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TERMS OF TRADE AND ECONOMIC GROWTH IN MALAYSIA

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Abstract

The main aim of the study is to investigate the impact of terms of trade on economic growth of Malaysia using time series data. Moreover, the study examines Granger-causality between terms of trade and economic growth. The empirical models are based on an augmented production function. The study employs two measures of terms of trade, namely commodity terms of trade and income terms of trade. The estimates of cointegrating equations and error correction models suggest that an increase in commodity terms of trade or income terms of trade would lead to an increase in economic growth. Nonetheless, there is no strong evidence to suggest that terms of trade Granger causes economic growth and vice versa in the short run. Generally, changes in terms of trade have a significant impact on economic growth of Malaysia.

Keywords: Terms of trade; Commodity terms of trade; Income terms of trade; Economic growth; Malaysia.

1. Introduction

The relationship between terms of trade and economic growth had been documented in the middle of 1900s. Prebisch (1950) and Singer (1950) alleged that terms of trade of commodity exporting countries, mainly developing countries (DCs) had deteriorated and would continue to deteriorate as long as they specialised in commodity products. Deterioration of terms of trade is one of the important respects to explain the widening income gap between DCs and developed countries. This is an argument supporting import substitution in many DCs in the 1990s. Generally, a change in terms of trade is said to have a significant impact on economic growth of a country. An increase in terms of trade would lead to higher levels of investment and therefore economic growth (Mendoza, 1997; Bleaney and Greenaway, 2001; Blattman *et al*., 2003).

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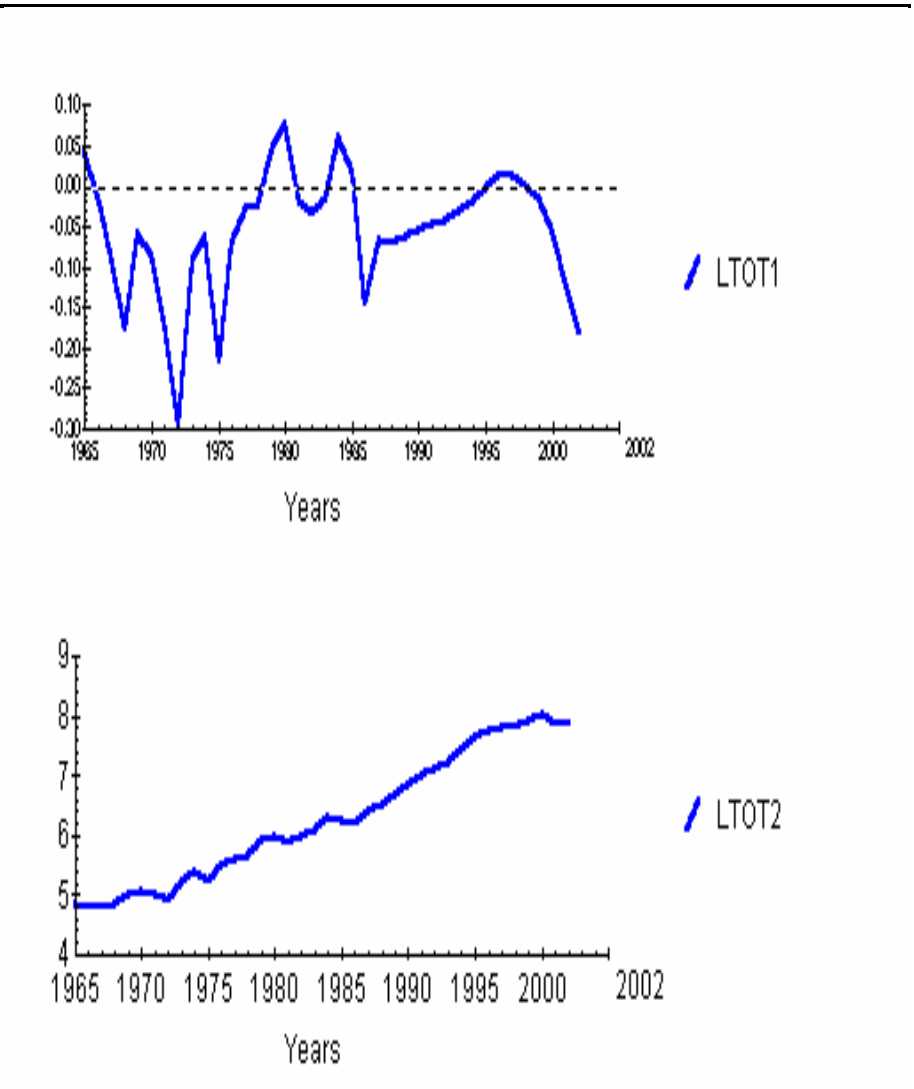
Generally, commodity terms of trade of Malaysia fluctuated over the past decades. In 1965-1969, the average of commodity terms of trade was 0.95. The average of commodity terms of trade was relatively low in 1970-1979, i.e. 0.91. In 1980-1989 and 1990-1999, the average of commodity terms of trade was 0.98, respectively. In 2002, commodity terms of trade was 0.83. Generally, commodity terms of trade was less than one over the past decades. On the other hand, income terms of trade of Malaysia rose in the same periods. In 1965-1969, the average of income terms of trade was 130.99. The average of income terms of trade increased from 220.79 in 1970-1979 to 523.80 in 1980-1989. In 1990-1999, the average of income terms of trade was 1842.34. In 2002, income terms of trade was 2617.12. The plots of the logarithms of commodity terms of trade and income terms of trade, respectively against time, are given in Figure 1. The figure shows that commodity terms of trade fluctuated and income terms of trade fluctuated on an upward trend. The growth rate of the real gross domestic product (GDP) per capita of Malaysia rose over the past decades.[1] The average of the growth rate of the real GDP per capita in 1965-1969, 1970-1979, 1980-1989 and 1990-1999 was 1.6 percent, 5.7 percent, 3.1 percent and 4.5 percent per annum, respectively. In 2002, the growth rate of the real GDP per capita was -2.8 percent. The issue is that commodity terms of trade or income terms of trade and economic growth are correlated?

