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Electricity wholesale market prices in Europe: Convergence? ☆

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Abstract

This paper tests the hypothesis that the ongoing restructuring process in the European electricity sector has led to a common European market for electricity. Based on a Principal Component Analysis (PCA) of wholesale electricity prices in 2002–2006, we reject the assumption of full market integration. For several pairs of countries, the weaker hypothesis of (bilateral) convergence is accepted based on unit root tests (KPSS and ADF) and a convergence test based on filtered pairwise price relations. This indicates that the efforts to develop a single European market for electricity were so far only partially successful. We show that the daily auction prices of scarce cross-border transmission capacities are insufficient to explain the persistence of international price differentials. Empirically, our findings confirm the insufficiency of explicit capacity auctions as stated in the theoretical literature.

JEL classification: L94; C5; G1

Keywords: Electricity prices; European integration; Time series analysis

1. Introduction

A common electricity market is expected to increase welfare by ensuring security of supply, stimulating competition, and reaping the gains from international cooperation through such

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means as reserve sharing, combining different national consumption and production patterns, etc. To create a single European market for electricity the European Union has issued two directives, one regulation and several decisions that oblige both old and new EU member states to undertake substantial reform efforts. The measures require that: markets be opened (e.g. Directive 2003/54/EC); obstacles to cross-border trade be reduced (Regulation 1228/2003); and that non-discriminatory third-party access to the network be guaranteed (e.g. Directive 2003/54/EC). To date, implementation (via the enactment of national laws) among the member states varies. Even a cursory read of the reports benchmarking national electricity sector reforms such as EC (2005, 2006), and OXERA (2005) reveals the differences that remain. Although there has been substantial progress by some members, the EU's goal is yet far off.

Given these circumstances, several authors have wondered whether market outcomes can confirm the success of the reforms with respect to the EU's common market policy. Bower (2002), Armstrong and Galli (2003), Boisseleau (2004), Armstrong and Galli (2005), and Turvey (2006) compared day-ahead wholesale market prices at several European power exchanges. Bower (2002) applied correlation and cointegration analysis to 2001 prices from the Nordic countries, Germany, Spain, the UK, and the Netherlands. He concluded that some European electricity markets (especially the Nordic countries, the Netherlands, and its neighbors) were already integrated to a certain extent by 2001.[1] A relevant chapter in Boisseleau (2004) that focused on regression and correlation analysis determined that the level of integration of European markets is quite low. Both Bower (2002) and Boisseleau (2004) described the respective status quo of European market integration; in contrast, Armstrong and Galli (2005) analyzed the evolution of price differentials between France, Germany, the Netherlands and Spain from 2002 to 2004, concluding that European electricity prices converged in this period.[2] Turvey (2006) examined the use of interconnectors and the pricing of scarce transmission capacities. Based on the example of the Anglo-French Interconnector, he provided empirical evidence for the insufficient correlation of flows and price differentials.

International electricity price convergence[3] can be triggered by different factors, like: the convergence of factor prices; the convergence of product prices[4]; the harmonization of the institutional framework; the convergence of electricity market regulation; the convergence of production technologies and consumption patterns, as well as increasing international electricity trade. While changing investment as well as merger and acquisition behaviour will primarily have long-term impacts, rising international trade will promote market integration in the short- and medium-term. In this paper we will concentrate on the latter. Therefore we test whether European day-ahead electricity wholesale prices converged between 2002 and 2006. Showing that national prices approach over time would indicate that the single market policy was effective in the medium-term, while finding no convergence would imply the (at least initial) shortcoming of those policies.

[1] However, this result is mainly due to Bower's use of unweighted daily average data; given the strong differences between peak and off-peak price behavior on the electricity market, it is an inappropriate representation of price data.

[2] Their reasoning is based on the comparison of three yearly averages of price differentials. Because Armstrong and Galli did not perform statistical tests on the significance of their results and ignored the cross-border capacity rationing mechanisms, it remains uncertain whether their conclusions might be generalized.

[3] The term "convergence" is used throughout the text in the definition used by Engel and Rogers (2004), i.e. price convergence is the reduction of international price level dispersion over time.

[4] The Heckscher–Ohlin model, for example, predicts that factor (i.e., electricity) prices converge when product prices converge.