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The Re-examination of the Dynamic Relationship between Money, Output and Economic Growth in Malaysia

Norimah Bt Rambeli Ramli[a], Jan M. Pidivinsky[b], Norasibah Abdul Jalil[c],
[a,c]Universiti Pendidikan Sultan Idris, [b]University of Southampton, United Kingdom,

Historically, the development of the country's economy has explained how the country's financial and fiscal policies are being utilized in order to achieve the country's goals of increasing productivity and achieving developed nation status. The dynamic integration of the two policies each year requires a detailed investigation, especially as they involve specific policies to address the economic crisis. Thus, the motivation of this study is to examine the dynamic relationship between money, output and economic growth in two different exchange rate regimes in Malaysia, namely exchange rates before the Asian financial crisis (floating exchange rate) and exchange rates after the Asian financial crisis (floating with basket currencies exchange rate). Although many similar studies have been carried out, there is still little exploration in the issues studied involving different exchange rate regimes, particularly for Malaysian issues. In order to achieve this objective, monthly frequency time series data is used starting January 1990 until December 2018. The selected macroeconomics data is utilized, namely industrial production index, broad money, consumer price index, lending interest rate, net export, and bilateral exchange rate. The two exchange rate regimes are based on announcement commitment by the Central Bank of Malaysia, in dealing with the Asian financial crisis in 1997. This study adopted the Sims approach which includes multivariate Johansen Juselius co-integration test and vector error correction model. The results suggest that, broad money and output are moving together in the same direction in the long term to develop the long-term equilibrium among the variable in the equations system across the regimes. The results further suggest that, the output and broad money plays an important role in driving economic growth in Malaysia in every condition of the economic scenario, across the exchange rate regime. This has been proven by the significance result of broad money and output across the regimes under investigation.

Key words: *money, output, exchange rate regime, Asian financial crisis, multivariate model.*

Introduction

Malaya had been ruled by British for 171 years before independence. The effects of economic, political, and social aspects of British policies had separated people at that time according to ethnic groups. The separation shows a very significant change in economic activity, education system, culture, and location. In 1955, after winning the first federal election, the coalition led by the chief minister, Tunku Abdul Rahman Putra AL-Haj led his cabinet to plan the development policy of Malaya federation that promised independence in 1957. Tunku and his cabinet had made a draft of a development plan that was drafted by the British as a guide to its development. On August 31, 1957, the Malaya federation gained independence, as well as freedom from British colonies. At the time, the Tunku cabinet is confident that the success of the country will be measured from its development policies (Arkib Negara Malaysia, 2007).

After achieving independence, the government has set up a long-term development strategy by implementing national development plans that are framed within five years, namely First Malaya Plan (1956 – 1960), Second Malaya Plan (1961 – 1965), First Malaysia Plan (1966 – 1970), Second Malaysia Plan (1971 – 1975), Third Malaysia Plan (1976 – 1980), Fourth Malaysia Plan (1980 – 1985), Fifth Malaysia Plan (1986 – 1990), Sixth Malaysia Plan (1991 – 1995), Seventh Malaysia Plan (1996 – 2000), Eighth Malaysia Plan, (2001 – 2005) and Ninth Malaysia Plan (2006 – 2010). These plans are more geared towards plans for recovery and development to build on progress. In addition, economic development for the year 1971 to 1990 is governed by a new economic policy that is more focused on eradicating poverty and eliminating racial and ethnic economic gaps (Arkib Negara Malaysia, 2007).

On June 10, 2010, as part of Malaysia five-year economic blueprint, the Tenth Malaysia Plan was launched, covering the years from 2011 until 2015. It combined Government Transformation policy and New Economic policy. This plan is focusing on, creating a private sector-led economy, supporting innovation-led growth, creating innovation opportunities, funding innovation, rationalizing the role of the government in business, developing SMEs as an engine of growth and innovation, competing globally, establishing the world-class infrastructure to support growth and enhance productivity. On May 21, 2015, from Tenth Malaysia Plan change to the Eleventh Malaysia Plan which covers the period from 2016 to 2020. All these plans are aimed at achieving sustainable economic growth through increased employment, reducing unemployment, increasing national income, reducing country debt and increasing domestic production. However, the Tenth Malaysia Plan and the Eleventh Malaysia Plan, are more focusing on international level business that involves exchange rates for transactions matter.

Modern Malaysia has transformed from an economy heavily reliant on its natural resources and agricultural produce in the sixties and seventies, to a highly diversified economy by the new millennia. These transformations occur after Malaysia achieved independence on August 31, 1957, when Malaysia has adopted the open economy policy. With this policy, Malaysia can develop diplomatic and trade relations with other countries who want to establish international trade relations with Malaysia. This is in line with the goals of previous Malaysia plans to become a developed country. Furthermore, with this practice, import and export trading activity will involve foreign exchanges rates. According to international trade theory, when the value of a country's currency increases, it will reduce foreign traders' interest in buying goods, which in turn will cause the country's exports to decline, but imports will increase. Traditionally, the foreign exchange rate for Malaysia has increased as the value of the currency has increased (Fatemeh, Azali, Lee, Habibullah ,2017; Norimah and Podivinsky, 2013; Siddiqui and Anjum, 2013; Norimah, 2004, among others).

