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## **DETERMINANTS OF FORWARD PREMIA IN ELECTRICITY MARKETS: A TAXONOMIC EMPIRICAL ANALYSIS**

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### **Overview**

The (current) forward price of a commodity can be split up into a forecast of the future spot price at delivery and a risk premium. This article introduces a taxonomy of electricity forward premia determinants as the understanding of the drivers of the forward premium allows a better regulation of electricity markets and design of corresponding market rules. Specifically, our aim is to extend established concepts of forward premia in electricity markets. We have organised these components into a taxonomy of fundamental influences, behavioural effects, market conduct, dynamic effects and shock effects.

### **Methods**

The components of the ex post forward premium are unravelled with the help of an empirical modelling approach. The biggest regional European power market is assessed: the Western European power market with its leading power exchange, the European Energy Exchange (EEX).

### **Results**

*Baseload forward premia* are positively influenced by the volatility in the oil market. This confirms the “sentimental” importance of the oil market for energy commodities in general. Its influence is as important as the influence of the volatility on the electricity market itself. The volatility of electricity spot prices positively influences the futures price and, hence, the forward premium. Furthermore, realised premia in the gas market influence the electricity premia, which shows the importance of gas fired power plants also in baseload. If market participants perceive a decreasing margin in the spot market the forward premium increases since forward prices increase. The significant positive influence of the basis (current forward-spot difference) shows that upward trends in the, to a certain extent, tied spot and forward price series yield an increasing forward premium. Finally, the significant positive margin shock coefficient can assess mis-judgements of future supply/demand conditions and captures the premium’s forecast error part.

The *electricity peak load premium* is positively influenced by realised premia in the gas market. The significant positive influence confirms the importance of these generation technologies. The skewness of spot prices positively influences peak forward premia. Positively skewed spot prices increase the hedging demand of retailers given fixed retail prices. On the other hand, they represent opportunity costs of generators having sold forward. Both factors contribute to a positive forward premium (Bessembinder and Lemmon, 2002). However, we observe a negative influence of price spikes occurring in the spot market which appears counterintuitive. Yet, skewness, which computes cubic difference terms, can put too much weight on extremes (i.e. spikes) which gets trimmed by a negative influence of the spike dummy variable. Still, if market

participants perceive a decreasing margin in the spot market the forward premium increases. A decreasing margin is related to the increased likelihood of spikes occurring in the spot market and, due to the convex supply curve, an increased skewness of spot prices. Interestingly, the forward premium is positively influenced by the market power estimate. In fact, spot price mark ups yield increases in the forward premium. This can be caused by a higher willingness to pay of the buyers, which price generator market power as a risk factor, a compensation demanded by dominant producers to be willing to sell forward (Anderson and Hu, 2008), and hence loose incentives to exercise their market power in the spot market due to the contracted generation, or a combination of both. This result suggests, that the (positive) competitive effect of forward markets is, in fact, limited. Upward trends in the, to a certain extent, tied spot and forward price series yield an increasing basis. This, in turn, results in an increasing forward premium which is reflected in a significant regression coefficient. Finally, the scarcity shock coefficient shows the expected sign and is statistically significant. This variable captures, similar to the baseload case, the forecast error part of the forward premium.

## **Conclusions**

The risk attitude of participants in the electricity market is strongly influenced by the agents' assessment of commodities, which serve as fuel input (gas) or are of sentimental importance for energy commodities in general (oil market). Market participants react sensitively on volatility in the electricity market itself and on extreme events occurring in the spot market during the trading period of forward contracts. This is mirrored in a significant influence of the skewness of spot prices, price spikes and the margin of the system. Furthermore, significant margin shock measures contribute to explain the forecast error part of the ex post forward premium. This is in line with our assumption on the adaptiveness of the market participants. Interestingly, parameters indicating price mark ups and, correspondingly, the exercise of market power contribute to increased forward premia which questions the competitive effect of long term markets. More specifically, the dampening effect on the spot price caused by earlier contracted quantities may be partially offset. This has important policy implications since forward markets have, so far, been considered by regulatory authorities to be socially beneficial for concentrated electricity markets (Bushnell, 2007). Policy makers and regulators seek to increase consumer welfare. In the context of electricity markets this is associated with measures aiming to reduce the forward premium. From a fundamental perspective, the system margin plays a crucial role in this context. First, a decreasing margin increases the spot price (which is amplified in the case of concentrated markets and market power) and, moreover, as shown in our analysis, also the forward premium. Hence, consumers take a double hit if the margin reduces. The causes of the forward premium appear therefore to be more important for regulators than the causes of spot prices.

## **References**

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