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BALANCE-OF-PAYMENTS-CONSTRAINED GROWTH MODEL: EMPIRICAL EVIDENCE FROM MALAYSIA

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ABSTRACT

Applying cointegration approach, the present study aims to examine the validity of the Harrod-Thirlwall balance-of-payments-constrained growth model in Malaysia. The results show that real income and real exports are not cointegrated during the period 1960-2000. This reveals that the Harrod-Thirlwall balance-of-payments-constrained growth hypothesis has not been supported in Malaysia.

Keywords: Harrod-Thirlwall balance-of-payments-constrained growth model; bounds test; cointegration; exports; income.

ABSTRAK

Dengan menggunakan pendekatan kointegrasi, kajian ini bertujuan untuk mengkaji model pertumbuhan imbangan pembayaran Harrod-Thirlwall dikonstren di Malaysia. Keputusan menunjukkan bahawa pendapatan benar dan eksport benar adalah tidak berkointegrasi bagi tempoh 1960-2000. Ini mendedahkan bahawa model pertumbuhan imbangan pembayaran Harrod-Thirlwall dikonstren tidak disokong di Malaysia.

Kata kunci: *Model pertumbuhan imbangan pembayaran Harrod-Thirlwall dikonstren; Ujian 'bounds'; kointegrasi; eksport; pendapatan.*

INTRODUCTION

The present study applies the basic balance-of-payments-constrained growth model that was developed by Thirlwall (1979), to the analysis

of Malaysia's economic growth in 1970-1998 and follows Atesoglu (1997), Moreno-Brid (1999), and Julio and Alberto (2000), that is to empirically examine the presence of a long run relationship between Malaysian real Gross Domestic Product (GDP) and real exports as postulated in Harrod-Thirlwall model using cointegration approach (see section 3, Theoretical Framework, Data and Method).[1] Basic balance-of-payments-constrained growth model (or Harrod-Thirlwall model) is a Keynesian demand-driven model that real income is determined by aggregate demand and, in particularly, by real exports. The balance-of-payment-constrained growth model was first advanced by Harrod (1933), and revistalised by Thirlwall (1979). A support of Harrod-Thirlwall balance-of-payments-constrained growth model of real income growth is met, if in the long-run, a country's growth rate (real income) is equal to the rate of growth of real income that is consistent with the current account balance, $q_t=(1/p)x_t$ (where p is the income elasticity of demand for real imports, and x_t is the long-run growth rate of real exports) (Atesoglu, 1997: 327-328). Methodologically, the key prediction of the Harrod-Thirlwall model is a positive cointegration relationship between real exports and real income (Atesoglu, 1997: 330). Thirlwall (1997: 380) had stressed that it is true that the assumptions of the model may appear unrealistic in the short-run, but the model is designed to understand long-term differences in growth performance.

Using annual data of United States and cointegration technique, Atesoglu (1997) had found that real exports and real income are cointegrated during the 1931-1994 period, indicating a strong support of the Harrod-Thirlwall balance-of-payments-constrained growth model. Another study is Moreno-Brid (1999), whom had applied the basic balance-of-payments-constrained growth model to Mexico's economic growth in 1950-1996. The Johansen cointegration tests (Johansen, 1988; Johansen & Juselius, 1990) have revealed that real exports and GDP were cointegrated in 1950-1996, and selected subperiods - supporting balance-of-payments-constrained growth model as a relevant hypothesis to explain Mexico's long-term economic growth. Applying similar cointegration technique to Argentina, Brazil, Columbia, and Mexico for over the period spans 1965 to 1996, Julio and Alberto (2000) had concluded that "cointegration of output with exports allows us to confirm the validity of Thirlwall's law for the countries under consideration".

