

Hussin Abdullah; El-Rasheed, Shehu; Hafizah Hammad Ahmad Khan

**Article**

## Asymmetric impact of exchange rate changes on money demand in Malaysia

Contemporary Economics

**Provided in Cooperation with:**

University of Finance and Management, Warsaw

*Suggested Citation:* Hussin Abdullah; El-Rasheed, Shehu; Hafizah Hammad Ahmad Khan (2022) : Asymmetric impact of exchange rate changes on money demand in Malaysia, Contemporary Economics, ISSN 2300-8814, University of Finance and Management in Warsaw, Faculty of Management and Finance, Warsaw, Vol. 16, Iss. 3, pp. 317-328, <https://doi.org/10.5709/ce.1897-9254.484>

This Version is available at:

<https://hdl.handle.net/10419/297607>

**Standard-Nutzungsbedingungen:**

Die Dokumente auf EconStor dürfen zu eigenen wissenschaftlichen Zwecken und zum Privatgebrauch gespeichert und kopiert werden.

Sie dürfen die Dokumente nicht für öffentliche oder kommerzielle Zwecke vervielfältigen, öffentlich ausstellen, öffentlich zugänglich machen, vertreiben oder anderweitig nutzen.

Sofern die Verfasser die Dokumente unter Open-Content-Lizenzen (insbesondere CC-Lizenzen) zur Verfügung gestellt haben sollten, gelten abweichend von diesen Nutzungsbedingungen die in der dort genannten Lizenz gewährten Nutzungsrechte.

**Terms of use:**

*Documents in EconStor may be saved and copied for your personal and scholarly purposes.*

*You are not to copy documents for public or commercial purposes, to exhibit the documents publicly, to make them publicly available on the internet, or to distribute or otherwise use the documents in public.*

*If the documents have been made available under an Open Content Licence (especially Creative Commons Licences), you may exercise further usage rights as specified in the indicated licence.*



<https://creativecommons.org/licenses/by/4.0/>

Primary submission: 18.05.2018 | Final acceptance: 28.09.2021

# Asymmetric Impact of Exchange Rate Changes on Money Demand in Malaysia

Hussin Abdullah<sup>1</sup>, Shehu El-Rasheed<sup>2</sup>, Hafizah Hammad Ahmad Khan<sup>3</sup>

## ABSTRACT

The relationship between exchange rate and money demand has long been debated among macroeconomists due to its impact on the stability of money demand and monetary policy. Following the significant depreciation in the currency exchange associated with the political instability in Malaysia in recent years, examining the relationship between exchange rate and money demand is crucial to ensure the monetary policy remains prudent. This study examined the asymmetric impact of exchange rate changes on money demand in Malaysia using both linear and nonlinear ARDL approaches. The findings reveal that the money demand responds asymmetrically to exchange rate changes both in the short and long run, whereby the response to a negative shock (local currency depreciation) outweighs the positive shock (local currency appreciation). The result also suggests that the substitution effects dominate the exchange rate and money demand relationship. Consequently, with the economic and political instability continuing, the currency exchange is expected to depreciate further, contributed by the strong substitution effects. This will greatly affect the stability of money demand and the monetary policy and thereby call upon a policy intervention to strengthen the currency exchange and sustain the long-run economic performance.

## KEY WORDS:

asymmetric, exchange rate, Malaysia, money demand, nonlinear ARDL.

**JEL Classification:** E41, E52, F31.

<sup>1</sup>School of Economics, Finance & Banking, Universiti Utara Malaysia, 06010 Sintok, Kedah, Malaysia

<sup>2</sup>Department of Economics and Development Studies, Federal University Kashere, P.M.B 0182, Gombe State, Nigeria

<sup>3</sup>Faculty of Business and Management, Universiti Teknologi MARA, 08400 Merbok, Kedah, Malaysia

## 1. Introduction

The demand for money plays a vital role in monetary policy design and macroeconomic modeling due to its importance in formulating an effective monetary policy. However, the aftermath of the Asian financial crisis has led many developing economies to face an unstable economic environment, including instability in money demand. The instability in money demand will eventually result in ineffective domestic macroeconomic policies (Bhatta, 2013).

A pioneer work by Mundell (1963) argued that the exchange rate plays an essential role in determining the stability of the money demand of a country where-

by the exchange rate fluctuations would decrease the effectiveness of the monetary policy. However, Arango and Nadiri (1981) claimed that the effect is ambiguous since the exchange rate appears to be associated with the money demand function via the wealth or substitution effects.

