Integration and Shock Transmissions Across European Electricity Forward Markets

Studio dell’integrazione dei mercati elettrici europei

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1. Introduction

Electricity is a comparatively new commodity, but it represents an increasingly important sector of trading, and a challenging area of research. Although a substantial amount of research has already appeared to model the economic and dynamic properties of spot prices, eg Weron (2006), a full characterisation of the multicommodity, temporal and spatial aspects of forward electricity prices still presents many open questions. This paper seeks to advance our understanding of the efficiency of European electricity spot and forward prices looking at their predictability and at their spatial properties, where several regional markets may be linked by capacity constrained interconnections. We pursue this through an analysis of forward and spot prices at the French, German, Dutch, British and Spanish markets within the European grid looking at spatial efficiency, cross-market interactions with respect to market integration and shock transmissions, for both price levels and volatility considering only a financial dimension without considering physical configuration of the grid and related problems of connection saturations.

2. Efficiency and market integration

Among the aspects of market efficiency, authors have considered the law of one price (that is observing the same price between different locations/markets), some others consider the predictability of forward prices (see Fama and French (1987)) and finally others again the existence of zero risk premia (Hadsell and Shawky (2007)). As first aspect of market efficiency, we consider the possibility that forward prices contain some information on realized spot prices. Thus, if markets are efficient we expect that forward prices are unbiased predictors of future spot prices or that the differences between current spot and forward prices, known as the basis, will help us in forecasting probable changes between current spot prices and those observed at the delivery $T$. Thus, the following analysis has been performed

$$S(T) - S(t) = \alpha + \beta (F(t,T) - S(t)) + \varepsilon_T$$

where $S(T)$ is the future spot price at delivery date, $S(t)$ is the spot price at time $t$, $F(t,T)$ is the forward price observed at time $t$ for delivery at time $T$, $\varepsilon_T$ is the error and $\alpha$ and $\beta$ are real coefficients with optimal conditions of $\alpha = 0$ and $\beta = 1$. We first conclude that generally the forward prices with longer maturity are better predictors than those with shorter maturity given that alpha tends to become insignificant and beta tends to one as time increases and secondly that there is an efficiency problem in all these
markets since generally the optimal conditions are never satisfied simultaneously and we observe a perfect forecastability only in one market and just for one type of price. See for example Table 1. As a second aspect of efficiency, we have considered the analysis of spatial integration. In this case efficiency would be manifest in the ease with which shocks in one location get transferred to its neighbouring locations. Therefore we first looked at the 10 pairs of spot prices, for base and peak periods, using Granger causality tests and cointegration analysis, given that spot prices are stationary and forward prices are found to be nonstationary. We find, in contradiction to our expectations, that the European Forward markets are in general less integrated than the spot ones. Results are summarized in Figure 1, where arrows mean relationships. More revealing perhaps than the longer term cointegration tests are the short-term transmissions of shocks in price levels and volatility. Hence we have investigated the dynamics of shocks for prices and squared logarithmic returns (as proxy of volatility), using impulse response functions in Vector Autoregressive (VAR) for spot prices and Vector Error Correction (VEC) models for the forward prices and these confirm our previous results.

3. Conclusions

New results have been presented relating to the integration of the French, German, British, Dutch and Spanish power markets at day ahead, week–ahead, month–ahead and two month–ahead lead times. In general, there is evidence of market integration, increasing over time, despite an underlying inefficiency in each market with respect to the forward and spot price convergence.

Table 1: Forecast Power of German Forward Prices

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<thead>
<tr>
<th></th>
<th>Base Period</th>
<th>Peak Period</th>
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<tbody>
<tr>
<td></td>
<td>α</td>
<td>β</td>
</tr>
<tr>
<td>Germany</td>
<td>-1.1 (0.006)</td>
<td>0.9 (0.000)</td>
</tr>
<tr>
<td>wa</td>
<td>-0.5 (0.178)</td>
<td>0.9 (0.000)</td>
</tr>
<tr>
<td>1ma</td>
<td>0.1 (0.908)</td>
<td>1.0 (0.000)</td>
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<tr>
<td>2ma</td>
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Figure 1: Spot and Forward Market Integrations

References

