FORECASTING EXCHANGE RATE FOR THE
RINGGIT MALAYSIA VIS-À-VIS EURO

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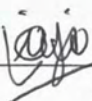@ Tesis dimaksudkan sebagai tesis bagi Ijazah Doktor Falsafah dan Sarjana secara penyelidikan, atau disertasi bagi pengajian secara kerja kursus dan penyelidikan, atau Laporan Projek Sarjana Muda (LPSM).

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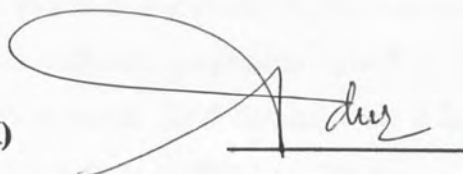
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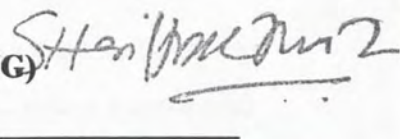HS2004-2577

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ABSTRAK

Kajian ini adalah berdasarkan aplikasi siri masa iaitu kaedah pendekatan Box-Jenkins yang digunakan untuk meramal kadar pertukaran mata wang antara Ringgit Malaysia dengan Euro untuk tahun 2007. Data yang digunakan adalah data harian dari 23 Ogos 2002 hingga 30 Ogos 2006. Data bagi 1000 cerapan telah digunakan untuk membina satu model yang akan meramal kadar pertukaran mata wang untuk 120 hari kemudian. Kewujudan punca unit diuji dengan ujian Dickey Fuller untuk mendapatkan data pegun. Dalam kajian ini, terdapat dua model yang disyaki mempunyai potensi untuk menjadi model yang terbaik iaitu model ARIMA (0,1,1)dan model ARIMA (1,1,0). Ujian Akaike Information Criteria digunakan untuk memilih model yang terbaik. Nilai ramalan daripada cerapan ke-1001 hingga cerapan ke-1020 telah digunakan untuk membuat perbandingan dengan nilai kadar pertukaran mata wang yang asal. Pengukuran kejituan model dihitung dengan kaedah Min Ralat Peratusan Mutlak. Model ARIMA (0, 1, 1) didapati merupakan model yang terbaik dan digunakan untuk meramal 120 hari pada jangka masa depan. Analisis data juga menunjukkan model ini menghasilkan nilai ralat yang kecil di mana nilai asal tidak jauh berbeza dengan nilai ramalan.

ABSTRACT

This study was based on the application of time series forecasting method which is Box-Jenkins method to forecast the exchange rate between Ringgit Malaysia and Euro for year 2007. Data that is used is a daily data from August 23rd, 2002 to August 30th, 2006. The 1000 observations data were used to establish a model to forecast for the 120 days following. The present of unit root was tested using the Dickey-Fuller test to determine the stationary data. In this research, two possible models, ARIMA (0, 1, 1) and ARIMA (1, 1, 0) are suspected to be the best model for forecasting. Akaike Information Criterion (AIC) is used to choose the best model between the two models. The estimated values from 1001 observation to 1020 observations were used to compare with the actual exchange rate. Forecasting accuracy measurement is determined by the Mean Absolute Percentage Error (MAPE). Model ARIMA (0, 1, 1) is determined to be the best model and it is used to forecast the 120 days ahead. Data analysis shows that this model produces a small error where the value of observations and the value of forecast are not much different.

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LIST OF SYMBOLS

ε_t	residual
χ^2	Chi-squared distribution
$\sum$	summation
e	exponential
RM	Ringgit Malaysia
€	Euro

CHAPTER 1

FOREWORD

1.1   Introduction

In the early of B.C., the concept of foreign exchange had existed although the monetary system did not exist. In the barter system, mankind began to trade foods, spices, silks and other commodities. As trade became formalized, specific mediums of exchange such as gold, silvers, precious metals and shells had been recognized. The value of the traded goods became related to certain quantity of commodities and thus currencies evolved, each with a value which could be measured against others (Carew & Slayter, 1995).