The Malaysian economy has become a compelling case to study since its economic and political environment has changed significantly, making its currency more sensitive to shocks. The rise in political instability experienced by the country, such as 1Malaysia Development Berhad (1MDB) political scandal as well as the shift in political leadership, has led to significant policy changes and increased the fragility of

Correspondence concerning this article should be addressed to:

**Hafizah Hammad Ahmad Khan**, Faculty of Business and Management, Universiti Teknologi MARA, 08400 Merbok, Kedah, Malaysia.

E-mail: hafizahhammad@uitm.edu.my

the country's economy and investors' confidence in the future growth prospects (Bank Negara Malaysia, 2018a, 2018b). Thus, examining the stability of the money demand is necessary to ensure its long-run economic stability.

Although the effects of the exchange rate on money demand have been addressed in the past studies, however, most of the studies have relied on a linear assumption (Arango & Nadiri, 1981; Domowitz & Elbadawi, 1987; Suliman & Dafaalla, 2011; Bhatta, 2013; Bahmani-Oskooee & Baek, 2017; Bahmani-Oskooee, 2017; Alsamara & Mrajat, 2019). Unfortunately, failure to consider the asymmetric effects of the exchange rate may result in biased estimation and lead to a wrong economic interpretation (Bahmani Oskooee & Nayeri, 2018).

Although many scholars have investigated the asymmetric impact of exchange rate on money demand in recent years, it has not been extensively studied in developing countries, mainly in Malaysia. Apparently, with the country's economic and political environment that has changed dramatically and makes its currency more sensitive to shocks, examining the impact of its exchange rate fluctuations on money demand in Malaysia is essential for policy implications.

The contribution of this study is twofold. First, this study will utilize the nonlinear ARDL approach to examine the asymmetric impact of exchange rate changes on money demand in Malaysia. The main advantage of this method is that it enables the study to distinguish the impact of currency appreciation and depreciation on money demand. Second, a comparison will be made with the linear model to determine whether the results are significantly affected when the nonlinear model was adopted.

The remainder of the paper is organized as follows. Section 2 discusses the background of the study and follows with the literature review in Section 3 and methodology in Section 4. Next, Section 5 presents the findings and discussion, and finally, the conclusion and recommendation are presented in Section 6.

## 2. Background of the Study

In the aftermath of the Asian financial crisis, currency fluctuation became an important aspect of Malaysia's economic stability after switching

to the flexible exchange rate regime. As a result, exchange rate stability has become an important monetary policy goal for the country.

As shown in Figure 1, the decision to float the country's currency from the fixed to the floating exchange rate regime in 2005 resulted in the Malaysian currency strengthening against the US dollar mainly after the subprime crisis that hit the US economy during this period. Unfortunately, the currency exchange has shown a significant decline since 2013 due to growing political instability, resulting in high capital outflows.

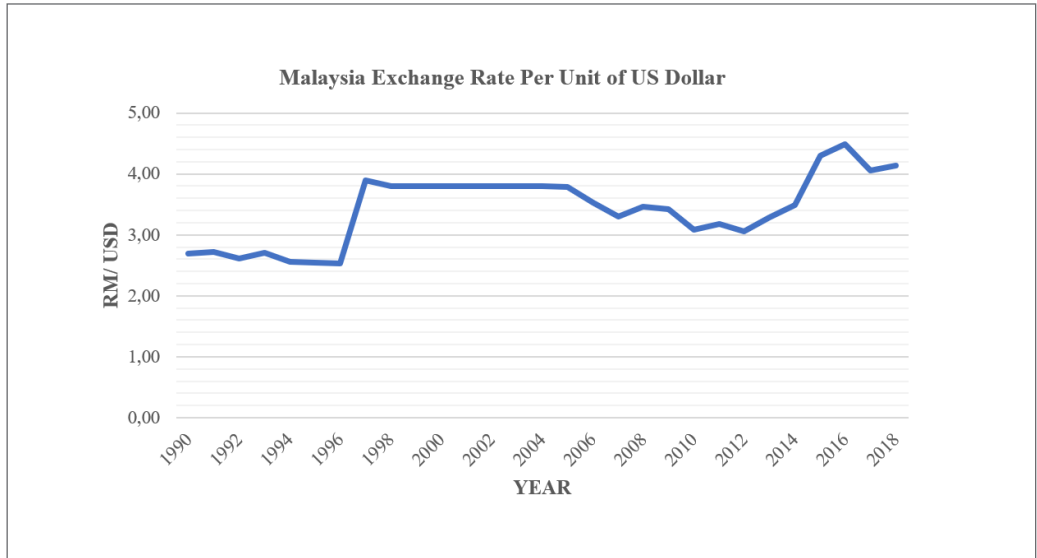
According to Bank Negara Malaysia (2018a), the Malaysian ringgit depreciated nearly 50 percent between mid-2013 to early 2017, from RM 2.9675 per US dollar to RM 4.4995 in Jan 2017. The exposure of the political scandal of the 1Malaysia Development Berhad (1MDB) and followed by the new political landscape associated with the unexpected results of the country's general election that sided towards the opposition party for the first time in its history has raised the uncertainties among investors (Bank Negara Malaysia, 2018b). The political crisis which continues to worsen, has affected the investor's confidence in the country's future growth prospect and results in a massive capital outflow in the bond and equity market, and causes the Malaysian ringgit to depreciate further.