In the literature of terms of trade and economic growth, studies are mainly examined using cross-country evidence. The study that uses time series evidence is relatively scarce. Furthermore, for studies using cross country evidence, Malaysia is mostly not included (Bleaney and Greenaway, 2001; Blattman *et al*., 2003, 2004). Thus, the study investigates the impact of terms of trade on economic growth of Malaysia using time series data over the period 1965-2002. Moreover, the study examines Granger-causality between terms of trade and economic growth. An increase in terms of trade could lead to an increase or a decrease in economic growth (Prebisch, 1950; Singer, 1950; Blattman *et al*., 2003, 2004). Thus, it is an empirical issue.

The empirical models are based on an augmented production function. It is not uncommon to estimate economic growth of a country using an augmented production function. For example Harrison (1996) estimated economic growth using an augmented production function, which amongst others openness to international trade is included as an independent variable. Thus, the study provides an alternative approach to examine the relationship between terms of trade and economic growth. Conversely, most of study on the relationship between terms of trade and economic growth is examined using a bivariate framework. The study employs two measures of terms of trade, namely commodity terms of trade and income terms of trade. In the literature of terms of trade and economic growth, commodity terms of trade is mainly used. Nonetheless, income terms of trade is argued to be more useful than commodity terms of trade for the matter of economic growth (Appleyard and Field, 2001: 111). Therefore, the study provides some evidence if the impact of terms of trade on economic growth is different using different measures of terms of trade.

[1] The real GDP per capita is computed as GDP divided by the GDP deflator (1995=100) and then divided by population. The data were obtained from International Financial Statistics, International Monetary Fund.

Figure 1
The Logarithms of Commodity Terms of Trade and Income Terms of Trade against Time (1965-2002)



Notes: LTOT1 and LTOT2 indicate the logarithms of commodity terms of trade and income terms of trade, respectively.

Finally, the study examines the impact of the Asian financial crisis (1997-1998) and the implementation of the capital control in Malaysia on its economic growth. The episode of capital control is still fresh in the discussion of policy makers in Malaysia. The Dickey and Fuller (1979) and Phillips and Perron (1988) unit root test statistics are used to examine the stationarity of the data. The Johansen (1988) cointegration method is used to examine the long-run relationship in the empirical models. The error-correction models (ECMs) are estimated to examine the short-run impact of terms of trade on economic growth. The Granger-causality between terms of trade and economic growth are examined.

The paper is organised as follows. Section 2 gives a discussion on terms of trade and economic growth. Section 3 explains the methodology and data used in this study. Section 4 presents the empirical results and discussion. Section 5 contains some concluding remarks.

2. A Discussion on Terms of Trade and Economic Growth

There are many studies on the relationship between terms of trade and economic growth. This issue is closely related with the observations made by Prebisch (1950) and Singer (1950), or it is well-known to be Prebisch-Singer hypothesis that terms of trade of commodity exporting countries had deteriorated and would continue to deteriorate as long as they specialised in commodity products. Baxter and Kouparitsas (2000) reported that changes in terms of trade are twice as large as in DCs as in developed countries. Indeed, several studies have concluded that changes in terms of trade can account for roughly half of output volatility in DCs (Mendoza, 1997; Kose, 2002). The relationship between terms of trade and economic growth is getting critical particularly during world episodes of global integration or disintegration when export prices converge or diverge world wide, inducing large terms of trade changes and economy wide responses (Blattman *et al*., 2003). Moreover, DCs export mainly commodity products and generally have a high degree of openness to international trade and therefore a change in terms of trade will lead to a large change in their economies (Broda and Tille, 2003: 2). Furthermore, export prices of commodity products are fluctuating and price elasticities of commodity products are inelastic.[2]

If the world is divided into only two groups, namely DCs and developed countries, then a decline in terms of trade for DCs must be accompanied with a rise in terms of trade for developed countries. Moreover, if an increase in terms of trade leads to reinforcement in comparative advantage, then it would induce less industrialisation in DCs and more industrialisation in developed countries since DCs export mainly commodity products while developed countries export mainly manufactured products. If industrialisation is an important engine for economic growth, an increase in terms of trade would lead to an increase in the long-run economic growth of developed countries and would lead to a decline in the long-run economic growth of DCs. Furthermore, developed countries with more sophisticated institutions and markets are likely to have cheaper ways to insure against price volatility than DCs. Thus, terms of trade volatility is likely to have less negative impact in developed countries than DCs (Blattman *et al*., 2003).

Mendoza (1997) examined the impact of terms of trade on economic growth of a sample of 40 industrial and developing countries (9 industrial countries and 31 developing countries) using cross-country evidence over the period 1971-1991. The results show that a positive relationship between terms of trade and economic growth.