Ansari, Hashemzadeh, and Xi (2000) had tested the Thirlwall's law in Southeast Asian countries including Malaysian data. Their study had

documented the empirical support of Thirlwall's law in Malaysia over the annual period 1970 to 1996. However, their findings are questionable since the data used were in growth rates for estimating import demand function, and they also used growth rate of real exports and real income for testing the Harrod-Thirlwall balance-of-payments-constrained growth hypothesis. According to Harrod (1933), the level of income will equal the *level* of exports divided by the marginal propensity to import. In addition, Thirlwall (1997: 383) had added "... from the empirical support given to my own (simple) model of balance-of-payments-constrained growth that $y=x/p$ in the long run". Atesoglu's (1997: 328) study had strictly highlighted that "... the use of growth rates of the variables can sacrifice long-run information contained in the levels of the variables".[2] The theoretical framework of Harrod-Thirlwall Model (Atesoglu, 1997) is described in Section 3 for testing the cointegrating relation among real income and real exports.

Furthermore, using quarterly data, Bahmani-Oskooee and Alse (1993) had found no long-term relationships between export and economic growth in Malaysia. Doraisami (1996), however, had confirmed a cointegrating relation between exports and growth using annual data from 1963 to 1993. The studies had employed the Engle-Granger two-step procedure (Engle & Granger, 1987) in analysis. Using the Johansen approach, Al-Yousif's (1999) study, however, had confirmed Bahmani-Oskooee and Alse's (1993) study showing no long-term relationship between real GDP and real exports over the period 1955 to 1996 (annual data). However, these studies were aimed to examine the export led growth hypothesis in Malaysia instead of a direct test for Harrod-Thirlwall balance-of-payments-constrained growth hypothesis.[3] A reservation made on their studies came from Mah (2000: 243), who had noted that the conventional cointegration tests such as Engle-Granger or Johansen-Juselius approach is unreliable for small sample sizes, but bounds test is appropriate for small sample study. Thus, the present study has been motivated to re-examine the validity of Harrod-Thirlwall balance-of-payments-constrained growth hypothesis in Malaysia using a recently developed cointegration technique by Pesaran, Shin and Smith (2001), namely the bounds test. Annual data from 1960 to 2000 have been employed for analysis (as well as quarterly data, see Appendix 1).

This paper is organised as follows. The next section is the literature review. The theoretical framework, data and method used in the analysis are briefly discussed in Section 3. Section 4 reports the empirical findings, and concluding remarks are cited in last section.

LITERATURE REVIEW – MALAYSIA

The existing studies in international trade literature have basically examined the export-led hypothesis using causality approach rather than to directly examine the Harrod-Thirlwall balance-of-payments-constrained growth model, for the case of Malaysia. However, these studies have indirectly investigated the Harrod-Thirlwall hypothesis by finding a long-term relationship between exports and economic growth. Using quarterly data, Bahmani-Oskooee and Alse (1993) documented that there was not a stable long-term relationship between export and economic growth. Doraisami (1996), however, confirmed a cointegrating relation between exports and growth using annual data from 1963 to 1993. Both studies used the Engle-Granger two-step procedure (Engle & Granger, 1987). Using the Johansen approach, Al-Yousif's (1999) study showed no long-term relationship between real GDP and real exports over the period 1955-1996 (annual data). Thus, this provides a chance for recent study to re-examine the long-term relationship between real GDP and real exports for testing the Harrod-Thirlwall balance-of-payments-constrained growth model by using a recently developed cointegration technique namely bounds testing approach (Pesaran *et al.*, 2001).

On the other hand, to account the bias of the omission of variable phenomenon in export-led analysis, using quarterly data 1970 to 1994 and Johansen's multivariate cointegration techniques, Baharumshah and Salim (1999) found that GDP, exports and imports were cointegrated. Meanwhile, to consider the bias of OLS long-term estimates, Ghatak, Milner and Utkulu (1997) had employed the Johansen's multivariate test to test the relationship between exports expansion and economic growth using annual data (1966-1990). They found non-export real GDP and real exports were cointegrated with one cointegrating vector. A 'unique' cointegrating vector was found between real GDP, real exports of manufactured products, fuel, non-fuel primary products, physical capital and human capital. Two vectors were found for non-export real GDP specification. Recently, Khalafalla and Webb (2001) found that economic growth, total exports, and total imports were cointegrated using Malaysian quarterly data (1965-1996).

