Modeling Multi-horizon Electricity Demand Forecasts in Australia: A Term Structure Approach

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Accurate electricity demand forecasting plays a crucial role in the decision-making process of many market participants. Forecasting is used by the market operator for scheduling and dispatch of generation capacity which is crucial to system stability. For generators, demand forecasts are an important driver of strategic choices involved in bidding and rebidding of capacity, whereas for retailers demand forecasting affects decisions about the balance between hedging and spot acquisition of electricity. To aide these decisions the Australian Energy Market Operator AEMO publishes historical electricity demand data that is calculated as the half-hourly average of actual four-second regional operational demand measured in gigawatts. It also generates one-day forecasts of half-hourly average demand for each trading day which are then updated every half hour up to the time of dispatch.

This paper identifies an important property of these official multi-horizon forecasts, namely the tendency to overpredict load at longer horizons. A model is developed that explicitly takes account of the information provided by forecasts generated at all time horizons. A special property of the model is the identification of a set of latent factors describing the evolution of demand forecasts over time. Using the Australian data, the empirical results provide evidence of a three-factor term structure model. The three factors are interpreted as level, slope and curvature factors, a result that is akin to the factor structure of models of the term structure of interest rates.

Having identified a factor structure, the economic value of the official forecasts and the information provided by the factor structure are assessed in terms of a cost-loss decision-making model. It is demonstrated that the official forecasts, although irrational in an econometric sense, do provide economic value over a wide range of the cost-loss ratio. This result is of concern because acting on forecasts that systematically over-predict imposes a social cost on the environment. A simple adjustment to the forecasts is proposed that uses the factor structure to compensate for strategic over-prediction. The information contained in the term structure of multi-horizon forecasts is then shown to add to the economic value of the official forecasts, especially at longer horizons.

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