UNIVERSITY OF SOUTHAMPTON

FACULTY OF SOCIAL AND HUMAN SCIENCES

School of Social Sciences

Essays on Applied Exchange Rate Issues:

Some New Evidence on the Export Led Growth Hypothesis, Exchange Rate Exposure and the Exchange Rate Volatility-Export Nexus

by

Norimah Ramli

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ABSTRACT

FACULTY OF SOCIAL AND HUMAN SCIENCES

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ESSAYS ON APPLIED EXCHANGE RATE ISSUES: SOME NEW EVIDENCE ON THE EXPORT LED-GROWTH HYPOTHESIS, EXCHANGE RATE EXPOSURE AND THE EXCHANGE RATE VOLATILITY-EXPORTS NEXUS

By Norimah Ramli

The thesis comprises three essays, all of which are empirical studies of different issues on exchange rates. Implementing advanced econometrics methodologies with monthly time series data, these studies focus on macroeconomic determinants to measure the relationships within the variables. The first essay (Chapter Two) re-examines the robustness of the export-led growth hypothesis across the exchange rate regimes in Malaysia. According to the exchange rate regime history, Malaysia experienced three different exchange rate mechanisms from 1990 to 2010. Generally, the results vary across the time and regimes. Specifically, the study suggests bi-directional and/or unidirectional causality between exports and economic growth across the regimes, both in the short-run and long-run. The second essay (Chapter Three) tries to bridge the gap between the exchange rate issues by investigating the impact exchange rate exposure on sector level in Malaysia from October, 1992 to December, 2010. The purpose of this study is to examine the impact of the exchange rate exposure in Malaysia sectorial returns by using an augmented model. Overall, in all instances, the results suggest that the exchange rate exposures in Malaysia can be categorized as the long memory in the volatility process. After investigating currency exposure in two types of models, the results further suggest that the sectors are largely affected by the currency fluctuations. The third essay (Chapter Four) explores the channels and magnitude of exchange rate volatility-export nexus empirically on the export flow of five ASEAN countries namely, Singapore, Malaysia, Thailand, Philippines and Indonesia to the United States from January, 1990 to December, 2010. The major results show that increases in the volatility of the real bilateral exchange rate, exert significant effects upon export demand in the short run in each of the ASEAN countries. This study further suggests significant negative effects from the bilateral exchange rate volatility of exports flow in Singapore, Malaysia and Philippines. However, these findings do not apply to Indonesia and Thailand.

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Declaration of Authorship

I, **Norimah Ramli**

Declare that the thesis entitled,

Essays on Applied Exchange Rate Issues:
Some New Evidence on the Export Led Growth Hypothesis, Exchange Rate Exposure and the Exchange Rate Volatility-Export Nexus

and the work presented in the thesis are both my own, and have been generated by me as the result of my own original research. I confirm that:

- This work was done wholly or mainly while in candidature for a research degree at this University;
- where any part of this thesis has previously been submitted for a degree or any other qualification at this University or any other institution, this has been clearly stated;
- where I have consulted the published work of others, this is always clearly attributed;
- where I have quoted from the work of others, the source is always given. With the exception of such quotations, this thesis is entirely my own work;
- I have acknowledged all main sources of help;
- Where the thesis is based on work done by myself jointly with others, I have made clear exactly what was done by others and what I have contributed myself;
- parts of this work have been published as:

    - Ramli, Norimah (January) 2011. *The Export Led Growth Hypothesis under Different Exchange Rate Regime. Multidisciplinary PG Research Showcase*. Poster Presentation. 31th January, 2011. University of Southampton, United Kingdom.
    - Ramli, Norimah (February) 2011. *The Robustness Analytical Analysis of Export Led Growth Hypothesis across Exchange Rate Regime Environment*. Faculty of Social & Human Sciences Research Showcase. Poster Presentation. 21st February, 2011. University of Southampton, United Kingdom.
    - Ramli, Norimah (April) 2011. *Analytical Sophistication of First and Second Moment Exchange Rate Exposure in Malaysia. The Third International Conference on Prediction and Information Markets, International Conference on Gambling Studies, and Sixth International Conference on Money Investment and Risk*. Conference Paper. 3th – 5th April 2011. Nottingham Trent University, United Kingdom.
    - Ramli, Norimah and Podivinsky, Jan M. (November) 2011.*The Effects of Exchange Rate Volatility on Exports: Some New Evidence for Regional ASEAN Countries*. Conference Paper and Poster Presentation. 7th ESDS Annual Conference. 28th, November, 2011. Institute of Materials, London.

Signed: ....

Date:..

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List of Abbreviations

GDP	Gross Domestic Product
NBM	National Bank of Malaysia
VECM	Vector Error Correction Modelling
GARCH	Generalized Autoregression Conditional Heteroscedasticity
VAR	Vector Autoregression
ASEAN	Association of South East Asian Nations
GNP	Gross National Product
GDI	Gross Domestic Income
ADF	Augmented Dickey Fuller
DF	Dickey Fuller
REER	Real Effective Exchange Rate
CPI	Consumer Price Index
IMF	International Monetary Fund
ESDS	Economic and Social Data Service
BOP	Balance of Payment
ARMA	Autoregression Moving Average
AR	Autoregressive
CAPM	Capital Asset Pricing Model
US	United States
LBP	Large Bank Portfolio
APT	Arbitrage Pricing Theory
KLS	Kuala Lumpur Stock
ARCH	Autoregressive Conditional Heteroscedasticity
PRF	Population Regression Function
SRF	Simple Regression Function
CLRM	Classical Linear Regression Model
EEC	European Economic Conference
EU	European Union
OECD	Organization for Economic Co-operation and Development
MLE	Maximum Likelihood Estimator

Chapter 1

1.1 Introduction

The quickening pace of globalisation over the last quarter of a century has transformed the scenery of economic relations in terms of the importance of trade and financial flows. National economies are now increasingly inter-dependent and an understanding of international economic and financial issues is ever more relevant to everyday life in both the economic system and the wider environment. Nouriel Roubini[1] listed the exchange rate[2] as one of eight current major global concerns in the world today. These issues have attracted a great deal of interest from both economists and policy makers. Moreover, throughout the developing world, the effects of the exchange rate on other macroeconomic determinants, stands out as perhaps the most contentious aspect of macroeconomic policy and of course its effects on economic growth are vital.

The impact of exports on economic growth, for instance, is a common issue discussed theoretically and empirically. But, there is little agreement amongst researchers concerning the impact of exports on economic growth under different exchange rate regimes. There are however substantial empirical studies of the impact of exchange rate exposure in stock returns. Most of the studies suggest a significant impact of exchange rate exposure on sector returns. There is also broad empirical evidence for the negative impact of exchange rate volatility in promoting exports. However, there is lack of contributions for ASEAN nations. The implication of the Asian Financial Crisis (hereafter: AFC) in 1997 to 1998 has however generated a momentous structure break in the economic system worldwide and therefore gives a significant impact on macroeconomic variables. It is important to consider this impact in all instances.

---

[1] Dr. Nouriel Roubini is ranked 12 in the 2011 Foreign Policy's list of Top Global Thinkers. He was named to Fortune Magazine's list of "10 new economics gurus you should know". He was also in the 2010 Time magazine list of 100 Most Influential People in the World.

[2] The exchange rate is the rate at which one currency trades against another on the foreign exchange market. In other words, if the present exchange rate is 1USD = RM3.33 this means that to go to Malaysia from America you would get RM333 for 100USD. Similarly, if a Malaysian comes to America she would have to pay RM333 to get 100USD. Although in the real life, the dealer would make a profit during the transaction, and this really depend upon to the market price. Thus, this is a very basic explanation for the notion of the exchange rate.

Therefore this thesis contributes to the empirical evidence by deepening our understanding on the three issues of exchange rates mentioned in the previous paragraph. In Chapter Two, the exchange rate regime is shown to condition the impact of exports on economic growth. Chapter Three investigates the impact of exchange rate exposure on sector returns. Finally, Chapter Four examines the sensitivity of the exchange rate volatility on export demand.

Chapter Two, is inspired by recent empirical studies pointing towards the effect of exports on growth in Malaysia. In other words, this chapter tests the Export Led Growth Hypothesis (hereafter: ELGH). Although this sounds ordinary tests due to exports have traditionally been understood in terms of contributions to Malaysia's economic growth, but economists always fail to account for different exchange rate regimes as part of their analysis. It is well known that the AFC which started in 1997 has pushed Malaysia's economic systems to peg their exchange rate in 1998. In 2005, due to economic stability, Malaysia has been floating back its exchange rate. Following this scenario, it is shown that from 1990 to 2010, Malaysia's economy faced three different exchange rate regimes. Adopting the ELGH the objective of this research is to re-examine the relationship between exports and economic growth in Malaysia in different exchange rate environments. Essentially, previous studies suggest the relation between exports and growth maybe bidirectional, or unidirectional. It predicts a positive relationship between exports and growth during the floating exchange rate regime. The main insight is that the liberalization of the floating exchange rate regime is assumed to provide support for the ELGH, where economic freedom allows the economic agent to make decisions in the market. Several studies also predict a positive relationship between exports and growth during pegged exchange rate regimes. Some of the previous studies also suggest that the diffusion of knowledge depends on other intervening factors. Thus, several factors have been put forward as important determinants to economic growth: import, price competitiveness and crisis dummy. To provide empirical support for this hypothesis, the study adopts an advanced econometrics approach based on multivariate modelling.

Fundamentally, the main research questions for this study are as follows;

i. Is the ELGH valid across different regimes in Malaysia?
ii. If the ELGH is valid in Malaysia, is there any short- and long-run relationship between the variables across regimes?
iii. Following Darrat's (2000) exogeneity tests procedure, is there strong evidence of ELGH in Malaysia across the regimes?

iv. Across the regimes in Malaysia, are imports and the exchange rates important in explaining growth?

The contribution of Chapter Two is twofold. The first contribution is that it provides the first empirical evidence on the ELGH in different exchange rate regimes, for the case of Malaysia. We expand the regime further by including the dummy variable in regime one and two, which is based on the economic history; these two regimes are vastly affected by the AFC in 1997 and 1998. Also, we take two actions to check for the robustness of the main modelling. Firstly, we merge the entire regime, in the condition with and without imposing the crisis dummy in the models. Secondly, we also observe the impact of export on growth in Malaysia in the condition pre-AFC and post-AFC. These two models are purely based on the situation before and after the AFC occurred, without taking in to account the situation during pegged exchange rate regime.

The second contribution of this research is to depart from the existing literature from a methodological standpoint by explicitly allowing for the long-run and short-run relationship by using the Granger Causality within vector error correction modelling. Also, we expand the empirical framework further by including the exogenous tests in the vector error correction framework proposed by Darrat *et al.* (2000), in order to detect the strong case of ELGH across the regimes.

Chapter Three investigates empirically the impact of exchange rate exposure on sector returns in Malaysia. Theory suggests that the impact of exchange rate exposure to sector returns is through cash flow channels. Several recent models suggest that the diffusion of exchange rate exposure to sector returns could be ambiguous, while, some other findings document the positive or negative effect from exchange rate exposure to sector returns. However, a large number of empirical studies focused on developed countries as their case study, with lack of study focusing on developing countries like Malaysia. Therefore, this research tries to fill the gap by exploring the sensitivity of the exchange rate exposure, namely, first moment exchange rate exposure, second moment exchange rate exposure, and asymmetric exchange rate exposure in effecting sector returns in Malaysia. In the view of the investor, the knowledge of which sectors are sensitive to the ups and downs of the exchange rate and the volatility of the exchange rate, are important in making decisions when investing. As the economic agent is predicted to behave risk aversely, the decision making always considers the sector of less risk. Also, the inclusion of two dummy variables in some of the estimation models, namely peg exchange rate dummy and Asian crisis dummy, are to observe for any sensitivity between sector returns and the dummies.

Specifically, this chapter answers the following questions:

i. Are the sector returns in Malaysia sensitive to the market returns?
ii. Does the level of exchange rate fluctuation (first-, second-, and asymmetric exchange rate exposure) affect sector returns in Malaysia?
iii. If the sectors in Malaysia sensitive to the exchange rate fluctuation, what is the directions of the relationship (negative, positive or ambiguity)?
iv. In Malaysia, are the sector returns sensitive to the dummy variables (the peg exchange rate dummy and the Asian Crisis dummy)?

This research contributes to the existing literature addressing the impacts of exchange rate exposure to sector price indexes in Malaysia. In particular, it is in the spirit of Ibrahim (2008) extending the literature along the following dimensions. Firstly, it provides time series evidence on the exchange rate issue in Malaysia. Where, the current study employs the time series data techniques by applying the maximum likelihood estimator (MLE). In addition to CAPM theory and top-down approach proposed by Adler and Dumas (1984), the study includes some other macroeconomic variables namely, exchange rate volatility generated by GARCH(1,1), exchange rate asymmetric effects variables, and two types of dummy variables namely: Asian crisis and peg exchange rate dummies. These two dummies are assumed to give a significant impact on sector returns. Thirdly, this study analyses the exchange rate exposure issue in Malaysia by comparing the results between contemporaneous and one day lagged exchange rate estimations modelling.

Chapter Four investigates the exchange rate issues in term of sensitivity of the export demand to exchange rate volatility in selected ASEAN countries. The study hypothesizes that, if the exchange rate movement are not fully anticipated, an increase in the exchange rate volatility may lead risk-averse agents to reduce their international trading activity. Therefore, the agents will prefer to focus on domestic investment, thus a negative relationship between exchange rate volatility and exports are hypothesized.

The main questions of this chapter are as follows:

i. Across countries, does a short and long run relationship between the variables in the multivariate systems exist?
ii. Do the effects of exchange rate volatility-exports vary across the ASEAN countries?
iii. Is importing country growth significant with positive impacts in promoting export in ASEAN countries?

This study makes important contribution to the literature in several aspects. First, the novelty of this study stems from the in-depth research of developing countries in ASEAN5: Singapore, Malaysia, Philippines, Thailand and Indonesia. It attempts to answer the question of whether there is exists a statistically significant relationship between exports and the exchange rate volatility in ASEAN5 countries. Secondly, in order to analyse to short run relationship between the variable in the system, the error correction modelling is applied. Finally, the Granger causality in a vector error correction framework is utilised to distinguish between the short and long run relationships among the variables in the system.

Chapter 2

Essay on Export Led Growth Hypothesis: Empirical Evidence in Different Exchange Rate Regime

2.1 **Introduction**

The study of the relationship between macroeconomic determinants, to be precise, exports, and economic growth is not new. The empirical testing for emerging market countries of the export led-growth hypothesis (hereafter: ELGH) have a long pedigree. The original work centered on simple correlations between exports and income has been examined by Emery (1967) and Kravis (1970), among others. With the creation of time series data bases and the development of new time series techniques, the work advanced by the pioneering study of Jung and Marshall (1985) and Chow (1987). In the earlier study, they tried to investigate the relationship between exports and growth by using Granger causality approach in the vector error correction modelling framework. In fact, the last few years have witnessed an explosion of studies on different countries or aspects of the exports-growth relationship using various time series approaches.

The 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 finally

(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.

The ELGH is symptomatic of the Malaysian economy since this nation has benefited tremendously from a framework of sound macroeconomic policy-mix since the economic boom began in 1988. The Malaysian economy is known as one of the most developed economies in South-East Asia. Since its independence in 1957, Malaysia has continued to generate its economy growth. In the 1960s Malaysia pursued an agricultural-diversification and industrial-promotion programme based on import substitution in the 1960s. The major impact of the government policy was reflected in greater diversification of agricultural exports, with timber, palm oil and petroleum playing an increasingly important role (Baharumshah and Rashid, 1999).

Previously, the economy has relied heavily on tin and rubber industries which generated about 75% of export earnings. The government shifted to an export promotion strategy in the early 1970s following the experience of newly industrialized economies (NIE) that showed developing economies could catch up with advanced countries by applying the export-led growth model. The result of the policy change is reflected in the composition of the gross domestic product (GDP). The share of agriculture exports declined from 37.9% in 1960 to 15.9% in 1994 while manufacturing exports increased from 8.7% to 34.7% over the same period. Malaysian economy has roughly been growing at an average of 8.5% per year for more than a decade[3] in 1985-1995. Malaysia is also known as one of the countries in the Asian region that has experienced rapid economic growth and has accomplished expansion in trade and capital flows in the past two decades.

However, the Asian financial crisis in 1997/1998 has put an end to 13 years of uninterrupted growth with a decline in GDP by 7.4% in 1998. The government's response was to embark on a massive economic recovery program to generate growth, aimed at stabilizing the currency, restoring market confidence, maintaining

[3] The figures are from Malaysia Annual Statistical Report from 1970 to 1995.

market stability, strengthening economic fundamentals, furthering socioeconomic goals, reviving badly affected sectors, and stabilizing the international trade, namely, exports and imports. Thus far, after more than a decade, Malaysia still continues to strengthen the economy growth stabilization. From earlier empirical research on ELGH, that since the midst-1980s Malaysia has been growing very rapidly with a widely held view that such growth is export led (Al-Yousif, 1999; Reinhardt, 2000). In contrast, Dorado (1993) notes that export growth have had a negative (rather than positive) effect on Malaysia's economic growth. However, Doraisami (1996) shows that there is a bi-directional relationship between export and economic growth in Malaysia.

To my knowledge, there is a lack of studies on ELGH in Malaysia, especially in different 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. With the growth on the related topic worldwide[4], an attempt to investigate to which exchange rate regimes in Malaysia fits into the ELGH is an issue this chapter attempts to address in this chapter. The final outcome of this chapter is expected to contribute towards existing literature on ELGH and also useful for policy makers such as government and also for investors in decision making.

Actually, the exports-growth nexus is not directly related. Price instability and economic crisis for example have great impacts in affecting the relationship. For this reason, the exchange rate is included in the model to reflect the price competitiveness in international markets (Henriques and Sadorsky, 1996) and it's indirectly influence on economic performance via export channel (Al-Yousif, 1999). In addition, in this chapter we use the term of exchange rate regime[5] to show the presence of exchange rate variable in the model. The regimes are the responses by the Central Bank of Malaysia to change the exchange rate policy in Malaysia as a

[4] Please see Table 2.1b in appendix at the end of this thesis.

[5] The choice of exchange rate regime and its impact on economic performance is probably one of the most controversial topics in macroeconomic policy. Generally, when an exchange rate regime is known, there are two procedures to identify each regime, by de jure and de facto. Based on Desquilbet (2008), the characteristic of the each exchange rate regime can be referring using de jure procedure. On the other hand, Kamin (2007) identify each exchange rate regime with de facto. Moreover, based on Cambridge dictionary, the word de facto is from Latin expression that 'means concerning the fact'. Meanwhile, de jure also the Latin words that means 'of law'. Furthermore, the term of de jure and de facto are used instead of 'in principle' and 'in practice', respectively. Regardless of the given definition, in this research each regime would characterize based on de facto procedure. To be precise, in this procedure the identification for each regime is based on declared commitments of the central bank, in this case by national Bank (BNM) in Malaysia.

reaction to the Asian Financial crisis 1997/1998. Mainly the exchange rate regime is divided into two types of mechanisms, fixed[6] or floating[7]. According to Levy-Yeyanti (2007), the choice of exchange rate regime and its impact on economic performance is probably one of the most controversial topics in macroeconomic analysis today. Even when the economic literature does suggest a link between exchange rate regimes and growth, it does not provide unambiguous implication as to its sign.

As stated earlier, the channel through which the exchange rate regime might influence growth is trade, specifically through exports channel. Theoretical considerations relate exchange-rate effect on growth to the level of uncertainty imposed by flexible option of the rate. However, while reduced policy uncertainty under a peg promotes an environment which is conductive to production of factor growth, trade and hence to output, which such targets do not provide an adjustment mechanism in times of shocks, thus stimulating protectionist behaviour, price distortion signals and therefore misallocation of resources in the economy (Levy-Yeyati, and Sturzenegger, 2003). Consequently, the relationship remains blurred and requires in-depth empirical examination.

Furthermore, imports are included in the causal relationship to investigate the importance of this variable on Malaysia's economic growth in different exchange rate regimes. As stated in Riezman et al. (1996), that imports are crucial variable to be included in the modelling to avoid producing a spurious causality results. Riezman et al. (1996), also points that the finding of no cointegration between exports and output may be due to the omitted variable such imports. The inclusion of imports variable in the regression model is expected to be significant in the analysis.

The main objective of this chapter is to re-examine the ELGH in Malaysia across different exchange rate regimes, by using an advance time series procedure. In particular, the present chapter is unique among the other ELGH is empirical studies in several aspects. Firstly, the goal of this chapter is also to acknowledge the impact of various exchange rate mechanisms into ELGH in Malaysia. 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

[6] Fixed exchange rates, by definition, are not supposed to change. They are meant to remain fixed for, ideally, a permanent period of time.
[7] Floating rates do just that, they float, up and down, down and up, from year to year, week to week, and minute by minute. What a floating exchange rate will be a year from now, or even a week from now, is often very difficult to predict.

in Malaysia in different exchange rate regime. 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.

The second objective of this chapter is to investigate the relationship between exchange rate and economic growth across the regime. According to Yeyati and Sturzenegger (2002), the industrial countries exchange rate regimes do not appear to have any significant impact on growth. In contrary, Ghosh et al. (1997b) and Broda (2001) suggested that floating exchange rate regime gives better environment to economic growth. Yet, the floating exchange rate is presumed to have a positive significant impact on economic performance. In addition, Aizenman (1994) argues, in the context of a theoretical model, that higher output volatility as a result of adoption of a peg exchange rate regime may foster investment and enhance the economic growth. By giving this setting, in this chapter we attempted to explore the relationship between exchange rate and economic growth across the regimes.

Third, is to examine the impact of imports on growth. As stated earlier, the inclusion of imports is based on the argument of Riezman et al. (1996) that to avoid producing a spurious causality outcomes. In addition, they also claimed that due to omitted variable such as imports will leads to fail to detect the correlation between exports and growth. Moreover, according to Serlatis (1992), considering the fact that export externality effects are possibly due to the role of exports in relieving a foreign borrowing constraints. Based on his argument, the influence of imports is expected to be significant in the analysis. Increasing in imports may reduce the country's international services, thereby slowing down the economic growth. Thus, negative relationship between imports and growth is expected.

Finally, this chapter proposes two groups of regimes to test for the robustness of the ELGH in Malaysia. Since the first group of regimes are responses to the changing exchange rate policy in Malaysia, the second group is based on the critical dates to the crisis, following official information of the recovery date from Chee, Hui and Annuar (2004) and Tiwari (2003) and non-official information about the Asian financial crisis recovery approximately end date, on the internet site of Wikipedia site[8]. As a benchmark, I also refer to the randomness movement of exchange rate by plotting the generalized autoregressive conditional

[8] Wikipedia site, visit; online: http://en.wikipedia.org/wiki/1997_Asian_financial_crisis

heteroscedasticity modelling (GARCH 1,1) data[9]. Thus the each regime can be called as, pre-AFC, and post-AFC. In the third group, we also estimate the full model without splitting the data into regimes, to test the same hypothesis. For robustness purposes, we also divided the three main regimes into two types, which are with and without crisis dummy variable in the systems equation. For details about the developing of the equations structure, please refer to Section 2.3 and Table 2.29 in the appendix section.

The rest of this chapter is structured as follows. Section 2.2 presents some related literature on earlier empirical studies on ELGH, followed by model specification in Section 2.3. Next, is Section 2.4 discusses about the data sources. Data description is given in Section 2.5. The method for the testing of ELGH is discussed in Section 2.6 and empirical results revealed in Section 2.7. While, Section 2.8 summarizing and concludes the paper.

[9] Please refer to figure 2.1 and figure 2.2 in Appendices 2.2a and 2.2b section at the end of this thesis to see GARCH (1, 1) and real exchange rate returns graphs.

2.2 **Literature Review**

There are a lot of empirical studies on ELGH for developing countries since the late 1960s. However, not many studies considered the Malaysian case, where there are quite few attempts to investigate the relationship between export and growth. In most previous studies, the ELGH is conducted either focusing only on Malaysia or by having Malaysia as one of the sample. A summary of selected studies of ELGH in Malaysia are given in Table 2.1 , and Table 2.1b in the appendix, presents a broad summary of a set of 82 empirical studies conducted between 1967 and 2008. Both tables include author name, year of study, time period of the data set, econometrics approach, variables name, and conclusions of each analysis.

The issues around international export and growth nexus have gained the attention and scrutiny of researchers since 1960s. Broadly discuss of this topic covered from the previous researcher, namely, Emery (1967), Balassa (1978, 1985), Darrat (1987), Kunst and Marin (1989), Ghartey (1993), Jin (1995), Jin and Yu (1996), Shan and Sun (1998), Awokuse (2004) among others. Recent studies, include the work of Hooi (2008), Maneschiold (2008), Ibrahim (2002), Ahmad (2001), and Maneschiold-Ola(2008). For broad ELGH example, I refer to seminal study by Awokuse (2004) in Canada. This study applied an advanced econometric time series approach namely, VECM and the augmented vector autoregressive (VAR) methodology developed in Todo and Yamamoto (1995). According to Awokuse findings, the long-run steady state exists among the models consist six variables. Moreover, this study also suggests for the unidirectional relationship from real exports to real GDP, thus support for the ELGH in Canada. Shan et al. (1998) estimated the ELGH by using an augmented growth equation on the basis of times series data from China. The results indicate a bidirectional causality between exports and real industrial output in China in the period from 1987 to 1996. In this study, the ELGH is defined as a unidirectional causal ordering from exports to output, is therefore rejected in the case of China. Despite the positive contribution of exports on China's real output is documented in this study.

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). The study of Riezman et al. (1996) investigates the validity of the ELGH for over 126 countries, running annually data from 1965 to 1999. 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, 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. 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. 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.

Table 2.1:
A brief selection of empirical framework of the related economic literature on the Export Led Growth Hypothesis (ELGH) for Malaysia

About the Paper		Methodology					Result and conclusions
		Data set				Econometrics Approach	
Researcher	**year**	**Type of data set**	**Growth**	**Export**	**Other variables**		
Dodaro	1993	Time series (1967-1986), 87 developing countries	Real GDP/GNP	Real exports	None	Granger's test with 2 lags	Exports cause GDP growth in 4 cases; bidirectional causality in 10 cases and no causality in the rest
Bahmani-Oskooee and Alse	1993	Time series (1953-1991), 26 Developing countries	Real GDP/GNP	Real exports	None	Cointegration test	Exports and GDP are cointegrated in all cases
Ahmad and Harnhirun	1995	Time series (1966-1990), ASEAN countries	Real GDP	Real exports	None	Johansen cointegration tests, with 2 unit roots, Granger's test	No cointegration between exports and GDP in any country, except Singapore. Bidirectional causality in the case of Singapore
Ahmad and Harnhirun	1996	Time series (1966-1988), ASEAN countries	Real GDP	Real exports	None	Engle and Yoo cointegration test, Granger's test, error-correction models	No cointegration between variables, GDP causes exports in all countries
Doraisami	1996	Annual time series data from 1963 to 1993	Real GDP	Real Exports	None	ADF unit root, cointegration, VECM	Support for the export-led growth hypothesis.

Table 2.1: (Continue)

Gatak	1997	Annually Time series Data for Malaysia from 1955 to 1990	Real GDP	Real Exports	Non-export Real GDP	New Growth Theory (Production Function Model); ADF unit root test; Johansen Juselius Cointegration procedure;	The result supports for the export-led growth hypothesis
Al-Yousif	1999	Annually Time series (1973-1993)	Real GDP growth	Real export growth, and export change/output	Labour force and GDI/GDP	ADF unit root, Granger causality test, production function	Evidence that supports the hypothesis in the short-run. However, it fails to find any long-run relationship (no cointegration)
Baharunshah et al.	1999	Quarterly Time series (1970:1 -1993:4)	Real GDP growth	Real Total exports	Real Total imports, Real manufacturing exports, Real agricultural exports.	ADF and PP unit root, Johansen Juselius Cointegration test, VECM.	Support for the export-led growth hypothesis.
Ibrahim	2002	Annually Time series Data for Malaysia from 1960 to 1997	Real GDP per capita	Real exports of GDP ratio	Imports, government consumption	ADF and PP unit root; Johansen Juselius Cointegration test; VECM	Found evidence for bilateral causality in VECM framework between export and growth

Sources: Author's survey. Copyright ®

2.3 The Export Led Growth Model Specification

In the light of previous literature of export-growth nexus, in this section, we set up a model to test rigorously the long-run relationship and causality issues. There are three main regimes namely; regime one (floating exchange rate), regime two (pegging exchange rate) and regime three (post-pegging exchange rate). For robustness test purposes[10], we expand the model further by taking into account the Pre-AFC and the Post-AFC. Table 2.29 in the appendix[11] explains in detail according the estimated models. Hence, following the specification models by Al-Yousif[12] (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;

1. Exchange Rate Regimes Model

Without the crisis dummy

$$\ln g_{it} = \alpha_0 + \alpha_1 \ln e_{it} + \alpha_2 \ln I_{it} + \alpha_3 \ln er_{it} + \varepsilon_{it} \qquad (2.1)$$

With sign expectation for model (2.1);

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

And,

With the crisis dummy

$$\ln g_{it} = \alpha_0 + \alpha_1 \ln e_{it} + \alpha_2 \ln I_{it} + \alpha_3 \ln er_{it} + \alpha_4 CD_{it} + \varepsilon_{it} \qquad (2.2)$$

With sign expectation for model (2.2) is;

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

Here,

---

[10] We expand the main regime by dividing into two estimated models namely; with and without crisis dummy variables. The inclusion of the crisis dummy variables in the system is to observe the role of the Asian crisis on the model (on growth). This is consistent with the assumption by Baharumshah et al. (1999) that the Asian Financial Crisis in 1997/1998 gave a significant impact on economic growth. To be specific, the crisis dummy is only included in Regime One, Regime Two and the Pooled Model (combination of Regime One, Regime Two and Regime Three). For Regime Three, we estimate only have one type of model, which is without the crisis dummy. Besides, Regime Two is also separated into two groups that explained in Table 2.2.

[11] See Appendix 2.6.

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

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.

The extended models are as follows;

<u>2. Pooled models</u>

Without the crisis dummy

$$\ln g_{it} = \delta_0 + \delta_1 \ln e_{it} + \delta_2 \ln I_{it} + \delta_3 \ln er_{it} + \Sigma_{it} \quad (2.3)$$

With sign expectation for model (2.3) is;

$\delta_1 > 0$ [13], $\delta_2 < 0$ [14], $\delta_3 > 0$ or $\delta_3 > 0$ [15]

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[13] Refer to Balassa (1985), among others.
[14] See for example Esfahami, 1991 ; Serletis, 1992; Riezman et al., 1996; Liu et al., 1997).
[15] Refer to Henriques et al. (1996) among other.

And,

With the crisis dummy

$$\ln g_{it} = \delta_0 + \delta_1 \ln e_{it} + \delta_2 \ln I_{it} + \delta_3 \ln er_{it} + \delta_4 CD_{it} + \Sigma_{it} \quad (2.4)$$

With sign expectation for model (2.4) is;

$\delta_1 > 0$, $\delta_2 > 0$, $\delta_3 > 0$ or $\delta_3 < 0$, and $\delta_4 > 0$ or $\delta_4 < 0$

3. Crisis Regimes Model

Without the crisis dummy

$$\ln g_{it} = \beta_0 + \beta_1 \ln e_{it} + \beta_2 \ln I_{it} + \beta_3 \ln er_{it} + v_{it} \quad (2.5)$$

With sign expectation for model (2.5) is;

$\beta_1 > 0$, $\beta_2 > 0$, $\beta_3 > 0$ or $\beta_3 > 0$

And,

With the crisis dummy

$$\ln g_{it} = \beta_0 + \beta_1 \ln e_{it} + \beta_2 \ln I_{it} + \beta_3 \ln er_{it} + \beta_4 CD_{it} + v_{it} \quad (2.6)$$

With sign expectation for model (2.6) is;

$\beta_1 > 0$, $\beta_2 > 0$, $\beta_3 > 0$ or $\beta_3 < 0$, and $\beta_4 > 0$ or $\beta_4 < 0$

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'*

v_{it}, Σ_{it} = The error terms for regime *'i'* and time *'t'*

β_{it}, δ_{it} = Coefficient for determination variables

2.4 Data Sources

The empirical analysis is based on monthly data, from January, 1990 to December, 2010. All data set are in real basis. Growth is represented by real output, exports by real export, imports by real import. We used real effective exchange rate (REER) as a proxy to exchange rate. REER is preferable measurement to exchange rate rather than nominal spot exchange[16] rate because it still moves randomly during the fixed exchange rate regime[17].

The growth formula is:

$$growth_{(Feb,1990)} = \left[\frac{\text{real output}_{(Feb,1990)} - \text{real output}_{(Jan,1990)}}{\text{real output}_{(Jan,1990)}}\right]$$

2.5 Data Definitions

2.5.1 Real output

In this chapter, the Industrial Product Index is utilized as a proxy for output. The data has been transformed to the real form using the following formula;

$$g_{it} = \frac{IPI_{it}}{CPI_{it(2005=100)}} \qquad (2.7.1)$$

Where,

g_{it} =is real output as a determinant of economic growth for regime 'i' and time 't'

IPI_{it} =is Industrial Product Index for regime 'i' and time 't'

CPI_{it} = is Consumer Price Index for regime 'i' and time 't'

Then, the data above is transformed to natural logarithm form as follows;

$$\ln(g_t) = \ln\left(\frac{IPI_{it}}{CPI_{it(2005=100)}}\right) \qquad (2.7.2)$$

2.5.2 Crisis Dummy

In order to capture the structure break from July 1997 to December, 1999, I introduce the crisis dummy variable denote as CD_{ijt} in the modelling. There will be always a

[16] Note that, the dominance of the US dollar for Malaysia's international transactions and its wide use in other studies, the nominal spot exchange rate vis-à-vis the US dollar is not appropriate since the Ringgit is fixed against the US dollar for second regime.

[17] Moreover, the effective exchange rate would better reflect the international competitiveness of Malaysian firms since they better capture the price of trade with major trading partner (Ibrahim, 2008).

significant improvement in the stochastic properties of the VAR model is obtained by adding dummy/dummies to capture this historical episodes (Baharumshah, 2009). Thus, it is treated as an exogenous variable in the system. This chapter assumed there will be significant impact of crisis period (CD_{ijt}) on exports. The dummy proposed in this model is as follows;

Dummies regime

$CD_{ijt} = 1$ if from July, 1997 to December, 1999

$CD_{ijt} = 0$ if otherwise

2.5.3 Trade Indicator

The trade indicator in this chapter refers to both total exports and total imports. Both of these trade indicators are also transformed to a real basis by dividing by the consumer price index (CPI) base year 2005.

2.5.3.1. Real Exports

$$e_{it} = \frac{TEX_{it}}{CPI_{it(2005=100)}} \tag{2.8.1}$$

Where,

e_{it} = is real exports for regime 'i' and time 't'

TEX_{it} = is total exports for regime 'i' and time 't'

CPI_{it} = is Consumer Price Index for regime 'i' and time 't'

Then, the equation above is transformed to natural logarithm form as follows;

$$\ln(e_t) = \ln\left(\frac{TEX_{it}}{CPI_{it(2005=100)}}\right) \tag{2.8.2}$$

2.5.3.2. Real Imports

$$I_{it} = \frac{IMP_{it}}{CPI_{it(2005=100)}} \tag{2.9.1}$$

Where,

I_{it} = is real imports for regime 'i' and time 't'

IMP_{it} = is total imports for regime 'i' and time 't'

CPI_{it} = is Consumer Price Index for regime 'i' and time 't'

Then, the variable above is transformed to natural logarithm form as follows;

$$\ln(I_t) = \ln\left(\frac{IMP_{it}}{CPI_{it(2005=100)}}\right) \tag{2.9.2}$$

2.5.4 Exchange Rate Indicator

We believed the exchange rate effects trade significantly. Therefore, in this chapter the exchange rate is referring to the real effective exchange rate (REER). In mathematical formulation, the real effective exchange rate for country labelled J is given as;

2.5.4.1. Real Effective Exchange Rate (REER)

$$REER_{J=Malaysia} = \sum_k w_{kj} e_{kj} \left(\frac{CPI_J}{WPI_k}\right) \tag{2.10}$$

Where,

WPI_k = Wholesale price index of partner country k

CPI_J = Consumer price index of home country J

e_{kJ} = Exchange rate index between country 'k' and 'J' expressed in foreign currency per local currency

w_{kJ} = Share of country 'k' in the total trade of country 'J'

Malaysia can be used as an example. The REER formula is expanded with the assumption that it has only two trading partners, Japan and the US.

$$REER_{J=Malaysia} = \frac{USD}{RM}.w_{M'sia,US}\left(\frac{CPI_{M'sia}}{WPI_{US}}\right) + \left(\frac{USD}{RM}\right)\left(\frac{YJ}{USD}\right).w_{M'sia,Japan}\left(\frac{CPI_{M'sia}}{WPI_{Japan}}\right)$$

In the example above, $\left(\frac{USD}{RM}\right)$ is the nominal rate but specified as the amount of dollars per-ringgit Malaysia (RM). The REER is simply the nominal exchange rate adjusted for price differences and changes in the US Dollar's value compared to other major currencies. This takes into account the fact that the Malaysia trades with other than US. The way the equation is specified, an appreciation of the RM vis-à-vis the dollar means that $\left(\frac{USD}{RM}\right)$ will increase while depreciation means that $\left(\frac{USD}{RM}\right)$ will decrease. Therefore, an increase (decrease) in the REER means that the currency appreciates (depreciates) in real terms. The REER used in this study was converted to an index with year 2005 as a base year.

