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ARE MALAYSIAN EXPORTS AND IMPORTS COINTEGRATED?

CHOONG CHEE KEONG[a]
Universiti Tunku Abdul Rahman

SOO SIEW CHOO
Monash University Malaysia

ZULKORNAIN YUSOP
Universiti Putra Malaysia

ABSTRACT

This paper investigates the long-run relationship between Malaysian exports and imports. Towards this end, multivariate cointegration techniques have been applied. For all measures (or cases), both the unrestricted and restricted cointegration results demonstrate that there exists a long-run relationship between Malaysian exports and imports. Simply put, both the variables will converge towards equilibrium in the long run which indicates the effectiveness of Malaysia's long-term macroeconomic planning in stabilising trade balance. Thus, the Malaysian economy does not violate its inter-temporal budget constraint.

Key words: Trade balance, Inter-temporal budget constraint, cointegration.

INTRODUCTION

Malaysia, as a small country with an open economy, is highly dependent on foreign trade. Any changes in the international market, either through price of commodities or international demand, and domestic macroeconomic policies—both fiscal and monetary policies—will greatly affect exports, imports and economic growth. Malaysia's dependency on trade is illustrated in Table 1. In the fifth column, we find that the dependency ratio (exports plus imports divided by nominal GDP) has been increasing from 1980 to 2000, and is expected to grow further in the future. This implies that the Malaysian economy is highly dependent on foreign trade. During the Asian financial crisis of 1997–2000, Malaysia's foreign trade volume (both exports and imports) was double that of its Gross Domestic Product (GDP).

The relationship between exports and imports is presented in Figures 1 to 4 for 1959 through 2000. In all four figures, exports and imports move closely together from 1959 to 1997. From 1998, however, both series begin to drift away from each other and fluctuate until 2000. It is strongly believed that the short-run disequilibrium is due to some forms of external and internal shocks in the Malaysian economy.

The Asian financial crisis that first erupted in July 1997 in Thailand before affecting Malaysia in the subsequent months, for example, is viewed as a source of disequilibrium for Malaysia's trade balance. Early in the crisis, Malaysia's macroeconomic policy underwent a

E-mail: [a]choongck@mail.utar.edu.my.

U-turn from initially contractionary fiscal and monetary policies to expansionary policies. Later, the controversial capital controls were implemented, followed by the dramatic switch to a pegged exchange rate regime on 1 September 1998—deemed an economic heresy by the world. These moves have had a great impact on the country's trade balance.

These policy changes raise two questions: (1) are the fluctuations between exports and imports sustainable in the long term, and (2) do these macroeconomic policies effectively influence the trade balance? This study aims to investigate and to answer the questions posed. In the following section, we discuss a simple theoretical model between exports and imports. Next, some econometric techniques are described. Finally, the empirical results are reported.

Table 1. Malaysia's Dependency Ratio, 1980–2000

Year	GDP (RM Millions) (a)	Exports (RM Millions) (b)	Imports (RM Millions) (c)	Dependency Ratio [(b) + (c)]/ (a)
1980	53308	30676	29342	1.1259
1985	77547	42537	38561	1.0458
1990	119081	88675	86241	1.4689
1991	135123	105161	110107	1.5931
1992	150681	114494	112450	1.5061
1993	172193	135896	136068	1.5794
1994	195460	174255	177389	1.7991
1995	222472	209323	218077	1.9211
1996	253732	232359	228842	1.8177
1997	281889	262713	260093	1.8547
1998	284474	325325	263319	2.0692
1999	299662	363591	289364	2.1790
2000	339420	426523	359015	2.3144

Source: International Monetary Fund (1980–2000), *International Financial Statistics*, various issues.

SIMPLE THEORETICAL MODEL

Following Husted (1992), we consider consumers who live in a small, open economy with no government intervention. The consumers are assumed to maximise their utility function subject to a budget constraint, and they borrow and lend in international markets at a predetermined world interest rate to achieve maximum utility. The consumers' revenues consist of an endowment of outputs and profits distributed from firms. These revenues are used for consumption and saving. Hence, the individual's current period budget constraint is as follows:

$$C_t = Y_t + B_t - I_t - (1 + r_t) B_{t-1} \tag{1}$$

where C_t is current consumption; Y_t is output level; I_t is investment; r_t is the current world interest rate; B_t is the international borrowings; and $(1 + r_t)B_{t-1}$ is the debt of the previous period, which corresponds to the country's external debt.

