Abstract

The present study is an attempt to build a new statistical model to forecast the value of imports in Malaysia. The study will use regression, time series, and a composite model (combining of regression and time series) methods. According to the data available, the time frame for this study will be determined by using monthly data covering the period between 1990-2010 (a period building model) and the period between 2011-2013 (as a period for testing the predictive ability model proposed). The study will be limited to six variables which are the exchange rate, average tariff tax, average sales tax, producer price index, value of exports and the value of imports in the previous time period. The study is of great importance in helping of Malaysia in drawing policies for imports in general, and particularly imports of machinery and transport equipment, and crude materials, as the proportions spent on total imports of machinery and transport equipment and crude materials were respectively 56%, 3% of the total value of imports in Malaysia during the study period. The current study considers utilization of probabilistic forecasting methods in the decision-making process which reflects the level of uncertainty in future demand forecasts.

Keywords—Malaysia’s Import, Forecasting, Regression, Time Series, Composite Model.

Introduction

The imports in the world occupy big place. It has been proven that, there is relationship between imports and economic growth. As stated in Liu, et al.(2001), Chen, et al.(2009), Azgun, et al.(2010), Alam, et al.(2009), Wong, et al.(2004) and Kogid, et al.(2011) concluded that, imports have an impact on economic growth in Malaysia, and he recommended to focus on the study of imports in the long term. Based on that, in this work we are trying to build appropriate statistical model to predict the value of imports in Malaysia. In order to help Malaysia in drawing imports policies in the future.
The nature of imports. As reported in (Department of statistic in Malaysia) the classification of imports differs according to their objectives, the following study uses the SITC (Standard International Trade Classification) developed by the United Nations and in which imports of commodities are divided into 10 parts, such as:
0 – Food.
1 – Beverages and Tobacco.
2 – Crude Materials.
3 – Mineral fuels, lubricants, etc.
4 – Animal and Vegetable oils and fats.
5 - Chemicals.
6 – Manufactured goods.
7 – Machinery and Transport Equipment.
8 – Miscellaneous manufactured Articles.
9 – Miscellaneous transaction and commodities.

In Figure 1 the following Table 1 shows the amount of imports in Malaysia during the years from 1990 to 2010 as they increased from 79118.6 million (RM) in 1990 to 529194.8 million (RM) in 2010 with a growth rate of 568.86%.

The study is limited to imports of machinery and transport equipment, and crude materials. As the large increase in the volume of imports of machinery and transport equipment was up to 56% during the years of the study, as shown in Figure 2, especially with skyrocketing of their prices, as well as the negative effects of the local currency, local industries competition and internal price levels. On the other hand, there was an acute reduction in the volume of imports of crude materials was up to 3%. We know that crude materials are crucial elements in industry, and how industry plays a great role in the community development. Hence, this requires to decrease imports of machinery and transports equipment, and to increase the volume of imports of crude materials.

<table>
<thead>
<tr>
<th>Code</th>
<th>Commodity sections</th>
<th>1990</th>
<th>2010</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Food</td>
<td>4582.5</td>
<td>18168</td>
</tr>
<tr>
<td>1</td>
<td>Beverages and Tobacco</td>
<td>292.9</td>
<td>2815</td>
</tr>
<tr>
<td>2</td>
<td>Crude Materials , lendable</td>
<td>2551.2</td>
<td>19128.8</td>
</tr>
<tr>
<td>3</td>
<td>Mineral Fuels , lubricants, etc</td>
<td>4021.0</td>
<td>101958.4</td>
</tr>
<tr>
<td>4</td>
<td>Animal and Vegetable oils and ats</td>
<td>218.0</td>
<td>54139.4</td>
</tr>
<tr>
<td>5</td>
<td>Chemicals</td>
<td>6716.8</td>
<td>40168.3</td>
</tr>
<tr>
<td>6</td>
<td>Manufactured goods</td>
<td>12499.1</td>
<td>56391.2</td>
</tr>
<tr>
<td>7</td>
<td>Machinery and Transport Equipment</td>
<td>39740.5</td>
<td>280416</td>
</tr>
<tr>
<td>8</td>
<td>Miscellaneous Manufactured Articles</td>
<td>4496.8</td>
<td>60406.7</td>
</tr>
<tr>
<td>9</td>
<td>Miscellaneous Transactions and commodities</td>
<td>3999.6</td>
<td>3780.6</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>79118.6</td>
<td>529194.8</td>
</tr>
</tbody>
</table>

Source : Department of Statistics Malaysia, official portal.
Obviously, the research is of great importance in helping Malaysia in drawing policies for imports in general, and particularly imports of machinery and transport equipment, and crude materials, as the proportions spent on total imports of machinery and transport equipment and crude materials were respectively 56\% , 3\% of the total value of imports in Malaysia during the study period, as shown in Figure 2.

