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AN ECONOMIC MODEL OF LONG-TERM ELECTRICITY PRICES IN THE LIBERALISED EUROPEAN ELECTRICITY MARKET

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Overview

Several market platforms for short- and long-term trading of electricity have emerged throughout the EU since liberalisation of the European electricity sector has started. Long-term contracts, traded on these wholesale markets, represent the starting point for pricing of client contracts. Hence the determination of the relevant influence factors on the price formation on long-term electricity markets is of great interest.
The major objective of this article is to determine the crucial influence parameters of long-term electricity prices.

Methods

An econometric model as well as a fundamental marginal cost model is used to conduct an empirical-quantitative and a qualitative analysis of the price formation on long-term electricity markets. The examination focuses on year-ahead baseload futures traded at the European Energy Exchange (EEX). The EEX is the leading energy exchange in Central Europe.

Results

The most important influence parameters are futures prices for primary energy (Coal and gas futures) and CO_2 allowances. By comparing futures prices with spot market prices one can also identify an adaptive component since a rising historical 12 months spot market average drives up the futures price as well.
Both spot and long-term electricity prices have been rising continuously over the last years. The highest increases could be observed during 2005. The main cause, besides rising prices for natural gas, can be found in the European emissions trading scheme which commenced operation in January 2005.
Figure 1 depicts the year-ahead futures prices for hard coal (ARA ports), natural gas (Zeebrugge hub), CO_2 allowances and the baseload year-ahead futures traded on the EEX. Figure 1 shows a positive relation between CO_2, natural gas and electricity futures as well as no correlation between stable coal prices and rising electricity futures quotations. Therefore the influence of the gas price on the electricity price prevails also in baseload.
In competitive markets marginal generation costs crucially determine electricity prices; hence a fundamental marginal cost model is introduced here. Simplified, (short run) year-ahead electricity generation costs can be calculated by formula (1) using the input data depicted in Figure 1:

$$SRMC = \frac{p_{PRIM}}{\eta} + \frac{p_{CO_2} \cdot f_{CO_2}}{\eta} \quad (1)$$

Year-ahead electricity futures show a higher correlation with generation costs of gas-fired (CCGT) plants compared to coal-fired power stations. The comparison of year-ahead

marginal costs therefore proves the higher influence of the CCGT technology on the electricity price.
An econometric analysis is performed to assess the quantitative influences of the relevant parameters by testing several regression models:

$$LnYearAhead_{Base(t,T)} = b_1 + \sum_{i=1}^{n} b_i LnX_{i(t,T)} \quad (2)$$

Regressing the electricity futures with marginal costs of coal plants yields unsatisfactory results. Marginal year-ahead generation costs of CCGT plants as well as the historical yearly spot market averages provide an excellent explanation of the year-ahead electricity price whereas the spot market exerts a more dominant influence on the futures market compared to the CCGT generation costs. This result indicates a pronounced adaptive expectation formation on the futures market.

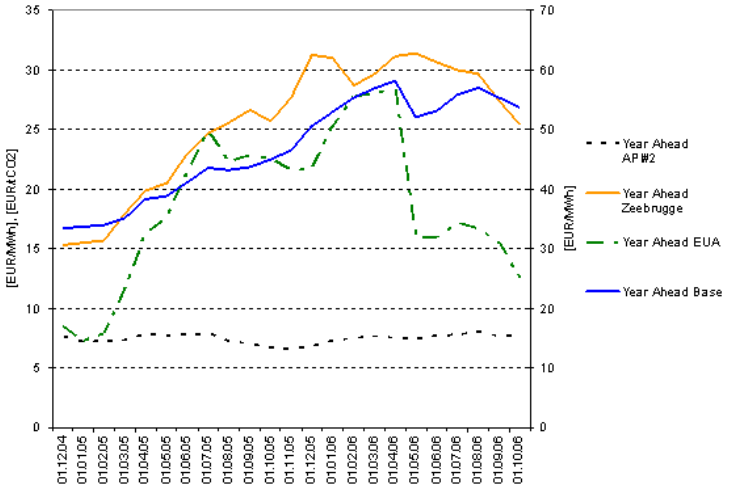

Fig. 1: Coal, gas, and CO_2 year-ahead futures (left scale) vs. EEX year-ahead baseload futures (right scale)

Within this analysis it is tested whether the futures price represents a good predictor of the future spot price. As 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:

$$F_{t,T} = S_t e^{(r+s)(T-t)} \quad (3)$$

Hence the risk premium is used to compare spot and futures prices of different contracts traded on the EEX (Hadsell and Shawky 2006):

$$Risk\_premium = \frac{1}{T-1}\sum_{t=1}^{T-1}\frac{F_{t,T} - S_T}{S_T} \quad (4)$$

The majority of investigated risk premiums show a negative sign. This result can be interpreted with the convenience yield concept (Stoft et al 1998). Contracts with longer delivery periods are characterised by a higher absolute value of the risk premium, as market participants can only anticipate future conditions with higher uncertainty.

Conclusions

The price formation on the long-term market of the EEX contains economically irrational components. This regards both the adaptive component (Influence of the historic spot market) and the nearly perfect correlation between futures prices and generation costs of CCGT plants calculated by using border prices for natural gas. Still, these border prices do not contain year-ahead deliveries.

References

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