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Anticipating electricity prices for future needs – Implications for liberalised retail markets

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HIGHLIGHTS

- GARCH and Structural Breaks gives good lower bound forecasts of electricity prices.
- Tariff setting for smaller consumers can be possibly benchmarked from weekly forecasts.
- Making reliable price forecasts available publicly can help reduce consumer welfare loss.
- Price forecasts can help monitor competitiveness in a liberalised electricity market.
- Magnitude of weekly price spikes may be reasonably forecasted from univariate models.

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ABSTRACT

Electricity price forecasting is a mature research area, with various techniques already developed in recent years to help both generators and retailers hedge against price and load associated risks. This paper aims to add on to the forecasting literature, with emphasis on the importance of making such forecasts transparent to facilitate countries' transitions towards more liberalised retail electricity markets.

We conduct univariate forecasting of Singapore's weekly wholesale electricity prices with the Autoregressive Integrated Moving Average (ARIMA) models, complimented with the use of Generalized Autoregressive Conditional Heteroscedasticity (GARCH) models and their variants to account for volatility. Results show that our models reasonably emulate the price trends based on out of sample forecasts. The magnitude of expected future weekly price spikes may be estimated to a reasonable extent based on historical price outages, determined exogenously in the model. These forecasts can thus serve as possible references to retail players in a competitive market for all parties to make more informed decisions before participating in the open market. This is especially important for smaller consumers of electricity who are typically last to be exposed to retail choices. Adequate knowledge of prices will be necessary to increase desired switching rates.

1. Introduction

Forecasting electricity prices have traditionally been in the domain of electricity generators and large-scale utility providers, both of which must accurately predict future price trends and anomalies to hedge associated risks. However, with retail market competition becoming more prevalent across the world, it is imperative that such forecasts be made transparent to the smaller consumers of electricity so that they can make more informed choices when participating in the liberalised market. Such participation can come either in demand-side response programs or when choosing an alternative electricity provider and the associated tariff plans.

Typically, electricity market liberalization occurs in phases. The last phase is termed 'Full Retail Contestability' (FRC), where even the smallest consumers will get to select their own electricity providers. As retail price competition is currently relatively new for these smaller consumers of electricity, it is important to devise price forecasts that are easily constructible, and are capable of providing consumers with a reasonable sense of how prices would evolve, such that more informed decisions could be made prior to any entering of commitments in pricing contracts on the demand-side. Such pricing contracts can tie consumers down for a duration of 1–3 years, during which consumer welfare could be compromised if they were to pay a higher price than that of a reference price scenario. As pricing contracts after liberalization become more complicated over time, the need for a better understanding of future price trends is even more necessary. Furthermore,

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as the responsiveness of households towards prices is very low, they will depend more on medium-term monthly or yearly forecasts rather than short-term day-ahead forecasts before deciding which retailer to choose to lock their prices in.

Singapore has the most deregulated electricity market in Southeast Asia. As the first country to launch a wholesale electricity trading market back in 1998 [1], Singapore has seen significant progress since then, with a significant increase in both supply-side and retail competition. The top 3 power generation companies – Senoko Energy Pte, PowerSeraya Ltd, and Tuas Power Generation Pte Ltd – used to command 83.0% of licensed capacity back in 2005. Their market power has become 61.7% in 2015, corresponding to a 25% decrease in 10 years.

Similarly, the market share for electricity retail is distributed more evenly now, with dominant firm SP Services controlling just 31% in 2015, down from 41.7% in 2005, as detailed by the Energy Market Authority [2]. This is the result of liberalization in the electricity retail market, whereby Singapore progressively allowed larger consumers of electricity to select a retailer of their choice (Fig. 1). During the most recent phase of retail liberalization in July 2015, all small and medium enterprises (SME) who face a demand of at least 2000 kW h monthly are made contestable, pushing up the number of consumers with retail choice to 80%. Plans are currently being made for full retail competition in the second half of 2018. This move will provide liberties for the remaining 1.2 million residential households to choose retail price plans that suit their needs.

More importantly, due to the recent deregulation developments, electricity retailers, of which some are also generation companies in Singapore, are now open to more consumers and competition. Thus, they are faced with the challenge of creating pricing contracts that can help them garner a sizable market share of newly contestable consumers who are deciding to switch to more competitive rates when the opportunity arises.