2.6 Econometrics 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).

2.6.1 The Augmented Dickey Fuller Tests

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;

$$e_t = \alpha + \beta_1 e_{t-1} + \beta_2 e_{t-2} + ... + \beta_i e_{t-i} + v_t \qquad (2.11)$$

If this is the process generating the data but an AR (1) model is fitted, say

$$e_t = \alpha + \beta_1 e_{t-1} + \varepsilon_t \qquad (2.12)$$

Then,

$$\varepsilon_t = \beta_2 e_{t-1} + ... + \beta_i e_{t-i} + v_t \qquad (2.13)$$

Here, the autocorrelations of ε_t and ε_{t-k} for k > 1; will be nonzero, because of the presence of the lagged 'e' terms. Thus an indication of whether it is appropriate to fit an AR (1) model can be aided by considering the autocorrelations of the residual from the fitted models. To illustrate how the DF test can be extended to autoregressive processes of order greater than 1, consider the simple AR (2) process below.

$$e_t = \alpha + \beta_1 e_{t-1} + \beta_2 e_{t-2} + v_t \qquad (2.14)$$

Then notice that this is the same as:

$$e_t = \alpha + (\beta_1 + \beta_2) e_{t-1} - \beta_2 (e_{t-1} - e_{t-2}) + v_t \qquad (2.15)$$

And subtracting g_{t-1} from both sides gives:

$$\Delta e_t = \delta_1 + \delta_2 e_{t-1} + \delta_3 e_{t-1} + v_t \tag{2.16}$$

Where the following have been defined:

$$e_t = \beta_1 + \beta_2 - 1 \tag{2.17}$$

And

$$\delta_1 = 1\beta_2 \tag{2.18}$$

Therefore to perform a Unit Root test on an AR (p) model the following regression should be estimated:

$$\Delta e_t = \delta_1 + \delta_2 e_{t-1} - \sum_{j=1}^{p} \delta_i \Delta e_{t-i} + v_t \tag{2.19}$$

The Standard Dickey-Fuller model has been 'augmented' by Δe_{t-i}. In this case the regression model and the '*t*' test are referred as the ADF unit root test. In equation (2.19) above, Δe_t is set of variable under observation including, real GDP, real export, real import and real exchange rate. And, Δ is differencing operator, *t* indicates as time series data. While v_t is the white noise residual of zero mean and constant variance. Set of parameter to be estimated including, $\delta_1, \delta_2, \theta_i, \ldots \theta_m$. Both of the null and alternative hypotheses in unit root tests are;

Hypothesis null:

$Ho: \delta = 0$ (e_t is non-stationary/a unit root process)

Hypothesis alternative:

$Ho: \delta \neq 0$ (e_t is stationary)

The unit root hypothesis of the ADF can be rejected if the t-test statistic from these tests is negatively less than the critical value tabulated. In other words, by the ADF test, a unit root exists in the series e (implies non-stationary) if the null hypothesis of delta equal zero is not rejected (Gujarati 1995, p: 719-720)

2.6.2 The Johansen and Juselius Cointegration Tests

Generally, 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)[18]. 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. La g 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.

A brief discussion on the Johansen Juselius cointegration approach is present below. Suppose the vector of n-variables, $Y_t = (Y_{it}, Y_{2t}, Y_{3t}, ...Y_{nt})$, is generated by the k[th] order vector autoregressive process with Gaussian errors;

$$Y_t = \Phi + \phi_1 Y_{t-1} + \phi_2 Y_{t-2} + \phi_3 Y_{t-3} + ...+ \phi_4 Y_{t-k} + \varepsilon_t \qquad (2.20)$$

And,

$t = 1,2,3,4,5,..t.$

Where Y_t is a $(p \times 1)$ vector of stochastic variables, and, $\varepsilon_1,......,\varepsilon_T$ are i.i.d with normal probability $(0, \sigma^2)$, mean zero and constant in variance.

Since we want to distinguish between stationary by linear combination and by differencing this process may be written in vector error correction VECM framework form as equation below;

$$\Delta Y_t = \Phi + \Gamma_1 \Delta Y_{t-1} + \Gamma_2 \Delta Y_{t-2} + \Gamma_3 \Delta Y_{t-3} + ...+ \Gamma_{k-1} \Delta Y_{t-k+1} + \Pi y_{t-1} + \varepsilon_t \qquad (2.21)$$

And,

$t = 1,2,3,4,5,......t,$

[18] 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.

Based on equation above, the matrix of Π contain information about the long run relationship between the variables in the vector. Information about the number of cointegrating vectors is found in the rank of Π. In other words, the rank of Π determines how many linear combinations of Y_t vector are stationary. If the $(p \times p)$ matrix Π has rank equal to zero, then r = 0 means all elements of Y_t are non-stationary. Thus, there are no cointegration relationships between the variables. If Π is of full rank $r = p$, then all elements of Y_t are stationary. Thus, any combination of the variables results in a stationary series is cointegrated. In the intermediate case, when $r < p$, there are r non-zero cointegrating vectors among the elements of Y_t and p-r common stochastic trends. If a non-zero relationship is indicated by the test, a stationary long-run relationship is implied.

In the case where $0 < r < p$, Π can be factored as $\alpha\beta'$ (or $\Pi = \alpha\beta'$) where α and β are both (p × r) matrices. The matrix α contains the adjustment parameters while β is called the cointegrating matrix and has the property that $\beta Y_t \tilde{} I(0)$, where I(0) indicates integrated of order zero. Thus we can interpret the relations of βY_t as the stationary relations among potentially non-stationary variable that is, as cointegrating relations. (Johansen, 1990) developed a maximum likelihood estimation procedure for Φ, Γ, α and β . This method also provides tests for a number of cointegration vectors; λ_{trace} and $\lambda_{\max}$ formulation as follows;

$$\lambda_{trace} = -T \sum_{i=r+1}^{n} \ln(1 - \hat{\lambda}_i) \qquad (2.22)$$

Where T is the sample size and $\lambda_{r+1}, \ldots\ldots \lambda_{r+i}$ is the ordered $p-r$ smallest Eigen values. The λ_{trace} statistic tests the null hypothesis that there are not at most r cointegrating vectors against a general alternative. However, the second statistics tests, $\lambda_{\max}$ statistics, test the null hypothesis that there are r cointegrating vectors against the alternative that there are cointegrating vectors. This statistic is written as;

$$\lambda_{\max} = -T \ln\left(1 - \hat{\lambda}_{r+1}\right) \qquad (2.23)$$

Here in equation above, λ_{r+1} is an estimated Eigen value. The critical values for λ_{trace} and $\lambda_{\max}$ statistics are provided in (Johansen, 1990) and (Osterwald-Lenum, 1992).

2.6.3 The Granger Causality in the Vector Error Correction Model

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 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

2.6.4 The Exogeneity Tests

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;

$$\Delta e_{it} = \eta_2 + \sum_{i=1}^{G}\alpha_i \Delta g_{t-i} + \sum_{i=1}^{E}\beta_i \Delta e_{t-i} + \sum_{i=1}^{IN}\phi_i \Delta I_{t-i} + \sum_{i=1}^{ER}\gamma_i \Delta er_{t-i} + \Pi\ ECT_{t-1} + \Omega_{2t} \qquad (2.24)$$

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. As I already mentioned in earlier section, 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 (2.24) is statistically significant.

2.6.5 The Diagnostic Tests

This chapter employs three types of diagnostic tests as part of it robustness check for estimations modelling. The tests including, the Breusch Pagan Godfrey tests, Breusch Godfrey tests and Jarque Bera normality tests.

2.6.5.1. The Breusch-Pagan-Godfrey Test

The Breusch-Pagan-Godfrey (BPG) statistic test is also known as LM test, is an analytical procedure to test for heteroscedasticity problem in regression model. For a detail explanation regarding this tests, refer to Gujarati (2003) on page 411 to 412. According to the classical linear regression model, the variance of each disturbance term, say e_t , conditional on the chosen values of the explanatory variables, is some constant number equal to σ^2. Thus, this is the assumption of homoscedasticity. By symbolically;

$E(e_i^2) = \sigma^2$ and $i = 1,2,\ldots,n$ (2.25)

In contrast, the heteroscedasticity problem exists when the conditional variance of one variable (say, Y_t) increases as the other variable (say, X_t) increases occurred. Here, the variances of Y_t are not the same. By symbolically is in eq. (2.25). Notice here the subscript of σ^2 is no longer constant.

$E(e_i^2) = \sigma_i^2$ and $i = 1,2,\ldots,n$ (2.26)

2.6.5.2. The Breusch Godfrey Test

In order to avoid some of the pitfalls of the Durbin Watson d tests of autocorrelation, statisticians namely; Breusch and Godfrey have developed a test of autocorrelation that is general in the sense that it allows for:

(i). Non-stochastic regressors, such as the lagged values of the regressand.

(ii). Higher-order autoregressive, such as AR (2), etc.

(iii). Simple or higher-order moving averages of white noise error terms.

2.6.5.3. The Jarque-Bera Test

The JBT test is a goodness-of-fit test of whether sample data have the skewness and kurtosis matching a normal distribution. The JBT also can be defined as follows;

$$JBT = \frac{n}{6}\left(S^2 + \frac{1}{4}(K-3)^2\right) \tag{2.27}$$

In the equation above, n is the number of observation (degree of freedom). Also, S is the sample of skewness, and K is the sample of kurtosis. The mathematical formulation for S and K are as follows;

$$S = \frac{\hat{\mu}_3}{\hat{\sigma}^3} = \frac{\frac{1}{n}\sum_{i=1}^{n}\left(x_i - \bar{x}\right)^3}{\left(\frac{1}{n}\sum_{i=1}^{n}(x_i - \bar{x})^2\right)^{3/2}} \tag{2.28}$$

$$K = \frac{\hat{\mu}_4}{\hat{\sigma}^4} = \frac{\frac{1}{n}\sum_{i=1}^{n}\left(x_i - \bar{x}\right)^4}{\left(\frac{1}{n}\sum_{i=1}^{n}\left(x_i - \bar{x}\right)^2\right)^2} \quad (2.29)$$

According to the theory, the $\hat{\mu}_3$ and $\hat{\mu}_4$ are the estimates of third and fourth central moments, respectively. Meanwhile, $\hat{x}$ is the sample mean and $\hat{\sigma}^2$ is the estimate of the second central moment or the variance. For normal distribution data, the JBT statistic asymptotically has a chi-squared distribution with two degree of freedom (is also known as two rule of thumb), so the statistic can be used to test the hypothesis that the data are from a normal distribution. The null hypothesis is a joint hypothesis of the skewness being zero and the excess kurtosis being zero. Samples from a normal distribution have an expected skewness of 0 and an expected excess kurtosis of 0. By definition the JBT shows any deviation from this, increase the JBT statistic.

2.7 Empirical Results

In this section, we discuss the empirical findings of this chapter. The results include the ADF unit root tests, the Johansen Juselius cointegration tests, the Error Correction Model (ECM) and the Granger causality tests in a Vector Error Correction Model (VECM).

2.7.1 Results of Augmented Dickey Fuller Tests

In this chapter, the univariate Augmented Dickey Fuller (ADF) unit root test is conducted in the separate regimes. The unit root tests are employed to investigate the stationarity of the macroeconomic series at the level and then at the first difference of each series. To ensure that disturbances in all these equations are white noise, a sufficient number of lagged dependent variables have been estimated[19]. The result of the tests, both at the level and at first differencing are reported in Tables 2.3 until 2.8, by taking into consideration with time trend and without time trend variable in the regression.

According to Table 2.3, 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 2.3. Obviously, this result is consistent with some of the previous studies, such as Shan et al. (1998a, 1998b), Al-Yousif (1999), Ibrahim (2002), among others. As claimed by Nelson and Plosser (1982), most of the macroeconomics and financial series are expected to contain unit root and thus are integrated of order one, I(1), at their differencing level.

As a result, this chapter concludes that the series are integrated of order one, and a higher order of differencing is not required to be executed. All other tables reported also suggest similar results.

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[19] For the optimal lag length estimator, this study employs the Akaike Information Criteria (AIC).

Table 2.2:
The Results of Augmented Dickey Fuller Tests for Model 1 and Model 2

Data Series	At level		At first difference	
	without trend	with trend	without trend	with trend
Growth	-0.950146	-2.793974	-7.154064*(11)	-7.145358*(11)
Real Export	-1.610884	-3.472064	-7.686063*(10)	-7.679995*(10)
Real Import	-1.548273	-2.785269	-7.350730*(1)	-7.332581*(4)
Real Exchange rate	-1.841956	-2.363536	-7.355709*(9)	-7.363817*(6)

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

Table 2.3:
The Results of Augmented Dickey Fuller Tests for Model 3

Data Series	At level		At first difference	
	without trend	with trend	without trend	with trend
Growth	-0.308014	-2.494629	-5.049939*(3)	-5.081941*(4)
Real Export	-1.339562	-3.064432	-6.798721*(4)	-6.826013*(5)
Real Import	-1.149377	-2.404288	-6.318409*(5)	-6.315456*(4)
Real Exchange rate	-1.880212	-3.051303	-5.407346*(2)	-5.433058*(3)

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

Table 2.4:
The Result of Augmented Dickey Fuller Tests for Model 4

Data Series	At level		At first difference	
	without trend	with trend	without trend	with trend
Growth	-2.03189	-1.169839	-4.94794*(4)	-5.229007*(4)
Real Export	-1.014338	3.176149	-4.745787*(3)	-4.725061*(4)
Real Import	-1.830721	0.573789	-4.178526*(3)	-4.80262*(4)
Real Exchange rate	-1.179059	-1.31592	-4.77786*(5)	-4.99929*(6)

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

Table 2.5:
The Result of Augmented Dickey Fuller Tests for Model 5 and Model 6

Data Series	At level		At first difference	
	without trend	with trend	without trend	with trend
Growth	0.071547	-2.445123	-6.375008*(4)	-6.455691*(6)
Real Export	-0.379060	-2.588241	-6.734348*(5)	-6.817691*(9)
Real Import	-0.788118	-3.074133	-6.057563*(8)	-6.231430*(6)
Real Exchange rate	-3.076851	-3.143353	-6.306279*(7)	-6.206455*(5)

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

Table 2.6:
The Result of Augmented Dickey Fuller Tests for Model 7 and Model 8

Data Series	At level		At first difference	
	without trend	with trend	without trend	with trend
Growth	-1.301892	-2.080589	-5.992128*(7)	-5.974775*(5)
Real Export	-0.570882	-1.763448	-6.362948*(5)	-6.364489*(5)
Real Import	-1.050197	-1.913336	-5.803971*(6)	-5.766722*(4)
Real Exchange rate	-0.676273	-1.449741	-5.081238*(5)	-5.405295*(2)

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

Table 2.7:
The Result of Augmented Dickey Fuller Tests for Model 9

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.

2.7.2 Results of Optimum Lag Length

The uniform lag structure of the system is set up through a research process proposed by Vahid and Engle (1993), using the likelihood ratio test with a potential lag length of 1 through 12 (Baak, 2007). The null hypothesis is a system of variables generated from a Gaussian VAR with p_0 lags against the alternative specification of p_1, whereas p_1 is larger than p_0. The test statistic computed is asymptotically distributed as Chi-square with n^2 $(p_1\text{-}p_0)$ degree of freedom. Based on the procedure mentioned above, the optimum lag length of VAR is reported in Table 2.8. Furthermore, as stated in Vahid et al. (1993), A VAR of order 2 in levels implies a VECM of order 1, if the series are cointegrated. Thus, in our case, the optimal lag lengths of VECM are also reported in Table 2.8. All the remaining analysis will depend on this selected lag length.

Table 2.8:
The Results of Optimum Lag Length for Multivariate Estimations

System	Specification	Selected Optimum Lag Length
VAR	Model 1	4
	Model 2	8
	Model 3	9
	Model 4	6
	Model 5	11
	Model 6	5
	Model 7	12
	Model 8	3
	Model 9	4
System	**Specification**	**Selected Optimum Lag Length**
VECM	Model 1	3
	Model 2	7
	Model 3	8
	Model 4	5
	Model 5	10
	Model 6	4
	Model 7	11
	Model 8	2
	Model 9	3

*VAR denotes vector autoregression and VECM is vector error correction model.

2.7.3 Results of Johansen Juselius Cointegration Tests

The prerequisite for a set of series to be cointegrated is that they should be integrated in the same order. Therefore, given the power of the unit root tests of I(1) process, now we can proceed to the cointegration test. The cointegration test is designed to test for the presence of common stochastic trends between a set of variables that are individually non-stationary in levels (Hooi, 2007). Thus, in this chapter, we utilize the Johansen (1988) and Johansen and Juselius (1990) multivariate cointegration process to test for the existence or absence of the cointegration statistic tests. As stated earlier, the number of cointegration vector(s) is determined by two likelihood ratio tests, namely the maximum eigenvalue and trace eigenvalue statistics. The critical values for each test are from the Osterwald-Lenum (1992) table. As the tests are run for all regimes under examination, the overall the result suggest for the similar outcome. In general, we found at least one cointegration vector in each cointegration system.

Intuitively, the results further suggest for a long run relationship between the variables in the systems. These findings moreover are consistent with previous Malaysian studies, among others, Gatak et al. (1997), Al-Yousif (1999), Baharumshah and Rashid (1999) and Ibrahim (2002). Based on their results, the evidence supports a unique cointegrating vector. For a precise discussion we refer to Table 2.12.

For the case of regime one (here after: Model 4) when incorporating the crisis dummy, 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 81.26545 is obviously larger than the critical values at 0.05 and 0.01, these being 68.52 and 76.07, respectively. Nonetheless, if we test the null hypothesis of $r\leq1$, we definitely fail to reject the hypothesis as the computed value at 45.68893 is smaller than the critical values at 0.05 and 0.01 significant levels, which are 47.21 and 54.46, respectively. Therefore, based on the trace statistic test result, we conclude that there exists a single cointegrating vector in the model.

In particular, we have found the similar outcome for a maximum eigenvalue test. The result of the maximum statistic test demonstrates that the null hypothesis of $r=0$ against its alternative $r>1$, is easily rejected at 0.01 and 0.05 significant levels. The computed value is 35.60770 is obviously larger than the critical value at the 0.05 significant level, with the critical value being 33.46. Nonetheless, if we test the null hypothesis of $r\leq1$, we definitely fail to reject the hypothesis due to the computed value at 21.93135 being smaller than the critical value at the 0.05 and 0.01 significant levels, which are 27.07 and 32.24, respectively. Thus far, based on the trace and maximum statistic tests, we finally summarize that in Model 4[20], there is presence of at least one cointegrating vector in the system. Based on these outcomes, the chapter 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. The same conclusions can also be applied for any other regime (regimes two and three) in every conditions or restrictions of the model.

Table 2.9:
The Results of Johansen Cointegration Tests for Model 1

Data Series : January,1990 to December, 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	52.13093*	47.21	54.46	25.48436	27.07	32.24
r≤1	r>1	26.64657	29.68	35.65	20.50405	25.97	25.52
r≤2	r>2	6.142517	15.41	20.04	4.999917	14.07	18.63
r≤3	r>3	1.142600	3.76	6.65	1.142600	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)

[20] Refer to Table 2.13, as the result also suggest for the unique cointegration vector between the variables in the system.

Table 2.10:
The Results of Johansen Cointegration Tests for Model 2

Data Series : January,1990 to December, 2010		**Cointegration system : F (Growth, Real Export, Real Import, Real Exchange Rate, Crisis Dummy)**					
Hypothesis		**λ Trace**	**5% critical value**	**1% critical value**	**λ Max**	**5% critical value**	**1% critical value**
H0	**H1**						
r=0	r>0	72.76423*	68.52	76.07	27.02773	33.46	38.77
r≤1	r>1	45.73651	47.21	54.46	18.70580	27.07	32.24
r≤2	r>2	27.03071	29.68	35.65	15.33839	25.97	25.52
r≤3	r>3	11.69232	15.41	20.04	10.16877	14.07	18.63

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)

Table 2.11:
The Results of Johansen Cointegration Tests for Model 3

Data Period : January,1990 to June, 1997		**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	49.41815*	47.21	54.46	32.07942*	27.07	32.24
r≤1	r>1	17.33873	29.68	35.65	1074329	25.97	25.52
r≤2	r>2	6.595436	15.41	20.04	6.544351	14.07	18.63
r≤3	r>3	0.051086	3.76	6.65	0.051086	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)

Table 2.12:
The Results of Johansen Cointegration Tests for Model 4

Data Period : January,1990 to August, 1998		**Cointegration system : F (Growth, Real Export, Real Import, Real Exchange Rate, Crisis Dummy)**					
Hypothesis		**λ Trace**	**5% critical value**	**1% critical value**	**λ Max**	**5% critical value**	**1% critical value**
H0	**H1**						
r=0	r>0	81.265**	68.52	76.07	40.026*(**)	33.46	38.77
r≤1	r>1	41.23936	47.21	54.46	23.42044	27.07	32.24
r≤2	r>2	17.81892	29.68	35.65	9.650414	25.97	25.52
r≤3	r>3	8.168510	15.41	20.04	5.584625	14.07	18.63

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)

Table 2.13:
The Results of Johansen Cointegration Tests for Model 5

Data Period : July,1997 to August, 2005		**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	65.4765**	47.21	54.46	43.320**	27.07	32.24
r≤1	r>1	22.15619	29.68	35.65	13.55072	25.97	25.52
r≤2	r>2	8.605469	15.41	20.04	8.225994	14.07	18.63
r≤3	r>3	0.379474	3.76	6.65	0.379474	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)

Table 2.14:
The Results of Johansen Cointegration Tests for Model 6

Data Period : July,1997 to August, 2005		**Cointegration system : F (Growth, Real Export, Real Import, Real Exchange Rate, Crisis Dummy)**					
Hypothesis		**λ Trace**	**5% critical value**	**1% critical value**	**λ Max**	**5% critical value**	**1% critical value**
H0	**H1**						
r=0	r>0	89.6369**	68.52	76.07	43.2404**	33.46	38.77
r≤1	r>1	27.89699	47.21	54.46	21.07489	27.07	32.24
r≤2	r>2	5.979839	29.68	35.65	18.60746	25.97	25.52
r≤3	r>3	0.287763	15.41	20.04	6.248128	14.07	18.63

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)

Table 2.15:
The Results of Johansen Cointegration Tests for Model 7

Data Period : Sept,1998 to August, 2005		**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	73.7182**	47.21	54.46	44.6612**	27.07	32.24
r≤1	r>1	29.05703	29.68	35.65	16.30102	25.97	25.52
r≤2	r>2	12.75601	15.41	20.04	12.73608	14.07	18.63
r≤3	r>3	0.019926	3.76	6.65	0.019926	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)

Table 2.16:
The Results of Johansen Cointegration Tests for Model 8

Data Period : Sept,1998 to August, 2005		Cointegration system : F (Growth, Real Export, Real Import, Real Exchange Rate, Crisis Dummy)					
Hypothesis		λ Trace	5% critical value	1% critical value	λ Max	5% critical value	1% critical value
H0	H1						
r=0	r>0	81.2966**	68.52	76.07	35.60770*	33.46	38.77
r≤1	r>1	45.68893	47.21	54.46	21.93135	27.07	32.24
r≤2	r>2	23.75758	29.68	35.65	13.20634	25.97	25.52
r≤3	r>3	10.55123	15.41	20.04	10.54062	14.07	18.63

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)

Table 2.17:
The Results of Johansen Cointegration Tests for Model 9

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)

2.7.4 Results of Granger Causality in the Vector Error Correction Model

In this section, the temporal test estimates of Granger causality provided in the vector error correction framework for each regime are summarized in Tables 2.19 to 2.27. 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:

Type One Models

$$\Delta g_{it} = \eta_1 + \sum_{i=1}^{G} \alpha_i \Delta g_{t-i} + \sum_{i=1}^{E} \beta_i \Delta e_{t-i} + \sum_{i=1}^{IN} \phi_i \Delta I_{t-i} + \sum_{i=1}^{ER} \gamma_i \Delta er_{t-i} + \delta_1 ECT_{t-1} + \Omega_{1t} \qquad (2.30)$$

$$\Delta e_{it} = \eta_2 + \sum_{i=1}^{G} \alpha_i \Delta g_{t-i} + \sum_{i=1}^{E} \beta_i \Delta e_{t-i} + \sum_{i=1}^{IN} \phi_i \Delta I_{t-i} + \sum_{i=1}^{ER} \gamma_i \Delta er_{t-i} + \delta_2 ECT_{t-1} + \Omega_{2t} \qquad (2.31)$$

$$\Delta I_{it} = \eta_3 + \sum_{i=1}^{G} \alpha_i \Delta g_{t-i} + \sum_{i=1}^{E} \beta_i \Delta e_{t-i} + \sum_{i=1}^{IN} \phi_i \Delta I_{t-i} + \sum_{i=1}^{ER} \gamma_i \Delta er_{t-i} + \delta_3 ECT_{t-1} + \Omega_{3t} \qquad (2.32)$$

$$\Delta er_{it} = \eta_4 + \sum_{i=1}^{G} \alpha_i \Delta g_{t-i} + \sum_{i=1}^{E} \beta_i \Delta e_{t-i} + \sum_{i=1}^{IN} \phi_i \Delta I_{t-i} + \sum_{i=1}^{ER} \gamma_i \Delta er_{t-i} + \delta_4 ECT_{t-1} + \Omega_{4t} \qquad (2.33)$$

Here the notations of g_{it}, e_{it}, I_{it} and er_{it} in the equations *2.30* to *2.33*, 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 *2.30* 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).

As seen in equations 2.30 to 2.33 (the models without a crisis dummy variable), the inclusion of an error correction term denoted as ECT_{t-1} in the equation actually explains the speed of adjustment of convergence towards equilibrium in the long run due to disequilibrium in the short run. Theoretically it suggests that, disequilibrium in the short run is usually because of a shock (sudden stop) occurring. According to the findings, the error correction term (s) in Tables 2.19, 2.21, 2.23, 2.25, and 2.27, are found to have various speeds[21] of convergence to equilibrium, ranging from the lowest 13.48% to the highest 55.51%.

However, in ranging by the regime, we found that regime three has the fastest speed of adjustment at 33.47%, followed by regime one at 21.59% of speed of adjustment from disequilibrium in the short term to the equilibrium in the long term. The results further suggest two situation recoveries for regime two (without the dummy variable), according to Models 5 (Table 2.23 – pegged exchange rate regime with crisis period) and 7 (Table 2.25 – pegged exchange rate regime). These two tables are slightly different, where it is explicitly shows in Table 2.29, appendix section. The results suggest that the speed of adjustment of the model without a crisis period is fastest than the model with the crisis period, by 20.66% and 13.48%, respectively. Moreover, the speed of adjustment between the pre-AFC (model 3) and post-AFC (model 9) are also different. According to the result, the speed of adjustment of the model 9 is also fastest than the model 3, by 33.47% and 21.59%, respectively.

According to Masih (1996), the coefficient of the lagged error-correction term (ECT) represent a short term speed of adjustment coefficient and represents the proportion by which the long term disequilibrium (or imbalance) in the dependent variable is being corrected in each short period. Therefore, as stated previously in Table 2.27 for the regime three, the speed of adjustment is at 33.47%. Econometrically, whenever

[21] Here in this chapter, for the comparison purposes, we use the term of percentage (%) to show the different speed of adjustment, between the estimations.

there is a deviation from the equilibrium cointegrating relationship as measured by ECT, it is growth indicator that bears the brunt of adjustment rather than other macroeconomic variables in adjusting to restore long term equilibrium within the system. In other words, if a shock occurs in the economy, Malaysia takes about 33.47% of speed adjustment from disequilibrium in the short term to the equilibrium in the long term. In implication, this result is reliable, since regime three is also known as the recovering regime for Malaysia after the Asian crisis raised in 1997. Besides that, Malaysia also switched from peg to a floating exchange rate mechanism in the same time due to positive growth in economic performance during that period. Hence, if regime three produces the fastest short term recovery due to shock, this actually consistent with the economic performance of that regime.

Furthermore, the VECM estimator allows us to estimate the short-run relationship between the variables in the system across the regimes. As stated earlier, the ELGH is divided into three groups of hypotheses. The first group would occur when there is exists Granger causality in the VECM framework from exports to growth in the short-run. This relationship indirectly supports for the export-led growth hypothesis in the regimes. The second group suggests for the growth-driven exports hypothesis proves that the direction of the relationship is from growth to exports. The third group is the two-way relationship in the VECM framework from exports to growth, and *vice versa*. However, based on the previous restriction in the earlier section, only the first and third hypotheses are exceptions to support for the ELGH in this study[22].

To understand this hypotheses deeper, now refer to the results provided in Tables 2.21 (Model 3), 2.23 (Model 5), 2.25 (Model 7), and 2.27 (Model 9), (without the crisis dummy variable) as our examples to discuss. For regime one (Model 3), there is an indication of short-run causality running from both, exports to growth and from growth to exports at the 99% significant level. Likewise, the findings in the regimes three (Model 9) and two (Model 7), it suggest for the Granger causality from exports to growth at the 90% significant level in regime three (95% significant level in regime two) and from growth to exports at the 99% significant level for the both regimes. On the contrary, in regime two for Model 5, we observe that only growth Granger cause exports at the 99% significant level. In other words, this regime is incoherent with the ELGH.

Therefore to conclude, by dividing the regime accordingly followed by the actual exchange rate mechanism, the ELGH remains robust in regimes one and three.

[22] See page 8, for the earlier hypotheses.

However, by the inclusion of the shock period in the system (Table 2.25), has however disturbed the direction of causality from exports to growth and finally the ELGH is violated (Model 7). For simplify purposes, I transform this explanation into table presentation as follows;

Table 2.18.1:

The Export Led Growth Hypothesis (ELGH) results summaries (Without dummy).

Model	Exports Granger cause Growth	Growth Granger cause Exports	ELGH
Table 2.19 (Model 1)	Significant	Significant	Hold
Table 2.21 (Model 3)	Significant	Significant	Hold
Table 2.23 (Model 5)	Insignificant	Significant	Not Hold
Table 2.25 (Model 7)	Significant	Significant	Hold
Table 2.27 (Model 9)	Significant	Significant	Hold

For the robustness modelling and to observe the role of the Asian financial crisis in the system precisely, we include the crisis dummy *(cd_t)* in the system. Due to the Asian Financial crisis in 1997/1998, the inclusion of the crisis dummy is also to capture for the structure break effects in the model. This dummy variable moreover is assumed to react as an exogenous variable in the system. Therefore as we seen here, especially in regimes one and two, the estimation models are extended into two types, namely, with and without the crisis dummy. The systems without the crisis dummy are the same as in equations 2.30 to 2.33. Whilst, the systems with the crisis dummy are as follows (equations 2.34 to 2.37);

Type two models

$$\Delta g_{it} = \eta_5 + \sum_{i=1}^{G} \alpha_i \Delta g_{t-i} + \sum_{i=1}^{E} \beta_i \Delta e_{t-i} + \sum_{i=1}^{IN} \phi_i \Delta I_{t-i} + \sum_{i=1}^{ER} \gamma_i \Delta er_{t-i} + \sum_{i=1}^{CD} \varphi_i \Delta cd_{t-i} + \theta_1 ECT_{t-1} + \Omega_{5t} \quad (2.34)$$

$$\Delta e_{it} = \eta_6 + \sum_{i=1}^{G} \alpha_i \Delta g_{t-i} + \sum_{i=1}^{E} \beta_i \Delta e_{t-i} + \sum_{i=1}^{IN} \phi_i \Delta I_{t-i} + \sum_{i=1}^{ER} \gamma_i \Delta er_{t-i} + \sum_{i=1}^{CD} \varphi_i \Delta cd_{t-i} + \theta_2 ECT_{t-1} + \Omega_{6t} \quad (2.35)$$

$$\Delta I_{it} = \eta_7 + \sum_{i=1}^{G} \alpha_i \Delta g_{t-i} + \sum_{i=1}^{E} \beta_i \Delta e_{t-i} + \sum_{i=1}^{IN} \phi_i \Delta I_{t-i} + \sum_{i=1}^{ER} \gamma_i \Delta er_{t-i} + \sum_{i=1}^{CD} \varphi_i \Delta cd_{t-i} + \theta_3 ECT_{t-1} + \Omega_{7t} \quad (2.36)$$

$$\Delta er_{it} = \eta_8 + \sum_{i=1}^{G} \alpha_i \Delta g_{t-i} + \sum_{i=1}^{E} \beta_i \Delta e_{t-i} + \sum_{i=1}^{IN} \phi_i \Delta I_{t-i} + \sum_{i=1}^{ER} \gamma_i \Delta er_{t-i} + \sum_{i=1}^{CD} \varphi_i \Delta cd_{t-i} + \theta_4 ECT_{t-1} + \Omega_{8t} \quad (2.37)$$

We observe from the results of Tables 2.22 (regime one) and 2.26 (regime two), there exists the Granger causality from exports to growth in the short run. Choosing regime one as an example, the results indicate that, exports are significant in explaining growth at the 99% significant levels. Therefore, this indirectly supports the ELGH for the case when the crisis dummy is included in the system. In addition, there is also evidence that the short run relationship in the VECM framework is from growth to export, for instance in Model 4. This on the other hand, is coherent with the evidence of growth promoting export strategy, which is also applied in many emerging countries nowadays, including Malaysia. Table 2.18.2, summarising the results of the ELGH (with the Asian Financial Crisis dummy)

Table 2.18.2:

The Export Led Growth Hypothesis (ELGH) results summaries (With dummy).

Model	Exports Granger cause Growth	Growth Granger cause Exports	ELGH
Table 2.20 (Model 2)	**Significant**	**Significant**	**Hold**
Table 2.22 (Model 4)	**Significant**	**Significant**	**Hold**
Table 2.24 (Model 6)	**Significant**	**Significant**	**Hold**
Table 2.26 (Model 8)	**Significant**	**Significant**	**Hold**

For the extreme case of ELGH, we extend further the analysis by adopting the research procedure proposes by Darrat et al. (2000) in Ibrahim (2002). Based on the ELGH test procedure proposed by Darrat, these hypothesis tests become more reliable when we provide the VECM framework that allowed for exogeneity tests. Furthermore based on this test, in order to make a strong case for the ELGH, exports need to be structurally invariant to structural changes or regime shift (Ibrahim, 2002). In other words, the ELGH must not undergo a structural break. Therefore, exports must be super-exogenous. Additionally, weak exogeneity is a necessary condition for super-exogeneity, thus testing for weak exogeneity of exports is required. According to Johansen (1992), this test can be carried out by looking at the significance of the error correction terms(s). The precise explanation is in Darrat et al. (2000), where the weak exogeneity of exports can be rejected if the error correction term(s) are statistically significant. Table 2.18.3 summarizes the final result for short run and long run relationships between growth and exports in regimes. Among the results of interest, we found the significant coefficients of the error correction term(s), for both types of models (with and without the crisis dummy, across the regimes). This indirectly supports for the presence of cointegration between the variables in the model.

In addition, in the export model, we found a significant coefficient of the error correction term(s) in all export ratio systems, excluding Model 2. 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[23].

Besides the export-growth nexus, we observe the significant relationship between imports and economic growth across the regimes. In other words, imports are also essential variables in determining the economic growth. In Table 2.21 (regime one) the results suggest that imports influence growth at the 99% significant level. This study may also note from other regimes under consideration, that import growth has played an important role in impact economic growth in the short run. This result moreover, provides further evidence under the exchange regime environment and on the other hand supports for the *"import compression hypothesis"* by Khan and Knight (1988). This result is consistent with Riezman et al. (1996), where they documented the importance of imports in the causal interactions between economic growth and exports. This result also concurs with Ibrahim (2002), where he claimed that the export oriented economy like Malaysia, imports of intermediate and capital goods in particularly are highly essential for the promotion of exports.

The result further suggests a one-way causality from exchange rate to economic growth, in most of the models including Model 4, Model 5, Model 6 and Model 7. Furthermore, a two-way relationship found between exchange rate and economic growth is only in Model 3. Meanwhile, Model 8 shows a bidirectional relationship from growth to the exchange rate. However, no relationship between exchange rate and growth in Model 9 is found. The result further suggest that only Model 9 is consistent with Goldstein (2002), where based on his study he claimed the exchange rate variable usually behaves nominally in the economy, thus it does not affect the real economy in the long term. If it is exists a relationship between the exchange rates and the economic growth, it usually insignificant. Even though the relationship between exchange rate and growth is always the nominal one (Goldstein (2002), most of the

[23] As stated by Darrat et al. (2000), the weak exogeneity of the export ratio is rejected if the error correction term(s) in Table 2.19 are statistically significant.

error correction term(s) from all regimes under consideration are significant. Hence, we ought to conclude long term relationships are documented between exchange rate and economic growth from this chapter[24].

[24] An overall critique of the literature examining the relationship between exchange rate regime and growth is offered by Goldstein (2002).

