"A Study of Exogeneity Tests on Export-Led Growth Hypothesis" The Empirical Evidences on Post-Crisis Exchange Rate Regime in Malaysia

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ABSTRACT

The focal point of this study is to examine the robustness of the export-led growth hypothesis in Malaysia after the Asian Financial Crisis in 1997/1998. This study adopts the Vector Error Correction Mechanism (VECM) to differentiate between short run and long run causal effects in examining the led growth determinants. By using the standard time series procedures, the result propose for the bi-directional and/or uni-directional causality between exports and economic growth, both in the short-run and long-run. Moreover, this study found the evidence for the strong case of Export Led Growth Hypothesis (ELGH) in Malaysia in post crisis regime by employ the test procedure proposes by Darrat (2002). Hence, we conclude for the robustness cases of ELGH in post-crisis exchange rate regime in Malaysia, is successfully documented.

KEYWORDS

Export Led Growth Hypothesis, Post-Crisis Exchange Rate Regime, Vector Error Correction Modelling.

1.0 INTRODUCTION

The Export-Led Growth Hypothesis (Hereafter: ELGH) can be specified as export expansion is one of the main determinants of economy growth. According to the ELGH, overall growth of countries (in our case is Malaysia) can be generated not only by increasing the amounts of labour and capital within the economy, but also by expanding exports. Therefore, exports can also be known as an *"engine of growth".*In general, ELGH is based on two theories, namely, aggregate production function theory and international trade and development theory. This chapter however, focuses on international trade and development theory in structuring its theoretical framework. Basically, the international trade and development theory suggest a positive relationship between export growth and economic growth. In other words, exports provide a favourable condition to economic growth. This is because according to the theory, the export expansion is a significant tool for improving productivity growth that in turn enhances the economic growth (Balassa, 1985). Yet the hypothesis can be further divided into three groups, namely;

(i) The export-led growth hypothesis (ELGH),
(ii) The growth-driven exports hypothesis (hereafter: GDXH), and

(iii) The bidirectional relationship, which is a combination of (i) and (ii). But, in this study, we only use the first and third groups to prove the existence of ELGH in the system.

Moreover, there is a lack of studies on ELGH in Malaysia, especially in post crisis regime environment. In addition, most of the previous researches are focused on the exchange rate regime before the Asian Financial Crisis 1997/1998 (Dorado, 1993; Doraisami, 1996; among others). Only a few paper focused on the regime during the peg exchange rate regime including Al-Yousif (1999), Baharunshah et al. (1999) and Ibrahim (2002), among others.

Hence, the main objective of this paper is to acknowledge the impact of exchange rate mechanisms into ELGH in Malaysia especially in post crisis exchange rate regime. In order to achieve this objective we applied a testing procedure proposed by Darrat (2000). This test is powerful among other tests in terms of identifying the strongest case of the ELGH in Malaysia. Furthermore, we also apply Granger causality tests in vector error correction model (Hereafter: VECM framework) in order to capture the short-run and long-run relationship between the variables in the systems.

2.0 LITERATURE REVIEW

In relation to the case of Malaysia, earlier and current empirical studies support for this hypothesis, mainly, Dodaro (1993), Fuso (1990,1996), Doraisami (1996), Riezman (1996), Shan (1998a,1998b), Al-Yousif (1999), Ibrahim (2002). But, most of the previous studies are not focusing in post crisis regime environment. For instance, the study of Riezman et al. (1996) investigates the validity of the ELGH for over 126 countries, running annually data from 1965 to 1999 (pre- and during crisis regime by the inclusion of the structural break in modelling). This study is different from previous studies in the same field which had included real import as one of the explanatory variables in the estimation model. According to Riezman, The inclusion of imports variable in the estimations model is about to avoided the spurious results. The results suggest mild relationship between export and growth.

Moreover, the study of Al-Yousif (1999) investigates the ELGH in five variables framework, including, real gross domestic product (hereafter: GDP), real exports, employment index, real gross fixed capital formation, and real exchange rate, using annual data from 1955 to 1996. Applying cointegration and vector error correction model, he documents further evidence supporting the ELGH for the Malaysia case (pre-crisis regime). In addition, Baharumshah and Rashid (1999) further suggest the important role of exports in tri-variate framework which also includes real imports in the modelling. As a result, positive relationship between exports and growth is documented in this study.

In contrast, Jung and Marshall (1985), Dorado (1993), Sengupta and Espana (1994) claimed that export growth has had a negative (rather than positive) effect on the Malaysian economic growth. The most interesting economic phenomenon suggests a two way causal relationship between growth and trade. Among others, Doraisami (1996) using annually data from 1963 to 1993 found bi-directional relationship between Malaysia export and growth performance.