A foreign exchange rate is the relative value between two currencies. In particular, it is the quantity of one currency required to buy or sell one unit of the other currency. It is by far the largest market in the world and includes trading between large banks, central banks, currency speculators, multinational corporations,

governments and other financial markets and institutions. For instance, according to table 1.1, an interpretation from Bank Negara Malaysia's online foreign exchange data, one Great Britian Pound can be exchanged for RM 7.00 and 100 Japanese Yen can be exchange for RM 3.14.

Table 1.1 Middle Rates in relations to the RM at 12 noon Malaysian time, equivalent to one unit of foreign currency (unless stated otherwise)

	USD	GBP	EUR	CHF	AUD	CAD	SGD	SDR
1/9/2006	3.6790	7.0035	4.7111	2.9883	2.8131	3.3290	2.3398	5.4733
	JPY100	HKD100	THB100	PHP100	TWD100	KRW100	IDR100	SAR100
	3.1379	47.2995	9.8002	7.2493	11.1919	0.3829	0.0405	98.0906

(Source : http://www.bnm.gov.my)

1.2   Historical Background

1.2.1   The Classical Gold Standard

Classical Gold Standard Era is the western's golden age in the nineteenth and twentieth century. With the troublesome problem of silver, the world was on a gold standard. This meant that each national currency like dollar, pound and others was merely a name for a certain definite weight of gold.

Central banks played an important role in the classical gold standard. The international gold standard provided an automatic market mechanism for keeping the balance of payments of each country in equilibrium. Many central banks inflate its supply of money and then its prices will rise. These increasing incomes in money will lead to the prices of imports being lower. At the same time, the higher prices at one's country will discourage exports and were deficit in the balance of payments, which must be paid for by foreign countries cashing for gold. If the inflation has taken the form of bank deposits, then the central banks have to decrease their loans and deposits in order to avoid bankruptcy. The contraction lowers prices at own country and generates an export surplus, thereby reversing the gold outflow, until the price levels are equalized in the central banks.

1.2.2   The Interwar Gold Standard

After the World War One, Britain and other countries were facing a postwar experience of inflation and exchange rate instability. Based on principles developed at the Genoa Conference in 1922, members were encouraged to adopt central bank statues that substituted foreign exchange for gold reserves and discourage gold holdings by the private sector (Bordo & Jonung, 2000). United States remain dollars in gold while Britain and the other countries of the west returned to a pseudo-gold standard. British pounds and other currencies were not payable in gold coins except for international transactions. This prevented the ordinary citizens of Britain and other European countries from using gold in their daily life and thus permitted wider degree bank inflation. This new system only lasted for 6 years.

1.2.3 The Bretton Woods Era

During the 1930s, many of the world's major economies had unstable currency exchange rates and many nations used restrictive trade policies. In the early 1940s, the United States and Great Britain had developed a proposal for the creation of new international financial institutions that would stabilize exchange rates and boost international trade. Therefore an agreement that is Bretton Woods Agreement has established (Bordo & Jonung, 2000).

Bretton Woods system was the first example of a fully negotiated international monetary framework to govern currency relations among independent nation-states. In this monetary system, the exchange rate of each countries currency will not be permitted to fluctuate beyond a range of 1%. Under this system, central bank of countries other than United States was given the task of maintaining fixed exchange rate between their currencies and the U.S. dollar. If a country's currency was too high relative to the U.S. dollar, its central bank would sell its currency thus pulling down the value of its currency. On the other hand, if the value of a country's money was too low, the country would buy its own currency to pull up the price. United States has agreed that trading of gold at the price $35 per ounce. This was called the 'pegged rate' or 'adjustable peg' currency system, also known as the par value system.

Under Bretton Woods's system, the new international monetary system, the International Monetary Fund (IMF) and the International Bank for Reconstruction and Development or better known as World Bank were established. IMF provides temporary financing for a country when the country experiences financial problems.

IMF usually commits in lending aid over a period of three years. Meanwhile, the World Bank's initial objective is to help fund post-war reconstruction in Europe. This bank lends to poor countries which need financial help as well as provide loans at the different rate to the different countries.

