The relationship between exchange rate and trade balance: evidence from Malaysia based on ARDL and Nonlinear ARDL approaches

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The relationship between exchange rate and trade balance: evidence from Malaysia based on ARDL and Nonlinear ARDL approaches

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Abstract:

This paper is focused on the relationship between exchange rate (MYR/RMB) and trade balance. Malaysia is used as a case study. Share price, money supply and exports to China are used as control variables. ARDL and Nonlinear ARDL methods are used to test whether the relationship between exchange rate and trade balance is symmetric or asymmetric in the short and long run. The results tend to indicate that the variables are theoretically related as evidenced in their being cointegrated. Furthermore, the relationship between exchange rate and trade balance is evidenced to be symmetric in the short run but asymmetric in the long run. The Granger-causality test tends to indicate that exchange rate is an endogenous (dependent) variable driven by money supply followed by share price and trade balance. The findings contain strong policy implications.

Keywords: exchange rate, trade balance, ARDL, NARDL, VDC, Malaysia

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1. Introduction

The study of exchange rate is a significant topic of economic research, as it is a major price in an open economy that influences businesses, investment and policy-making. Exchange rate has undergone a rapid development, mostly in the post-Bretton Woods era. During that time, the foreign exchange rate was very unstable due to the floating exchange rate regime starting with 1973.

After the Asian Financial Crisis of 1997/1998, China emerged as the biggest trading partner for a large number of East Asian countries. In 2012, for the ASEAN-10, which is the Southeast Nations, China held 12.9% of the national trading, exceeding USA at 8.1% as well as Japan at 10.6%. Research has been conducted in regards to the corresponding impact of China for its trading partners alongside the enhanced economic link. Multinational corporations are including China into its worldwide production system with the earlier players, which increases national trading. China's businesses are specializing with its regional counterparts which increased the industry-to-industry trading in differentiated goods. The rise of China as an economic giant has led to a growth of labor diversification and intra-regional trading. This will then lead to an economic integration which can be likened to the European Union or the NAFTA.

However, the conflicting aspects of China's economic development have been brought up. According to the Ministry of Commerce in China, the country has become the global top exporter since 2007 and its current account surplus accumulated up to $260 billion, which was top-ranked internationally in 2013. Concerns rise due to China's yuan regime, investment magnetism, minimal labor costs as well as the agreement with the WTO in November 2001, which may set China to crowd-out other developing Asian nations. For Malaysia, it has faced a constant trade deficit with China since 2002, which reached $4.2 billion in 2007, prior to the correction in 2009. There have been discussions on the relationship between the emergence of China and the devaluation of the Renminbi in 1994 to the Asian Financial Crisis. The issues have challenged the accords of sustainable trade competitiveness at the regional level. No conclusive agreement has been reached regarding the economic rise of China. It is not easy to assess if the relationship between China and its regional economies overtake the competitive threats.

The study highlights the Malaysia-China case to assess if the real exchange fluctuations, and the demand and supply channels determine the bilateral trade balance performance in the 2000-2017. Out of all the ASEAN-10 members, Malaysia is the biggest trading partner for China.

2. Objective of the studies

This paper is focused on the relationship between exchange rate (MYR/RMB) and trade balance. Malaysia is used as a case study. Share price, money supply and exports to China are used as control variables. ARDL and Nonlinear ARDL methods are used to test whether the relationship between exchange rate and trade balance is symmetric or asymmetric in the short and long run

3. Theoretical underpinning

The elasticity model for the balance of trade has displayed the theoretical relationship between trade balance and exchange rate. Empirically, multiple studies have been carried out to investigate the relationship between exchange rate and trade balance. The studies were aimed to provide valuable inputs to policy makers on the effectiveness of exchange rate policy. This includes devaluation-based adjustment policies to provide balance to foreign trading ((Lal and Lowinger, 2002; Singh, 2002).

As mentioned by Bahmani-Oskooee (2001), theoretically, nominal depreciation of exchange rate is said to change the real exchange rate, which leads to a direct effect on trade balance. It was further explained that devaluation of a currency may allow a country to gain international competitiveness and enhance its trade balance. This is because exports will become relatively cheaper, and imports are reduced as it becomes relatively more expensive, hence trade balance is improved.

The elasticity model of the balance of trade has shown the existence of a theoretical relationship between exchange rate and the trade balance. Empirically, various studies have been conducted to assess the influence of exchange rate on trade balance, with the objective of providing valuable inputs to policy makers on the effectiveness of exchange rate policy such as devaluation-based adjustment policies (effected through nominal exchange rate) to balance a country's foreign trade (Lal and Lowinger, 2002; Singh, 2002).

In theory, nominal depreciation (appreciation) of exchange rate is assumed to change the real exchange rate and thus has a direct effect on the trade balance (Bahmani-Oskooee, 2001). Bahmani-Oskooee (2001) state that an effort to gain international competitiveness and help to improve its trade balance, a country may adhere to devaluation or allow her currency to depreciate. Devaluation or depreciation increases exports by making exports relatively cheaper, and discourage imports by making imports relatively more expensive, thus improving trade balance.

The study confirms that money supply and exchange rates have a strong positive relationship with inflation and have to be managed. Studied by Mpofu (2011). The monthly data used in the study was from January 1999 to September 2010. It was found that exchange rate and money supply have a strong and negative relationship. The popular notion of the economists is that most basic factors that affect commodity prices are supply and demand factors. In accordance to that, a rise in money supply will lead to an increase in demand for goods and services. This leads to an increase in prices which also lead to an increase in inflation. Hence, the home country's currency will depreciate.