Because condition (1) must hold for every time period, the inter-temporal budget constraint is obtained by the summation of all individuals' budget constraint in the economy:

$$B_t = \sum_{t=1}^{\infty} l_t TB_t + \lim_{n\to\infty} l_n B_n \quad (2)$$

where $TB_t = X_t - M_t (= Y_t - C_t - I_t)$ indicates the trade balance in period t, X_t is exports, M_t equals imports, $l_0 = 1/(1+r_t)$ and is the discount factor defined as the product of the first t values of l. When the last term of equation (2) equals to zero, then a country's borrowing (lending) is exactly the same as the present value of the future trade surpluses (deficits).

We can derive the testable model by rearranging equation (1) as

$$Z_t + (1+r)B_{t-1} = X_t + B_t \quad (3)$$

where $Z_t = M_t + (r_t + r)B_{t-1}$ and it is assumed that the world interest rate is stationary with unconditional mean r. According to Hakkio and Rush (1991), equation (3) can be expressed in more detail:

$$M_t + r_t B_{t-1} = X_t + \sum_{j=0}^{\infty} l^{j-1}\left[\Delta X_{t+j} - \Delta Z_{t+j}\right] + \lim_{j\to\infty} l^{t+j} B_{t+j} \quad (4)$$

where $l = 1/(1+r)$ and Δ is the first-difference operator. The left-hand side represents expenditure on imports as well as interest payments (receipts) on net foreign debt (assets). If X_t is subtracted from both sides of (4) and each side is multiplied by minus one, then the left-hand side becomes the country's current account.

Assuming both X and Z are I(1) variables (that is, they are non-stationary at level form), then equation (4) can be re-expressed as:

$$X_t = a + MM_t - \lim_{j\to\infty} l^{t+j} B_{t+j} + e_t \quad (5)$$

where $MM_t = M_t + r_t B_{t-1}$; $a = [(1+r)^2/r](a_2 - a_1)$ and $e_t = \sum l^{j-1}(e_{2t} - e_{t-1t})$. a is the drift parameters (possibly equal to zero) and e_t are stationary process. From equation (5), since $j \to \infty$, then the limit term will become zero. Hence, equation (5) can be re-stated as a standardised regression:

$$X_t = a + b * MM_t + e_t \quad (6)$$

Equation (6) states that a country satisfies its inter-temporal budget constraint if the estimated coefficient of MM_t equals to unity $(b = 1)$ and e_t is white noise disturbance term and stationary. If both the conditions are valid, then exports and imports are cointegrated.

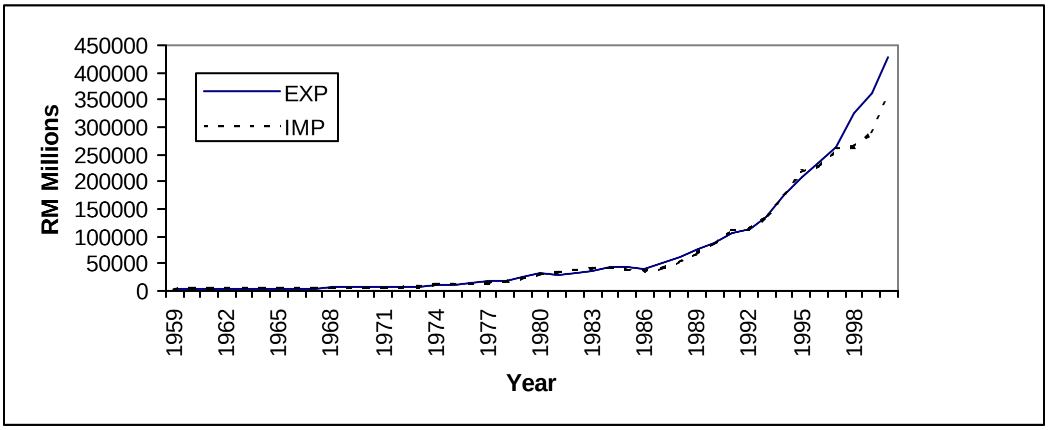

Figure 1. Nominal Value of Exports and Imports (RM). Source: International Monetary Fund (1959–2001), *International Financial Statistics*, various issues.