Table 2.18.3:
The Results of Direction between Exports and Growth in Granger Causality within the VECM Framework

Direction of Causality	**Result**		
Model 1	**Wald test**	**p-value**	**ECT(t-1)**
Growth Granger-cause Exports	7.1749	0.0000	Insignificant
Exports Granger-cause Growth	4.1381	0.0000	Significant**
Model 2	**Wald test**	**p-value**	**ECT(t-1)**
Growth Granger-cause Exports	6.7594	0.0000	Insignificant
Exports Granger-cause Growth	6.6265	0.0000	Insignificant
Model 3	**Wald test**	**p-value**	**ECT(t-1)**
Growth Granger-cause Exports	8.4044	0.0000	Significant***
Exports Granger-cause Growth	4.2488	0.0045	Insignificant
Model 4	**Wald test**	**p-value**	**ECT(t-1)**
Growth Granger-cause Exports	5.0452	0.0002	Significant**
Exports Granger-cause Growth	5.1257	0.0015	Significant***
Model 5	**Wald test**	**p-value**	**ECT(t-1)**
Growth Granger-cause Exports	1.7335	0.1063	Significant***
Exports Granger-cause Growth	10.0850	0.0000	Significant***
Model 6	**Wald test**	**p-value**	**ECT(t-1)**
Growth Granger-cause Exports	2.8291	0.0103	Insignificant
Exports Granger-cause Growth	8.4477	0.0000	Significant***
Model 7	**Wald test**	**p-value**	**ECT(t-1)**
Growth Granger-cause Exports	2.2887	0.0309	Significant***
Exports Granger-cause Growth	8.7983	0.0000	Significant***
Model 8	**Wald test**	**p-value**	**ECT(t-1)**
Growth Granger-cause Exports	6.7967	0.0001	Significant***
Exports Granger-cause Growth	7.7759	0.0001	Significant***
Model 9	**Wald test**	**p-value**	**ECT(t-1)**
Growth Granger-cause Exports	2.0615	0.0983	Insignificant
Exports Granger-cause Growth	7.6217	0.0002	Significant***

Note: Asterisks (***), (**) and (*) indicates statistically significant at 1%, 5% and 10% levels, respectively.

Table 2.19:
The Results of Granger Causality in VECM Framework for Model 1

Dependent Variables	Independent variables				
	$\Delta growth_t$	$\Delta exports_t$	$\Delta imports_t$	$\Delta ex\text{-}rate_t$	$ECT_{r=1(t-1)}$
$\Delta growth_t$	-	[7.1749] (0.0000)	[3.3607] (0.0365)	[3.5280] (0.0043)	[[-0.555169]]
$\Delta exports_t$	[4.1381] (0.0013)	-	[5.5493] (0.0000)	[3.0221] (0.0306)	[[-0.0328]]**
$\Delta imports_t$	[2.1926] (0.0708)	[3.6619] (0.0017)	-	[2.6866] (0.0323)	[[-0.02373]]*
$\Delta ex\text{-}rate_t$	[2.2967] (0.0786)	[4.9227] (0.0003)	[3.7997] (0.0007)	-	[[0.003821]]

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.

Table 2.20:
The Results of Granger Causality in VECM Framework for Model 2

Dependent Variables	Independent variables					
	$\Delta growth_t$	$\Delta exports_t$	$\Delta imports_t$	$\Delta ex\text{-}rate_t$	$\Delta Crisis\ Dummy_t$	$ECT_{r=1(t-1)}$
$\Delta growth_t$	-	[6.7594] (0.0000)	[3.2364] (0.0412)	[4.6020] (0.0038)	[1.2003] (0.3030)	[[-0.52825]]
$\Delta exports_t$	[6.6265] (0.0003)	-	[3.8138] (0.0006)	[3.2736] (0.0221)	[2.7459] (0.0294)	[[-0.06124]]
$\Delta imports_t$	[2.6455] (0.0501)	[3.0437] (0.0112)	-	[1.9327] (0.0658)	[2.2792] (0.0619)	[[-0.02743]]
$\Delta ex\text{-}rate_t$	[3.1764] (0.0146)	[5.2589] (0.0016)	[4.2105] (0.0011)	-	[13.1528] (0.0000)	[[-0.01889]]
$\Delta Crisis\ Dummy_t$	[2.7954] (0.0122)	[8.4290] (0.0000)	[13.2797] (0.0000)	[2.0722] (0.0854)	-	[[0.183801]]

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 2.34 to 2.37 to read the table. The grey matrix area in the table presenting the Granger causality tests results.

Table 2.21:
The Results of Granger Causality in VECM Framework for Model 3

Dependent Variables	Independent variables				
	Δ$growth_t$	**Δ$exports_t$**	**Δ$imports_t$**	**Δ$ex\text{-}rate1_t$**	**$ECT_{r=1(t-1)}$**
Δ$growth_t$	-	[8.4044] (0.0000)	[3.0230] (0.0078)	[4.7456] (0.0007)	[[-0.21595]]***
Δ$exports_t$	[4.2488] (0.0045)	-	[13.9066] (0.0000)	[3.6567] (0.0102)	[[-0.101888]]
Δ$imports_t$	[4.4262] (0.0005)	[4.4170] (0.0003)	-	[3.8104] (0.0057)	[[0.397620]]***
Δ$ex\text{-}rate1_t$	[2.2263] (0.0931)	[2.7744] (0.0696)	[4.2604] (0.0181)	-	[[0.023914]]***

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.

Table 2.22:
The Results of Granger Causality in VECM Framework for Model 4

Dependent Variables	Independent variables					
	Δ$growth_t$	**Δ$exports_t$**	**Δ$imports_t$**	**Δ$ex\text{-}rate1_t$**	**ΔCrisis $Dummy_t$**	**ECTr=1(t-1)**
Δ$growth_t$	-	[5.0452] (0.0002)	[1.9224] (0.1047)	[2.5823] (0.0278)	[2.5987] (0.0170)	[[-0.005830]]**
Δ$exports_t$	[5.1257] (0.0015)	-	[5.0279] (0.0001)	[5.5030] (0.0001)	[6.8992] (0.0000)	[[-0.03586]]***
Δ$imports_t$	[4.3183] (0.0006)	[2.3563] (0.0801)	-	[1.6996] (0.1250)	[5.7230] (0.0002)	[[0.003825]]
Δ$ex\text{-}rate1_t$	[2.0659] (0.1346)	[0.7394] (0.5322)	[4.2505] (0.0020)	-	[32.2016] (0.0000)	[[0.002961]]***
ΔCrisis $Dummy_t$	[1.3877] (0.2343)	[5.0127] (0.0007)	[4.8566] (0.0001)	[2.8217] (0.0327)	-	[[-0.012421]]

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 2.34 to 2.37 to read the table. The grey matrix area in the table presenting the Granger causality tests results.

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Table 2.23:
The Results of Granger Causality in VECM Framework for Model 5

Dependent Variables	Independent variables				
	Δgrowth$_t$	**Δexports$_t$**	**Δimports$_t$**	**Δex-rate2$_t$**	**ECT$_{r=1(t-1)}$**
Δgrowth$_t$	-	[1.7335] (0.1063)	[3.0641] (0.0069)	[2.6938] (0.0101)	[[-0.1348]]**
Δexports$_t$	[10.0850] (0.0000)	-	[11.1014] (0.0000)	[4.2465] (0.0015)	[[-0.646]]***
Δimports$_t$	[6.6101] (0.0000)	[5.6217] (0.0001)	-	[3.7504] (0.0037)	[[-0.544]]***
Δex-rate2$_t$	[1.0728] (0.3837)	[3.4691] (0.0077)	[2.3700] (0.0786)	-	[[0.016417]]

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.

Table 2.24:
The Results of Granger Causality in VECM Framework for Model 6

Dependent Variables	Independent variables					
	Δgrowth$_t$	**Δexports$_t$**	**Δimports$_t$**	**Δex-rate2$_t$**	**ΔCrisis Dummy$_t$**	**ECT$_{r=1(t-1)}$**
Δgrowth$_t$	-	[2.8291] (0.0103)	[2.4442] (0.0236)	[3.9525] (0.0010)	[3.4058] (0.0066)	[[-0.048895]]
Δexports$_t$	[8.4477] (0.0000)	-	[13.4194] (0.0000)	[6.7189] (0.0006)	[3.7091] (0.0015)	[[-0.03317]]***
Δimports$_t$	[8.5149] (0.0000)	[6.0209] (0.0000)	-	[8.4696] (0.0000)	[8.3288] (0.0000)	[[0.096322]]***
Δex-rate2$_t$	[1.8471] (0.1329)	[3.5417] (0.0033)	[3.4728] (0.0056)	-	[3.3709] (0.0100)	[[0.010918]]***
ΔCrisis Dummy$_t$	[5.7357] (0.0005)	[7.2403] (0.0014)	[1.9459] (0.0987)	[2.8261] (0.0665)	-	[[0.044724]]

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 2.34 to 2.37 to read the table. The grey matrix area in the table presenting the Granger causality tests results.

Table 2.25:
The Results of Granger Causality in VECM Framework for Model 7

Dependent Variables	Independent variables				
	$\Delta growth_t$	$\Delta exports_t$	$\Delta imports_t$	$\Delta ex\text{-}rate2_t$	$ECT_{r=1(t-1)}$
$\Delta growth_t$	-	[2.2887] (0.0309)	[2.4632] 0.0188	[2.8086] (0.0245)	[[-0.2066]]***
$\Delta exports_t$	[8.7983] (0.0000)	-	[11.3447] (0.0000)	[5.6050] (0.0002)	[[-0.2339]]***
$\Delta imports_t$	[2.4787] (0.0367)	[1.5646] (0.1997)	-	[1.4190] (0.2279)	[[0.059465]]**
$\Delta ex\text{-}rate2_t$	[1.3673] (0.2474)	[1.7762] (0.1361)	[0.7786] (0.5701)	-	[[0.003276]]

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.

Table 2.26:
The Results of Granger Causality in VECM Framework for Model 8

Dependent Variables	Independent variables					
	$\Delta growth_t$	$\Delta exports_t$	$\Delta imports_t$	$\Delta ex\text{-}rate2_t$	$\Delta Crisis\ Dummy_t$	$ECT_{r=1(t-1)}$
$\Delta growth_t$	-	[6.7967] (0.0001)	[9.7813] (0.0000)	[1.7811] (0.1626)	[7.6170] (0.0001)	[[-0.36375]]**
$\Delta exports_t$	[7.7759] (0.0001)	-	[11.1220] (0.0000)	[3.3573] (0.0061)	[2.8779] (0.0224)	[[0.107518]]**
$\Delta imports_t$	[2.1398] (0.0484)	[3.9833] (0.0142)	-	[1.8935] (0.0811)	[2.5491] (0.0540)	[[0.291410]]*
$\Delta ex\text{-}rate2_t$	[5.2243] (0.0010)	[6.5699] (0.0001)	[6.8747] (0.0001)	-	[4.0041] (0.0026)	[[-0.129401]]*
$\Delta Crisis\ Dummy_t$	[4.3744] (0.0012)	[8.3141] (0.0007)	[3.4636] (0.0389)	[1.2186] (0.3125)	-	[[0.111950]]

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 2.34 to 2.37 to read the table. The grey matrix area in the table presenting the Granger causality tests results.

Table 2.27:
The Results of Granger Causality in VECM Framework for Model 9

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.

2.8 Summary and Conclusion

The main purpose of this chapter is to re-examine the robustness of the ELGH under three different regimes in Malaysia – from January, 1990 to December, 2010. Among other model specifications discussed earlier in the introduction of this chapter, this study tests the significance of ELGH in different exchange rate regimes in Malaysia. Theoretically, the ELGH shows the direction in which exports stimulated growth, and so called exports is an engine of growth. In the line of Al Yousif (1999) and Baharumshah et al. (1999), this chapter also incorporates robust determinants of economic growth, imports and the exchange rate. 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. 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 (excluding; Model 2), 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 time. The other macroeconomic elements like investment, financial development and services have also the important role in influencing the economic growth. Thus, besides the fundamental component to ensure positive growth, other complementary policies are also important to be improved. The services component for instance, is a good channel in terms of inviting more foreign business from abroad and directly generating more income. Thus, excellent services would assure the perpetuity of high-quality growth for Malaysia. Therefore, to expand this research, further investigations are needed in evaluating the role of other macroeconomic determinants in impacting growth.

Chapter 3

Essay on Exchange Rate Exposure: Some New Evidence of First and Second Moment Exchange Rate Exposure on Sector Returns

3.1 **Introduction**

By definition the exchange rate exposure[25] can be specify as the elasticity of change in the market value of a firm resulting from a unit change in the exchange rate (Adler and Dumas, 1984). Additionally Joseph (2002), proposed that the exchange rate exposure refers to the degree to which the value of a firm or an industry is affected by exchange rate changes. As a result, the exchange rate exposures play an important role in affecting the value of the sector returns in the market, locally or internationally.

Following Azman-Saini et al. (2006), among many reasons this relationship is vital for investigation due to the emergence of new capital markets, adoption of more flexible exchange rate regimes and the liberalization of financial markets in many emerging markets. Moreover Ibrahim (2008) suggests that the way an exchange rate exposure can affect the sector returns is through the cash flows channels. As note by Bodnar and Gentry (1993), there are three channels from which the exchange rate exposure can affect cash flows, these are;

(i) Domestic exporters' terms of competition with foreign firms.

- For example, an individual investor who owns a portfolio consisting of securities in different currencies or a multinational company with subsidiaries and branches in foreign locations[26].

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[25] In this chapter the term of exchange rate exposure is divided into two types, namely, the exchange rate changes and exchange rate volatility. These two types of exposures are central to many investment decisions particularly in the new product areas and in the critical variables in options.

[26] Exchange rates can affects stock price not only for multinational and export oriented firms but also for domestic firms. For a multinational company, changes in exchange rate will result in both an immediate change in value of its foreign operations and a continuing change in the profitability of its foreign operations reflected in successive income statements. Therefore, the changes in economic value of firms' foreign operation may influence stock price. Domestic firms can also be influenced by changes in exchange rate since they may import a part of their inputs and export their outputs. For example, a devaluation of its currency makes imported inputs

(ii) Inputs, outputs, and substitute goods prices.

- These factors play a significant role in determining the competitive position of domestic companies with no direct international operations relative to foreign firms (Jorian, 2002)[27]

(iii) Firms' assets denominated in foreign currencies (among others; dollar, euro, ringgit, peso)[28]

Although, the economic theory suggests that foreign exchange changes can have an important impact on the stock price by affecting cash flow, investment and profitability of firms, there is no consensus about these relationships and the empirical studies of how these three factors are related (Joseph, 2002; and Vygodina, 2006). However, the linkage between these financial variables can be established through the instruments of wealth, demand for money, interest rates etc. (Mishra, 2004).

Research by Granger, Huang and Yang (2002), suggest that stock prices are expected to react ambiguously to exchange rates. Aggrawal (1981) provide illustrative example documenting a positive effects while Soenen and Hennigar (1988) find negative effects of exchange rate on stock market. Interestingly, Wu (2000), suggests that the exchange rate may effects stock price negatively and positively.

Nowadays, the borderlessness of financial transactions between countries makes capital market in each country more important as a source of funds. Nonetheless, there are no final conclusion ever made regarding its relationships and the condition comes along with obstacles. Besides the market index returns as a common factor influencing stock returns, sensitivity of stock returns to exchange rate returns and exchange rate volatility are two other factors that investors should consider, in constructing their securities portfolio and before they take any decision on investing.

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more expensive and exported outputs cheaper for a firm. Thus, devaluation will make positive effects for export firms (Aggarwal, 1981) and increase the income of these firms, consequently, boosting the average level of stock prices (Wu, 2000).

[27] Exchange rate changes affect the competitiveness of firms through their impact on input and/or output price. For instance, when the exchange rate appreciates, since exporters will lose their competitiveness in international market, the sales and profits of exporter will shrink and the stock price will decline. On the other hand, importers will increase their competitiveness in domestic markets. Therefore, their profit and stock price will increase. The depreciation of exchange rate will make adverse effects on exporters and importers. Exporters will have advantage against other countries' exporters and increase their sales and their stock price will be higher (Yau and Neih, 2006). Hence, currency appreciation has both a negative and a positive effect on the domestic stock market for an export-dominant and an import-dominated country, respectively (Ma and Kao, 1990).

[28] As stated in Nieh and Lee (2001), that in an open economy, since the expectations of relative currency values affect the domestic and foreign interest rate and these changes affect the present value of a firm's assets, exchange rates play a crucial role on stock prices, especially for internationally held financial assets.

For the case of Malaysia, the high fluctuations between exchange rate exposure[29] and stock returns have attracted a great deal of interest from policy makers such as the government and researchers. This topic has become more interesting when we take in to account any economic event, for instance, the changes in exchange rates policy and the 1997/1998 Asian financial crisis in 1997. In general, the crisis which originally started in Thailand had triggered a significant wave of currencies depreciation and appreciation on stock markets in the Asia region. Among the effected countries, Malaysia was the first country faced by massive movements in exchange rates and stock prices on its financial market history. In order to stabilize the ringgit, selective capital controls were introduced on the 1 September 1998 which witnessed the ringgit being pegged at MYR3.80 per dollar. This represented 34% depreciation from the pre-crisis peak. According to Azman-Saini et al. (2006), the immediate impact of the ringgit depreciation was on stock market. The stock market declined by 44.8% in the second half of 1997 which was the worse in the history of Malaysia. As the contagion effects caused by the crisis spread across the Asian region, investor confidence was further battered. As a result, the reversal of short term capital pushed down the price further and the Kuala Lumpur stock index price declined to a low of 286 points on 1 September 1998, the day capital controls were introduced. After the crisis, the stock price has been recovering progressively.

In the light of international financial market studies, this study uses the terms of the first-moment and second-moment exchange rate exposure to represent the degree to which the sector returns are sensitive to the exchange rate returns and the exchange rate volatility, respectively (Narulita and Titi (2006) and Chee, Hui, and Annuar (2004) among others). Consistent with these terms, the focal point of this chapter is to examine the first-moment and second-moment exchange rate exposures over the period of October, 1992 to December, 2010 for all eight Malaysia main board sector returns namely, financial, plantation, properties, tin and mining, trade and services, consumer goods, construction, and industrial sector returns. The basic intuition behind this investigation is that the sector returns in Malaysia are partially explained by the exchange rate exposure, namely exchange rate changes and exchange rate volatility.

From previous studies, researchers show mixed results of exchange rate exposure on stock returns. Nonetheless, most of them concluded that exchange rate exposure has relatively been significant in infecting the stock returns (Where, Koutmos et al. (2003) ;

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[29] Here, the exchange rate variability refers to exchange rate changes and the exchange rate volatility. These two terms will be explained further in the modeling section.

Dominguez et al. (1998); Lobo (2000); Joseph (2002), offering international evidence, specifically for Malaysia cases including Ibrahim (2008) and Azman-Saini et al. (2006); among others). Thus, based on these earlier studies the first research question for this study is; does the level of exchange rate fluctuation affect sector returns? Therefore, based on this research question and from the previous literature, the first hypothesis for this chapter is as follows;

Null Hypothesis:
The first-moment exchange rate exposure and second-moment exchange rate exposure do not significantly affect the sector returns.

Alternative Hypothesis:
The first-moment exchange rate exposure and second-moment exchange rate exposure significantly affect the sector returns.

Moreover, this chapter makes several important contributions to literature. It stems in depth from the implementation of the capital asset pricing model (CAPM) in measuring the sensitivity of the sector returns to the market returns. This chapter extends the CAPM model by including the exchange rate changes and exchange rate volatility in the estimations model. In light of the *'top-down approach'* proposed by Adler and Dumas (1984), this chapter seeks to produce an important finding to extend further the existing literature.

Next, we also measure the sensitivity of the sector returns to the exchange rate appreciation and depreciation for the asymmetric exposure. The asymmetric exposure, generally, can be specified as the sensitivity of the sector returns to the exchange rate appreciation and depreciation values, between small and large changes in the exchange rate. From this variable, we try to answer this question: "Is the exchange rate exposure of Malaysia stock returns asymmetric during the appreciation and depreciation?" Thus the second hypothesis for this chapter is as follows;

Null Hypothesis:
The asymmetric exchange rate exposure does not significantly affect the sector returns.

Alternative Hypothesis:
The asymmetric exchange rate exposure significantly affects the sector returns.

This chapter extends further the previous studies on exchange rate exposure by exploring contemporaneous and lagged exchange rate exposure of eight Malaysian sector price indexes as stated earlier. Bartov and Bodnar (1994), Martin, Madura and Akhibge (1999), and Di Iorio and Faff (2000) found that lagged exchange rate changes significantly impact sector returns. In fact, Di Iorio et al. (2000) argued that a lagged response to exchange rate movements provides some evidence of asymmetric responses to currency appreciation and depreciation.

Additionally, for both models this chapter extends previous literature deeper by including two types of dummy variable in the models, a pegging exchange rate dummy and 1997/1998 Asian financial crisis dummy. The first dummy variable is PEG_{it} (September, 1998 to August, 2005; 1 and otherwise; 0) for the period where the Malaysia ringgit is pegged to the US dollar[30]. The second one is CD_{it} (July, 1997 to December, 1999; 1 and otherwise; 0) for time where there crisis has occurred[31].

This chapter is organized as follows. Section 3.2 presents some related literature on exchange rate exposure, followed by model specifications in Section 3.3. The method for the testing exchange rate exposure to sector returns in Malaysia is discussed in Section 3.4. Data Sources and Data Definition are in Section 3.5 and 3.6, respectively. The empirical results are given in Section 3.7. Section 3.8 provides a summary and conclusion.

[30] Refer to Baharumshah (2009).
[31] Following, official information of the recovery date from Chee, Hui and Annuar (2004) and Tiwari (2003) and non-official information about the Asian financial crisis recovery approximately end date, on the internet site of Wikipedia site, online: http://en.wikipedia.org/wiki/1997_Asian_financial_crisis

3.2 Literature Review

Over the past few decades, there have been vast debates amongst economists and the researchers regarding the effect of exchange rate fluctuations on stock returns. The ideas of exchange rate exposures were started by Dumas (1978), Adler and Dumas (1980, 1984), and Hodder (1982). Generally, the exchange rate exposure can be interpreted as the exchange-rate movement of the regression coefficient of the real value of the firm on the exchange rate (Jorian, 1990). Additionally, Adler et al. (1984) points out that the concept of exposure is arbitrary in the sense that stock prices and the exchange rate is determined jointly. For the effect of exchange risk on the firm, this been studied by Heckerman (1972), Shapiro (1975), Adler et al. (1980), Hodder (1982), Schmidt and Broll (2008), Kamil (2009), among others.

The impact of exchange rate volatility and its returns on stock returns has received considerable attention in the academic literature. The standard approach broadly proposed by the previous literature such Adler and Dumas (1984), Jorian (1990), Dominguez et al. (1998), Lobo (2000), Joseph (2002), Koutmos and Martin (2003), Ibrahim (2008), among others, provides useful information to measure the exposure to exchange rate by estimating the sensitivity of stock returns to exchange rate changes.

In addition, because of the potential cash flow costs, it is important to examine how exchange rate changes and exchange rate risks affect stock returns. Following Koutmos et al. (2003), there are two channels explaining how exchange rate risk could affect cash flows. Firstly, cash flow can be affected by altering the volume of international trade. Thus, if the volume of trade flows could be affected by the level of exchange rate fluctuation, so should the value of stock returns.

Much previous literature tries to investigate the relationship between exchange rate risk and stock returns, for example, Cushman (1983), Pozo (1992), Sercu (1992a, 1992b), Chowdhury (1993), Kroner and Lastrapes (1993), Sekmen and Saribas (2007), Adnan, Hye, Iran, and Hye (2009) Kumar (2009), among others. But, there is still no final agreement regarding its general direction. Moreover, based on Brown (2001), the exchange rate volatility could affect cash flows by increasing the volume of hedging and/or increasing the transaction costs of hedging exchange rate volatility with derivatives.

We therefore start this section by analyzing a paper written by Koutmos et al. (2003). This study investigated the impact of first- and second-moment exchange rate exposure[32] on the daily returns of nine U.S. sectors from 1992 to 1998. It inspired this current paper, for instance from how the author separates the model into contemporaneous and one-day lagged models. The finding shows that, in 17.8% of the cases they detect significant first-moment exposure when contemporaneous exchange rates are used. Furthermore, 25% of the significant exposures are asymmetric. In contrast, for one-day lagged model, they found 42.2% of the cases are significant and 79% are asymmetric. Concerning second-moment exposure, the financial sector is found to be the most sensitive sector when using contemporaneous and one-day lagged models.

In related vein, Jayasinghe and Tsui (2008) attempted to address three relevant aspects simultaneously, namely sensitivity of stock returns to exchange rate changes, sensitivity of volatility of stock returns to volatility of changes in foreign exchange market, and the correlation between volatilities of stock returns and exchange rate changes. This paper employed a bivariate GJR-GARCH model to examine all such aspects of exchange rate exposure of sector indexes in Japanese industries. Using sample data for fourteen sectors, they found significant evidence of exposed returns and its asymmetric conditional volatility of exchange rate exposure.

Furthermore Aydemir and Demirhan (2009), investigate the relationship between stock price and exchange rates in Turkey using a multivariate framework. Interestingly, this paper used data from 23rd February 2001 to 11th January 2008, where the reason for selecting this period is that exchange rate regime is determined as floating. Thus this idea quite encouraged present paper due to its motivation on analysis data regarding specific time regime. The results show, during the floating regime in Turkey, there exist a bidirectional causal relationship between the exchange rate and all stock market indices. While the negative causality exists from National 100, services, financials and industrials stock price indices to the exchange rate, there is a positive causal relationship from technology indices to the exchange rate. In contrast, a negative relationship from the exchange rate to all stock market indices is determined.

Although the exchange rate exposure-sector returns nexus has been heavily researched at both theoretical and empirical levels, studies on Malaysia remain few. Specifically for Malaysia, some of the earlier researchers geared at providing empirical results to support or against this hypothesis, namely, Ibrahim (2008), Hooy, Tan and Nassir (2004), and Azman-Saini et al. (2006) among others.

[32] The impact of the exchange rate changes (first moment exposure) and the exchange rate volatility (second moment exposure) on sector returns.

To begin, Ibrahim (2008) investigated the relationship from exchange rate exposure to stock returns for the case of Malaysia using an augmented standard market model. The data utilized in the analysis are monthly covering the period from January 1994 to December 2004. This paper proposes the basic and estimates model as follow;

Basic Model

$$SECTR_t = \alpha + \beta MKTR_t + \theta EXR_t + \phi CR_t + \varepsilon_t \quad (3.1)$$

Here in eq(3.1), SECTR is the return of a sector under consideration, MKTR is the market return, EXR is the change in exchange rate, *CR* is an Asian crisis dummy. In the above model, the focal coefficient is theta (θ). This coefficient shows the sensitivity of the sector returns to the rate of change in the exchange rate. The above model assumes symmetric currency exposure and thus does not admit different values of exposure during periods of appreciation and depreciation. Furthermore, the exposure is also assumed to be constant regardless of crisis or non-crisis period. In the spirit of Tai (2005), and Ihrig and Prior (2005), this paper extends this model at eq(3.1) to allow for currency exposure to depend on market condition. This extended model is as follows;

Estimated Model

$$SECTR_t = \alpha + \beta MKTR_t + \theta_1 EXR_t + \theta_2 D_i (EXR_t) + \phi (D_i = CR_t) + \varepsilon_t \quad (3.2.1)$$

$$SECTR_t = \alpha + \beta MKTR_t + \theta_1 EXR_t + \theta_2 D_i (EXR_t) + \phi (D_i = I_t) + \varepsilon_t \quad (3.2.2)$$

In the model above, the notation *'D_i'* represents a dummy variable. The appreciation dummy variable i.e *D=I* takes the value of 1 during appreciation period and zero otherwise. Meanwhile, the crisis dummy variable, i.e, *D=CR*, equal 1 during the crisis and zero otherwise. In general, the results are supportive of significant exposure for the majority of the sectors considered. Based on this finding, there is limited evidence for significant exchange rate exposure during the crisis period. The results hint that the firms' values are not so much affected by exchange rate changes during normal or non-crisis periods. But, they are likely to be affected by large fluctuations in currency value.

Furthermore, many studies have been carried out on interest rate in banks stock pricing, such as the study by Hooy, Tan and Nassir (2004). The data used in their study consists of seven commercial bank stocks, traded on main board of Kuala Lumpur

Stock Exchange (KLS). The seven commercial bank stocks are disaggregated by size according to their capital into two equal weighted portfolios: large bank portfolio (LBP) and small bank portfolio (SBP). The weekly dataset employed covers the period from January 1, 1995 to July 26, 2000 with a total of 291 observations. The objective of this paper presents the sensitivity of commercial banks stock excess returns to their volatility and financial risk factors, measured by interest rates and exchange rates, across the recent Asian Financial Crisis. By adopting the modern theoretical framework on asset pricing that based on the Capital Asset Pricing Model (CAPM) and the Arbitrage Pricing Theory (APT), this model expend further the existing literature. The model proposes from this paper are as follows;

Mean Equation

$$ER_t = \mu + b_1\sigma_{IT,t-1} + b_2\sigma_{EX,t-1} + \delta\sqrt{h_t} + \sum_{k=1}^{m}\varphi_k ER_{t-k} + \sum_{l=1}^{n}\theta_l\varepsilon_{t-1} + \varepsilon_t \quad (3.3)$$

Variance Equation

$$h_t = \omega + \sum_{j=1}^{p}\beta_j h_{t-j} + \sum_{i=1}^{q}\alpha_i\varepsilon_{t-i}^2 + \gamma_1\sigma_{IT,t-1}^2 + \gamma_2\sigma_{ER,t-1}^2 \quad (3.4)$$

Where, ER_t is the excess returns and σ_{IT} and σ_{EX} represent the conditional standard deviation of the interest and exchange rates, respectively. The square form of σ_{IT} and σ_{EX} are the conditional variance. The parameters of the variables are $b_1, b_2, \delta, \theta_1, \phi_k, \alpha_i, \beta_j, \gamma_1$ and γ_2, while μ and ω are the intercepts. The log likelihood functions of ER_t is calculated by:

$$ER_t = \sum \frac{1}{2}\left[-\ln(2\pi) - \ln(h_t) - \frac{\varepsilon_t^2}{h_t}\right] \quad (3.5)$$

In general, they found that there are no significant differences among Malaysia commercial banks in their risk exposure prior to and during the Asian Financial Crisis. The introduction of selective capital controls, a fixed exchange rate regime, and a forced banking consolidation program, however increased the risk exposure of both large and small domestic banks. The effects of these risk factors were significantly detected in both large and small banks.

Finally, Azman-Saini et al. (2006) contribute to the debate on stock prices and exchange rates in Malaysia for the data covering January, 1997 through August 1998, with a total numbers of 1378 observations available for analysis. All the data are obtained from *Data stream* and transformed into natural logarithm. This paper studied the relationship between stock price and exchange rates by using a new Granger non-causality test proposed by Toda and Yamamoto (1995). Following Toda and Yamamoto approach, the stock prices and exchange rates can be causally linked in a system as follows;

$$\begin{bmatrix} SP_t \\ EX_t \end{bmatrix} = \alpha_0 + \alpha_1 \begin{bmatrix} SP_{t-1} \\ EX_{t-1} \end{bmatrix} + \alpha_2 \begin{bmatrix} SP_{t-2} \\ EX_{t-2} \end{bmatrix} + \alpha_3 \begin{bmatrix} SP_{t-3} \\ EX_{t-3} \end{bmatrix} + \alpha_4 \begin{bmatrix} e_{SP} \\ e_{EX} \end{bmatrix} \quad (3.6)$$

Here, α_0 is an identity matrix and $E(\varepsilon_t) = [\varepsilon_{SP}\varepsilon_{EX}] = 0$ and $E(\varepsilon_t \varepsilon_t^{'}) = \Sigma$. For example, if $k = 2$ and $d_{max} = 1$, a causality from EX to SP, its can be established through rejecting the null of EX_{t-1} and EX_{t-2} are jointly equal to zero in the first equation of the above system. A similar procedure can be used to test the causality from SP and EX by establishing a significance of the MWALD statistic for a group of lagged SP variables in the second equation of the system. In the finding of interest, there is a feedback interaction between exchange rates and stock prices for the pre-crisis period. The results also reveal that exchange rates influence stock price for the crisis period. Thus this paper concludes, in a financially liberalized environment, exchange rates stability is important for stock market well-being.

From the previous literature discussed above, in the next section there will be detailed discussions concerning model specification applied in this study. By adopting the combination ideas between the CAPM model (Sharpe, 1964) and Lintner, 1965) and top-down approach (Adler and Dumas, 1984) as a point of departure for the basic models, the exchange rate exposure model is also divided into two types of model, namely, contemporaneous exchange rate exposure model and one-day lagged exchange rate exposure model. According to Jorian (1990) in Ibrahim (2008) the exposure can be measured by running regression of change in stock prices that are normally used to represent the value of the firm, on the exchange rate change. In addition, following Koutmos (2003), the exchange rate volatility also affects sector returns through international trade channel. Thus, like the studies by Jorian and others namely Ibrahim and Koutmos, this paper makes use of the augmented market model to include the exchange rate change and exchange rate volatility as a further extension for the basic models. Finally, with the inclusion of two dummy variables in the model, namely, *PEG*[33] and *CD*[34], the models are assumed to produce the significant impact in the related filed in the existence study.

[33] The short form of *'PEG'* is referring to Pegging Exchange Rate period.
[34] Meanwhile, the short form of *'CD'* is referring to Crisis Dummy period.

3.3 The Exchange Rate Exposure Model Specification

According to Dominguez and Tesar (2001), the exchange rate movement is important for firms' decision making. Moreover the type of firms affected by these exposures and the directions of exposure depends on the specific foreign exchange rate being used and it varies over time. It suggests that firms dynamically adjust their behavior in response to exchange rate risk over time. In fact, Adler *et al.* (1980, 1984) claim that exchange rate exposures are typically defined as the correlation between exchange rate movements and asset values.

In line with the capital asset pricing model (CAPM) by Sharpe (1964) and Lintner (1965), only market fluctuations should be a relevant instrument to a firm's asset values in equilibrium. Therefore, only changes in the market returns should be systematically related to firm returns.

Capital asset pricing model (CAPM) by Sharpe (1964) and Lintner (1965):

$$SR_{it} = \Omega + \beta_{m,i} MR_{it} + \varepsilon_{it} \tag{3.7}$$

Where,

SR_{it} = the return on firm *'i'* at time *'t'*

MR_{it} = the return on the market portfolio

$\beta_{m,i}$ = the firm's market Beta

Ω = constant

ε_{it} = the sector *'i'* error term in month *'t'*

According to equation (3.7) above, if the CAPM were the true model for asset pricing, thus the coefficient on the market returns, $\beta_{m,i}$, should be positive. The positive relationship between sector returns and market returns indicates that there is exists co-movement between them. In addition, Dumas (1978), Adler and Dumas (1980) and Hodder (1982) showed that the exposure of foreign asset is the slope coefficient in the univariate linear regression of the random home currency price of a risky asset on a given future data against possible future exchange rates. Adler and Dumas developed a simple model in an attempt to measure exchange rate exposure in terms of firm value using a top-down approach (Adler and Dumas, 1984). Therefore, following this approach, only changes in the exchange rate changes should significantly affect firm returns;

A top-down approach by Adler and Dumas (1984):

$$SR_{it} = \Omega + \beta_{\Delta S,i} \Delta S_{it} + \varepsilon_{it} \tag{3.8}$$

$$\varepsilon_{it} \sim N\left(0, \sigma^2\right)$$

Here,

SR_{it} = the return on firm *'i'* at time *'t'*

ΔS_{it} = the change in the relevant exchange rate (first-moment exchange rate exposures)

$\beta_{\Delta S,i}$ = is the firm *i*'s exchange rate exposure elasticity coefficient, which measures the sensitivity of a firm's returns to the exchange rate movements.

ε_{it} = is the residual that is unexplained by the regression model.

Ω = is the constant

Based on equation (3.8) above, in the light of symmetric assumption we can conclude that the regression coefficient concept of exposure can provide a single comprehensive result that summarizes the sensitivity of a firm to all the various ways in which exchange rate changes can affect it. Moreover, some argument for CAPM with the evidence that $\beta_{\Delta S,i}$ is non-zero could be interpreted as proof against the joint hypothesis that the CAPM does not hold. Formally, the measurement for the value of $\beta_{\Delta S,i}$, resulting from the following two-factor regression specification;

The combination idea between the CAPM model and top-down approach:
(Basic Model)

$$SR_{it} = \Omega + \beta_{m,i} MR_{it} + \beta_{\Delta S,i} \Delta S_{it} + \varepsilon_{it} \tag{3.9}$$

Where,

SR_{it} = the return on firm *'i'* at time *'t'*

MR_{it} = the return on the market portfolio

ΔS_{it} = the change in the relevant exchange rate (first-moment exchange rate exposures)

Ω = constant

$\beta_{m,i}$ = the firm's market Beta

$\beta_{\Delta s,i}$ = the exchange rate change Beta

ε_{it} = the sector *'i'* error term in month *'t'*

According to Bodnar and Wong (2000), the exposure estimated in this extended model is a conditional exposure that is more stable across periods. This is because, the market returns is powerful in explaining a significant amount of the typical firm's stock returns variation. Moreover, the market returns is a noteworthy indicator in clarifying the firm's stock returns because of its ability to reduce the residual variance of the regression and improve the currency of the exposure estimates. Particularly, the enclosure the market returns indicator in the estimated model affects the interpretation of the exposure estimates in that the residual exposure measures the deviation of the firms' exposure from the market portfolio's exposure. Another beneficial outcome is that, controlling for the market portfolio removes large negative cash flow effects, shifting the estimates upward relative to the total exposure estimates resulting from the regression model.

