AUTOREGRESSIVE DISTRIBUTED LAG MODELLING

FOR MALAYSIAN PALM OIL PRICES

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To my beloved parents, siblings and my loved ones

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ABSTRACT

Modelling food commodities prices has become the area of interest in financial time series. This study aims to model Malaysian average monthly prices of crude palm oil using dynamic regression approach. The sample period covers from January 2000 until December 2013. The model investigated is Autoregressive Distributed Lag (ARDL) model. The model uses multivariate analysis with monthly prices, productions, imports, exports and closing stocks of crude palm oil as the variables. The ARDL model is selected using Akaike Information Criteria (AIC) and Schwartz-Bayesian Criteria (SBC). The capabilities of this model in estimating the crude palm oil prices is compared to Box-Jenkins Autoregressive Integrated Moving Average (ARIMA) model by using Mean Absolute Error (MAE) and Mean Absolute Percentage Error (MAPE). The process of modelling is done by using Eviews and Microfit statistical software. This study concluded that ARDL model is a better model in modelling the palm oil prices. The ARDL model selected by using AIC produce better estimation than the ARDL model selected by using SBC. Furthermore, there exist long-run relationship between crude palm oil prices and its determinants.

ABSTRAK

Pemodelan harga komoditi makanan telah menjadi bidang penting dalam siri masa kewangan. Kajian ini bertujuan utuk membuat pemodelan purata harga minyak sawit mentah di Malaysia menggunakan pendekatan regresi dinamik. Sampel data adalah merangkumi bulan Januari 2000 sehingga Disember 2013. Model yang dikaji ialah model Autoregresif Lat Teragih (ARDL). Model ini menggunakan analisis multivariasi dengan mengambil kira harga, penghasilan, import, eksport dan stok bulanan minyak sawit mentah sebagai pemboleh ubah. Model ARDL dipilih menggunakan Kriteria Maklumat Akaike (AIC) dan Kriteria Schwartz-Bayesian (SBC). Keupayaan model ini dalam menganggar harga minyak sawit mentah dibandingkan dengan model Purata Bergerak Bersepadu Autoregresif Box-Jenkins (ARIMA) menggunakan Purata Ralat Mutlak (MAE) dan Purata Ralat Peratus Mutlak (MAPE). Proses pemodelan dilakukan dengan menggunakan perisian statistik Eviews dan Microfit. Kajian ini menunjukkan model ARDL adalah model yang lebih sesuai dalam membuat pemodelan harga minyak sawit mentah. Model ARDL yang dipilih menggunakan AIC adalah lebih baik dalam proses pemodelan berbanding model ARDL yang dipilih menggunakan SBC. Selain itu, terdapat hubungan jangka panjang antara harga minyak sawit mentah dan penentu-penentunya.

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CHAPTER 1

INTRODUCTION

1.0 Introduction

Time series refers to a collection of observations that are made sequentially at regular time intervals. Application of time series covers all areas of statistics but some of the most important areas are economic and financial time series as well as many areas of ecological and environmental data. Examples of time series data are daily rainfall, daily exchange rate, monthly data for unemployment and share prices.

There are two main goals of time series analysis. Firstly to describe and summarize the time series data and secondly to make prediction of the future values of time series variables. Both of these goals need the pattern of the observed time series data. Once the pattern has been identified, interpretation of the data can be made. As an example, an increasing pattern of the data can lead to increasing forecast value for the future.

Most time series patterns can be classified into two basic components which are trend and seasonality. For trend analysis, it is normally referred to as a long-term movement, either consistently increasing or decreasing. For instance, the price of gold is considered to have an increase in trend. For seasonality analysis, the variation of time series is dependent of the time of the year. For example, the sales volumes during Aidilfitri are larger compared to other days.

1.1 Background of the Study

The last few decades saw an increase in primary commodity prices after a downward trend in the 1970s until the beginning of the 21st century (World Bank, 2007). The Food and Agriculture Organization of the United Nations (FAO) food price index rose by 23 percent in 2011 compared with the previous year. The surge in prices has been led primarily by the cereals and oil price indices with highest increments of 35% and 30% respectively, but prices of other commodities, have also increased significantly.

The excessive price changes or high volatility of agricultural commodities created anxiety about world food security in the future. The Business and Industry Advisory Committee to the OECD (BIAC) claims that these changes are caused by structural factors such as supply and demand and market adjustment processes, and unexpected shocks such as severe weather incidents, disease epidemics and hasty and misdirected policy decisions. Both sorts of factors can affect each other, potentially augmenting their individual effects.

The escalation in vegetable oils prices is a major concern to most of the developing countries as they are a major source of fat in the developing world. Tropical vegetable oils mainly palm oil plays a major role in the global market of vegetable oils. They account for major share in the global production and trade of vegetable oils due to cheaper prices (Ramli and Mohd Alias, 2006). Like any other agricultural commodities, palm oil is subjected to significant price fluctuation.

The determination of agricultural commodities prices are based on a complex interactions among multiple factors including crude petroleum oil price, exchange rates, time-lag, demand and supply situation and slowing growth in agricultural productivity as well as the government policies. The palm oil industry in Malaysia is vulnerable to price fluctuations due to changes in the world economic forces such as fundamental factors of supply, demand and other technical and social factors (Mad Nasir, Zainalabidin and Fatimah, 1988).

Strong demand for oil palm products will lead to an increase in palm oil prices in the market. However if the supply of palm oil growth is much faster than its demand, the prices will be negatively affected (Fatimah and Amna Awad, 2013). The low stocks or uncertainty about stock levels in some countries also causes price to rise sharply. Stocks can be drawn down in response to a supply or demand shock. However, supply cannot be increased until new production arrives. Malaysian average crude palm oil prices is used as a case study in this research. Suitable time series models are determined so as to obtain models that will be precise enough to forecast the data.