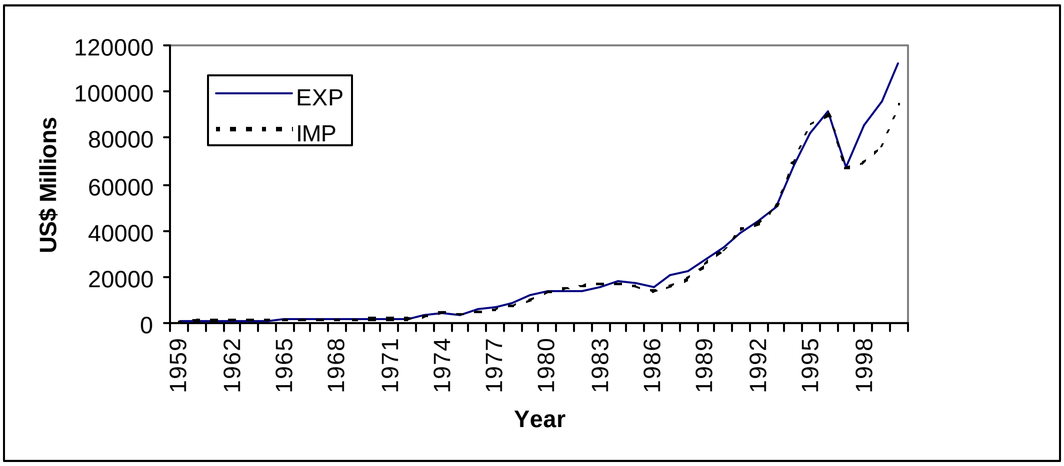

Figure 2. Nominal Value of Exports and Imports (US$). Source: International Monetary Fund (1959–2001), *International Financial Statistics*, various issues.

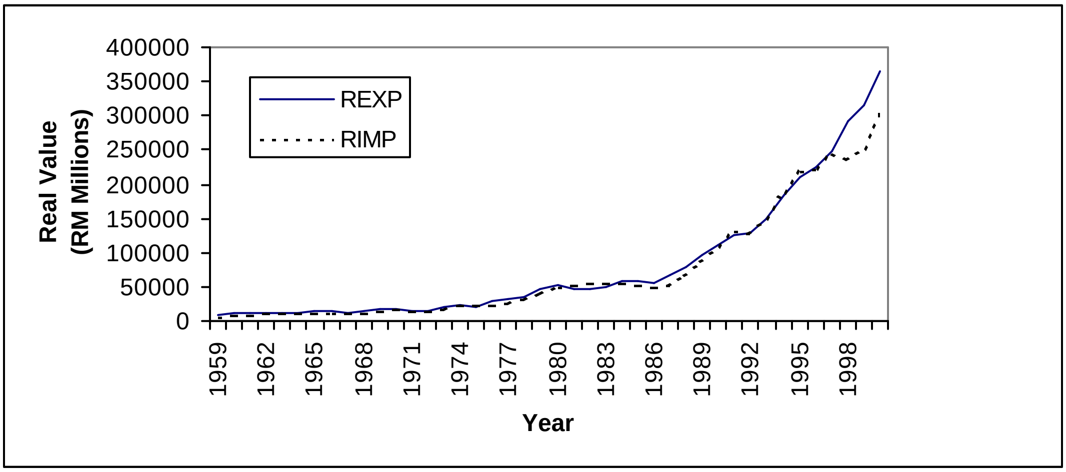

Figure 3. Real Value of Exports and Imports (RM). Source: International Monetary Fund (1959–2001), *International Financial Statistics*, various issues.

