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Impact of Exchange Rate Volatility on Trade Balance in Malaysia

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Abstract

This paper examined the impact of real exchange rate volatility on trade balance in Malaysia by using quarterly data from year 2000 until 2019. Generalized Autoregressive Heteroscedasticity (GARCH) model was used to extract the volatility component of real exchange rate before examining its impact on trade balance. Furthermore, Autoregressive Distributed Lag (ARDL) model was used to investigate the long-run relationship and short-run dynamic between trade balance, money supply, national income and volatility of exchange rate. Empirical results show the existence of co-movement between variables under study in the long-run. However, the results also suggest that volatility of real exchange rate does not significantly affect trade balance neither in the long-run nor short-run. The risk which is associated in the movement of exchange rate do not influence trader's behaviour toward Malaysia exports and imports. Thus, it should be note that any depreciation or appreciation in Malaysian Ringgit do not have an impact towards trade balance either it is being further improved or deteriorates. Hence, exchange rate volatility may not be too concern for policymakers. This may be partially due to manage floating exchange rate regime that has been adopted by Malaysia eventually eliminated the element of risk in the currency market.

Keywords: Exchange Rate Volatility, Trade Balance, Income, Money Supply, ARDL

JEL Classification Code: E51, F14, F31, F32, G15

1. Introduction

Since the breakdown of the Bretton Wood fixed exchange rate system in 1973, many researchers and practitioners do great contributions to investigating the impact of real or nominal exchange rates on the export and import sector as well as the trade balance (see Rose, 1990; Bahmani-Oskooee & Kantipong, 2001; Narayan & Narayan, 2004; Duasa, 2007; Bahmani-Oskooee & Fariditavana, 2015; Zainuddin & Zaidi, 2020; Mohamad & Zainuddin, 2021). The exchange rate can be seen as economic indicator whereby the movement in its currency can be a benchmark for traders to determine the economic activities in the country's thus helping them in rearranging their decision towards trading activities. Meanwhile, from the perspective of devaluation-based adjustment policy, depreciation of exchange rate could improve trade balance in the long-run (Liew, Lim, & Hussain, 2003). As for this, most of the researchers concern about the J-curve phenomenon whereby devaluation of currency will deteriorate the trade balance in the short-run but improves it in the long-run (Bahmani-Oskooee, Arize, & Kalu, 2022).

Bulk of past literature that studied the impact of exchange rate volatility on trade found a mixed result, whereby the result may depend on the sample size, country classification (developed vs developing country), the proxies of exchange rate volatility and the choice of econometrics model (Ozturk, 2006). In general, there is common believed that higher volatility of exchange rate eventually hurts trade. However, how far this statement is true in the context of Malaysia since the country adopted a manage floating exchange rate

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regime. Furthermore, the study on exchange rate volatility seems to be very limited compared to the study on exchange rate itself. Since volatility usually associated with risk, it is interesting to see how the volatility of exchange rate impacting the trade. Ozturk (2006) states that the volatility of exchange rate refer to the risk which associate with unexpected movement in the exchange rate. This statement is supported by Sewell (2011) which argues that volatility can be uses as a proxy for risk where it's can be measured by using standard deviation. In trading activity, the behaviour of the traders toward risk is independent from each other which means traders act differently when they facing huge or less risk. If trader's has a high degree of risk-aversion, they will export more because increase in exchange rate volatility will increase expected marginal utility of export revenue. However, different situation happen if trader's are not risk-averse where they pretend to export less because of the decrease in expected marginal export (De Grauwe, 1988). Nowadays, there exist such markets that can hedge the risk in the future which called forward market. These markets allow the traders to hedge any unexpected movement in the exchange rate during the transaction that be made earlier. Unfortunately, those procedures are very costly and have some limitation (Lotfalipour & Bazargan, 2014).

Recently, Malaysia had facing a serious issue on Ringgit's currency since it has achieved MYR 4.63 per USD on 28th September 2022, a huge depreciation in Malaysian history. Historically, the ringgit has depreciated due to various reasons such as fall in the global demand, rising inflation and also high outflow of investment (Abdullah, Rasheed, & Khan, 2022). Meanwhile, Bahmani-Oskooee (2001) argues that any appreciation or depreciation of nominal exchange rate is believed to change the real exchange rate and thus has an impact on trade balance. Hence, the purpose of this paper is to investigate the impact of real exchange rate on trade balance using volatility approach by using quarterly data which spanning from year 2000 until 2019. An ARDL model is being use in this study since its consistent in small sample (Narayan & Narayan, 2004; Duasa, 2007).