[2] The demand for commodity is price inelastic mainly because only a small portion of income is spent for commodity and few substitutes are available. Thus, when the price of the commodity changes, it does not significantly change the consumption on it. Moreover, the demand for the commodity exports of developed countries is unstable because of business cycle fluctuations in developed countries. The supply of commodity exports of DCs is price inelastic because of internal rigidities and inflexibilities in resource used in most DCs. Supplies are unstable or shifting because of weather conditions and so forth (Salvatore, 2004: 367-369).

Moreover, terms of trade shocks are reported to account for nearly half of changes in actual GDP. Bleaney and Greenaway (2001) examined the impact of terms of trade on economic growth of 14 sub-Saharan African countries using cross-country evidence over the period 1980-1995. They found that an increase in terms of trade leads to an increase in economic growth.

Blattman *et al*. (2003) analysed of a near century of pre-World War II data, 1870-1938 for 35 countries (19 core and 16 periphery). They found that terms of trade has a significant impact on economic growth. Moreover, the impact of terms of trade is more important in the periphery than in the core. A decline in terms of trade experienced by the periphery represented a significant drag on economic growth during those seven decades. But even more damaging to the primary product producers in the periphery was the high degree of volatility in the terms of trade that exerted a negative impact on economic growth more than twice the size of the negative impact of the trend. The two combined served to halve economic growth of the periphery. Moreover, there is asymmetry between the core and periphery. Terms of trade or terms of trade volatility seems to have played a little role in the core, despite the fact that terms of trade volatility was almost as high in the core as in the periphery. However, terms of trade appears to have played an important role at explaining economic growth of the periphery. The more the core could escape the damaging consequences of terms of trade instability, an escape that was apparently unavailable to primary product exporters of the periphery. In another study, Blattman *et al*. (2004) employed a panel data analysis and reported the about same conclusions that they obtained earlier. They found that terms of trade secular chance have a significant impact on economic growth. Furthermore, the impact of terms of trade secular chance is more important in the periphery than in the core. Nonetheless, terms of trade secular chance is less important than terms of trade volatility on economic growth.

Peletier (1998) presented a model, which combines an endogenous growth framework with traditional Heckscher-Ohlin-Samuelson international trade. The model shows that the long-run GDP growth rates of DCs depend upon world price levels. As a country with a comparative advantage in labour intensive production would normally have a relatively high autarky price of the capital-intensive good, opening up to trade would cause a drop in the domestic price of that good. Traditional trade theory states that this nation as a whole will benefit from trading with the world. However, it is show that trade in this case will lower the long-run economic growth, possibly even causing a drop in overall welfare of the country. An improvement in terms of trade will raise economic growth, the longer terms effects for DCs might be negative.

Hadass and Williamson (2003) examined the relationship between terms of trade and economic growth using cross-country evidence over the period 1870-1940. They classified countries in their study according to the core and periphery, which are defined according to labour scarcity and level of development criteria. They also tried few criteria of the periphery in their sample. On the whole, they found that although terms of trade movement favoured primary product exporters, it reduced their economic growth. Moreover, there is strong evidence of asymmetry in economic growth between the core and periphery. Generally, the impact of terms of trade on economic growth was very small for the core and periphery. In the pre-war period, changes in terms of trade explained less than one-fifth of economic growth, which is

expressed by the GDP per capita growth rate. Nonetheless, the study covers few of DCs that remained poor up to World War II.

3. The Methodology and Data

Basically, testing for the existence of the long-run relationship among variables involves two steps. First, the individual series is examined to determine its order of integration and second, the series are examined for cointegration. In this study, the Dickey and Fuller (1979) and Phillips and Perron (1988) unit root test statistics are employed to test the stationarity of the data[3]. The Dickey and Fuller (1979) unit root test statistic uses the parametric approach, i.e. to change the estimating regression to solve the heterogeneity and serial correlation in an error term. On the other hand, the Phillips and Perron (1988) unit root test statistic uses the non-parametric approach, i.e. to modify statistic to obtain estimator and statistic. The Dickey and Fuller (1979) unit root test statistic is a low power test under the null hypothesis of a unit root that posits root close to the unit circle or tends to stationary. The Phillips and Perron (1988) unit root test statistic is known to be more robust in an error term process, i.e. an error term is allowed to be weakly heterogeneous.

According to Engle and Granger (1987), series that are integrated of the same order may cointegrate together. The cointegrated series may drift apart from each other in the short-run but the distance between them tends to be constant or in a stationary process in the long-run. More formally, a vector of series (n × 1), Y_t is said to be cointegrated if each of the series is integrated of the same order, an existing non-zero cointegrating vector (n × 1), α' such that the linear combination of these series, $\alpha' Y_t$ are stationary or is said to be integrated of zero and denoted by $I(0)$. Thus, the study proceeds to estimate the cointegration vector.