4. Literature Review

The relationship between four emerging economies, which are India, Phillipines, South Korea and Pakistan were studied by Abdalla and Murinde (1997). An error correction model was applied with the usage of monthly data from International Finance Corporation stocks and real exchange rates from January 1985 to July 1994. It was found that there was a causal link between exchange rates to stock prices in all of the economies, except for Phillipines which ran in an opposing direction.

The Asian Financial Crisis 1997 incited an interest in the Asian nations. Granger,Huan and Yang (1998) developed a study highlighting the nine Asian nations, which are Japan, Singapore, Malaysia, Philippines, Thailand, Taiwan, South Korea, Indonesia and Hong Kong. The daily data used for the aforementioned study was from January 1986 to November 1997. A traditional approach was adopted for the Japan and Thailand data in order for the exchange rates to have a positive correlation to the stock prices. For Taiwan, the analysis resulted in a causal link between stock prices to exchange rates with a negative correlation. This was a case of portfolio balance approach. Furthermore, there was a solid feedback relations for Malaysia, Philippines, Korea and Indonesia, whereas no such causality for Singapore.

The study was followed by a subsequent version by Granger, Huan and Yang (2000), in which the duration covered was from January 3 of 1986 to June 16 of 1998. From the study, the causality was found to run from exchange rates to stock prices for Korea, but ran in the opposite direction for Philippines. Moreover, data of Malaysia, Hong Kong, Thailand, Singapore and Taiwan displayed sturdy feedback relations but showed no relationship for Indonesia and Japan.

Ibrahim and Aziz (2003) conducted a cointegration analysis and vector autoregression modelling for a study regarding Malaysia. The monthly data from January 1977 to August 1998 was used, which was when capital controls were set and the government imposed a fixed exchange rate. The effect of the Asian Financial Crisis on the relationship between the variables were included in the study. The study conducted consisted of the relationships between Malaysian equity market and the four macroeconomics variables, which are real output, money supply, price level and exchange rate. The results displayed an unstable relationship between the stock prices and exchange rates during the crisis. In addition, it was doubted that the Asian Financial Crisis has affected the interactions between the variables.

Furthermore, Mazila and Rahman (2013) also conducted a study in the Malaysian context. The Granger causality effect was investigated and it was found feedback exists between the two markets.

Abdalla and Murinde (1997) examine the relationship for four emerging market economies; India, Pakistan, S. Korea, Philippines. The authors apply an error correction model by using monthly data from International Finance Corporation (IFC) stocks and real exchange rates for the period from January 1985 to July 1994. The results indicate that causality runs from exchange rates to stock prices in India, Pakistan and S. Korea while in Philippines, it runs in the opposite direction.

1997 Asian crisis sparked growing interest in Asian countries. Granger, Huang and Yang (1998) is one such study which focuses on nine Asian countries including Hong Kong, Indonesia, South Korea, Taiwan, Thailand, Philippines, Malaysia, Singapore and Japan. The authors use daily data from January 1986 to November 1997, during the Asian crisis. The data of Japan and Thailand support the traditional approach, so that exchange rates lead stock prices with a positive correlation. In the case of Taiwan, the analysis shows that causality runs from stock prices to exchange rates with a negative correlation as an example of portfolio balance approach. The results

indicate strong feedback relations for Indonesia, Korea, Malaysia and the Philippines while no causality exist for Singapore.

A subsequent version of this paper, Granger, Huang and Yang (2000) covers the period from January 3, 1986 to June 16, 1998. They observe that causality runs from exchange rates to stock prices for Korea while in Philippines, it runs in the opposite direction. Further, the data of Hong Kong, Malaysia, Singapore, Thailand and Taiwan indicate strong feedback relation while Indonesia and Japan indicate no relation between the exchange rate and the stock market indices.

In the Malaysian context, Ibrahim and Aziz (2003) employ cointegration analysis and vector autoregression modelling. Authors use monthly data from January 1977 to August 1998 when capital controls were in place and a fixed exchange rate was imposed by the government. They also consider the effect of the Asian crisis on the interaction among the variables. They investigate the interactions between Malaysian equity market and four macroeconomic variables; real output, price level, money supply and exchange rate. Their results show that unstable interactions between the stock prices and exchange rates exist during the crisis period. In addition to this, they note that they doubt whether the Asian crisis has changed the relationships among variables.

In the Malaysian context, Mazila and Rahman (2013) examine the Granger causality effect and point out that there is feedback between the two markets.

5. Data & Methodology

The data variable are exchange rate (MYR/RMB) with macroeconomics in Malaysia i.e. trade balance (TB), share price (SP), money supply (M1) and export to China (EX). Qyarterly data were collected from Bloomberg for 18 years starting with 2000. Said and Dickey (1984) expand the fundamental autoregressive unit root test to suit general ARMA(p, q) models with obscure requests and their test is alluded to as the expanded DickeyFuller (ADF) test. The ADF test tests the invalid theory that a period arrangement Yt is I(1) against the elective that it is I(0), accepting that the elements in the information have an ARMA structure. The ADF test is based on estimating the test regression.

The Augmented Dicker Fuller and Philips Peron tests were utilized to test for stationarity of time arrangement information to build up whether the information utilized has a consistent mean and a steady fluctuation to decrease odds of getting false outcomes in the gauge condition.