The organization of this paper is as follows. Section 2 discuss on background of trade balance in Malaysia while section 3 discuss on literature review about exchange rate and trade balance relationship. Next, section 4 discuss the data and methodology part while section 5 focus on empirical results and findings. Finally, section 6 concludes the paper.

2. Background of Trade Balances in Malaysia

Post-independence of Malaysia on 31st August 1957 have witnessed that Malaysia have well develop under several Prime Minister with their mission and vision in promoting Malaysia to be one of develop country in the world. Along the time, Malaysia has maintains a stable economic growth on average 5%–7% a year with some exceptional during a crisis period. In year 1973, growth of Malaysia GDP is at the peak where the growth rate is about 11.7%. This is due to the high inflation during that year (10.62%) which is mainly causes by a shortage of food and raw materials. At the same time, Organization of Arab Petroleum Exporting Countries (OAPEC) proclaimed an oil embargo to several countries following the Yom Kippur War where this actions lead to a world first oil crisis 1973–74. As a results, inflation is being surge up to 17.29% in 1974 (Cheng & Tan, 2002). Moreover, both crises is claim to be source of declining in the trade balance from RM1.44 billion to RM0.3 billion as Malaysia economy during that period depends on import sector rather than export sector resulting in situation known as imported inflation. Meanwhile as stressed by Lim (1987), the primary role of industrial development strategy in Malaysia is import-substitutions strategy.

Moreover, following the next oil crisis 1979–1981 due to Iranian evolution and Iran-Iraq war, same situation occur whereby trade balance decline persistently from RM7.06 billion to RM0.51 billion. The decline of trade balance was continued until 1982 where it's exerts negative value (deficit) for about RM915 million -a first time deficit since the independence of the nation. Dark history of Malaysia economy not just stop at 1981 but it's was continued in 1985–86 due to commodity crisis causes by the implementation of US high-interest rate policy in the early 1980s. The policy that also known as the 'Volker shock' has made Malaysia economy collapse whereby the economic growth taken negative value for the first time which is 1.12% in 1985 (Athukorala, 2010). Impact of this crisis also can be seen through the decrease in both export and import from RM38.02 billion to RM35.32 billion and from RM30.44 billion to RM27.92 billion in year 1985–86. Even though the commodity crisis had such negative effect, the Malaysia still have a surplus in trade balance with small declining from RM7.58 billion to RM7.4 billion. It is interesting to note that during this period of crisis, country's inflation is very low for about 0.2% and 0.8% with a stable exchange rate around RM2.50 per USD.

As from 1983 until 1990, Malaysia maintain a trade surplus with increasing in the value for the first five year before its decline to RM0.53 billion in 1990. The more expanding of the import sector rather than export sector has made further deterioration of trade balance in 1991 with a huge decrease from RM0.53 billion to negative RM6.33 billion making its second time deficit since 1957. This could be due to immediately increase in inflation rate from 2.61% in 1990 to 4.39% in 1991. Increasing of the inflation during that period is due to the increase in oil price from US$18 per barrel in April 1990 to US$36 in October 1990 as stated by Cheng and Tan (2002) while at the same time Hamilton (2011) argued that oil price being doubled after a few weeks

following invasion of Iraq on Kuwait (First Persian Gulf War) on August 1990. In addition, as clearly mentioned by Abeysinghe (2001) Malaysia and Indonesia cannot escape from the negative impact of high oil price even though they are net oil exporter.

After a Gulf War crisis which ended in February 1991, oil price return back to normal price for about US$20 per barrel but the effect on Malaysia inflation remain high at 4.75% as noted by Cheng and Tan (2002). Moreover, both oil price and inflation seems stable after 1992 until 1997 before inflation spikes to 5.27% in 1998 due to Asian Financial Crisis 1997–98. However, during the tranquil period (1993–1997) trade balance consistently deficit for 4 years from 1994 until 1997 before it's has a surplus in the following years. Malaysia experiences a greatest deficit for about RM9.4 billion during 1995 even though her economic growth at average 9% over a period of tranquillity. The deficit in trade balance is cause by an appreciation in Yen which make Malaysia import from Japan are high in value while Japan among major trading partner. Following the appreciation in Yen value, companies in Japan takes an opportunity to placing their firm in Malaysia which in return increase Malaysia import from Japan. This situation becomes more severe when Malaysian export to Japan decreased due to slow economic growth in Japan (Ministry of Finance, 1995). In 1996, the moderate increase in growth of export and significant decrease in growth of import has make trade deficit much smaller (Ministry of Finance, 1997) until 1997 which is valued for about RM46 million.

