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A multiple-unit, multiple-period auction in the British electricity spot market

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Abstract

This paper examines the electricity pool in England and Wales. The approach followed in this paper builds on the auction approach of Von der Fehr and Harbord (Von der Fehr, N.H.M., Harbord, D., 1993. Spot market competition in the UK electricity industry. *Econ. J.* 103, 531–546), but adds realism by allowing explicitly for multiple-unit firms and multiple periods. In a formal setting, a bidding range will be derived, by characterizing the polar cases. The more interesting lower bidding rule will be characterized in detail, providing insights in the performance of the British electricity pool. Four aspects are examined more closely: (1) the mark-up; (2) the number of firms; (3) the auction frequency (bidding flexibility); and (4) load-profile competition. © 2001 Elsevier Science B.V. All rights reserved.

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1. Introduction

In 1990, the electricity supply industry in the United Kingdom has been re-

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formed thoroughly, setting an example for various other countries.² One of the major elements was the introduction of a (centralized) electricity pool with the purpose to coordinate the (competitive) generation of electricity. It has been expressed that the generation firms ‘play a game’ in determining who will be producing how much and against which price. The idea is that the generation firms offer willingness-to-produce against an offered price. A central institution — the electricity pool — schedules which firms with which generation units will actually produce how much and against which price. The procedure to determine generation-quantities and -prices is accurately specified in the so-called pool rules.

The ‘game’ which is played by the generation firms has attracted academic attention. Two approaches have been developed to model the pool and thereby the behavior of the generation firms. First, and the most influential, stems from Bolle (1992) and Green and Newbery (1992), with a recent and powerful extension by Newbery (1998). They have modeled the pool by means of so-called supply-function equilibria. The advantage of this approach is that it is tractable to a large extent; the functions are continuous and differentiable, which allows mathematical manipulation. As the framework stands it turns out that it is fairly easy to extend analysis of the pool without using high-powered mathematics. The other side of the same coin, however, is exactly the assumed continuity; it is an abstraction. In reality, the generation units are not atomistically small. The marginal costs of a firm are, due to multiple generation units, rather discontinuous or stepwise.³ Another problem is that in the supply-function approach demand is taken to be elastic, which does not entirely conform to the pool rules.

These criticisms triggered an alternative approach to model the pool: the auction approach by Von der Fehr and Harbord (1993). They note with regard to the supply-functions approach (Von der Fehr and Harbord, 1993, p. 532): ‘[a]s we demonstrate [...], the particular types of [supply functions] equilibria [...] do not generalize to a model where sets are of positive size’. Its main element is stepwise increasing bids, which is inherently discontinuous. Whereas this might be realistic, it contains the major difficulty as well. It hardly allows mathematical manipulation. Nevertheless, Von der Fehr and Harbord come up with some insightful conclusions, which invite further research in this direction. The auction approach offered by Von der Fehr and Harbord seems to have been somewhat short of attention in comparison to the supply-function approach. However, the auction approach does offer further potential to extract insights in the pool behavior.

It is the purpose of this paper to extend the auction approach of Von der Fehr and Harbord and extract further insights in the performance of the British

²See for more extensive descriptions, e.g. Bartels et al. (1991), Beharrell (1991), Green (1991) and Brunekreeft (1997). See Pollitt (1997) for a recent survey of liberalization of electricity markets in various countries.

³Newbery (1998, p. 4) points out that this difficulty might be overcome by assuming that the firms use mixed strategies, which would make the functions continuous.

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