Apparently, with the currency exchange continues to fluctuate, this has made it more challenging for the country to sustain the stability in its money demand and price level and thereby limit the effectiveness of its monetary policy. Hence, examining the effects of currency fluctuations on the money demand is crucial for policy implications in achieving long-run economic stability. Even though there is a vast literature on the link between exchange rate and demand for money, however, most of the published works are tailored towards the symmetry assumptions, while studies on the asymmetric effects of exchange rate fluctuations on money demand are very limited, mainly in the context of Malaysia and thereby become the motivation of this study.

## 3. Literature Review

A study on money demand is a crucial issue in

**Figure 1**  
*Malaysia Exchange Rate (1990-2018)*



Source: Bank Negara Malaysia

monetary economics. Money demand plays an essential role in the conduct of monetary policy and thus in an economy's overall growth and development. A significant number of empirical studies have stressed the importance of money demand stability as an effective monetary policy mechanism (Bahmani-Oskooee & Rehman 2005; Jawadi & Soussa 2013; Kumar & Rao 2012; Kumar et al. 2013; Thornton 2014). Therefore, understanding the dynamics of money demand function and its determinants is essential for the effective conduct of monetary policy.

Among the leading theories on money demand was developed by Keynes (1936). Keynes's theory of demand for money suggested three main motives which are the transactions motive, precautionary motive, and speculative motive. In particular, the theory has identified the income level and interest rate as the key determinants of money demand.

In contrast, a pioneer work by Mundell (1963) has further highlighted the importance of including exchange rate as part of the determinant of money demand. Besides, several other studies also highlighted the significance role of the currency exchange on the money demand stability (Arango & Nadiri, 1981;

McNown & Wallace, 1992; Bahmani-Oskooee & Rhee, 1994; Tan, 1997; Ibrahim, 2001; Arize & Nam, 2012). However, Arango and Nadiri (1981) argued that the effect of the exchange rate on money demand is ambiguous due to wealth and substitution effects. In view of the wealth effect, a depreciation in local currency (or appreciation in foreign currency) raises the value of the foreign asset in local currency and results in rising demand for local currency for consumption purposes. On the other hand, the substitution effects suggest that when the foreign currency appreciates, local demand for foreign currency will rise due to the expectation that they will gain from the currency appreciation. The overall effects of the exchange rate on money demand depend on whether the wealth or substitution effects dominate.

Despite the crucial effects of the exchange rate on money demand highlighted in the past studies, however, most of the studies have relied on a linear assumption (Arango & Nadiri, 1981; Domowitz & Elbadawi, 1987; Suliman & Dafaalla, 2011; Bhatta, 2013; Bahmani-Oskooee & Baek, 2016; Alsamara & Mrajat, 2019). Contrary to the linear assumption, the nonlinear relationship is based on the proposi-

tion that the response of the money demand function to a positive change could be different from its response to an adverse change. A recent study by Bahmani-Oskooee et al. (2019) in emerging economies and Bahmani-Oskooee and Gelan (2019) based on African countries found strong evidence of asymmetric effects of exchange rate on money demand.