July 1997 showed a greatest recession in Asian region following the collapse of Thai Baht after speculative attack which the impact was spread to other countries (Chung, 2021). Malaysia was one of the countries that have been caught in this crisis which resulting in huge depreciation of Ringgit Malaysia from MYR 2.53 per USD in 1996 to MYR 3.89 in December 1997. The depreciation of Ringgit Malaysia has a positive effect on trade balance where the export growth is much larger than import growth which in turn gives a surplus in trade balance (Ministry of Finance, 1999). It is worth to note that trade balance is improved from negative RM0.046 billion to RM58.44 billion in 1998 while it is not surprise that Malaysia economic growth rate was −7.36% with high inflation at 5.27% due to Asian Financial Crisis. The dark episode of Malaysian economic continues when global recession so-called Global Financial Crisis 2007–09 starts from United States of America which is triggered by housing bubbles phenomenon spills to around the world. Meanwhile, outflow of fund investment from subprime security and equity to commodity has surge up the price of oil and commodity which in turn increase the push cost inflation around the world. Even though inflation rate of Malaysia increase from 2.03% in 2007 to 5.44% in 2008, Malaysia still have a stable growth rate at 4.83% due to strong domestic demand. On the other hand, trade balance shows a surplus for about RM143.21 billion- a large surplus in its history which caused by a strong growth in both commodities and manufactured sector (Central Bank of Malaysia, 2009).

During the recent COVID-19 pandemic outbreak, the trade balance in Malaysia had increased by 25.9%, from RM145.7 billion in 2019 to RM183.3 billion in 2020. In 2021, Malaysia's trade balance has continued to record a surplus, with a value of RM253.7 billion, the highest trade surplus ever recorded, increased by 38.4% from the previous year. Malaysia's export expansion was supported mainly by higher exports to Singapore, China, the United States, India, Hong Kong, and the European Union. The main products which contributed to the increase in exports were electrical and electronics products, rubber products, and palm oil and palm oil-based agriculture products. (Department of Statistics Malaysia, 2022).

Overall picture of Malaysia trade balance shows that it's has a positive trade balance with some deficit in several years (1982, 1991, and 1994–1997). In 2021, Malaysia had reached the highest trade balance so far, and it was the 24th year of a trade surplus since 1998. In addition to trade balance, Malaysia major export partner in 2021 are China (15.5%), Singapore (14.0%), USA (11.5%), Hong Kong (6.2%) and Japan (6.1%), while Malaysia major import partner are China (23.2%), Singapore (9.5%), Taiwan (7.6%), USA (7.6%) and Japan (7.5%) (MATRADE, 2022).

3. Literature Review

Vast amount of literature has focus concerning the issue of the exchange rate and it's volatility towards trade balance since the breakdown of Bretton Wood system in the early 1970's (Magee, 1973; Nguyen, Nguyen, Vo, & Tran, 2021). The first person that discover about the J-curve phenomenon was Magee (1973) – depreciation of the exchange rate will cause further deterioration of the trade balance before its being improves. Bahmani-Oskooee (1985) was the first person that tested the J-curve concept empirically using some evidence from less develops countries (LDC) and he found significant evidence for the J-curve phenomenon. Moreover, Bahmani-Oskooee and Kantipong (2001) found the evidence of J-curve in Thailand export to both US and Japan using ARDL approach proposed by Pesaran, Shin, and Smith (2001). The finding of J-curve phenomenon in Thailand is consistent with Onafowora (2003) where he found that all 3 ASEAN countries (Indonesia, Malaysia and Thailand) has a different period of the exchange rate effect toward trade balance. Meanwhile, by using the same approach in Bahmani-Oskooee and Kantipong (2001), Narayan and Narayan (2005) found an evidence of J-curve in the case of Fiji. Besides, they also found that national income have depressed the trade balance while foreign income improves it.

The evidence of the J-curve was further investigated by Bahmani-Oskooee and Fariditavana (2015; 2016) using the improvement of the ARDL model which is Nonlinear ARDL (NARDL). They reveal that, the asymmetric effect of exchange rate has an impact on trade balance and support the J-curve theory. Bahmani-Oskooee, Bose, and Zhang, (2018) found the evidence of J-curve that is only due to appreciation or depreciation of the Yuan in cases of five partners. Although some of the authors found the relationship between exchange rate and trade balance, there is still a consensus among economist about the impact of the exchange rate toward trade balance. Bao and Le (2021) on the other hand found that there are short-run J-curve effect are found in the vehicle currency models between ASEAN-EU trade. Rose (1990) which examined the impact of the exchange rate in number of developing countries indicate that the depreciation of exchange rate does not have any significant impact on trade balance for most of the countries. Meanwhile, in the case of Malaysia, Liew et al. (2003) and Duasa (2007) also do not find any significant relationship between exchange rate and trade balance. Liew et al. (2003) argue that the trade balance is more influence by the real money while as stated by Duasa (2007), money supply and income are the most influential variables in determining the trade balance of Malaysia. On the other hand, Zainuddin and Zaidi (2020) found asymmetric impact of exchange rate on trade balance between Malaysia and China, this is consistent between Malaysia and Singapore (Bahmani-Oskooee, Aftab & Harvey 2016).