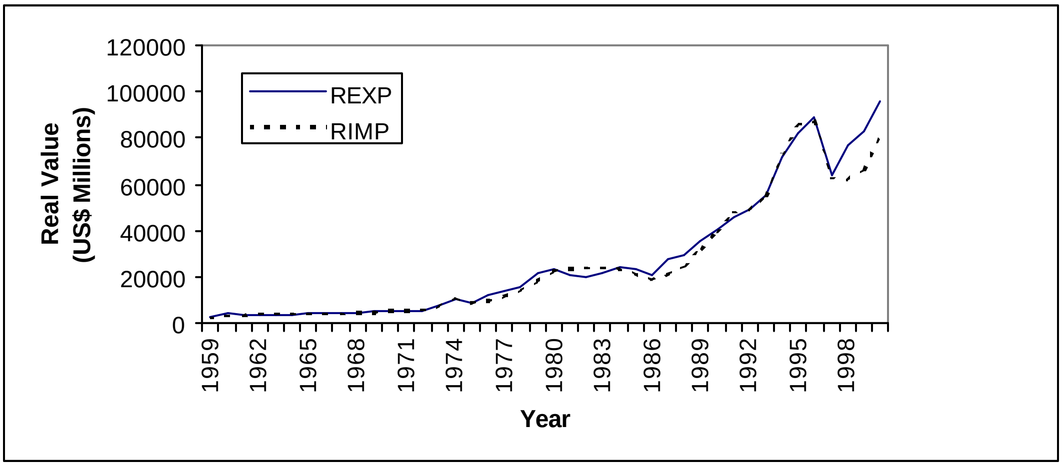

Figure 4. Real Value of Exports and Imports (US$). Source: International Monetary Fund (1959–2001), *International Financial Statistics*, various issues.

METHODOLOGY

Many economic time series clearly display trend and seasonal components and some also exhibit common features over time such as stationarity. However, it is only recently that time series econometricians have formalized in econometric models the concept of common co-movements at particular frequencies, as well as the idea that common factors may influence the trend component of some macroeconomic variables. Nevertheless, the statistical underpinnings of time series analysis require data to be stationary. This requires a first-difference for most macroeconomic series before estimating the economic models.

Hence, the significance of detecting and rectifying the trend component in macroeconomic data is sufficiently indicated.

If two or more variables have a common trend, then causality must exist in at least one direction (Engle and Granger, 1987). Moreover, if a trend component exists between two variables, both variables will move together towards a long-term equilibrium. Many series, which separately are non-stationary, when joined linearly have a long-term equilibrium relationship (Engle and Granger, 1987). Hence, both series are said to be cointegrated. Cointegration tests are concerned with the long-term behaviour among the components of partially non-stationary time series which is an indication of a common trend component. In other words, cointegration is the statistical approach that tests for the existence of a long-run equilibrium relationship among non-stationary variables integrated of the same order.

Two non-stationary series are said to be integrated if there exists a linear combination of the two series. For example, by using standard OLS regression techniques, we can estimate the parameters of the cointegrating regression and calculate the residual terms, U_t, where:

$$Y_t = a + bX_t + U_t \quad (7)$$

Suppose that the variables are first-order integrated, I(1), but that there exist values of α and β such that $U_t = Y_t - a - bX_t \sim I(0)$, with zero mean, that is, $E(Z_t) = 0$. Then we conclude that the variables are cointegrated.

According to the multivariate model of Johansen and Juselius (1990), the following vector autoregressive models are estimated:

$$X_t = \Pi_1 X_{t-1} + \Pi_2 X_{t-2} + ... + \Pi_k X_{t-k} + n_t \quad (8)$$

where X is an $N \times 1$ vector of I(1) variables. The long-run equilibrium associated with (2) is $\Pi X = 0$, where the long-run coefficient matrix Π is defined as

$$\Pi = I - \Pi_1 - \Pi_2 - ... - \Pi_k \quad (9)$$

The long-run cointegrating matrix Π is an $N \times N$ matrix whose rank determines the number of cointegrating vectors, say p. If we define two matrices a and b (both $N \times r$) such that $\Pi = ab'$, where the prime denotes the matrix transpose, the row of b will be from the p cointegrating vectors. Johansen and Juselius (1990) have introduced two likelihood ratio tests in determining the number of cointegrating vectors, namely, the maximum-eigenvalue and trace tests.