This result is also consistent with the studies carried out by Kandil et al. (2007); Kandil and Dincer (2008) in Turkey; Bahmani-Oskooee et al. (2016) in China and Bahmani-Oskooee and Baek (2017) in Korea; Mahmood and Alkhateeb (2018) in Saudi Arabia as well as Alsamara and Mrabet (2019) in Turkey using a nonlinear approach. Hence, it can be concluded that the nonlinear model is more suitable when examining the relationship between exchange rate and money demand since the failure to consider it in the estimation model may result in biased estimation and wrong economic interpretation (Bahmani-Oskooee & Nayeri, 2018).

In the context of Malaysia, even though several studies have been done to examine the relationship between exchange rate and money demand, the findings are inconsistent due to the symmetric assumption used in the study. For instance, a study done by Azali et al. (2000) found that the exchange rate positively influences the money supply M2 while the effect is insignificant in the case of money supply M1. However, this result contradicts Marashdeh (1998) and Tan (1997) findings, who found a significant influence of the exchange rate on the money supply M1 while there is no effect on M2. On the other hand, a study carried out by Ibrahim (2001) using M1 and M2 concluded that the exchange rate exerts a negative effect on money demand. The inconsistency found may be due to the failure to consider the non-linearity behavior of the money demand function (Bahmani-Oskooee and Wang, 2007). Hence, this present study will help fill the gap by comparing the finding based on linear and nonlinear models.

#### 4. Methodology

This study aims to examine the nonlinear relationship between exchange rate changes and money demand in Malaysia. Annual data on broad money supply, exchange rate, income (GDP), and interest rate for the period 1975 to 2019 were collected from

the World Development Indicators of the World Bank. The sample period covered encompasses a different portfolio of monetary regimes that make it possible to obtain additional information regarding the necessity to identify the workings of money demand.

The conventional money demand theory based on Keynes (1936) develops money demand as a function of income and interest rate. However, Mundell (1963) has further highlighted the importance of the exchange rate in the money demand equation. Thus, following Mundell (1963), the model is expressed as follows.

$$\ln MD_t = \phi + a \ln GDP_t + b \ln ITR_t + c \ln EXR_t + \varepsilon_t \dots \quad (1)$$

Where  $MD$  is aggregate money demand measured by the broad money supply M3,  $GDP$  is the real gross domestic product as a proxy for income,  $ITR$  is the real interest rate,  $EXR$  is the nominal exchange rate, while  $\varepsilon$  is the error term. All variables are transformed into their natural logarithmic form for consistent and reliable empirical results (Shahbaz et al., 2016). The expected sign for income is positive, the interest rate is negative, and the exchange rate is expected to be ambiguous since it could be negative or positive, depending on either the currency substitution or wealth effect is dominant (Arango & Nadiri, 1981). The model in Equation 1 can be re-specified in an error correction form based on the Pesaran et al. (2001) as follows.

$$\begin{aligned} \Delta \ln MD_t = & \delta + \sum_{i=1}^{n1} a_i \Delta \ln MD_{t-i} + \sum_{i=0}^{n2} b_i \Delta \ln GDP_{t-i} + \sum_{i=0}^{n3} c_i \Delta \ln ITR_{t-i} + \\ & \sum_{i=0}^{n4} d_i \Delta \ln EXR_{t-i} + \rho_0 \ln MD_{t-1} + \rho_1 \ln GDP_{t-1} + \rho_2 \ln ITR_{t-1} + \\ & \rho_3 \ln EXR_{t-1} + \nu_t \end{aligned} \quad (2)$$

Equation (2) is an unrestricted error correction specification based on the Pesaran et al. (2001) bound testing method of estimating short and long-run coefficients. The Equation also tests for cointegration using the F-test for the joint significance of lagged level variables. Previous studies estimated the model in Equation (2) using different methods to assume that the exchange rate has a symmetric effect on money demand. However, Shin et al.

(2014) argued that the asymmetric relationship is vital because the appreciation and depreciation might have different effects in terms of magnitude and size on the money demand. Following Shin et al. (2014), the exchange rate changes are divided into the partial sum of the positive (appreciation) and negative changes (depreciation) as follows to test whether the exchange rate has an asymmetric effect on the money demand.