Therefore, the motivation of the study is to examine the dynamic relationship between money, output, and foreign exchange rates in two different regimes, namely unrecovered regime for exchange rate before the Asian financial crisis happened and recovery regime that is represented by the exchange rate regime after the Asian financial crisis. This study included money supply or broad money (M3), industrial production index (IPI), consumer price index (CPI), lending interest rate (LIR), net export (BOT), bilateral exchange rate between pound sterling and ringgit (GBPMYR) in representing the financial and fiscal policies variables. As well as policies practiced by governments for both regimes in dealing with the effects of a financial crisis on economic growth.

The Keynesian theory explains that the relationship between money, output and economic growth in the long term is different across the exchange rate regime (Joseph and Kamas, 1994). These finding is parallel to Gultekin and Penati (1989), indicating that, by using multifactor asset pricing model, that the different regime of the exchange rate will give a different impact on the gross domestic product. Further, Peter (2003) has confirmed that the relationship between money and output is important in macroeconomic theory and policy in order to find the best combinations, and it also appropriates method for the purpose of the study of causal relationships using quantity theory of money in developed countries. In addition, quantity theory of money pioneered by Granger (1969), Sims (1972), Hsiao (1979, 1981), Cuddington (1981) and Biswas and Saunders (1986) has confirmed the relationship between financial growth and output within the scope of macroeconomic levels are both important. Although many such studies have been conducted, there are still few studies focusing on issues in Malaysia that also represent developing countries in ASEAN.

Prior to the financial crisis, Malaysia practiced a floating exchange system where the value of the currency was free to move up or down based on the changes that occurred to demand and supply. Currency values may rise or fall due to changes in demand and supply of currency values in the foreign exchange market. This system relies heavily on the stability of money in the country and how money is traded in the foreign exchange market. To face the financial crisis, the government and central bank changed from a float exchange rate system to a fixed exchange rate system. In a fixed exchange rate system, the value of the currency has been tightened. Freedom movement of capital and freedom of monetary policy is limited with the outflow of capital within the country and controlled. This is to ensure that the foreign exchange market is always stable (Khalid, Ahmad, and Hamidi, 2018; Masih, 2005; Masih and Masih, 1997).

In line with the policies implemented by the government in addressing crisis problems under unrecovered (pre-Asian Financial Crisis) and recovery regime (post-Asian Financial Crisis), this study was conducted to learn of the implementation of monetary policy and fiscal policy which had a much more significant impact on the short-term and long-term. Also, to identify the implications of policy implementation on the country's economic growth, economic indicators such as money supply or broad money, industrial production index, consumer price index, lending interest rate, net export, and the exchange rate between U.K. pound sterling and ringgit Malaysia are considered in this study under a re-examined model. So, series that influenced policy in short-term and long-term can be identified.

Data, Model Specification and Methodology
Data source

For analysis purposes, this study utilized the selected macroeconomics data including the Gross domestic product (GDP), industrial production index (IPIt), broad money (M3t), consumer price index (CPIt), lending interest rate (LIRt), net export (BOTt), and bilateral exchange rate (GBPMYRt). All data series will be divided into two different exchange rate regimes in Malaysia, namely exchange rates before the Asian financial crisis (floating exchange rate- January 1990 to December 1996) and exchange rates after the Asian financial crisis (floating with basket currencies exchange rate-January 2010 to December 2018). The time series data used in this study are obtained from the official website of Bank Negara Malaysia (BNM), investing dataset, global economy report and International Monetary Funds (IMF) dataset.

Model Specification

The model used in this study is based on Keynesian theory. The specification model in this study is a model inspired from a study conducted by and Norimah (2004) to identify the existence of a dynamic relationship between economic growth that is measured by Gross domestic product (Gt), industrial production index (denotes as IPIt), consumer price index (CPI), lending interest rate (LIR), broad money (M3), balance of trade (BOT) in two different regimes. Moreover, the system also includes the exogenous variable to capture the strangeness of international financial system that are represented by the bilateral exchange rate between the Pound Sterling and the US Dollar (Norimah, 2004). However, the study by Norimah (2004), employ three different exchange rate regimes, whereas the previous study included another one regime that represent the fixed exchange rate scenario. Therefore as mention before,this study will only focused on two main regimes that are exchange rates before the Asian financial crisis (floating exchange rate- January 1990 to December 1996) and exchange rates after the Asian financial crisis (floating with basket currencies exchange rate-January 2010 to December 2018). The general specification model for the two regimes is as follows:

$$G_{it} = \alpha_0 + \alpha_1 M3_{it} + \alpha_2 IPI_{it} + \alpha_3 CPI_{it} + \alpha_4 LIR_{it} + \alpha_5 BOT + \alpha_6 GBMY_{it} + \varepsilon_{it} \qquad (1)$$

According to Equation (1), G_{it} represent the economic growth indicator by using gross domestic product (GDP). $M3_{it}$ is broad money supply indicator and IPI_{it} is industrial production index. Next is CPIit stand for Consumer Price Index a proxy for inflation level in economy while, LIR_{it} is lending interest rate. This study includes one control variable that is trusted to be a strong exogenous variable in the system equation (Darrat, 2002), in this case it is a bilateral exchange rate between Pound sterling and the US Dollar (GB/US), denoted as $GBMY_{it}$ in the equation (1).