In this study, the Johansen (1988) cointegration method is used to estimate the long-run relationship among variables in the empirical models, which are estimated based on an augmented production function. The method is said to be optimal in terms of symmetry, unbiasedness and efficiency (Phillips, 1991). Moreover, Gonzalo (1994) in a Monte Carlo study shows the superior properties of the method relative to several other single and multivariate techniques. In the method, all variables are treated as endogenous. Provided that cointegration exists among variables, the cointegrating vector is normalised on economic growth. The empirical model used to investigate the impact of terms of trade on economic growth is based on an augmented production function. It is not uncommon to estimate economic growth of a country by using an augmented production function (Harrison, 1996). More specifically, the models to be estimated in this study are:

$$\ln Y_t = \beta_{11} \ln K_t + \beta_{12} \ln L_t + \beta_{13} \ln TOT1_t + \beta_{14} D_t, \quad (1a)$$

$$\ln Y_t = \beta_{21} \ln K_t + \beta_{22} \ln L_t + \beta_{23} \ln TOT2_t + \beta_{24} D_t, \quad (1b)$$

[3] If a time series has to be differenced once to become stationary, the time series is said to be integrated of order one. In general, if a time series has to be differenced d times to become stationary, the time series is said to be integrated of order d (Gujarati, 2003: 804-805).

where ln represents natural logarithm; Y_t stands for the output, which is expressed as the real GDP per capita[4]; K_t refers to the capital, which is expressed as the real gross fixed capital formation; L_t is the labour, which is expressed as employment; $TOT1_t$ represents the commodity terms of trade[5]; whereas $TOT2_t$ stands for income terms of trade; and D_t is a dummy variable to capture the impact of the Asian financial crisis (1997-1998) and the implementation of the capital control in Malaysia (0 for 1965-1996 and 1 for 1997-2002). This episode of capital control is still fresh in the discussion of policy makers in Malaysia[6]. The above models are named as Model 1 and Model 2, respectively. The commodity terms of trade is defined as export price index divided by import price index. On the other hand, the income terms of trade is defined as export price index multiplied by export volume and divided by import price index. Alternatively, the income terms of trade is approximated by the ratio of exports value to import price index, whereas the commodity terms of trade focuses only the price relations between exports and imports. On the other hand, the income terms of trade tries to quantify the trend of export-based capacity of a country to import goods. A rise in commodity terms of trade implies that export price is relatively higher than import price, which also implies that a unit exports from a country, is able to purchase a larger quantity of imports. Therefore, more imports can be obtained with a given quantity of exports and the welfare of the country is improved. Conversely, a fall in commodity terms of trade implies that more exports are required to purchase a quantity of imports. However, commodity terms of trade and income terms of trade do not have to move in the same direction. A rise in the export price relative to the import price could be more than offset by a decline in quantity of exports. Also, a rise in commodity terms of trade for a country can be reinforced by a rise in the quantity of exports, so that income terms of trade rises to a greater extent than commodity terms of trade. Moreover, the income terms of trade is judged to be more useful than the commodity terms of trade from economic growth perspective (Appleyard and Field, 2001: 111).

A rise in capital or labour would lead to a raise in economic growth. Thus, coefficients of capital and labour are expected to be positive, respectively. In the previous section, terms of trade is said to have an uncertainty impact on economic growth of DCs, particularly for those exporting mainly commodity, which demand of commodity is inelastic. Nonetheless, an increase in terms of trade is generally argued to lead to an increase in economic growth. Therefore, the coefficient of terms of trade is expected to be positive.

The Johansen (1988) cointegration method can be used to compute two likelihood ratio tests for testing the number of cointegrating vectors in the system, namely the

[4] The real GDP per capita is usually used to measure output in the literature of terms of trade and economic growth (Blattman *et al*., 2003, 2004).

[5] Commodity terms of trade is also called net barter terms of trade (Appleyard and Field, 2001: 105).

[6] Malaysia has experienced three episodes of capital controls. Those are in 1960-1972, 1993-1994 and 1998-2002 (to recent). However, the focus of the study is to examine the impact of the Asian financial crisis (1997-1998) and the implementation of the capital control in Malaysia. The impact of capital controls implemented in 1960-1972 and 1993-1994 is likely to be automatically 'naturalised' over time.

maximum eigenvalue (λ_{Max}) and trace (λ_{Trace}) statistics, which are respectively computed as:

$$\lambda_{Max} = -T \ln(1 - \lambda_{r+1}), \tag{2}$$

and

$$\lambda_{Trace} = -T \sum_{i=r+1}^{p} \ln(1 + \lambda_i), \tag{3}$$

where T is the sample size and λ_i is the eigenvalue. The λ_{Max} test statistic tests the null hypothesis (H_0) of r cointegrating against the alternative hypothesis (H_a) that there are (r + 1) cointegrating vectors. The λ_{Trace} test statistic tests the H_0 that has at most r cointegrating vectors in the system. That is, the number of cointegrating vectors is less than or equal to r (Johansen, 1988). The likelihood ratio test statistics can be sensitive to the choice of the lag length used in the estimation of the test statistics. Thus, the choice of the lag length in this study is determined by Schwarz Bayesian criterion (*SBC*).

Engle and Granger (1987) demonstrated that cointegration implies an error correction model (ECM). Suppose that there is one cointegrating vector among variables in Equations (1a) and (1b), the equations can be re-estimated respectively as:

$$\Delta \ln Y_t = \beta_{30} + \sum_{i=0}^{p} \beta_{31i} \Delta \ln K_{t-i} + \sum_{i=0}^{p} \beta_{31i} \Delta \ln L_{t-i} + \sum_{i=0}^{p} \beta_{33i} \Delta \ln TOT1_{t-i} + \gamma_1 EC_{1,t-1} + u_{1t}, \tag{4a}$$

and

$$\Delta \ln Y_t = \beta_{40} + \sum_{i=0}^{p} \beta_{41i} \Delta \ln K_{t-i} + \sum_{i=0}^{p} \beta_{41i} \Delta \ln L_{t-i} + \sum_{i=0}^{p} \beta_{43i} \Delta \ln TOT2_{t-i} + \gamma_2 EC_{2,t-1} + u_{2t}, \tag{4b}$$

