Testing for Marshall-Lerner Condition: Bilateral Trades between Malaysia and Trading Partners

Siok Kun Sek  
School of Mathematical Sciences, Universiti Sains Malaysia, Penang CO 11800 Malaysia  
Email: sksek@usm.my

Wai Mun Har  
Faculty of Accountancy and Management, Department of Economics, UTAR, Selangor CO 11800 Malaysia  
Email: harwm@mail.utar.edu.my

Abstract—In this paper, empirical approaches are applied to test the validity of Marshall-Lerner condition, i.e. if devaluation in real exchange rate helps to improve the trade balance of domestic country. The analyses are focused on five pairs of bilateral trades between Malaysia and its main trading partners of China, EU, Japan, Singapore and U.S. respectively. Applying the Least Square and Fully Modified Least Square approaches, our results fail to show the validity of Marshall-Lerner condition in all five pairs of bilateral trades. However, our results show that higher income level of trading partners may lead to improvement in the trade balance of domestic country.

Index Terms—trade balance, exchange rate devaluation, Marshall-Lerner condition, cointegration.

I. INTRODUCTION

The impact of exchange rate on economics is always an interesting topic to be studied especially in the context of emerging economies. One of the impacts of exchange rate is through trade balance. The impact can be studied through price effect and quantity effect. The depreciation of exchange rate may lead to the changes in relative prices between imported and exported goods. The price effect takes place when depreciation of exchange rate makes imported goods more expensive than exported goods. Producer will adjust their volume of production in response to changes in prices which leads to deterioration in trade balance in the short run. However, cheaper exported goods may attract higher demand on domestic goods and the volume of production increase. Hence the quantity effect may improve the trade balance in the long run. This phenomenon, i.e. depreciation of exchange rate leads to improvement in the trade balance in the long run is named as Marshall-Lerner condition.

In this paper, we conduct empirical analyses to test the validity of Marshall-Lerner hypothesis in the bilateral trade between Malaysia and its main trade partners, for the period of 1980–2012. We fail to prove the validity of Marshall-Lerner condition in all five pairs of bilateral trades. Our results reveal that higher income of foreign trade partner may improve the trade balance of domestic country.

II. LITERATURE REVIEW

A. Theoretical Model and Concept

The modeling on the relationship between exchange rate and trade balance is discussed in many papers. The below discussion can refer to the paper by [1].

Theoretically, real exchange rate, \( E_t \) is defined to be domestic price level, \( P_t \) multiplied by nominal spot exchange rate, \( S_t \) and divided by foreign price level, \( P_t^* \).

\[
E_t = \frac{S_t P_t}{P_t^*}
\]

(1)

On the other hand, trade balance is calculated as the ratio of total export divided by total import as shown in equation (2):

\[
B_t = \frac{P_t X_t}{P_t^* S_t M_t}
\]

(2)

where total export is obtained by multiplying domestic price level with volume of export while total import calculated as foreign price level multiplied by nominal spot exchange rate and the volume of import. By expressing equation (2) into logarithms form (using lower case letters),

\[
b_t = x_t - m_t - (x_t^* - p_t^* + y_t^* + y_t^* \epsilon_t) = x_t - m_t - e_t
\]

(3)

We define the long run demand functions for export and import as in equation (4) and (5):

\[
x_t = \alpha_x + \beta_x x_t^* + \gamma_x \epsilon_t
\]

(4)
\[ m_t = \alpha_m + \beta y_t + \gamma_m e_t \quad (5) \]

where \( y_t \) and \( y_d \) are the real income for foreign country and domestic country respectively; \( \gamma_s \) and \( \gamma_m \) are the elasticities of export and import respectively. Taking both equations into trade balance equation in (3), we finally get the long run trade balance equation as below:

\[ b_t = (\alpha_s - \alpha_m) + \beta_s y_t - \beta y_s + (\gamma_s + \gamma_m - 1)e_t \quad (6) \]

For Marshall-Lerner condition to be hold, we should fulfill the following condition:

\[ \gamma_s + \gamma_m - 1 > 0 \]
\[ \gamma_s + \gamma_m > 1 \]

**B. Empirical Review**

Despite being studied numerous times, there is still no conclusive evidence to proof a general validity of Marshall-Lerner theorem. Nonetheless, there are relatively more literatures that supported the existence Marshall-Lerner (ML) condition.