On the one hand, several studies have included additional macroeconomic variables in export-led growth analysis. Besides exports, economic growth and imports of consumption goods, Choong, Zulkornain, and Liew (2003) included capital formation, labour force and exchange rate into multivariate cointegration analysis for annual data from 1959 to 2000. The study had confirmed a cointegrating vector

among the examined variables. Their study revealed that export-led growth hypothesis was valid in the Malaysian economy in both the short and long-runs. Similarly, using a multivariate framework (real GDP, real exports, real imports, real effective exchange rate, real gross fixed capital formation, and real GDP of U.S – quarterly data from 1970 to 2000), and the Johansen cointegration method, Leow (2004) had found that these variables are cointegraated. Using the Johansen approach, Al-Yousif (1999) had found no long-term relationship between real GDP and real exports over the period 1955 to 1996 (annual data). However, one cointegrating vector among real GDP, labour force, real exports, real effective exchange rate and real gross fixed capital has been confirmed. Mohamad and Ahmadi (1999) employed an artificial intelligence approach to test the export-led growth hypothesis in Malaysia. Labour force, investment, and exports have been included as input to growth rate and natural logarithm of GDP. The findings supported that exports strongly contributed to the economic growth and development of Malaysia. However, the artificial intelligence approach is applicable for forecasting and not to test the economic theory such as cointegration approach.

THEORETICAL FRAMEWORK, DATA AND METHODOLOGY

Theoretical Framework – Harrod-Thirlwall Model (Atesoglu, 1997)

The Harrod-Thirlwall balance-of-payments-constrained growth model for explaining the real income can be depicted with the following equations:

$$lnM_t + lnPm_t = lnX_t + lnPx_t \quad (1)$$

$$lnM_t = \pi lnQ_t + \Phi(lnPx_t - lnPm_t) + u_t \quad (2)$$

$$lnQ_t = (1/p)\, lnX_t + \varepsilon_t \quad (3)$$

where *ln* is natural logarithms. M is real imports, X is real exports, Q is real income, Px is export prices, and Pm is import prices expressed in domestic currency. *U* and ε are residuals.

Equation (1) is the equilibrium condition of the model, where nominal imports is equal to nominal exports that is the current account balance. Equation (2) is the import demand function. Solving equations (1) and (2) for real income, and assuming that the terms of trade is constant ($lnPx_t - lnPm_t = 0$)[4], yields equation (3) that is the Harrod foreign-trade multiplier relation. According to equation (4), real income consistent with a current account balance is given by the foreign-trade multiplier,

1/p, real exports and residuals, e (Atesoglu, 1997: 331). According to Harrod (1933), the *level* of income will equal the *level* of exports divided by the marginal propensity to import. If the economy's real income, lnQ_t can be expected to move back to its path consistent with the current account balance as predicted by lnX_t/p, indicating a support for Harrod-Thirlwall balance-of-payments-constrained model. In other words, an empirical support of the Harrod-Thirlwall balance-of-payments-constrained growth hypothesis requires equation (3), the key prediction of the model to be consistent with the data. That is, in the long-run, lnQ_t should be cointegrated with lnX_t, where (1/p) is the cointegration coefficient.

Data

The real exports (X_t) and real income (real Gross Domestic Product, Q_t) used in analysis covers annual data from 1960 to 2000 (in 1995 prices and based on local currency).[5] The data are obtained from *World Tables* (World Band, various issues). The GDP and exports deflators were used to derive the real values. The use of annual data is due to data unavailability in quarterly form, particularly real GDP. Mohammad and Tang (2000: 260) had warned the measurement errors may be more serious when the data used are constructed data that were derived using approximations. Therefore, they used annual data to estimate the aggregate import equation in Malaysia.

