

# ***STRUCTURAL BREAKS IN THE SPANISH ELECTRICITY PRICES: THE ROLE OF RENEWABLE ENERGY***

Aitor Ciarreta, University of the Basque Country (UPV/EHU), +34 946013823, aitor.ciarreta@ehu.eus  
Cristina Pizarro, University of the Basque Country (UPV/EHU) and Basque Centre for Climate Change (BC3), +34946013657, mariacristina.pizarro@ehu.eus  
Ainhoa Zarraga, University of the Basque Country (UPV/EHU), +34 946017033, ainhoa.zarraga@ehu.eus

## **Overview**

Participation of Electricity from Renewable Energy Sources (RES-E) in Spain has been growing since 2004, when the Renewable Energy Act was passed and an incentive scheme based on tariffs and premiums was approved. However, this system imposed an important cost-burden and therefore suffered cost-containment measures from 2010 onwards, until it was completely phased out in 2013. Finally, in 2014 it was substituted by a new incentive system based on the remuneration for investment and operation of the plant. During this whole period, electricity prices experienced important changes not only in levels but also in volatility. We argue that the participation of RES-E, which is strongly linked to the regulatory framework, had a crucial influence on them. Therefore, we analyze possible structural changes that regulation may have entailed in the Spanish electricity spot price volatility during the period from January 2002 to December 2017. Specifically, we identify three structural breaks linked to important measures related to RES-E.

## **Methods**

The data used consists of daily Spanish electricity prices constructed as the arithmetic mean of the hourly prices for the period from 1-1-2007 to 12-31-2017. We specify and estimate several Generalized Autoregressive Conditionally Heteroscedastic (GARCH) models, which capture the main stylized features of electricity prices such as volatility clusters. Although these models assume constant unconditional variance of the price series, electricity regulation changes can cause structural breaks in the unconditional variance or, equivalently, structural breaks in the parameters of the conditional price volatility. Therefore, we test for the presence of breaks using the methodology based on the approach by Inclán and Tiao (1994). They propose a test valid for independent and identically distributed processes and therefore it is not suitable for dependent processes like GARCH. To solve this problem, we apply the test to the standardized residuals of the GARCH processes.

The mean equation of the GARCH processes accounts for the autocorrelation and seasonalities of electricity prices. With regard to the variance equation, different specifications, which correspond to GARCH-type models, are considered. The benchmark is the GARCH model, which is compared to the Integrated GARCH model (IGARCH), the exponential GARCH model (EGARCH), and the asymmetric GARCH model.

Dummy variables for the structural breaks detected are then included as exogenous variables in the variance equation of each GARCH-type model. The models are finally re-estimated to analyze the impact of regulatory changes on price volatility.

## **Results**

Results show the presence of three structural breaks in 2006, in 2010 and in 2014, which should be taken in consideration to explain price volatility. In fact, results support the evidence that persistence is overestimated in GARCH models that ignore breaks (as in Ewing and Malik, 2017). The structural breaks found are clearly linked to regulatory measures in the Spanish electricity market addressed to the introduction of renewable energy. Specifically, in 2006 the retribution to RES-E was updated and the procedure to connect photovoltaic facilities to the network changed. In 2010 measures to tackle the growing cost of the incentive scheme to RES-E were first taken which resulted in a substantial reduction in the feed-in tariff mechanism. Finally, in 2014 the new incentive scheme based on a fixed rate of return to investment together with a new Electricity Law entered into force. Under the new framework the regulator seeks to control the burden of the Feed-in Tariff mechanism and promote demand side management.

## Conclusions

The structural breaks found are clearly linked to regulatory measures in the Spanish electricity market addressed to the introduction of renewable energy. This paper proves that the methodology used is useful to relate structural breaks to regulatory policies, which is interesting for transforming energy markets. Although this analysis is carried out for the Spanish electricity market, it could be easily extended to other electricity markets which are subject to similar regulatory pressures.

## References

Ewing, B.T. and Malik, F., 2017. "Modelling asymmetric volatility in oil prices under structural breaks". *Energy Economics* 63, 227-233.

Inclán, C. and Tiao, G.C., 1994. "Use of cumulative sums of squares for retrospective detection of changes of variance". *Journal of the American Statistical Association* 89, 913-923.