Furthermore, Ibrahim (2002) evaluates the ELGH in the five variables framework, which includes real GDP per capita to measure real output, fixed capital formation to measure investment ratio, real exports, real imports, and government consumption, using annually data from 1960 to 1997 (pre-crisis regime). Applying standard procedures of unit root testing, cointegration and error-correction modelling, he found evidence supporting the role of

exports in Malaysian economic development in the short term. Moreover, he further suggests that exports are not weak exogenous and subsequently not super exogenous.

3.0 MODEL SPECIFICATION

In the light of previous literature of export-growth nexus, in this section, we set up a model to test rigorously the exogineity test on export-growth nexus model. Following the specification models by Al-Yousif[1] (1999) and Baharumshah et al. (1999) and with additional specifications, the long run equilibrium relationships between the economic growth and its determinant variables in this chapter is as follows;

$$\ln g_{it} = \alpha_0 + \alpha_1 \ln e_{it} + \alpha_2 \ln I_{it} + \alpha_3 \ln er_{it} + \varepsilon_{it} \qquad (1)$$

With sign expectation for model (1) is;

$\alpha_1 > 0, \alpha_2 > 0, \alpha_3 > 0$ or $\alpha_3 < 0$, and $\alpha_4 > 0$ or $\alpha_4 < 0$

Here,

g_{it} = Real output for regime *'i'* and time *'t'*
e_{it} = Real exports for regime *'i'* and time *'t'*
I_{it} = Real imports for regime *'i'* and time *'t'*
er_{it} = Real effective exchange rate for regime *'i'* and time *'t'*
CD_{it} = The crisis dummy for regime *'i'* and time *'t'*
ε_{it} = The error terms for regime *'i'* and time *'t'*
α_{it} = Coefficient for determination variables

In general Balassa (1985) argued that the production of export goods is focused on those economic sectors of the economic which are already more efficient. Therefore, export expansion helps to concentrate investment in these sectors, which in turn increase the overall total productivity of the economy. Thus, positive relationship between exports and economic growth is hypothesized.

While imports are an important since the manufacturing base of the country is built on export-oriented industries and imports may play a central role in explaining the economic performance. It can be argued that by providing needed intermediate goods, imports are an important determinant of economic performance (see for example Esfahami, 1991; Serletis, 1992; Riezman et al., 1996; Liu et al., 1997). Moreover, according to Henriques et al. (1996), it is expected that positive correlation exists between exchange rate (RM/US$) and economic growth. If the Malaysian Ringgit depreciates (i.e. RM/US$) increases), then this will raise the competitiveness of the domestic commodities, and hence encourages exports.

[1] The growth equations used in Al-Yousif (1996) specify the growth rate using real GDP while the export measure by the real exports.

4.0 METHODOLOGY

This section outlines the methodology framework used in this chapter. Firstly, this chapter utilizes the univariate unit root test proposed by Dickey and Fuller (1979). Then, in order to capture the long term relationship between the variables, the test procedure continues by adopting the cointegration tests recommended by Johansen and Juselius (1990). Lastly, this chapter expands the analysis by utilizing the Granger causality tests in vector error correction model (VECM) proposed by Engle and Granger (1987).

In general, the unit root test is a formal preparation test before we proceed to cointegration tests. Here, in order to tests for presence or absence of unit root we employ the Augmented Dickey Fuller (ADF) test propose by Dickey and Fuller (1979), Basically, The ADF unit root test genuinely from Dickey Fuller (DF) unit root test proposes by Dickey, (1976). Based on the previous reading (Gujarati, 2003), pp: 817) stated that, in conducting the DF unit root tests, we assumed that the error term (U_t) is uncorrelated. In addition, for the case where the U_t is correlated, Dickey and Fuller (1979) have developed a test known as ADF unit root tests. The well knows Augmented Dickey Fuller tests use a parametric autoregression to approximate the Autoregressive Moving Average (ARMA) structure of the errors in the test regression. The ADF tests structures are however are as follows. Consider a simple general AR (p) process given by;

$$e_t = \alpha + \beta_1 e_{t-1} + \beta_2 e_{t-2} + \ldots + \beta_i e_{t-i} + v_t \qquad (2)$$

The cointegration test procedure can be proceed into two main approaches namely, Engle and Granger (1987) two steps procedure and the Johansen and Juselius (1990)[2]. In this study, we performed latter approach, since this particular method is claimed to be one of most superior to the regression based to former method. Lag truncation under this method proposes by Vahid and Engle (1989) is applied. Here, the cointegration tests have been employed to tests for the long-run equilibrium between economic growth, exports, imports, and exchange rate in Malaysia. The cointegration refers to the possibility that non-stationary variables may have a linear combination that is stationary. The existing of a cointegration vector implies that there is long-run equilibrium relationship among these variables.