Other than to investigate the first moment exposure over the periods, this chapter incorporates the second-moment exposure factor into each model under estimation. We include the second moment exposure based on argument that the volume of international trade and transaction costs could be affected by exchange rate volatility as found by others namely, Pozo, (1992), Sercu, (1992a) and (1992b), Sekmen and Saribas (2007), Adnan Hye, Iran, and Hye (2009) and Kumar (2009). Moreover, the study includes the asymmetric exchange rate exposures in the models. Inspired by Ibrahim (2008) and others, the particular econometric specification used in this study is as follows;

The contemporaneous exchange rate estimations model;

$SR_{it} = \Omega_i + \theta_{m,i}MR_{it} + \Phi_{\Delta S,i}\Delta S_{it} + \Phi_{dS,i}D_t\Delta S_{it} + \Phi_{\Pi,i}\Pi^2_{it} + \alpha_{p,i}PEG_{it} + \alpha_{cd,i}CD_{it} + \varepsilon_{it}$ (3.10.1) Where,

SR_{it} = the return on firm *'i'* at time *'t'*

MR_{it} = the return on the market portfolio variable

ΔS_{it} = the change in the exchange rate variable

$D_t\Delta S_{it}$ = the relationship between the exchange rate changes and appreciation dummy variable

$\Pi^2{}_t$ = the exchange rate volatility variable, follows GARCH(1,1)[35]

PEG_{it} = the pegging exchange rate dummy variable

CD_{it} = the crisis dummy variable

ε_{it} = the sector error term

Ω = constant

$\theta_{m,i}$ = the firm's market coefficient

$\Phi_{\Delta s,i}$ = the exchange rate change coefficient

$\Phi_{ds,i}$ = the sensitivity of the sector returns to the exchange rate appreciation and depreciation coefficient (asymmetric exposure)

$\Phi_{\Pi,i}$ = the sensitivity of sector returns to the exchange rate volatility (second-moment exposures) coefficient

$\alpha_{P,i}$ = the pegging exchange rate dummy coefficient

$\alpha_{CD,i}$ = the crisis exchange rate dummy coefficient

It is also shows that, the volatility process of the exchange rate follow the GARCH(1,1) process as follows;

$$\Pi^2_t = \beta_0 + \beta_1\mu^2_{t-1} + \beta_2\Pi^2_{t-1} \quad (3.10.2)$$

Here, the notation of Π^2_t denotes the conditional variance of the exchange rates that follows GARCH(1,1) process. The notation of Π^2_{t-1} and μ^2_{t-1} represents as the conditional variance lagged and the error term square lagged. While, the one day lagged model is as follows;

[35] GARCH refer to Generalized Autoregressive Conditional Heteroskedasticity.

The one-day lagged exchange rate estimations model;

$$SR_{it} = \Omega_i + \theta_{m,i}MR_{it} + \Phi_{\Delta S-1,i}\Delta S_{it-1} + \Phi_{dS-1,i}D_t\Delta S_{it-1} + \Phi_{L\Pi,i}L\Pi_{it}^2 + \beta_{p,i}PEG_{it} + \beta_{cd,i}CD_{it} + \upsilon_{it} \quad (3.11.1)$$

Where,

SR_{it} = the return on firm *' i'* at time *'t'*

MR_{it} = the return on the market portfolio variable

ΔS_{it-1} = the change in the lag-exchange rate variable

$D_t\Delta S_{it-1}$ = the relationship between the lag-exchange rate changes and appreciation dummy variable.

$L\Pi_t^2$ = the lag-exchange rate volatility variable, follows GARCH (1,1)[36]

PEG_{it} = the pegging exchange rate dummy variable

CD_{it} = the crisis dummy variable

ε_{it} = the sector error term

Ω = constant

$\theta_{m,i}$ = the firm's market coefficient

$\Phi_{\Delta s-1,i}$ = the exchange rate change coefficient

$\Phi_{ds-1,i}$ = the sensitivity of the sector returns to the exchange rate appreciation and depreciation coefficient (asymmetric exposure)

$\Phi_{\Pi-1,i}$ = the sensitivity of sector returns to the exchange rate volatility (second-moment exposure) coefficient

$\beta_{P,i}$ = the pegging exchange rate dummy coefficient

$\beta_{CD,i}$ = the crisis exchange rate dummy

The volatility process of the exchange rate follow the GARCH(1,1) process as follows;

$$L\Pi_t^2 = \beta_0 + \beta_3 L\mu_{t-1}^2 + \beta_4 L\Pi_{t-1}^2 \quad (3.11.2)$$

Again, the notation of $L\Pi_{-t}^2$ denotes the conditional variance of the exchange rates that follows GARCH(1,1) process. The notation of $L\Pi_{t-1}^2$ and $L\mu_{t-1}^2$ represents as the conditional variance lagged and the error term square lagged. Following to Ibrahim (2008), the traditional first moment exchange rate exposures can be evaluated by

[36] As stated earlier, GARCH refer to Generalized Autoregressive Conditional Heteroscedasticity.

testing whether $\Phi_{\Delta s,i}$ and/or $\Phi_{ds,i}$ in equation (3.10) is statistically significant[37]. However, the asymmetric exposures are examined by testing whether $\Phi_{ds,i}$ is statistically significant[38]. For the second moment exposures, it is measured by $\Phi_{\Pi,i}$ [39]. For instance, if the volume of trade increases for net exporter due to lower exchange rate volatility, so, $\Phi_{\Pi,i}$ will be negative. Similarly, if the cost of hedging with derivatives decreases with smaller volatility, then $\Phi_{\Pi,i}$ will also be negative (Koutmos et al., 2003).

The exchange rate change (ΔS_t) follows the martingale process. Based on Meese and Rogoff (1982) the best forecast of the exchange rate for time '*t+1*' is the value at the time '*t*'. Specially, if S_t is the log exchange rate at level, then the conditional expectation operator for $E_{t-1}(S_t) = S_{t-1}$ is S_{t-1}. Thus, S_t follows a drift less martingale of the form:

$$S_t = S_{t-1} + \Delta S_t \tag{3.12}$$

and ,

$$S_{t-1} + \Delta S_t = S_t$$

$$\Delta S_t = S_t - S_{t-1} \tag{3.13}$$

Where, ΔS_t is the innovation or unexpected change in the exchange rate used in equation (3.14). The conditional variance of S_t is defined as a GARCH (1,1) process given as follows;

Contemporaneous exchange rate GARCH (1,1) model

$$\Pi_t^2 = \beta_0 + \beta_1 \mu_{t-1}^2 + \beta_2 \Pi_{t-1}^2$$

One-day Lagged exchange rate GARCH (1,1) model

$$L\Pi_t^2 = \beta_0 + \beta_3 \mu_{t-1}^2 + \beta_4 L\Pi_{t-1}^2$$

The GARCH specification allows us to model the variance of exchange rate changes as time dependent. This contrast with the usual assumption made when estimating a

[37] For one day lagged exchange rate model in equation (3.11), the first moment exchange rate exposure is evaluated by testing whether coefficient denotes by $\Phi_{\Delta s-1,i}$ and $\Phi_{ds-1,i}$ are statistically significant (denoted by $\Phi_{\Delta s-1,i}$ or $\Phi_{ds-1,i}$ are statistically significant).

[38] The same exposure is examined by $\Phi_{ds-1,i}$ in equation 3.11.

[39] The same exposure is evaluated by $\Phi_{L\Pi,i}$ in equation 3.11.

moving average process in which it is assumed that the error term has a constant patterns and persistence in the behavior of volatility. The time dependent specification has the additional property that it explains the heavily-tailed nature of the distribution of exchange rate changes. In a GARCH (p,q) model different combinations of p and q may be applied but, as indicated by Bollerslev et al. (1992, page: 10), GARCH (1,1) is sufficient for most financial and economic series. Bollerslev (1988) provides a method of selecting the length of p and q in a GARCH model.

The calculation of log returns is as follows;

$$SR_{it} = Ln\left(\frac{PI_{it}}{PI_{it-1}}\right) = Ln(PI_{it}) - Ln(PI_{it-1}) \qquad (3.14)$$

As diagnostic tests for the autocorrelation, we obtained the correlogram graphs analysis. From the results of autocorrelation and partial autocorrelation (ACF and PACF), the outputs confirm that there is no autocorrelation in the sector returns data. Hence, the data can be proceed into the regression model using GARCH(1,1) process and lead us to analyze on the first and second moment exchange rate exposures. Again, following Bartov et al. (1994), Martin et al. (1999) and Di Iorio et al. (2000) argue that lagged exchange rate change impact returns. Thus the one day lagged exchange rate model is included as a robustness check[40].

[40] Finally, for each contemporaneous and one day lagged model, we extend further the robustness check by applying the Robust Standard Errors (RSEs). This test is also called as Huber or White estimator or Sandwich estimators of variance. As stated above, heteroscedasticity causes standard error to be biased. The Ordinary Least Squares (OLS) method assumes that errors are both independent and identically distributed; but, RSEs relax either or both of those assumptions. Hence, when heteroscedasticity is present, robust standard errors tend to be more trustworthy.

3.4 Data Sources

The data set consist of the monthly prices for the stock indexes in Malaysia, namely Financial, Plantation, Properties, Industrial, Tin and Mining, Trade and Services, Consumer Products and Construction sector indexes. The data utilized in this chapter cover the period October, 1992 to December, 2010. We employ monthly data instead of higher frequency data such as daily or weekly data due to the following reasons. The high frequency data such as daily and weekly data contain too much noise and are subject to the problem of non-synchronous and infrequent trading.

Moreover, in essence of our main research objective, this chapter aims at measuring the sensitivity (exposure) of the firm's value to the rate of change and volatility in the exchange rate. This we contend may not be captured by using high frequency data. The reason is that the value of the firm does not fluctuate by day or by week according to day-by-day or week-to-week, ups and downs in the market. Accordingly, the use of monthly frequency data is sensible. Moreover, for the exchange rate determinant, we use real effective exchange rate as a measurement of exchange rate returns and exchange rate volatility (Ibrahim, 2008).

3.5 Data Definitions

3.5.1 Data Returns and Formula

All the data are in monthly basis and due to it closing date. If the data at related date is not available, the closest data will be chosen as replacement. Also, all data is on logarithm form. The returns data for each sector under observation are calculated by:

Log Returns

$$SR_{it} = Ln\left(\frac{PI_{it}}{PI_{it-1}}\right) = Ln(PI_{it}) - Ln(PI_{it-1}) \qquad (3.15.1)$$

Where, the log returns of sector *'i'* at time 't' is calculated based on formula at equation (3.18.1). Also, PI_{it-1} is a price index of sector *'i'* at the lag time *(t-1)* and PI_{it} is a price index of sector *'i'* at existing time. For example, the return for January, 2010 is calculated as follows;

$$SR_{it} = Ln\left(\frac{PI_{it=January,2010}}{PI_{it-1=December,2009}}\right) = Ln(PI_{it=January,2010}) - Ln(PI_{it-1,December,2009}) \qquad (3.15.2)$$

For the real effective exchange rate, please refer to Section 2.5.4.1.

3.6 Econometrics Methodology

This section outlines the methodology applied in this chapter. The estimating approach includes; the measurement of exchange rate volatility namely the Generalized Autoregression Conditional Heteroscedasticity - GARCH *(p,q)* model, and the Maximum Likelihood Estimator.

3.6.1 The Measurement of Exchange Rate Volatility

The Generalized Autoregression Conditional Heteroscedasticity - GARCH *(p,q)* model pioneered by Bollerslev (1986) and its subsequent extension are well-documented in the literature on modelling conditional volatility in empirical economics and finance. Therefore, this study used to obtain measures of volatility in monthly real exchange rate change.

According to Akhtar and Spencer Hilton (1984) suggested the variance (or standard deviation) of the exchange rate is the most commonly used definition of the exchange rate volatility. However, Bailey, Tavlas and Ulan (1986, 1987), furthermore explained that there are another two definition for the exchange rate volatility. The first group is the polynomial distributed lag of the absolute value of the period-to period change in the exchange rate. And, the second group is the logarithms of the moving standard deviations of the exchange rate. Yet, following Jansen (1989), the unconditional measure of volatility is lacks of a parametric model for the time varying variance of a time series. Therefore, Following Arize (1985), the better measurement for the exchange rate volatility is by using the Autoregressive Conditional Heteroscedastic (hereafter: ARCH) model of Engle (1982). Importantly, in this study, conditional variance of the first difference of the log of the exchange rate is applied as volatility. Moreover, the conditional variance is estimated by means of the Generalized Autoregressive Conditional Heteroscedastic (GARCH) model of Bollerslev (1986).

By given this setting, we now understand that there are several different measures of ERV have been previously applied by the earlier researcher. As also stated earlier, in this chapter we applied GARCH model as a measurement for the ERV proposes by Bollerslev (1986). He proposes in GARCH model that the conditional variance of a time series depends upon the squared residual of the process and has the advantage of incorporating heteroscedasticity into the estimation procedure of the conditional variance. Moreover, as stated in Bollerslev et al. (1992) that the GARCH*(p,q)* model can be viewed as a reduced form of a more complicated dynamic structure for the time varying conditional second order moments. Therefore, the returns of the real exchange rate in this study can be expressed by the GARCH*(p,q)* model as follows;

$$x_t = \ell + \varepsilon_t$$
$$\varepsilon_t / \Omega_{t-1} \sim N(0, h_t) \qquad (3.16)\text{–}(3.18)$$
$$h_t = \theta + \sum_{i=1}^{q} \alpha_i h_{t-i} + \sum_{i=1}^{p} \beta_i \varepsilon_{t-i}^2$$

Here, x_t is real exchange rate changes, while ℓ is the mean of conditional on past information (Ω_{t-1}) and the following inequality restriction $\ell > 0$, $\alpha_i > 0$, and $\beta_i > 0$ are imposed to ensure that the conditional variance (h_t) is positive. The size and significance of β_i indicates the magnitude of the effect imposed by the lagged error term (ε_{t-i}) on the conditional variance (h_t). In other words, the size and significance of the β_i indicates the presence of the ARCH effects in the residual (volatility clustering in the data). The estimated of the h_t (conditional variance) from the $GARCH(p,q)$ model is applied in the estimation of $eq.(1)$.

3.6.2 The Maximum Likelihood Estimator

The maximum-likelihood estimation (MLE) is a method of estimating the parameters of a statistical model. When applied to a data set and given a statistical model, maximum-likelihood estimation provides estimates for the model's parameters.

The method of maximum likelihood corresponds for many well-known estimation methods in statistics. For example, one may be interested in the heights of adult students in the university, but be unable due to cost or time constraints, to measure the height of every single student in a population. Assuming that the heights are normally (Gaussian) distributed with some unknown mean and variance, the mean and variance can be estimated with MLE while only knowing the heights of some sample of the overall population. MLE would accomplish this by taking the mean and variance as parameters and finding particular parametric values that make the observed results the most probable (given the model). In general, for a fixed set of data and underlying statistical model, the method of maximum likelihood selects values of the model parameters that produce a distribution that gives the observed data the greatest probability (i.e., parameters that maximize the likelihood function). Maximum-likelihood estimation gives a unified approach to estimation, which is well-defined in the case of the normal distribution and many other problems.

3.6.2.1. MLE Principle

Suppose there is a sample x_1, x_2, ..., x_n of n independent and identically distributed observations, coming from a distribution with an unknown pdf $f_0(\cdot)$. It is however surmised that the function f_0 belongs to a certain family of distributions $\{ f(\cdot|\theta), \theta \in \Theta \}$, called the parametric model, so that $f_0 = f(\cdot|\theta_0)$. The value θ_0 is unknown and is referred to as the "*true value*" of the parameter. It is desirable to find an estimator $\hat{\theta}$ which would be as close to the true value θ_0 as possible. Both the observed variables x_i and the parameter θ can be vectors.

To use the method of maximum likelihood, one first specifies the joint density function for all observations. For an iid (independent and identically distributed) sample, this joint density function is,

$$f(x_1, x_2, \ldots\ldots, x_n \mid \theta) = f(x_1 \mid \theta) f(x_2 \mid \theta) \ldots\ldots f(x_n \mid \theta) \quad (3.19)$$

Now we look at this function from a different perspective by considering the observed values x_1, x_2, ...,x_n to be fixed "parameters" of this function, whereas θ will be the function's variable and allowed to vary freely; this function will be called the likelihood:

$$L(\theta \mid x_1, x_{2,\ldots\ldots}, x_n) = f(x_1, x_2, \ldots\ldots, x_n \mid \theta) = \prod^{n} f(x_i \mid \theta) \quad (3.20)$$

In practice it is often more convenient to work with the logarithm of the likelihood function, called the log-likelihood:

$$\ln L(\theta \mid x_1, x_2, \ldots\ldots, x_n) = \sum^{n} \ln f(x_i \mid \theta) \quad (3.21)$$

or the average log-likelihood':

$$\hat{\ell} = \frac{1}{n} \ln L \quad (3.22)$$

The $\hat{\ell}$ indicates that it is akin to some estimator. Indeed, $\hat{\ell}$ estimates the expected log-likelihood of a single observation in the model.

The method of maximum likelihood estimates θ_0 by finding a value of θ that maximizes $\hat{\ell}(\theta \mid x)$. This method of estimation defines a maximum-likelihood estimator (MLE) of θ_0

$$\left\{\hat{\theta}_{mle}\right\} \subseteq \left\{\underset{\theta \subseteq \Theta}{\arg\max}\ \hat{\ell}(\theta \mid x_1, \ldots, x_n)\right\} \quad (3.23)$$

if any maximum exists. An MLE estimate is the same regardless of whether we maximize the likelihood or the log-likelihood function, since log is a monotone transformation.

For many models, a maximum likelihood estimator can be found as an explicit function of the observed data $x_1, \ldots, x_n$. For many other models, however, no closed-form solution to the maximization problem is known or available, and an MLE has to be found numerically using optimization methods. For some problems, there may be multiple estimates that maximize the likelihood. For other problems, no maximum likelihood estimate exists (meaning that the log-likelihood function increases without attaining the supremum value).

In the exposition above, it is assumed that the data are independent and identically distributed. The method can be applied however to a broader setting, as long as it is possible to write the joint density function $f(x_1,\ldots,x_n \mid \theta)$, and its parameter θ has a finite dimension which does not depend on the sample size n. In a simpler extension, an allowance can be made for data heterogeneity, so that the joint density is equal to $f_1(x_1|\theta) \cdot f_2(x_2|\theta) \cdot \ldots \cdot f_n(x_n|\theta)$. In the more complicated case of time series models, the independence assumption may have to be dropped as well.

3.7 Empirical Results

In this section, the analysis is based on two main models, the contemporaneous model and a one day lagged model of eight traded sectors returns, namely, Financial, Plantation, Properties, Industrial, Tin and Mining, Trade and Services, Consumer Products and Construction. Following our main objective of this chapter, we may note from Table 3.1 for contemporaneous exchange rate regression model and Table 3.2 for one day lagged exchange rate regression model outcome, in order to observe the result of interest.

3.7.1 The Results of Regression Models

The result suggests a reliable outcome between contemporaneous exchange rate regression model and one day lagged exchange rate regression model. This finding directly supports the argument made by Bartov et al. (1994), Martin et al. (1999) and Di Iorio et al. (2000). Hence, the result shown in Tables 3.1 and 3.2, remain robust[41]. A similar conclusion was also made in a study by Koutmos and Martin (2003), among others. The result suggests that the exchange rate exposure tends to vary across the sectors. Generally, all models in this chapter support for the CAPM, as the coefficient Theta ($\theta_{m,i}$) maintains significance across models and across sectors, with a positive sign[42]. These findings indicate that there exist co-movement between the sectors return and market returns. While, some sectors are riskier than the market portfolio, others tend to be less risky.

From Table 3.1, the results classify financial, properties and construction sector returns to be more volatile than the market portfolio, when the market portfolio coefficient is more than one[43]. As an example, at the 99% significant level, if the market returns increase by 1%, this will lead the financial sector returns rising at 1.09% higher than the market portfolio. In other words, these results show in comparison that the sectors portfolio is more risky than the market portfolio. These sectors are also expected to be more sensitive to financial shock and more speculative in nature. In contrast, plantation, consumer goods, tin and mining, trade and services and industrial portfolio have market coefficient of less than one. For instance, at the 99% significant

[41] Bartov et al. (1994), Martin et al. (1999) and Di Iorio et al. (2000) find that lagged exchange rate changes impact returns. Thus the one day lagged exchange rate is included as a robustness check.

[42] The results for the basic models are provided in the appendix.

[43] These results refer to coefficients in Table 3.1 between $\Phi_{\Delta S,i}$ and $\theta_{m,i}$.

level, if the market portfolio grows by 1%, this indirectly influences the industrial portfolio to rise at 0.736%. Thus these sectors are assumed to be less volatile and are safer than the market portfolio.

The results are found to be consistent with the one day lagged model in Table 3.2. For the one-day lagged regression exchange rate model, some of the sectors are also more volatile than the market portfolio[44]. These sectors are financial, properties, and construction. As a result, these sectors tend to be more sensitive to shocks and more risky than the market portfolio. Besides, plantation, consumer goods, tin and mining, services and industrial sectors are safer than the market portfolio. This is because; the coefficients $\Phi_{\Delta S,i}$ value is less than one and in comparison less volatile than the former group.

Turning to our main objective, we may also note from Tables 3.1 and 3.2 that the exchange rate exposure tends to vary across sectors in Malaysia. To begin with, we start our discussion with a focus on the contemporaneous model in Table 3.1.

In general, results from this model imply that there is high sensitivity of seven out of eight sectors (7:8) to the first moment exposure (i.e. exchange rate change/mean equation), namely, the financial, plantation, properties, consumer goods, construction, tin and mining and industrial sectors, when the coefficient $\Phi_{\Delta S,i}$ and/or $\Phi_{dS,i}$ are found to be significant. Also from that proportion, the results further suggest five out of eight sectors among them are sensitive to asymmetric exposure, namely, financial, plantation, properties, tin and mining and industrial sectors. This is when the coefficient $\Phi_{dS,i}$ is significant. Additionally, five sectors (5:8) are found to be significant to the second moment exposure (i.e variance equation), including, financial, plantation, properties, consumer, construction and services.

Meanwhile, for the one day lagged exchange rate model in Table 3.2, the outcome suggests that seven sectors (7:8) react significantly to the first moment exposure, namely, financial, plantation, properties, consumer goods, construction, tin and mining and industrial. Additionally, only four out of five sectors (4:5) are significant to the asymmetric exposure (i.e financial, plantation, properties, consumer goods and industrial. Moreover, the results have found ample evidence for a second moment exposure for the model. The results suggest that, six out of eight sectors (6:8) are

[44] These results refer to coefficients in Table 3.2 between $\Phi_{\Delta S-1,i}$ and $\theta_{m,i}$.

sensitive to the exchange rate risk. The sectors include financial, plantation, properties, consumer goods, construction, and services.

Nevertheless, one interesting feature shown in Tables 3.1 and 3.2 is that, the results suggest a positive volatility effect for the financial sector coherent with the idea that volatility induces greater hedging. Thus this is indirectly consistent with the idea by Brown (2001), where he indicates that firms have greater incentive to hedge with greater exchange rate volatility. Additionally, in both models, it is clear that in all instances, the exchange rate volatilities are time dependent. Specifically, the level of volatility at time *t* is a function of its past value as well as past squared errors. We have found that, the relevant parameters, β_1 and β_2, also β_3 and β_4, are statistically significant throughout the analyses. Furthermore, these outcomes suggests for a long memory process in the volatility model. (Lobo, 2000).

Table 3.1: The Results of Parameter Estimations for Contemporaneous Exchange Rate Models

Mean Equation:

$$SR_{it} = \Omega_i + \theta_{m,i} MR_{it} + \Phi_{\Delta S,i} \Delta S_{it} + \Phi_{ds,i} D_t \Delta S_{it} + \Phi_{\Pi,i} \Pi_{it} + \alpha_{p,i} PEG_{it} + \alpha_{cd,i} CD_{it} + \varepsilon_{it}$$

Variance Equation:

$$\Pi_t^2 = \beta_0 + \beta_1 \mu_{t-1}^2 + \beta_2 \Pi_{t-1}^2$$

	Time Period : October, 1992 to December, 2010								
	Mean Equations							Variance Equations	
Sectors	Ω_i	$\theta_{m,i}$	$\Phi_{\Delta S,i}$	$\Phi_{dS,i}$	$\Phi_{\Pi,i}$	$\alpha_{p,i}$	$\alpha_{cd,i}$	β_1	β_2
Financial (Fin)	0.0039595 (0.0050988)	1.094787 (0.0877144)***	1.026051 (0.2950004)*	1.2738884 (0.3627409)*	1.80809 (2.836624)*	0.0034832 (0.0068772)	-0.0056492 (0.0154758)	0.285826 (0.057736)***	0.758924 (0.045984)***
Plantation (Plant)	0.0158047 (0.0061922)**	0.8423196 (0.0881409)***	0.1550244 (0.2430937)	-0.0715053 (0.4101702)*	-6.014441 (2.763255)**	-0.0107003 (0.0078013)	-0.0188805 (0.0144996)	0.138229 (0.056702)**	0.833919 (0.057870)***
Properties (Pro)	0.0082703 (0.006529)	1.015397 (0.0803116)***	1.1441542 (0.2287076)**	1.2637784 (0.3875469)**	-10.81737 (3.13053)***	-0.005116 (0.0082855)	-0.0180266 (0.0168787)	0.167875 (0.035082)***	0.785990 (0.041493***)
Consumer goods (Cmr)	0.0026543 (0.0068776)	0.7653726 (0.0601342)***	0.212118 (0.3233566)*	0.3046342 (0.5180021)	5.949925 (3.256134)*	0.0014969 (0.0090456)	0.0016636 (0.205335)	0.108586 (0.049510)**	0.831701 (0.066357)***
Construction (Con)	-0.0007419 (0.0108033)	0.8775357 (0.1096554)***	1.2354212 (0.4693799)*	1.0169162 (0.7008466)	10.34686 (5.536933)*	-0.0117772 (0.0142799)	0.0156644 (0.0323912)	0.273590 (0.058752)***	0.765665 (0.053126)***
Tin and Mining (Tinm)	0.0065581 (0.0095113)	1.190993 (0.133057)***	0.0186036 (0.4082175)*	-0.3580863 (0.7872962)*	-6.630467 (8.580642)	0.0000338 (0.0131538)	-0.0176927 (0.0256121)	0.140524 (0.062849)**	0.728743 (0.116993)***
Services (Serv)	0.0010184 (0.0072707)	0.5479297 (0.1753163)***	-0.5399382 (0.4142637)	1.045765 (0.6324488)	12.07165 (5.287216)**	0.0011263 (0.0106053)	0.0077759 (0.024891)	0.231967 (0.045861)***	0.768350 (0.042630)***
Industrial (Ind)	0.007276 (0.0459025)***	0.7366774 (0.1886504)***	-0.0478992 (0.2453425)**	0.1329856 (2.087997)*	-2.138027 (0.0036309)	0.0015656 (0.0071302)*	-0.013308 (0.003425)**	0.208462 (0.051682)***	0.794665 (0.049697)***

Here, SR_{it} is the sector return for sector *i* at time *t*, MR_{it} is the market return, ΔS_{it} is the unexpected percent change in the exchange rate, D_t equals 1 if $\Delta S_{it} > 0$ and zero otherwise, Π_{it} is the time-varying exchange rate volatility. The coefficient estimates are provided along with their associated with White standard error in parentheses. The superscript ***,**,* indicates significance at 99%, 95%, and 90% level

Table 3.2: The Results of Parameter Estimations for One Day Lagged Exchange Rate Models

Mean Equation:

$$SR_{it} = \Omega_i + \theta_{m,i} MR_{it} + \Phi_{\Delta S-1,i} \Delta S_{it-1} + \Phi_{dS-1,i} D_t \Delta S_{it-1} + \Phi_{L\Pi,i} L\Pi_{it}^2 + \alpha_{p,i} PEG_{it} + \alpha_{cd,i} CD_{it} + \upsilon_{it}$$

Variance Equation:

$$L\Pi_t^2 = \beta_0 + \beta_3 \mu_{t-1}^2 + \beta_4 L\Pi_{t-1}^2$$

	Time Period : October, 1992 to December, 2010								
	Mean Equations							Variance Equations	
Sectors	Ω_i	$\theta_{m,i}$	$\Phi_{\Delta S-1,i}$	$\Phi_{dS-1,i}$	$\Phi_{L\Pi,i}$	$\alpha_{p,i}$	$\alpha_{cd,i}$	β_3	β_4
Financial (Fin)	0.0031829 (0.005114)	1.095292 (0.0876392)***	1.1382383 (0.2126021)*	1.0537133 (0.2971886)*	1.2331891 (2.727794)*	0.0036057 (0.0069906)	-0.0047092 (0.0156573)	0.612861 (0.065922)***	0.746178 (0.052238)***
Plantation (Plant)	0.01553 (0.00638)**	0.8446831 (0.0884348)***	-0.3507028 (0.2341765)*	0.3362306 (0.3519799)*	-5.246568 (3.660937)**	-0.0106211 (0.0078202)	-0.016726 (0.0144823)	0.182624 (0.057497)***	0.794432 (0.066643)***
Properties (Pro)	0.008776 (0.0063087)	1.016702 (0.0795258)***	1.7150706 (0.2190453)***	1.17831 (0.3586291)***	-4.06889 (3.24121)**	-0.005271 (0.0080934)	-0.0150383 (0.0168306)	0.200534 (0.041414)***	0.776067 (0.042471)***
Consumer goods (Cmr)	0.0003798 (0.006463)	0.8659436 (0.0586813)***	0.1130315 (0.2187989)*	0.0224677 (0.3403122)*	5.868288 (3.003095)*	0.0020342 (0.0089062)	0.0018781 (0.0204266)	0.109263 (0.051251)**	0.829809 (0.068179)***
Construction (Con)	-0.009853 (0.0097645)	0.7805556 (0.1094318)***	1.3576289 (0.3469294)*	-0.8580606 (0.5614072)	6.70453 (4.67135)**	-0.0100108 (0.0144229)	0.0145608 (0.0321708)	0.273417 (0.062313)***	0.764106 (0.056608)***
Tin and Mining (Tinm)	0.0077001 (0.009232)	1.192736 (0.1330271)***	-0.7560496 (0.3780344)**	0.3934529 (0.6979319)	-1.341287 (5.530025)	0.0001803 (0.0133763)	-0.0155728 (0.0256698)	0.215411 (0.097222)**	0.504358 (0.185212)***
Services (Serv)	-0.0048119 (0.0068371)	-0.1453387 (0.0733654)**	0.264455 (0.2684283)	0.0112373 (0.5099373)	9.820387 (4.239899)**	0.0008494 (0.0105491)	0.008774 (0.0246671)	0.239669 (0.047843)***	0.773107 (0.039429)***
Industrial (Ind)	0.0069518 (0.0036122)*	0.7379253 (0.0460705)***	-0.195599 (0.1079945)*	0.1953226 (0.1771942)*	0.1953226 (0.1771942)	-1.20794 (1.462659)	0.0014009 (0.0037078)	0.206754 (0.052050)***	0.794885 (0.051251)***

Here, SR_{it} is the sector return for sector *i* at time *t*, MR_{it} is the market return, ΔS_{it-1} is the unexpected percent change in the exchange rate in lagged order, D_t equals 1 if $\Delta S_{it} > 0$ and zero otherwise, $L\Pi_{it}$ is the time-varying exchange rate volatility. The coefficient estimates are provided along with their associated with White standard error in parentheses. The superscript ***,**,* indicates significance at 99%, 95%, and 90% level.

3.7.2 The Results of Exchange Rate Exposure

Tables 3.3 to 3.6 provide a full report of the findings. These tables indirectly answer both hypotheses that were developed in the introductory section. Specifically, Tables 3.3 and 3.4 represent the information concerning the level of significance of the coefficient(s). Meanwhile, Tables 3.5 and 3.6 show the sign(s) of each coefficient(s), and whether they are significant or otherwise.

3.7.2.1. The Significance Level Analysis

Tables 3.3 to 3.4 present the summary results in terms of the exchange rate exposure significance level analysis. Generally for both models, the contemporaneous exchange rate model and the one-day lagged exchange rate model, the results suggest a mixed outcome between significant and non-significant parameters. In this chapter we only consider the significance levels between the 99% to 90% levels[45]. We assume the highest significance level at 99% as the strongest exposure. While, the 90% significance level can be consider as the weakest (among the significant group). The other significance level which is not included in this chapter can be assumed as a weak exposure, and is not reported here.

According to Table 3.3, in all instances, the results suggest that all sector returns are sensitive to a market portfolio at the 99% significance level. For example, referring to the financial sector for the contemporaneous exchange rate model, the results suggest that financial returns are significantly dependent on market returns, at the 99% significance level. This outcome indicates that, the market portfolio is an important explanatory variable in influencing the movement of financial sectors returns. The outcomes are also consistent in both models, contemporaneous and one day lagged model as the financial sector producing the same conclusions. These outcomes are also consistent with the findings of Ibrahim (2008), which indicates that the coefficient beta's that represents the relationship from market returns to sector returns is always positive. These findings indirectly show in Malaysia most sectors are strongly dependent on the core economy especially to their financial market. Hence, failure to include the market portfolio in the model estimation can lead to a biased specification and may produce missspecified regression.

[45] In this chapter we specify that (***) is at 99% significance level, (**) is at 95% significance level and (*) is at 90% significance level.

Furthermore the discussions of Table 3.3 show the relationship between each sector returns and exchange rate changes. From a statistical point of view, if the sector returns significantly responds to the exchange rate changes, the exchange rate change is important in influencing the sector returns. The findings confirm that seven out of eight sectors are sensitive to the exchange rate change in Malaysia. Indeed the results suggest that the properties and industrial sector returns are significant to the exchange rate changes at the 95% significant levels. Therefore, the exchange rate change is important in determining these two sectors in the model. Failure to include this variable in the model could lead to spurious model and produces wrong decision in investing.

We may also observe that, some others sectors including financial, consumer goods, construction, and tin and mining are sensitive to the exchange rate change at 90% significance level. In contrast, the finding also shows two other sectors which show insensitivity to exchange rate change. These sectors are plantation and services sector returns. Thus, these sectors are clearly not dominated in foreign currencies and are less risky in comparison with other sectors that are sensitive to exchange rate changes. In other words these two sectors are safer to invest in compared to other sectors which are sensitive to the exchange rate changes.

Although the results suggest ample evidence in supporting the first moment exchange rate exposure, they have limited evidence in supporting the second moment exchange rate exposure for all sectors. In this chapter we have employed a bivariate GARCH model in order to capture the exchange rate volatility. From Table 3.3, the findings successfully confirm that six out of eight sectors are sensitive to the exchange rate volatility in Malaysia. The results further suggest the properties sector recode the most sensitivity to the exchange rate volatility that is at 99% significant level. While, the other sectors, including financial, plantation, consumer goods, construction and services are sensitive to the exchange rate volatility at only 90% significant level. In contrast, tin & mining, and industrial sectors are detected as unresponsive to the exchange rate volatility in the contemporaneous model.

Table 3.3:
The Significant Level Analysis for First-, Second-, Asymmetric Moment Exposure (Contemporaneous Exchange Rate Model)

Sectors	MBPI	Exchange Rate Returns (First Moment Exposure)	Dummy (Asymmetric Exposure)	Exchange Rate Volatility (Second Moment Exposure)
Financial	S (1%)	S (10%)	S (10%)	S(10%)
Plantation	S (1%)	NS	S (10%)	S (5%)
Properties	S (1%)	S (5%)	S (5%)	S (1%)
Consumer goods	S (1%)	S (10%)	NS	S (10%)
Construction	S (1%)	S (10%)	NS	S (10%)
Tin & Mining	S (1%)	S (10%)	S (10%)	NS
Services	S (1%)	NS	NS	S (5%)
Industrial	S (1%)	S (5%)	S (10%)	NS

Note that the signs 'S' and 'NS' indicates significant and not significant, respectively. In the parentheses is level of significant. While, 'MBPI' stand for (Main Board Price Index Market)

Table 3.4:
The Significant Level Analysis for First-, Second-, Asymmetric Moment Exposure (One-day Lagged Exchange Rate Model)

Sectors	MBPI	Exchange Rate Returns (First Moment Exposure)	Dummy (Asymmetric Exposure)	Exchange Rate Volatility (Second Moment Exposure)
Financial	S (1%)	S (10%)	S (10%)	S (10%)
Plantation	S (1%)	S (10%)	S (10%)	S (5%)
Properties	S (1%)	S (1%)	S (1%)	S (5%)
Consumer goods	S (1%)	S (10%)	S (10%)	S (10%)
Construction	S (1%)	S (10%)	NS	S (5%)
Tin & Mining	S (1%)	S (5%)	NS	NS
Services	S (1%)	NS	NS	S (5%)
Industrial	S (1%)	S (10%)	S (10%)	NS

Note that the signs 'S' and 'NS' indicates significant and not significant, respectively. In the parentheses is level of significant. While, 'MBPI' stand for (Main Board Price Index Market)

Also seen in Table 3.3, the sensitivity of sector returns to the asymmetric exposure represented by the high and low value of the exchange rate changes in influencing the sector returns are also recorded. In this chapter, we observed the existence of a relationship between the sector returns and exchange rate appreciation value. As the outcome shows, most of the sector returns in Malaysia are sensitive to the exchange rate asymmetric exposure at 90%, excluding Tin & Mining sectors and Industrial sectors. The result suggests that the financial sector returns significantly respond to the exchange rate asymmetric effects at 90% significant level. In other words, when the values of exchange rate raise (positive values) they indirectly affect the firm's value, positively or negatively. Hence, the exchange rate appreciation is important in influencing the sector returns.