where Δ is the first difference operator; $EC_{i,t-1}(i = 1, 2)$ is respectively an error correction term generated from using the Johansen (1988) cointegration method; and $u_{it}(i = 1, 2)$ is respectively an error term. The error correction term is included in the estimation as an additional independent variable to avoid the lost of potentially relevant information. The coefficient $\gamma_i(i = 1, 2)$ measures the response of the regressand in each period to departure from equilibrium condition. The ECM gives both the short-run dynamics and long-run relationship of variables in an equation. The study uses the general-to-specific modelling approach to estimate the ECMs. Initially, three lags of each first difference variable are used. Subsequently, as guidance, the independent variable that is not statistically significant at 10 percent level and does not contribute to the goodness of fit for the model being estimated significantly will

be dropped. The dropping strategy is first applied to the independent variable, which is least statistically significant.

In the Granger (1969) sense of a variable *X* causes another variable *Y* if the current value of *Y* can better be predicted by using past values of *X*. On the other hand, *Y* Granger causes *X* if the past values of *Y* can be used to improve the prediction of *X*. When series are cointegrated, the simple Granger-causality test becomes inappropriate. Thus, the testing of Granger-causality is in the ECM. The joint test of lagged variables by the mean of the *F*-statistic is significantly different from zero, which implies the presence of Granger-causality. For example, if the joint test of lagged variables of $TOT1_t$ is significantly different from zero, then it implies that $TOT1_t$ Granger causes Y_t. The minimum final prediction error (*FPE*) criterion proposed by Akaike (1971) is used to determine the optimal lags of the model.[7]

The data for economic growth, capital and labour are the real GDP per capita, the real gross fixed capital formation and employment (thousands of person), respectively. The GDP (millions of Ringgit) and gross fixed capital formation (millions of Ringgit) data were obtained from Ministry of Finance Malaysia (MFM). The population (millions of person) and GDP deflator (1995 = 100) data were obtained from International Monetary Fund (IMF). The employment data was obtained from MFM. The export price index (1995 = 100) and import price index (1995 = 100) data were obtained from the World Tables, World Bank. For the detail of definitions and constructions of the export price index and the import price index, see World Tables, World Bank. The value of exports (millions of Ringgit) data was obtained from MFM. The data are annually. All the data were transformed in logarithms. The sample period is from 1965 to 2002.

4. Empirical Results and Discussions

The results of the Dickey and Fuller (1979) and Phillips and Perron (1988) unit root test statistics are reported in Table 1. The lag length used to compute the Dickey and Fuller (1979) test statistics is based on Akaike (1973) information criterion (*AIC*). For the Phillips and Perron (1988) unit root test statistics, the results that are reported are based on three truncation lags, which are used to compute the test statistics after considering truncation lags one to three in computing the test statistics. Generally, the results of the Dickey and Fuller (1979) unit root test statistics show the null hypothesis of a unit root for level data is not rejected. However, they reject the non-stationary hypothesis for differenced data. The same conclusion is shown by the Phillips and Perron (1988) unit root test statistics. Thus, all the variables, namely the real GDP per capita (Y_t), capital (K_t), labour (L_t), commodity terms of trade ($TOT1_t$) and income terms of trade ($TOT2_t$) are said to be integrated of order one.

[7] Granger (1988: 203) showed that there are two types of causality, namely (i) the long-run causality, which implies by the significance of *t*-statistic on the coefficient of the error correction term in an ECM, and (ii) the short-run causality, which implies by the significance of *F*-statistic on the coefficient(s) of the lagged value(s) of a variable. An implication of cointegration is an ECM that implies the long-run causality. Thus, cointegration implies the long-run causality. However, the focus of the study is to discuss the short-run causality.

The results of the Johansen (1988) cointegration method are reported in Table 2. The results of the λ_{Max} and λ_{Trace} test statistics are computed with restricted intercepts and no trends. For Model 1, the λ_{Max} test statistic shows that the null hypothesis $r = 0$ is rejected at 95 percent critical value in favour of $r = 1$. Moreover, the null hypotheses of $r \leq 1$, $r \leq 2$, $r \leq 3$ and $r \leq 4$ are not rejected in favour of the alternative hypotheses of $r = 2$, $r = 3$, $r = 4$ and $r = 5$, respectively. The λ_{Trace} test statistic shows that the null hypothesis r = 0 is rejected at 95 percent critical value in favour of $r \geq 1$. The rest of the null hypotheses, i.e. $r \geq 2$, $r \geq 3$, $r \geq 4$ and $r \geq 5$ are not rejected at 95 percent critical value. For Model 2, the λ_{Max} test statistic shows that the null hypothesis $r = 0$ is rejected at 95 percent critical value in favour of $r = 1$. The rest of the null hypotheses are not rejected at 95 percent critical value. The λ_{Trace} test statistic shows that the null hypothesis $r = 0$ is nearly rejected at 95 percent critical value in favour of $r \geq 1$. The rest of the null hypotheses are not rejected at 95 percent critical value. Generally the results of the λ_{Max} and λ_{Trace} test statistics indicate the presence of one cointegrating vector for all the estimated models. In other words, there is a long-run equilibrium relationship among the real GDP per capita, the real gross fixed capital formation, employment, terms of trade and a dummy variable in each of the estimated models.