Unit root test is used for tests of stationary. Following the work of Baharumshah (2001) and Sugema (2005), Augmented Dickey-Fuller (ADF) test and Philips-Perron (PP) test is applied for testing stationarity in economic data. If ADF test and PP test show different results, the Kwiatkowski-Philips-Schmidt-Shin (KPSS) test is used as decisive results. In order to solve the spurious regression problem and violation assumptions of the Classical Regression Model, cointegration analysis used to examine the long-run relationship between XRt, TBt, M1t, SPt and EXt. To test for cointegration, three methods are used. These are Engle-Granger Test, and Johansen Test, ARDL and non-ARDL

In order to know the disequilibrium error, we rewrite equation (1) as:

XRt TBt M1t SPt Ext u lnXR lnTB lnM1 lnSP lnEX. (1)

In order to perform Engle-Granger Test, the order of integration of the estimated residual, ut, should be tested. If there is a cointegrating regression, then disequilibrium errors in equation (1) should form a stationary time series, and have a zero mean, the ut should be stationary, I(0) with $E(ut) = 0$.

Following the work of Onafowora (2003), Gomez and Alvarez-Ude (2006), Johansen test is utilized to know whether the long-run relationship exists.

Pesaran and Shin (1995) and Pesaran et al (1996b) proposed Autoregressive Distributed Lag (ARDL) method to deal with cointegration methodology for a long run relationship, independent of whether the basic variables are I(0), I(1) or a combination of both. In such circumstance, the use of ARDL is the way to deal with cointegration that will give reasonable and productive evaluations. In contrast to the Johansen and Juselius(1990) cointegration technique, Autoregressive Distributed Lag (ARDL) deals with cointegration which helps in recognizing the cointegrating vector(s). That is, every one of the fundamental factors remains as a solitary long run relationship condition. In the event that one cointegrating vector (i.e the underlying equation) is recognized, the ARDL model of the cointegrating vector is re-parameterized into ECM. The reparameterized result gives short-run elements (i.e. traditional ARDL) and long run relationship of a single model. The re-

parameterization is conceivable on the grounds that the ARDL is a dynamic single model condition and of the equivalent frame with the ECM. Distributed lag Model simply means the inclusion of unrestricted lag of the regressors in a regression function.

The long run harmony might be seldom watched, however there is an inclination to move towards balance. In this manner, Error Correction Model is utilized to speak to the long-run and short-run connections between exchange balance, genuine conversion scale, residential and outside pay. According to Baharumshah (2001), Onafowora (2003), Ahmad and Yang (2004) and Sugema (2005), Vector Error Correction Model is suitable to estimate the effect of exchange rate on trade balance.

The equation (3) represents Error Correction Model as:

$$t\Delta\ XR = \text{lagged}\ \Delta TB\ \Delta M1\ \Delta SP\ \Delta EX - ut + v - 1 * \ln(,,,)\ \lambda \quad (3)$$

where ut-1 represents the residual term at t-1 in long term. Both, Engle-Granger Test and Vector Error Correction Model (VECM), are test for whether the long-run relationship exists in equation only. Next, the VDCs is applied to show the portion of the variance in the forecast error for each variable due to innovations to all variables in the system. This method is also based on a vector moving average model and orthogonal error terms. In contrast to impulse response, the task of variance decomposition is to achieve information about the forecast ability. According to the interactions between the equations, the uncertainty is transformed to all equations. The aim of VDC is to reduce the uncertainty in one equation to the variance of error terms in all equations. The forecast error variance decomposition is based upon the orthogonalised impulse response coefficient matrices.

The impulse response test shows the effects of an exogenous shock on the whole process over time (Stock, and Watson, 1990). The idea is initially to look at the adjustment of the endogenous variables and to detect the dynamic relationships among contemporaneous values of the variables over time, after a hypothetical shock in time t. This adjustment is compared with the time series process without a shock, i.e. the actual process. The impulse response sequences plot the difference between this two time paths which offers additional arguments for adjusting its appearance. Thus, it is possible to pre-occupy the effect of a non-recurring shock in one variable, to all variables over time.

6. Data, Empirical Results and Findings

UNIT ROOT TEST

Unit roots of all the variables are tested and found them I(1) on the basis of ADF and PP tests. There is the optimal lag that could be taken as two on the basis of AIC and SBC criteria. Unit roots test is to check whether the variables are stationary or non-stationary. If the t-stat < critical value, then we failed to reject null hypothesis (non-stationary). ADF test and PP test has been conducted and the results were that in log form all of the variables are non-stationary (failed to reject null hypothesis) whereas in 1st difference form all of the variables are stationary(reject null hypothesis). The results for ADF test are shown in table 1 and 2: PP and KPSS are in the appendix.