$\ln EXR = \ln EXR_0 + \ln EXR_t^+ + \ln EXR_t^-$ ; whereby  $\ln EXR_t^+$  and  $\ln EXR_t^-$  are a partial sum output of  $\ln EXR$  drawn from the following equations.

$$\ln EXR_t^+ = \sum_{j=1}^t \Delta \ln EXR_j^+ = \sum_{j=1}^t \max(\Delta \ln EXR_j, 0) \quad (3)$$

$$\ln EXR_t^- = \sum_{j=1}^t \Delta \ln EXR_j^- = \sum_{j=1}^t \max(\Delta \ln EXR_j, 0) \quad (4)$$

The asymmetric cointegration is based on the partial sum decomposition through equations (3) and (4), introducing a non-linearity into the model. Equations (3) and (4) depict positive changes (appreciation) and negative changes (depreciation) of the local currency, respectively. The exchange rate variable is replaced in Equation (2) by the two series obtained from the decomposition process that is  $\ln EXR_t^+$  and  $\ln EXR_t^-$  thereby producing Equation (5).

$$\begin{aligned} \Delta \ln MD_t = & \delta + \sum_{i=1}^{n1} a_i \Delta \ln MD_{t-i} + \sum_{i=0}^{n2} b_i \Delta \ln GDP_{t-i} + \sum_{i=0}^{n3} c_i \Delta \ln ITR_{t-i} \\ & + \sum_{i=0}^{n4} d \Delta \ln EXR_{t-i}^+ + \sum_{i=0}^{n5} g \Delta \ln EXR_{t-i}^- + \gamma_0 \ln MD_{t-1} \\ & + \gamma_1 \ln GDP_{t-1} + \gamma_2 \ln ITR_{t-1} + \gamma_3 \ln EXR_{t-1}^+ + \gamma_4 \ln EXR_{t-1}^- + \varphi_t \end{aligned} \quad (5)$$

The model in Equation (5) is referred to as a Non-linear Auto-Regressive Distributed Lag (NARDL) model as proposed by Shin et al. (2014) and used to test whether exchange rate variations have an asymmetric effect on the money demand for both the short and long run. The NARDL model has certain advantages over the other techniques since it provides a flexible framework by allowing variables with different order of integration in a model and is suitable for a study with a small sample size (Katrakilidis & Trachanas, 2012). Moreover, this technique is ideal for this study since it allows the model to capture the asymmetric effects (Fousekis et al., 2016).

Based on Equation 5, the coefficient estimates of  $d$  measures the short-run impact of the appre-

ciation of the local currency on the movements in money demand, while  $g$  measures a short-run effect of the depreciation of the local currency on variations in the money demand. If the estimated coefficient of the positive and negative series have the same numerical value and sign, it can be concluded that exchange rate changes have symmetric short-run effects. On the other hand, the long-run asymmetric impact can be tested with the use of a Wald test by evaluating the null hypothesis for an asymmetry  $H_0: \gamma^+ = \gamma^-$  against an alternative  $H_1: \gamma^+ \neq \gamma^-$ . Rejection of the null hypothesis shows a presence of asymmetrical impact of financial exchange rate on money demand. A long-run effect of an appreciation or depreciation in the exchange rate is provided by  $\beta_3 = \frac{-\gamma^+}{\alpha_0}$  and  $\beta_4 = \frac{-\gamma^-}{\alpha_0}$  respectively while  $\sum_{i=0}^s EXR_t^+$  and  $\sum_{i=0}^s EXR_t^-$  capture the influence in the short run of an appreciation and depreciation in the exchange rate. If the wealth effect exists, the depreciation in local currency will result in higher money demand and a lower money demand if the substitution effect dominates (Bahmani-Oskooee & Baek, 2016). In other words, a depreciation in Malaysia ringgit that increases the money demand indicates a stronger wealth effect and a decrease in the money demand if the substitution effect is more prominent.

## 5. Results and Discussion

The main purpose of this study is to investigate the impact of exchange rate changes on money demand in Malaysia. Table 1 reports the descriptive statistics of the variables included in this study. The data shows that the money demand has the highest standard deviation in the sample, while the exchange rate bears the least deviation from the mean among all variables. On the other hand, the results of the skewness and Kurtosis show the asymmetric nature in the data distribution, while the Jarque-Bera statistics confirm that all variables are normally distributed.