METHODOLOGY

The present study employs a recently developed econometric method for cointegration analysis, namely bounds testing approach (Pesaran *et al.*, 2001). The bounds tests are mainly based on Unrestricted Error-Correction Model (UECM) or conditional AutoRegressive-Distributed Lag (ARDL) model estimates. The test can avoid the bias of low power of unit root tests that yield different results, that is pre-investigation of the series integration I(*d*) is not required once we can make a conclusion of bounds test about the presence of a cointegrating relation (Pesaran *et al.*, 2001). [6]In other words, the bounds test procedure is applicable irrespective whether the underlying regressors are integrated of order zero (*I*(0)) or one (*I*(1)) (Pesaran *et al.*, 2001). Mah (2000: 243) had noted that the bounds test is appropriate for small sample study as compared to Engle and Granger's, and Johansen's techniques.[7] Another important advantage of the bounds test procedure is that estimation is possible even when the explanatory variables are endogenous. To carry out the bounds test, the following UECM has been constructed for the Harrod-Thirlwall model (equation 3):

$$\Delta lnQ_t = b_0 + \sum_{i=0}^{l} b_{1i}\Delta lnX_{t-i} + \sum_{i=1}^{l} b_{2i}\Delta lnQ_{t-i} + b_3 lnQ_{t-1} + b_4 lnX_{t-1} + b_5 Trend + u_t \quad (4)$$

where Δ is first difference operator. *Ln* is natural logarithms. *Trend* is the time variable that is used to capture the time effects. *l* is the lag length. *u* is the residuals. Ordinary Least Squares (OLS) is used as the estimator. The usage of auto regression or lag parameter $b_3 lnQ_{t-1}+b_4 lnX_{t-1}$ is in the unrestricted form of error correction term ($e_{t-1} = \beta_1 lnQ_{t-1} - \beta_2 lnX_{t-1}$) in the Engle and Granger (1987) representation theorem. The jointly significant of estimated b_3 and b_4 is conducted ($b_3 = b_4 = 0$) for cointegrating test (Pesaran *et al.*, 2001). The terms of $\sum_{i=0}^{l} b_{1i}\Delta lnX_{t-i}$ and $\sum_{i=1}^{l} b_{2i}\Delta lnQ_{t-i}$ are dynamic terms (short-term) as part of the error-correction model in the Engle and Granger (1987) Representation Theorem.

Pesaran *et al.* (2001) had proposed the use of *F*-statistic (Wald test) and t-statistic for investigating the existence of a cointegrating relation among variables of interest, irrespective whether the explanatory variables are purely *I*(0) or purely *I*(1). The null hypothesis of no cointegration is tested based on a joint significance test for $b_3 = b_4 = 0$ (Wald test), against the alternative hypotheses for a $H_0 : b_3 \neq 0, b_4 \neq 0$ (a cointegrating relation). Alternatively, the coefficient of lnQ_{t-1} is tested (*t*-test) for the null of no cointegrating relation ($H_0 : b_3 = 0$), against the alternative hypotheses for a cointegrating relation ($H_0 : b_3 \neq 0$). Given α=10%, 5% and 1%, if the computed test statistic (*F*- or *t*-statistic) lies outside the critical bounds, lower and upper bounds, a conclusive inference can be made without considering the order of integration of the explanatory variables. That is, if the test statistic exceeds the upper bound, then the null of no cointegration can be rejected. The null hypothesis cannot be rejected if the test statistic lies below the lower bound, thus, there is no cointegrating relation among the examined variables.