Table 1: Log form of ADF test

	VARIABLE	ADF	VALUE	T-STAT.	C.V.	RESULT
LOG FORM	LXR	ADF(1)=AIC	141.5415	- 2.3766	-3.4759	Non-Stationary
		ADF(1)=SBC	137.1025	- 2.3766	-3.4759	Non-Stationary
	LM1	ADF(4)=AIC	158.3585	- 1.1764	-3.4759	Non-Stationary
		ADF(4)=SBC	150.9502	- 1.1764	-3.4759	Non-Stationary
	LTB	ADF(1)=SBC	75.4675	- 3.0499	-3.4759	Non-Stationary
		ADF(5)=AIC	82.2700	- 2.2335	-3.4759	Non-Stationary
	LSP	ADF(1)=AIC	94.2425	- 3.3911	-3.4759	Non-Stationary
		ADF(1)=SBC	89.8035	- 3.3911	-3.4759	Non-Stationary
	LEX	ADF(2)=SBC	29.0860	- 2.0505	-3.4759	Non-Stationary
		ADF(5)=AIC	35.5233	- 1.7650	-3.4759	Non-Stationary

Table 2: Differential form of ADF test

	VARIABLE	ADF	VALUE	T-STAT.	C.V.	RESULT
1ST DIFF. FORM	DXR	ADF(1)=AIC	137.2304	- 5.2801	-2.9048	Stationary
		ADF(1)=SBC	133.9234	- 5.2801	-2.9048	Stationary
	DM1	ADF(3)=AIC	156.3331	- 3.4550	-2.9048	Stationary
		ADF(3)=SBC	150.8214	- 3.4550	-2.9048	Stationary
	DTB	ADF(1)=SBC	73.3798	- 5.1195	-2.9048	Stationary
		ADF(4)=AIC	79.2734	- 3.6778	-2.9048	Stationary
	DSP	ADF(2)=SBC	90.5077	- 6.3394	-2.9048	Stationary
		ADF(3)=AIC	94.5183	- 5.3152	-2.9048	Stationary
	DEX	ADF(1)=AIC	32.6751	- 9.8777	-2.9048	Stationary
		ADF(1)=SBC	29.3680	- 9.8777	-2.9048	Stationary

Further, test was done with KPSS where t-stat < critical value (failed to reject null hypothesis =stationary). The results shown in KPSS test were that both in log form and difference form are in stationary form.

VECTOR AUTOGRESSION (VAR)

This method is to check how many lags are there in the equations. The results provided that there are 2 lags order. The p-Value is 0.017 which less than the critical value.

Table 3

Order	AIC	SBC	p-Value	C.V.
2	500.0512	439.4222	[0.017]	5%

COINTEGRATION

Engle-Granger

The Engle-Granger provide insight that if the variable has more than 5% of the critical value. Hence, there is cointegration with the dependent variable. The results state that Exchange rate (XR) has only one variable that is cointegrated which is the trade balance (TB) (p=0.082). Other variables such as M1, SP and EX has no cointegration.

The standard Johansen cointegration test is applied (Table 1) and found them to have two cointegrating vector on the basis of maximal eigen value test. A proof of cointegration suggests that the relationship among the factors is not deceptive, i.e., there is a hypothetical relationship among the factors and that they are in equilibrium over the long haul. Be that as it may, so as to make the coefficients of the cointegrating vector predictable with the hypothetical and from the earlier data of the economy 'long run structural modeling' method is applied.

Johansen Test is when t-stat > critical value means that the null hypothesis is rejected whereas t-stat < critical value, the null hypothesis is accepted. Hence, the results comes out that there are 2 cointegration.

Table 4: Cointegration LR test

Cointegration LR Test Based on Maximal Eigenvalue of the Stochastic Matrix					
Null	**Alternative**	**Statistic**	**95% Critical Value**	**90% Critical Value**	**Result**
r = 0	r = 1	42.245	37.860	35.040	2 cointegration
r<= 1	r = 2	39.811	31.790	29.140	
r<= 2	r = 3	15.6336	25.42	23.1	
Cointegration LR Test Based on Trace of the Stochastic Matrix					
Null	**Alternative**	**Statistic**	**95% Critical Value**	**90% Critical Value**	**Result**
r = 0	r>= 1	115.276	87.170	82.880	2 cointegration
r<= 1	r>= 2	73.031	63.000	59.160	
r<= 2	r>= 3	33.2204	42.34	39.34	

ARDL APPROACH TO COINTEGRATION

Presented by Pesaran et al (2001), the ARDL procedure does not require pretests for unit roots. Thus, ARDL cointegration procedure is best when managing factors that are coordinated of various order I(0) and I(1). The long-run relationship of the factors is identified through the F-test(Wald test). Long-run relationship of the series is said to be built up when the F-test surpasses the critical value bound.

From Table 5, we test for long-run relationship and found that F-statistics in exchange rate and trade balance are higher than upper critical bound. Thus, we reject the null hypothesis of no long-run relationship and conclude that there is a cointegration among variables.

Table 5: Test of long-run relationship in ARDL

Model	F-statistic	Critical bound F statistic(95%)	
XR(TB,SP,M1, EX)	5.8732	I(0)	I(1)
TB(XR, TB,SP, M1, EX)	2.6859	3.539	4.667
SP(XR,TB,SP,M1,EX)	3.252		
M1(XR,TB,SP,M1,EX)	0.68896		
EX(XR,TB,SP,M1,EX)	2.9236		

From Table 6 long-run coefficient of ARDL are estimated using the Schwarz Bayesian Criterion. All variables are significant at 5% level, showing long-run effect on exchange rate. Export has positive and significant relationship with exchange rate at 5% level. This implies that

1% increase in export will increase exchange rate 0.4% (decrease in real exchange rate). Intuitively, the devaluation of the Malaysia ringgit will decrease prices of Malaysia's exports abroad and increase the price of imports at home, inducing export quantity to rise and import quantity to decrease, thereby influencing the trade balance positively.