After employing the Augmented Dickey Fuller (ADF) unit root testing (Dickey-Fuller, 1979), the next procedure is to find the long term co-integrating vector. In this case, this study employs the Johansen-Juselius cointegration testing (Johansen and Juselius 1990). This method is a powerful approach in finding the co-integrating vector in the equation system. Moreover, Johansen-Juselius method is capable of producing a more robust estimator compared to other methods, such as Engle Granger's method of combining (Gonzalo, 1994). The Johansen method contains two likelihood ratio statistics to test the existence of a co-integration vector, Trace test (λ_{trace}) and maximum test (λ_{max}) are based on following formula:

$$\lambda_{trace}(r) = -T \sum_{i=r+t}^{n} \ln(1-\lambda_i) \quad (2)$$

$$\lambda_{mas}(r, r+1) = -T \ln(1-\lambda_{r+1}) \quad (3)$$

Where,

T = number of observations used
λ = eigen values

The results of these two statistical values will be compared with the critical values available from the tables provided by Osterwald – Lenum (1992). Co-integration can be defined as a form of long-run balance or joint movement between sets of time series data in a system. However, in the short run, variables may be scattered from each other and cause imbalances in the system. Therefore, the error correction model (ECM) measures the extent to which the system is out of short-run balance (Norimah and Podivinsky, 2013; Asmah, 2013) among others.

The next procedure is developing the Vector Error Correction Model (VECM) for the short run relationship testing procedure. In this case, the Granger causality test will be conducted in the Vector Error Correction Model (VECM) framework. Granger causality can be used to define the relationship between the variable in the short run. To be precise, according to Granger (1969), variable Y is said to be Granger to variable X, if Y information is significant in making the forecasting on the value of X. If both X and Y are stationary at first difference level, that is the co-integration on the degree of integration. Then the period of error correction should be included in the model before the Granger cause test can be performed. The existence of an error correction term (ECT) describes any movements in the dependent variable as actually an imbalance function in the co-integration relationship (as described by ECT) and also the same for other independent variables (Engle Granger, 1987). Based on Engle Granger (1987) and Toda Phillips (1993), failure to estimate error correction factor will cause incorrect results. In other words, error correction term (ECT) in VECM pioneered another method to ensure that the Granger causality test is more accurate. Therefore, if all the variables involved in this study are stationary at first difference level then the error of the long-term relationship regression may be used to estimate VECM as below. (Note that the symbol Δ in the equation represents the first difference level for each variable involved in the study):

Unrecovered Regime:

$$\Delta G_{it} = \alpha_{11} + \beta_{11} ECT_{(t-1)} + \sum_{i=1}^{n} \theta_{11} \Delta G_{t-i} + \sum_{i=1}^{n} \theta_{12} IPI_{t-1} + \sum_{i=1}^{n} \theta_{13} \Delta M3_{t-i} + \sum_{i=1}^{n} \theta_{14} \Delta CPI_{t-i} + \sum_{i=1}^{n} \theta_{15} \Delta LIR_{t-i} + \sum_{i=1}^{n} \theta_{16} \Delta BOT_{t-i} + \sum_{i=1}^{n} \theta_{17} \Delta GBMY_{t-i} + \upsilon_{it}$$

(1.1)

$$\Delta IPI_{it} = \alpha_{12} + \beta_{11} ECT_{(t-1)} + \sum_{i=1}^{n} \theta_{11} \Delta G_{t-i} + \sum_{i=1}^{n} \theta_{12} IPI_{t-1} + \sum_{i=1}^{n} \theta_{12} \Delta M3_{t-i} + \sum_{i=1}^{n} \theta_{13} \Delta CPI_{t-i} + \sum_{i=1}^{n} \theta_{14} \Delta LIR_{t-i} + \sum_{i=1}^{n} \theta_{15} \Delta BOT_{t-i} + \sum_{i=1}^{n} \theta_{16} \Delta GBMY_{t-i} + \upsilon_{it}$$

(1.2)

$$\Delta M3_{it} = \alpha_{13} + \beta_{11} ECT_{(t-1)} + \sum_{i=1}^{n} \theta_{11} \Delta G_{t-i} + \sum_{i=1}^{n} \theta_{12} IPI_{t-1} + \sum_{i=1}^{n} \theta_{12} \Delta M3_{t-i} + \sum_{i=1}^{n} \theta_{13} \Delta CPI_{t-i} + \sum_{i=1}^{n} \theta_{14} \Delta LIR_{t-i} + \sum_{i=1}^{n} \theta_{15} \Delta BOT_{t-i} + \sum_{i=1}^{n} \theta_{16} \Delta GBMY_{t-i} + \upsilon_{it}$$