EMPIRICAL RESULTS

A set of UECMs (equation 4) has been estimated for *l*= 3, 2, and 1 considering the common practice of using annual data in cointegration analysis (see Atesoglu, 1997: 332).[8] It provides a checking on the sensitivity of cointegration tests from various lag structures. As

indicated in Figures 1, 2 and 3, the CUSUM tests[9] are moving within the 5% critical lines, implying the estimated parameters of UECM are stable over the period under study even though Malaysian international trade has undergone a structural break from the commodities-dependent export sector.[10] Optimum lag structure is one, which minimises the Akaike information criterion. The estimated UECMs are not reported here but available from the author upon request. Table 1 presents the results of bounds tests for UECM with l=3, 2, and 1.

Table 1
Results of the Bounds Tests (Dependent variable: *ln*Q)

Independent variable: *ln*X Lag structure, *l*:	F-statistics (H_0: $b_3 = b_4 = 0$)	t-statistics (H_0: $b_3 = 0$)
3	1.15	-1.50
2	0.83	-1.27
1*	1.32	-1.62
Critical values at 10 percent level:-	*lower; upper*	*lower; upper*
	5.59; 6.26	-3.13; -3.40

Notes: * Denotes optimum lag structure which minimises the Akaike information criterion and Schwarz criterion. The reported critical values are from Pesaran, Shin and Smith (2001) Table CI (v) Case V: Unrestricted intercept and unrestricted trend (page 301) and Table CII (v) Case V: Unrestricted intercept and unrestricted trend (page 304) for F- and t-statistics, respectively (k=1).

Table 1 shows that the computed *F*- and *t*-statistics are below the lower bound of 5.59 and –3.13, respectively at 10% significance level. Thus, the null hypothesis of no cointegration cannot be rejected indicating no long-term relationship among real income and real exports during the 1960 to 2000 period. It indicates that in the long-run, real exports and real income in the Malaysia cannot be expected to move together over time. Econometrically, the OLS estimate of equation (3) is *spurious*.[11] The finding is not sensitive to various lag structures used in UECM viz. 1, 2, and 3 lags. It provides empirical evidence that the relevance of the Harrod-Thirlwall balance-of-payments constrained growth hypothesis to understand Malaysia's long-term economic growth during 1960-2000 is not supported empirically. The finding of no cointegration among exports and real GDP is consistent with the results that are based on quarterly data (see Appendix A).