Table 1
The Results of the Dickey and Fuller (1979) and Phillips and Perron (1988) Unit Root Test Statistics

Variable	t_γ - no trend	t_γ - trend	$Z(t_\gamma)$ - no trend	$Z(t_\gamma)$ - trend
$\ln Y_t$	-1.9239(1)	-2.5474(3)	-0.8792(3)	-1.8789(3)
$\Delta \ln Y_t$	-4.5854**(0)	-4.9768**(0)	-4.5205**(3)	-4.4995**(3)
$\ln K_t$	-1.9004(1)	-2.1492(1)	-1.2896(3)	-1.6266(3)
$\Delta \ln K_t$	-3.9111*(0)	-4.1574*(0)	-3.9912*(3)	-4.0252*(3)
$\ln L_t$	-0.6704(0)	-2.4702(0)	-0.8425(3)	-2.4252(3)
$\Delta \ln L_t$	-5.0367**(1)	-5.0251**(1)	-5.8418**(3)	-5.8089**(3)
$\ln TOT1_t$	-1.6868(2)	-1.1981(2)	-3.2658(3)	-3.3266(3)
$\Delta \ln TOT1_t$	-7.4609**(1)	-7.5425**(1)	-7.2984**(3)	-7.1987**(3)
$\ln TOT2_t$	-0.0004(2)	-1.9439(2)	0.0629(3)	-2.7372(3)
$\Delta \ln TOT2_t$	-5.9157**(1)	-5.7981**(1)	-6.1822**(3)	-6.0623**(3)

Notes: ln stands for logarithm. Δ is the first difference operator. t_γ is the Dickey-Fuller (*DF*) or Augmented Dickey-Fuller (*ADF*) *t*-statistic. $Z(t_\gamma)$ is the Phillips and Perron (1988) *t*-statistic. Values in parentheses are the lag length used in the estimation of the unit root test statistics. Critical values for t_γ ($Z(t_\gamma)$) with a drift (no trend) at 1% and 5% for sample size 35 are -3.63 and -2.95, respectively. Critical values for t_γ ($Z(t_\gamma)$) with a drift and a time trend (trend) at 1% and 5% for sample size 35 are -4.24 and -3.54, respectively (MacKinnon, 1996). ** denotes significance at 1 percent level. * denotes significance at 5 percent level.

Table 2
The Results of the Johansen (1988) Likelihood Ratio Test Statistics

λ_{Max} Test Statistic					
H_0:	r=0	$r \leq 1$	$r \leq 2$	$r \leq 3$	$r \leq 4$
H_a:	r=1	r=2	r=3	r=4	r=5
Model 1	35.68*	22.33	13.70	4.10	0.21
Model 2	38.57*	17.16	6.47	6.08	0.95
c.v. (1)	33.64	27.42	21.12	14.88	8.07
c.v. (2)	31.02	24.99	19.02	12.98	6.50
λ_{Trace} Test Statistic					
H_0:	r=0	$r \leq 1$	$r \leq 2$	$r \leq 3$	$r \leq 4$
H_a:	r≥1	r≥2	r≥3	r≥4	r≥5
Model 1	76.02*	40.34	18.01	4.32	0.21
Model 2	69.23	30.66	13.50	7.03	0.95
c.v. (1)	70.49	48.88	31.54	17.86	8.07
c.v. (2)	66.23	45.70	28.78	15.75	6.50

Notes: All the models are estimated using order of VAR = 1. c.v. (1) denotes 95 percent critical value. c.v. (2) denotes 90 percent critical value. * denotes significant at 95 percent critical value. See Pesaran *et al.* (2000) for the critical value.

The results of the estimated cointegrating vector normalised by economic growth are reported in Table 3. On the whole, all explanatory variables in each of the models are found to have the expected signs. An increase in capital or labour leads to an increase in economic growth. An increase in terms of trade, namely commodity terms of trade or income term of trade leads to an increase in economic growth. The dummy variable to capture the impact of the Asian financial crisis (1997-1998) and the implementation of the capital control in Malaysia is found to have a significant positive impact on economic growth. Thus, capital, labour, terms of trade and the impact of the Asian financial crisis (1997-1998) and the implementation of the capital control in Malaysia is said to have a long-run positive impact on economic growth. The results show no different impact of different measures of terms of trade on economic growth.

The Granger representation theorem shows that cointegration implies an error correction representation. The results of the ECMs are reported in Table 4. The plots of CUSUM and CUSUMSQ statistics for all the estimated ECMs show no evidence of instability (Figure 2). On the whole, the results show all the models to have a high-adjusted R^2, i.e. 0.7745 for Model 1 and 0.7834 for Model 2. Moreover, all the models fulfil the conditions of no-autocorrelation, normality and homoscedasticity of error terms, and no-functional form misspecification (except Model 2). The one-

lagged error correction terms are all found to have the expected negative sign and are statistically significant at 5 percent level and 1 percent level for Model 1 and Model 2, respectively. Thus, the finding supports the validity of an equilibrium relationship among the variables in each of the cointegrating equations. Generally, commodity terms of trade and income terms of trade are found to have a significant impact on economic growth. Again, there is no different impact on economic growth due to different measures of terms of trade. The results of Granger-causality test are reported in Table 5. Generally, there is no strong evidence or no empirical evidence at 10 percent level to suggest that terms of trade, either commodity terms of trade or income terms of trade Granger causes economic growth and vice versa.