(1.3)

$$\Delta CPI_{it} = \alpha_{14} + \beta_{11} ECT_{(t-1)} + \sum_{i=1}^{n} \theta_{11} \Delta G_{t-i} + \sum_{i=1}^{n} \theta_{12} IPI_{t-1} + \sum_{i=1}^{n} \theta_{12} \Delta M3_{t-i} + \sum_{i=1}^{n} \theta_{13} \Delta CPI_{t-i} + \sum_{i=1}^{n} \theta_{14} \Delta LIR_{t-i} + \sum_{i=1}^{n} \theta_{15} \Delta BOT_{t-i} + \sum_{i=1}^{n} \theta_{16} \Delta GBMY_{t-i} + \upsilon_{it}$$

(1.4)

$$\Delta LIR_{it} = \alpha_{15} + \beta_{11} ECT_{(t-1)} + \sum_{i=1}^{n} \theta_{11} \Delta G_{t-i} + \sum_{i=1}^{n} \theta_{12} IPI_{t-1} + \sum_{i=1}^{n} \theta_{12} \Delta M3_{t-i} + \sum_{i=1}^{n} \theta_{13} \Delta CPI_{t-i} + \sum_{i=1}^{n} \theta_{14} \Delta LIR_{t-i} + \sum_{i=1}^{n} \theta_{15} \Delta BOT_{t-i} + \sum_{i=1}^{n} \theta_{16} \Delta GBMY_{t-i} + \upsilon_{it}$$

(1.5)

$$\Delta BOT_{it} = \alpha_{16} + \beta_{11} ECT_{(t-1)} + \sum_{i=1}^{n} \theta_{11} \Delta G_{t-i} + \sum_{i=1}^{n} \theta_{12} IPI_{t-1} + \sum_{i=1}^{n} \theta_{12} \Delta M3_{t-i} + \sum_{i=1}^{n} \theta_{13} \Delta CPI_{t-i} + \sum_{i=1}^{n} \theta_{14} \Delta LIR_{t-i} + \sum_{i=1}^{n} \theta_{15} \Delta BOT_{t-i} + \sum_{i=1}^{n} \theta_{16} \Delta GBMY_{t-i} + \upsilon_{it}$$

(1.6)

$$\Delta GBMY_{it} = \alpha_{17} + \beta_{11} ECT_{(t-1)} + \sum_{i=1}^{n} \theta_{11} \Delta G_{t-i} + \sum_{i=1}^{n} \theta_{12} IPI_{t-1} + \sum_{i=1}^{n} \theta_{12} \Delta M3_{t-i} + \sum_{i=1}^{n} \theta_{13} \Delta CPI_{t-i} + \sum_{i=1}^{n} \theta_{14} \Delta LIR_{t-i} + \sum_{i=1}^{n} \theta_{15} \Delta BOT_{t-i} + \sum_{i=1}^{n} \theta_{16} \Delta GBMY_{t-i} + \upsilon_{it}$$

(1.7)

Regime 2:

$$\Delta G_{it} = \alpha_{21} + \beta_{21} ECT_{(t-1)} + \sum_{i=1}^{n} \theta_{21} \Delta G_{t-i} + \sum_{i=1}^{n} \theta_{22} IPI_{t-1} + \sum_{i=1}^{n} \theta_{23} \Delta M3_{t-i} + \sum_{i=1}^{n} \theta_{24} \Delta CPI_{t-i} + \sum_{i=1}^{n} \theta_{25} \Delta LIR_{t-i} + \sum_{i=1}^{n} \theta_{26} \Delta BOT_{t-i} + \sum_{i=1}^{n} \theta_{27} \Delta GBMY_{t-i} + \upsilon_{it}$$

(2.1)

$$\Delta IPI_{it} = \alpha_{22} + \beta_{21} ECT_{(t-1)} + \sum_{i=1}^{n} \theta_{21} \Delta G_{t-i} + \sum_{i=1}^{n} \theta_{22} IPI_{t-1} + \sum_{i=1}^{n} \theta_{23} \Delta M3_{t-i} + \sum_{i=1}^{n} \theta_{24} \Delta CPI_{t-i} + \sum_{i=1}^{n} \theta_{25} \Delta LIR_{t-i} + \sum_{i=1}^{n} \theta_{26} \Delta BOT_{t-i} + \sum_{i=1}^{n} \theta_{27} \Delta GBMY_{t-i} + \upsilon_{it}$$

(2.2)

$$\Delta M3_{it} = \alpha_{23} + \beta_{21} ECT_{(t-1)} + \sum_{i=1}^{n} \theta_{21} \Delta G_{t-i} + \sum_{i=1}^{n} \theta_{22} IPI_{t-1} + \sum_{i=1}^{n} \theta_{23} \Delta M3_{t-i} + \sum_{i=1}^{n} \theta_{24} \Delta CPI_{t-i} + \sum_{i=1}^{n} \theta_{25} \Delta LIR_{t-i} + \sum_{i=1}^{n} \theta_{26} \Delta BOT_{t-i} + \sum_{i=1}^{n} \theta_{27} \Delta GBMY_{t-i} + \upsilon_{it}$$