The econometric estimation of causality between economic variables began with Granger (1969) and Sims (1972). They hypothesized that, if two variables are cointegrated, the finding of no causality in either direction one of the possibilities with the standard tests, is ruled out. In other words, if two variables are found to possess a common stochastic trend (moving together), causality (in Granger sense) must exist in at least one direction, either unidirectional or bi-directional. However, although cointegration indicates presence or absence of Granger causality between the variables, it does not provide the direction of causality between the variables. This direction of the Granger causality can only be detected

[2] One of appealing features of Johansen et al (1990) cointegrating procedure, it is allows more than one cointegrating relation among the variables being examined. Also, this cointegrating procedure concerns about the small-sample bias in estimates from Engle-Granger technique. Unlike the Johansen procedure, the drawback of the Engle-Granger two-step procedure, its does not easily accommodate dynamics in the cointegrating analysis. Thus, this procedure assumes uniqueness of the cointegrating vector in the cointegrating system.

through the VECM framework derived from the long run cointegrating vector. In addition, to indicating the direction of causality among variables, the VECM framework distinguishes between the short run and long run Granger causality

The presence of cointegration among the variable under consideration implies that these variables must be temporally causally linked in at least one direction. According to Engle and Granger (1987), a vector error correction model can appropriately represent the causal link among the cointegrated variables. The VECM conveniently combines variables in first differences and the error correction term to explain the dynamic behaviour of a variable of interest. Using the export model, we can write the vector error correction model as follows;

$$\Delta e_{it} = \eta_2 + \sum_{i=1}^{G} \alpha_i \Delta g_{t-i} + \sum_{i=1}^{E} \beta_i \Delta e_{t-i} + \sum_{i=1}^{IN} \phi_i \Delta I_{t-i} + \sum_{i=1}^{ER} \gamma_i \Delta er_{t-i} + \Pi \ ECT_{t-1} + \Omega_{2t} \quad (3)$$

Here, the notation of Δ denotes as the first difference operator. While, *ECT* denotes the error correction terms from the cointegration vector equation, and other variables are as defined previously. With this specification, the change in export ratio depend on only changes in other variables but also on one period lagged deviations from long run equilibrium as represented by *ECT*. According to Todo and Phillips (1994), the former may termed as short-run causality, that from included variables to export ration (i.e. the standard Granger causality test) while the letter may be termed as long-run causality.

Moreover, the coefficient of the *ECT* represents the speed of adjustment of the dependent variable to correct any deviation from its long run equilibrium path. In this chapter, a comparison is made in percentage term to show the difference on the speed of adjustment among the regimes. The motivation behind this is to compare the fastest and the slowest speed of adjustment according to the coefficient values. The fastest adjustment consumes less time of back to equilibrium in the long term .Thus the coefficient of ECT is much bigger than the slowest one. Therefore, for the regime with the small ECT coefficient, it requires more time to return to the long-term equilibrium condition.

More importantly, in our context, the model readily provides a framework for exogeneity tests. In order to make a strong case for ELGH, exports need to be structurally invariant to structural changes or regime shifts. In other words, exports must be super-exogeneity. Since weak-exogeneity is a necessary condition for super-exogeneity, testing for weak-exogeneity of export ratio is required. Following to Johansen (1992), this test can be carried out by examining the significance of the error correction term. More specifically, as stated by Asafu-Adjaye and Chakraborty (1999), and Darrat et al. (2000), weak-exogeneity test procedure of the export ratio is rejected if the error correction term in (3) is statistically significant.

5.0 RESULT AND DISCUSSIONS

The result of the ADF unit root tests, both at the level and at first differencing are reported in Tables 1, by taking into consideration with time trend and without time trend variable in the regression. According to Table 1, the t-test statistics for all series from ADF tests are statistically insignificant to reject the null hypothesis of non-stationarity. This result indicates that these series are non-stationary at their level form. Whereas, the result fails to reject the null hypothesis of unit roots in their level form in the autoregressive representation of each variable, thus, they are all not I(0). Therefore, these variables contain a unit root process or they share a common stochastic component. Thus, the tests are continued in the first differencing stages. When the ADF test is conducted at the first difference of each variable,

the null hypothesis of non-stationary is easily rejected at 99% significance levels as shown in Table 1.