Money Supply (M1) has a negative and significant relationship with exchange rate as Malaysia's money supply increase which mean there are less demand from China to exchange for ringgit, hence the ringgit will devaluate. Thus, exchange rate is lowered in the long-run. Share price has positive and significant relationship with exchange rate as share price increase, China will not buy it as it is expensive , resulting in Malaysia ringgit depreciation. Trade balance has positive and significant relationship with exchange rate as Malaysia's ringgit depreciate, the trade balance will increase due to the export become cheaper. Hence, more export to China.

Table 6: long-run coefficients of ARDL

Regressor	Coefficient	P-value
LEX	0.40765	0.009*
LM1	-0.84398	0*
LSP	0.31902	0.006*
LTB	-0.11926	0.202

Cointegration discloses to us that there is a long-run relationship between variables. In any case, there could be a short-run deviation from the long-run equilibrium. Cointegration does not tell the procedure of short-run adjustment in accordance with achieve long-run equilibrium. Consequently, error-correction model will be examine to look at the short-run dynamics.

Vector Error Correction Model (VECM)

Cointegration, in any case, are not able to disclose to us the course of Granger-causality with respect to which variable is driving and which variable is lagging (i.e., which variable is exogenous and which variable is endogenous). For recognizing the endogeneity/exogeneity of the factors, the vector error-correction modeling technique was applied on table below(Table 7).

The coefficient of error-correction model demonstrate indicates criticism impact of the deviation from equilibrium on the dependent variable. At the point when the coefficient is significant, that dependent variable bears the weight to realize equilibrium. In this way, it is endogenous. On the off chance that it is not significant, the dependent variable is exogenous.

Table 7: Vector Error-Correction

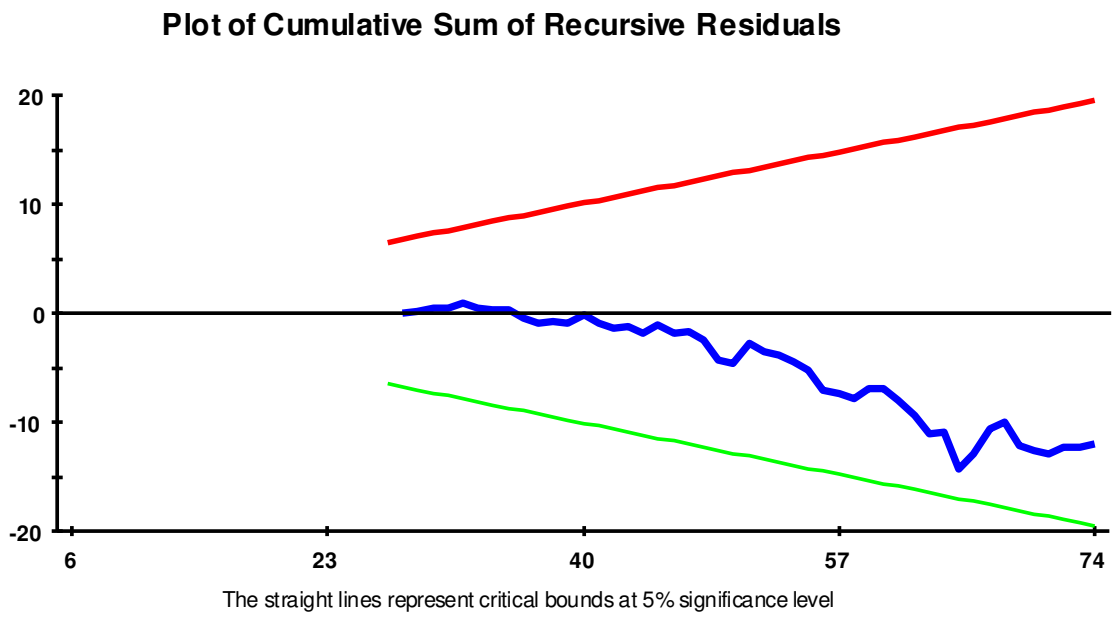
ecm1(-1)	Coefficient	Standard Error	T-Ratio [Prob.]	C.V.	Result
dLXR	-0.013885	0.015110	-0.91893 [0.362]	5%	Exogenous
dLTB	-0.10280	0.04599	-2.2347[0.029]	5%	Endogenous
dLSP	0.036584	0.036049	-1.0148[0.314]	5%	Exogenous
dLM1	0.011425	0.016141	0.70782[0.482]	5%	Exogenous
dLEX	0.43141	0.069297	6.2255[0.000]	5%	Endogenous