(2.3)

$$\Delta CPI_{it} = \alpha_{24} + \beta_{21} ECT_{(t-1)} + \sum_{i=1}^{n} \theta_{21} \Delta G_{t-i} + \sum_{i=1}^{n} \theta_{22} IPI_{t-1} + \sum_{i=1}^{n} \theta_{23} \Delta M3_{t-i} + \sum_{i=1}^{n} \theta_{24} \Delta CPI_{t-i} + \sum_{i=1}^{n} \theta_{25} \Delta LIR_{t-i} + \sum_{i=1}^{n} \theta_{26} \Delta BOT_{t-i} + \sum_{i=1}^{n} \theta_{27} \Delta GBMY_{t-i} + \upsilon_{it}$$

(2.4)

$$\Delta LIR_{it} = \alpha_{25} + \beta_{21} ECT_{(t-1)} + \sum_{i=1}^{n} \theta_{21} \Delta G_{t-i} + \sum_{i=1}^{n} \theta_{22} IPI_{t-1} + \sum_{i=1}^{n} \theta_{23} \Delta M3_{t-i} + \sum_{i=1}^{n} \theta_{24} \Delta CPI_{t-i} + \sum_{i=1}^{n} \theta_{25} \Delta LIR_{t-i} + \sum_{i=1}^{n} \theta_{26} \Delta BOT_{t-i} + \sum_{i=1}^{n} \theta_{27} \Delta GBMY_{t-i} + \upsilon_{it}$$

(2.5)

$$\Delta BOT_{it} = \alpha_{26} + \beta_{21} ECT_{(t-1)} + \sum_{i=1}^{n} \theta_{21} \Delta G_{t-i} + \sum_{i=1}^{n} \theta_{22} IPI_{t-1} + \sum_{i=1}^{n} \theta_{23} \Delta M3_{t-i} + \sum_{i=1}^{n} \theta_{24} \Delta CPI_{t-i} + \sum_{i=1}^{n} \theta_{25} \Delta LIR_{t-i} + \sum_{i=1}^{n} \theta_{26} \Delta BOT_{t-i} + \sum_{i=1}^{n} \theta_{27} \Delta GBMY_{t-i} + \upsilon_{it}$$

(2.6)

$$\Delta GBMY_{it} = \alpha_{27} + \beta_{21} ECT_{(t-1)} + \sum_{i=1}^{n} \theta_{21} \Delta G_{t-i} + \sum_{i=1}^{n} \theta_{22} IPI_{t-1} + \sum_{i=1}^{n} \theta_{23} \Delta M3_{t-i} + \sum_{i=1}^{n} \theta_{24} \Delta CPI_{t-i} + \sum_{i=1}^{n} \theta_{25} \Delta LIR_{t-i} + \sum_{i=1}^{n} \theta_{26} \Delta BOT_{t-i} + \sum_{i=1}^{n} \theta_{27} \Delta GBMY_{t-i} + \upsilon_{it}$$

(2.7)

The F-test and t-test in Vector Error Correction Model (VECM) can be interpreted as a granger causality test in the sample (Masih and Masih, 1996). The results only determine exogenous degree or endogenous of the dependent variable in the sample. It does not present the strength of the causal relationship between variables passing the sample data. To identify the dynamic relationship in an equation system, the Impulse Response Functions (IRFs) test is used. Impulse Response Functions (IRFS) detect the dynamics response to any shock from one variable to all variables including the variable itself. Econometrically, responses to new designs or shock for time series variables can be identified using Vector Moving Average (VMA) in the following equation:

$$Y_t = \beta_t + \sum_{i=1}^{k} \theta_{ij}\, e_{t-i} \qquad (3.34)$$

Where β_t is a constant term that can be used as the mean value of Y_t, θ_{ij} is a matrix $N\, x\, N$ with an θ_{ij} element which measures the effect of a unit change for an error termination of the endogenous variables in the equation system, and e_{t-i} is the vector $N\, x\, i$ for the overcurrent and current shock value.

Result analysis

Augmented Dickey Fuller (ADF)

To achieve the objective of the study, this study needs a same stationary level for each set of data that is involved as a variable. This test procedure has become a pre-condition in implementation of co-integration analysis and granger causality in Vector Error Correction Model (VECM) framework. In this study, the Augmented Dickey Fuller (ADF) test is employed. The optimum lag selection is based on the smallest value generated by Akaike Info Criterion (AIC). T- Statistic value of Augmented Dickey Fuller (ADF) will be compared with critical values generated by result estimation.