Table 1
The Result of Augmented Dickey Fuller Tests for Post-Crisis Exchange Rate Regime

Data Series	At level		At first difference	
	without trend	with trend	without trend	with trend
Growth	-1.873833	-1.855715	-5.220341*(4)	-5.175559*(4)
Real Export	-1.699196	-1.748619	-4.048050*(6)	-4.037940*(4)
Real Import	-1.575489	-1.613460	-3.998575*(5)	-4.014604*(5)
Real Exchange rate	-1.418894	-2.028193	-4.119030*(7)	-4.088449*(3)

Notes: Figures in parentheses are the lag order selected based on the AIC where '*' indicates significant at the 99% level.

For the result of cointegration test inpost-crisis exchange rate regime, the result of the trace statistic test demonstrates that the null hypothesis of r=0 against its alternative r>1, is easily rejected at the 0.01 and 0.05 significant levels. The computed value 53.37645 is obviously larger than the critical values at 0.05 and 0.01, these being 47.21 and 54.47, respectively. Nonetheless, if we test the null hypothesis of r≤1, we definitely fail to reject the hypothesis as the computed value at 22.86650 is smaller than the critical values at 0.05 and 0.01 significant levels, which are 29.68 and 35.68, respectively. Therefore, based on the trace statistic test result, we conclude that there exists a single cointegrating vector in the model. The study suggest for the similar result for Lambda Trace and Lambda Max. Based on these outcomes, the study further suggests that the economic growth and its macroeconomic determinants exhibit a long-run relationship in the regime one (converge). This is means the series in the system are moving together and cannot move far from each other.

Table 2:
The Results of Johansen Cointegration Tests for Post-Crisis Exchange Rate Regime

Data Period : Sept,2005 to Dec, 2010		Cointegration system : F (Growth, Real Export, Real Import, Real Exchange Rate)					
Hypothesis		λ Trace	5% critical value	1% critical value	λ Max	5% critical value	1% critical value
H0	H1						
r=0	r>0	53.37645*	47.21	54.46	30.50994*	27.07	32.24
r≤1	r>1	22.86650	29.68	35.65	11.70558	25.97	25.52
r≤2	r>2	11.16093	15.41	20.04	8.832038	14.07	18.63
r≤3	r>3	2.328889	3.76	6.65	2.328889	3.76	6.65

Note that, the notation 'r' denotes the number of cointegrating vectors. The superscript (*) indicates statistically significant at 95% and (**) at 99% levels. The critical values for the Johansen Juselius test were obtained from (Osterwald-Lenum, 1992)

Furthermore, the temporal test estimates of Granger causality provided in the vector error correction framework for post-crisis regime is summarized in Tables 3. As illustrated by Engle and Granger (1987), the evidence of cointegration among variables also rules out the possibility of the estimated relationship being *'spurious'*. Although cointegration indicates the existence or absence of Granger-causality, it does not indicate the direction of causality between variables (Masih and Masih, 1998). The path of causality among variables however can be detected through the Vector Error Correction Model (VECM), derived from the long run cointegrating vectors.

In the line of the export-led growth hypothesis, the basic idea is that there may be co-movements (moving together) across the variables, mainly, growth, exports, imports, and the real exchange rate across the regimes. There might also be possible co-movements among all these variables, in the long term trend together in finding the stability equilibrium. In general, modelling the Granger representation environment in this study posits the following testing relationships which constitute the vector error correction model as follows:

Modelling

$$\Delta g_{it} = \eta_1 + \sum_{i=1}^{G} \alpha_i \Delta g_{t-i} + \sum_{i=1}^{E} \beta_i \Delta e_{t-i} + \sum_{i=1}^{IN} \phi_i \Delta I_{t-i} + \sum_{i=1}^{ER} \gamma_i \Delta er_{t-i} + \delta_1 ECT_{t-1} + \Omega_{1t} \quad (4.1)$$

$$\Delta e_{it} = \eta_2 + \sum_{i=1}^{G} \alpha_i \Delta g_{t-i} + \sum_{i=1}^{E} \beta_i \Delta e_{t-i} + \sum_{i=1}^{IN} \phi_i \Delta I_{t-i} + \sum_{i=1}^{ER} \gamma_i \Delta er_{t-i} + \delta_2 ECT_{t-1} + \Omega_{2t} \quad (4.2)$$