Turning to Table 3.4 for the one-day lagged exchange rate model, the result was found to be robust for some of the parameters and consistent with the previous results in Table 3.3. By adopting the same approach as in the contemporaneous model, the one day-lagged model suggests that all sectors under observation are sensitive to the market portfolio returns at 99% significant level. These results show the important role played by the Market Portfolio in influencing all sector returns in Malaysia. They also indirectly, support the findings of Ibrahim (2008) where all sector returns in Malaysia were found to significantly affect sector returns. We also observe significant first moment exposure of all sectors under observation, excluding the services sector. Moreover, we document ample evidence of second moment exposure between the sector returns. For example, we note from Table 3.4 that properties sector returns are significantly affected by the exchange rate volatility generated by GARCH(1,1).

3.7.2.2. The Sign(s) Analysis

Tables 3.5 and 3.6 in this section highlight the summary results of the first and second moment exchange rate exposure in terms of sign analysis. Overall, according to the result in the tables the relationship between sectors returns and exchange rate exposure can be mixed between positive and negative sign. These results are consistent with Wu (2000) that exchange rates can effect stock returns negatively or positively. In general, these relationships however depend on two types of disturbances which are real interest rate and inflation. Regarding the real interest rate disturbance, when the real interest rate rises, capital inflow increases and the exchange rate falls, hence the stock price will decline. An inflationary disturbance may explain negative relationship between exchange rate and stock price. When inflation increases, the exchange rate rises and because of high inflation expectations, investors will demand a higher risk premium and high rate of return. As a result, stock prices will decrease.

Moreover, the identification of the exposure sign is important in identifying the impact of the exchange rate fluctuation to the sector returns. As previously stated, the exposure tends to vary across sectors and models. For example, according to the contemporaneous exchange rate model in Table 3.5, the first-moment exposure is positive for six sectors and is significant in five of them. These five sectors are the Financial, Properties, Consumer goods, Construction, and Tin & Mining. Intuitively, for these sectors, an increase in the rate of appreciation affects these sectors positively. Note that, conforming to the correlation results, the value of exposure is relatively high for financial, properties and construction. As may also be observed from Table 3.5, currency appreciation shocks are negatively related to services and industrial returns. Some other sectors, including Plantation and Services, do not seem to have significant exchange rate exposure in this model.

Turning to Table 3.6 for the one-day lagged exchange rate model, the result is found to be robust for some of the parameters. All sectors excluding Plantation, Tin & Mining and Industrial react positively to the exchange rate change. For these sectors, an increase in the rate of appreciation with the regards to the exchange rate change affects these sectors positively. On the other hand, an increase in the appreciation shocks tends to be negatively associated with the value of these sectors. Meanwhile, three sectors are sensitive to the exchange rate risk negatively. The negative sign may be due to high exchange rate volatility in the market. Similarly, if the cost of hedging rises with derivative increase with greater volatility, then the correlation between sector returns and exchange rate volatility can be also negative.

Moreover, we compare the result with the expected sign (in the grey column) as our benchmark (Please refer to Tables 3.5 and 3.6). The justification by comparing the actual result with the expected sign is to ensure that the result is not misleading. The results suggest for first moment exchange rate, only five over eight sector consistence with the expected sign (i.e. financial, properties, consumer goods, construction and tin and mining). Also, for the asymmetric exposure, only three over eight sectors essentially follow the benchmark sign (i.e. financial, properties and industrial). Finally, six sectors is found to be significant to the second moment exchange rate exposure only two of them are obviously follow the expected sign. Tables 3.7 and 3.8 provide further information concerning the comparison between actual result and benchmark. It's also summaries all findings in estimates models including, the first-moment exchange rate exposure, asymmetric exchange rate exposure and the second-moment exchange rate exposure.

Table 3.5:

The Sign(s) Analysis for First-, Second-, Asymmetric Moment Exposure (Contemporaneous Exchange Rate Model)

Sectors	Market Portfolio	Market Portfolio (Expected sign)	Exchange Rate Returns	Exchange Rate Returns (Expected sign)	Asymmetric Response	Asymmetric Response (Expected Sign)	Exchange Rate Volatility	Exchange Rate Volatility (Expected sign)
Financial	S(+ve)	S(+ve)	S (+ve)	S (+ve)	S (+ve)	S (+ve)	S (+ve)	S (-ve)
Plantation	S(+ve)	S(+ve)	NS (+ve)	S (+ve)	S (-ve)	S (+ve)	S (-ve)	S (-ve)
Properties	S(+ve)	S(+ve)	S (+ve)	S (+ve)	S (+ve)	S (+ve)	S (-ve)	S (-ve)
Consumer	S(+ve)	S(+ve)	S (+ve)	S (+ve)	NS (+ve)	S (+ve)	S (+ve)	S (-ve)
Construction	S(+ve)	S(+ve)	S (+ve)	S (+ve)	NS (+ve)	S (+ve)	S (+ve)	S (-ve)
Tin & Mining	S(+ve)	S(+ve)	S (+ve)	S (+ve)	S (-ve)	S (+ve)	NS (-ve)	S (-ve)
Services	S(+ve)	S(+ve)	NS (-ve)	S (+ve)	NS (+ve)	S (+ve)	S (+ve)	S (-ve)
Industrial	S(+ve)	S(+ve)	S (-ve)	S (+ve)	S (+ve)	S (+ve)	NS (-ve)	S (-ve)

Note that the signs ‘S’ and ‘NS’ indicates significant and not significant, respectively. In the parentheses is level of significant. The Sign ‘-ve’ and ‘+ve’ indicates negative exposure and positive exposure, respectively. While ‘MBPI’ stands for ‘Main Board Price Index Market)

Table 3.6:

The Sign(s) Analysis for First-, Second-, Asymmetric Moment Exposure (One-day Lagged Exchange Rate Model)

Sectors	Market Portfolio	Market Portfolio (Expected sign)	Exchange Rate Returns	Exchange Rate Returns (Expected sign)	Asymmetric Response	Asymmetric Response (Expected Sign)	Exchange Rate Volatility	Exchange Rate Volatility (Expected sign)
Financial	S(+ve)	S(+ve)	S(+ve)	S (+ve)	S(+ve)	S (+ve)	S(+ve)	S (-ve)
Plantation	S(+ve)	S(+ve)	S(-ve)	S (+ve)	S(+ve)	S (+ve)	S(-ve)	S (-ve)
Properties	S(+ve)	S(+ve)	S(+ve)	S (+ve)	S(+ve)	S (+ve)	S(-ve)	S (-ve)
Consumer	S(+ve)	S(+ve)	S(+ve)	S (+ve)	S(+ve)	S (+ve)	S(+ve)	S (-ve)
Construction	S(+ve)	S(+ve)	S(+ve)	S (+ve)	NS(-ve)	S (+ve)	S(+ve)	S (-ve)
Tin & Mining	S(+ve)	S(+ve)	S(-ve)	S (+ve)	NS(+ve)	S (+ve)	NS(-ve)	S (-ve)
Services	S(+ve)	S(+ve)	NS(+ve)	S (+ve)	NS(+ve)	S (+ve)	S(+ve)	S (-ve)
Industrial	S(+ve)	S(+ve)	S(-ve)	S (+ve)	S(+ve)	S (+ve)	NS(+ve)	S (-ve)

Note that the signs ‘S’ and ‘NS’ indicates significant and not significant, respectively. In the parentheses is level of significant. The Sign ‘-ve’ and ‘+ve’ indicates negative exposure and positive exposure, respectively. While, ‘MBPI’ stands for ‘Main Board Price Index Market)

Table 3.7:

The Comparison between the outcomes and benchmark (First and Asymmetric moment exchange rate exposure at 90% level)

Sectors	Models					
	Contemporaneous			One day Lagged		
	Results	Results that follows Expected Result		Results	Results that follows Expected Result	
		First Exchange Rate Exposure	Asymmetric Exchange Rate Exposure		First Exchange Rate Exposure	Asymmetric Exchange Rate Exposure
Financial (Fin)	1[a]	√	√	1[a]	√	√
Plantation (Plant)	1	-	-	1[a]	-	√
Properties (Pro)	1[a]	√	√	1[a]	√	√
Consumer Goods (Cmr)	1	√	-	1[a]	√	√
Constructions (Con)	1	√	-	1	√	-
Tin and Mining (Tinm)	1[a]	√	-	1	-	-
Services (Serv)	0	-	-	0	-	-
Industrial (Ind)	1[a]	-	√	1[a]	-	√
Total First Exposure	7/8	5/8	-	7/8	4/8	-
Total Asymmetric Exposure	4/7	-	3/8	4/7	-	5/8

Note that, the sign '0' indicates no exposure, while '1' indicates significant for first moment exposure. Also, the notation '1[a]' indicates significant and asymmetric for first moment exposure.

Table 3. 8:

The Comparison between the outcomes and benchmark (Second moment exchange rate exposure at 90% level)

Sectors	Models			
	Contemporaneous		One day Lagged	
	Results	Results that follows Expected Result	Results	Results that follows Expected Result
Financial (Fin)	+1	-	+1	-
Plantation (Plant)	-1	√	-1	√
Properties (Pro)	-1	√	-1	√
Consumer Goods (Cmr)	+1	-	+1	-
Constructions (Con)	+1	-	+1	-
Tin and Mining (Tinm)	0	-	0	-
Services (Serv)	+1	-	+1	-
Industrial (Ind)	0	-	0	-
Total Second Exposure	6/8	-	6/8	-
Total Expected Second Exposure	-	2/8	-	2/8

Note that, the notation of '0' indicates no second moment exposure. While, the notation of '1+' and '1-' indicates significant with positive or negative sign.

3.8 Summary and Conclusion

This chapter developed the hypothesis that there is a significant relationship between the exchange rate exposure and the stock market in Malaysia – from October, 1992 to December, 2010. Specifically, in this chapter we impose two types of exchange rate exposures; first moment exchange rate exposure and second moment exchange rate exposure. It is presumed in the earlier chapter that the link between first moment exchange rate exposure and sector returns is positive. While, the negative relationship between second moment exchange rate exposure and sector returns is predicted. We employ the maximum likelihood estimator as our estimation engine. In addition, we utilize the GARCH(1,1) as volatility measurement.

To conclude, the results support the hypothesis developed in the earlier chapter, it is suggested the exchange rate exposure has a significant effect to the sector returns in Malaysia. In particular, the result further suggested that Malaysian sectors are overwhelmingly positively exposed, i.e. their returns increase as Ringgit rises. This finding may be due to the reason of Malaysian economy relies heavily on exports activity since 1970s. This result consistence with the finding by Aggrawal (1981), which provide illustrative example documenting a positive effect and increase the income of the firm, consequently, boosting the average level of stock prices (Wu, 2000).

However, in order to find a concrete reason about this finding, further estimation is required. Hence, further estimation model may be useful to expand this research. As a future study, it is suggested that other regression method could be used to provide more representative model according to the hypothesis of the research, like panel data analysis. The outcome could be also much interesting when exploring the relationship between the variables in the panel condition.

Chapter 4

Essay on Exchange Rate Volatility-Exports Nexus: An Application of Advanced Econometric Model

4.1 **Introduction**

In this chapter we study about the relationship between the exchange rate volatility and export demand. By definition, the exchange rate volatility (hereafter: ERV) is a source of concern as currency values partially determine the price paid or received for output of goods and consequently, this affects the profits and welfare of producers and consumers (Akhtar and Spencer, 1984[46]). As a result, ERV can affect the volume of goods traded internationally by making prices and profits indeterminate. Yet, the exchange rate volatility-exports nexus has been investigated in a large number of empirical and theoretical studies.

There are two groups of ERV-exports nexus. The first group suggests that the high ERV impact exports negatively (see Cushman, 1983; Koray and Lastrapes, 1989). This negative impact may come directly through uncertainty and adjustment costs, and indirectly through its effect on allocation of resources and government policies (Cote, 1994). If the exchange rate movements are not fully anticipated, an increase in ERV may lead *risk-averse* agents to reduce their international trading activities. While reduce their international market, the agents will shift their sales to domestic markets. In addition, the presumption of a negative nexus between ERV and trade is an argument routinely used by proponents of managed of fixed exchange rates. This argument has also been reflected in the establishment of the Europe Monetary Union (EMU), as one of the stated purposes of EMU is to reduce ERV in order to promote intra-EU trade and investment (EEC Commission, 1990).

In contrary, the second group recommends that the ERV affect exports positively. This argument has been supported by Baron (1976) and De Grauwe (1988), among others.

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[46] Also read Choudhry (2005) for citations of papers that explain the mechanism by which exchange rate volatility affects trade internationally.

For example, De Grauwe (1988) shows, an increase in ERV will encourage the agents to increase their export volume. This may be due to the agent becoming *'very risk averse'* and too concerned about the worst possibility outcome to their investment. Therefore, when risk rises they tend to export more in order to avoid the possibility of a drastic decay in their profit. Additionally, previous empirical studies have also supported for the negative and positive relationships between ERV and international trade. Among others, Secru and Uppal (2000) showed the theoretical possibility of both positive and negative relationships, and Baccheta and Wincoop (2000) illustrated a theoretical model regarding no relationship between these variables.

Furthermore, the connection between ERV and exports also depends on various factors. This relationship may deal with the choices of sample period, model specification, proxies for ERV (nominal or real basis), and countries considered (developed, developing, Asia, ASEAN, etc.). Moreover numerous studies have shown that the higher degree of volatility of ERV has led policy makers and researchers to investigate the nature and extent of the impact of such movements on volume of trade, especially for exports (Hooi (2008), Maneschiold (2008), Ibrahim (2002), and Ahmad (2001), among others). Export expenditure actually has a close relationship with growth, through the export-led growth hypothesis (ELGH) channel. According to this hypothesis, exports are an essential macroeconomic determinant in stimulating economic growth.

Therefore, export stability is vital in generating growth, due to a positive relationship is expected in the hypothesis (Balassa, 1985). Yet, the relationship is still essential enough to be explored especially for the principle ASEAN countries namely, Singapore, Malaysia, Thailand, Philippines, and Indonesia (hereafter: ASEAN5), due to various macroeconomic events, for instance the Asian financial crisis in 1997/1998.

By giving this setting, the relationship between its major trading partners like the United States is of interest. In my knowledge, for most of these countries the export activity has been one of the major engines of economic growth. Furthermore, the United States is also known as ASEAN5 main trading partner, together with Japan, China, India and Europe countries. Thus in the light of international trade, the main purpose of this chapter is to investigate the impact of ERV on exports from ASEAN5 countries to the United States.

Our investigation differs from that reported to date in a few major ways. Firstly, this chapter utilizes an advanced time series approach by adopting the time window that has not yet been used to investigate the same research question. In fact, this chapter examines the impact of the ERV on ASEAN5 to the United States bilateral export demand function from January, 1990 to December, 2010. In particular, in this chapter, we assume that the agent in the market react to avoid the risk in the market. In other words, there are *risk-averse* agents. By referring to this assumption, we hypothesize that the ERV impact exports from ASEAN5 to the United States negatively.

A second distinguishing feature of this chapter pertains to the measurement of exchange rate variability. Here, the measurement of ERV is employed – the generalized autoregressive conditional Heteroscedastic (GARCH 1,1) model[47] of Bollerslev (1986). According to Kroner and Lastrapes (1993), Caporate and Doroodian (1994, Lee (1999) and Choudhry (2005), also apply the GARCH model to estimate the volatility of exchange rate. The beneficial of using GARCH for the ERV, because the measurement is standard, therefore there result given through this method is optimum and is the best (Choudhry, 2005).

According to new growth economics theory, exports in the developing countries (such as in ASEAN5), depends on world demand for exports goods, at the same time the world demand depends on the price of goods and income of buyer. Consistent with the theory, we include the other variables such as the importing country income, which in our case is the United States. In this chapter, the income of the United States has been substituted by the industrial production index (hereafter: IPI). According to Cote (1994), there exists a positive relationship between these two variables. Therefore, the inclusion of the IPI of the United States is to observe its relationship with exports in ASEAN5 countries. In other words, if the incomes of the United States increases will their expenditure in exporting increases too.

Furthermore, we include the bilateral exchange rate in the system equation in order to measure the sensitivity of this variable to exports. Essentially, the relationship between these two variables is assumed to be positive. In fact, the rise in the bilateral exchange rate value will give a favorable impact on exports. Finally, this chapter imposes an Asian Financial Crisis Dummy in the model from July, 1997 to December, 1999 in order to capture the impact of the structure break in the model. We assume that, the crisis gives a significant impact on countries' exports.

The rest of this chapter is structured as follows. Section 4.2 presents some related literature review, followed by model specification in Section 4.3. Section 4.4 discusses

[47] According to Jansen (1989), the unconditional measure of volatility lacks a parametric model for the time varying variance of a time series. Therefore, referring to Arize (1995), the exchange rate volatility may be modeled by the Autoregressive Conditional Heteroscedastic (ARCH) model of Engle (1982). Furthermore, in this chapter the conditional variance of the first difference of the log of the exchange rate is applied as volatility. The conditional variance is estimated by means of the Generalized Autoregressive Conditional Heteroscedastic (GARCH) model of order (1,1).

about the data sources. Data Description is given in Section 4.5. The method for the testing of ELGH is discussed in Section 4.6 and empirical results are given in Section 4.7. Section 4.8 provides a summary and concludes the paper.

4.2 Literature Review

Generally, ERV can be defined as a state of doubt about future rates at which various currencies will be exchanged against each other (Akhtar and Hilton, 1984). Thus, the ERV is a source of concern because currency values partly determine the price paid or received for output and consequently affect the profits and welfare of producers and consumers. In fact, in the international market the ERV can affect trade volume directly[48] or indirectly[49].

Moreover, the effect of the ERV on trade volume can be positive or negative, based on the role played by the agents in the market. The impact of ERV on trade volume (in this case, exports) has been investigated in a significant number of studies, both theoretically and empirically. Some detailed literature survey on the effects of ERV on trade has been outlined by previous researchers among other, Cote (1994), Mckenzie (1999) Clark, Tamirisa and Wei (2004) and Ozturk (2006). According to these surveys, the ERV can encourage the export volume through various factors[50].

Yet, from these factors the ultimate relationship between ERV and the export volume can be categorized into three types of relationships as follows;

Type 1: The ERV affects exports negatively (significant or not significant)

Type 2: The ERV affects exports positively (significant or not significant)

Type 3: There is no relationship between these variables.

Broad discussion of this topic has been covered by previous researchers, namely, Hooper and Kohlhagen (1978), Gotur (1985), Brada and Mendez (1988), Peree and Steinherr (1989), Klein (1990), Feenstra and Kendall (1991), Hook and Boon (2000), Doyle (2001), Baak (2004), among others. For more recent studies, see Arize et al. (2005), Lee and Saucier (2005), Baak et al. (2007), Chit et al. (2008), Aize (2008) and Baak (2009). However, most of these studies have rarely investigated the issue

[48] The exchange rate volatility can directly affect the volume of international trade by making prices and profits indeterminate or uncertain. For example, consider a firm choosing between buying a foreign-made product and a similar domestic substitute when both are equally valued in local currency terms using current exchange rate levels.
[49] This situation illustrates how exchange rate uncertainty may directly reduce trade flows by making product prices and profits indeterminable, or at least more uncertain, for either importers or exporters when an order is placed.
[50] From the types of exchange rate (nominal or real exchange rate), types of countries (developing or developed), group of countries (ASEAN, Asian, EU, OECD, etc.).

according to the exports of ASEAN countries. So far, only a small number of studies e.g. Arize et al. (2000), Baum et al. (2001), Doganlar (2002|), Bahmani-Oskooee and Goswami (2004), Baak et al. (2007) have focused or included ASEAN countries in their analysis.

Some empirical evidence from these surveys such as Akhtar and Hilton (1984), Cushman (1986), Peree and Steinherr (1989), Bini-Smaghi (1991), Savvides (1992), Chowdhury (1993), Hook and Boon (2000), Baak (2004), Arize et al. (2005), Lee and Saucier (2005), Baak et al. (2007), Chit et al. (2008), Augustine (2008) and Baak (2009) shows that an increase in exchange rate risk will have negative effect on the volume of exports.

In contrast, the evidence from other researchers such as Sercu and Vanhulle (1992), Baccheta et al. (2000), Aristotelous (2001), Bahmani et al. (1993), Gagnon (1993), Doyle (2001) and Bredin et al. (2003) demonstrated that the effect between exchange rates volatility and trade is either positive or ambiguous. Following the work of Das (2003), Kasman and Kasman (2006), Arize et al. (2005), Baak (2007, 2008) and Augustine et al. (2008) among others, examines the long run and the short run relationship between ERV and exports by implementing cointegration tests and Granger causality tests in vector error correction model in their study.

4.3 The Exchange Rate Volatility-Export Nexus Model Specification

This chapter investigates the long run and short run relationship between ERV and exports by performing Granger causality test in the vector error correction (VECM) framework, as in the studies of Baak (2001, 2007, 2008) and Arize Osang and Slottje (1999, 2000). Following the typical specification of others, and with additional specification as stated earlier in the introduction, the long run equilibrium relationship between exports and other economic variables in this chapter is examined based upon the following export demand equation:

$$\ln A_{ijt} = \alpha_0 + \alpha_1 \ln G_{jt} + \varepsilon_2 \ln P_{ijt} + \alpha_3 \ln\left(\sigma^2_{ijt}\right) + \alpha_4 CD_t + v_{ijt} \qquad (4.1)$$

Here, A_{ijt} denotes as real exports from a country *i* (for example, Malaysia or Singapore) to a country *j* (the United States); G_{jt} is the GDP of an importing country, *j* ; P_{ijt} is the real bilateral exchange rate, reflecting the price competitiveness; σ^2_{ijt} is the volatility of the bilateral real exchange rates; CD_t is representing the crisis dummy due to the Asian financial crisis in July, 1997 to December,1999; finally v_{ijt} denotes as a disturbance term. All variables are in natural logarithms and the subscript *t* indicates the time period.

In the equation, the variable G_{ijt} is used as a proxy for the level of economic activity in the importing country, in this case is the United States. It is expected that, the higher the economic activity in the importing country, the higher the demand for exports (Cote, 1994). Therefore, the value for α_1 is expected to be positive. Since the higher real exchange rate implies a lower relative price, the value for α_2 is also expected to be positive (Arize et al. (2000). As stated earlier, ERV may effects trade negatively or positively. However, if the economic agents are moderately risk averse, as De Grauwe (1988) shows, it is generally expected that the impact of ERV is negative. Thus, in this study because of the assumption of the economic agents is avoiding the risk, so the value for α_3 will be negative. Finally, a dummy variable (CD_t) is included in the model to represent the Asian financial crisis in 1997/1998. In this case, CD=1 for the period from July, 1997 to December, 1999, and zero otherwise.

4.4 Data Sources

This chapter uses monthly data covered from January, 1990 to December, 2010. Overall this chapter uses over 210 observations. The data such as consumer price indices (CPI), export unit value indices, production indices of the United State, and nominal exchange rates were obtained from the International Financial Statistics (IFS) of the International Monetary Fund (IMF). The data for exports from each ASEAN country to the United States were collected from the Direction of Trade Statistics (DOTS).

4.5 Data Definitions

In estimating this model each variable definition follows the guidance proposed by Baak et al. (2007).

4.5.1 The Crisis Dummy

In order to capture the structure break of the Asian financial crisis from July 1997 to December, 1999, we introduce the crisis dummy variable denoted as CD_t above. There will be always a significant improvement in the stochastic properties of the VAR model is obtained by adding dummy/dummies to capture this historical episodes (Baharumshah, 2009). Thus, it is treated as an exogenous variable in the system. This study assumed there will be significant impact of crisis period (CD_t) on exports.

4.5.2 The Importing Country Income

As stated in Baak et al. (2007, 2008), the real GDP of the importing country j (in this case is the United States) is commonly used as a proxy measure for economic activity. However, due to the data availability for monthly data, in this study we prefer to use the production index as a proxy to economic activity. The same measurement has been used by the previous literature such as Chou and Shih (1998), (2000), Chou (2000), Baum (2001), among others.

4.5.3 Real Export Indicator

Real exports from country *i* to country *j* can be expressed as follows,

$$A_{ijt} = \ln\left(\frac{a_{ijt}}{auv_{it}} x100\right) \tag{4.2}$$

Here, the notation of A_{ijt} denotes as the log value of the real total exports of country *i* to country *j*. While, a_{ijt} can be specify as a monthly nominal exports of country *i* to *j* and the auv_{it} is the export unit value index of country *i*.

4.5.4 Exchange Rate Volatility Indicator

For the ERV calculation, we apply the conditional variance that estimated by means of the Generalized Autoregressive Conditional Heteroscedastic (GARCH) model of Bollerslev (1986). He proposes in GARCH model, the conditional variance of a time series depends upon the squared residual of the process and has the advantage of incorporating heteroscedasticity into the estimation procedure of the conditional variance. Moreover, as stated in Bollerslev et al. (1992) that the GARCH*(p,q)* model can be viewed as a reduced form of a more complicated dynamic structure for the time varying conditional second order moments. Therefore, the GARCH(1,1) process in this chapter is as follows;

$$h_t = \theta + \sum_{i=1}^{q} \alpha_i h_{t-i} + \sum_{i=1}^{p} \beta_i v_{t-i}^2 \tag{4.3.1}$$

In order to standardize the data in the estimation model, we transform all the bilateral ERV into logarithm form as follows;

$$\ln(h_t) = \ln(\theta + \sum_{i=1}^{q} \alpha_i h_{t-i} + \sum_{i=1}^{p} \beta_i v_{t-i}^2) \tag{4.3.2}$$

4.5.5 The Real Bilateral Exchange Rate

The bilateral trade between two countries depends upon, among other factors, exchange rates and the relative price level of the two trading partners. Hence, the real exchange rates are included in the export equations of this chapter and are computed as follows;

$$P_{ijt} = \ln\left(EX_{ijt} x\left[\frac{CPI_{jt}}{CPI_{it}}\right]\right) \tag{4.4}$$

Here, P_{ijt} denotes the real monthly exchange rate in natural logarithm scale, while, EX_{ijt} is the nominal monthly exchange rate. The CPI_{it} and CPI_{jt} symbolize the monthly data for consumer price indexes of an exporting country *i* and an importing country *j*, respectively.

4.6 Econometrics Methodology

This section provides methodology framework for the chapter. According Arize et al. (2008), the multivariate analysis may lead to a precise analysis in order to capture the long run and short run relationship between the variables. Therefore, similar with the methodology in Chapter 2, in this chapter we apply both cointegration analysis and Granger causality in vector error correction model. However, before we go further, the beginning of a multivariate analysis for time series data lies in the univariate unit root tests. In this study, we perform the unit root tests proposed by Dickey and Fuller (1979). Then, we proceed to use cointegration techniques pioneered by Engle and Granger (1987). Hendry (1986) and Granger (1986) made a significant contribution towards testing Granger causality. Two or more variables are said to be cointegrated (i.e.: they exhibit long run equilibrium relationship(s)), if they share common trends. According to this technique pioneered by Granger (1969) and Sims (1972), if two variables are cointegrated, the finding of no causality in either direction one of the possibilities with the standard tests, is ruled out. As long as the two variables have common trends, causality must exist in at least one direction, either unidirectional or bidirectional. Evidence of cointegration among variables also rules out the possibility of the estimated relationship being 'spurious'. Although cointegration indicates the presence or absence of Granger causality, it does not indicate the direction of causality between variables. This direction of the Granger (or temporal) causality can be detected through the vector error correction model derived from the long run cointegration vectors. As diagnostic tests, we applied the Durbin Watson test (DWT), Breusch-Pagan-Godfrey test (BPGT), and the Jarque-Bera Normality test (JBT). For the volatility measurement we applied the GARCH proposes by Bollerslev (1986).

4.6.1 The Generalized Autoregressive Conditional Heteroscedasticity

Akhtar and Spencer Hilton (1984) claimed that the variance (or standard deviation) of the exchange rate is the most commonly used definition of the ERV. Bailey, Tavlas and Ulan (1986, 1987), furthermore explained that there are another two definition for the ERV. According to them, the first group is the polynomial distributed lag of the absolute value of the period-to period change in the exchange rate. Second group is the logarithms of the moving standard deviations of the exchange rate. However following Jansen (1989), the unconditional measure of volatility is lacks of a parametric model for the time varying variance of a time series. As a result, according to Arize (1985), the best measurement for the ERV is by using the Autoregressive Conditional Heteroscedastic (hereafter: ARCH) model of Engle (1982). Importantly, in this study, conditional variance of the first difference of the log of the exchange rate is applied a s volatility. Moreover, the conditional variance is estimated by means of the Generalized Autoregressive Conditional Heteroscedastic (GARCH) model of Bollerslev (1986).

By given this setting, we now understand that there are several different measures of ERV have been previously applied by the earlier researcher. As also stated earlier, in this chapter we applied GARCH model as a measurement for the ERV proposes by Bollerslev (1986). He proposes in GARCH model that the conditional variance of a time series depends upon the squared residual of the process and has the advantage of incorporating heteroscedasticity into the estimation procedure of the conditional variance. Moreover, as stated in Bollerslev et al. (1992) that the GARCH*(p,q)* model can be viewed as a reduced form of a more complicated dynamic structure for the time varying conditional second order moments. Therefore, first difference of the bilateral exchange rate in this study can be expressed by the GARCH*(p,q)* model as follows;

$$
\begin{aligned}
x_t &= \ell + v_t \\
v_t / \Pi_{t-1} &\sim N(0, h_t) \\
h_t &= \theta + \sum_{i=1}^{q} \alpha_i h_{t-i} + \sum_{i=1}^{p} \beta_i v_{t-i}^2
\end{aligned}
\qquad (4.19)-(4.21)
$$

Here, h_t is equal to $\log(P_t / P_{t-1})$, and P_t is the bilateral exchange rate, while ℓ is the mean of x_t conditional on past information (Π_{t-1}) and the following inequality restriction $\ell > 0$, $\alpha_i > 0$, and $\beta_i > 0$ are imposed to ensure that the conditional variance (h_t) is positive. The size and significance of β_i indicates the magnitude of the effect imposed by the lagged error term (v_{t-i}) on the conditional variance (h_t). In other words, the size and significance of the β_i indicates the presence of the ARCH effects in the residual (volatility clustering in the data). The estimated of the h_t (conditional variance) from the GARCH (p , q) model is applied in the estimation of $eq.(1)$.

4.7 Empirical Results

In this section we discuss empirical results for this chapter. To start with, we discuss all the results in general, starting from ADF unit root tests to the Johansen and Juselius cointegration tests, error correction model (ECM), and vector error correction model (VECM). Detailed discussion is provided at the end of this section.

4.7.1 The Results of Augmented Dickey Fuller Tests

The univariate Augmented Dickey Fuller (ADF) unit root test conducted in all systems under this chapter concludes that all the data are *I(1)* processes. The unit root tests are employed to investigate the stationarity of the macroeconomic series at levels and then at first difference of each series.

To ensure the disturbances in all these equations are white noise, a sufficient number of lagged dependent variables have been included in the estimated regression[51]. The results of the tests, both at levels and at first differencing, are reported in Tables 4.1 to 4.5, both with and without a time trend variable in the regression. For ASEAN5 countries, the t-test statistics for all series from ADF tests are statistically insignificant to reject the null hypothesis of non-stationary at the 99% significance level. This result indicates that these series are non-stationary in their levels form. As the tests fail 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 movement.

The tests continue to the first differencing stages. When the ADF test is conducted for first differences of each variable, the null hypothesis of non-stationarity is easily rejected at 0.01 significance levels as shown in Tables 4.1 to 4.5. Apparently, this result is consistent with some of the previous studies, says Das (2003), Kasman and Kasman (2005), Arize et al. (2005), Baak (2007, 2008) and Arize et *al.* (2008) among others. As claimed by Nelson and Plosser (1982), most of the macroeconomics and financial series are expected to contain a unit root and thus are integrated of order one, I(1). Therefore, this chapter concludes that the series are integrated of order one, and a higher order of differencing is not required.

[51] For the optimal lag length estimator, this chapter employs the Akaike Information Criteria (AIC).

Table 4.1:
The Results of Augmented Dickey Fuller Tests for Singapore

Singapore				
Data Series	**At Level**		**At first difference**	
	without trend	**with trend**	**without trend**	**with trend**
Real Export	-2.537878 (4)	-2.520144 (4)	-8.964511 (4)*	-9.010142(4)*
Real Income	-1.511249 (4)	-1.054364 (4)	-6.952419 (4)*	-7.041146 (4)*
Real Bilateral Exchange Rate	-0.897839 (4)	-0.723620 (4)	-6.237290 (4)*	-6.242019 (4)*
Exchange rate volatility (GARCH)	-1.918365 (4)	-2.006650 (4)	-6.795549 (4)*	-6.800304 (4)*

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

Table 4.2:
The Results of Augmented Dickey Fuller Tests for Malaysia

Malaysia				
Data Series	**At Level**		**At first difference**	
	without trend	**with trend**	**without trend**	**with trend**
Real Export	-2.392370 (2)	-1.919868 (4)	-7.933085 (4)*	-8.275650 (4)*
Real Income	-1.511244 (4)	-1.054364 (4)	-6.952419 (4)*	-7.041146 (4)*
Real Bilateral Exchange Rate	-1.511563 (4)	-1.322453 (4)	-6.261529 (4)*	-6.299796 (4)*
Exchange rate volatility (GARCH)	-1.536856 (4)	-1.996264 (4)	-5.777183 (4)*	-5.768497 (4)*

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

Table 4.3:
The Results of Augmented Dickey Fuller Tests for Thailand

Thailand				
Data Series	**At Level**		**At first difference**	
	without trend	**with trend**	**without trend**	**with trend**
Real Export	-2.334833 (4)	-3.132127 (4)	-8.729152 (4)*	-8.79133 (4)*
Real Income	-1.511249 (4)	-1.054364 (4)	-6.952419 (4)*	-7.04114 (4)*
Real Bilateral Exchange Rate	-1.495946 (4)	-1.180035 (4)	-5.915259 (4)*	-5.96630 (4)*
Exchange rate volatility (GARCH)	-2.384251 (5)	-2.984798 (4)	-10.11501 (4)*	-10.1146 (4)*

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

Table 4.4:
The Results of Augmented Dickey Fuller Tests for Philippines

Philippines				
Data Series	**At Level**		**At first difference**	
	without trend	**with trend**	**without trend**	**with trend**
Real Export	-2.011978 (4)	-1.457708 (4)	-9.014934 (4)*	-9.24750 (4)*
Real Income	-1.511249 (4)	-1.054364 (4)	-6.952419 (4)*	-7.04114 (4)*
Real Bilateral Exchange Rate	-1.389683 (4)	-1.239872 (4)	-5.964669 (4)*	-5.98730 (4)*
Exchange rate volatility (GARCH)	-1.592908 (4)	-1.437663 (4)	-8.308243 (4)*	-8.36916 (4)*

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

Table 4.5:
The Results of Augmented Dickey Fuller Tests for Indonesia

Indonesia				
Data Series	**At Level**		**At first difference**	
	without trend	**with trend**	**without trend**	**with trend**
Real Export	-2.019012 (4)	-2.792339 (4)	-8.973682 (4)*	-9.00140 (4)*
Real Income	-1.511249 (4)	-1.054364 (4)	-6.952419 (4)*	-7.04114 (4)*
Real Bilateral Exchange Rate	-1.966732 (4)	-1.813688 (4)	-5.747611 (4)*	-5.77177 (4)*
Exchange rate volatility (GARCH)	-2.66509 (11)	-3.102286 (3)	-5.579170 (4)*	-5.56999 (4)*

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

4.7.2 The Results of Optimum Lags Length

Table 4.6 shown, the uniform lag structure of the system is set up through a research process proposed by Vahid and Engle (1993), using the likelihood ratio test with a potential lag length of 1 through 12. The null hypothesis is a system of variables generated from a Gaussian VAR with p_0 lags against the alternative specification of p_1, whereas p_1 is larger than p_0. The test statistic computed is asymptotically distributed as Chi-square with n^2 $(p_1\text{-}p_0)$ degrees of freedom. Based on the procedure mentioned above, the optimum lag length of VAR, VECM, and the cointegration for each country are as follows;

Table 4.6:
The Results of Optimum Lag Length results for Multivariate Estimations

Systems	Countries	Optimum Lag Length
VAR	Singapore	12
	Malaysia	7
	Thailand	12
	Philippine	9
	Indonesia	6
VECM	Singapore	11
	Malaysia	6
	Thailand	11
	Philippine	8
	Indonesia	5

From the observations, the final results for the VECM are always less one lag in comparing with the lag length in VAR and Cointegration. This is consistent with the test procedure proposed by Vahid et al. (1993) where according to the study, if a lag order of 2 minimizes the AIC in the sample, thus, a VAR of order 2 in levels implies a VECM of order 1 if the series are cointegrated. As the results, all the remaining analysis will depends on this selected lag length.