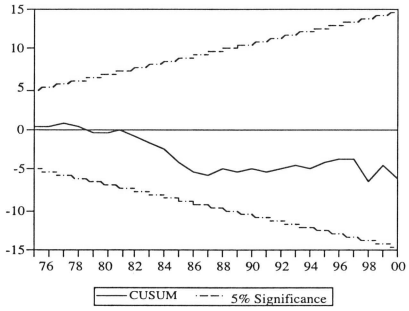

Figure 1
CUSUM plot for UECM with l=3

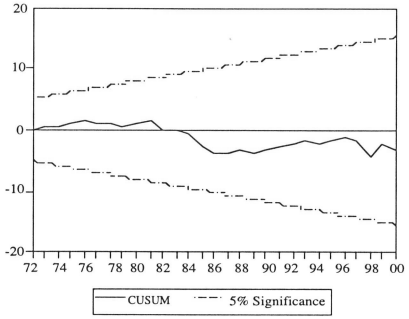

Figure 2
CUSUM plot for UECM with l=2

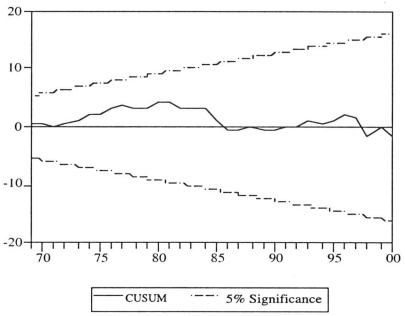

Figure 3
CUSUM plot for UECM with l=1

CONCLUDING REMARKS

The present study has examined the validity of Harrod-Thirlwall balance-of-payments-constrained growth hypothesis in Malaysia using the recently developed cointegration technique, bounds test (Pesaran *et al.*, 2001). The results show no cointegrating relation between real income and real exports. Thus, there is no evidence to support the relevance of the Harrod-Thirlwall balance-of-payments-constrained growth hypothesis in Malaysia. No cointegrating relationships between real income and real exports as has previously been confirmed by Bahmani-Oskooee and Alse (1993), and Al-Yousif (1999), which have used quarterly and annual data based on Engle-Granger and Johansen techniques, respectively. The policy implication that may probably be drawn here is that Malaysia should not over-emphasise on the outward-looking growth strategy via export performance for a continued high rate of economic growth in the long-term. This is not a surprising issue

since Al-Yousif (1999) had found that Malaysian real income and real exports are not cointegrated, but cointegration is found by including other macroeconomic variables. Al-Yousif's (1999: 71) study documented that export-led growth is a short-term phenomenon in Malaysia. On the other hand, Baharumshah and Salim (1999) had found that GDP, exports and imports are cointegrated, and supporting externally generated growth hypothesis and not export-led growth hypothesis since their study included imports as the additional regressor to growth. Their results (vector-error correction model) showed that economic growth has been driven by exports in the short-run. However, it is important to recognise that this implication is restricted to a single-equation method for modelling. It also holds potential for further empirical pursuit, in particular for policy inference.

END NOTES

1 Here I would like to clarify that the present study is not aimed to test the export-led growth hypothesis in empirical literature, but to test the validity of balance-of-payments-constrained growth model (Harrod-Thirlwall model) in Malaysian data. Contrary to balance-of-payments-constrained growth model, the empirical considerations behind export-led growth thesis are as follows (Baharumshah & Salim, 1999: 391). Firstly, trade expansion will enhance productivity through greater economies of scale in the export sector. Secondly, increased competition encountered in the international markets will undoubtedly provide greater incentives for technological advancement and better management, the effects of which will spill over into the non-export sectors, and thus raise the overall productivity of the economy. Thirdly, increased export earnings will ease constraints on growth by enhancing the capacity to import essential goods. That is export expansion promotes capital accumulation and, consequently, overall economic growth. Fourthly, exports may have a positive impact on productivity owing to better allocation of resources through specialisation based on comparative advantage. Fifthly, an export-oriented approach in a labour-surplus economy permits rapid expansion of employment and real wages. Lastly, Lucas (1993) linked trade to learning by doing and pointing out that the learning-spillover technology is consistent with the strong relationship between rapid productivity and trade openness (Baharumshah & Salim, 1999: 391).

2 See, Engle and Granger (1987).

3 More existing empirical studies are cited in Section 2, which employed more than two-variables rather than real income and real exports.

4 This is an assumption made in order to derive equation 3 in the long-term. Thirlwall (1997: 380) had documented that "Likewise, the terms of trade or real exchange rate may fluctuate in the short term, but in the long run it appears to remain relatively stable". Previous studies such as Atesoglu (1997: 331), Moreno-Brid (1999: 152) and Julio and Alberto (2000: 477) followed this assumption to test the long-term relationship between real GDP and real exports. This assumption is not tenable given the small economy such as Malaysia particularly during late 1970s and early 1980s, the terms of trade was not constant. Following Thirlwall (1997), however, these fluctuations were considered as short-tern phenomenon. If we assume the terms of trade was not constant in the long-run, the Terms Of Trade (TOT) variable has to be included into the cointegration analysis. The empirical results do not support the inclusion of terms of trade based on its statistically insignificant coefficients (at 10% levels), and no cointegration among real GDP, real exports and terms of trade (see Appendix 2).

5 Given the cointegration analysis, annual data can be used since the cointegration depends on the time span and not on the number of observations (see Hakkio and Rush, 1991).

