Vítor Marques, Isabel Soares and Adelino Fortunato

BEHAVIOUR PATTERNS AND THE ELECTRICITY MARKET DESIGN: EVIDENCE FROM THE SPANISH DAILY MARKET

E-mail: vmarques@erse.pt, isoares@fep.up.pt, adelino@fe.uc.pt

Overview

Out of four main companies in the fast-growing Spanish electricity market, Endesa and Iberdrola control 80% of the generation and distribution assets. the wholesale market has been the stage for frequent price wars, most of which unreated to cost shifts thus being explained by strategic considerations. Recently, the projected Gas Natural/Endesa merger has called the attention to the complicate, biased performance of the spanish market and how important may be the analysis of certain market events/periods in order to find eventual behaviour patterns. Taking the events of Summer 2004 when Iberdrola claimed that Endesa was leading anti-competitive practices in the daily market, benefiting from market design, the authors' aim was to analyse if any particular behaviour pattern carried by Iberdrola and Endesa could be found . This pattern should highlight the effects of the wholesale market design on agents' behaviour.

The Spanish wholesale market was created in 1998. It was divided into a daily market and an intra-daily market. Those markets are uniform-priced since the energy sold there by generators should be paid at the system marginal price. However, its bid would only be accepted if the price submitted by the generator is equal or lesser than the system marginal price. The daily market is the main market: more than 90% of the electricity is traded in the daily market. After the creation of the wholesale market, Spanish generators lost the warranty they had on the payment of their investments, which was allowed by former legal frame. In order to recover those stranded costs, it was established a transitory regime, Costes de Transición a la Competencia, CTC, that allows the companies, which own power stations, to receive a compensation on the loss of revenues. Endesa benefits more from CTC than any other company.

Then, the Spanish electricity market is an oligopoly rather concentrated, almost a duopoly, with some exogenous mechanisms[1], such as the CTC, which can modify the expected competitive behaviours.

The fact that the Spanish electricity market is nearly a duopoly may induce to market power practising. Under a short term point of view, the market power can be measured by the Lerner index: This analysis is $L = \frac{(P - cmg)}{P}$ conducted through static economical models.

However, strategies that restrict the competition can be developed in the medium or long term. The economic dynamic models allow to analyse such situations.

It's known that in the case of a game having an indeterminate number of moves, i.e, in the case of a super game, this game will turn into a tacit collusion. Hence, the quasi-duopoly that exists in Spain may propitiate stable collusions. However, some social and political factors which characterize the Spanish market, besides other features such as the CTC, may change expectable behaviours.

The impact of CTC in the profit function is obvious. When the power station, i, is previous to 1997, the profit function π_i corresponds to: $F(\pi_i) = P_{fe}Q_i - C_{i(Q_i)}Q_i + CTC_{ai}$ (1)

Where CTC_{ai} is the compensation due to CTC, each year, $C_{i(Qi)}$ is the average unit costs and Q_i the quantity sold. $CTC_{ai} \cong (CTC_{i36} + 36 - P_{fe})Q_i$ (2)

---

[1] There's other subsidies

Where CTC_{i36} is the unitary compensation for electricity sold by the power station, i, at a market price of 36 €/MWh.

This way, $F(\pi_i) = P_{fe} Q_i - C_{i(Qi)} Q_i + (CTC_{i36} + 36 - P_{fe})Q_i$ (3); and $F(\pi_i) = (CTC_{i36} + 36 - C_{i(Qi)})Q_i$ (4)

Thus, the profit function of power stations previous to 1997 doesn't vary directly with the market price.

The same doesn't happen to any power station, i, posterior to 1997, whose profit level depends on the sale prices, besides depending on the quantities sold and on its ability to decrease its costs: $F(\pi_i) = \left(P_{fe} - C_{i(Q_j)}\right)Q_i$ (4)

It matters to set off that Iberdrola has got more units in this situation than Endesa.

Methods

In the context of the present work, the application of dynamic models to determine anticompetitive behaviour is rather complex, as production costs are not accurately known by outside players, due to the traditional lack of information about Spanish producer costs and other factors, such as the subsidies for Spanish coal consumption. Therefore, it is difficult to determine the level of the activity profits. This work prefers to point out possible market power, indirectly, through analysing the two main generators behaviour, Endesa and Iberdrola, by the light of expected behaviour in a uniform-price market. As quantities supplied by the power stations depend on the price bid, price and quantities strategies are mixed and some conclusions about behavioural pattern can be inferred through the analysis of the quantities supplied[2].