Instead of looking at the exchange rate itself, Bahmani-Oskooee (2002) discover the impact of exchange rate volatility in black market toward trade flow in Iran. He found that, volatility of exchange rate in black market hurt import and non-oil export sector. Meanwhile, Ozturk and Kalyoncu (2009) use a moving standard deviation (MSD) to represent the volatility of exchange rate in six countries. Empirical result shows that volatility of exchange rate adversely affected export for South Korea, Pakistan, Poland and South Africa. In line with Ozturk and Kalyoncu (2009), Aristotelous (2001) also use MSD as proxy for exchange rate volatility. He then use generalized gravity model to determine the effect of exchange rate volatility and its regime on export volume. Empirical finding shows that both volatility and regime of exchange rate do not have any significant impact on export volume from British export to United States. Furthermore, Nazlioglu (2013) who study about the disaggregate data (industry-level) to avoid aggregation bias problem shows that volatility of exchange rate have different effect on different industry. Besides, he supported the argument by Narayan and Narayan (2004) where foreign income is the key role in determining the Turkish export.

From the aspect of volatility, Engle (1982) has proved that variance that varies according time can be model through Autoregressive Conditional Heteroscedasticity (ARCH) model. This finding has motivated some of the researchers in modelling the volatility of stock market as well as exchange rate. The uses of ARCH model in modelling the exchange rate have been done by Bakhromov (2011) for the case of Uzbekistan where he found that the volatility negatively affected import and export in the long-run. However, the ARCH model that introduced by Engle (1982) need a high order of parameter to capture the variance that is not constant over time. Thus, to overcome the over-parameterization problem, Bollerslev (1986) improved the ARCH model by including the past conditional variance in the model so that the equation will become more parsimony (Enders, 2010). The generalization of ARCH model which is known as GARCH model proposed by Bollerslev (1986) has further develop by other researchers by taking into account the asymmetric effect and tail behaviour.

Lotfalipour and Bazargan (2014) use a GARCH model to develop the exchange rate volatility and investigate its impact on trade balance in panel context. They found that exchange rate volatility does not have any significant effect on trade balance. Meanwhile, different result have recorded by Aftab, Abbas, and Kayani (2012) where they found that exchange rate volatility have a negatively significant impact on export. Aftab, Syed and Katper (2017) found that exchange-rate volatility affect the trade flows in a limited number of industries. Ekanayake and Dissanayake (2022) explored the effects of real exchange rate volatility on the United States' exports to BRICS. They found that exchange rate volatility hurts exports in the long run in BRICS countries. On the other hand, Asteriou, Masatci, and Pilbeam (2016) found no linkages between exchange rate volatility and international trade activities in the long run except for Turkey.

Sugiharti, Esquivias, and Setyorani (2020) performed a study to analyze the impact of volatility of exchange rates on Indonesia's export destinations to China, India, South Korea, Japan, and the USA. Their study found that the depreciation of the Indonesian currency has negative impact on exports to China, South Korea, and the USA, while only exports to Japan have positive impact. Some studies analyse at the commodity level such as Yunusa (2020) that focus on the Nigerian crude oil export and found that exchange rate volatility significantly influenced crude oil export for Nigeria. For the case of Malaysia, Wong (2019) analyse the impact of exchange rate volatility on Malaysia's bilateral export and conclude that volatility does influence Malaysia's bilateral export. As for this, this paper aims to examine the impact of exchange rate volatility on trade balance in Malaysia starting from year 2000 until 2019.