6 The present study, however, has performed the Phillips and Perron (1988) unit root test for real income (Q) and real exports (X) series. The results revealed that both series are nonstationary or in $I(1)$ process. $I(d)$ means the series has achieved stationary after differing d times. Thus, $I(1)$ means the series is stationary in its first differenced form. These results are not reported here, but available from the author upon request.

7 A note has to be made here, that the finite sample property of the bounds test has not been verified through reasonably well-organised simulation works. Therefore, in small samples, we do not have a definite answer to whether the bounds test performs better than the conventional tests, as the statement made in Mah (2000: 243) without containing any Monte Carlo simulations that compare the finite sample performances of the bounds tests with those of the conventional tests for cointegration relationship.

[8] Enders (1995: 313) documented "Using quarterly data, you might start with a lag length of 12 quarters (Vector autoregression) based on the a priori notion that 3 years is sufficiently long to capture the system's dynamics".

[9] The CUSUM test (Brown, Durbin, & Evans, 1975) is based on the cumulative sum of the recursive residuals. This option plots the cumulative sum together with the 5% critical lines. The test finds parameter instability if the cumulative sum goes outside the area between the two critical lines.

[10] It is possible for a structural break from commodities-dependent export sector. However, the parameters stability test, CUSUM shows stability of the estimated parameters of UECM with l=3, 2, and 1, therefore, evaluating cointegration between real income and real export allowing for structural breaks in the intercept or slope, or both, are not considered in this study.

[11] See, Engle and Granger (1987) for *spurious* regression while regressing nonstatioanry variables that are not cointegrated using OLS estimator.

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APPENDIX 1

Estimation Based on Quarterly Data

To have a cross check with the results of annual data, a cointegration test has been conducted here based on quarterly data. The exports (X_t) and income (Q_t) variables covers the available quarterly period from 1970 (first quarter) to 1998 (fourth quarter). The raw data are obtained from *International Financial Statistics* (International Monetary Fund, various issues). The above variables are measured in RM millions, and in real terms (deflated by Consumer Price Index, CPI in 1995 prices). The Gross Domestic Product, GDP, is used as the proxy variable of income. The quarterly nominal GDP was constructed from annual data using approximation approach since it is not available in quarterly basic. Referring to the *International Financial Statistics* published by the International Monetary Fund, we were not able to obtain quarterly data for GDP. Quarterly data on Gross Domestic Product (GDP) at constant 1978 prices and volume of GDP (1995=100) were only available from 1988 (first quarter). Here, we outline a method to approximate quarterly figures from annual data (from *International Financial Statistics Yearbook,* various issues). To obtain quarterly figures for income (GDP), the yearly proportion of industrial production index for each quarter is multiplied with the annual GDP. The similar approximation method has been highlighted in Mohammad and Tang (2000) for obtaining quarterly data of disaggregated expenditure components. An example calculation is illustrated as below.

	1998Q1	1998Q2	1998Q3	1998Q4
Industrial Production Index	113.88	113.9	112.78	113.56
Proportion (in percentage)	25.08%	25.08%	24.83%	25.01%
Annual GDP (nominal) = 283243				
Constructed GDP (nominal)	71029.05	71041.53	70342.96	70829.46

Note: The figures are in RM millions.

A set of UECMs (equation 4) was estimated based on l=12, 8, and 4 considering the use of quarterly data and with a year gap. Enders (1995: 313) had documented "Using quarterly data, you might start with a lag length of 12 quarters (Vector Autoregression) based on the a priori notion that 3 years is sufficiently long to capture the system's dynamics". The CUSUM tests are moving within the 5 % bounds, implying the estimated parameters of UECM are stable over the period under study. The plots are not reported here but available upon request from author. The optimum lag structure is four, based on Akaike information criterion.

