

Analysis of electricity industry liberalization in Great Britain: How did the bidding behavior of electricity producers change?



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ABSTRACT

Promoting competition among electricity producers is crucial for ensuring allocative efficiency and lower electricity prices. This paper empirically examines the wholesale electricity market of England and Wales in order to analyze to what extent regulatory reforms were successful at promoting competition among electricity producers.

As a theoretical benchmark we consider a duopoly case, based on which a regression model is specified. The estimation of the regression model allows for documenting new results about the impact of regulatory reforms on the incentive and disincentive to exercise market power by electricity producers during the liberalization process.

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1. Introduction

Great Britain was the first among the OECD countries to liberalize its electricity supply industry. Liberalization included splitting up the previously vertically integrated utility into its production and infrastructure parts and creating a wholesale market to exchange electricity between producers and retail suppliers in England and Wales. Trading was organized as a uniform price auction, where electricity producers are asked to bid prices at which they are willing to produce electricity.

Research has shown, however, that producers have exercised market power by submitting price bids significantly exceeding marginal costs (for example, Crawford et al., 2007; Sweeting, 2007).

An exercise of market power leads to higher uniform auction prices, i.e., the System Marginal Price (SMP), and, therefore, higher revenues for electricity producers. A higher SMP increases payments by retail suppliers, which are in the end reflected in higher prices paid by consumers. Another consequence of an exercise of market power is the possible loss in the efficient allocation of production facilities. In other words, due to possible differences in setting bid markups, there need no longer be any guarantee that, based on ordered price bids, the least-cost production facilities are indeed scheduled to produce electricity.

These market power issues are also discussed in Bergman et al. (1998) in the analysis of the first form of benefits that electricity market reforms could bring to consumers: lower prices resulting from lower price-cost margins and more cost-efficient electricity production. Other benefits that electricity market reforms could bring to consumers include a high degree of security of supply and an environmentally friendly electricity supply system, which in the long run would not critically depend on exhaustible natural resources.

As part of the liberalization process, in order to mitigate an

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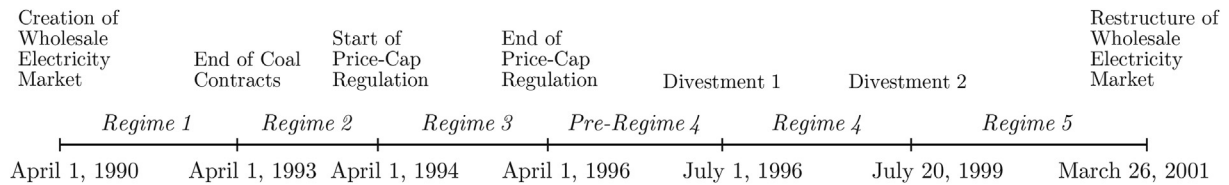


Fig. 1. : Institutional changes and regulatory reforms during 1990–2001.

Sources: Department of Trade and Industry (1997–2002), National Grid Company (1994–2001), Newbery (1999), Robinson and Baniak (2002), Wolfram (1999); author's illustration.

exercise of market power by incumbent electricity producers, the regulatory authority, the Office of Electricity Regulation (Offer, later constituted as the Office of Gas and Electricity Markets, or Ofgem), introduced several reforms. This paper analyzes how the regulatory reforms affected the bidding behavior of electricity producers. In particular, we quantify and document new empirical evidence about how the incentive and disincentive to exercise market power changed over the 1995–2000 period.

The measures designed to mitigate an exercise of market power and promote competition during the liberalization process were more extensive in Great Britain when compared to Germany, France, Italy, or Sweden (Bergman et al., 1998). Joskow characterizes the privatization, restructuring, market design, and regulatory reforms pursued in England and Wales as the international gold standard for energy market liberalization (Joskow, 2008, 2009). In this respect, the new findings documented in this research could be of interest to countries that have structured or are about to structure their electricity markets similar to the original model adopted in England and Wales.

