MARKET INTEGRATION OF EUROPEAN ELECTRICITY MARKETS? – EVIDENCE FROM SPOT PRICES

Klaus GUGLER[1], Adhurim HAXHIMUSA[1], Mario LIEBENSTEINER[1]

Introduction

One of the major targets of the EU is to promote the integration of initially autarkic national electricity markets to increase competition, induce competitive prices, enhance efficiency, achieve higher standards of service, and secure supply and sustainability (Directive 2009/72/EC; European Commission, 2014). In order to connect electricity markets, efforts by the EU to introduce market coupling (i.e. simultaneous auctioning of power and capacity), remove transmission bottlenecks and to foster invest in interconnector capacity are crucial.

On theoretical grounds we argue that electricity trade is welfare enhancing compared to autarkic supply, since it promotes allocative efficiency. Eventually, we provide reasoning that price convergence (law of one single price) from market integration represents a normative benchmark for policy from a social welfare perspective, yet it may be politically cumbersome to realize, because the transition brings about winners and losers. Electricity trade causes the initially low-price market A to export to the initially high-price market B, so that the price in market A rises, while the price in market B declines. While consumers in market A lose some of their rent, producers gain some rent. In market B, consumers win and producers lose. Besides these rent redistributions, we face a rise in welfare in both markets.

The paper is relevant because it bears some important features compared to the existing literature. First, we are able to empirically address interconnection congestion (and its direction) at the hourly level. Second, we contend that for day-ahead spot markets each hour of the day represents its own relevant market (rather than the whole 24 hours of a day). Third, we put price convergence to empirical scrutiny that goes beyond econometric modelling of other studies not only in its scope but also in its application (see below).

Methodology & Data

Against this background, we empirically investigate the current state of integration among European electricity markets in a two-step analysis. First, we focus on the long-run cointegrating price relation of both adjacent and indirect (no common border) market pairs: : $P_{A,t} = \alpha + \beta P_{B,t} + Z_t$. If the two price series are integrated of order one ($P_{A,t}$ & $P_{B,t} \sim I(1)$), they have a long-rung equilibrium relation (β) between $P_{A,t}$ and $P_{B,t}$ so that a shock ($Z \sim I(0)$) cannot cause these two series to move away from each other for long. In a second step, we apply an error correction model (ECM) to evaluate the *efficiency* of markets: $\Delta P_{A,t} = \gamma + \delta \Delta P_{A,t-24} + \eta \hat{Z}_{t-24} + \theta' X + \varepsilon_t$, where $\Delta P_t = P_t - P_{t-24}$. The coefficient of the error correction term (ECT) η shows by how much a shock to the system is absorbed within 24 hours. In other words, the faster spot prices adjust back to their long-run cointegrating relation, the higher the efficiency from market integration. The vector *X* includes control variables that may influence demand and/or supply. Although the model is specified in first differences, all coefficients can be interpreted as changes in levels.

In contrast to the existing literature, we stress that the general applications of an error correction model as in other literature (e.g.) is inadequate for electricity prices at the hourly level because during times of unconstrained trade flows (given unconstrained interconnection capacity and market coupling) the law of one price holds and shocks to the system are absorbed instantaneously ($ECT = -\infty$). Hence we estimate the ECM both for daily averages of peak and off-peak periods (1am-7am & 7pm-24pm) and for periods of congestion spells (i.e. consecutive daily hours of congested interconnection). While the first allows for inference about the *average daily* efficiency of market integration, the latter enables us to infer about the *efficiency of market integration at given hours during periods of congestion*.

[1] Vienna University of Economics and Business, Department of Economics, {klaus.gugler|adhurim.haxhimusa|mario.liebensteiner}@wu.ac.at

For this analysis, we employ novel data on hourly day-ahead spot prices from 25 markets for the period 01.01.2010-30.06.2015 and combine these with a rich set of control variables, such as hourly interconnection congestion (and its direction), market coupling, daily input prices of gas and oil, hourly forecasts of wind and solar production (for selected markets) and seasonal fixed effects (days of week, months, years, national holidays).

Preliminary and Expected Results

Preliminary results show that on average, 49 out of 76 adjacent market pairs have a cointegrating relation of greater than 80%, which we interpret as an already high degree of integration. Yet there are still a few (15) adjacent market pairs with $\beta \leq 0.60$. Indirect market pairs exhibit lower degrees of integration on average, but their cointegrating relationships have been increasing rapidly over time. This is an indication for increasing international integration of European markets.

Moreover, the ECM shows that while some market pairs (mainly in central Europe) are able to deal very efficiently with shocks during congested hours, there are many market pairs which cannot deal with shocks as efficiently. Results vary strongly by the respective hour of the day. On average, market efficiency is lowest when interconnection congestion is especially pronounced. What is more, for some markets (e.g. Germany) congestion (to France) would cause a fall in prices. In such countries, consumers lose from market integration. This may explain political obstacles for investments in interconnection capacity or the implementation of market coupling.