Independent variable: lnX Lag structure, l:	F-statistics (H_0: $b_3 = b_4 = 0$)	t-statistics (H_0: $b_3 = 0$)
12	2.343	-1.663
8	3.502	-2.635
4*	3.531	-2.633
Critical values at 10 per cent level:-	lower; upper	lower; upper
	5.59; 6.26	-3.13; -3.40

Notes: * Denotes optimum lag structure which minimizes the Akaike information criterion and Schwarz criterion. The reported critical values are from Pesaran, Shin and Smith (2001) Table CI (v) Case V: Unrestricted intercept and unrestricted trend (page 301) and Table CII (v) Case V: Unrestricted intercept and unrestricted trend (page 304) for F- and t-statistics, respectively (k=1).

The computed *F*-and *t*-statistics are below the lower bound, 5.59 and -3.13, respectively at 10 % significance level. Thus, both tests fail to reject the null hypthesis of no cointegration, and indicating no long-term relationship among real income and real exports during the period 1970 to 1998. The results of the cointegration tests fail to support the relevance of the Harrod-Thirlwall balance-of-payments-constrained growth hypothesis to understand Malaysia's long-term economic growth during the 1970 to 1998 period.

APPENDIX 2

Analysis by Including Terms of Trade Variable

An additional variable, terms of trade (the ratio of export prices over import prices) has been included in the cointegration analysis considering its fluctuation given a small economy such as Malaysia, particularly during late 1970s and early 1980s, when the terms of trade was not constant. The annual export prices and import prices were obtained from *World Tables* (World Bank, various issues) for the period 1960-2000. The Phillip-Perron test shows tht terms of trade is stationary, $I(0)$ (test statistic is -4.7147, and MacKinnon critical value at 1% is -4.2023). However, the bounds test procedure is applicable irrespective whether the underlying regressors are integrated order zero ($I(0)$) or one ($I(1)$) (Pesaran *et al.*, 2001). Now the UECM with inclusion of Terms Of Trade (TOT) variable can be written as:

$$\Delta lnQ_t = b_0 + \sum_{i=0}^{l} b_{1i}\Delta lnX_{t-i} + \sum_{i=1}^{l} b_{2i}\Delta lnQ_{t-i} + \sum_{i=0}^{l} b_{3i}\Delta TOT_{t-i} + b_4 lnQ_{t-1} + b_5 X_{t-1} + b_6 TOT_{t-1} + b_7 Trend + u_t$$

where Δ is first difference operator. *Trend* is the time variable that is used to capture the time effects. l is the lag length. u is the residuals. UECM has been estimated using the Ordinary Least Squares (OLS) estimator. The estimated UECMs are not reported here but available from the author upon request. All of the estimated coefficients of TOT are not different from zero even at 10% levels. The results of bounds tests (F-and t-statistics) are reported as below.

Independent variable: *lnX, TOT* Lag structure, *l*:	F-statistics ($H_0: b_3 = b_4 = 0$)	t-statistics ($H_0: b_3 = 0$)
3	0.93	-1.48
2	0.55	-0.88
1*	1.06	-1.29
Critical values at 10 percent level:-	*Lower; upper* 4.19; 5.06	*Lower; upper* -3.13; -3.63

Period (annual) for UECM: 1960-2000. * denotes optimum lag structure which minimizes the Akaike information criterion and Schwarz criterion. The reported critical values are from Pesaran, Shin and Smith (2001) Table CI (v) Case V: Unrestricted intercept and unrestricted trend (page 301) and Table CII (v) Case V: Unrestricted intercept and unrestricted trend (page 304) for F- and t-statistics, respectively (k=2).

Both test statistics are below the lower bound, thus the null hypothesis of no cointegrating relation cannot be rejected. It indicates no long-term relationships between real GDP, real exports and terms of trade in Malaysia for the period 1960-2000. All these findings reject the inclusion of TOT variable in Harrod-Thirlwall balance-of-payments-constrained growth model, and supporting the assumption that the terms of trade is constant in the long-term.