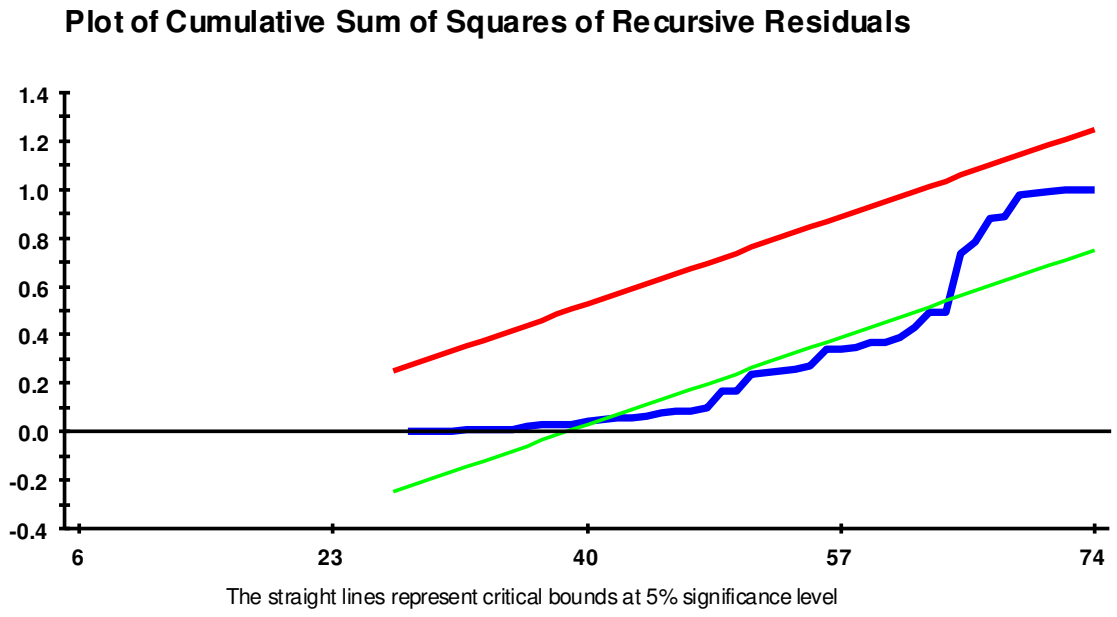
As the results are displayed, looking at the significance or the error-correction coefficients show that XR,SP and M1 are exogeneous, however TB dan EX are endogenous. This indicate that TB variable responds to the XR. The error-correction term in the TB equation is significant. It implies that the deviation of the variables has a significant feedback effect on the TB variables which hold the burden of short-run adjustment that can bring out the long-term equilibrium. The error-correction model is able to identify the difference between the short term and long term Granger-causality. The error-correction terms stands for the long term relation among the variables.

Intuitively, money supply is exogenous variable because a change in money supply in Malaysia is an external shock which could not be controlled by one country. Exchange rate (MYR/RMB) is exogenous as Malaysia exchange rate is against Renminbi which its supply and demand is determined in a global market. Share price from Malaysia could be influenced by internal factor such as fiscal and monetary policies. Trade balance is endogenous as it depends on many domestic factors, for example, real exchange rate as depreciation increases net export.

The diagnostic of all the equations of the error-correction model (testing for the presence of autocorrelation, functional form, normality and heteroscedasticity) in general demonstrate that the conditions are very much determined. Additionally, checked the stability of the coefficients by the CUSUM and CUSUM SQUARE tests (Figure 1) which demonstrate that they are stable. In any case, CUSUM SQUARE test does not demonstrate that they are stable as it went over the line which means that there are unusual event that happened.

Figure 1 (LXR)


Plot of Cumulative Sum of Recursive Residuals
20
10
0
-10
-20
6
23
40
57
74
The straight lines represent critical bounds at 5% significance level


Plot of Cumulative Sum of Squares of Recursive Residuals
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0
-0.2
-0.4
6
23
40
57
74
The straight lines represent critical bounds at 5% significance level

NON-ARDL APPROACH TO COINTEGARTION

Two variables are focused on: exchange rate (dependent variable) and trade balance (independent variable). The asymmetric relationship of exchange rate and trade balance without control variables should be focused on as it can give a clearer picture of the relationship.

NARDL model enables the investigation of the short-run and long-run relationship when these linkages are non-linear and asymmetric. NARDL model will decompose trade balance into its positive ΔRER_{t-i}^{+} and negative ΔRER_{t-i}^{-} partial sums for increases and decreases. Introducing the short-run and long-run asymmetries in the standard ARDL model leads to the following general form of NARDL model.

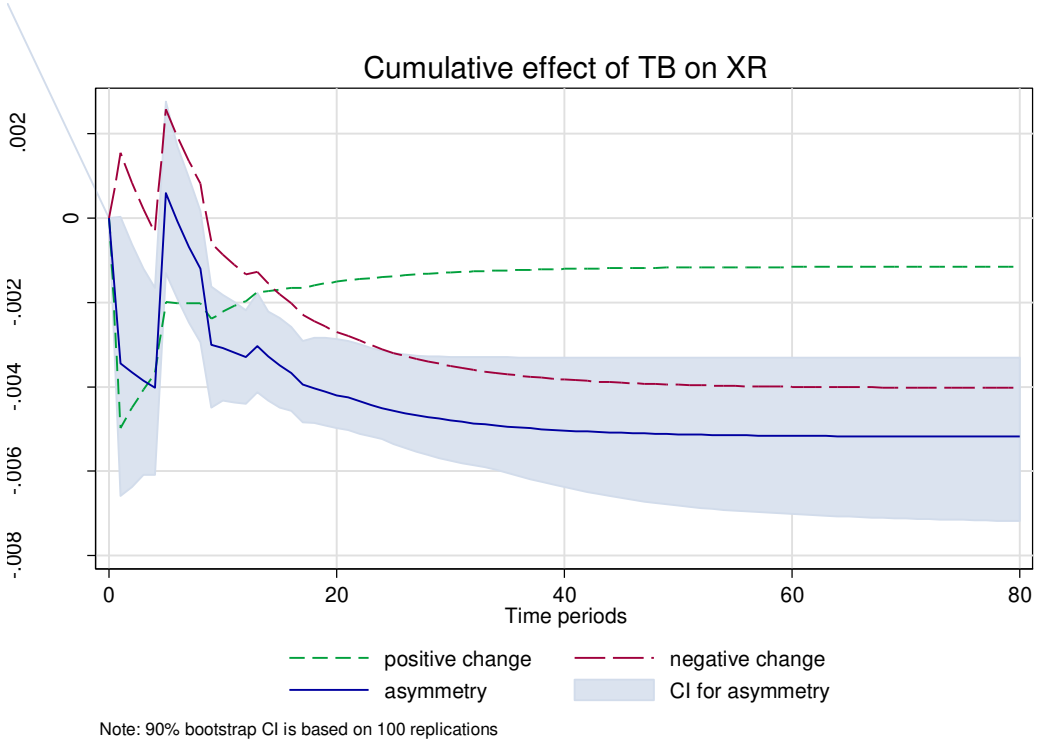
$$\Delta XR_t = \alpha_0 + \alpha_1 XR_{t-1} + \alpha_2 TB_{t-1}^{+} + \alpha_3 \Delta TB_{t-1}^{-}$$
$$+ \sum_{i=1}^{p} \beta\, \Delta XR_{t-i} + \sum_{i=0}^{q} \beta\, \Delta TB_{t-i}^{+} + \sum_{i=0}^{q} \beta\, \Delta TB_{t-i}^{-}$$