US dollar became the international reserve currency after the war. Other countries were happy to let the United States went from being in surplus to running trade deficits because this will provide liquidity in the international monetary system. However, if United States attempted to correct its balance of payments deficit, it would cause a liquidity crisis. If the deficits continue, other countries will lose confident in the US dollar as reserve currency. With the announcement from United States regarding the abandon of the convertibility of the dollar, Bretton Woods era have come the end (Joshini, 2006).

1.2.4   Floating Exchange Rates Era

With the dollar breaking apart, the world shifted again to a system of fluctuating fiat currencies. In the early years of floating exchange rate, it is often characterized as a 'dirty float'. The world has become fed up with the unprecedented inflation and unpredictability of currency exchange rate. This volatility is the consequence of the national fiat money system which fragmented the world's money and added artificial political instability to the natural uncertainty in the free market price system. In recent years, floating exchange rates have been assailed from many quarters for excessive volatility in both nominal and real exchange rates, which in turn increase

macroeconomic instability and raise the costs of international transactions (Bordo & Jonung, 2000).

1.2.5 Towards European Monetary Union

Europe had moved steadily towards a new monetary union with perfectly fixed exchange rate after the breakdown of Bretton Woods's system. The European Council encouraged participating countries to keep the fluctuations of their currency exchange rates within an acceptable band. However, it collapsed at the end because of the pegged exchange rates, capital mobility and policy autonomy did not mix. It collapsed in the face of massive speculative pressure on countries, regardless of whether they were following policies inconsistent with their pegs to Germany or seemingly following the rules whose ultimate commitment to the peg was doubted by the agents in financial markets in the face of rising unemployment (Bordo & Jonung, 2000).

1.3 Forecasting

The term forecasting is generally used in the context of trying to predict the future, the principles apply equally well to predicting cross-section variables (Ramanathan, 2002). In making a forecast, it is also important to provide a measure of how accurate one can expect the forecast to be. The use of intuitive methods usually precludes any quantitative measure of confidence in the resulting forecast. The statistical analysis of the individual relationships that make up a model, and of the model as a whole, makes it possible to attach a measure of confidence to the forecasting model.

Exchange rate forecasts are necessary to evaluate the foreign denominated cash flows involved in international transactions. Thus, exchange rate forecasting is very important to evaluate the benefits and risks attached to the international business environment. There are two pure approaches to forecasting foreign exchange rates. They are the fundamental approach and the technical approach.

1.3.1 The Fundamental Approach

The fundamental approach is based on a wide range of data regarded as fundamental economic variables that determine exchange rates. These fundamental economic variables are taken from economic models which included variables like GNP, consumption, trade balance, inflation rates, interest rates, unemployment, productivity indexes and many more. In general, the fundamental forecast is based on structural (equilibrium) models. These structural models are modified to take into account statistical characteristics of the data and the experience of the forecasters.

1.3.2   The Technical Approach

The technical approach focuses on a smaller subset of the available data. In general, it is based on price information. The analysis is "technical" in the sense that it does not rely on a fundamental analysis of the underlying economic determinants of exchange rates or asset prices but only on extrapolations of past price trends. Technical analysis looks for the repetition of specific price patterns. The most popular technical approach models are simple and rely on filters such as moving averages (MA) or momentum indicators.

1.4   Objectives

    i.   To build a model with Box-Jenkins method.

    ii.   To measure the accuracy of forecasting.

    iii.   To estimate the exchange rate for the Ringgit Malaysia against Euro for the year 2007.

1.5   Research Scope

The scope of this research is using the daily middle exchange rate data of Ringgit Malaysia against Euro over the period of four years, from 23rd August 2002 to 30th August 2006. Data were taken from Bank Negara Malaysia's online foreign exchange rate. Model forecasting that being used in this reasearch is the Box-Jenkins model.

CHAPTER 2

LITERATURE REVIEW

2.1   Introduction

Forecasting foreign exchange rate is an important factor for the success of many businesses and fund manager. Therefore, the research regarding the forecasting exchange rate started at the early of 1970s when the world is adopting a system of floating exchange rates. There are numerous method that been used in forecasting exchange rate like econometric model, time series model, structural monetary model and others. Most of the researches are based on the east countries and less on the Asia Pacific.