Among other past literatures that support ML condition exists in various countries include [15]-[22], [23] revealed positive and significant relationship between exchange rate increase (devaluation) and trade balance for France, Finland and New Zealand but negative and significant results for United Kingdom and Guyana. [24] found negative but very weak correlation between current account and exchange rate while [25] reported long-run cointegration. The later also reported no causality evidence. [26] found ML condition for Turkey’s trade existed with seven of its nine largest trading partners, namely Austria, Belgium, England, Germany, Holland, Italy and United States for the period between 1960 and 2000. The two exception countries are France and Italy. Interestingly, [8] found ML condition holds for bilateral trade between Brazil and Italy. [27] revealed marginal impact between real exchange rate and trade balance in Sri Lanka.

Nonetheless, there are also literatures whose claimed ML condition is not statistically supported. Among them are [28] who studied on selected OECD countries (United Kingdom, Canada, Germany, Japan, and the United States); [29] on Sweden; [30] on ASEAN countries; and [31] on United States and Singapore. Studying Gulf Corporation Council countries of Kingdom of Bahrain, Kuwait, Oman, Qatar, Saudi Arabia, and United Arab Emirates for the period between 1980 and 2006, [32] claimed ML condition does not hold. Other findings not supporting ML condition are [33], [34] and [35].

Various reasons of not fulfilling ML condition being proposed by previous literatures. [15] and [36] believe that Italy’s high inflation countered the positive effect of devaluation. Lengthy lag time may also affect the validity of ML condition. Among reported lag time adjustments are three quarters as in [17], six quarters as in [16] and two years as in [15]. Meanwhile, [29] and [30] claimed that trade balance is more responsive to income effect and real money respectively as compared to exchange rate. Other reasons possibly affecting the validity of ML condition include effect of exchange rate volatility with level of exporters’ risk tolerance as in [37] and [38] that exchange rate misalignments and price rigidity. Exchange rate system also plays an influencing role with more literatures found fixed regime likely enable validity of ML condition as mentioned in [8], [9] and [12].

**C. Research Background–Bilateral Trades of Malaysia**

Malaysia has been part of World Trade Organization (WTO) since 1995. Besides, Malaysia has been members of various trade commitments or co-operations such as ASEAN Free Trade Area (AFTA), Asia Pacific Economic Co-operation (APEC), South-South Cooperation and many others bilateral free trade agreement (FTA). [39] reported that Malaysia’s AFTA utilization ratio (share of export under FTA scheme) rose from merely 1.2% in 1990 to 17.8% in 2010. United Nations Commodity Trade Statistics (COMTRADE) data shows that Malaysia’s total merchandise exports and imports for year 2011 are about US$228.1 billion and US$187.5 billion respectively. Its top destinations of merchandise export are China (13.1%), followed by Singapore (12.7%), Japan (11.5%), European Union (10.4%) and United States (8.3%). Its top destinations for merchandise import also follow same order as export. Manufacturer products are top merchandise export component at 62% of total. “Fuel and mining” products amounted to 20.2% while agricultural export amounted to 17.1%. Merchandise import component also followed export ranking order.

Meanwhile, Malaysia’s commercial service exports and import for year 2011 totaled US$35.9 billion and US$38.3 billion respectively. There is no top destination information for commercial services export or import. Three top items of commercial service export import are highlighted. Travel is top commercial service export component (54.6%) but only ranked third for principle service import items. Transportation is the second highest service import items but ranked third in export category. “Other commercial services” item is top import and second
in export category for year 2011.

III. DATA

In this paper, we test the validity of Marshall-Lerner through the bilateral trade between Malaysia and its five main trading partners of China, EU, Japan, Singapore and U.S. respectively. In particular, we intend to investigate if devaluation of exchange rate will improve the trade balance in the long run. There are four variables used in this analysis namely the trade balance (TB), real exchange rate (RER), the income of trading partner (Y*) and the income of domestic country (Y). The trade balance is proxy by the ratio of total export/ total import while the real exchange rate is proxy by the real effective exchange rate based on consumer price and the income (Y*) and (Y) are proxy by industrial production index. The data for industrial production index is collected from Datastream while the other data are obtained from International Monetary Fund (IMF) and the data spans from year 1980 to 2012. All data are transformed into logarithm form. The detail of the data is as summarized in Table I.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Data Source</th>
<th>Period</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>Y</td>
<td>Log of Industrial production index for country i</td>
<td>1980-2012</td>
<td>Datastream</td>
</tr>
<tr>
<td>RER</td>
<td>Log of real effective exchange rate for Malaysia</td>
<td>1980-2012</td>
<td>IMF</td>
</tr>
<tr>
<td>TB</td>
<td>Log of the ratio of export/ import for Malaysia</td>
<td>1980-2012</td>
<td>IMF</td>
</tr>
</tbody>
</table>

