

“Integration of European Electricity Markets: Evidence from Spot Prices”

We analyze the current state of market integration of European wholesale electricity prices at day-ahead power exchanges. Energy, and in particular electricity, is among the key sectors targeted by the European Union to integrate initially isolated national markets. The idea is that the fundamental good “electricity” should obtain benefits of integration, such as enhanced balancing of supply and demand shocks, better integration of intermittent renewables, security of supply, reduced price variance (i.e. less risk), and lower competitive prices on average, building on the general theory that unrestricted trade results in welfare improvements. However, electricity market integration requires enormous investments in the grid to remove transmission bottlenecks, in additional interconnector capacity, as well as in the implementation of market coupling to ensure an efficient allocation of available cross-border capacities. Besides, there are substantial political obstacles to overcome as the transition towards integrated markets, with lower prices *on average*, yields higher prices in initially low-price markets.

The empirical approach follows a two-step approach, where we first apply cointegration analysis to draw conclusions about the long-run price relations of adjacent and indirect market pairs. In a second step, we focus on error correction to infer about markets’ strength of the error correction mechanism after price shocks, which allows for a judgement about markets’ ability to deal with new information. This is relevant because we put price convergence to empirical scrutiny that goes beyond econometric modelling of the existing literature: (1) We show that error correction can only be investigated when trade frictions occur; (2) for the sake of comparability, we analyze the strength of error correction back to a uniform price relation (in contrast to an observed but imperfect relation); and (3) we evaluate cointegration and error correction not only for daily averages to draw a general picture but also at the hourly resolution and account for intra-day demand and supply rigidities. A special feature is our rich and novel dataset that combines hourly spot price series from 25 European electricity market areas for the period 2010Jan01/01h–2015Jun30/24h with a large set of important control variables, such as hourly interconnection capacity congestion and its direction, availability of market coupling, input prices of combustible technologies, forecasted electricity feed-in from intermittent renewables, and national holidays.

Our results indicate that market integration increased from 2010 to mid of 2012 but then declined until 2015. Despite efforts to introduce market coupling in many markets, cross-border capacities are congested more frequently after 2012. Based on data for Germany, we show that an increasing penetration from intermittent renewables, which can feed-in whenever possible regardless of demand, provide a reason for the observed divergence. This is of importance as obstacles against further electricity market integration may result in more frequent interconnection congestion and more extreme price effects (of both positive and negative price peaks), given the strong deployment of renewables across Europe. Furthermore, we reach the conclusion that markets' strength of error correction is rather modest and for some regions very low. Although investments are costly and generally sunk, this gives rise for a large potential for welfare improvements from additional capacity investments and further promotion of market coupling among European electricity markets.