$$\Delta I_{it} = \eta_3 + \sum_{i=1}^{G} \alpha_i \Delta g_{t-i} + \sum_{i=1}^{E} \beta_i \Delta e_{t-i} + \sum_{i=1}^{IN} \phi_i \Delta I_{t-i} + \sum_{i=1}^{ER} \gamma_i \Delta er_{t-i} + \delta_3 ECT_{t-1} + \Omega_{3t} \quad (4.3)$$

$$\Delta er_{it} = \eta_4 + \sum_{i=1}^{G} \alpha_i \Delta g_{t-i} + \sum_{i=1}^{E} \beta_i \Delta e_{t-i} + \sum_{i=1}^{IN} \phi_i \Delta I_{t-i} + \sum_{i=1}^{ER} \gamma_i \Delta er_{t-i} + \delta_4 ECT_{t-1} + \Omega_{4t} \quad (4.4)$$

Here the notations of g_{it}, e_{it}, I_{it} and er_{it} in the equations *4.1* to *4.4*, denote as the growth, exports, imports and real exchange rates, respectively. While, the difference operator represents by Δ. Moreover, subscript *'i'*and *'t'*, indicates regimes *(i=1, 2, 3)* and time series data, accordingly. The error correction term lag one (ECT_{t-1}) parameter is denoted by δ. These parameters are estimated from a long-run cointegrating relationship via the Johansen maximum likelihood procedure. At the end of each equation, the parameter denoted by the Ω_{it}(and *i=1, 2, 3, 4*) is the serially-uncorrelated random error term with mean equal to zero. From these equations, equation *4.1* for instance, could be used to test for the relationship between real exports, real imports and real exchange rate to growth. As an extra, the *VECM* procedure allowed us to distinguish between short-run and long run relationships between the variables. Intuitively, when the variables are cointegrated, and then in the short-run deviations from this long-run equilibrium will feed back on the changes in the dependent variable in order to force the movement towards the long-run equilibrium. In addition, if exports Granger cause growth in the short run, thus this supports the ELGH (Maneschiold, 2008). In addition, in the export model, we found a significant coefficient of the error correction term(s) in all export ratio systems. Thus, the VECM tends to indicate that exports

appear not to support weak exogeneity in most of the regimes under observation. Since weak exogeneity is an important condition for super exogeneity, the condition for exports to be super-exogenous is violated.

Table 3:
The Results of Granger Causality in VECM Framework for Post-Crisis Exchange Rate Regime

Dependent Variables	Independent variables				
	$\Delta growth_t$	$\Delta exports_t$	$\Delta imports_t$	$\Delta ex\text{-}rate3_t$	$ECT_{r=1(t-1)}$
$\Delta growth_t$	-	[2.0615] (0.0983)	[2.2474] (0.0656)	[0.8359] (0.5347)	[[-0.334711]]
$\Delta exports_t$	[7.6217] (0.0002)	-	[14.5341] (0.0000)	[7.3564] (0.0001)	[[-1.0723]]***
$\Delta imports_t$	[3.9888] (0.0107)	[2.5909] (0.0469)	-	[1.9156] (0.0958)	[[1.488597]]*
$\Delta ex\text{-}rate3_t$	[0.7807] (0.6092)	[0.9581] (0.4272)	[0.9304] (0.5085)	-	[[-0.32070]]**

All variables in each data set are in first differences (denoted by Δ) with the exception of the lagged error correction term (ECTt-1). All equations for all data set passed the diagnostic tests. In varies brackets, [], (), and [[]], specify for Wald-test, Wald-test probability, and error correction term coefficient. Also the superscript '***', '**', and '*' specify significant at 99%, 95%, and 90% significance levels. Please refer to equations 2.30 to 2.33 to read the table. The grey matrix area in the table presenting the Granger causality tests results.

6.0 CONCLUSIONS

By using advanced time series procedures, we find evidence for bi-directional and/or unidirectional causality between exports and growth, in the long-run and in the short-run for post-crisis exchange rate regime in Malaysia. In order to find strong cases for ELGH within the regimes, we apply the Darrat (2002) testing procedure. The results suggest that in all regimes under consideration export appears not to support for weak exogeneity in all regimes. To conclude, the weak case for ELGH in Malaysia in all regimes under estimation is found. In particular, imports as well as the exchange rate variables are also important in terms of contributing to the success of economic performance in Malaysia. However in the real economy, it is not only exports, imports, and exchange rates led economic growth in long and short term, but other macroeconomic elements like investment, financial development and services have also the important role in influencing the economic growth. Thus, besides the essential component to ensure positive growth, other complementary policies are also important to be developed.

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