Variables related to study. Several factors affect the value of imports of machinery and transport equipment, and crude materials, but this study is limited to following factors because of their significant role on imports and, they have been repeatedly studied in the literature.

1. Exchange Rate.
2. Tariff Tax.
3. Sales Tax.
4. Producer price index.
5. Lagged quantity of imports.

6. The volume of exports.

The research problem

The research problem begins to crystallize in trying to build an appropriate statistical model for predicting the value of imports in Malaysia, and setting up clear and comprehensive mechanism for the application of the models in the theoretical side. Wong, et al. (2004) shows that, changes in trade have a significant impact on economic growth in Malaysia, and Kogid, et al.(2011) concluded that, in Malaysia during the observed period, economic growth is significantly influenced by import. Therefore, more emphasis should be accorded on this determining factor especially in the drafting of the long term economic growth policies of the country. The absence of a suitable statistical model to predict the value of imports will reflect in drawing financial and economic policies in the future. Based on that, in this work we propose to build an appropriate statistical model to predict the value of imports in Malaysia, and setting up clear and comprehensive mechanism for the application of the models in the theoretical side. In order to help Malaysia in drawing imports policies in the future.

Research objectives

- To build the right model to predict the value of imports in Malaysia using several statistical methods including Regression analysis, Time series analysis and Composite model(Combined Regression and Time Series Model).
- To identify the most important economic variables that affect the value of imports in Malaysia.
- To choose right form among following forms, linear form, double-log form, semi log form, and exponential form in order to build the right model in regression to predict the value of imports.
- To highlight the mechanism of the application of models to predict and how to overcome problems during the analysis in the theoretical side.

Research questions

- Which one of the following models is better to build the right statistical model to predict the value of imports in Malaysia? Regression analysis, Time series analysis and Composite model (Combined Regression-Time Series Model).
- Which one of the following variables has more effect on the imports in Malaysia? Exchange rate, Average Tariff Tax, Average Sales Tax, producer price index, and the value of imports in the previous time period.
- Which one of the following models is better in predicting the value of imports in Malaysia in terms of regression linear form, double-log form, semi-log form and exponential form?
- How does the mechanism of the application of these models theoretically contribute to predicting and overcoming problems during the analysis?

Scopes of research

The study will focus only on two types of imports (M.C) regarding their importance to the researcher and leave the rest of imports to be treated by other researchers. According to
the data available the time frame for this study will be determined by using monthly data covering the period between 1990-2010 (a period building model) and the period between 2011-2013 (as a period for testing the predictive ability model proposed).

The study will be limited to six variables which are: exchange rate, average tariff tax, average sales tax, producer price index, the value of exports and the value of imports in the previous time period.

