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Competition with supply and demand functions

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Abstract

If economic agents have to determine in advance their supply or demand in reaction to different market prices we may assume that their strategic instruments are supply or demand functions. The best examples for such markets are the spot markets for electricity in England and Wales, in Chile, in New Zealand, in Scandinavia and perhaps elsewhere. A further example is computerized trading in stock markets, financial markets, or commodity exchanges. The functional form of equilibria is explicitly determined in this paper. Under a certain condition, equilibria exist for every finite spread of (stochastic) autonomous demand, i.e. demand from small, non-strategically acting consumers. Contrary to competition with supply functions alone, however, there is no tendency for market prices to converge to 0 if the spread of autonomous demand increases infinitely. Lower bounds of market prices can be computed instead.

JEL classifications: C73; D43

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1. Introduction

On 1 April 1990, a spot market for electricity was established in England and Wales. This is probably the best example for competition with supply functions. The three big suppliers, National Power, PowerGen, and (former) Nuclear Electric[1], as well as some small ones are required to submit bids for each of their generators[2]. The ranked bids of every supplier form a staircase supply function and can be

[1] Now British Energy.

[2] In the New Zealand spot market for electricity, a different price can be required for every megawatt.

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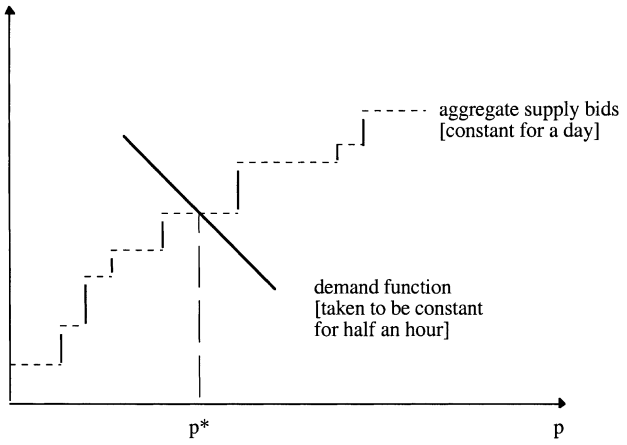

Fig. 1. The determination of the half-hourly spot market price in England and Wales.

integrated into an aggregate supply function. Every half-hour a price is determined so that supply meets demand which in turn may depend on the spot price (see Fig. 1) and which has a stochastic component. For further details of the British electricity system and its performance, see Green (1994) and Littlechild (1994). The theoretical implications of competition with differentiable supply functions were independently derived by Klemperer and Meyer (1989) — who had other examples in mind[3] — and Bolle (1992) who was explicitly concerned with electricity markets. Further studies stem from Green and Newbery (1992) and Newbery (1991). The alternative to smoothing the staircase supply function is to regard the market as a multiple-bid auction (Bolle, 1997).[4]

Although the British electricity market had a predecessor in Chile, it was the British example which made the Scandinavian countries, New Zealand, California and Spain introduce a similar market and makes other southern and eastern European countries prepare one. In the United States as well as in Germany, electricity markets still depend on Third Party Access or similar rules; but in both countries spot markets may be introduced later on. In Norway, New Zealand, California, and from autumn 2000 on also in England and Wales (Power in Europe, 1999) the bids are extended to include demand-side bids. So, in addition to the aggregate supply function there is an aggregate demand function resulting from those bids. The spot market price is determined by the cutting point of the gross excess supply (supply-bids minus demand-bids) and autonomous demand by small

[3]Their point of departure for competition with supply functions was Bertrand competition with non-constant marginal costs.

[4]The 'natural' assumption for competition with supply (and demand) functions is incomplete information about total demand (and/or supply); in the case of multiple-bid auctions it is incomplete information about the competitor S' values (costs).