IV. METHODOLOGY

A. Augmented Dicky-Fuller (ADF) Unit-Root Test

Unit-root test is used to identify if a series is stationary or non stationary. Assume a series follows an AR (p) process:

\[ y_t = \alpha_0 y_{t-1} + \ldots + \alpha_p y_{t-p} + u_t \]  

(7)

This equation can be written in lag operator form:

\[ (1 - \alpha_0 L - \ldots - \alpha_p L^p) y_t = u_t \]  

(8)

To test the stationarity process of \( \alpha(1) = 1 - \alpha_0 - \ldots - \alpha_p = 0 \), we can reparameterize equation (7) by subtracting \( y_{t-1} \) on both sides and rearranging terms to give (see [40]):

\[ \Delta y_t = \phi y_{t-1} + \sum_{j=1}^{p-1} \alpha_j \Delta y_{t-j} + u_t \]  

(9)

where \( \phi = -\alpha(1) \) and \( \alpha_j = -(\alpha_{j+1} + \ldots + \alpha_p) \). The hypotheses will be \( H_0 : \phi = 0 \) versus \( H_1 : \phi < 0 \). The ADF has the t-statistic of the coefficient \( \phi \) based on the OLS estimation on equation (9). The rejection of the null hypothesis indicates no unit-root problem or the series is stationary.

B. Cointegration Tests

Consider a cointegrating equation in the following representation:

\[ y_t = X_t^\prime \beta + D_t^\prime y_t + u_t \]  

(10)

With \( D_t = (D_{1t}, D_{2t}) \) as deterministic trend regressors. The \( n \) stochastic regressors of \( X_t \) are obtained from the system equation as below:

\[ X_t = \Gamma_{21} D_{1t} + \Gamma_{22} D_{2t} + \varepsilon_{2t} \]  

(11)

\[ \Delta \varepsilon_{2t} = u_{2t} \]

The innovations \( u_t = (u_{1t}, u_{2t}) \) are assumed to be strictly stationary with mean zero, contemporaneous covariance matrix \( \Sigma \), one-sided long-run covariance matrix \( \Lambda \) and nonsingular long-run covariance matrix \( \Omega \) as in [41].

\[ \Sigma = E(u_t u_t') = \begin{bmatrix} \sigma_{11} & \sigma_{12} \\ \sigma_{21} & \sigma_{22} \end{bmatrix} \]

\[ \Lambda = \sum_{j=0}^{\infty} E(u_{1t} u_{1t-j}) = \begin{bmatrix} \lambda_{11} & \lambda_{12} \\ \lambda_{21} & \lambda_{22} \end{bmatrix} \]

\[ \Omega = \sum_{j=-\infty}^{\infty} E(u_{1t} u_{1t-j}) = \begin{bmatrix} w_{11} & w_{12} \\ w_{21} & w_{22} \end{bmatrix} = \Lambda + \Lambda' - \Sigma \]

Both Engle-Granger and Phillips-Quliaris are tests based on the residuals obtained through OLS estimation of equation (10). The Engle-Granger test has the regression on the p-lag augmented Dicky Fuller equation:

\[ \Delta \hat{u}_{1t} = (p-1) \hat{\delta} + \sum_{j=1}^{p} \hat{\delta}_j \Delta \hat{u}_{1t-j} + v_t \]  

(12)

The two test statistics are:

\[ \hat{\xi} = \frac{\hat{\delta} - 1}{se(\hat{\delta})} \]

and

\[ \hat{\varpi} = \frac{T(\hat{\rho} - 1)}{1 - \sum_{j=1}^{p} \hat{\delta}_j} \]

where \( se(\hat{\delta}) = \hat{\xi} \left( \sum_{t} \Delta \hat{u}_{1t}^{-2} \right)^{-1/2} \) is the standard error for \( \hat{\delta} \) as in [42]. The null hypothesis is the series are not stationary.
cointegrated. The rejection of the null hypothesis will reveal the existence of cointegrating relationship.

