UNIVERSITI TEKNOLOGI MARA

DETECTION OF STRUCTURAL BREAKS IN ELECTRICITY CONSUMPTION DATA: A COMPARATIVE ANALYSIS OF MLE AND BAYESIAN APPROACH IN A STATE SPACE MODEL

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ABSTRACT

Structural break is an important issue in electricity consumption data. Previous studies concluded that if structural breaks or changes are ignored, inference and forecasting would lead to unreasonable consequences. In performing structural breaks analysis, a few issues need to be catered carefully by the researchers and one of the most crucial issues is to identify whether the series contain a break. Many unit root tests have been introduced by researchers over the decade in determining the existence of break, such as Augmented Dickey Fuller test, Phillip-Perron test, KPSS test, and many more. Researches concerning structural break or structural change most likely need to deal with the problem of the identification of the numbers of structural breaks in the data series and mostly in identification of single, two breaks or more than two structural breaks. Therefore, the correct procedure used is very important in order to ensure the reliability of the results. The main objectives of this thesis are first to model Malaysia electricity consumption data using state space models based on the Maximum Likelihood Estimation (MLE) and Bayesian Approach and secondly, to detect the structural break based on the proposed models. Data series starting from 1999 to 2012 of electricity consumption from residential, commercial, transport and industrial sector in Malaysia were used. Unit root tests were performed as a confirmatory test using the augmented Dickey-Fuller (ADF), Phillips-Perron (PP), the Kwiatkowski-Phillips-Schmidt-Shin (KPSS) and Zivot and Andrews (ZA) test. Then, the state space models using both the MLE and Bayesian methods were proposed, followed by Kalman Filtering, smoothing and forecasting. The results show that in detecting structural break, auxiliary residuals were used as they are potential in detecting both outliers and structural breaks simultaneously and able to distinguish between them. The MLE approach produces very confusing results when it identifies structural breaks as outliers. While the Bayesian approach is capable to detect structural breaks and is able to distinguish between outliers and structural breaks. This research hopefully aid in providing a positive direction in identifying structural breaks in electricity data from a set of more efficient and effective results.

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CHAPTER ONE
INTRODUCTION

1.1 AN OVERVIEW OF STRUCTURAL BREAKS

Structural breaks exist in a wide variety of macroeconomic and financial series. Structural break is defined by Kapetanios and Tzavalis (2004) as an unexpected incident that alters the framework of an econometric modeling. Structural breaks can also be considered as a non-linear form, such as threshold behavior and Markov Switching (Carrasco, 2002). However, these non-linearities cannot serve as a formal form of structural breaks. According to Hansen (2001), if one or more of the parameter changes at a particular time in the series, the structural breaks are expected to occur.

The presence of structural breaks has a great impact upon estimation and forecasting purposes. Statistically, in econometric modelling, if structural breaks are ignored, then it will cause to model misspecification, as well as imprecise forecast, spurious estimation results of model parameters, and hence, misleading policy decisions and recommendations. As reported by Clements and Hendry (1998), they believed that structural break is one of the major reasons of poor forecasting performance. James (1994) claimed that problem of parameter instability will exist if the structural change commonly happen. Clements and Hendry (1998, 1999), Koop and Potter (2001), and Pesaran et al. (2006) concluded that if structural breaks or changes in estimation are ignored, inference and forecasting would lead to unreasonable consequences.

Wang and Zivot (2000) also highlighted that when using macroeconomic time series, structural breaks are detected at the level and trend; while in economic and financial data, structural breaks are detected in volatility. The existence of structural breaks is also said to influence important historical events, such as wars, policy changes, technique innovations, and economic crises. As the identification of structural break or structural changes is very crucial in economic time series, it is indeed important to check for the existence of a structural break in time series data or any macroeconomic data before proceeding to the next statistical analysis. Since electricity data are important economic data in many countries, many researchers had tested and proved that these types of data did contain structural breaks. Thus, sufficient information and good