FORWARD PRICE APPROXIMATION FOR COUPLED EUROPEAN ELECTRICITY MARKETS

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ABSTRACT. European electricity markets have recently experienced various fundamental changes with significant impacts on price dynamics. These include the introduction of emissions markets, the growth of renewables and the ongoing cross border integration through market coupling, a mechanism by which system operators optimally allocate country-to-country power flows during the day-ahead auction. This last structural change has had perhaps the most striking effect, for example with spot prices in France and Belgium identical in over 90% of hours since market coupling began in November 2006. However, the degree of price convergence between neighboring countries is strongly dependent on the amount of installed border capacity relative to market size. Since coupling was introduced between Germany and France in November 2010, only about 65% of hourly prices are identical, and large price differentials can still occur. Such an important structural change provides a significant obstacle for traditional reduced-form models, as price histories become unreliable for parameter estimation. Furthermore, typical models of correlated price processes are inadequate. An alternative is to replicate and solve the complex optimization problem through which coupling is implemented in practice, but this approach is highly unsuited to typical financial applications such as derivative pricing and calibration to market forward curves. Instead, we propose here a closed-form approximation for forward prices (or expected spot prices) in a system of n coupled power markets, using a simple structural model of spot price dynamics driven by exogenous correlated demand processes for each country. We analyze the performance of the approximation technique by comparing with simulation results, varying the number of markets coupled and the relative sizes of border capacity. We also compare with historical data from the European power markets (both before and after coupling) and illustrate the models success in capturing the key changes witnessed in spot and forward price dynamics.

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