Improving Electricity Market Price Scenarios by Means of Forecasting Factor Models

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Abstract: Generation companies that participate in liberalized electricity markets around the world need to know the prices at which the energy will be paid in order to decide how to bid and how to schedule their resources for maximizing their profit. The problem is that the market price is only known once the market has been cleared so it is needed to forecast it. In fact, not only is the price needed for forecasting, but also its distribution.

Our main objective is to include short-term forecasting of the electricity market spot price in an optimization model for the management of a generation company in order to obtain realistic market price scenarios in which the generation company should decide how to optimally operate and to easily update these scenarios over time. Our approach has been applied to the Iberian electricity market.

The problem with building electricity price scenarios has been tackled within many areas. Nonparametric statistic methods –such as clustering or bootstrapping—applied to historical data were the first and simplest approaches. The advantage of these methods is that they are easy and computationally cheap to use but, on the other hand, they do not characterize the price distribution properly.

Electricity spot prices exhibit non-constant mean and variance, daily and weekly seasonality, calendar effects on weekends and holidays, high volatility and the presence of outliers. Those characteristics do not necessary make it easy for electricity price short-term forecasting. Several approaches have been proposed in the power system literature which basically can be classified into parametric/nonparametric, conditional homocedastic/ heteroscedastic, going from the most popular ARIMA models belonging to the class of parametric models to the most sophisticated ones, as for example wavelet or neural networks models. The classical GARCH models and their variants are used for estimating the conditional heteroscedasticity of the electricity spot prices. All of them present advantages and drawbacks; nevertheless any one of them is absolutely convenient for our main objective.

Our approach in this work is to apply the well known methodology of factors models to forecast electricity market prices in a short-term horizon (24 hours). In this case, the spot prices have been interpreted not as a single time series but a set of 24 time series, one for each hour. The factor model procedure allows us to

identify common unobserved factors, which represent the relationship between the hours of a day. Despite the fact that dynamic and static factor models have been extensively used in many different frameworks, their application to short term electricity market prices forecasting has not been exploited. Previous results have shown that dynamic factor models are better for improving or extending them, but on the other hand, some authors conclude that these benefits are not sufficient to justify their use compared to the ease of estimating static factor models. Both procedures have been applied and evaluated for the Iberian electricity spot prices.

The second part of our objective is to apply the results obtained from the presented forecasting technique to a stochastic optimization model for the management of a generation company operating in an electricity day-ahead market. The stochastic model is based on the representation through scenarios of the random variable involved in the problem. In our case, the stochastic variable is the day-ahead market clearing price. So, a set of scenarios for the day-ahead market clearing price will be built from the forecasting results. Once this set of scenarios is obtained, it is introduced into the optimization model, whereby the stability analysis and results are obtained. The forecasting technique used results in a characterization of the market clearing price that is easy to estimate and to update. The results obtained in the forecasting part allow us to build realistic price scenarios that –once introduced into the model— provide suitable results for the optimization objective.

Key words and phrases: Electricity market prices, short term forecasting, factor models, price scenarios