Table 8 : NARDL long-run and short-run asymmetry test

Independent XR	Long-run asymmetry		Short-run asymmetry	
	F-stat	P>F	F-stat	P>F
TB	47.68	0.00	0.01672	0.898

From Table 8, it seems to have a short run symmetry and long run asymmetry relationship between exchange rate and trade balance in Malaysia. Therefore, the exchange rate with trade balance in Malaysia will move along together in the short-run. This is probably Malaysia and China market are highly correlated since both of the countries are big traders. However, the trade balance increase will have an effect on Ringgit in the long run due to money supply increase. Thus, Malaysia export to China increase as Malaysia export becomes much cheaper. Figure 2 shows the graph of the cumulative effect on trade balance on exchange rate.

Figure 2



VARIANCE DECOMPOSITIONS (VDC)

In spite of the fact that the error-correction model generally demonstrate the endogeneity/exogeneity of a variable, there is needed to apply the generalized variance decomposition technique (Table 10) to recognize the relative degree of endogeneity or exogeneity of the variables. The relative exogeneity or endogeneity of a variable can be dictated by the extent of the change clarified by its own past. The variable that is explained generally by its own shocks (and not by others) is deemed to be the most exogenous of all.

Table 10: Generalized Variance Decompositions

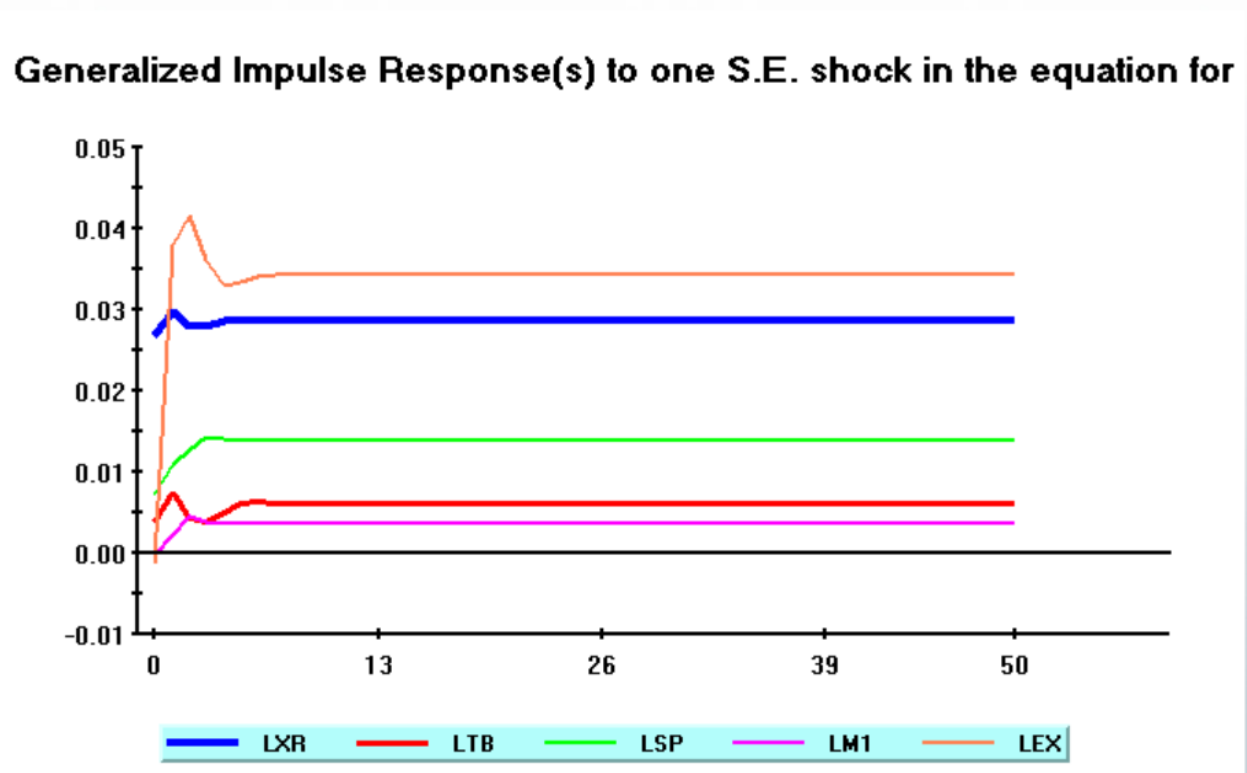
	Horizon	LXR	LTB	LSP	LM1	LEX	Total
LXR	20	70.24%	19.68%	24.25%	1.54%	2.26%	118%
LTB	20	0.27%	89.63%	5.78%	0.53%	29.85%	126%
LSP	20	2.09%	18.51%	95.27%	13.99%	0.51%	130%
LM1	20	2.35%	8.25%	10.29%	95.43%	3.00%	119%
LEX	20	34.40%	33.71%	2.82%	2.48%	38.48%	112%
Ranking		4	3	2	1	5	