2. Regulation in the electricity supply industry

The institutional changes and regulatory reforms that took place in the production level of the electricity supply industry (ESI) in Great Britain during the 1990–2001 period are summarized in Fig. 1 and described in detail in the following paragraphs.

The UK regulatory authority noted the growing discrepancy between rising wholesale electricity prices and falling fuel costs, and specifically the sharp increase in electricity prices in April 1993.¹ In the literature, this is also associated with the expiry of coal and other initial contracts imposed by the government. Hence, April 1, 1993 is considered as the *first structural break*.

Earlier research (for example, Green and Newbery, 1992) concluded that an exercise of market power enabled electricity producers to raise prices above competitive levels. Later, the regulatory authority advocated the introduction of price-cap regulation into the ESI, which would set an explicit ceiling on annual average prices charged for electricity production by the two incumbent electricity producers: National Power (the larger producer) and PowerGen (the smaller producer). Faced with the alternative of a referral to the Monopolies and Mergers Commission (MMC), these producers agreed to a price cap for two financial years: 1994/1995 and 1995/1996 (Wolfram, 1999; Robinson and Baniak, 2002). Therefore, April 1, 1994 and April 1, 1996 are considered as the *second and third structural breaks*, respectively.

In order to improve competition and decrease the influence of the incumbent electricity producers, the regulatory authority introduced horizontal restructuring through two series of divestments that took place in 1996 and 1999.

When defining regime periods for an ex-post regulation analysis, we consider the exact dates in which the reforms were

introduced. This approach better corresponds to the nature of the divestment series introduced by the regulatory authority.

For example, the introduction of the first series of divestments for PowerGen led to the transfer of all medium coal production facilities to Eastern Group (National Grid Company, 1994–2001). In this case, choosing a structural break slightly different from the actual date of the transfer would have resulted in a short time series (either PowerGen just before transferring medium coal production facilities if the cut-off were early, or Eastern Group just after acquiring medium coal production facilities if the cut-off were after the transfer), which would be difficult to analyze.

Hence, it is assumed here that the structural breaks are exogenously given by the dates when the reforms were introduced. The structural changes introduced through the divestment series differ because the first series of divestments included the lease² and the second series of divestments included the sale of production facilities (National Grid Company, 1994–2001). Therefore, the effect of the two divestment series generally need not be the same.

In March 2001, the wholesale electricity market was replaced by the New Electricity Trading Arrangements (NETA) in order to introduce bilateral trading arrangements.

3. Related literature

Seminal research in modeling electricity auctions is presented in Von der Fehr and Harbord (1993). The authors assume that N electricity producers serve the British electricity market operated as a uniform price auction. They also assume that marginal costs are common knowledge and differ only across electricity producers. The last assumption implies that all production units of a certain electricity producer have the same marginal costs, which can be partly supported by the fact that during the early 1990s approximately 70% of production capacity was based on coal (Department of Trade and Industry, 1997–2002). However, this assumption has a limitation because thermal efficiency rates of different coal production units belonging to a certain electricity producer generally need not be the same.

The authors show that no pure-strategy bidding equilibrium exists when electricity demand falls within a certain range. Their result is explained by an electricity producer's conflicting incentives to bid high in order to set a high price and to bid low in order to ensure that its production unit is scheduled to produce electricity.

Wolfram (1998) empirically examines the bidding behavior of electricity producers in the same electricity market. As a benchmark model, she analyzes a duopoly case, where the first producer has several production units and the second producer has one production unit. The intuition and conclusions of the duopoly case are then used in the construction of a regression model.

Her main finding is that electricity producers submit price

¹ However, the regulatory authority rarely made comparisons between price bids and marginal costs (Green, 2011), which is the purpose of this research.

² Eastern Group was charged an earn-out payment per MWh output, which affects the calculation of marginal costs. Details of the earn-out payment are described in Evans and Green (2005).

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