In testing the long-run relationship between exports and imports by applying cointegration procedures, four different measures will be employed for each variable. Following Bahmani-Oskooee and Rhee (1997), the first measure is the nominal value of exports and imports in terms of the Malaysian ringgit, denoted by C1EXP and C1IMP. The second measure is also a nominal term, but denominated in U.S. dollars, denoted by C2EXP and C2IMP. The third measure for each variable is the real exports as well as imports in terms of a constant ringgit. These measures can be obtained by dividing C1EXP and C1IMP by the consumer price index (CPI), denoted by C3EXP and C3IMP. The fourth measure is also in real terms, where we deflate C2EXP and C2IMP by the CPI. The real exports and imports measured in U.S. dollars are denoted by C4EXP and C4IMP, respectively.

These four measures are crucial in reflecting the effectiveness of macroeconomic policies. Dividing the measures with the Malaysian ringgit and the U.S. dollar is significant in reflecting the effectiveness of the exchange rate policy or regime that has been implemented. Moreover, both exports and imports expressed in nominal and real terms aim to show the success of the Malaysian government in stabilising and controlling aggregate price level (inflation), economic growth and trade policies. Therefore, if the results of all measures provide similar conclusions, then we can conclude that the Malaysian government has been implementing effective macroeconomic policies. Conversely, if the results of the measures give different findings, then we can deduce which type of policy is more effective. Annual data were used for the 1959–2000 period and the data were collected from International Financial Statistics published by International Monetary Fund (IMF).

EMPIRICAL RESULTS AND INTERPRETATION

The results of the Augmented Dickey-Fuller (ADF) unit root test are demonstrated in Table 2. We found that all series are non-stationary at their level form since the null hypothesis of non-stationarity cannot be rejected at the 5% significance level. However, the null hypothesis is easily rejected at the 5% significance level after the first difference. Simply, the variables are now I(1) variables.

Table 2. Unit Root Results (lag-length, $k = 1$)

Variable	ADF Test			
	Level		First Difference	
	Constant, No Trend	Constant with Trend	Constant, No Trend	Constant with Trend
Sample Period: 1959–2000				
C1EXP	1.6554	–3.0993	–5.2109**	–5.7870**
C1IMP	0.9534	–2.9768	–4.0590**	–4.1748**
C2EXP	0.4160	–3.0625	–5.1500**	–5.1317**
C2IMP	0.0140	–3.0586	–4.2966**	–4.2341**
C3EXP	1.6561	–2.5434	–5.9351**	–6.6912**
C3IMP	0.8929	–2.6262	–4.1902**	–4.3026**
C4EXP	0.2192	–3.2867	–5.6513**	–5.6106**
C4IMP	–0.1863	–3.2189	–4.3713**	–4.2962**

Note: The null hypothesis is that the series is non-stationary, or contains a unit root. The rejection of the null hypothesis for the ADF test is based on the MacKinnon critical values; ** indicates the rejection of the null hypothesis of non-stationarity at 5% significance level.

With the same order of integration between the variables, we have satisfied the condition for the Johansen and Juselius multivariate cointegration test in investigating the long-run relationship between exports and imports for all cases. In Table 3 (Panel A), we can reject the null hypothesis of $r = 0$ against its alternative $r = 1$, for all measurements, or cases at the 95% confidence level. However, we failed to reject the null hypothesis of $r \leq$

1 against its alternative $r = 2$ at the same level of significance. Therefore, we conclude that there exists a single cointegrating vector in all cases.

Table 3. The Results of Cointegration Test (lag-length, $k=5$)

Variable	Null Hypothesis	Alternative Hypothesis	λ-max	95%	Trace Test	95%
Panel A:						
Case 1:	$r = 0$	$r = 1$	17.29**	14.1	18.93**	15.4
C1EXP & C1IMP	$r \leq 1$	$r = 2$	1.64	3.8	1.64	3.8
Case 2:	$r = 0$	$r = 1$	18.38**	14.1	18.39**	15.4
C2EXP & C2IMP	$r \leq 1$	$r = 2$	0.002	3.8	0.002	3.8
Case 3:	$r = 0$	$r = 1$	17.71**	14.1	21.37**	15.4
C3EXP & C3IMP	$r \leq 1$	$r = 2$	3.66	3.8	3.66	3.8
Case 4:	$r = 0$	$r = 1$	17.94**	14.1	17.95**	15.4
C4EXP & C4IMP	$r \leq 1$	$r = 2$	0.008	3.8	0.008	3.8

Panel B:

Case	C1EXP	C1IMP	C2EXP	C2IMP	C3EXP	C3IMP	C4EXP	C4IMP
1	–1.0000	0.9901						
	–1.0000	0.7816						
2			–1.0000	0.9924				
			–1.0000	0.8560				
3					–1.0000	0.9807		
					–1.0000	0.7577		
4							–1.0000	0.9889
							–1.0000	1.2145

** indicates the rejection of the null hypothesis of non-stationarity at 5% significance level.

In addition, there appears to be a positive relationship between exports and imports in the long term, as indicated by the estimated cointegrating vectors for all cases, which range from 0.9807 to 0.9924 (Table 3, Panel B). From the estimated cointegrating vectors, which are positive and close to unity, we interpret these findings as Malaysia's adherence to the international budget constraint. To confirm this conclusion, we conducted the restricted cointegration test to examine the one-to-one relationship between exports and imports. In Table 4, for all cases, we were unable to reject the null hypothesis of a unity relationship between these two variables. In other words, the Malaysian government has been playing a crucial role in stabilising the trade balance (exports and imports), and all of Malaysia's macroeconomic policies have been effective in leading exports and imports into a long-run steady-state equilibrium relationship.

Table 4. The Results of Restricted Cointegration Test (lag-length, $k=5$)

Case	Likelihood Ratio (F statistics)	Decision
1	1.1158 [0.2908]	Do not reject H_0
2	1.124 [0.2890]	Do not reject H_0
3	1.5898 [0.2074]	Do not reject H_0
4	1.1791 [0.2775]	Do not reject H_0

Note: Figures in [] are marginal level.
Null hypothesis: The estimated coefficient of import is equal to unity.

The results discussed, however, do not reflect the overall picture of the export-import disequilibrium in the short run. The short-run disequilibrium, as demonstrated in Figures 1 and 4, brings forth the question of whether it is driven by exports or imports. Therefore, the Granger causality test within the vector error correction model (VECM) was applied to examine the dynamic short-run causality between these two variables. The causality results are reported in Table 5. Several findings are to be noted. First, unidirectional causality running from exports to imports in Case 1 and Case 3 and statistically significant at 5 percent significance level. In contrast, Case 2 and Case 4 are insignificant even at 10% significance level. The error correction terms in all cases, however, are highly significant at 5% level of significance. Second, short-run causality relationship between two variables does not exist in Cases 2 and 4, even at 10% significance level, which implies that these variables drift apart from each other and that there is no error correction mechanism in correcting these fluctuations. Finally, we can conclude that the disequilibrium is particularly created by the instability in the foreign exchange market. Nevertheless, the Malaysian government has succeeded in stabilising domestic macroeconomic environment with a stable level of inflation.

Table 5. Granger Causality Results based on Vector Error Correction Model (Uniform lag length, k=5)

Dependent Variables	Independent Variables D(EXP)	D(IMP)	ECT
	F-statistic (Significance level)		t-statistic
Case 1:			
D(EXP)	0.2411	0.7220	–0.0256
D(IMP)	0.0221**	0.0553	2.8398**
Case 2:			
D(EXP)	0.6351	0.8892	0.2790
D(IMP)	0.2129	0.2286	2.1865**
Case 3:			
D(EXP)	0.2702	0.8643	0.68523
D(IMP)	0.0241**	0.0402**	3.46279**

Table 5 (continued)

Dependent Variables	Independent Variables		ECT
	D(EXP)	D(IMP)	
	F-statistic (Significance level)		t-statistic
Case 4:			
D(EXP)	0.5388	0.8955	0.66754
D(IMP)	0.1976	0.1893	2.56893**

Notes: The F-statistics tests the joint significance of the lagged values of the independent variables, and t-statistics tests the significance of the error correction term (ECT). The asterisks indicate the following levels of significance: *10%, **5% and ***1%.

CONCLUSION

The main aim of this study is to investigate the long-run relationship between Malaysia's exports and imports by applying well-developed econometric techniques. Using cointegration procedures, we found that Malaysia's exports and imports will converge in the long run. This means that the short-run fluctuations between exports and imports are not sustainable since in the long run; exports and imports will eventually converge towards an equilibrium state. The ultimate convergence towards equilibrium signifies the overall effectiveness of Malaysia's past macroeconomic policies in stabilising trade conditions, which does not exceed the inter-temporal budget.

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