Hence, the aim of this paper is to help policy makers, retailers and demand-side respondents to conduct weekly wholesale price forecasting utilizing the autoregressive integrated moving average (ARIMA) and ARIMA-GARCH models for univariate time series. The impending arrival of FRC makes Singapore a good case study to demonstrate the potential of our forecasts to policy makers.

This analysis will hence display results for both short and medium-term forecasting with the specified models, with discussion centred on four policy questions:

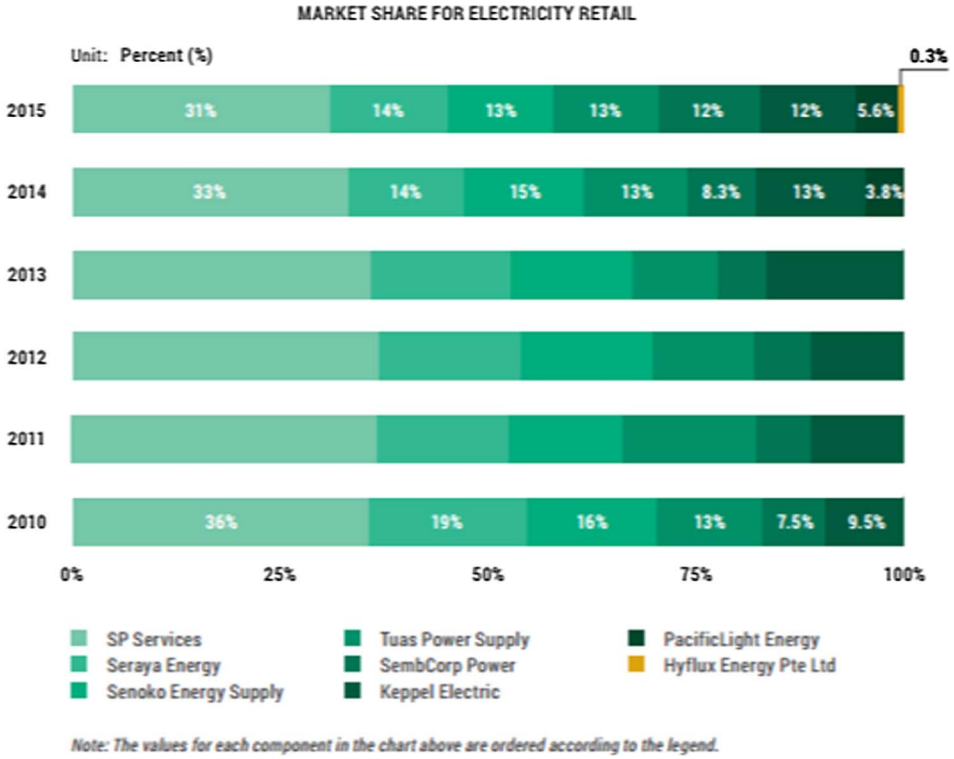
- Does accounting for structural breaks improve price forecasts?
- Does ARIMA-GARCH with structural breaks perform better than pure ARIMA and ARIMA-GARCH models for both the short and medium run?
- How will welfare be affected based on medium term price forecasts, based on current price trends?
- Can the magnitude of weekly price spikes be anticipated?

This study is novel to our knowledge; it is the first publicly available study that explicitly accounts for structural breaks simultaneously with GARCH modelling for electricity prices, as well as the first to introduce out-of-sample forecasting for electricity prices using ARIMA-GARCH models. This analysis is also the first to make a comparison between the Lee and Strazicich [3] and Bai and Perron tests [4] for out-of-sample forecast accuracy based on weekly electricity price data. We also attempt to determine a possible lower bound electricity price that retailers can work towards as they compete on a price war to attract more demand from newly liberalised electricity consumers. In addition, we will also attempt to account for the possibility of accommodating future price spikes in the forecasts, based on previous outages.

2. Literature review

2.1. Overview of forecasting methods

ARIMA and ARIMA-GARCH models have been used for decades to forecast both real-time daily and consolidated weekly electricity prices with varying levels of accuracy in established electricity markets such



Source: Energy Market Authority, Singapore (2015)

Fig. 1. Market Share for Electricity Retail in Singapore.