Executive summary

Electricity futures prices in an emissions constrained economy: Evidence from European power markets

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In this paper we study the relationship between spot and futures electricity prices in the European emissions constrained economy. Our objective is to gain key insights for pricing relevant derivative instruments under the risk premium approach. Such insights are of relevance and importance not only for electricity producers and consumers but also for a wide range of other market stakeholders, including, energy traders, speculators and funds.

To this end, we examine whether risk premia in the case of Nordic, French and British electricity futures respond to four economic measures of risk. These are the volatility of electricity spot prices, electricity demand and electricity revenues, and the price volatility of the carbon futures traded under the EU Emissions Trading Scheme (EU ETS). Spot price risk, demand risk and revenue risk are commonly investigated as drivers for risk premia in the

non-storable commodity literature. Moreover, these have been identified as significant drivers for the day-ahead electricity risk premia in both a theoretical and empirical setting. Here, we examine for the first time whether this is also the case for the risk premia observed in electricity futures prices. We include the latter in our analysis on the basis of the carbon risk that electricity producers face in the European emissions constrained economy. To be more specific, we argue that the EU ETS entails significant uncertainties that can affect the supply, demand and consequently price for carbon permits. Thus, in a rational expectations framework, and assuming risk-averse economic agents, one would expect for these uncertainties to be priced in the electricity futures market. Hence, our underlying hypothesis that we put to test here is that carbon risk represents one of the main economic risk factors driving electricity risk premia in Europe.

Our results indicate that electricity risk premia for the futures contracts under scrutiny are significantly related to the four risk factors considered. This finding is robust under different specifications for the test regressions and also when the estimations are performed across markets. Moreover, by analysing in detail the hedging behaviour of electricity producers and consumers we are able to provide an intuitive understanding for the direction of the established relationships. In this manner, we empirically identify the main economic drivers of futures electricity risk premia, explain on a theoretical setting the way in which these factors impact electricity risk premia, and consequently enhance our understanding of the relationship between spot and futures electricity prices in Europe.

Our analysis provides two further insights. First, since electricity risk premia respond to economic risk measures, we can infer that the prices of the electricity futures under study are the result of a rational price generating process. Second, carbon market uncertainties are a main driver of electricity risk premia in Europe, even after controlling for the potential effect

of the price volatility of the primary fuels used for power generation (coal, natural gas and oil). For example, ranking the four risk factors based on the number of statistically significant coefficients obtained reveals that carbon risk is the most important driver of electricity risk premia, followed by electricity spot price risk, electricity revenue risk and electricity demand risk, respectively. Moreover, the inclusion of the carbon risk factor in the test equation increases considerably the explanatory ability of our model. Most important, we observe a consistent inverse association between electricity risk premia and the carbon risk factor. This implies that power producers provide consumers with a carbon related premium (in the form of a discount in electricity futures prices) for motivating them to buy electricity through the futures market. In turn, this finding highlights a previously unidentified role of electricity futures markets in Europe: they provide a platform for power producers to manage their carbon risk.

Finally, our findings have a clear policy implication. The inverse association observed between electricity risk premia and the carbon risk factor suggests that power producers provide electricity consumers with a discount that is proportional to carbon price volatility as compensation for eliminating their carbon risk. Consequently, increased volatility in the carbon market results in increased hedging costs for power producers. European environmental policy makers should therefore take actions to reduce EU ETS market uncertainties as these have significant but unnecessary cost implications for electricity producers. A way to achieve this is to provide transparent information regarding the emissions reductions achieved to date on a regular (e.g., yearly) basis along with preliminary estimates on the level of the future emissions cap. A natural extension of our work is to study the potential impact of the EU ETS on both the day-ahead electricity risk premia and the optimal hedging decisions in the electricity futures market.