Literature Review

Empirical studies on the relationship between the imports and the economic growth are Chou, et al. (2008) a modified regression model for forecasting the volumes of Taiwan’s imports, using data from 1989 to 2001, and then compares the accuracy of the traditional regression model and this modified regression model proposed. Used eight factors: Export, population, GNP, GNP per capita, GDP, agricultural GDP, industrial GDP and service GDP. Zhou, et al. (2012) analyzed the potential seasonality of China’s crude oil import. In order to achieve the goal X-12-ARIMA method was used. Yue, et al. (2010) examined a import demand model for Cote d’Ivoire, and used cointegration technique to analyze time series data for the period 1970-2007. Used four factors: final consumption expenditure, the investment expenditure, the export expenditure and relative prices. Wang, et al. (2012) estimated the import demand elasticity for China using three fully efficient cointegrating regressions and the autoregressive distributed lag (ARDL) method. Narayan, et al. (2008) studied forecast Fiji’s exports and imports for the period 2003-2020. To achieve the goal, the autoregressive moving average with explanatory variables (ARMAX) model was applied. Pappalardo, et al. (2004) evaluated several econometric models performing short horizon forecasts of Italian imports of goods. Putphan, et al applied time series and regression to forecast the monthly demands of lubricant products and Import demand models in regression was estimated with ordinary least squares (OLS), and Appropriate form in the estimate was linear. Used two factors: Gross Domestic Product, and Vehicle Production. Keck, et al. (2009) developed a time series model to forecast the growth in imports by major advanced economies in the current and following year (two to six quarters ahead). Sahu, et al. (2013) focused on forecasting the cultivated area, production, import and export of spices in India and China using Autoregressive Integrated Moving Average (ARIMA) model. Shu, et al. used and compared autoregressive integrated moving average (ARIMA) model, Grey model, and their joint Fourier modified models, in order to obtaining an efficient model to forecast the cargo throughput at a sea port. Wu, et al. (2011) concerned about specifying the threshold autoregressive model and forecasting using U.S. Imports. Abd, et al., (2013) used and compared forecasting accuracy between ARIMA model, Regression model and neural network model. This study depended on three factors: population size, wheat area, and production, and form of regression function was linear. Zhang, et al. (2013). Take the total volume of import and export trade of Ningbo port in 2004-2011 as the original data, a mathematical model of gray forecasting is established for the total volume of import and export trade of port. Kargo, et al. (2007) used alternative approaches to forecasting agricultural exports and imports in South Africa. The models used include: exponential smoothing, autoregressive integrated moving average (ARIMA), vector autoregression (VAR), Engle–Granger (EG) single equation and vector error-correction models (VECM). Farinelli, et al. (2009) presented an empirical analysis of the import demand for Brazilian ethanol. Import demand models were estimated with ordinary least squares (OLS), using quarterly time series data for the 1997-2007 time period, and Appropriate form in the estimate was logarithmic. Used seven factors: G.D.P, exchange rate, import tariff, trend,
lagged quantity of ethanol, imports price, and world imports crude oil price. Khan, et al.(2011) selected an appropriate model for time series forecasting of total import of Bangladesh. More, et al.(2012) discussed a possibility to predict future export and import values of Croatian furniture industry on the basis of established values in the period 2000.-2010. Where used time series models to predict in future. Because of turbulences in this market and the length of analyzed time series the prediction is limited to the year 2015. Yazdani, et al.(2008) aimed this study to the corn import demand estimation for the Iranian economy. The specification of corn import has been estimated using the least squares estimators(OLS) and a conventional set of explanatory variables, and Appropriate form in the estimate was logarithmic. Used six factors: relative price. Per capita national disposable income, Quantity of domestic product(corn), Quantity of domestic consumption(corn), First lag of Governmental Stock corn quantity and Dummy variable (corn insurance). Ghafoor, et al.(2005) conducted to analyze the growth rates and forecasting of three important variables of the wheat economy in Pakistan i.e. production, procurement and imports. Time series data were used from 1970 to 2003. Import demand function of wheat was also calculated to establish a relationship between government procurement and wheat imports. Cadogan, et al.(2010) provided a sectoral examination of the impact of trade policies and custom valuation procedures on estimating time varying import content of Japanese transplant automobiles. Import demand models were estimated with ordinary least squares (OLS), using monthly data from 1985-1992, and Appropriate form in regression equation was logarithmic. Using, they introduce an error correction model (ECM) and a state space VAR model to purify trade data of measurement errors induced by unobservable prices and customs valuation procedures. Used three factors: IP,REER and VIX. Rogers, et al.(2000) behaviour of Fiji’s imports during the period 1968-1998 was studied and important factors that determine imports are identified. The estimation of an error correction model enables the separation of the short- and long-run elements of this relationship. Fukumoto, et al.(2012) estimated the disaggregate import demand functions for three basic classes of goods as defined in the System of National Accounts (SNA): capital goods, intermediate inputs, and final consumption goods, and use the findings to shed light on the effects of China's economic growth on its current account. Lutero, et al (2010) examined the forecasting approach of foreign trade unit value indices followed in the compilation of quarterly national accounts of Italy. Total imports and exports indices are indirectly obtained from the aggregation of ARIMA forecasts.

Methodology

Through research objectives will use the experimental method to build the right model to predict the value of imports in Malaysia.

- Using regression to build the right model to predict the value of imports, and chooses the best one of the commonly used economic forms are linear form – Double-log form – semi log form – exponential form on the basis of stages as in the following chart.
Using time series analysis to build the right model to predict the value of imports in Malaysia. In this research, we will use Box-Jenkins method to build the right model to predict the value of imports in Malaysia.