4.7.3 The Results of Johansen and Juselius Cointegration Tests

The prerequisite for a set of series to be cointegrated is that they should be integrated in the same order. Thus far, given the power of these unit root tests of I(1) process, now we can proceed to the cointegration test. The cointegration test is designed to test for the presence of common stochastic trends between a set of variables that are individually non-stationary in levels (Hooi, 2007). Thus, in this chapter, we utilize the Johansen (1988) and Johansen and Juselius (1990) multivariate cointegration process to test for the existence of cointegration relationships, both for trace and maximum eigenvalue statistics.

The summary results of cointegration analyses for each county are reported in Tables 4.7 to 4.11. As stated earlier, the number of cointegration vector(s) is determined by two likelihood ratio tests, namely the maximum eigenvalue and the trace eigenvalue statistics. The critical values for each test are from Osterwald-Lenum (1992). Overall, we found similar results for every country under consideration. We conclude that there exists at least one cointegration vector in the cointegration systems. This conclusion applies for Singapore, Malaysia, Thailand, the Philippines and Indonesia.

As an example, for the case of Singapore, 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 of 77.07210 is obviously larger than the 0.05 and 0.01critical values at, 68.52 and 76.07, respectively. Nonetheless, if we test the null hypothesis of $r\leq1$, thus we fail to reject the hypothesis due to the computed value at 39.36122 is smaller than the 0.05 and 0.01 critical values at, 47.21 and 54.46, respectively. Therefore, based on the trace statistic test results, we conclude that there exists a single cointegrating vector in the model. Consistent with that, we also find the maximum eigenvalue test suggests a similar result.

Moreover, based on the trace and maximum eigenvalue tests, the results reveal the null hypothesis of $r=0$ against its alternative $r>1$ is rejected at 0.01 and 0.05 significant levels. Using the Eviews Version 6 software, as our estimating engine, the computed value 37.71088 is obviously larger than the 0.05 and 0.01 critical values at, 33.46 and 38.77, respectively. If we test the null hypothesis of $r\leq1$, we definitely fail to reject the hypothesis due to the computed value at 15.98193 being smaller than the 0.05 and 0.01 critical value at, 27.07 and 32.24, respectively. Overall, the study summarizes that for the case of Singapore, there is at least one cointegrating vector in the system. Based on this conclusion, this study furthermore suggests that economic growth and its macroeconomic determinants exhibit a long-run relationship in the Singapore cointegrating system. This means, the existence of at least one cointegrating vector in the system equation indicates that the system move together and cannot move far from each other. The same conclusions can also be applied for the cases of Malaysia, Thailand, the Philippines and Indonesia.

Table 4.7:
The Results of Johansen Juselius Cointegration Tests for Singapore

		Cointegration system: F(Exports, Income, Bilateral exchange rate, Exchange Rate Volatility, Dummy Variable)					
Hypothesis		λ Trace	5% critical value	1% critical value	λ Max	5% critical value	1% critical value
H0	H1						
r=0	r>0	77.0721*	68.52	76.07	37.7108**	33.46	38.77
r≤1	r>1	39.36122	47.21	54.46	15.98193	27.07	32.24
r≤2	r>2	23.37929	29.68	35.65	13.10595	20.97	25.52
r≤3	r>3	10.27334	15.41	20.04	8.859741	14.07	18.63
r≤4	r>4	1.413595	3.76	6.65	1.413595	3.76	6.65

Note that, the notation 'r' denotes the number of cointegrating vectors. The superscript (*) indicates statistically significant at 5% and (**) at 1%. The critical values for the Johansen Juselius test were obtained from (Osterwald-Lenum, 1992)

Table 4.8:
The Results of Johansen Juselius Cointegration Tests for Malaysia

		Cointegration system: F(Exports, Income, Bilateral exchange rate, Exchange Rate Volatility, Dummy Variable)					
Hypothesis		λ Trace	5% critical value	1% critical value	λ Max	5% critical value	1% critical value
H0	H1						
r=0	r>0	88.36177*	68.52	76.07	41.53120*	33.46	38.77
r≤1	r>1	46.83056	47.21	54.46	18.54683	27.07	32.24
r≤2	r>2	28.28373	29.68	35.65	13.41724	20.97	25.52
r≤3	r>3	14.86649	15.41	20.04	11.49842	14.07	18.63
r≤4	r>4	3.368069	3.76	6.65	3.368069	3.76	6.65

Note that, the notation 'r' denotes the number of cointegrating vectors. The superscript (*) indicates statistically significant at 5% and (**) at 1%. The critical values for the Johansen Juselius test were obtained from (Osterwald-Lenum, 1992)

Table 4.9:
The Results of Johansen Juselius Cointegration Tests for Thailand

		Cointegration system: F(Exports, Income, Bilateral exchange rate, Exchange Rate Volatility, Dummy Variable)					
Hypothesis		λ Trace	5% critical value	1% critical value	λ Max	5% critical value	1% critical value
H0	H1						
r=0	r>0	101.5702*	68.52	76.07	58.44194*	33.46	38.77
r≤1	r>1	43.12830	47.21	54.46	16.92207	27.07	32.24
r≤2	r>2	26.20623	29.68	35.65	14.05542	20.97	25.52
r≤3	r>3	12.15081	15.41	20.04	9.563480	14.07	18.63
r≤4	r>4	2.587330	3.76	6.65	2.587330	3.76	6.65

Note that, the notation ‘r’ denotes the number of cointegrating vectors. The superscript (*) indicates statistically significant at 5% and (**) at 1%. The critical values for the Johansen Juselius test were obtained from (Osterwald-Lenum, 1992)

Table 4.10:
The Results of Johansen Juselius Cointegration Tests for Philippines

		Cointegration system: F(Exports, Income, Bilateral exchange rate, Exchange Rate Volatility, Dummy Variable)					
Hypothesis		λ Trace	5% critical value	1% critical value	λ Max	5% critical value	1% critical value
H0	H1						
r=0	r>0	86.41198*	68.52	76.07	40.81620*	33.46	38.77
r≤1	r>1	45.59578	47.21	54.46	17.46097	27.07	32.24
r≤2	r>2	28.13480	29.68	35.65	14.86239	20.97	25.52
r≤3	r>3	13.27241	15.41	20.04	9.544347	14.07	18.63
r≤3	r>3	3.728066	3.76	6.65	3.728066	3.76	6.65

Note that, the notation ‘r’ denotes the number of cointegrating vectors. The superscript (*) indicates statistically significant at 5% and (**) at 1%. The critical values for the Johansen Juselius test were obtained from (Osterwald-Lenum, 1992)

Table 4.11:
The Results of Johansen Juselius Cointegration Tests for Indonesia

		Cointegration system: F(Exports, Income, Bilateral exchange rate, Exchange Rate Volatility, Dummy Variable)					
Hypothesis		λ Trace	5% critical value	1% critical value	λ Max	5% critical value	1% critical value
H0	H1						
r=0	r>0	86.93364*	68.52	76.07	47.10336*	33.46	38.77
r≤1	r>1	39.83028	47.21	54.46	19.36090	27.07	32.24
r≤2	r>2	20.46938	29.68	35.65	12.46644	20.97	25.52
r≤3	r>3	8.002940	15.41	20.04	5.369981	14.07	18.63
r≤3	r>3	2.632959	3.76	6.65	2.632959	3.76	6.65

Note that, the notation 'r' denotes the number of cointegrating vectors. The superscript (*) indicates statistically significant at 5% and (**) at 1%. The critical values for the Johansen Juselius test were obtained from (Osterwald-Lenum, 1992)

4.7.4 The Results of Error Correction Model (ECM)

Following the Johansen and Juselius cointegration tests, the results identify one long-run relationship for each of the export equations, then the error correction models were estimated to observe the long-run relationship in the models[52]. In order to find a reasonable equation for exports models, we performed many estimation experiments. In this stage, there will be two parts of the estimation procedure (Baak, 2008). Firstly, the estimated regression equation includes each explanatory variable up to 12 lags. Then, each lagged variable which was not found to be insignificant will be omitted from the systems. The full results for this stage are reported in Table 4.6. Additionally, all systems passed the diagnostic tests as reported in Table 4.18 in the appendix section. In general, the models are free from any estimations problem.

In general, some of the estimated coefficients of the explanatory variables were consistent with the previous studies, namely Baak *et al.* (2007), Baak (2008) and Arize *et al.* (2007), in a few ways.

Firstly, the error correction term(s) has a negative sign and significant. As seen in Table 4.12, the parameter values of the error correction term(s) denotes by ECT_{ijt-1}, are all negative and significant at least at 10% significance levels. This finding indirectly reconfirms the existence of a long term relationship among the variables in each export functions. In other words, the ECM outcomes are coherent with the findings in the cointegration tests.

Secondly, as also found in the previous studies, for some of the equations (systems ECM) the negative and positive impacts are mingled. For example, the relationship between ERV and exports in Malaysia and Thailand are mixed between positive and negative sign(s). According to Baak (2008), if the negative sign is obvious than the positive sign, the overall relationship could be concluded as the negative relationship between these variables. In some other cases as proposed in Baak et *al.* (2007), whenever the positive sign is more obvious than the negative sign in the system thus, the relationship is concluded to be ambiguous. However, following Arize *et al.* (2007), if sum of the estimates on lagged values of $\Delta\sigma_{ijt-k}$ for all countries is negative, thus, the overall effects is also negative.

Third and foremost, some of the results of interest in this chapter are coherent with the finding in Baak *et al.* (2007) that the results across time and nations are different.

[52] The error correction terms were estimated by the cointegrating equation systems. The summary results were reported in the Table 4.12.

For instance, the current chapter observes that there exists a negative relationship between ERV and exports in Singapore and ambiguous in Thailand. Thus, from the observation the results concluded that the impact of the ERV to exports tends to be varies across the nation. In other word, the ERV gives a different impact on different countries. This may be due to the exchange rate mechanism in the country which makes a significant contribution in the way the ERV may effects the exports.

From the findings, we also highlight the certain outcomes that contradict our main assumption in the earlier section of this chapter. However, the overall results contradict our expectations in just a few cases. Firstly, the effects of the importing country growth of the importing country (in our study this is the United States), are estimated to be both negative and positive in the systems. But, for Thailand the relationship between exports and the importing country growth are positive. Therefore, the overall effects of the relationship are positive and ambiguous.

Secondly, the result suggests a positive relationship in the short-run between exports and the bilateral exchange rate, for Singapore and Malaysia. This result denotes that, when depreciation of the exporting country's currency (depreciations of the domestic currency i.e.; Ringgit Malaysia (RM) for the Malaysia case) usually leads to an increase in exports (from the United States). However, this finding does not apply for Indonesia, Thailand and Philippines, where the results are mixed and lead to sign ambiguity.

Third, the short-run effects of the ERV are more complicated. The assumption in this chapter is that there is a negative relationship between ERV and exports, across the ASEAN5 countries. But, there are positive effects in the exports of Indonesia to the United States. Besides, the results further suggest for the negative relationship between exports and ERV, from Philippines and Singapore to the United States. The results are found to be mixed in the Malaysia and Thailand systems. Therefore, as a conclusion, the effects of the ERV to Malaysia and Thailand are ambiguous, while the same relationship for Indonesia and the Philippines/Singapore are positive and negative, respectively.

Table 4.12:
The Results of Error Correction Model for Singapore, Malaysia, Thailand, Philippines, and Indonesia

Variables	ASEAN Countries				
	Singapore	Malaysia	Thailand	Philippine	Indonesia
Constant	-0.0009 (-1.58)	0.006 (1.66)*	0.018 (4.674)***	0.004 (0.99)	0.012 (2.29)**
ECT_{iit-1}	-0.22 {-5.00}***	-0.018{-1.78}*	-0.0254{-7.42}***	-0.028 {-5.70}***	-0.013 {-1.57}*
ΔA_{iit-1}	-0.681 (-11.33)***	-0.279 (-4.41)***	-0.599 (-9.56)***	-0.375 (-6.18)***	-0.444 (-7.46)***
ΔA_{iit-2}	-0.262 (-3.80)***	-0.088 (-1.59)	-0.557 (-7.66)***	-0.324 (-5.34)***	-0.203 (-3.20)***
ΔA_{iit-3}	0.104 (1.57)	-	-0.438 (-6.19)***	-0.177 (-3.21)***	-0.175 (-2.926)***
ΔA_{iit-4}	0.161 (2.73)***	0.019 (0.34)	-0.508 (-7.97)***	-0.302 (-4.94)***	-0.194 (-3.14)***
ΔA_{iit-5}	-	-	-0.463 (-7.43)***	-0.271 (-4.41)***	-0.222 (-3.521)***
ΔA_{iit-6}	-	-0.138 (-2.32)**	-0.526 (-8.95)***	-0.214 (-3.74)***	-0.226 (-3.697)***
ΔA_{iit-7}	-0.199 (-3.55)***	-0.144 (-2.40)**	-0.581 (-9.65)***	-0.156 (-2.82)***	-0.109 (-1.705)*
ΔA_{iit-8}	-	-	-0.584 (-9.29)***	-0.268 (-4.31)***	-0.087 (-1.47)
ΔA_{iit-9}	0.102 (1.77)*	-	-0.482 (-7.22)***	-0.28 (-4.65)***	-
ΔA_{iit-10}	0.100 (1.72)*	-	-0.404 (-5.98)***	-0.187 (-3.39)***	-0.093 (-1.761)*
ΔA_{iit-11}	-	0.129 (2.17)**	-0.248 (-4.23)***	-	-
ΔA_{iit-12}	0.144 (2.61)***	0.257 (4.27)***	-	0.206 (3.48)***	0.242 (4.44)***
ΔG_{it-1}	0.009 (2.57)**	0.008 (2.86)***	0.008 (2.86)***	0.016 (4.40)***	0.015 (3.48)***
ΔG_{it-2}	0.020 (4.69)***	0.016 (4.62)***	0.019 (6.22)***	0.012 (3.316)***	0.014 (3.59)***
ΔG_{it-3}	0.012 (3.21)***	0.002 (0.69)	0.011 (3.08)***	-	-
ΔG_{it-4}	-	-	0.007 (2.16)**	-	-
ΔG_{it-5}	-0.013 (-3.38)***	-	0.007 (2.44)**	0.003 (1.27)	0.009 (2.29)**
ΔG_{it-6}	-0.021 (-5.34)***	-0.005 (2.12)**	-	-	-0.007 (-1.93)*
ΔG_{it-7}	-	-	0.012 (4.21)***	-	-
ΔG_{it-8}	-	-0.015 (-4.92)***	-	-0.015 (-4.70)***	-0.0089 (-2.19)**
ΔG_{it-9}	0.014 (3.64)***	-0.005 (-1.68)*	0.013 (4.49)***	0.005 (1.67)*	-0.004 (-1.08)
ΔG_{it-10}	0.007 (1.91)*	-	0.009 (3.01)***	-	-
ΔG_{it-11}	-	-	-	-	-
ΔG_{it-12}	-	-	-	0.009 (2.93)***	0.008 (2.09)**
ΔP_{it-1}	-	-	-	-	0.155 (1.79)**
ΔP_{it-2}	0.962 (2.60)**	-	0.013 (0.08)	0.262 (1.36)	-
ΔP_{it-3}	-	0.246 (1.13)	-	-	-
ΔP_{it-4}	0.753 (2.06)**	-	-	-	-
ΔP_{it-5}	-	-	-	0.544 (2.48)**	-0.316 (-2.27)**
ΔP_{it-6}	0.544 (1.45)	0.506 (2.32)**	-0.01 (-0.07)	-0.256 (-1.29)	-
ΔP_{it-7}	0.839 (2.18)**	-	-	-	-
ΔP_{it-8}	-	-	-	-	-
ΔP_{it-9}	-	0.49 (2.418)**	-	-	-
ΔP_{it-10}	0.429 (1.13)	-	0.214 (1.41)	-	-
ΔP_{it-11}	-	-	-	0.240 (1.23)	-0.174 (-2.16)**
ΔP_{it-12}	-	-	-	-	-
$\Delta\sigma_{iit-1}$	-	-	-	-	0.148 (1.17)
$\Delta\sigma_{iit-2}$	-	-	0.620 (2.52)**	-	0.007 (0.063)
$\Delta\sigma_{iit-3}$	-	0.986 (1.43)	0.291 (0.89)	-	-
$\Delta\sigma_{iit-4}$	-	-	-	-2.02 (-3.13)***	0.500 (2.499)**
$\Delta\sigma_{iit-5}$	-	-1.215 (-1.65)*	-	-	-
$\Delta\sigma_{iit-6}$	-2.09 (-1.15)	-	-	-0.818 (-1.39)	-
$\Delta\sigma_{iit-7}$	-4.23 (-2.26)**	-1.135 (-1.460)	0.103 (0.45)	-1.189 (-2.08)**	-
$\Delta\sigma_{iit-8}$	-	-0.737 (-0.97)	-	-	-
$\Delta\sigma_{iit-9}$	-	-	-	-	-
$\Delta\sigma_{iit-10}$	-	-	-0.086 (-0.24)	-1.672 (-2.67)***	-
$\Delta\sigma_{iit-11}$	-	-	-	-	-
$\Delta\sigma_{iit-12}$	-	1.118 (1.93)*	-	-	-
ΔCD_{iit-1}	-	-0.028 (-1.65)	-	-	-
ΔCD_{iit-2}	-	0.111 (2.62)***	0.134 (3.16)***	0.105 (2.37)**	0.153 (2.69)***
ΔCD_{iit-3}	-	-0.066 (-1.54)	-	-0.093 (-2.09)**	-
ΔCD_{iit-4}	-0.126 (-2.24)**	-0.104 (-2.43)**	-0.037 (-0.91)	-	-0.072 (-1.28)
ΔCD_{iit-5}	-0.094 (-1.67)*	-0.058 (-1.309)	-	-0.034 (-0.74)	-
ΔCD_{iit-6}	-0.082 (-1.45)	-	-	-	-
ΔCD_{iit-7}	-0.122 (-2.12)**	-	-0.006 (-0.14)	-0.094 (-1.98)**	-0.102 (-1.65)*
ΔCD_{iit-8}	-	-	-	-0.059 (-1.258)	-
ΔCD_{iit-9}	-	-	-	-	-
ΔCD_{iit-10}	-	-	-	-	-

Table 4.12:
The Results of Error Correction Model for Singapore, Malaysia, Thailand, Philippines, and Indonesia (Continue)

Variables	Countries				
	Singapore	**Malaysia**	**Thailand**	**Philippine**	**Indonesia**
ΔCD_{iit-11}	-	-	0.075 (1.44)	-	-0.094 (-1.46)
ΔCD_{iit-12}	-	0.106 (2.25)**	0.004 (0.10)	-	-
DW	**2.0213**	**2.0680**	**1.9032**	**2.0800**	**2.0822**
LMT	**F=1.5[lag4/0.34]**	**F=1.9[lag12/0.35]**	**F=1.2[lag2/0.31]**	**F=1.1[lag2/0.22]**	**F=1.5[lag2/0.25]**
Jarque-Bera	**8.432*** **	**6.241** **	**6.342** **	**5.794** **	**7.811*** **
R^2 **Ads. R^2** **F-stat** **Prob.(F-Stat)**	**0.6343** **0.5868** **13.3624** **(0.0000)**	**0.5384** **0.4759** **8.6229** **(0.0000)**	**0.6816** **0.6296** **13.1045** **(0.0000)**	**0.6306** **0.5744** **11.2332** **(0.0000)**	**0.5746** **0.5171** **9.9880** **(0.0000)**

Note: All variables in each data set are in first differences (denoted by Δ) with the exception of the lagged error correction term (ECT_{t-1}). All equations for all data set passed the diagnostic tests reported in Table 6. Also the superscript '***', '**', and '*' specify significant at 99%, 95%, and 90% significance levels. Also, figure in parentheses are the absolute t-statistic.

4.7.5 The Results of Granger Causality in the Vector Error Correction Model

Tables 4.13 to 4.17 provide summaries for the temporal test estimates of Granger causality provided in the vector error correction framework for each countries of ASEAN5. According to the tables, the result suggests that across the countries, the error correction term(s) are found to be significantly negative. In other words, there exists a long run relationship between the variables in the system in the long term. This finding indicates that, for all counties under analysis, the results suggest that the error correction coefficient is statistically negative at the 99% significance level for Singapore, Thailand and Philippines, while at the 90% significance level for Malaysia and Indonesia. As an example (say, Thailand) at the 99% significance level suggesting a rejection of the null hypothesis of no cointegration between the economic determinants, namely, gross domestic product (GDP), real exports, ERV and real bilateral exchange rate. In the line of international finance economics, the foremost idea is that there may be co-movement (moving together) within the variables. There might be also possible among all these variables, in the long term trend together in finding stability equilibrium. Thus, in the general estimating model, the Granger representation environment in this chapter posits the following testing relationships which constitute the vector error correction model as follows;

Granger-causality in Vector Error Correction Framework

$$\Delta A_{it} = \vartheta_i + \sum_{i=1}^{A} \lambda_i \Delta A_{t-i} + \sum_{i=1}^{G} \alpha_i \Delta G_{t-i} + \sum_{i=1}^{P} \beta_i \Delta P_{t-i} + \sum_{i=1}^{\sigma} \phi_i \Delta \sigma^2{}_{t-i} + \sum_{i=1}^{CD} \gamma_i \Delta CD_{t-i} + \mu\, ECT_{t-1} + \varepsilon_{it} \quad (4.28)$$

$$\Delta G_{it} = \vartheta_i + \sum_{i=1}^{A} \lambda_i \Delta A_{t-i} + \sum_{i=1}^{G} \alpha_i \Delta G_{t-i} + \sum_{i=1}^{P} \beta_i \Delta P_{t-i} + \sum_{i=1}^{\sigma} \phi_i \Delta \sigma^2{}_{t-i} + \sum_{i=1}^{CD} \gamma_i \Delta CD_{t-i} + \mu ECT_{t-1} + \varepsilon_{it} \quad (4.29)$$

$$\Delta P_{it} = \vartheta_i + \sum_{i=1}^{A} \lambda_i \Delta A_{t-i} + \sum_{i=1}^{G} \alpha_i \Delta G_{t-i} + \sum_{i=1}^{P} \beta_i \Delta P_{t-i} + \sum_{i=1}^{\sigma} \phi_i \Delta \sigma^2{}_{t-i} + \sum_{i=1}^{CD} \gamma_i \Delta CD_{t-i} + \mu\, ECT_{t-1} + \varepsilon_{it} \quad (4.30)$$

$$\Delta \sigma^2{}_{it} = \vartheta_i + \sum_{i=1}^{A} \lambda_i \Delta A_{t-i} + \sum_{i=1}^{G} \alpha_i \Delta G_{t-i} + \sum_{i=1}^{P} \beta_i \Delta P_{t-i} + \sum_{i=1}^{\sigma} \phi_i \Delta \sigma^2{}_{t-i} + \sum_{i=1}^{CD} \gamma_i \Delta CD_{t-i} + \mu\, ECT_{t-1} + \varepsilon_{it} \quad (4.31)$$

In equations 4.28 to 4.31 are exports, the income of the importing country, bilateral exchange rate and the ERV, respectively. Difference operator denotes by Δ. Moreover, subscript *'i'* and't', indicates countries *(i=1, 2, 3,4,5)* and time series data, accordingly. Error correction term lag one *(ECT_{t-1})* operator denotes by parameter Π_i. These parameters are generated from long-run cointegrating relationship via the Johansen maximum likelihood procedure. The parameter denotes by sign μ_i (and *i=1, 2, 3, 4,5*) are serially-uncorrelated random error terms with mean equal to zero. In equation 4.*28* for instance, we test the relationship between real exports, GDP, ERV, and real bilateral exchange rate.

As stated previously, the *VECM* procedure allowed us to distinguish between short-run and long run between the variables. Intuitively, when the variables are cointegrated, 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 (Masih *et al.*,1996). Following equations 4.28 to 4.31, the addition of the error correction indicated as ECT_{ijt-k} in each equation to define the speed of adjustment from disequilibrium in the short run to the long-run equilibrium. According to the theory, disequilibrium in short run is dealing with the shock or sudden stop in the time series data. Tables 4.13 to 4.17 are summarizing the full results for each country including, short and long run relationships outcomes. These results are covering for all systems; therefore it is not only focus for the exports system in ECM results like in Table 4.12.

The speeds of adjustment are found to be varied across observation countries. For the exports system, the result suggests that the speed of adjustment[53] across the countries can be ranging from the lowest at 1.3% in Indonesia and the fastest is in Singapore at 22.96% speed of adjustment. Intuitively, if a shock occurs in the economy, a country takes from 1.3% to 22.96% of speed convergence back to long term equilibrium. These results further suggest that, Singapore faces a fast phase recovering process compared to Indonesia if a shock or sudden stop in the economy occurs. The huge variation in speed of adjustment is maybe due to the economic performance between the countries. As we can see that among these five countries Singapore has strongest currency, while Indonesia has the weakest currency among others. It is also expected that the huge variation is due to the way they react to the sudden shock (i.e. it might rely on the power of the currency of the country).

[53] For further explanation according to ECT speed of adjustment, please refer to page 28 and 29.

Table 4.13:
The Results of Granger Causality in VECM framework for Singapore

Independent Variables	Dependent Variables				
	ΔA_{ijt}	ΔG_{jt}	ΔP_{ijt}	$\Delta \sigma^2_{ijt}$	CD_{ijt}
ΔA_{ijt}	-	[8.040731]*** (0.0000)	[2.464001]** (0.0464)	[3.276808]*** (0.0010)	[2.975193]* (0.0936)
ΔG_{jt}	[5.772851]** (0.0134)	-	[5.221915]** (0.0361)	[5.963143]*** (0.0006)	[2.501817]* (0.0844)
ΔP_{ijt}	[2.896895]** (0.0298)	[4.305532]** (0.0057)	-	[0.556777] (0.5739)	[5.344860]** (0.0314)
$\Delta \sigma^2_{ijt}$	[5.701542]* (0.0539)	[6.254153]*** (0.0004)	[2.983785]** (0.0126)	-	[2.680480]** (0.0478)
CD_{ijt}	[2.100148]** (0.0666)	[1.528905] (0.1948)	[1.615349] (0.1868)	[1.629994] (0.1532)	-
$ECT_{r=1(t-1)}$	{-0.2296}***	{-0.2637}	{-0.0107}**	{1.0341}***	{0.0290}

Note: All variables in each data set are in first differences (denoted by Δ) with the exception of the lagged error correction term (ECT_{t-1}). All equations for all data set passed the diagnostic tests reported in Table 6. In various brackets, [], (), and {}, specify for Wald-test, Wald-test probability, and error correction term coefficient. Also the superscript '***', '**', and '*' specify significance at 99%, 95%, and 90% levels.

Table 4.14:
The Results of Granger Causality in VECM framework for Malaysia

Independent Variables	Dependent variables				
	ΔA_{ijt}	ΔG_{jt}	ΔP_{ijt}	$\Delta \sigma^2_{ijt}$	CD_{ijt}
ΔA_{ijt}	-	[8.345103]*** (0.0000)	[3.273001]** (0.0173)	[3.251890]* (0.0828)	[5.749757]*** (0.0009)
ΔG_{jt}	[3.461092]*** (0.0009)	-	[20.92412]*** (0.0000)	[5.720910] (0.0000)	[3.692430] (0.0032)
ΔP_{ijt}	[2.896694]** (0.0362)	[4.167463]** (0.0213)	-	[12.92630]*** (0.0000)	[8.427553]*** (0.0000)
$\Delta \sigma^2_{ijt}$	[4.748995]* 0.0511	[3.445165]* 0.0652	[4.147784]** 0.0270	-	[25.10459]*** (0.0000)
CD_{ijt}	[4.083430]*** (0.0007)	[3.072270]** (0.0173)	[0.774060] (0.4624)	[0.540457] (0.5833)	-
$ECT_{r=1(t-1)}$	{-0.018}*	{-0.0225}	{-0.0014}	{0.1508}***	{0.0141}

Note: All variables in each data set are in first differences (denoted by Δ) with the exception of the lagged error correction term (ECT_{t-1}). All equations for all data set passed the diagnostic tests reported in Table 6. In various brackets, [], (), and {}, specify for Wald-test, Wald-test probability, and error correction term coefficient. Also the superscript '***', '**', and '*' specify significance at 99%, 95%, and 90% levels.

Table 4.15:
The Results of Granger Causality in VECM framework for Thailand

Independent Variables	Dependent variables				
	ΔA_{ijt}	ΔG_{jt}	ΔP_{ijt}	$\Delta\sigma^2_{ijt}$	CD_{ijt}
ΔA_{ijt}	-	[10.33975]*** (0.0000)	[1.553225] (0.2019)	[2.059396] (0.1067)	[3.407552] (0.1056)
ΔG_{jt}	[7.763687]*** 0.0001	-	[3.636793]** 0.0169	[1.009936] 0.3660	[2.825780]** 0.0259
ΔP_{ijt}	[2.921997]** 0.0221	[2.486647]* 0.0616	-	[7.187769]*** 0.0000	[11.27918]*** 0.0000
$\Delta\sigma^2_{ijt}$	[3.716035]*** 0.0001	[4.228343]*** 0.0005	[3.199085]** 0.0485	-	[3.029918]** 0.0414
CD_{ijt}	[3.521151]* 0.0971	[2.529650] 0.1582	[1.517738] 0.1981	[7.251399]*** 0.0000	-
$ECT_{r=1(t-1)}$	{-0.0254}***	{-0.5861}**	{-0.0227}**	{0.7105}***	{0.0487}*

Note: All variables in each data set are in first differences (denoted by Δ) with the exception of the lagged error correction term (ECT_{t-1}). All equations for all data set passed the diagnostic tests reported in Table 6. In various brackets, [], (), and {}, specify for Wald-test, Wald-test probability, and error correction term coefficient. Also the superscript '***', '**', and '*' specify significance at 99%, 95%, and 90% levels.

Table 4.16:
The Results of Granger Causality in VECM framework for Philippines

Independent Variables	Dependent variables				
	ΔA_{ijt}	ΔG_{jt}	ΔP_{ijt}	$\Delta\sigma^2_{ijt}$	CD_{ijt}
ΔA_{ijt}	-	[9.081831]*** 0.0000	[1.783678] 0.1334	[2.643697]* 0.0503	[4.314323]* 0.0756
ΔG_{jt}	[3.089922]** 0.0264	-	[5.614280]*** 0.0001	[4.073418]*** 0.0007	[2.190046]* 0.0714
ΔP_{ijt}	[2.411186]** 0.0284	[1.703807] 0.1674	-	[4.104434]** 0.0232	[7.486734]*** 0.0000
$\Delta\sigma^2_{ijt}$	[3.128514]** 0.0458	[2.868297]** 0.0375	[9.965955]*** 0.0000	-	[6.792234]*** 0.0000
CD_{ijt}	[3.486855]** 0.0166	[2.551512] 0.1401	[2.250074] 0.1834	[1.282867] 0.2793	-
$ECT_{r=1(t-1)}$	{-0.028}***	{-0.0233}	{0.0003}	{-0.00157}	{0.0015}

Note: All variables in each data set are in first differences (denoted by Δ) with the exception of the lagged error correction term (ECT_{t-1}). All equations for all data set passed the diagnostic tests reported in Table 6. In various brackets, [], (), and {}, specify for Wald-test, Wald-test probability, and error correction term coefficient. Also the superscript '***', '**', and '*' specify significance at 99%, 95%, and 90% levels.

Table 4.17:
The Results of Granger Causality in VECM framework for Indonesia

Independent Variables	Dependent variables				
	ΔA_{ijt}	ΔG_{jt}	ΔP_{ijt}	$\Delta \sigma^2_{ijt}$	CD_{ijt}
ΔA_{ijt}	-	[7.230116]*** 0.0000	[2.577867]** 0.0784	[2.945997]** 0.0688	[1.387649] 0.2520
ΔG_{jt}	[3.135461]** 0.0236	-	[2.271531]* 0.0627	[2.637357]** 0.0351	[1.199737] 0.3109
ΔP_{ijt}	[1.451962] 0.2288	[3.010525]** 0.0176	-	[3.545376]** 0.0155	[8.824876]*** 0.0000
$\Delta \sigma^2_{ijt}$	[2.546731]** 0.0213	[2.671075]* 0.0560	[3.441421]** 0.0229	-	[3.945519]** 0.0208
CD_{ijt}	[2.975667]** 0.0325	[2.494180]* 0.0539	[1.967851] 0.1197	[4.661510]** 0.0104	-
$ECT_{r=1(t-1)}$	{-0.013}**	{-0.1382}**	{0.0019}	{-0.0312}	{0.0027}

Note: All variables in each data set are in first differences (denoted by Δ) with the exception of the lagged error correction term (ECT_{t-1}). All equations for all data set passed the diagnostic tests reported in Table 6. In various brackets, [], (), and {}, specify for Wald-test, Wald-test probability, and error correction term coefficient. Also the superscript '***', '**', and '*' specify significance at 99%, 95%, and 90% levels.

Furthermore, the VECM estimator allowed us to investigate the short term relationship between the variables in the VECM framework across the countries under observation. The inclusion of other economic determinants, say the industrial product index, in the Granger causality model, is assumed to have a significant relationship with exports in the short run which in turn gives important impact on export. According to the theory, this growth indicator for the importing country has a significant relationship with exports. In other words, if growth in the importing country increases this leads to rise in exports in Singapore. Results in Table 4.13, are found to be coherent with this assumption. The result suggests that, the United States growth indicator is significant in influencing their imports from Singapore at 99% significance level. Therefore, this study concludes that the growth of importing country like the United States is vital in explaining exports in the short run. The same outcomes are revealed for Malaysia, Thailand, Philippines and Indonesia. These coherent findings within the countries across time indirectly support the robustness relationship between importing country economic growth and export demand.

Surprisingly, the relationship between exports to importing country economic growth seems strong, since this finding is applied in all countries under observation. For instance, referring to Table 4.14, the results suggest that the exports parameter denoted by ΔA_{ijt} (in the independent panel) significantly impacts the importing country economic growth (denoted by ΔG_{ijt} in independent panel) at the 99%

significance level. This outcome may be due to the price competitiveness between domestic and foreign prices. In this case, if the domestic price in the exporting country, say Malaysia, decreases, this will indirectly influence the importing country to increase their imports from Malaysia. From the United States point of view, although growth in the importing country is not significantly increased, but because of the price in the exporting country is lower in comparing with domestic price in the United States, thus they will increases their imports from Malaysia. Therefore, a negative relationship is assumed for the export-importing country growth nexus.

The results further suggest unidirectional causality from real bilateral exchange rate to exports in Singapore, Malaysia and Indonesia. On the contrary, the results suggest for bidirectional relationship from real bilateral exchange rate to exports in Thailand and Philippines. According to economic theory, the real bilateral exchange rate gives a positive impact on export. In practice, (say in Philippines), if Peso currency value depreciates (Peso/USD is increased) then this will raise the competitiveness of the domestic commodity price. In this condition, from the investor point of view, buying from abroad (importing) is cheaper compared with the price of the domestic product in the United States. As a result, this scenario encourages exports to rise in the Philippines.

The inclusion of the Crisis Dummy (CD) indicator due to Asian Financial Crisis in 1997/1998 in the VECM system is assumed to give a significant impact on ASEAN5 exports from the United States. In general, the results offer consistent findings with the earlier assumption generated in this chapter. From the results we observe that all countries under observation are sensitive with the CD. As an example, Indonesia's export to the United States is sensitive with the Asian Financial Crisis at 95% significant levels. Thus, this study suggests that exports are sensitive to sudden stop (or shock) in the economy. Failure to include this variable (CD) in the system VECM may lead to a biased specification in inference or in the estimated model. Hence, the results will be *spurious*.

4.8 Summary and Conclusion

Although the ERV-exports nexus has been heavily researched at both theoretical and empirical levels, the impact of this relationship in the time window covering the Asian Financial Crisis period has so far received much less attention, especially for ASEAN5 countries. Thus, this chapter offers empirical evidence of ERV-exports nexus, for the ASEAN5 countries, namely Singapore, Malaysia, Thailand, Indonesia and Philippines to the United States over the monthly period from January, 1990 to December, 2010. Following the results in the ECM model, this study suggests for the robust negative significant relationship between ERV-exports nexus in Singapore and Philippines. In addition, for Indonesia, this study suggests for the positive relationships between these two variables, ERV and exports. However, these finding are slightly different, such as from Baak *et al.* 2007. For example, Baak *et al.* (2007) found an ambiguous relationship between ERV and exports in Singapore. Moreover, a similar result is documented for Thailand, where the relationship is found to be significantly negative.

In the nutshell, this chapter contributed to the literature of volatility modeling. However the evidence for ASEAN5 countries (i.e. Singapore, Malaysia, Philippines, Thailand and Indonesia) is not tremendously robust that exchange rate volatility has a negative effect on exports. Therefore for extension study, it is suggest for more robust estimation is required. This may include an array of alternative formulations involving different measures of exchange rate volatility, other estimation techniques (i.e. dynamic panel analysis); enlarge country grouping and disaggregation by type of export product. Following this alternative, we may find systematic evidence of a negative effect of volatility on trade.