Table 1: Augmented Dickey Fuller (ADF) of Unit Root Test

Variables	**At level**		**First difference**	
	Intercept	Trends And Intercept	Intercept	Trends And Intercept
$M3_t$	1.098887 [12]	-1.467049 [12]	-7.642870*** [2]	-8.329055***[3]
IPI_t	-2.239374 [13]	-2.285132 [13]	-3.765324***[12]	-4.052690***[12]

CPI_t	0.718068 [12]	-1.665949 [8]	-5.694574***[11]	-5.750486***[11]
LIR_t	-1.179668 [12]	-2.988995 [12]	-4.901386***[11]	-4.889957***[11]
BOT_t	-1.538941 [12]	-1.861089 [12]	-6.386260***[16]	-6.416647***[16]
$GBPMYR_t$	-2.015589 [2]	-2.011946 [2]	-16.76624***[1]	-16.74829***[1]

Noted: Numbers in [ ] are numbers of lag that follow Akaike Info Criterion (AIC). The sign *** indicates the significant level at 1%.

The result of the ADF unit root tests, both at the level and at first differencing are reported in Table 1, by taking into consideration with time trend and without time trend variable in the regression. According to Table 1, the t-test statistics for all series from ADF tests are statistically insignificant to reject the null hypothesis of non-stationarity. This result indicates that these series are non-stationary at their level form. Whereas, the result fails to reject the null hypothesis of unit roots in their level form in the autoregressive representation of each variable, thus, they are all not I(0). Therefore, these variables contain a unit root process, or they share a common stochastic component. Thus, the tests are continued in the first differencing stages. When the ADF test is conducted at the first difference of each variable, the null hypothesis of non-stationary is easily rejected at 99% significance levels as shown in Table 1.

Johansen Juselius co-integration test

Tables 2 and 3 cover co-integration test results. In general, both regimes suggested the existence of at least one co-integrating system in the long-term equilibrium. For the result of co-integration test in 'before Asian Financial crisis regime', the result of the trace statistic test demonstrates that the null hypothesis of r=0 against its alternative r>1, is easily rejected at the 0.01 and 0.05 significant levels. The computed value 98.72 is obviously larger than the critical values at 0.05 and 0.01, these being 94.15 and 103.18, respectively. Nonetheless, if we test the null hypothesis of r≤1, we definitely fail to reject the hypothesis as the computed value at 62.36 is smaller than the critical values at 0.05 and 0.01 significant levels, which are 68.52 and 76.07, respectively. Therefore, based on the trace statistic test result, we conclude that there exists a single co-integrating vector in the model. The study suggests a similar result for Lambda Trace and Lambda Max. Based on these outcomes, the study further suggests that the economic growth and its macroeconomic determinants exhibit a long-run relationship in the unrecovered regime. This is means that the series in the system are moving together and cannot move far from each other. The same results are also concluded for recovery regime.

Table 2: The results of Johansen Juselius Co-integration Tests for Regime 1 (January 1990 to December 1996) before Financial Crisis

Hypothesis (H0)	**Co-integration System**					
Lag 4	λ ***Trace***	**5% Critical Value**	**1% Critical Value**	λ ***Max***	**5% Critical Value**	**1% Critical Value**
$r = 0$	98.72*(**)	94.15	103.18	44.36*(**)	39.37	45.10
$\boldsymbol{r = 1}$	62.36	68.52	76.07	30.35	33.46	38.77
$\boldsymbol{r = 2}$	40.00	47.21	19.793	27.07	32.24	32.24
$\boldsymbol{r = 3}$	20.21	29.68	35.65	11.55	20.97	25.52
$\boldsymbol{r = 4}$	8.65	15.41	20.04	7.85	14.07	18.63
$\boldsymbol{r = 5}$	0.80	3.76	6.65	0.80	3.76	6.65

Note: Critical values is obtained from Osterwald-Lenum (1992). Sign * and *(**) denote rejected critical values at significant level of 5% and 1%.

Table 3: The results of Johansen Juselius Co-integration Tests (January 2010 to December 2018) after Financial Crisis

Hypothesis (H0)	**Co-integration System**					
Lag 11	λ ***Trace***	**5% Critical Value**	**1% Critical Value**	λ ***Max***	**5% Critical Value**	**1% Critical Value**
$r = 0$	116.0089*(**)	94.15	103.18	52.50578*(**)	39.37	45.10
$\boldsymbol{r = 1}$	63.50307	68.52	76.07	30.74407	33.46	38.77
$\boldsymbol{r = 2}$	32.75900	47.21	54.46	16.23840	27.07	32.24
$\boldsymbol{r = 3}$	16.52060	29.68	35.65	11.78047	20.97	25.52
$\boldsymbol{r = 4}$	4.740127	15.41	20.04	3.433824	14.07	18.63
$\boldsymbol{r = 5}$	1.306303	3.76	6.65	1.306303	3.76	6.65

Note: Critical values is obtained from Osterwald-Lenum (1992). Sign * and *(**) denote rejected critical values at significant level of 5% and 1%.

Through Vector Auto regression (VAR) analysis, we can determine the optimum lag length for each Vector Error Correction Model (VECM) equation system. In addition, in this part the results of the VAR analysis acknowledge that, optimum lag length of unrecovered regime is 4 based on the lowest Akaike Info Criterion (AIC) value obtained. Through the same process, optimum lag length for recovery regime and regime is at lag 11.

