

IMPACT OF CARBON PRICE ON THE INTEGRATING EUROPEAN ELECTRICITY MARKET

Piia Aatola, Government Institute for Economic Research (VATT)
P.O.Box 1279, FIN-00101 Helsinki, Finland
Phone: +358 40 3045538, e-mail: piia.aatola@vatt.fi

Overview

In this paper we investigate the market integration within the four different electricity markets presenting six price areas in the EU in the presence two overlapping energy market policies: EU emission trading scheme (ETS) and creation of internal electricity markets. We study the price convergence and estimate the long run relationships between the regional electricity prices and the price of EU allowance (EUA). We study these questions with the price series of different local electricity markets: Nordic, UK, Central-Europe and Iberian. We use daily forward data from 2003 till August 2011. We are especially interested to study how the implementation of the EU ETS has affected the electricity price relationships after 2005 as the EU ETS started. Our research questions and hypotheses are the following:

- How has the EU ETS market affected the integration of the European electricity markets and convergence of the electricity prices? Our hypotheses is that EU ETS as a common, EU wide market creates a new, cost factor for the fossil fuel based electricity production. This common factor may increase the price convergence even with regions with no physical transmission capacities as a financial price transmission channel. To study this we estimate the long run price relationships between the different prices before the implementation of EU ETS (2003-2004) and during the two phases of EU ETS 2005-2007 and 2008-2011. We expect the integration of the electricity prices to be stronger on the latter parts of the study periods.
- Does the price of EUA have different impact on regional electricity prices? How does the relation between the EUA price and different regional electricity prices evolve? We expect the relation between these prices to be positive. If the price of electricity increases the price of EUA should increase as well, *ceteris paribus*. (See Aatola et al. 2012). One could also argue that the increase in the EUA price leads to increase in the electricity price and thus we study this by running the pair wise Granger causality tests for the regional electricity prices and the price of EUA for all the sub periods. Pair wise Granger causality reveals also information of the electricity price relations and signs of integration.

Method

To study these questions we use the time series analysis methods. We start with a simple correlation analysis and pair wise Granger causality analysis to elicit the relationships between the variables. Then we run a cointegrated VAR models with multivariate time series based on the Johansen (1998) cointegration analysis. We study the common trends within these markets and study the variance decompositions to find the price relationships within these markets. Studying these questions we shed light on the market integration and price converge process in these strongly related markets. The results give insight on the market interactions between the regional electricity markets and also the impact of EU ETS on this market integration process. There are also papers looking at the long run relation between carbon prices, electricity price and fuel prices (Fezzi and Bunn (2008) and Creti et al. (2012)) but to our knowledge this is among the first papers to look at the impact and interactions of these markets in the sense of electricity market integration and price convergence.

Results

We study the four regional market areas of electricity, Nordic, Central European, UK and Iberian with six market prices. The regional electricity prices studied in this paper show strong market integration in time. From the first sub period to the last one, we see clear increase in the market integration and also the impact of EUA in equalizing the prices. The cross border trade has increased in both electricity and EUA markets, which is a necessary condition for the marginal cost equalization and cost efficiency. Being aware that the physical transmission capacity is the crucial source of market integration our focus in this paper is to study the impact of the common, overreaching third market, EU ETS that impacts the electricity markets in all regions. The efficiency is improved as both the electricity market integration equalizes the marginal generation costs and the EU ETS market equalizes the marginal abatement costs among the actors.

We find support to our hypotheses of increasing integration and price convergence in the markets. The simple correlation coefficients show that the pair wise correlations have increased in time moving from the first sample to the last one. The pair wise Granger causalities show similar effects. The bidirectional Granger causalities increase in time and the price series become more endogenous: Prices become more dependent on each other as the physical market integration increases. The price of EUA seems to have the biggest impact on the countries and regions with gas dominated electricity generation mixes, i.e. UK and the Netherlands.

We see from the results that the number of cointegration relations has increased in time and that the relationship between the EUA price and electricity has improved the integration within electricity prices. The first sub period has only one cointegration relation whereas the last one has even four. The addition of the price of EUA into the models further increases the integration. Variance decompositions of the CVAR models show that the countries with widest transmission capacities are most endogenous and most sensitive to the shocks.

Conclusions

The EU emissions trading scheme, EU ETS, is a flagship policy instrument in the EU climate policy. The EU ETS creates an overreaching factor in the regional electricity markets. Unlike the physical transmission capacity EU ETS market works as a financial price transmission channel in the electricity markets. EU ETS is a common market for all the regional and still spatially separated markets. Harmonization and integration of markets and creating strong internal market is one of the main purposes of EU. (Monti, 2010). Thus these two markets, the EU ETS and the pan-European electricity markets are in the very heart of the EU policy of gaining efficiency via open trade. Harmonization, free trade and market efficiency are not, however, easily achievable within the 27 Member States. Both markets have their own obscurities but gaining progress all the time.

The statistical analysis of these closely connected markets show signs of increasing integration. The results of the investigation of the three sub periods show that the integration of prices has increased and thus one can expect the efficiency gains to be achieved: The marginal generation cost of electricity production and the marginal abatement costs to equalize among different market areas and thus the prices to converge.

References

- Bosco, B., Parisio, L., Pelagatti, M., Baldi, F. 2010. Long run relations in European electricity prices. *Journal of Applied Econometrics*, 25, 805-832.
- Bunn, D., Gianfreda, A. 2010. Integration and shock transmissions across European electricity forward markets. *Energy Economics*, 32, 278-291.
- Creti, A., Jouvét, P-A., Mignon, V. 2012 Carbon price drivers: Phase I versus Phase II equilibrium? *Energy Economics* 34 327–334.
- Fezzi, C., Bunn, D. 2010 Structural interactions of European carbon trading and energy prices. *The Journal of Energy Markets*, 2, 4 53-69.
- Jamasb and Pollitt, 2005 T. Electricity market reform in the European Union: review of progress toward liberalization and integration, . *Energy Journal*, pp. 11–41
- Milunovich, G., Joyeux, R., 2010. Market Efficiency and Price Discovery in the EU Carbon Futures Market. *Applied Financial Economics*, 20.
- Monti, M. 2010. A New Strategy for the Single Market. Report to the President of the European Commission
- Review and Analysis of EU wholesale energy markets. 2008. For European Commission by The Moffatt Associates Partnership.
- State and Trends of Carbon Markets 2010. The Carbon Finance Unit. World Bank. Washington D.C. URL: http://siteresources.worldbank.org/INTCARBONFINANCE/Resources/State_and_Trends_Updated_June_2011.pdf
- Zachmann, G. 2008. Electricity wholesale market prices in Europe: Convergence? *Energy Economics*, 30, 1659-1671.
- Weigt, H., 2009. A Review of Liberalization and Modeling of Electricity Markets. Electricity Markets Working Papers, WP-EM-34. Dresden University of Technology.