TAIL RISK IN POWER PRICE MODELLING AND FORECASTING WITH RES

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Overview

The on-going restructuring and market design processes for the power sector, with its complex objectives of competition, security and decarbonisation has modified market mechanisms and created new needs for understanding the drivers of change and the nature of electricity price dynamics. Since electricity is a unique commodity, not easily storable with important implications when balancing supply and demand, any imbalances can cause large and sharp changes in price. In the last years, we have observed an increasing share of intermittent generation in almost all EU countries. Germany, for instance, decided to exit from nuclear power by 2020 focussing on renewable energy sources and energy efficiency. In this context, while in the United States the renewable energy made an estimated addition of electrical capacity equal to 39% in 2011; in the European Union, renewables accounted for more than 71% of total electricity capacity addictions, bringing renewable energy's share of total electric capacity to 31.1% with Germany being the leader market.

Methods

These new generation sources have significantly influenced electricity price dynamics requiring for further investigations to provide empirical evidence of this massive structural change in the energy market. Therefore, we detect price changes and investigate appropriate modelling and forecasting techniques for the occurrence of abnormal price excursions in electricity markets, focusing upon market level data and specifically at the intermittent characteristics of new technologies (wind and solar). We present nonlinear models for short term power price modelling and forecasting, accounting for the effects of increased intermittent generation on tail price risk showing that wind deeply affects the left tail distribution. We compare Quantile Regressions and Generalized Additive Models controlling for the price formation fundamentals of demand and fuels. These approaches are applied to the main reference market for Europe, the EEX, with extensive out-of-sample testing.

Results

We show that the stochastic nature of intermittent generation poses a new set of distributional properties for the power price risks. More importantly we provide evidence of wind and solar affecting lower and higher quantiles of electricity hourly price distributions. We provide a new set of methods which outperform in their tail risk forecasting performances when RES are considered.

Conclusions

The high renewable penetration has been promoted to reduce carbon emissions. However, these sources have increased the complexity of the electricity industry given the high variability and partial predictability hence we propose new forecasting methods to provide reliable tail risk modelling of the new electricity spot price dynamics.

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