On the other hand, the Phillips-Quliaris test is based on the following unaugmented Dickey-Fuller regression:

$$\Delta \hat{u}_t = (\rho - 1) \hat{u}_{t-1} + w_t$$  \hspace{1cm} (13)

The estimated results are used to compute the long-run variance of $w_t$. The test statistics are corresponding to the test statistics of Engle-Granger test:

$$\hat{\tau} = \hat{D}^* - 1$$

$$se(\hat{\rho}) = \hat{w}_{1/2} \left( \sum T \hat{\rho}_{11}^{-1} \right)^{-1/2}$$

where

And

$$\hat{\tau} = T \left( \hat{\rho}^* - 1 \right)$$

where

See the manual of Eviews 8 for details.

C. Estimation Approaches

A linear combination of two or more series that are I (1) will give stationary or I(0) series which we termed it as cointegrated. The linear combination that reveals cointegrating relationship will characterize the long-run relationship between variables as in [43]. If no cointegrating relationship is revealed, we will proceed with the estimation using Ordinary Least Square (OLS) approach where all variables are stationary variables in first differencing. In case cointegrating relationship is detected, we will proceed with the estimation using Fully Modified OLS or FMOLS as OLS ignores the long run information. FMOLS estimator is asymptotically unbiased. This method corrects for the problems due to the long run correlation between the cointegrating equation and the stochastic regressors innovations. Let $\hat{u}_t$ be the residuals from estimating equation (10). Then $\hat{u}_2 = \Delta \hat{\sigma}_2t$ can be obtained via regressing the following equation:

$$\Delta X = \hat{\sigma}_{21} \Delta d_t^1 + \hat{\sigma}_{22} \Delta d_t^2 + \hat{u}_t$$  \hspace{1cm} (14)

From $\hat{u}_2 = (\hat{u}_{12}, \hat{u}_{22})'$, we can compute $\hat{\sigma}$ and $\hat{\Lambda}$ which are used to define the modified data:

$$Y^* = Y_t - \hat{w}_{12} \hat{\Omega}_{22}^{-1} \hat{u}_2$$  \hspace{1cm} (15)

The biased correction term is computed as:

$$\hat{\lambda}_{12} = \hat{\lambda}_{12} - \hat{w}_{12} \hat{\Omega}_{22}^{-1} \hat{\Lambda}_{22}$$  \hspace{1cm} (16)

Whereas the estimator of FMOLS is given by:

$$\hat{\theta} = \left[ \begin{array}{c}
\hat{\Theta}_1 \\
\hat{\lambda}_{12}
\end{array} \right] = \left( \sum T \hat{Z}_1 \hat{Z}_2^* \right)^{-1} \left( \sum T \hat{Z}_1 \hat{y}_t^* - T \hat{\lambda}_{12} \right)$$

V. Result

Before conducting the estimation, the ADF unit-root test and cointegration tests are conducted to check the property of data. Table II summarizes the results of unit-root test. As observed, all variables are not significant at level, indicating the existence of unit-root at level. All variables become stationary after the first differencing process as the test statistics are significant at 1% level for all variables in first differenced. Since the variables are not stationary at level, applying these variables in OLS estimation may generate spurious results and gives incorrect conclusion.

Therefore, these variables should be transformed into stationary form via first differencing before entering the OLS estimation. However, the next consideration is if the variables are cointegrated or have long run relationship. If the cointegrating relationship is revealed, one should consider other approach for estimation such as using error correction model that considers for the long run information. OLS does not consider for long run relationship. Therefore, estimating the model with OLS when there is a cointegrating relationship may ignore the important information which is not efficient. Due to this reason, cointegration tests are conducted to detect the long run relationship among variables.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Test statistics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Level</td>
<td>First differenced</td>
</tr>
<tr>
<td>Y* - china</td>
<td>-1.6235</td>
</tr>
<tr>
<td>Y* - eu</td>
<td>-1.6837</td>
</tr>
<tr>
<td>Y* - jap</td>
<td>-2.0461</td>
</tr>
<tr>
<td>Y - mal</td>
<td>-0.2950</td>
</tr>
<tr>
<td>Y* - sp</td>
<td>-2.8687</td>
</tr>
<tr>
<td>Y* - us</td>
<td>-1.2099</td>
</tr>
<tr>
<td>RER</td>
<td>-1.4412</td>
</tr>
<tr>
<td>RER</td>
<td>-2.3542</td>
</tr>
</tbody>
</table>