Table 3
The Results of the Normalised Cointegrating Vector

Model	The Normalised Cointegrating Vector
1	$\ln Y_t = 0.3009 \ln K_t + 0.3957 \ln L_t + 0.0139 \ln TOT1_t + 0.1660 D_t$
2	$\ln Y_t = 0.2897 \ln K_t + 0.3252 \ln L_t + 0.0359 \ln TOT2_t + 0.1516 D_t$

On the whole, terms of trade is found to have a long-run and short-run impact on economic growth of Malaysia. Blattman *et al*. (2003) and Bleaney and Greenaway (2001), amongst others reported that commodity terms of trade has a significant positive impact on economic growth, particularly in DCs. On the other hand, Peletier (1998) and Hadass and Williamson (2003), amongst others argued that an increase in commodity terms of trade would lead to a decrease in economic growth in the long-run. Nonetheless, Hadass and Williamson (2003) reported that the negative impact of terms of trade on economic growth is small. Malaysia has transformed its economy from a commodity-based to an industrial-based. Moreover, Malaysia has successfully diversified its economy. The compositions of Malaysian exports are also diversified, mainly exporting manufactured products. The move to diversify the exports is important and appropriate. Nonetheless, Malaysian exports, mainly manufactured products such as electrical and electronic, are labour intensive. These products are facing increasingly competition from other countries such as Thailand, Vietnam, Indonesia and China, which have comparative advantage in producing those products. In the long-run, the effort should be given to produce and export more products that are capital and knowledge intensive, which the exports demand of those products are to be more price elastic. Moreover, Malaysia is loosing its comparative advantage in producing labour intensive products because of shortage in supplying of relatively cheap labour.

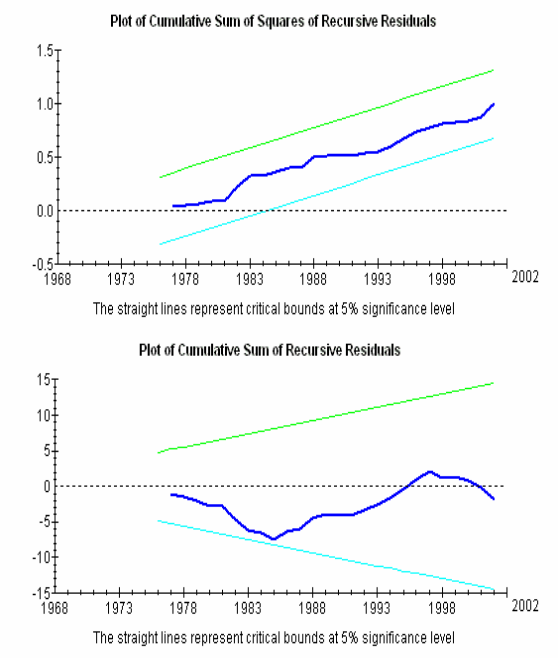
Table 4
The Results of the Error Correction Models

Model	1	2
Constant	-0.24591 (-1.7757)	-0.24450 (-2.9883)**
$\Delta \ln K_t$	0.21993 (7.6750)**	0.20677 (7.7478)**
$\Delta \ln L_t$	0.28633 (1.5039)	0.38439 (2.0670)*
$\Delta \ln L_{t-2}$	-0.34906 (-1.8856)	-0.28865 (-1.6480)
$\Delta \ln TOT1_t$	0.27474 (5.5735)**	-
$\Delta \ln TOT1_{t-2}$	0.07434 (1.4999)	-
$\Delta \ln TOT2_t$	-	0.17262 (5.7827)**
$\Delta \ln TOT2_{t-2}$	-	0.06205 (1.6814)
$\Delta \ln Y_{t-1}$	-0.13994 (-1.5005)	-
$\Delta \ln Y_{t-2}$	-	-0.10171 (-1.0032)
EC_{t-1}	-0.29163 (-2.0611)*	-0.49033 (-3.1838)**
Diagnostic Tests:		
Adjusted R^2	0.7745	0.7834
LM	0.1120	1.5836
Reset	1.5348	4.3688*
Normal	0.3129	0.6013
Hetero	1.9702	0.1373

Notes: EC_{t-1} is the error correction term. *LM* is the Lagrange Multiplier test of error term serial correlation. *Reset* is the test of functional form. *Normal* is the test of the normality of error term. *Hetero* is the test of heteroscedasticity. Values in parentheses are the *t*-statistic. ** denotes significant at 1 percent level. * denotes significant at 5 percent level.

Figure 2
The Plot of CUSUM and CUSUMSQ Statistics for the Estimated ECMs

Model 1



Model 2

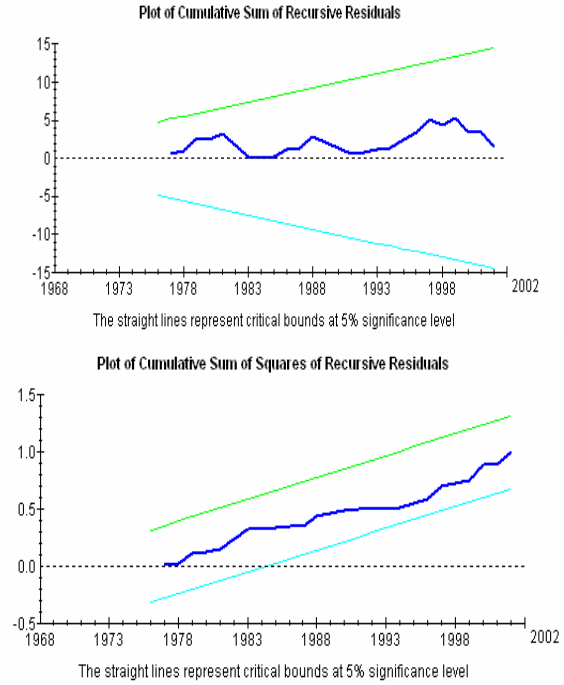


Table 5
The Results of the Granger-Causality Test

Model	$\Delta \ln TOT_t \mapsto \Delta \ln Y_t$	$\Delta \ln Y_t \mapsto \Delta \ln TOT_t$
1	0.3199	3.0667
2	1.0709	0.0992