Next, a unit root test was conducted based on the Augmented Dickey-Fuller (Dickey & Fuller, 1979) and Phillips-Perron (Phillips & Perron, 1988) to determine the stationarity of the variables. The result reported in Table 2 suggests that there is a mixed order of integration of  $I(0)$  and  $I(1)$  while none of

**Table 1**  
*Descriptive Statistics*

| Variable    | LMD     | LEXR   | LGDP    | LITR   |
|-------------|---------|--------|---------|--------|
| Mean        | 26.2573 | 1.0920 | 26.7923 | 1.5129 |
| Median      | 26.5173 | 1.0229 | 26.9651 | 1.4673 |
| Maximum     | 28.2248 | 1.4587 | 27.9460 | 2.2773 |
| Minimum     | 23.4899 | 0.7779 | 25.4079 | 0.7332 |
| Std Dev.    | 1.3975  | 0.2092 | 0.7549  | 0.4427 |
| Skewness    | -0.2806 | 0.1969 | -0.2062 | 0.2687 |
| Kurtosis    | 1.8965  | 1.5566 | 1.7702  | 1.6818 |
| Jarque-Bera | 2.8099  | 4.1037 | 3.0845  | 3.7154 |
| Probability | 0.2453  | 0.1285 | 0.2139  | 0.1560 |

**Table 2**  
*Unit Root Tests*

| Variable       | Augmented Dickey-Fuller |            |                  |            |
|----------------|-------------------------|------------|------------------|------------|
|                | Level                   |            | First Difference |            |
|                | Intercept               | With Trend | Intercept        | With Trend |
| LMD            | -1.9566                 | -2.5595    | -5.6452***       | -6.0857*** |
| LEXR           | -0.8774                 | -2.9527    | -5.0558***       | -5.0149*** |
| LGDP           | -1.9614                 | -1.6244    | -5.2480***       | -5.5009*** |
| LITR           | -1.6943                 | -3.6112*   | -5.3549***       | -5.2904*** |
| Phillip-Perron |                         |            |                  |            |
| LMD            | -2.4095                 | -2.5234    | -6.0436***       | -6.4809*** |
| LEXR           | -1.0254                 | -2.1437    | -4.9829***       | -4.9378*** |
| LGDP           | -1.8737                 | -1.7765    | -5.2057***       | -5.5104*** |
| LITR           | -1.6459                 | -2.5978    | -6.0034***       | -5.8952*** |

Note: \*\*\*, \*\*, and \* imply significance at 1%, 5% and 10% levels, respectively.

the variables are stationary at I(2). Thus, the ARDL and NARDL approaches are suitable for estimating the short run and long-run models.

Finally, in answering the main objective of this study, the linear and nonlinear ARDL models as specified in equations (2) and (5) are estimated to examine the short-run and long-run effects of exchange rate changes on money demand. In determining the optimum lag length, this study utilized the Akaike's Information Criterion (AIC) with a maximum of four lags. The results of the ARDL and NARDL models are reported in Table 3 and Table 4, respectively.

As shown by the result of the ARDL model (2,4,4,4) in Table 3, the short-run estimates show that all the variables are statistically significant with the error correction terms indicates that any deviation in the money demand from the long-run equilibrium will be fully corrected in the following year. The linear ARDL model suggests cointegration among the variables, but the long-run model reveals that the exchange rate has no relationship with the money demand. This is contrary to the prior expectation that the exchange rate will significantly affect money demand. The impact will depend on whether the wealth effects or substitution effects dominated.

Although the long-run model passes the diagnostic test for serial correlation, heteroscedasticity, specification test, and normality tests, the insignificant relationship found between exchange rate and money demand might be due to the linear assumption. Bahmani-Oskooee and Bahmani (2015) argued that relying on a linear assumption might not expose the actual effects of exchange rate changes on the money demand and result in a wrong interpretation. Hence, the nonlinear model in Equation (5) is estimated to determine whether an asymmetric effect exists between the exchange rate and money demand, and the results are reported in Table 4.

Based on the nonlinear ARDL model (3,4,4,2,3) reported in Table 4, the short-run estimates show that all the variables are statistically significant with error correction terms indicating that the deviation from the long-run equilibrium will be corrected by 66.2% in the following year. The variables  $\Delta\text{LEXR}^+$  and  $\Delta\text{LEXR}$  which represent the appreciation and depreciation in local currency, were also significant, suggesting the existence of asymmetric effects of exchange rate changes on money demand over the short-run period.