Use composite model (combining regression with time series) to build the right model to predict the value of imports in Malaysia. As cited in Pindyck, et al.(1998), the regression model takes the following form:

\[ y_t = a_0 + b_1 x_1 + b_2 x_2 + \epsilon_t \]

The error term (\( \epsilon_t \)) in equation above expresses of the random part which unexplained in \( y_t \) by explanatory variables \( x_1, x_2 \). However, one of the sources of prediction error equation comes through an additive error term which cannot predict its value. Therefore, we can use method time series analysis to build ARIMA model of the residuals of the estimated regression equation in the first stage, and then substitute the ARIMA model for the residuals of the error term in the estimated regression equation. The combined regression time series model is:

\[ y_t = a_0 + b_1 x_1 + b_2 x_2 + \phi^{-1}(B)\theta(B)\eta_t \]
Figure 4: Stages of building the statistical model using the Box-jenkins method:

Where:
Yt: the dependent variable (Regression).
x: Explanatory variables.
Φ, θ: Autoregressive Coefficients and Moving Average Respectively.
ηt: Error term (follows a normal distribution and has a contrast differs from 𝜖t).

Stages of building the statistical model using composite model (Combined Regression-Time Series Model).

The first stage: Using time series analysis to build ARIMA model of the residuals of the estimated regression equation in the first stage.
The second stage: Substitute of ARIMA model for residuals with the error term in the estimated Regression equation.
The third stage: Use the model in forecasting.

A comparison between models

We should distinguish between two types of prediction Ex post forecasting and Ex ante forecasting. Both predict the values of the dependent variable after the estimation period, but in this case Ex post forecasting the values of the dependent variable and explanatory variables are known exactly. While in the case Ex ante forecasting values of the dependent variable are unknown.

\[ t_1 \quad 1990-2010 \quad t_2 \quad 2011-2013 \quad t_3 \quad > 2013 \]
In the first step. We can verify the prediction by using the following table.

<table>
<thead>
<tr>
<th>Estimation Period</th>
<th>Ex post Forecasting</th>
<th>Ex ante Forecasting</th>
</tr>
</thead>
</table>

A table of values that will predict the results during testing the model (2011-2013).

<table>
<thead>
<tr>
<th>Month</th>
<th>The actual values</th>
<th>Values predicted using Regression</th>
<th>Values predicted using Time Series</th>
<th>Values predicted using Composite Model</th>
</tr>
</thead>
<tbody>
<tr>
<td>36</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Using the table, we can compare the actual values and predictive values, and this comparison provides us with the means to evaluate the model. While in the case Ex ante forecasting values of the dependent variable are unknown.

In the second step, measuring the accuracy of forecasting models: Lotfalipour, et al. (2013) shows that in order to calculate forecasting accuracy, the estimated results are evaluated by three different statistical methods.

- Root Mean Square Error (RMSE).
- Mean Absolute Error (MAE).
- Mean Absolute Percentage Error (MAPE).

The above criteria can be used in the comparison between the different models on the basis of value at least, with a note can be used to differentiate between the models for the following periods.
- Estimated Period.
- Ex post Period.
- Estimated and Ex post Period.

Expectation of the Research Results

The right model to predict:

We expect that the right model to predict the imports will be due to the use of composite model (Combined Regression and Time Series Model), because error term in equation composite model follows a normal distribution and error variance in the equation of the composite model is differs from the error variance in the regression equation.

Factors impact on imports:

We believe that all variables will have affect on imports, because they have been studied in the previous studied, the results show their significance with imports.

(Linear form – Double Log form – Semi log form – Exponential form):

Gujarati (2003) shows that There is no denying that a great deal of skill and experience are required in choosing an appropriate form, Khan, et al.(1977) suggested that the logarithmic formula has a preference on linear formula. There Empirical evidence supports this view, and Marquez, et al.(1989) reviewed the applied Studies during the period from 1941 to 1991 and found that among the 110 Empirical Study on estimating the determinants of the demand for imports 74 study adopted a logarithmic formula and assumed it was the most appropriate wording. Based on that, we expect that the appropriate form in this study will be logarithmic form.
Analysis Tools

The tools used in data analysis consists of SPSS and Minitab statistic programs.

Reference


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