2.2   Forecasting Exchange Rate

2.2.1   Parametric and Non-parametric Technique

According to Ince and Trafalis (2005), two stages of forecasting that is parametric techniques and non-parametric techniques have been proposed. Parametric techniques

include autoregressive integrated moving average model (ARIMA), vector regressive (VAR) and co-integrated technique while non-parametric techniques include support vector regression (SVR) and artificial neural network (ANN). A combination of the parametric and non-parametric technique is used in this study. As everyone knows, a parametric technique has specific assumption and this assumption has become its weakness while non-parametric technique does not have any assumption. Therefore, a combination of both techniques will produce the best forecasting model.

ARIMA and VAR will be used to determine the input in the first stage. Next, ANN and SVR are applied to the models that are specified in the first stage. Two machine learning techniques, multilayer perceptron (MLP), which uses the back-propagation algorithm as a training algorithm is used. The results show that ARIMA input will gives the best result for forecasting if SVR method is used. On the other hand, MLP network will perform the best if VAR technique to determine the input is used. From this research, combination of parametric and non-parametric technique is found to be as good as the pure technique.

Zhang (2001) stated that in the real world, there are rarely time series that are pure linear or pure non-linear. They often contains both linear and non-linear characteristic. Therefore, in his research, a combination of ANN and ARIMA model is carried out. The results are the same with the researcher Ince and Trafalis (2005) that the combination of model will perform the best among pure models like ARIMA and ANN model.

Another research on ANN and ARIMA models are done by Kamaruzzaman and Sarker (2003). In this paper, they are comparing the ANN-based model with the ARIMA model. There are three basic forecasting models using Standard Backpropagation (SBP), Scaled Conjugate Gradient (SCG) and Backpropagation with Bayesian Regularization (BPR). The research is focused on the exchange rate of the Australian Dollar with six other currencies such as US Dollar (USD), Great British Pound (GBP), Japanese Yen (JPY), Singapore Dollar (SGD), New Zealand Dollar (NZD) and Swiss Franc (SDR). ARIMA model is found to be suitable for short-term forecasting while ANN exhibit better performance in short-term and long-term forecasting. Overall, ANN outperforms ARIMA model and among the three ANN-based models, SCG will be the best model for forecasting.

2.2.2   Econometric Technique

Bhawnani and Kadiyala (1997) used econometric techniques to forecast exchange rates in three developing countries that is India, Mexico and Pakistan. The Bilson-Frenkel flexible price model (BF), sticky-price Dornbush-Frankel model (DF), Edison's error correction model, Agenor's monetary model and an alternative model that are proposed by them are use in this research. There are many important variables included in these models like money supply, interest rate, inflation rate, price level, nominal market stock and many other variables. The researcher uses predicted value and actual value for forecasting. With the predicted value, they found out that by using predicted value, the alternative model will perform the best while Agenor's model exhibits the worst forecasting. However, the result is different by using the actual values. The BF and DF models perform badly in these three countries.

From the research, the performance of the model for India and Pakistan are very similar. One of the factors is because of the geographical location of the two countries. The alternative model that is proposed by the researchers could be used for the long-run and short-run. Therefore, it is tested to be the better model for prediction.

2.2.3 Time Series Technique

a)   Multivariate Time Series

Another way of forecasting exchange rate is using the multivariate time series. This had been done by the researchers, Hoque and Latif (1993) for the Australian currency against the United States currency. In their research, they compare three models that is Bayesian vector autoregressive (BVAR), vector autoregressive (VAR) and structural model. Five variables have been included. They are:

i)   LERI - log of exchange rate index

ii)   TMRF - three month forward rate

iii)   CAB - current account balance

iv)   R - log of long-term relative interest rate

v)   P - log of relative price

VAR model allow all the variable interact linearly and uses the historical data to determine the quantitative impact while the BVAR combine the prior belief that gives researcher some flexibility in expressing their natural beliefs. Structural model outperform the best among three models in this research.

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