1.2 Problem Statements

The instability on food commodities price causes it to change rapidly over time. This also includes crude palm oil price. The palm oil prices fluctuated without any clear trend or cyclical pattern in the last three decades (Fatimah and Amna Awad, 2013). The volatility in palm oil prices is a significant risk in the production and marketing of palm oil. In the case of Malaysian crude palm oil, price forecasts represent valuable and fundamental information to direct and indirect traders in fats and oils market. There are few previous empirical studies on palm oil price prediction, ranging in complexity and data requirements from intuitive judgements through time series analysis to econometric models. The previous studies focuses on two approach ; the univariate and multivariate analysis.

In univariate analysis, the Box-Jenkins approach has been used where the Autoregressive Integrated Moving Average (ARIMA) model were used (Fatimah and Roslan, 1986; Khin, Zainalabidin, Chinnasamy and Seethaletchumy,2013). There are also artificial intelligent approach on forecasting the price by Abdul Aziz, Imbarine and Ismail (2013a) as well as fractionally integrated Autoregressive Moving Average (ARMA) by Abdul Aziz et al. (2013b) . In fact, Ahmad Borhan, Mohd Noor, Mohd Arif and Norhanani Mohd Baharin (2007) uses the difference between cash and futures prices to estimate the palm oil price in the future.

Meanwhile, in multivariate analysis, there are models that uses extreme values approach (Chuangchid, Wiboonpongse, Sriboonchitta and Chaiboonsri, 2012) and the multiple linear regression approach (Mad Nasir et al.,1988; Ramli and Mohd Alias, 2006). Furthermore, a study by Fadli, Nur Hayati, Errie Azwan, Bashir, Nurul Fahana and Kamaruzaman (2011) uses Johansen cointegration technique, error correction model and Granger causality tests in developing the forecast. These approaches relate palm oil price with various determinants such as total area planted,

production of crude palm oil, ending stock, price of crude oil, export product, domestic demand and price of other substitute oil.

Dynamic regression has gained attention of researcher in time series forecasting. It allows for the inclusion of information from the past observations of a series as well other information that may be relevant. There are two ways in formulating a dynamic regression model either as Autoregressive Distributed Lag (ARDL) or as Transfer Function (TF).

There has been increasing attention given to ARDL approach to derive the short and long-run relationship between variables. In forecasting price of palm oil using ARDL approach, a study by Fatimah and Amna Awad (2013) relates palm oil price with crude oil price and palm oil stock. Other study by Amna Awad, Fatimah, Mad Nasir and Zulkornain (2007) relates palm oil price with price of other oil substituent. Therefore, this study attempts to implement the ARDL model by relating palm oil price with other determinants. This includes stock, production, import and export of palm oil.

1.3 Research Objective

The objectives of this research are outlined as follows :

a. To develop the ARDL model in modelling the prices of palm oil.

b. To compare the performances of ARDL model with ARIMA model in modelling the prices of palm oil.

c. To compare the performances of ARDL model selected by using AIC and SBC in modelling the prices of palm oil.

d. To examine the long-run relationship between the prices of palm oil with its determinants.

1.4 Research Questions

This study attempts to address few research questions. The questions are stated below:

a. What is the ARDL model that can best fit the price of palm oil within the sample given?

b. Does ARDL model perform better than ARIMA model in modelling the prices of palm oil?

c. Does ARDL model selected by using AIC performs better than model selected by using SBC in modelling the prices of palm oil?

d. Does price, import, export, stock and production of palm oil exhibit long-run relationship?

1.5 Scope of the Study

This study focuses on the performances of time series model in modelling the monthly prices of palm oil by applying statistical tools incorporated in Eviews and Microfit. This study uses monthly prices of crude palm oil as well as monthly production of crude palm oil, monthly closing stock of crude palm oil, monthly export and import of crude palm oil from January 2000 until December 2013. All of the data were obtained from the official portal of Malaysian Palm Oil Board. The estimated value from ARDL or ARIMA model were compared to the actual value obtained beforehand.

1.6 Significance of the Study

This study aims to forecast the monthly price of palm oil using ARDL model. Apart from that, the study also compared the performances of ARDL model with other forecasting model such as ARIMA. It is expected that the findings of this study will be able to help in decision making especially among consumers, businesses and governments in the food commodities system.

For instance, the ARDL model will help potential investors to decide whether to be involved in crude palm oil market. As for the producers and manufacturers, the model will help to manage the demand and supply efficiently to avoid loss in the future. As for the government, the study will help to improve the profitability of the agricultural sector by imposing suitable export taxes on crude palm oil. This study also serves as an additional resources for studies related to dynamic regression method specifically the ARDL model.

1.7 Organisation of the Report

This study explores the use of ARDL models in modelling the prices of palm oil. This report consists of five chapters. Chapter 1 discusses the research framework. It starts with the introduction of time series and followed by statement of problems, objectives of the study, scope of the study and significance of the study.

Chapter 2 reviews some previous studies of the data forecasting and time series models related to the current study. It consists of the explanation and example of ARDL models in different areas and reviews on palm oil price forecasting. Chapter 3 describes the research methodology for this study. It consists of ARDL methodology and ARIMA methodology.

Chapter 4 presents the analysis of the data. The best model in ARDL were chosen based on AIC and SBC while the best model in forecasting the time series data will be chosen based on MAE and MSE. Discussion of the results will be presented in the last section of this chapter. Chapter 5 summarizes and concludes the whole study. Some suggestions for future study are also presented.

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