Chapter 5

5.1 **Conclusion**

This thesis attempted to investigate three different issues of exchange rate that were covered in three separate chapters (Chapters two, three and four). Chapter One gives a brief discussion of the research questions and the research contribution of the issues. This current chapter (five), gives deeper understanding of the outcome in term of its economic implication. The exchange rate issues is the most important economic determinate. For instance, the issue of inter temporal relation between stock returns and exchange rates has recently preoccupied the minds of economists, for theoretical and empirical reasons, since they both play important roles in influencing the development of a country's economy. Moreover, the continuing increases in the world trade and capital movements have made the exchange rates one of the main determinants of business profitability and equity prices (Kim, 2003). Finally, the exchange rates directly influence the international competitiveness of firms, given their impact on input and output price (Joseph, 2002). Therefore, the exchange rate is a tremendously vital factor for decision making of a country's economy.

As an economist once said,

"For most countries … the choice of exchange rate policy is probably their single most important macroeconomic policy decision, strongly influencing their freedom of action and effectiveness of other macroeconomic policies, the evolution of their financial system, and even the evolution of their economies"-
(Cooper, 1999)[54].

According to the International Monetary Fund (hereafter: IMF)[55] definition, the exchange rates are classified into three broad categories, reflecting the role of the authorities in the determination of the exchange rates and/or the multiplicity of exchange rates in a country; these are (1) the market rate, is used to describe exchange rates determined largely by market forces; (2) the official rate, is used to

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[54] See, Cooper, R. N., "Exchange Rate Choices", 1999.
[55] Refer to International Financial Statistics Yearbook, IMF, Washington D.C, 2000, Introduction, page ix.

describe the exchange rate determined by authorities; and (3) for countries maintaining multiple exchange arrangements, the rates may be labelled principal rate, secondary rate, and tertiary rate. Moreover, exchange rates may also be expressed as period average rates or end of period rates (IMF, 2000). Giving the exchange rate description above, it is understood that the exchange rates have a massive contribution on the economic systems. In addition, the exchange rate issues have been debated among the researchers and even among the policy makers, for years. Examples of the issues include; the impacts between ERV and growth, ERV-export demand nexus and many other issues.

Chapter Two has highlighted some problems with exchange rate issue by using the time series framework in testing for the ELGH in different exchange rate regimes in Malaysia. Most of the previous studies focus on developed countries like Japan, the European Union (EU), and even the United States. Moreover, there are few studies on developing countries like Malaysia as their focus. Therefore, this study is attempting to fill the gap and re-examine the relationship between exports and growth in separate regimes in Malaysia. Malaysia is chosen based on the fact that the country has been experiencing three different regimes in the period from 1990 to 2010. This is advantageous because the sample allows us to investigate the implication of different exchange rate regimes in influencing the relationship between exports and growth. Together with exports, we also include real imports and the real exchange rates as explanatory variable to growth. The analysis expands further by implementing the Darrat et al. (2000) testing procedure of exogeneity in multivariate system equations.

The estimation results emphasize a few important findings. Firstly, here the study argues that the impact of export on growth by using standard time series framework of Granger causality in estimating the relationship between exports and growth is inappropriate if cointegrating vectors are present between the variables. Therefore, by implementing the advanced econometric procedure including Johansen Juselius cointegration tests and Granger's causality in vector error correction modelling, this study finds ample evidences to support the short and long run relationship between export and growth in multivariate systems. According to the results, the relationship between exports and growth varies across regimes in Malaysia. The results suggest the short run bidirectional and/or unidirectional relationship between exports and growth across the regimes, excluding for Model 7 in regime two is present. This outcome indicates that, not only exports influence growth, but at the same time the impact is also from growth to export. The findings are found to be strong outcomes when the significance level is 90% or more. Therefore, this chapter concludes that the ELGH is valid and significant across the regimes in Malaysia.

Secondly, we extend the analysis further by adopting the exogeneity tests procedure proposed by Darrat et al. (2000). This test is essential in order to investigate the strong case of the ELGH across the regime in Malaysia. This test is actually related to Lucas' critique (Lucas, 1976). According to the Lucas critique, to make a strong case for the ELGH, exports need to be structurally invariant to structural changes or regime shifts. In other words, exports must be super exogenous. Because of weak exogeneity is a necessary condition for super exogeneity, hence testing for weak exogeneity of export is required. As stated in Darrat et al. (2000), weak exogeneity of the export is rejected if the error correction term is statistically significant. According to the results, the error correction term(s) are found to be significant, except for model two. In other words, exports are not weakly exogenous and subsequently, are not super exogenous. This result furthermore weakens the case for the ELGH in Malaysia. Hence, the strong ELGH in Malaysia is inappropriate. Therefore, it is concluded that in the Malaysian context, the Lucas critique applies, where according to the findings across the regime the relationship between exports and growth is not invariant to policy changes or regime shifts.

In conclusion, the exchange rate regimes do not seem to give any impact on export in stimulating growth. In other words, in every regime under observation, the results suggest similar conclusion; i.e. the export variable is an engine of economic growth in Malaysia. The relationship between exports and growth is also found to be not invariant to policy changes or regime shifts. So, it is recommended that, although the export-promotion policy has been credited for the success of fast-growing Malaysia economies, the implementation of this policy requires caution.

Following the outcome of Chapter Two, a few economic implications emerge. Firstly, the significant role of the exports on economic growth (across the regimes) indicates that the export sector has an important contribution in influencing Malaysian economic growth. Since the empirical evidence supports the export-expansion strategy, the economic growth in turn promotes higher export growth. Certainly, these results support the view expressed by Bhagwati (1988), which indicate that trade expansion increases income and more income facilitates more trade. Nonetheless, it is not clear whether export promotion strategies can continue to accelerate growth in the next decades, especially in the face of worldwide regionalism and limitation of the world market. It is argued that future success of export promotion strategies will depend on the ability to penetrate new markets; increased labour productivity and the productivity of quality products through product innovation and product development (Baharumshah and Rashid, 1999). Secondly as a small open economy, Malaysia is obviously sensitive to the changes in the international markets. Therefore, liberalisation of trade and investment policies without comprehensive preparation may hurt domestic economic and industries, as there is great pressure from abroad as the country is implementing its liberalisation policy. Thus, policy makers should liberalise such policies carefully in terms of trade and foreign direction investment in order to attract multinational corporations to setup their factory in certain resource abundant and high technology industries locally in order to improve the overall economic prosperity.

Next, Chapter Three accentuates the understanding of exchange rate exposure on sector returns in Malaysia. The exposures are first moment exchange rate (exchange rate changes), second moment exchange rate (exchange rate volatility) and exchange rate asymmetry. There are eight main sector returns in Malaysia namely, the Financial, Plantation, Properties, Industrial, Construction, Trade & Services, Tin & Mining, and Consumer price indices. As stated previously by Bodnar et al. (1993), they suggested three channels from which exchange rate exposure affects cash flows and indirectly the stock returns. The channels are ;(1) the domestic exporter's terms of competition with foreign firms, (2) the output, input or even substitute goods price with direct international operations relative to foreign firms, and finally (3) the firm's assets denominated in foreign currencies. It is recommended that the stock price reacts ambiguously through exchange rate fluctuation. However, some other studies suggest for negative or positive relationships between these variables. The relationship between these two variables however depends on the behaviour of the economic agent, risk averse or very risk averse. A risk averse investor dislikes risk, and therefore will stay away from adding high-risk stocks or investments to their portfolio and in turn will often lose out on higher rates of return. Thus, when high risk arises in the investment portfolio, they tend to diminish their investment or move to other portfolios with less risk. Within this setting, it is assumed that the investor will exhibit risk averse behaviours in Malaysia. Therefore they react negatively to the exchange rate risk, which tends to reduce their investment when risk increases. In order to test the relationship between exchange rate exposure and sector returns in Malaysia, we adopt the time series tests procedure following the Maximum Likelihood Estimator (MLE) regression. The main model is conducted in two types, namely the contemporaneous exchange rate and the one day lagged exchange rate models.

Three important conclusions emerge. Firstly, the findings provide support for the CAPM theory, for both contemporaneous and one-day lagged exchange rate models. According to the results, in all instances the market returns are found to be significant for sector returns. This finding is consistent with the argument by Sharpe (1964) and

Lintner (1965); that only market fluctuations can explain firm's asset values in the long run. Secondly, the first moment exposure appears to be a crucial determinant for some of the sector returns in Malaysia, thus directly supporting the top-down approach recommended by Adler and Dumas (1984), in estimation modelling. Surprisingly, some others appear to be more volatile or riskier than the market returns portfolio. Thirdly, the outcomes of second moment exposure are fairly exciting, where; according to the results nearly 75% of the sectors are sensitive to the exchange rate volatility in both estimating models in Malaysia.

Overall, from the finding it is understand that the exchange rate exposure or the currency fluctuation is important for a developing country like Malaysia. Not like other ASEAN countries, Malaysia has a different experience of economic history in facing the economics tribulation, and for that reason Malaysia has a preference for exchange rate stability systems, or in other words it prefers to react as *"fear of floating"*, especially during the Asian Financial Crisis in 1997/1998. To Malaysia, the exchange rate stability is essential due to its highly open economy but its fewer established financial markets. Therefore, the high exchange rate volatility during floating exchange rate mechanism could expose Malaysia to significant risk. Hence, it chose to peg its currency in 1998, to ensure stability for the financial market. This argument is also consistent with the current findings that most of the sector returns tends to significantly exposed to large exchange rate fluctuations. In implication, during high exchange rate volatility the investor should shift their investment from the risky portfolio (which sensitive to the exchange rate fluctuation) towards safer investment.

Chapter Four examines the role of exchange rate volatility on export demand from five ASEAN countries including, Singapore, Malaysia, Thailand, Philippines and Indonesia (denotes as ASEAN5) to the United States. This study is a continuation of the research of Chapter Three. In the Chapter Three, the study is focused on the impacts of exchange rate fluctuation on sector returns. Yet, in this chapter the study of exchange rate volatility is wider. It is well known that the emerging countries like ASEAN5 have high engagement with exchange rate vulnerability worldwide. Theoretically, a common hypothesis is that exchange rate volatility (or risk) will have a negative sign rather than the positive sign in influencing exports. No final agreement is reached on the direction of the sign. One possible reason for the non-robust results is that in previous empirical studies it has not been recognised that real exports and some proposed determinants such as real world trade, are potentially non-stationary integrated variables (Asseery and Peel, 1991). For years, this debate has received much research interest, generating a sizeable empirical literature on the direction of the relationship between exchange rate volatility and exports. Hence, this research has attempted to fill the gap by investigating the causality between exports and growth in the long-run and short run. Exploiting the multivariate time series modelling explicitly, cointegration tests, error correction modelling and the Granger causality tests in the vector error correction framework, the analysis addresses a few important findings.

Firstly, it is suggested that the exchange rate volatility is an important macroeconomic determinant in explaining export demand from the United States. However, according to the sign of the relationship, the findings are mixed. Some of the results recommend a negative relationship between exchange rate volatility and exports, while some others tends to be positive or ambiguous. Explicitly, the negative sign is offered by the model in Singapore and Malaysia. A positive relationship is found between exchange rate volatility and export demand in Indonesia, while, for Thailand and Philippines, it is ambiguous. The mixed results in ASEAN5 show proof of a variety of impacts of exchange rate volatility on export demand across the country border. One possible reason for the non-standardized relationship within the country may be due to the exchange rate policy applied in the country. The findings also noted the short and long relationship between the variables in estimations modelling. Secondly, besides the exchange rate volatility-exports nexus, the following research question is to observe the role of importing country income/growth channel in influencing export demand from the United States. It is shown that the importing country growth has a positively significant contribution in encouraging the import activity of the country. Hence, failure to include this variable in the estimation system may cause spurious outcomes.

In implication, the significant role of the exchange rate variable on export demand indicates that, the monetary authority has to monitor closely the exchange rate or price competitiveness in the international market. This is because; the response of the export demand from ASEAN5 region from the United States depends heavily on price stability to avoid risk in open market. Even though for some countries like Indonesia, the impact of exchange rate volatility is positive, the other 60% of the samples (Malaysia, Singapore, and Philippines) face negative impact from the exchange rate vulnerability. Thus, each country should use a monetary policy in mitigating the negative effects of internal and external impacts on the domestic economy. However, it is true that some of the countries in our sample adopt the floating exchange rate regime as their target currency. One of the reasons is that, the flexible exchange rate regime helps cushion the external and domestic shocks, but at the same time the government of the country needs to manage the currency properly and carefully. Moreover the foreign reserves could be increased to more comfortable levels over the medium term, thus supporting for the growth of the country.

To conclude, this thesis contributes the new evidences of three different exchange rate issue. This contribution, not only enlarges the existing literature in the related field, it also provides useful information for decision maker, like the government, investors, importers and exporters. From the findings, it is highlighted that the policy maker should not overlook the role of the exchange rate; in fact the exchange rate stability is essential in promoting Malaysian trade. As an example, the monetary authority for the small open economy (like National Bank, Malaysia) should play an important role in stabilising the exchange rate value to ensure that it is venerable in the international market and also to help the country to accomplish its domestic goals.

Appendices Section

Appendices for Chapter Two

Appendix 2.1: (Table 2.1b): A brief selection of empirical framework of the related economic literature on the Export Led Growth Hypothesis (ELGH) worldwide from 1997 to 2008

About the Paper		Methodology					Result and conclusions
		Data set				Econometrics Approach	
Researcher	year	Type of data set	Growth	Export	Other variables		
Emery	1967	Cross sectional (1953-1963)	GNP growth	Export growth	Current account	Ordinary Least Square (OLS)	Support for the export-led hypothesis
Syron and Walsh	1968	Cross sectional (1953-1963)	GNP growth	Exports	None	Ordinary Least Square (OLS)	The result support the hypothesis but its sensitive depending on type of country (LDCs or developed countries)
Serven	1968	Cross sectional (1953-1963)	GNP growth	Export growth and/or export change/output	None	Ordinary Least Square (OLS)	Support for the export-led hypothesis
Kravis	1970	Cross sectional (1835-1966)	GNP	Export growth	None	Spearman rank correlation	Support for the export-led growth hypothesis, but indicates that LDCs have been capable of diversifying their exports have been more successful in terms of growth
Michaely	1977	Cross sectional (1950-1973)	Per-capita GNP growth	Growth of export share	None	Spearman rank correlation	Support for the export leg growth and suggests the existence of a threshold effect in the data.
Balassa	1978	Cross sectional, 10countries (1960- 1973), 10 countries	GNP growth	Real Export growth	Labor force growth, investment, and foreign investment/output.	Rank correlation, Ordinary Least Square and production function.	The outcome of the analysis fully support the export-led growth hypothesis.
Heller and Porter	1978	Cross sectional (1950-1973)	Output growth rate GNP	Per-capita exports	None	Spearman rank correlation	Litter support for export-led growth hypothesis, because of GNP growth variable.
Fajana	1979	Cross sectional (1954-1974)	GDP growth	Export share of GDP and export change/GDP	Foreign capital	Ordinary Least Square (OLS) and two-gap model	Support for the export-led hypothesis

Tyler	1981	Cross sectional (1960-1977), Middle income LDCs, 55 countries	Real GNP growth and GNP per capita	Real export growth	Labor force growth and investment growth	Pearson and Spearman rank correlation, OLS and production function	Support for the export leg growth and suggests the existence of a threshold effect in the data.
Feder	1983	Cross sectional (1964-1973), 31 countries	GDP growth	Export growth and/or export change/output	Labor force growth and investment/output	OLS and production function	Support for the export-led hypothesis
Kavoussi	1984	Cross sectional (1960-1978), low and middle income LDCs, 73 countries	Real GDP growth	Real Export growth	Labor growth and capital growth	Spearman rank correlation and OLS	Support for the export-led hypothesis but not too strong.
Balassa	1985	Cross sectional (1974-1981), 10 countries	GNP growth	Export growth	Labor force growth and investment/output	OLS and production function	Support for the export-led hypothesis*
Jung and Marshall	1985	Time series (1950-1981), LDCs	Real GNP growth	Lagged Real Export growth	Lagged GNP and GDP growth	Ordinary Least Square (OLS), Granger causality test	Only 4 out of 37 countries supported export-led growth hypothesis (Indonesia, Egypt, Costa Rica, Ecuador)
Ram	1985	Time series (Two sub-period: 1960-1970, 1970-1977), Low and middle income LDCs	Real GDP growth	Real Export growth	Labor force growth and investment growth	OLS, White test for specification bias and heteroskedasticity	Support for the export leg growth and suggests the existence of a threshold effect in the data.
Chow	1987	Time series (1960-1980), NICs	Manufacturing output growth	Export growth of manufacturing goods	None	Sim's causality test (1972), bivariate model	Support for reciprocal causality hypothesis regarding export growth and industrial development
Darrat	1987	Time series (1955-1982), Four little dragon	Real GDP growth	Lagged Real Export growth	None	OLS, White test bivariate model	Reject export led growth hypothesis in 3 out of 4 cases (the test valid for Republic of Korea case base on causality test)
Ram	1987	Cross sectional (Two sub-period: 1960-1972, 1973-1982), Low and middle income LDCs	Real GDP growth	Real Export growth	Government size, GDI/GDP, labor force	OLS, production function	Support the export led growth hypothesis

Kunst and Marin	1989	Cross sectional (1970-1980)	Real GDP growth	Real Export growth	labor growth, real domestic investment growth	OLS, production function	Support the export led growth hypothesis and suggests the existence of an threshold effect.
Moschos	1989	Cross sectional	Real GDP growth	Real Export growth	labor force growth, real domestic investment growth	OLS, production function	Little support for export-led growth hypothesis, because of economic growth variable.
Kovacic and Djukic	1990	Time series (1952-1987), Yugoslavia	Real total GDP	Real Export growth	Manufacturing GDP	Cointegration tests, Granger's test with 4 different lag selection criteria	No cointegration between variables, manufacturing GDP causes exports
Chan et al.	1990	Time series (1952-1987), Taiwan	Real GDP	Real Export	None	Granger's test with impulse lags	GDP growth causes exports
Colombatto	1990	Cross sectional (In three separate years: 1971, 1978, and 1985)	Real GDP growth	Real Export growth	Government consumption, agriculture exports and degree of openness	OLS, correlation coefficients	Reject the export-led growth hypothesis
Fuso	1990	Pooled cross sectional (two period: 1960-1970, and 1970-1980) African countries	GDP growth	Rate of growth of merchandise exports	Rate of growth of GDP, labor growth	OLS, production function	Support the export led growth hypothesis
Bahmani-Oskooee	1991	Time series (1951-1986), 20 developing countries	Real GDP	Real exports	None	Granger's test , FPE criterion	Exports cause GDP in 3 cases, bidirectional in 2 cases, and in causality in others.
Sharma et al.	1991	Time series (1960-1987), Germany, Italy, UK, Japan, and the US	Real GDP	Real exports	None	Granger's test , FPE criterion	Exports cause GDP in Germany and Japan, GDP causes exports in UK and US
Kwan and Cotsomitis	1991	Time series (1952-1985), China	Real National Income	Growth rate of real exports	Per capita income	Granger's test	No causality during 1952-1978 period, and bidirectional causality for 1952-1985
Ahmad and Kwan	1991	Pooled cross sectional data (1981-1987), 47 African countries	Real GDP	Real total exports	Per capita GDP, manufactured exports, share of manufactures in total exports	Granger's test and AIC lag selection	No causality for the full sample
Salvatore and Hatcher	1991	Cross sectional (Two sub-period: 1963-1973, 1973-1985), 26 countries	Real GDP growth	Real Export growth	Labor input growth, capital input growth, and industrial growth	OLS, production function	Support for export-led growth hypothesis
Kugler	1991	Time series (1970-1987), US, Japan, Germany, France, and Switzerland	Real GDP	Real exports	Investment and consumption	Granger's test, and cointegration	Exports cointegrated with other variables only in France and Germany
Alxentiou and Serletis	1991	Time series (1950-1985), 16 developed countries	Real GDP/GNP	Real Exports	None	Cointegration tests, Granger's test with Schwartz criteria	Bidirectional causality in US; GDP causes exports in Canada, Japan and Norway; no causality in other countries.

Sengupta	1991	Time series (1967-1986), South-East Asia (Republic of Korea)	Real GDP growth	Real export growth	Labor growth, and capital growth	OLS, production function	Support the export led growth hypothesis and suggests the positive externality effects of exports on growth
Giles et al.	1992	Time series (1963-1991), new Zealand	Real GDP	Real exports	Total disaggregated data for 7 sectors	Granger's test	Exports cause GDP growth in food and beverages, and metals sectors; GDP causes exports in minerals; bidirectional causality in live animals; no causality in manufactured goods
Ahmad and Harnhirun	1992	Time series(5 member countries of the ASEAN)	Rates of growth of real GDP	Real exports	None	Granger's test, cointegration, and error-correction models	No causality in Thailand; in other cases, GDP growth causes exports.
Marin	1992	Time series (1860-1987), Germany, UK, US, and Japan	Productivity in manufacturing	Real exports	None	Cointegration test, Granger's test with error-correction models	Exports cause the growth of productivity in manufacturing in all countries, except the US
Serletis	1992	Time series (1870-1985), Canada	Real GNP	Real exports	Real imports	Cointegration test, Granger's test, Schwartz criterion	Exports cause the growth of imports, which in turn cause the growth of GDP
Kugler and Dridi	1993	Time series (1860-1989), 11 developing countries	Real GDP/GNP	Real exports	Investment and consumption	Cointegration test	Exports are cointegrated with other variables in 7 cases
Dodaro	1993	Time series (1967-1986), 87 developing countries	Real GDP/GNP	Real exports	None	Granger's test with 2 lags	Exports cause GDP growth in 4 cases; bidirectional causality in 10 cases and no causality in the rest
Gordon and Sakyi-Bekoe	1993	Time series (1955-1987), Ghana	Real GDP	Real exports	Real investment	Causality test using 5 different techniques	GDP causes exports on Granger's test; the causal direction is reversed on Holmes and Hutton test
Oxley	1993	Time series (1865-1985), Portugal	Real GDP	Real exports	None	Cointegration test, Granger's test with error-correction models	Growth of GDP causes exports
Bahmani-Oskooee and Alse	1993	Time series (1953-1991), 26 Developing countries	Real GDP/GNP	Real exports	None	Cointegration test	Exports and GDP are cointegrated in all cases
Lusssier	1993	Cross sectional and panel data (1960-1990) African economies	GDP growth	Real export growth	Labour growth, GDI/GDP, export share of GDP	OLS, 4 versions of production function	Supports the hypothesis in panel data but fails to find any positive association when using export growt
Lusssier	1993	Cross sectional and panel data (1960-1990) African economies	GDP growth	Real export growth	Labour growth, GDI/GDP, export share of GDP	OLS, 4 versions of production function	Supports the hypothesis in panel data but fails to find any positive association when using export growt

Sheehey	1993	Cross sectional (1960-1970) semi-industrialized countries	GDP growth	Real export growth	Labour growth, GDI/GDP, export share of GDP	OLS, production function	Inconsistent evidence of higher productivity in the export sector compared with the non-export sector; thus, suggest caution when analysing empirical result.
Dutt and Ghosh	1994	Time series (1953-1991), 26 Developing countries	Real GDP	Real exports	None	Various cointegration test	Exports and GDP are cointegrated in 20 out of 26 countries
Ukpolo	1994	Time series (1969-1988)	Manufacturing growth	Fuel export growth	capital growth, labour growth, non-fuel production growth	Extended production function OLS regression	Limited support for the hypothesis
Sengupta and Espana	1994	Time series (1961-1986), Korea	Real GDP growth	Real export growth	labour force growth	Engle and Granger causality augmented production function with two types of sections	Supports for the hypothesis
Greenaway and Sapsford	1994	Time series (Three sub-period: 1957-1985, 1970-1985, 1971-1985)	Real GDP growth	Real export growth, and export change/output	labour growth, rate of growth in investment, dummy for liberalization episodes	OLS, 3 versions of production function	Little support for the export-led growth hypothesis and for the positive liberalization effects on growth
Lee and Cole	1994	Cross Sectional (Two sub-period: 1960-1970, 1970-1977)	Real GNP growth	Real export growth	Labour growth, GDI/GDP	2SLS, production function, Hausman's test	Supports the existence of a bidirectional causality between exports and growth
Van den Berg and Schmidt	1994	Time series (1960-1987),17 Latin America countries	Real GDP	Real exports	None	Various cointegration tests	Exports and GDP are cointegrated in many cases
Love	1994	20 low income and lower middle income developing countries	Real GDP	Real net of exports	Real export, government expenditure	Granger's test, VAR models	Exports cause GDP in 14 cases and GDP net of exports in 5 others
Suliman et al.	1994	Time series (1967-1989), South Korea	Real manufacturing GDP	Real exports	The real of financial development measured by the ratio of currency to money supply	Granger's test VAR models	Exports cause GDP growth indirectly via changes in money supply
Ghartey	1993	Time series (1960-1990),US, Taiwan, Japan	Nominal GNP	Nominal export	Capital stock terms of trade in Japan's model. None for US and Taiwan	WALD-test for Hsiao's version of causality	Result tends to reject in US and Japan; support for the hypothesis in Taiwan.
Khan and Saqib	1993	Time series (1972-1988), Pakistan	GDP growth	Real export growth: primary products and manufactured goods	Labour growth, capital growth, World GDP index, relative prices	Cointegration test	Supports the hypothesis of a strong association between exports and growth performance

Jin	1995	Time series (1976-1993), Four little dragons	Real GDP	Real exports	Real exchange rate, foreign price shock, foreign output shock	F-test for Granger with IRFs and VDCs, Engle and Granger cointegration, ad hoc VAR models	Bidirectional causality in short run and no cointegration in long run.
Kwan and Kwok	1995	Time series (1952-1985), China	Real output	Real exports	None	Exogeneity of export growth	Support for export-led growth hypothesis
Jin and Yu	1995	Time series (1960-1987), Korea, Japan, Canada, and US	Real GDP	Real exports	None	Granger causality with FPE tests	No support for export-led growth; bidirectional causality in Japan and Korea
Ahmad and Harnhirun	1995	Time series (1966-1990), ASEAN countries	Real GDP	Real exports	None	Johansen cointegration tests, with 2 unit roots, Granger's test	No cointegration between exports and GDP in any country, except Singapore. Bidirectional causality in the case of Singapore
Amirkhalkhali ad Dar	1995	Time series (1961-1990), 23 LDCs countries	Output growth	Export	Input-input ratio, labour force growth	OLS and GLS production function	Support for the export-led growth hypothesis.
Doraisami	1996	Annual time series data from 1963 to 1993	Real GDP	Real Export	None	ADF unit root, cointegration, VEC modelling	Support for the export-led growth hypothesis.
Kwan et al.	1996	Time series (1953-1988), Taiwan	Real GDP	Real exports	Labour force, domestic investment	Exogeneity of export growth	Only weak support for export-led growth hypothesis
Ahmad and Harnhirun	1996	Time series (1966-1988), ASEAN countries	Real GDP	Real exports	None	Engle and Yoo cointegration test, Granger's test, error-correction models	No cointegration between variables, GDP causes exports in all countries
Riezman, et al.	1996	9 Asian countries in the Summer-Heston	GDP growth	Exports	Imports at current prices	2-variables ; 3-variables Granger causality tests	Mild support for export-led growth
Burney	1996	Cross sectional income group; continents 1965-1990	GDP growth	Exports growth	Labour growth; capital growth; and energy consumption growth	OLS and RC; Augmented production function	Limited support for the hypothesis
Xu	1996	Time series (1953-1988), 32 countries	Real GDP	Real exports	None	Engle and Granger cointegration, Two variable relationship	Only 50% from all sample support the hypothesis
Jin and Yu	1996	Time series (1959(1)-1992(3)) US quarterly data	Real GDP	Real Exports	None	6-variables VAR model with cointegration	No support for export-led growth hypothesis; no cointegration

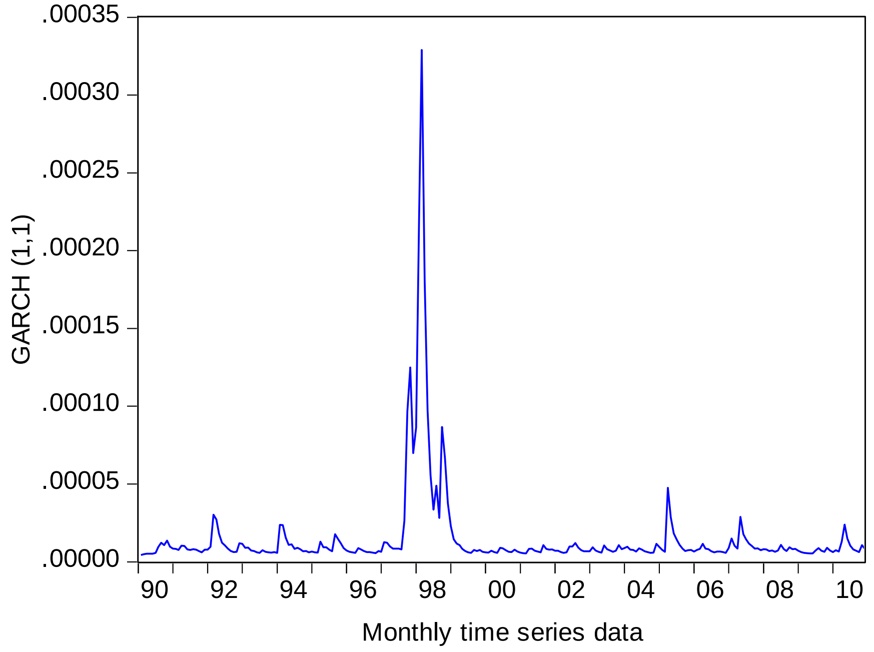
Dutt and Ghosh	1996	Time series (1953-1991), 14 countries	Real GDP	Real exports	None	Engle and Granger cointegration, Two variable relationship	Only 30% from sample countries support for the hypothesis
Henriques and Sadorsky	1996	Time series (1870-1991), Canada	Real GDP growth	Real exports growth	Term of trade	ADF unit root, VARs, Johansen's procedure, granger causality test	No support for the export-growth hypothesis but failed to reject it
Thornton	1997	Time series (19th century to 1913), ASEAN countries	Real GNP	Real exports	None	Cointegration and Granger causality tests	Causality from exports to GNP in Italy, Norway, and Sweden; from GNP to exports in the UK; and bidirectional in Denmark and Germany
Admad et al.	1997	Time series (1966-1994), ASEAN countries	Real GDP	Real exports	None	Cointegration tests with ECM models	No cointegration between variables, mixed results on causality tests
Al-Yousif	1997	Time series (1973-1993),	Real GDP growth	Real export growth, and export change/output	Labour force and GDI/GDP	ADF unit root, Granger causality test, production function	Evidence that supports the hypothesis in the short-run. However, it fails to find any long-run relationship (no cointegration)
Yamada	1998	Time series (1975(1)-1997(2)),US, Canada, UK, Italy, France and Japan	Real GDP	Real exports	Labour productivity	Granger causality in a VAR models	causality from exports to productivity only for Italy
Biswal and Dhawan	1998	Time series (1960-1990), Taiwan	Real GDP	Total exports	Manufactured exports	Granger causality in a VAR models	variables are cointegrated, causality bidirectional
Islam	1998	Time series (1967-1991), 15 Asian NICs countries	Real GDP	Real exports	None	Cointegration and Granger causality tests	Variables are cointegrated only in 5 countries; short-run causality from exports to growth in 10 out of 15 countries.
Shan and Sun	1998	Monthly Time series (1978(5)-1996(5)), China	Real GDP	Real exports	Labour force, investment and energy consumption	Ad Hoc production function, VAR	Result indicates a bidirectional causality between export and real output. Therefore, the export-led growth hypothesis defined as a unidirectional causal ordering from exports to growth is rejected.
Begun and Shamsuddin	1998	Time series (1961-1992), Bangladesh	Real GDP	Real export growth, and export change/output	Labour force, GDI/GDP, dummy and trend	OLS, VAR production function, MLE estimation and ARCH model	Result supports the hypothesis
Shan and Sun	1998	Monthly Time series (1978(5)-1996(5)), China	Real GDP	Real exports	Labour force, investment and energy consumption	Ad Hoc production function, VAR	Result indicates a bidirectional causality between export and real output. Therefore, the export-led growth hypothesis defined as a unidirectional causal ordering from exports to growth is rejected.

Begun and Shamsuddin	1998	Time series (1961-1992), Bangladesh	Real GDP	Real export growth, and export change/output	Labour force, GDI/GDP, dummy and trend	OLS, VAR production function, MLE estimation and ARCH model	Result supports the hypothesis
Kwan et al.	1999	Time series (Hong Kong:1966-1994; South Korea:1953-1992; Singapore: 1965-1991)	Real GDP	Real exports	None	Tests of cointegration and exogeneity	No cointegration between variables; mixed results on exogeneity
Baharunshah et al.	1999	Quarterly Time series (1970:1 - 1993:4)	Real GDP growth	Real Total exports	Real Total imports, Real manufacturing exports, Real agricultural exports.	ADF and PP unit root, Johansen Jusalius Cointegration test, VEC modelling.	Support for the export-led growth hypothesis.
Choong et al.	2003	Annually Time Series Data for Malaysia from 1959 to 2000	Real GDP	Real Exports	Gross fixed capital Formation, population, exchange rate, real imports	ADF and PP unit root test, Cointegration and Two Stage Least Square (2LS) procedure.	Supports for the export-led growth hypothesis.
Ibrahim	2003	Annually Time series Data for Malaysia from 1960 to 1997	Real GDP per capita	Real exports of GDP ratio	Imports, government consumption	ADF and PP unit root; Johansen Juselius Cointegration test; VECM	Found evidence for bilateral causality in VECM framework between export and growth
Awokuse	2003	Quarterly Time series (1961(1)-2000(4)), Canada	Real GDP	Real Export	Real terms of trade (export unit value divided by import unit value); manufacturing employment as proxy for labour; gross capital formation as proxy for capital; output	ADF unit root test; Cointegration test; Granger causality in VECM and causality in Toda-Yamamoto procedure	The empirical suggest that Granger causal flow is unidirectional from real export to real GDP, thus, supports for the hypothesis.
Hooi	2007	Annually Time series Data for (1958 to 1997), Singapore, Korea, Taiwan and Thailand	GDP per-capita	Total exports	Fixed capital formation, and broad money (M2)	ADF and PP unit root test; Cointegration; and Granger cause in VEC modelling.	Support for the export-led growth hypothesis
Maneschiold-Ola	2008	Quarterly Time series [Argentina:1993(1)-2006(1); Brazil:1991(1)-2006(1) and 1980(1) to 2006(1)]	GDP constant price	Export constant price	None	ADF and PP unit root test; Cointegration; and Granger cause in VEC modelling.	The causal relationship is either bi-directional or unidirectional from export to GDP revealing support to the ELG hypothesis and an outward oriented policy

Sources: Ahmed (2001), Shan and Sun (1998), plus additional from the author.

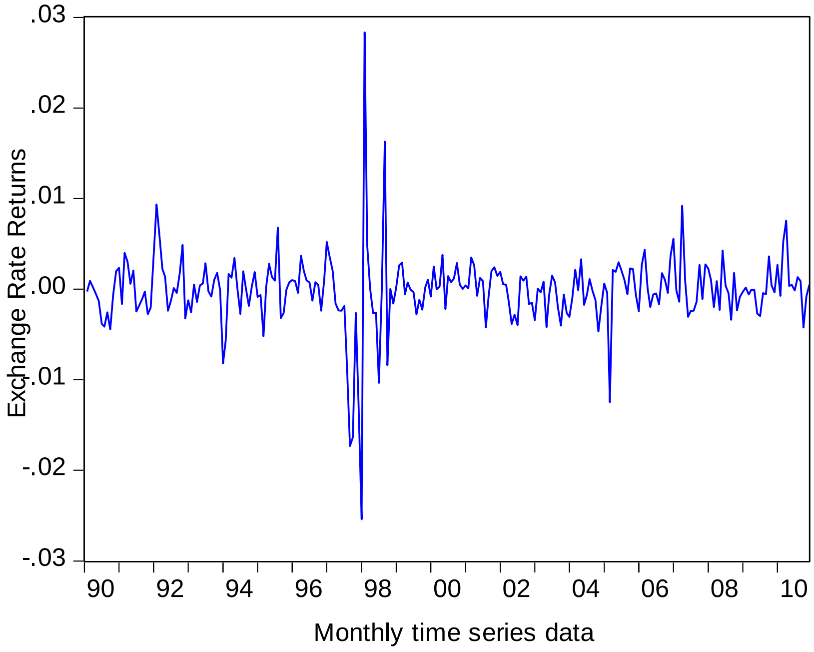
Appendix 2.2a:

Figure 2.1: Plotting of GARCH (1,1) of REER from January, 1990 to December, 2010



Appendix 2.2b:

Figure 2.2: Plotting of REER returns from January, 1990 to December, 2010.