4. Data and Methodology

The variables that are uses to investigate the impact of exchange rate volatility on trade balance are trade balance (TB) itself, national income proxy by real gross domestic product (RGDP), money supply which is M3 (M3) and volatility of exchange rate (VOL). As from traditional approach, the trade balance is measure by total export minus total import. Quarterly data from year 2000 until 2019 for TB, RGDP and M3 are extracted from International Monetary Fund (IMF) while volatility is computed from GARCH model of real exchange rate taken from Bank for International Settlement (BIS). Since the unavailability of quarterly data on real exchange rate from BIS, we use monthly data to represent the exchange rate. Next, univariate Generalized Autoregressive Conditional Heteroscedasticity (GARCH) proposed by Bollerslev (1986) were used to modelled the conditional variance of monthly real exchange rate that varies according time. Finally, the quarterly data of volatility series was constructed by averaging the monthly volatility series. The GARCH model has a specification as below:

$$\sigma_t^2 = \omega + \alpha_1 \varepsilon_{t-1}^2 + \beta_1 \sigma_{t-1}^2 \quad (1)$$

Where, σ_t^2 stand for conditional variance, ε_{t-1}^2 measure news about volatility while σ_{t-1}^2 measure persistency. The conditional variance is said to be stationary if the summation of α_1 and β_1 is less than 1. Sewell (2011) states that the volatility can be uses as a proxy for risk where it's can be measured by using standard deviation. As for this, we take a square root on conditional variance so that it will become a volatility series. The trade balance model follows Duasa (2007) with some of modification on the variables. There are at least 4 distinguish properties of this model from Duasa (2007) which are, 1) the frequency of the data. Duasa (2007) have uses annual data while our analysis using quarterly data; 2) time spanning. Our analysis uses more recent data from year 2000 until 2019 (exclude COVID-19 period); 3) TB measurement. Duasa (2007) use ratio of export to import in representing TB but in our case we use traditional approach as mention before; and 4) the moment of the variable. Duasa (2007) have use a first moment (level form) of real exchange rate to investigate the impact towards trade balance while our analysis uses second moment (volatility) approach. The questions are, is the volatility can have any impact on trade balance? Does behaviour of the traders towards risk can influence their decision on trading thus have a direct effect toward trade balance? The trade balance specification is as follows:

$$\mathrm{LTB}_t = \beta_0 + \beta_1 \mathrm{LRGDP}_t + \beta_2 \mathrm{LM3}_t + \beta_3 \mathrm{VOL}_t + \varepsilon_t \quad (2)$$

All variables are expressed in logarithmic form except for volatility series. Coefficient of β_1 is expected to be positive since growth of economics will leads to a more supply of export to other countries. Meanwhile, coefficient of β_2 is expected to be negative since the excess supply of money will be eliminated by outflows to other countries (Duasa, 2007). De Grauwe (1988) states that the impact of the volatility of exchange rate towards export is depending on the trader's degree of risk-aversion. If trader's has a high degree of risk-aversion, they will export more because increase in exchange rate volatility will increase expected marginal utility of export revenue. However, different situation happen if trader's are not risk-averse where they pretend to export less because of the decrease in expected marginal export. Thus, it can be conclude that the volatility of exchange rate has an impact toward trader's behaviour on export activity which can influence the trade balance.

First step toward Autoregressive Distributed Lag (ARDL) is bound testing approach proposed by Pesaran et al. (2001).

$$\begin{aligned}\Delta \mathrm{LTB}_t = {} & c_1 + \sum_{i=1}^{p} \pi_i \Delta \mathrm{LTB}_{t-i} + \sum_{i=0}^{q} \gamma_i \Delta \mathrm{LRGDP}_{t-i} \\ & + \sum_{i=0}^{r} \delta_i \Delta \mathrm{LM3}_{t-i} + \sum_{i=0}^{s} \alpha_i \Delta \mathrm{VOL}_{t-i} \\ & + \varphi_1 \mathrm{LTB}_{t-1} + \varphi_2 \mathrm{LRGDP}_{t-1} + \varphi_3 \mathrm{LM3}_{t-1} \\ & + \varphi_4 \mathrm{VOL}_{t-1} + \varepsilon_t\end{aligned} \quad (3)$$

To test whether there exist cointegration among the variables, all coefficient at level form (φ_i) are being restricted such that $\mathrm{H}_0 : \varphi_1 = \varphi_2 = \varphi_3 = \varphi_4 = 0$. Null hypothesis indicate that there is no co-movement in the long-run or cointegration among variables under study. The *F*-test has a non-standard distribution where it depends on; 1) the order of the integration of the variables in ARDL either it is I(0) or I(1), 2) the number of regressors and 3) whether the ARDL model contain an intercept and/or trend. Two sets of critical values are provided which is lower bound (when all regressor are I(0)) and upper bound (when all regressor are I(1)) to conclude the decision on cointegration. Since this analysis using quarterly data spanning from year 2000 until 2019 resulting in total 80 observations, Narayan (2005) critical value is use instead of Pesaran et al. (2001) due to small sample size. If calculated *F*-statistics is greater than upper bound, then conclusive decision can be made whereby cointegration is exist among the variables. However, if the *F*-statistics fall between lower bound and upper bound, inconclusive decision about cointegration are reach. Besides, no cointegration exist between variables if the calculated *F*-statistics fall below than lower bound critical value.