Besides, the result of the long-run model confirms the existence of cointegration among variables as shown by the F-test for joint significance.

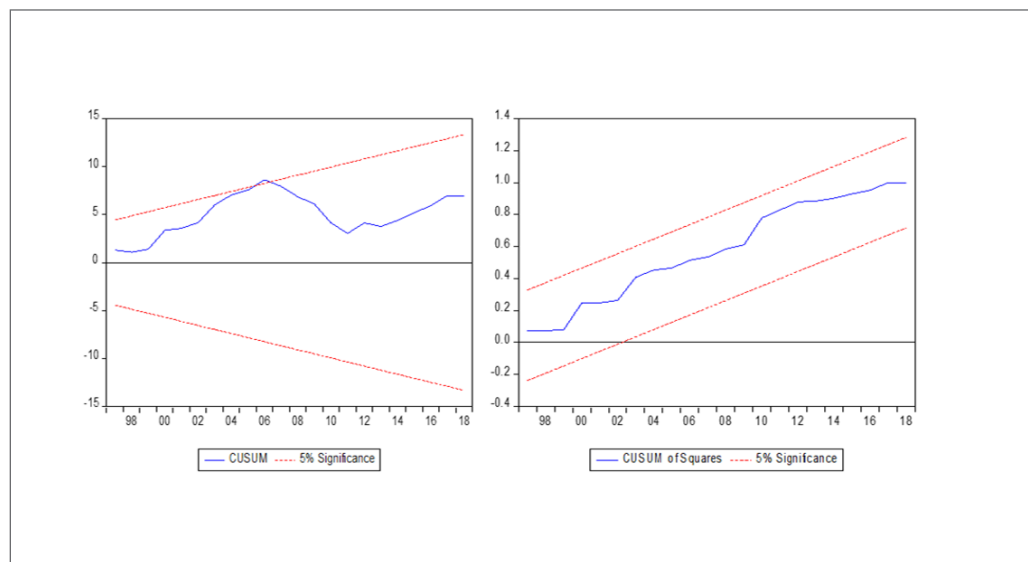
**Table 3**  
*Linear ARDL Estimates*

| <b>Panel A: Short Run Coefficients</b> |                   |                      |                     |                    |
|--|-------------------|----------------------|---------------------|--------------------|
| Lag order                              |                   | 1                    | 2                   | 3                  |
| $\Delta\text{LMD}$                     | -                 | 0.244**<br>(0.039)   | -                   | -                  |
| $\Delta\text{LEXR}$                    | -0.264<br>(0.204) | -0.253<br>(0.415)    | 0.738**<br>(0.021)  | -0.612*<br>(0.058) |
| $\Delta\text{LGDP}$                    | -0.404<br>(0.481) | -2.681***<br>(0.002) | -1.853**<br>(0.014) | -0.804<br>(0.116)  |
| $\Delta\text{LITR}$                    | 0.097<br>(0.184)  | -0.101<br>(0.141)    | -0.171**<br>(0.019) | 0.145**<br>(0.045) |
| $\text{ECT}_{t-1}$                     | -                 | -1.014***<br>(0.000) | -                   | -                  |
| <b>Panel B: Long-Run Coefficients</b>  |                   |                      |                     |                    |
| LEXR                                   |                   |                      |                     | -0.194 (0.365)     |
| LGDP                                   |                   |                      |                     | 1.889*** (0.000)   |
| LITR                                   |                   |                      |                     | 0.221* (0.062)     |
| Constant                               |                   |                      |                     | -24.055 (0.000)    |
| <b>Panel C: Diagnostic Tests</b>       |                   |                      |                     |                    |
| F test                                 |                   |                      |                     | 6.449***           |
| Lagrange Multiplier Test               |                   |                      |                     | 4.178 (0.124)      |
| Breusch-Godfrey test                   |                   |                      |                     | 23.259 (0.1379)    |
| Ramsey's Specification test            |                   |                      |                     | 0.055 (0.8177)     |
| Normality test                         |                   |                      |                     | 2.030 (0.362)      |

Note: The ARDL model (2,4,4,4) was selected based on AIC with the optimum lag of 4. The number in parenthesis represents the p-values. \*\*\*, \*\*, and \* imply significance at 1%, 5% and 10% levels, respectively.