In this context, Endesa´s and Iberdrola´s behaviour is indirectly analysed, during Spring and Summer time, between 2001 and 2004, by studying the correlation between the system marginal price and the amount of energy supplied every hour by company and by technology, (every Wednesday from May to September the "dry season") as well as by considering other external factors, such as the price of the fuels and the hydrological factors, which can influence the system marginal price. The data was grouped into three time-of-day periods:

- Peak hours.
- Half-peak hours.
- Off-peak hours.

Thus, 672 observations were obtained for each period. Besides gathering the data by time-of-day periods Time factor effects were highlighted through the introduction of dummies variables for each year.

First of all, the endogeneity between amounts supplied by technologies and the system marginal price is tested[3]. Some endogeneity should exist between system marginal price and the quantity supplied by the power station with the highest price bid, i e, quantities supplied by the peak load units could be partially determined by the dependent variable, the sys marginal price. However, endogeneity between system marginal price and quantity supplied by base load units may not occur. The confirmation of these assumptions ensures that agents behave as it would be expected in a uniform-price market.

The endogeneity bias was eliminated through the method of instrumental variables. It was used the quantities supplied by unit with 1, 24 and 25 hours lag, as instrumental variables of the hourly quantities supplied by unit, which are endogeneous variables.

The empirical work has been done, through the following steps:

---

[2] Price bids are also unknown.
[3] Data's characteristics compel to assume a linear function and prevent to assume a log function. This could also raise some functional form misspecification

1. For each time-of-day period, it was used a linear regression model through the ordinary least square method. Functional form, heteroscedasticity and residual autocorrelation were tested.
2. The endogeneity of the amounts supplied by technologies has been tested through the Wu-Hausman statistic.
3. Endogeneity problem is removed through the method of instrumental variables.
4. Whenever there's residual autocorrelation, Newey-West adjusted covariance matrix was calculated, in order to remove the less statistically significant variables from the model.
5. The first and the fourth steps have been repeated, in order to select the final model.

This analysis has to be completed, comparing the results obtained in each period.

The results and conclusions

For half-peak hours[4] periods the main results are:

- Endesa, in the analysed period, determined the clearing price through its fuel-oil units.
- Iberdrola's hydro units supplies are negatively correlated to the clearing price.
- The final model includes the overall amount hourly matched, which is positively correlated to the clearing prices.
- Monthly coal prices, 3 months lagged, are positively correlated to the clearing prices.
- System marginal prices have presented a different evolution in the years of 2002 and of 2004.
- The majority of units supplies are endogeneous variables (even for base load units supplies).

This "indirect" approach may be a major contribute to analyse agents' behaviour in situations such as this, where there's a great lack of information.

Reference

[1]   J Baldick R. and Baughman M. (2003), *An oligopoly simulation of a restructured ERCOT: Will futures prices be competitive?,* The Electricity Journal, p59-71, April 2003

[2]   Cabral, L.M.B. (1995*), Conjectural variations as a reduced form*, Economics Letters, 49(4), 1995, pp397-402

[3]   Ciarreta A, Espinosa, M (2003), "Market Power in the Spanish Wholesale Electricity Market" presented at International Industrial Organization Conference Boston, Massachusetts April 4-5, 2003

[4]   Fabra, N and Toro, J. (2004), *Price wars and collusion in the Spanish electricty market*, (avalaible online)

[5]   Green, R. and Newberry, D.(1992), *Competition in the British Electricity spot market*, Journal of political economy, vol100 (5), 1992 pp 929-953

[6]   Jara-Díaz, S, Martínez-Budría E and Ramos-Real, F (2002), *Structure, functioning and regulation of the Spanish electricity,* (avalaible online)

[7]   Kemplerer p.d. and Meyer, M.A (1989), *Supply function equilibria in oligopoly under Uncertainty*, Econometrica, 57(6) Nov. 1989 pp 1243-127

[8]   Omel, *Informe anual 2003*

[9]   Red Electrica de Espanã, *El sistema eléctrico español informe 2004*

[10] Sweeting, A. (2004), *Market power in the England and Wales wholesale electricity market 1995-2000,* (avalaible online)

[11] UNESA, Avance Estádistico 2003

---

[4] For the present, only half-peak hours analysis has been done, the remainings period are actually being analysed.