If there is sufficient evidence to conclude the existence of long-run relationship, an ARDL (p, q, r, s) is being estimated. The ARDL specifications are based on level form which is as follows:

$$\begin{aligned} \mathrm{LTB}_t = c_2 + \sum_{i=1}^{p} \lambda_{1i} \mathrm{LTB}_{t-i} + \sum_{i=0}^{q} \lambda_{2i} \mathrm{LRGDP}_{t-i} \\ + \sum_{i=0}^{r} \lambda_{3i} \mathrm{LM3}_{t-i} + \sum_{i=0}^{s} \lambda_{4i} \mathrm{VOL}_{t-i} + \varepsilon_t \end{aligned} \tag{4}$$

Moreover, the long-run estimation of trade balance model in (2) is based on the ARDL specification in (4) whereby the coefficient is being estimated as follows:

$$\begin{aligned} \beta_0 = \frac{c_2}{1 - \sum_{i=1}^{p} \lambda_{1i}}, \ \beta_1 = \frac{\sum_{i=0}^{q} \lambda_{2i}}{1 - \sum_{i=1}^{p} \lambda_{1i}}, \\ \beta_2 = \frac{\sum_{i=0}^{r} \lambda_{3i}}{1 - \sum_{i=1}^{p} \lambda_{1i}}, \ \beta_3 = \frac{\sum_{i=0}^{s} \lambda_{4i}}{1 - \sum_{i=1}^{p} \lambda_{1i}} \end{aligned} \tag{5}$$

Meanwhile, to further looking insight the analysis, short-run dynamic is implemented through Error Correction Model (ECM). The ECM has a following specification:

$$\begin{aligned} \Delta \mathrm{LTB}_t = c_3 + \sum_{i=1}^{p} \pi_{1i} \Delta \mathrm{LTB}_{t-i} + \sum_{i=0}^{q} \gamma_{1i} \Delta \mathrm{LGDP}_{t-i} \\ + \sum_{i=0}^{r} \delta_{1i} \Delta \mathrm{LM3}_{t-i} + \sum_{i=0}^{s} \alpha_{1i} \Delta \mathrm{VOL}_{t-i} \\ + \psi \mathrm{ECT}_{t-1} + \varepsilon_t \end{aligned} \tag{6}$$

Short-run dynamic from independent variables towards dependent variables are examined by restrict the coefficient of γ_{1i}, δ_{1i}, and α_{1i} with 0. For an example, to investigate short-run causality running from LRGDP to LTB, one should restrict the coefficient γ_{1i} such that $H_0 : \gamma_{11} = \gamma_{12} = \ldots = \gamma_{1q} = 0$ whereby null hypothesis indicate no short-run causality from LRGDP toward LTB. Meanwhile, the long-run information is gathered from the error correction term (ECT). The significant of the ECT coefficient (ψ) indicates that long-run relationship exist between variables thus supporting the finding from cointegration. Moreover, significantly negative of the coefficient measure speed of adjustment where the speed of which dependent variable responds to disequilibrium in the long-run following the deviation in the short-run.

5. Results and Analysis

Table 1 shows unit root test results for LTB, LRGDP, LM3 and VOL. Two types of unit root test which is Augmented Dickey Fuller (ADF) and Phillips Perron (PP) with intercept and trend specification were conducted to determine the order of integration. Even though ARDL model does not need a prior testing toward unit root, this test is conducted to ensure that there is no variable integrated with order 2 or I(2).

Result from Table 1 shows a mixture of unit root test result under both ADF and PP. Under ADF test, all variables are stationary after first differencing except for VOL while under PP test, all variables are stationary at level except for LM3. The mixture in the unit root test result probably because of the presence of seasonality in the series particularly for LTB and LRGDP. In order to overcome the seasonality effect in the long-run estimation later, a quarterly dummy variables are introduced. In short, result from unit root test concluded that there is a mixture of I(0) and I(1) variables. Given there is non-existence of I(2) variable, thus we proceed to the next stage of empirical estimation which is bound testing. Result for ARDL bound test to cointegration are reported in Table 2. From Table 2, null hypothesis of no cointegration can be slightly rejected at 10% significant level. The *F*-statistics of ARDL (3,0,3,1) which is 4.010 just above the 10% critical value (3.885). Thus, it's implies rejection of no cointegration suggesting existence of long-run relationship between the variables under investigation.