Granger causality in Vector Error Correction Model (VECM) framework

The results of co-integration test can only prove the existence of long-run relationships but not the form of causality relationships. Therefore, granger causality test will be conducted to determine the direction of causality relationships between seven variables which are involved in this study. Refer to Tables 4 and 5, the findings show that the money supply (M2) is part of the endogenous variables in the equation system, these results are support by the significant and negative sign (-0.037704 and -0.06813) of error terms variable (ECT) in both systems. In other words, during unrecovered regime, if a 1 percent shock occurs in the economics system, the money supply will react as a stabilization engine to take back the unbalance to a balanced system at least 3 percent. However, by comparing with recovery regime, if a 1 percent shock occurs in the economics system, the money supply will react as a stabilization engine and bare the burdens to taking back the unbalance to a balance system at least 6 percent.

These show, speed of adjustment in recovery regime is much faster compare to the unrecovered regime. In application, prior and after the Asian financial crisis in 1997, the Malaysian economy utilized money supply (M2) acted as a policy tools for any market imbalance. This also proves that money supply is responsible for balancing short-term disequilibrium towards long-term equilibrium. This result is in line with Milton Friedman's Classical macroeconomic theory which stated that fluctuations in the economy can be controlled through the implementation of expanding monetary policy. This theory was further supported by the emergence of the Neutrality Theory, this theory stated further, in long term all real variables will return to their normal (balanced) level and be referred to as the Policy ineffectiveness Theory. The results further suggest that, the output or productivity is also part of endogenous variable in the system. The ECT is found to be a negative sign and significance at 5 percent. According to the result, the coefficient value for output in uncovered regime is -0.064753 and for recovery regime is -0.038331.

The results further indicate that output is also part of the endogenous variables in the equation system, these results are supported by the significant and negative sign of error term variables (ECT), (-0.064753 and -0.038331) in both systems. Intuitively, the mechanics behind the VECM results imply that both these variables were the initial receptors of exogenous shocks to the long-term equilibrium relationship, and all the remaining variables including money supply, interest rate, price, and trade had to bear the burden of short-run adjustments (to long-term trends) endogenously in different proportions in order to bring the system back to its long-term equilibrium.

Moreover, Table 6 summarizing the causality results for both regimes. In the short run, there exists an important causal link between independent variables for both regimes. Referring to Table 5, the result further suggests bidirectional causality from money supply to economic growth and vice versa, in both models. Furthermore, the bidirectional relationship is also found between output and economic growth in regime before and after the Asian Financial Crisis.

Table 4: Granger Causality test in VECM framework for regime 1 from January 1990 to December 1996

Unrecovered Regime	**Independent Variables**							
	ΔG	$\Delta M3$	ΔIPI	ΔCPI	ΔLIR	ΔBOT	$\Delta GBMY$	ECT_{t-1}
ΔG		1.7421 [0.0245] **	3.2364 [0.0412] **	4.6020 [0.0038] ***	1.2003 [0.3030]	3.2736 [0.0221] **	2.7459 [0.1294]	-0.06124 [0.0003] ***
$\Delta M3$	6.6265 [0.0003] ***		4.57036 [0.0058] ***	3.83560 [0.1547]	1.790206 [0.0581] *	2.738190 [0.0370] **	3.438272 [0.0382]**	-0.037704 [0.0184] ***
ΔIPI	2.6455 [0.0501] *	2.764136 [0.1055]		3.56969 [0.2189]	3.824406 [0.2549]	7.050954 [0.0004] ***	0.803993 [0.3733]	-0.064753 [0.0012] ***
ΔCPI	3.1764 [0.0146	8.474546	2.24257 [0.1146]		2.563626	1.972290 [0.1279]	3.666054	0.08145 [0.0013

	] **	[0.0050] ***			[0.0626] **		[0.0600]	] ***
ΔLIR	2.7954 [0.1122]	2.083043 [0.0335] **	1.64147 [0.2048]	1.53161 [0.2243]		0.641153 [0.4265]	1.668441 [0.0011] ***	0.187409 [0.7021]
ΔBOT	2.1926 [0.0708] *	2.691756 [0.0394] **	0.66204 [0.5193]	0.26767 [0.6067]	1.693545 [0.1979]		6.016647 [0.0011] ***	1.381725 [0.1121] ***
$\Delta GBMY$	2.2967 [0.1786]	3.364655 [0.0244]	3.75815 [0.0851]	2.45420 [0.0715]	2.068454 [0.1364]	1.175181 [0.3159]		-0.461160 [0.3748]

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 1.1 to 1.7 to read the table.

