets are referred to Rebours and Kirschen (2005) who compare the definition and technical specification of reserve services of Great Britain, Pennsylvania–New Jersey–Maryland (PJM), California, Spain, the Netherlands, Germany, France, Belgium, and the UCTE as a whole. For instance, in the PJM-market, a comparable instrument are spinning reserves (which serve as a primary reserve among the operating reserve instruments available for tertiary control); for a detailed survey of the North American market see e.g. Lusztig et al. (2006).

[3] Primary and secondary control are auctioned once a month and have, upon calling by the system operator, to be balanced within 30 seconds and 5 minutes, respectively. For a detailed discussion of the balancing power instruments available in Germany see e.g. Swider and Weber (2007) and Riedel and Weigt (2007).

[4] As the focus of the present paper is to analyze auctioned prices for tertiary control and the efficiency of the minute reserve market, working charges – which can be set arbitrarily by the bidders – are not discussed.