Table 1: Unit Root Test

Series	ADF Statistics		PP Statistics	
	Level	1st Differencing	Level	1st Differencing
LTB	–2.197	–11.228***	–3.990**	–
LM3	0.149	–6.652***	–0.053	–7.028***
LRGDP	–2.742	–5.661***	–6.143***	–
VOL	–4.069***	–	–4.132***	–

Note: *, **, and *** represent significance level at 10%, 5% and 1%, respectively.

Table 2: Bound Test for Cointegration

ARDL(3,0,3,1)	Significant level	Lower bound	Upper bound
F-statistics = 4.010*	10%	2.823	3.885
k = 3	5%	3.363	4.515
n = 80	1%	4.568	5.96

Note: *, **, and *** represent significance level at 10%, 5% and 1%, respectively. *k* is the number of independent variable while *n* is the number of observation. The lower and upper bound *F*-statistics is based on Narayan (2005) case III.

Table 3: Long-Run Equation

Variables	Coefficient
LRGDP	7.1422 (0.0591)
LM3	3.7614 (0.0845)
VOL	0.4164 (0.3833)

Note: *, **, and *** represent significance level at 10%, 5% and 1%, respectively. Number in parentheses is *p*-value.

Empirical result from table 3 shows that exchange rate volatility has a positive relationship with trade balance in the long-run. The increase in the volatility due to the depreciation of real exchange rate improved country's trade balance by making her export more cheaper and competitive in the world market. However, the insignificant of the coefficient indicates that the second moment of real exchange rate do not give any impact on country trade balance. The result somehow consistent with Liew et al. (2003) and Duasa (2007) where both of them do not find any significant relationship between first moment (level form) of exchange rate and trade balance. Duasa (2007) states that, the insignificant of the real exchange rate could be due to the frequently intervention of Malaysian government on several occasions which make the exchange rate do not float freely. Furthermore, Duasa (2007) continue by saying that Malaysian Ringgit (MYR) should be determines by the market itself instead of being monitor by the government through ringgit's target zone. In addition, the manage floating exchange rate regime that has been adopted by Malaysia might influence the result since the exchange rate are not fully determine by the market. In other word, the volatility of the exchange rate which has been managed by the Central Bank of Malaysia eventually eliminate the excessive risk in the market.

Meanwhile, income which is proxied by RGDP has a significantly positive impact on trade balance. As domestic economic growth, the production will increase thus increasing country's supply to trading partner. Besides, the increasing production of substitute import goods could be a reason for improving the trade balance. Hence, to improve country's trade balance, policy maker should pay more attention to boost their economic growth. Moreover, increase in money supply can be associated due to several reason such as loosen of monetary policy and expansionary fiscal operation. Empirical result from table 3 shows that money supply has adversely affect country's trade balance significantly. This could happen since increase in money supply will lead to inflationary pressure thus reducing the purchasing power of household. This phenomenon eventually led to decline in domestic consumption which in turn results in excess supply of domestic goods thus worsen the term of trade (Bahmani-Oskooee & Shabsigh, 1996). Meanwhile, Duasa (2007) states that excessive increase in money supply will be eliminated by outflows of money to other countries thus worsen the trade balance.

The access towards short-run dynamic can be done through error correction model (ECM). Table 4 shows error correction model for trade balance in Malaysia from year 2000 until 2019. The significant of error correction term (ECT) at 1% significant level confirming the results by bound test which indicates existence of long-run relationship between the variables. The coefficient of the ECT can be interpret as speed of adjustment- speed of which dependent variable corrected the system to converge to long-run equilibrium following the deviation in the short-run. About 26% deviation in the short-run will be corrected by trade balance in next one quarter where this speed can be seen as a medium rate of speed. On top of that, empirical results from Table 4 shows that LM3 not only give impact on trade balance in the long-run, but also in the short-run.

However, there is no short-run granger causality running from both real GDP and volatility of exchange rate towards trade balance. This imply that the volatility of exchange rate do not influence trade balance for the case of Malaysia. The adequacy of the error correction model in modelling the long-run relationship and short-run dynamic can be tested by several diagnostic checking. Results shows that, the error correction model is well specified since there is no problem in serial correlation, functional form and heteroscedasticity by looking at *p*-value that are greater than 0.10. In addition, value of $\overline{R}^2$ which is 0.4127 shows that for about 41% variation in trade balance is explained by its independent variables.

