Abstract

With the introduction of competition in electricity markets, the participants in the industry were exposed to market risk i.e. exposure to competitors' decisions on pricing and its consequent effects on volume. Thus, various decisions related to operations and investments, which were straightforward in the regulated era, now required a thorough analysis of the behaviour of the electricity prices. Based on the physical characteristics of electricity, electricity prices are expected to exhibit certain characteristics such as seasonality, mean reversion, price dependent volatility and extreme spikes or jumps.

The model proposed in this study incorporates the above-mentioned characteristics by means of a combination of standard stochastic processes. The model parameters are estimated using the Maximum Likelihood approach, with both a normal and Student's t distribution specification for the error term. The study is also conducted for two electricity markets in the USA (California, New England) in order to provide insights into the differences in spot price behaviour arising out of differing market structure and rules.

The results indicate that a model that incorporates all the above characteristics performs better than a simple mean reversion model in terms of explaining the variation in the data for both markets. However, there is no significant improvement when the generalized model is estimated under a Student's t distribution specification as compared to that under the normal distribution specification, which suggests that the processes incorporating price dependent volatility and jumps under the normal distribution specification capture the leptokurtic nature of electricity prices to a significant extent. However, the performance of the generalized model under out-of-sample forecasting, as

measured by the root mean square error, is not significantly better than the restricted models.

Comparison of the model parameters across the two markets indicates that the behaviour of prices in the California market was far more complex than in the case of New England. The results for the generalized model under the normal distribution specification also indicate a non-stationary covariance process in the case of California as compared to a stationary covariance process in the case of New England. Further, the jump behaviour is not clearly identified in the case of California with the jump amplitude being very low, which suggests that the normal prices in California may have been higher than the costs warrant. The degree of mean reversion was higher in the case of New England, whereas the degree of mean reversion was expected to be higher in the case of California.

This study can be extended from a single stage model to a two or three stage regime-switching model to resolve the issue of the non-stationary GARCH process in the case of California. It can also be extended to incorporate a variable that captures the strategic bidding behaviour of the generators, which may be the reason for the behaviour of prices in California being contrary to expectations. Lastly, a better measure of forecast performance would be evaluation of the conditional density forecasts.