In the table, toward the finish of the forecast horizon number 20 , the contributions of various variables towards clarifying the forecast error variance of the XR variable are as per the following: Exchange rate variables (70.24%), Trade Balance variable (19.68%), Share Price variable (24.25%), money supply (1.54%) and export variable (2.26%). The results tend to indicate that the money has a significant role in explaining the forecast error variance of the exchange rate variable. The table also shows the ranking of the Generalized Variance Decompositions from the most exogeneous to the least exogeneous. The ranking is as follows: M1 (95.43%), SP (95.27%), TB (89.63%), XR (70.24%) and EX (38.84%).

However, it is essential to take note of that Orthogonalized VDCs depend to a great extent on the particular ordering of the variables in the VAR. It additionally makes the presumption that when a given variable is shocked, other variables in the framework are turned off. On the other hand, Generalized VDCs do not rely upon the order of variables in the VAR, nor do they force the limitation of turning it off.

The information which is presented in the VDCs can also be represented by Impulse Response Functions (IRFs) which present the graphical expositions of the shocks of a particular variable on all other variables. In other words, IRFs map the dynamic response path of all variables owing to a shock to a particular variable. Figures 3 show the Generalized IRF of XR when we shock other variables.

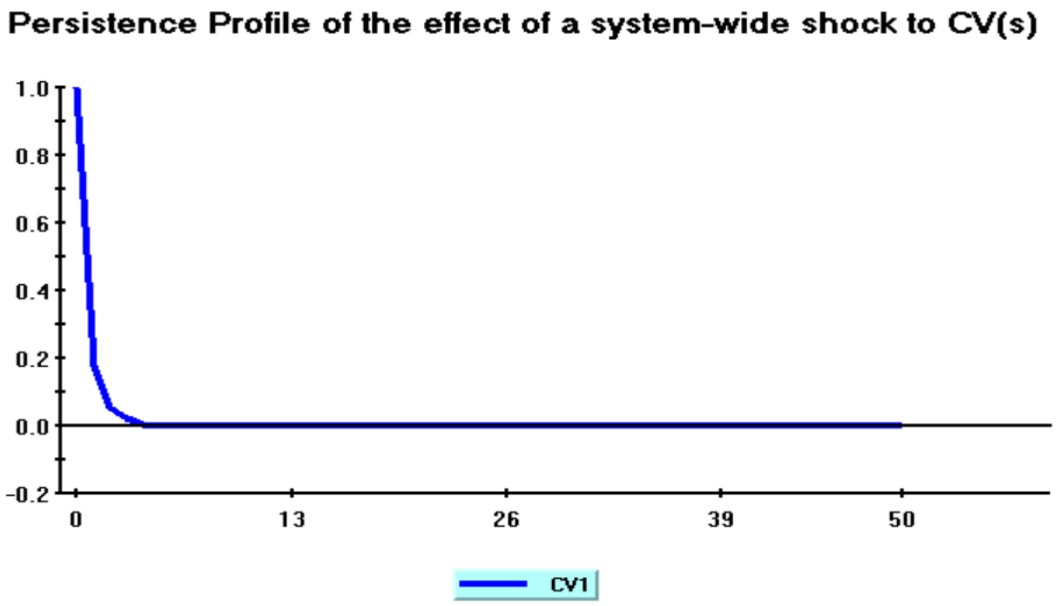
Figures 3



The IRFs presented above confirm our earlier findings that M1 is the most exogenous among all variables. This strengthens the earlier findings in the VECM and VDC analyses where M1 was found to lead the XR. As such, investors and policy makers can make use of such findings and anticipate corresponding effects to the exchange rate when the Malaysia Money Supply (M1) is shocked as shocks to the Malaysia Money Supply (M1) are most likely to impact their exchange rate.

The persistence profile test show that all variables in the cointegrating equation will need approximately 3 months to cointegrate again and return to long-run equilibrium.

Figure 4



CONCLUSION

This paper is focused on the relationship between exchange rate (MYR/RMB) and trade balance. Malaysia is used as a case study. Share price, money supply and exports to China are used as control variables. ARDL and Nonlinear ARDL methods are used to test whether the relationship between exchange rate and trade balance is symmetric or asymmetric in the short and long run. The results tend to indicate that the variables are theoretically related as evidenced in their being cointegrated. Furthermore, the relationship between exchange rate and trade balance is evidenced to be symmetric in the short run but asymmetric in the long run. The Granger-causality test tends to indicate that exchange rate is an endogenous (dependent) variable driven by money supply followed by share price and trade balance. The findings contain strong policy implications.

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