Appendix 2.3

Table 2.28: Diagnostic results for VECM systems

Models	Dependents	BG tests	BPG tests	JB tests
Model 1	ΔGrowth	3.719*	3.012*	3.124*
	ΔExports	3.233*	2.955*	3.421*
	ΔImports	2.34*	2.347*	4.086*
	ΔExchange rate	4.785*	3.632*	3.575*
Model 2	ΔGrowth	4.046*	3.232*	4.587**
	ΔExports	4.226*	2.962*	5.218**
	ΔImports	6.410**	4.562**	4.485**
	ΔExchange rate	3.104*	2.277*	3.0542*
Model 3	ΔGrowth	4.587**	2.185*	4.059*
	ΔExports	3.435**	3.641**	4.422**
	ΔImports	2.601	2.521*	5.298**
	ΔExchange rate	1.156	2.091*	4.513*
Model 4	ΔGrowth	4.407**	4.721**	5.738**
	ΔExports	6.787**	2.085*	3.420*
	ΔImports	3.627*	2.599*	3.555*
	ΔExchange rate	2.017*	2.053*	5.801**
Model 5	ΔGrowth	3.142*	3.176*	5.471**
	ΔExports	2.886*	3.220*	3.135*
	ΔImports	3.937*	2.371*	3.213*
	ΔExchange rate	1.531*	2.224*	4.842*
Model 6	ΔGrowth	8.078***	3.578**	4.443**
	ΔExports	2.576	2.224*	3.414*
	ΔImports	3.543*	4.443**	5.471**
	ΔExchange rate	2.894	2.658*	6.924**

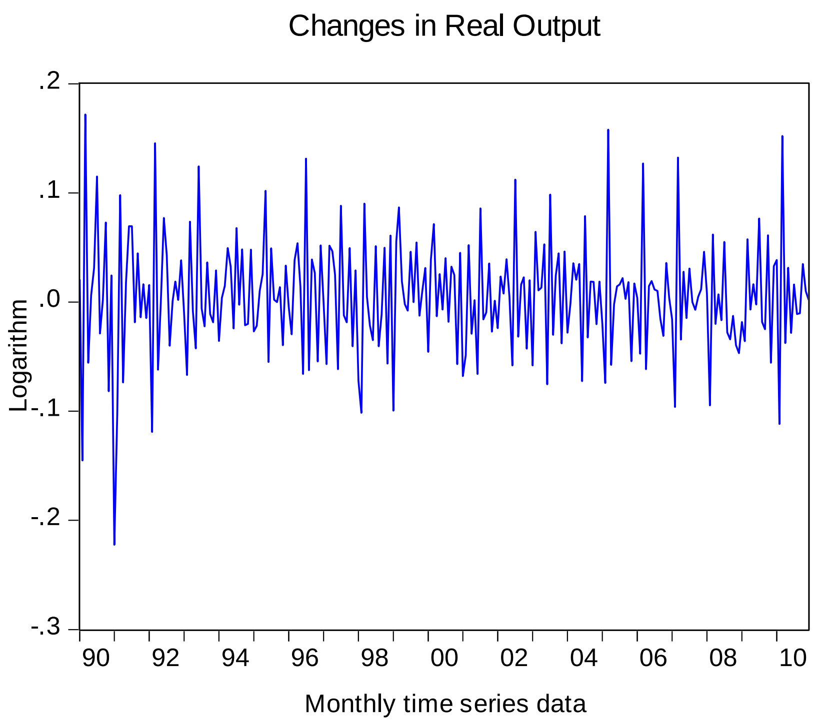
Table 2.28: Continue

Models	Dependent	ARCH tests	LM tests	JB tests
Model 7	ΔGrowth	3.791*	3.189**	8.697***
	ΔExports	2.935	3.002**	7.900**
	ΔImports	2.278	3.651**	6.772**
	ΔExchange rate	4.415**	4.489**	5.910**
Model 8	ΔGrowth	3.981*	3.644**	5.668**
	ΔExports	3.538*	2.567*	4.733*
	ΔImports	2.864*	3.257**	6.637**
	ΔExchange rate	4.793**	3.450**	3.344*
Model 9	ΔGrowth	2.0108	3.343**	8.297**
	ΔExports	1.4106	3.305*	5.414*
	ΔImports	3.275*	2.853*	7.717**
	ΔExchange rate	5.054**	3.734**	6.321**

Note that, all variables in this analysis are in first differencing (denotes as Δ) with the exception of the lagged error correction term (*ECT*) generated from Johansen order of cointergration tests conducted in erlier table. Superscript (***), (**), and (*) indicates significant level at 1%, %% and 10%. The robust statistic tests includes, Lagrange Multiplier test (LM-test) and ARCH-test are repeoted in F-test. While, Jarque Bera test (JB-tests) is for normality tests.

Appendix 2.4: Graphs Trend of Change in Real Output

Figure 2.3: The graph of change in real output



Appendix 2.5

The main analysis is using the monthly data set which is divided into three main sub-period, called regimes. Next, the regimes are also divided into two environments, namely, the exchange rate regime and the crisis regime. To be precise, the regimes are;

<u>Exchange rate Regimes cutting date</u>

Pre-floating exchange rate regime:

(1) January, 1990 to August, 1998 (with Crisis Dummy: July, 1997 to August, 1998)

Peg exchange rate regime:

(1) September, 1998 to August, 2005; and

(2) September, 1998 to August, 2005 (with Crisis dummy period covering from September, 1998 to December, 1999)

Post-floating exchange rate regime:

(1) September, 2005 to December, 2010 (purely floating exchange rate regime without the crisis dummy)

<u>The Crisis Regimes cutting date</u>

Pre-crisis:

(1) January, 1990 to June, 1997

During-crisis[56]:

(1) July, 1997 to August, 2005 and

(2) July, 1997 to August, 2005 (with Crisis Dummy: July, 1997 to December, 1999)

Post-Crisis:

(1) September, 2005 to December, 2010 (purely floating exchange rate regime without the crisis dummy)

<u>The Pooled Model</u>

Type One: January, 1990 to December, 2010 and

Type Two: January, 1990 to December, 2010 (with Crisis Dummy: July, 1997 to December,1999)

[56] This regime is unique among any other regimes under observation, because in this regime we assume starting date of crisis until the end of pegging exchange rate period as a crisis regime period. However, we impose the crisis dummy variable in this model in order to capture for the structure brake during the peak time of the crisis. As official information of the recovery date from Chee, Hui and Annuar (2004) and Tiwari (2003) and non-official information about the Asian financial crisis recovery approximately end date, on the website of Wikipedia online: http://en.wikipedia.org/wiki/Asian_financial_crisis, the cuttings date for the Asian crisis roughly, from July, 1998 to December, 1999.

Appendix 2.6

Table 2.29:
The Information Criteria of the ELGH model across different regime

	Models	Covering date (monthly time series data)	Dummy variable cutting date	Models specification
	Pooled Models			
Model 1	Regime all (Without the crisis dummy in the system)	January, 1990 to December, 2010	NON	$\ln g_{it} = \delta_0 + \delta_1 \ln e_{it} + \delta_2 \ln I_{it} + \delta_3 \ln er_{it} + \Sigma_{it}$
Model 2	Regime all (With the crisis dummy in the system)	January, 1990 to December, 2010	July, 1997 to December, 1999	$\ln g_{it} = \delta_0 + \delta_1 \ln e_{it} + \delta_2 \ln I_{it} + \delta_3 \ln er_{it} + \delta_4 CD_{it} + \Sigma_{it}$
	Regime One: Exchange Rate Regimes			
Model 3	Regime One (Without the crisis dummy in the system)	January, 1990 to June, 1997 **(Pre-AFC)**	NON	$\ln g_{it} = \alpha_0 + \alpha_1 \ln e_{it} + \alpha_2 \ln I_{it} + \alpha_3 \ln er_{it} + \varepsilon_{it}$
	Regime One: Crisis Regime			
Model 4	Regime One (With the crisis dummy in the system)	January, 1990 to August, 1998	July, 1997 to August, 1998	$\ln g_{it} = \beta_0 + \beta_1 \ln e_{it} + \beta_2 \ln I_{it} + \beta_3 \ln er_{it} + \beta_4 CD_{it} + \nu_{it}$
	Regime Two: Exchange Rate Regime			
Model 7	Regime Two	September, 1998 to August,	NON	$\ln g_{it} = \alpha_0 + \alpha_1 \ln e_{it} + \alpha_2 \ln I_{it} + \alpha_3 \ln er_{it} + \varepsilon_{it}$

	(Without the crisis dummy in the system)	2005 **(Pure peg regime)**		
Model 8	Regime Two (With the crisis dummy in the system)	September, 1998 to August, 2005 **(Pure peg regime)**	September, 1998 to December, 1999	$\ln g_{it} = \alpha_0 + \alpha_1 \ln e_{it} + \alpha_2 \ln I_{it} + \alpha_3 \ln er_{it} + \alpha_4 CD_{it} + \varepsilon_{it}$
	Regime Two: Crisis Regime			
Model 5	Regime Two (Without the crisis dummy in the system)	July, 1997 to August, 2005	NON	$\ln g_{it} = \beta_0 + \beta_1 \ln e_{it} + \beta_2 \ln I_{it} + \beta_3 \ln er_{it} + \nu_{it}$
Model 6	Regime Two (With the crisis dummy in the system)	July, 1997 to August, 2005	July, 1997 to December, 1999	$\ln g_{it} = \beta_0 + \beta_1 \ln e_{it} + \beta_2 \ln I_{it} + \beta_3 \ln er_{it} + \beta_4 CD_{it} + \nu_{it}$
	Regime Three: Exchange Rate Regime and Crisis Regime			
Model 9	Regime Three (Without the crisis dummy in the system)	September, 2005 to December, 2010 **(Post-AFC)**	NON	**Exchange Rate Regime Modelling:** $\ln g_{it} = \alpha_0 + \alpha_1 \ln e_{it} + \alpha_2 \ln I_{it} + \alpha_3 \ln er_{it} + \varepsilon_{it}$ **Crisis Regime Modelling:** $\ln g_{it} = \beta_0 + \beta_1 \ln e_{it} + \beta_2 \ln I_{it} + \beta_3 \ln er_{it} + \nu_{it}$

Sources: Author's survey. Copyrigh

Table 2.30: The Cointegrating vector equations

Models	ECT_{t-1}		$Growth_{t-1}$	$Export_{t-1}$	$Import_{t-1}$	$Exchange\ Rate_{t-1}$	Dummy	Intercept
Model 1	$ECT1_{t-1}$	=	1.0000	-6.513134 (1.13810) [-5.72280]	5.698617 (1.16752) [4.88096]	-4.584742 (1.18848) [-3.85767]	-	21.45185
Model 2	$ECT2_{t-1}$	=	1.0000	-1.847293 (0.26471) [-6.97853]	1.152356 (0.27450) [4.19798]	0.164477 (0.27458) [0.59902]	0.136551 (0.05045) [2.70678]	-20.110374
Model 3	$ECT3_{t-1}$	=	1.0000	1.570698 (1.26781) [1.23891]	-2.153271 (1.16679) [-1.84547]	-5.063558 (2.08418) [-2.42952]	-	22.94931
Model 4	$ECT4_{t-1}$	=	1.0000	23.69863 (5.51617) [4.29621]	-21.52037 (5.12347) [-4.20035]	-41.17299 (9.02762) [-4.56078]	-16.02904 (2.58879) [-6.19171]	21.7741
Model 5	$ECT5_{t-1}$	=	1.0000	-2.185427 (0.30813) [-7.09265]	0.850397 (0.26351) [3.22713]	-2.080038 (0.24219) [-8.58860]	-	11.10620
Model 6	$ECT6_{t-1}$	=	1.0000	-14.14700 (3.85538) [-3.66942]	3.035802 (3.01889) [1.00560]	-28.95003 (4.84016) [-5.98122]	-2.531793 (0.49737) [-5.09032]	18.0617
Model 7	$ECT7_{t-1}$	=	1.0000	-11.51698 (1.95401) [-5.89403]	7.487838 (1.46329) [5.11714]	-10.38529 (1.87028) [-5.55280]	-	26.99898
Model 8	$ECT8_{t-1}$	=	1.0000	-2.453606 (0.39986) [-6.13622]	1.269382 (0.32889) [3.85959]	-1.544752 (0.40859) [-3.78067]	0.148441 (0.03762) [3.94528]	18.011391
Model 9	$ECT9_{t-1}$	=	1.0000	-0.382741 (0.08811) [-4.34390]	-0.004188 (0.07698) [-0.05440]	0.297805 (0.08640) [3.44695]	-	-4.422948

Note that, the ECT denotes as "Error Correction Term) of normalized cointegrating vector equations for models 1 to 9. Varies brackets, () and [] specify standard error and t-statistic tests..

Appendices for Chapter Three

Appendix 3.1

Table 3.9:
Estimation Results of Contemporaneous Basic Regressions (Without Dummy variables)

Basic Modelling

$$SR_{it} = \Omega + \beta_{m,i} MR_{it} + \beta_{\Delta S,i} \Delta S_{it} + \varepsilon_{it}$$

Sector	Time series data: October, 1992 to December, 2010				
	Regression Modelling			Diagnostic Specification	
Coefficient	Ω	$\beta_{m,t}$	$\beta_{\Delta S,i}$	R^2	DW
Financial (Fin)	0.002 (0.003)	1.1017 (0.003)***	0.8112 (0.03)***	0.7509	2.0551
Plantation (Plant)	0.007 (0.004)*	0.8442 (0.005)***	-0.6542 (0.06)***	0.5529	2.1411
Properties (Pro)	-0.001 (0.004)	1.0261 (0.05)***	0.2494 (0.2107)	0.6249	1.8613
Consumer goods (Cmr)	0.005 (0.003)	0.6722 (0.004)***	0.0245 (0.6548)	0.7251	1.8842
Construction (Con)	0.004 (0.002)**	1.2112 (0.02)***	0.8546 (0.15)**	0.8524	2.0359
Tin and Mining (Tinm)	0.003 (0.006)	1.1981 (0.08)***	-0.067 (0.782)	0.5833	1.9415
Services (Serv)	0.0007 (0.005)	1.0325 (0.05)***	0.5502 (0.174)*	0.5002	1.8971
Industrial (Ind)	0.004 (0.002)**	0.7437 (0.043)***	-0.4122 (0.131)*	0.7737	2.1169

Model above is estimated using monthly data over the time period October, 1992 to December, 2010 for all major sectors in Malaysia. Where, SR_{it} is the sector return for sector i at time *t*, MR_{it} is the market return, ΔS_{it} is the unexpected percent change in the exchange rate. Numbers in parentheses are the values of standard error. The superscript ***,**,* can be specify significant at 99%, 95%, and 90% significant level.

Appendix 3.2

Table 3.10:
Estimation Results of Contemporaneous Basic Regressions (With Dummy variables)

Basic Modelling:

$$SR_{it} = \Omega_i + \beta_{m,t} MR_{it} + \beta_{\Delta S,i} \Delta S_{it} + \alpha_{p,i} PEG_{it} + \alpha_{cd,i} CD_{it} + \varepsilon_{2,it}$$

Sector	Time series data: October, 1992 to December, 2010						
	Regression Modelling					Diagnostic Specification	
Coefficient	Ω	$\beta_{m,t}$	$\beta_{\Delta S,i}$	$\alpha_{p.i}$	$\alpha_{cd,i}$	R^2	DW
Financial (Fin)	0.002 (0.004)	1.0990 (0.04)***	0.9195 (0.05)***	0.002 (0.007)	0.0045 (0.01)	0.8712	2.0575
Plantation (Plant)	0.014 (0.005)**	0.8478 (0.05)***	-0.5547 (0.17)*	-0.012 (0.008)	-0.017 (0.01)	0.6633	2.1922
Properties (Pro)	0.004 (0.005)	1.0288 (0.05)***	0.3211 (0.245)	-0.01 (0.008)	-0.014 (0.012)	0.6302	1.8903
Consumer goods (Cmr)	0.005 (0.003)	1.0254 (0.04)***	0.0452 (0.547)	0.003 (0.009)	0.00005 (0.013)	0.7521	2.0365
Construction (Con)	0.007 (0.004)	1.1780 (0.01)***	0.7119 (0.08)***	-0.007 (0.015)	0.0127 (0.02)	0.8955	1.9448
Tin and Mining (Tinm)	0.006 (0.008)	1.1945 (0.08)***	-0.1195 (0.169)	-0.0015 (0.013)	-0.016 (0.019)	0.5601	2.1762
Services (Serv)	-0.001 (0.006)	0.9451 (0.08)***	0.6582 (0.03) **	0.005 (0.008)	0.017 (0.01)	0.7541	1.8987
Industrial (Ind)	0.006 (0.002)**	0.7400 (0.02)***	-0.513 (0.08)**	0.0003 (0.004)	-0.0124 (0.006)	0.7778	2.1617

Model above is estimated using monthly data over the time period October, 1992 to December, 2010 for all major sectors in Malaysia. In the equation above, SR_{it} denotes as the sector return for sector *i* at time *t*, MR_{it} is the market return, and ΔS_{it} is the unexpected percent change in the exchange rate. Meanwhile, the variables *PEG* and *CD* represent dummy parameters. Numbers in parentheses are the values of standard error. The superscript ***,**,* can be specify significant at 99%, 95%, and 90% significant level.

Appendix 3.3

Table 3.11:
Estimation Results of One Day-Lagged Basic Regressions (With Dummy variables)

Basic Modelling:

$$SR_{it} = \Omega_i + \beta_{m,t}MR_{it} + \beta_{\Delta S-1,i}\Delta S_{it-1} + \alpha_{p,i}PEG_{it} + \alpha_{cd,i}CD_{it} + \varepsilon_{2,it}$$

Sector	Time series data: October, 1992 to December, 2010						
	Regression Modelling:					Diagnostic Specification	
Coefficient	Ω	$\beta_{m,t}$	$\beta_{\Delta S,i}$	$\alpha_{p.i}$	$\alpha_{cd,i}$	R^2	DW
Financial (Fin)	0.002 (0.004)	1.0996 (0.04)***	0.9245 (0.05)***	0.0018 (0.007)	0.004 (0.01)	0.8507	2.0548
Plantation (Plant)	0.014 (0.005)**	0.8508 (0.05)***	-0.6120 (0.12)*	-0.0001 (0.004)	-0.011 (0.006)	0.6643	2.1949
Properties (Pro)	0.003 (0.005)	1.0322 (0.05)***	0.3514 (0.232)	-0.01 (0.008)	-0.012 (0.012)	0.6277	1.8909
Consumer goods (Cmr)	0.004 (0.003)	1.0122 (0.04)***	0.07 (0.67)	0.003 (0.009)	-0.0002 (0.013)	0.7125	2.0406
Construction (Con)	0.005 (0.004)	1.1678 (0.01)***	0.7542 (0.027)***	-0.006 (0.015)	0.011 (0.02)	0.8421	1.9457
Tin and Mining (Tinm)	0.006 (0.008)	1.1874 (0.08)***	-0.2582 (0.021)	-0.002 (0.012)	-0.0169 (0.019)	0.6211	2.1719
Services (Serv)	-0.001 (0.006)	0.8951 (0.08)***	0.6712 (0.10)*	0.0061 (0.0078)	0.022 (0.01)	0.5672	1.8901
Industrial (Ind)	0.005 (0.002)**	0.7413 (0.02)***	-0.5781 (0.077)**	0.00044 (0.003)	-0.0155 (0.005)	0.7412	2.149

Model above is estimated using monthly data over the time period October, 1992 to December, 2010 for all major sectors in Malaysia. Here, SR_{it} is the sector return for sector *i* at time t, MR_{it} is the market return, and ΔS_{it-1} is the unexpected percent change in the exchange rate (lagged condition). Meanwhile, the variables *PEG* and *CD* represent dummy parameters. Numbers in parentheses are the values of standard error. The superscript ***,**,* can be specify significant at 99%, 95%, and 90% significant level.

Appendix 3.4: The returns of Main Board, Financial, Plantation, Properties, Industrial, Trade & Services, Consumer Product, Tin & Mining, and Construction price index in Malaysia from October, 1992 to December, 2010

Figure 3.1:
Main Board Price index from October, 1992 to December, 2010

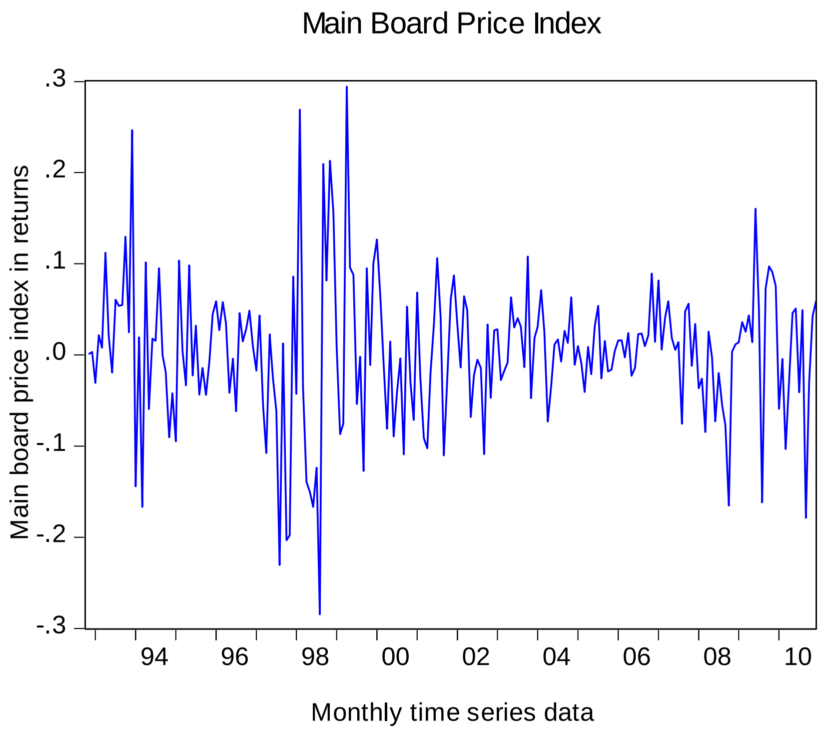


Figure 3.2:
Financial sector in Malaysia from October, 1992 to December, 2010

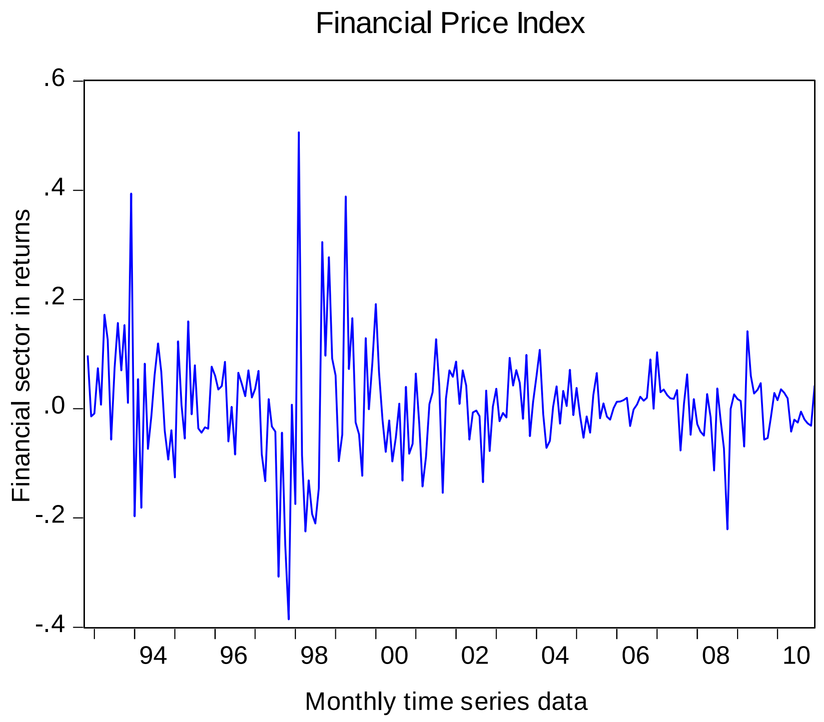


Figure 3.3:
Plantation sector in Malaysia from October, 1992 to December, 2010

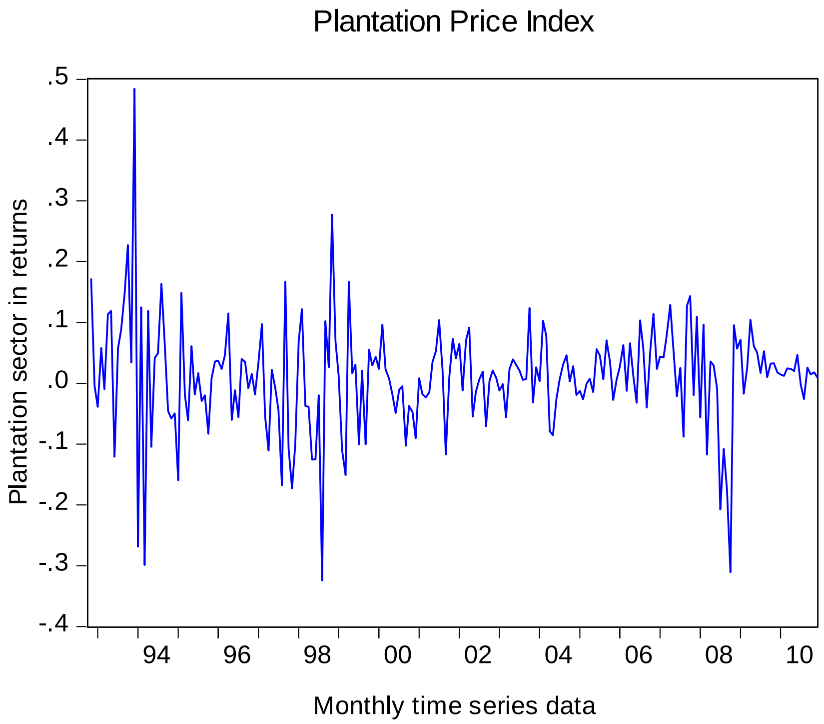


Figure 3.4:
Industrial sector in Malaysia from October, 1992 to December, 2010

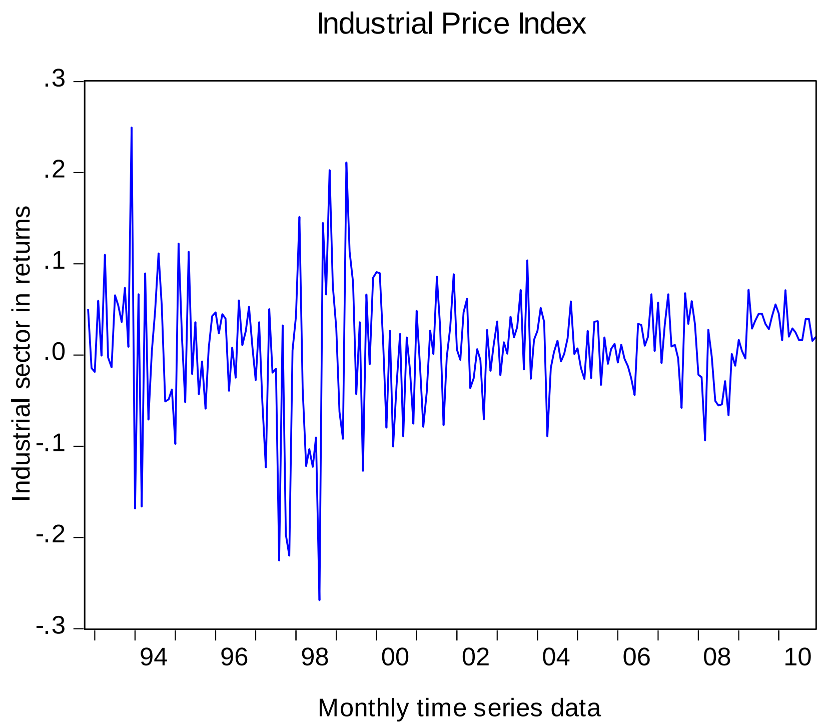


Figure 3.5:
Tin and Mining sector in Malaysia from October, 1992 to December, 2010

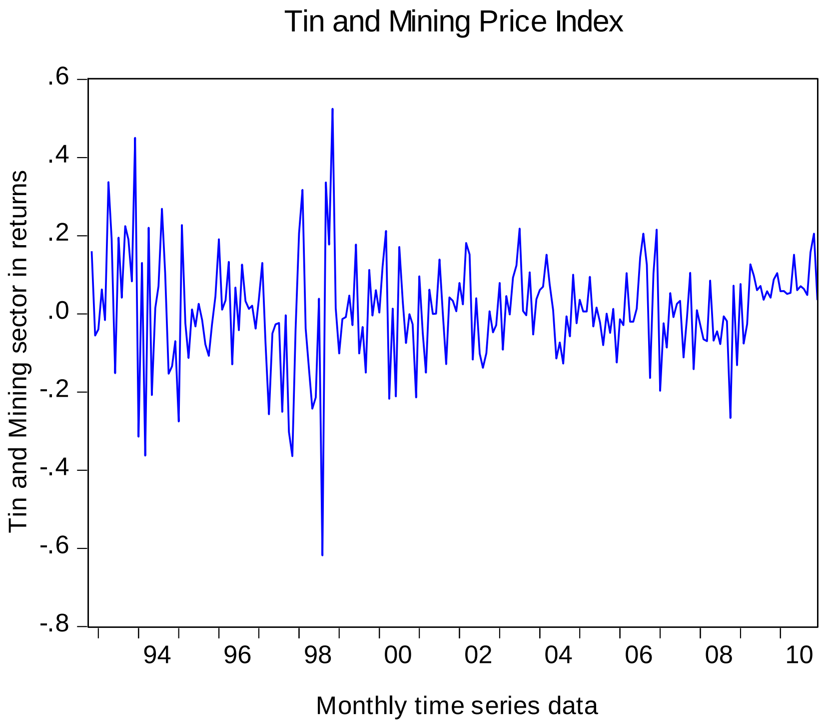


Figure 3.6:
Trade and Services sector in Malaysia from October, 1992 to December, 2010

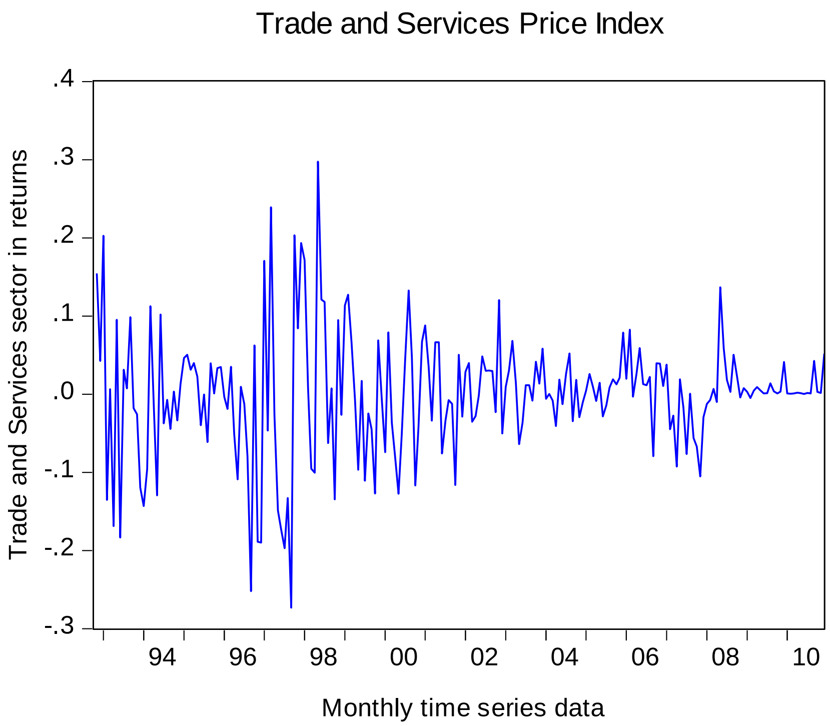


Figure 3.7:
Consumer sector in Malaysia from October, 1992 to December, 2010

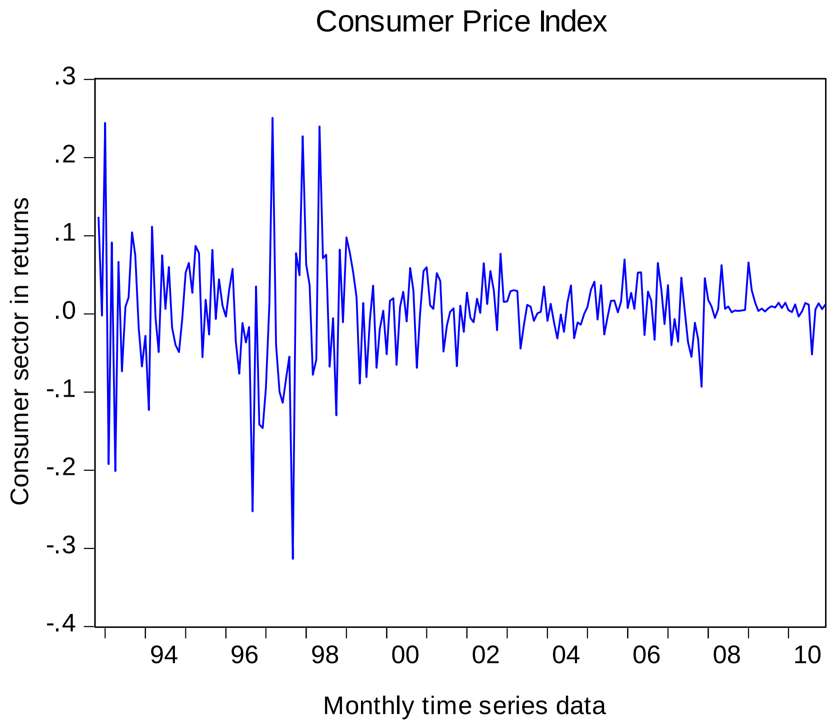


Figure 3.8:
Properties sector in Malaysia from October, 1992 to December, 2010

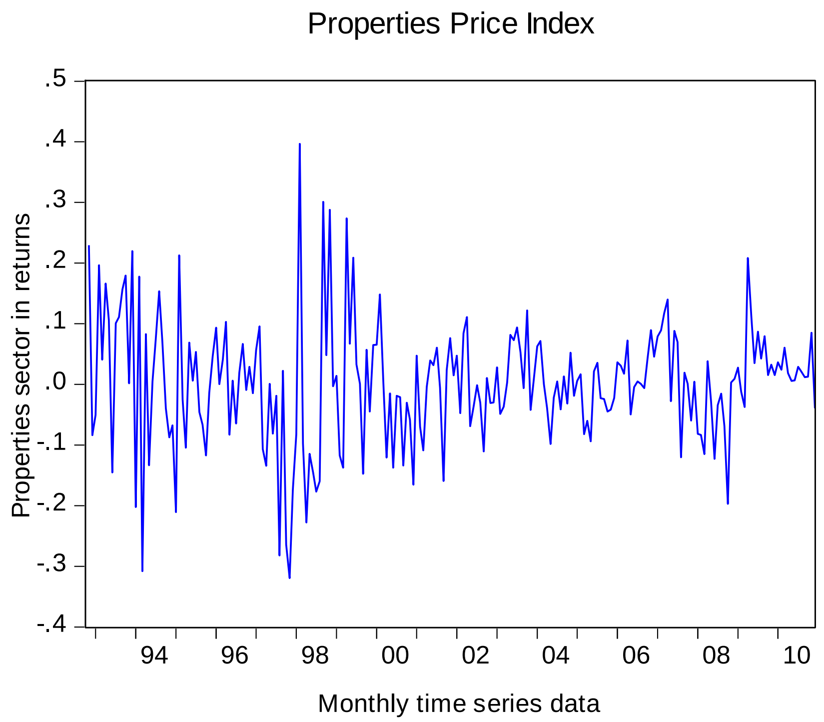


Figure 3.9:
Construction sector in Malaysia from October, 1992 to December, 2010

Appendices for Chapter Four

Appendix 4.1

Table 4.18: Diagnostic results for VECM systems

Countries	Dependent	DWT	BPG tests	JB tests
Singapore	ΔA_{t-i}	2.02	1.524*	8.432***
	ΔG_{t-i}	2.15	1.674*	10.521**
	ΔP_{t-i}	1.98	1.712*	7.325***
	$\Delta \sigma_{t-i}$	2.05	2.078**	12.862**
Malaysia	ΔA_{t-i}	2.06	1.957**	6.241**
	ΔG_{t-i}	1.80	2.348**	5.891*
	ΔP_{t-i}	2.11	2.085**	9.847**
	$\Delta \sigma_{t-i}$	2.05	1.875*	8.777**
Thailand	ΔA_{t-i}	1.90	1.211*	6.342**
	ΔG_{t-i}	1.83	1.981*	6.487*
	ΔP_{t-i}	2.08	2.073**	17.358***
	$\Delta \sigma_{t-i}$	2.13	2.133**	15.402***
Philippines	ΔA_{t-i}	2.08	1.129*	5.794**
	ΔG_{t-i}	2.45	1.941**	5.883*
	ΔP_{t-i}	2.33	1.975**	6.371*

	$\Delta\sigma_{t-i}$	1.82	2.068**	7.482**
Indonesia	ΔA_{t-i}	2.08	1.522*	7.811***
	ΔG_{t-i}	2.02	2.154**	7.955**
	ΔP_{t-i}	2.15	2.344**	10.470***
	$\Delta\sigma_{t-i}$	2.21	1.872**	11.354***

Note that, all variables in this analysis are in first differencing (denotes as Δ) with the exception of the lagged error correction term (*ECT*) generated from Johansen order of cointergration tests conducted in earlier table. Superscript (***), (**), and (*) indicates significant level at 1%, %% and 10%. The robust statistic tests include the Durbin Watson autocorrelation tests, and the Lagrange Multiplier test (LM-test) for heteroscedasticity. While, Jarque Bera test (JB-tests) is for normality tests.

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