Table 4: Error Correction Model

Variables	ECT_{t-1}	ΔLRGDP	ΔLM3	ΔVOL
		Wald *F*-Test		
ΔLTB	–0.260*** (0.000)	-	7.540 (0.057)	0.001 (0.981)
$\bar{R}^2$	0.413			
LM	χ^2 [4] = 7.060 (0.133)			
RESET	χ^2 [1] = 0.770 (0.380)			
JB	χ^2 [2] = 0.601 (0.741)			
ARCH	χ^2 [4] = 4.371 (0.358)			

Note: *, **, and *** represent significance level at 10%, 5% and 1%, respectively. Number in parentheses is *p*-value. LM stands for Lagrange Multiplier test for autocorrelation. RESET stands for Ramsey RESET test for functional form. JB stands for Jarque-Bera test for normality. ARCH stands for Autoregressive Conditional Heteroscedasticity test for heteroscedasticity.

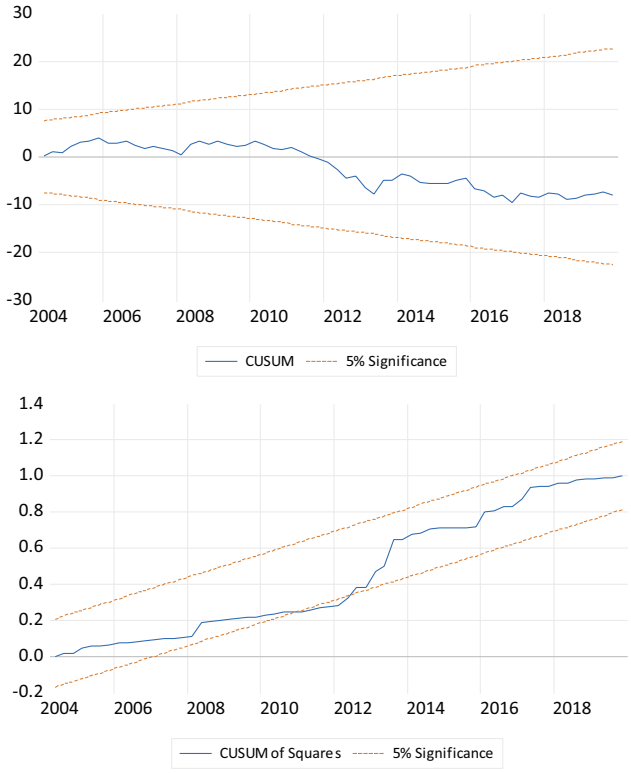

Figure 1: Plot of CUSUM and CUSUM-SQ

The stability of the error correction model is shown by figure 1. Both plot of CUSUM and CUSUM-SQ shows that the model is dynamically stable over the period of study since the blue line lies between the bound at 5% significant level.

6. Conclusion

Bulk of past literature that studied the impact of exchange rate volatility on trade found a mixed result, whereby the result may depend on the sample size,

country classification (developed vs developing country), the proxies of exchange rate volatility and the choice of econometrics model. In general, there is common believed that higher volatility of exchange rate eventually hurts trade. However, how far this statement is true in the context of Malaysia since the country adopted a manage floating exchange rate regime. Furthermore, the study on exchange rate volatility seems to be very limited compared to the study on exchange rate itself. Since volatility usually associated with risk, it is interesting to see how the volatility of exchange rate impacting the trade. Thus, this study attempted to investigate the impact of real exchange rate volatility on trade balance in Malaysia by using quarterly data which spanning from year 2000 until 2019. Generalized Autoregressive Heteroscedasticity (GARCH) model was used to extract the volatility component of real exchange rate before examining its impact on trade balance. Next, ARDL model is use in this analysis to determine the long-run relationship and short-run dynamic between variables under investigation.

Empirical results from bound testing procedure shows existence of long-run relationship between trade balance and selected variables. Even though long-run relationship is exist, volatility of exchange rate seems do not have any significant impact toward trade balance even at 10% significant level. It is being understand that, the risk which is associated in the movement of exchange rate do not influence trader's behaviour toward Malaysia exports and imports. Thus, it should be note that any depreciation or appreciation in Malaysian Ringgit do not make any changes in the trade balance either it is being further improved or deteriorate. Furthermore, the manage floating exchange rate regime that has been adopted by Malaysia might influence the result since the exchange rate are not fully determine by the market. In other word, the volatility of the exchange rate which has been managed by the Central Bank of Malaysia eventually eliminate the excessive risk in the market. Meanwhile, both RGDP and M3 have a significantly positive and negative effect on trade balance where increase in national income and decrease of money supply will improve the trade balance. Hence, policy makers should pay attention on both variables and take a precaution step in every decision regarding the supply of money and national income. Next, the long-run relationship is supported by the significance of the error correction term and short-run causality only existed from M3 toward TB. The error correction model is well specified since the error is white noise and there is no misspecification problem. In conclusion, one should more concentrate on national income and money supply rather than exchange rate volatility.

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