Notes: The arrow "$\mapsto$" denotes no Granger-causality. The reported values are the *F*-test statistics

Moreover, Malaysia is opening its economy to international trade. The openness of Malaysian economy to international trade in terms of total trade to gross domestic product (GDP) increased over time. The average of the ratio, i.e. total trade to GDP over the period 1970-1979 was 88.6 percent. The average of the ratio increased to 113.1 percent over the period 1980-1989 and 178.2 over the period 1990-1999. In 2000, the ratio was 230.8 percent (IMF). The openness of Malaysian economy is expected to increase with the liberalisation and globalisation of the world economy. Thus, an implication of a more openness of an economy to international trade is that Malaysian economy shall converge to the world economy is a faster rate than those are less openness to international trade. In other words, any changes in the world economy will be reflected quickly in Malaysian economy. Moreover, the impact of terms of trade on Malaysian economy is expected to be larger and quicker. Therefore, any changes in terms of trade shall affect quickly Malaysian economy and the past effect of terms of trade on the economy shall be very little. This could be an explanation for no strong evidence to suggest that terms of trade Granger causes economic growth and vice versa in Malaysia.

The impact of terms of trade on economic growth depends on exchange rate regime. Theory predicts that a country with a fixed exchange rate regime will adjust to a terms of trade shock through a change in its output while a country with a flexible exchange rate will adjust to a terms of trade shock through a change in its exchange rate. Broda and Tille (2003) examined the output effects of a 10 percent decline in export prices in seventy-five DCs with differing exchange rate regimes. They found that two years after the price decline, the real GDP is almost unaffected in countries with a flexible exchange rate, while it drops by about 2 percent in countries with a fixed exchange rate. Thus, a flexible exchange rate can help to insulate an economy against fluctuations in export and import prices. However, it does not necessarily follow that a flexible exchange rate is unambiguously the best choice for a country. Theory predicts that a flexible exchange rate be an automatic stabiliser, absorbing by means of its own movements the fluctuations in terms of trade. The effectiveness of the flexible exchange rate in responding to terms of trade shocks is only one of many considerations that DCs would weigh in choosing an exchange rate regime. In this study, a dummy variable is included in the estimation to capture the impact of the Asian financial crisis (1997-1998) and the implementation of the capital control in Malaysia. The results show the dummy variable to have a positive impact on economic growth of Malaysia. Thus, it could be an explanation that a fixed exchange rate regime, i.e. the implementation of the capital control in Malaysia after Asian

financial crisis (1997-1998) in the period of the study is suitable. Nonetheless, more studies should be carried-out to confirm the finding.

5. Concluding Remarks

The main aim of the study is to investigate the impact of terms of trade on economic growth of Malaysia using an augmented production function. Moreover, the study examines Granger-causality between terms of trade and economic growth. The Dickey and Fuller (1979) and Phillips and Perron (1988) unit root test results show that all variables are integrated of order one. The results of the Johansen (1988) cointegration method show that the estimated models are cointegrated. In other words, there is a long-run relationship between terms of trade and economic growth. More specifically, an increase in terms of trade leads to an increase in economic growth. The finding is the same regardless the measures of terms of trade, namely commodity terms of trade or income terms of trade. The results of the ECMs show that generally terms of trade has a short-run impact on economic growth. The results of Granger-causality show that terms of trade does not Granger cause economic growth and vice versa. Generally, the results show that the two measures of terms of trade have no different impact on economic growth in Malaysia. The episode of capital control after the Asian financial crisis (1997-1998) is said to have an important impact on economic growth in Malaysia.

Generally, economic growth is higher when terms of trade is more favourable. In the past, Malaysia has successfully transformed its economy from a commodity-based to an industrial-based. Malaysian exports are more diversifying. Nonetheless, Malaysian exports are mainly labour intensive. In the long-run, the effort should be concentrated towards exports of capital and knowledge intensive products. These products are usually to have higher prices in international markets, which terms of trade in Malaysia is expected to improve. The openness of Malaysian economy is expected to increase with the liberalisation and globalisation of the world economy. Thus, Malaysian economy is expected to converge to the world economy in a faster rate. At the same time, any changes in terms of trade shall affect quickly Malaysian economy. The implementation of the capital control after Asian financial crisis (1997-1998) in Malaysia is found to have a positive impact on economic growth. Thus, a fixed exchange rate regime is suitable in the period of study. Nonetheless, more studies should be carried-out to clarify the finding. It may be also interesting to compare the significance of the implementation of the capital control after Asian financial crisis (1997-1998) in Malaysia on economic growth with other episodes of capital control in Malaysia such as those in 1960-1972 and 1993-1994.

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