

# ***THE IMPACT OF EXCHANGE RATES AND OIL PRICES ON WHOLESALE ELECTRICITY SPOT PRICES IN EUROPEAN COUNTRIES: AN EMPIRICAL STUDY***

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## **Overview**

This study is the first to investigate the relationship between daily electricity spot price returns and crude oil spot price returns (in US dollars) and the exchange rate return across a sample of six European countries - namely France, Germany, Italy, The Netherlands, Spain, and the United Kingdom.

The EU countries investigated were selected on the basis of their national currency (EUR/USD or GBP/USD) and their dependency on oil for electricity production, with France, Spain and Germany using more nuclear, hydro and alternative sources than UK, the Netherlands and Italy. Furthermore, Spain was also chosen in order to provide terms of comparison with the results reported in Muñoz and Dickey (2009) [1].

The main contribution of our study is to show that there is in fact a transmission of volatility between both the exchange rate and the oil price towards the price of wholesale electricity and that, for some countries, the level of the electricity price is also affected by changes in exchange rate and oil price returns.

## **Methods**

In order to model the effect of the exchange rate and oil price on each of the country's spot price of wholesale electricity we make use of a Generalised Autoregressive Conditionally Heteroscedastic (GARCH) approach. The conditional mean is modelled as a simple GARCH process - AR(1)-GARCH(1,1) - while the conditional variance is modelled as a non-linear GARCH with orders AR(1)-NGARCH(1,1). We explicitly look at two time frames, 2005-07 and 2008-11 (i.e. before and after the start of the subprime crisis).

## **Results**

In the time period 2005-2007, the effect of exchange rate returns volatility on electricity price volatility was significant only for Italy, The Netherlands and Spain, but became significant for all the examined countries within the time frame 2008-2011. Given that the fuels used to produce electricity are traded in USD, it follows that the movements in the USD have affected the volatility of electricity prices. It has recently been shown [2] that peak oil prices, such as during oil supply restriction, more seriously hit some economic sectors compared to others. A 14% reduction of British electricity production and distribution was observed both in absolute and relative terms by increased oil prices with a loss of GBP 35.38 billion [2].

Exchange rate movements affected the Italian electricity price level in both periods indicating that the appreciation of the US dollar against the Euro is reflected through a rise of electricity prices in the country. In general, the more the oil import the larger should be the impact on oil price level and volatility. However, a country such as France, which shows most of the significant oil price impact on levels, has very little oil in its electricity mix. This apparent incongruity might derive from the strong process of price convergence which has been observed among the electricity markets of the Netherlands, Germany and France [3].

Interestingly, a significant effect of the GBP/USD exchange rate volatility on electricity price volatility was observed for the United Kingdom only after the year 2008. Božović (2008) [4] demonstrated that, in the time period 2005-2008, the average number of events with probability of jumps p.a. over 0.5 jumps was 8 p.a. for GBP and 11 p.a. for EUR, suggesting a larger stability of the exchange rate for the GBP. The highest concentration of jumps was found to be in 2008, likely as a consequence of the sub-prime mortgage crisis. Therefore, it is possible that only after that time the larger variability in the GBP/USD exchange rate, which translates into the presence of large spikes or jumps, may have reverberated on the volatility of the British electricity price.

Except for the UK, at least within the period 2005-2007, oil price returns volatility significantly affected the volatility of electricity prices in the other countries under study. This is not surprising given the importance of fossil fuels in European electricity production, as shown in Figure 1.

The better performance of the NGARCH- over the GARCH-model indicates that the effect of exchange rates and oil prices on electricity price volatility is asymmetric. Asymmetric effects imply that exchange rate and oil price increases have a clear negative impact on electricity price volatility while exchange rate while oil price decreases do not significantly affect the electricity price. A volatile environment weakens the effect on price level changes since it reduces the *surprise*. While there is no literature regarding the asymmetric effects of exchange rate against the USD, the presence of asymmetric effects of oil prices on electricity price volatility was previously described by Hadsell et al. (2004) [5] and Higgs and Worthington (2005) [6].

It is interesting to note that, in spite of the different methods used to measure the electricity price volatility, our study exhibits a similar outcome for the Spanish electricity price volatility to that previously shown by Muñoz and Dickey (2009), i.e. that the volatility of Spanish electricity spot prices was affected by the EUR/USD exchange rate. In relation to the different approaches, while we used GARCH models to assess the conditional variance and the conditional mean of electricity price returns, Muñoz and Dickey (2009) defined the volatility as the squared difference between present and one-period lagged prices to then apply a vector error correction model.

The few other studies reported in the literature regarding the effect of oil prices and/or exchange rates on electricity price volatility reach differing results. Mohammadi (2009) [7] did not find a long-run relationship between oil and US electricity prices. In contrast, Narayan *et al.* (2008) [8] observed that previous values of oil price and USD/EUR exchange rates affect the evolution of the future values of the exchange rate, both in level and volatility.

## Conclusions

In conclusion, the volatility - and in some cases, the levels - of electricity prices are affected by the exchange rate against the USD and by the oil price volatilities with a more extensive effect on all the countries studied in the time frame 2008-2011, likely as a consequence of the economic crisis that struck the Eurozone after the US subprime mortgage crisis.

A volatile wholesale price that will be passed through to electricity consumers implies significant risks to their bills. It is also unattractive to most low-carbon generators whose costs are not linked to fossil fuel prices. Ensuring that payments to these generators are largely de-linked from the overall level of power prices (as with Feed-in-Tariffs or the UK government's proposed Electricity Market Reform) would reduce risks for generators and consumers alike.

## References

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