

FORWARD MARKETS AND THEIR INTERACTIONS WITH SPOT MARKETS – AN EMPIRICAL ANALYSIS OF THE LIBERALISED EUROPEAN ELECTRICITY MARKET

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Overview

Since the liberalisation of the European electricity sector, forward and futures contracts have gained significant interest of market participants due to risk management reasons. For pricing of these contracts an important fact concerns the non-storability of electricity. The classical cost of carry approach therefore cannot be used to determine a relationship between spot and futures prices. Instead, a second theory on futures pricing relates forward prices to expected spot prices which are built on fundamental market expectations.

Hence, the major objective of this article is to determine the crucial impact parameters of forward electricity prices and to analyse the relationship between futures and spot prices.

Methods

Both econometric as well as fundamental marginal cost models are used to conduct quantitative and qualitative analyses of futures prices at two of the biggest European electricity exchanges: The European Energy Exchange (EEX) and the Nord Pool Power Exchange.

Results

Futures prices for primary energy and CO₂ emission allowances crucially determine electricity futures whereby gas prices exercise a more dominant influence on the electricity price compared to coal prices. The comparison of marginal costs proves the higher influence of the CCGT technology on the electricity price. Still, by comparing the electricity futures prices with current spot market prices one can also identify an adaptive price formation component.

Along with the liberalisation of the electricity supply industry and the introduction of competition, electricity became a tradable commodity. Especially since electricity cannot be stored economically the cost of carry approach, normally used in the area of finance and traditional commodity markets, cannot be used to determine a no-arbitrage condition between spot and futures prices.

Instead, economic theory relates forward prices to expected spot prices. The latter are built on fundamental expectations of market participants and are translated to forward prices by applying forward or risk premia which are a compensation for price risks. Finally, contracts are discounted to account for opportunity costs.

Ex-post determined forecast errors, which are the difference between forward prices in the trading period and spot prices in the delivery period, reveal considerable misjudgement of future conditions by market participants. The reason behind this is a deviation between actual generation conditions and fundamental generation conditions due to shocks between futures and spot trades like unexpected cold or warm weather, high or low CO₂ prices, etc. in the delivery period.

Assuming perfect foresight, the identified significant differences in spot and forward prices would indicate the existence of pronounced risk premiums in the forward markets. Clearly, perfect foresight of market participants is a very strong assumption. However, the considered sample of futures contracts may indicate that dominating motives of certain market participants contribute at least partly to a certain sign and, hence, bias of the forecast error.

Conclusions

Econometric analyses show high influences of generation costs of CCGT plants and moving 12 month spot market price averages on year-ahead electricity futures which, on the one hand, indicates both adaptive expectation behaviour, but also shows a stronger influence of the CCGT technology on the electricity futures price compared to hard coal power plants.

Due to lacking storage possibilities, no exact relationship between current spot and forward prices can be formulated. Instead, when assessing the pricing of futures and forward contracts the starting point is the expected spot price in the delivery period. Hence, forward prices are built on fundamental expectations of market participants, updated by applying risk or forward premiums and, finally, discounted to account for opportunity costs.

Ex-post determined differences between forward prices in the trading period and spot prices in the delivery period reveal considerable misjudgement of future conditions by market participants due to a deviation between actual generation conditions and fundamental generation conditions. Biased forecasts result from shocks between futures and spot trades (e.g. unexpected cold or warm weather, high or low CO₂ prices, high or low hydro availability, etc.). Nevertheless, significant positive signs of the forecast errors for baseload and peak load contracts may also arise from dominating motives of certain market participants.

References

- Botterud, A., Bhattacharyya, A., Ilic, M. (2002), "Futures and spot prices – an analysis of the Scandinavian electricity market".
- Bunn, D.W. (2006), "Risk and electricity price dynamics", Platts.com News Feature.
- Bunn, D.W. and Karakatsani, N. (2003), "Forecasting Electricity Prices," London Business School, London.
- Douglas, S., and Popova, J. (2006), "Storage and the Electricity Forward Premium" 26th USAEE/IAEE North American Conference, Ann Arbor, Michigan, September 24-27, 2006, Proceedings.
- EC (1997), "Directive 96/92/EC of the European Parliament and of the Council concerning common rules for the internal market in electricity", L027, Brussels.
- Gjolberg, O., and Johnsen, T. (2001), "Electricity Futures: Inventories and Price Relationships at Nord Pool" Discussion Paper #D-16/2001.
- Hadsell, L., and Shawky, H.A. (2006), "Electricity Price Volatility and the Marginal Cost of Congestion: An Empirical Study of Peak Hours on the NYISO Market, 2001-2004" *The Energy Journal*, 27-2, 157-179.
- Longstaff, F.A., and Wang, A. (2002), "Electricity Forward Prices: A High-Frequency Empirical Analysis" Working paper, University of California Los Angeles.
- Maisonnier, G. (2006), "The Ties between Natural Gas and Oil Prices" *IAEE Newsletter*, 15, Third Quarter, 26-29.
- Nordel (2007), "Annual statistics 2006", Helsinki.
- Skantze, P., and Ilic, M. (2000), "The Joint Dynamics of Electricity Spot and Forward Markets: Implications on Formulating Dynamic Hedging Strategies" Energy Laboratory, Massachusetts Institute of Technology, MIT EL 00-005, Cambridge.
- UCTE (2007), Online data available at http://www.ucte.org/statistics/onlinedata/definition/e_default.asp.