Note: the test is specified with a constant and trend with Newey-West Bandwidth length selection

** indicates significant at 5% level and *** as significant at 1% level

Two cointegration tests are conducted, namely the Engle-Granger and Phillips-Quliaris tests. The tests are conducted for five different models which involve the bilateral trades between Malaysia and five main trading partners respectively. The results of the tests are reported in Table III. On overall, the results detect only one cointegrating relationship case, i.e. in the second model which involves the bilateral trade between Malaysia and EU countries. Therefore, model 2 will be estimated using FMOLS while in the other cases with no cointegrating relationship detected, OLS will be applied. The results of estimations are reported in Table IV.
From the results obtained, it is observed that the coefficient of RER is negative and not significant in all cases with the exception in the case of Malaysia–EU which is significant at 1% level. In order for Marshall-Lerner condition to be hold, the coefficient of RER should be positive, i.e. devaluation in real exchange rate leads to improvement in trade balance. In all cases, none of the coefficient of RER is positive. The results fail to detect the validity of Marshall-Lerner condition in bilateral trades between Malaysia and main trading partners.

The income levels of trading partners can have impact on the trade balance of domestic country. In the bilateral trade of Malaysia-China and Malaysia–U.S., it is observed that the increase in the income level of China and U.S. lead to significantly increase in the trade balance of Malaysia. This phenomenon can be explained by higher purchasing power of foreign households, hence higher demand of foreign households on the products of Malaysia which leads to higher export of Malaysia. On the other hand, the increase in the income of domestic country seems to have no significant impact on improving the domestic trade balance.

VI. CONCLUSION

In this paper, we seek to test if the Marshall-Lerner condition holds in the bilateral trades between Malaysia and its main trading partners. In particular, we seek to investigate if devaluation in the real exchange rate leads to improvement in the trade balance of domestic country. Applying cointegration tests, the results detect only one cointegrating relationship in the trade of Malaysia–EU. We then proceed with the estimations. Our estimation results fail to reveal the validity of Marshall-Lerner condition in all five pairs of bilateral trades. However, it is observed that higher income level of trading partners may lead to improvement in the trade balance of domestic country. Conversely, higher income level of domestic country does not help to improve the trade balance of domestic country.

REFERENCES


Siok Kun Sek was born in the city of Malacca, Malaysia. She completed her primary, secondary and high school in Malacca. She obtained her Bachelor Degree in Economics from the National University of Malaysia (Selangor, Malaysia), 1997-2000 and Master in Economics in the same university, 2000-2001. After that she furthered her doctoral study in Quantitative Economics at Christian-Albrechts-University of Kiel, (Kiel, Germany), 2005-2009. Currently she is a Senior Lecturer at School of Mathematical Sciences, Universiti Sains Malaysia (Penang, Malaysia). Her main interest is econometrics/ time series and monetary policy and exchange rate. Dr. Sek has joined IEEE since 2010. Besides a member of IEEE since 2010, Dr. Sek is also a life member of Malaysian Mathematical Society (PERSAMA) since 2010. She became a member of International Economics Development Research Center (IEDRC) since year 2011. In addition, she also joined The Econometric Society since 2011.

Wai Mun Har was born in Teluk Intan, Perak. received his primary education at Saint Anthony Primary School, Teluk Intan, before continuing his secondary study until Form Five at Saint Anthony Secondary School, Teluk Intan and Form Six at Horley Methodist Secondary School, Teluk Intan. This Perakian later enrolled to Universiti Kebangsaan Malaysia (UKM), Bangi. At UKM, Har received Bachelor of Economics (Hons) for the field of Industrial Economics. He later further his study in the same university until receiving his Master of Economics for the field of Financial Economics. Currently, he is a senior lecturer in Economics Department, Faculty of Accountancy and Management, Universiti Tunku Abdul Rahman (UTAR). Believing in holistic view of knowledge, Har’s research interest is inter-related across the domains of economics, politics, language and globalization. Mr. Har’s articles were published in various magazines and international journals. To date, he has also co-authored four books, namely Economics, Basic Quantitive Techniques, Globalisasi, Media dan Budaya: Antara Hegemoni Barat dengan Kebangkitan Asia and Development economics: Theories and issues and co-edited Sustainable Development Weltanschaung: Beyond Theories into Reality.