Table 5: Granger Causality test in VECM for regime 2 from January 1999 to December 2018

Recovery Regime	**Independent Variables**							
	ΔG	$\Delta M3$	ΔIPI	ΔCPI	ΔLIR	ΔBOT	$\Delta GBMY$	ECT_{t-1}
ΔG		5.0279 [0.0001] ***	5.5030 [0.0788] *	5.0452 [0.1092]	1.9224 [0.1047]	2.5823 [0.0278] **	2.5987 [0.3170]	-0.00583 [0.0671] *
$\Delta M3$	5.1257 [0.0015] ***		3.189302 [0.0033]	5.58088 [0.0000]	2.503471 [0.0237]	1.708836 [0.1219]	1.657455 [0.1619]	-0.06813 [0.0981] *

			***	***				
ΔIPI	4.3183 [0.0006] ***	3.051647 [0.0030] ***		1.86381 [0.1187]	2.744338 [0.0141]	5.225057 [0.0000] ***	3.524153 [0.0008] ***	-0.038331 [0.0054] ***
ΔCPI	2.0659 [0.1346]	1.785198 [0.1179]	18.25722 [0.0000] ***		3.469704 [0.0093] *	2.044122 [0.1097]	3.260936 [0.0046] ***	1.310583 [0.9936]
ΔLIR	1.3877 [0.2343]	1.565282 [0.1596]	2.573225 [0.0204] **	2.49499 [0.0326] **		3.324362 [0.0015] ***	2.876584 [0.0106] ***	0.008043 [0.1705]
ΔBOT	4.2505 [0.0020] ***	1.906851 [0.1300]	3.246382 [0.0078] ***	2.07049 [0.0588] **	1.177740 [0.3200]		2.503841 [0.0439] **	-1.877504 [0.0000] ***
$\Delta GBMY$	[4.8566 [0.3531]	2.742545 [0.1141]	3.817039 [0.2053]	4.34668 [0.3155]	2.048779 [0.1894]	6.771969 [0.2116]		0.063010 [0.1773]

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, []specify for Wald-test probability. Also the superscript '***', '**', and '*' specify significant at 99%, 95%, and 90% significance levels. Please refer to equations 2.1 to 2.7 to read the table.

Table 6: Summarize of overall Temporal Granger Causality test

Number of Direction	Unrecovered Regime (Direction of Causality)	Wald test	p-value
1	Growth Granger-cause Money Supply	6.6265	0.0003***
	Money Supply Granger-cause Growth	1.7421	0.0245**
2	Growth Granger-cause Output	2.6455	0.0501*
	Output Granger-cause Growth	3.2364	0.0412**
3	Growth Granger-cause Price	3.1764	0.0146**
	Price Granger-cause Growth	4.6020	0.0038***
4	Growth Granger-cause Interest Rate	2.7953	0.1122
	Interest Rate Granger-cause Growth	1.2003	0.3030
5	Growth Granger-cause Trade	2.1926	0.0708*
	Trade Granger-cause Growth	3.2736	0.0221**
6	Growth Granger-cause Bilateral Exchange Rate between Pound Sterling and US Dollar	2.2967	0.1786
	Bilateral Exchange Rate between Pound Sterling and US Dollar Granger-cause Growth	2.7459	0.1294
Number of Direction	**Unrecovered Regime (Direction of Causality)**	**Wald test**	**p-value**
1	Growth Granger-cause Money Supply	5.1257	0.0015***
	Money Supply Granger-cause Growth	5.0279	0.0001***
	Growth Granger-cause Output	4.3183	0.0006***

2	Output Granger-cause Growth	5.5030	0.0788**
3	Growth Granger-cause Price	2.0659	0.1346
	Price Granger-cause Growth	5.0452	0.1092
4	Growth Granger-cause Interest Rate	1.3877	0.2343
	Interest Rate Granger-cause Growth	1.9224	0.1047
5	Growth Granger-cause Trade	4.2505	0.0020***
	Trade Granger-cause Growth	2.5823	0.0278**
6	Growth Granger-cause Bilateral Exchange Rate between Pound Sterling and US Dollar	4.8566	0.3531
	Bilateral Exchange Rate between Pound Sterling and US Dollar Granger-cause Growth	2.5987	0.3170

Note: Asterisks (****), (**) and (*) indicates statistically significant at 1%, 10% and 30% level, respectively.

Conclusions

The motivation of this study is to examine the dynamic relationship between money, output and economic growth in two different exchange rate regimes in Malaysia, namely exchange rates before the Asian financial crisis (floating exchange rate) and exchange rates after the Asian financial crisis (floating with basket currencies exchange rate). Although many similar studies have been carried out, there is still little exploration in the issues studied involving different exchange rate regimes, particularly for Malaysian issue. In order to achieve this objective, the monthly frequency time series data is used starting January 1990 until December 2018. The selected macroeconomics data is utilized, namely industrial production index, broad money, consumer price index, lending interest rate, net export, and bilateral exchange rate. The two exchange rate regimes are based on an announced commitment by the Central Bank of Malaysia, in dealing with the Asian financial crisis in 1997. This finding has strong policy implications for the Malaysian case. The results highlighted that the fiscal and monetary policies have been reinforced in both regimes. In other words, Malaysia has combined both policies in each regime in order to achieve the national target. Therefore, regulated monetary expansion and the planning of fiscal policies that stimulate long-term economic growth must continue to be implemented by the government. However, with changes in economic planning over a period of time, such as an economic shock or an economic crisis, the best combination between both policy shifts need to be implemented.

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