**Figure 2**  
CUSUM and CUSUMSQ test for Linear ARDL Model



Interestingly, based on the long-run estimates, all the variables are statistically significant in explaining the money demand, including the exchange rate, which is insignificant in the previous estimation based on the linear model. The result indicates that both the appreciation and depreciation in Malaysia ringgit significantly affect the money demand but in an asymmetric manner.

The diagnostic test also confirms the NARDL model is free from serial correlation, has a constant variance, well-specified, and its errors are normally distributed. Besides, the stability test based on CUSUM and CUSUMSQ presented in Figure 3 also confirms that the parameters are stable at a 5 percent significance level. Hence, it can be concluded the nonlinear assumption plays a significant role when examining the exchange rate and money demand relationship. This result is in line with recent studies carried out by Alsamara and Mrabet (2019) in Turkey, Bahmani-Oskooee et al. (2019) in emerging economies, and Bahmani-Oskooee and Gelan (2019) in the African countries.

Looking further at the long-run estimates of the NARDL model in Table 4, the result indicates that a 1 percent appreciation in the local currency exchange (LEXR<sup>+</sup>) will lead to a 3.4 percent reduction

in the money demand, while a depreciation of the local currency (LEXR<sup>-</sup>) by 1 percent will result in 5.8 percent decline in money demand. The negative coefficient of the local currency appreciation, LEXR<sup>+</sup>, implies that when the local currency appreciates, Malaysian will hold less of the local currency, which supports the existence of a wealth effect. On the other hand, the negative coefficient of the currency depreciation, LEXR<sup>-</sup>, implies that when the local currency depreciates, Malaysian will hold less of the local currency due to substitution effects or expectation that it will continue to decline. However, the overall results suggest that the exchange rate effects on money demand are dominated by the changes in expectations or substitution effect channel rather than the wealth effect

The dominance of the substitution effects also indirectly supports the existence of asymmetric effects of exchange rate on money demand since the substitution effect is based on people's expectations which are subject to change over time (Bahmani-Oskooee & Baek, 2016). Consistently, the Wald test reported in Table 5 also supports the asymmetric effects of exchange rate on money demand in both the short and long-run period, thus validating the importance of addressing the asymmetric effects in

**Table 4**  
*Nonlinear ARDL Estimates*

| <b>Panel A: Short Run Coefficients</b> |          |           |           |                   |
|--|----------|-----------|-----------|-------------------|
| Lag order                              |          | 1         | 2         | 3                 |
| $\Delta$ LMD                           | -        | -0.170*   | 0.396***  | -                 |
|  |          | (0.061)   | (0.000)   |                   |
| $\Delta$ LEXR <sup>+</sup>             | 0.468    | 2.521***  | 0.523     | -1.049**          |
|  | (0.162)  | (0.000)   | (0.266)   | (0.045)           |
| $\Delta$ LEXR <sup>-</sup>             | 0.011    | 1.791***  | 0.611     | 0.774***          |
|  | (0.976)  | (0.000)   | (0.114)   | (0.000)           |
| $\Delta$ LGDP                          | 1.425*** | -1.306**  | -         | -                 |
|  | (0.004)  | (0.020)   |           |                   |
| $\Delta$ LITR                          | 0.038    | -0.405*** | -0.444*** | -                 |
|  | (0.493)  | (0.000)   | (0.000)   |                   |
| ECT <sub>t-1</sub>                     | -        | -0.662*** | -         | -                 |
|  |          | (0.000)   |           |                   |
| <b>Panel B: Long-Run Coefficients</b>  |          |           |           |                   |
| LEXR <sup>+</sup>                      |          |           |           | -3.426** (0.017)  |
| LEXR <sup>-</sup>                      |          |           |           | -5.793*** (0.009) |
| LGDP                                   |          |           |           | 0.951*** (0.008)  |
| LITR                                   |          |           |           | 0.873** (0.023)   |
| Constant                               |          |           |           | -1.781 (0.816)    |
| <b>Panel C: Diagnostic Tests</b>       |          |           |           |                   |
| F test                                 |          |           |           | 15.895***         |
| Lagrange Multiplier Test               |          |           |           | 0.117 (0.733)     |
| Breusch-Godfrey test                   |          |           |           | 18.489 (0.555)    |
| Ramsey's Specification test            |          |           |           | 0.018 (0.895)     |
| Normality test                         |          |           |           | 4.065 (0.131)     |

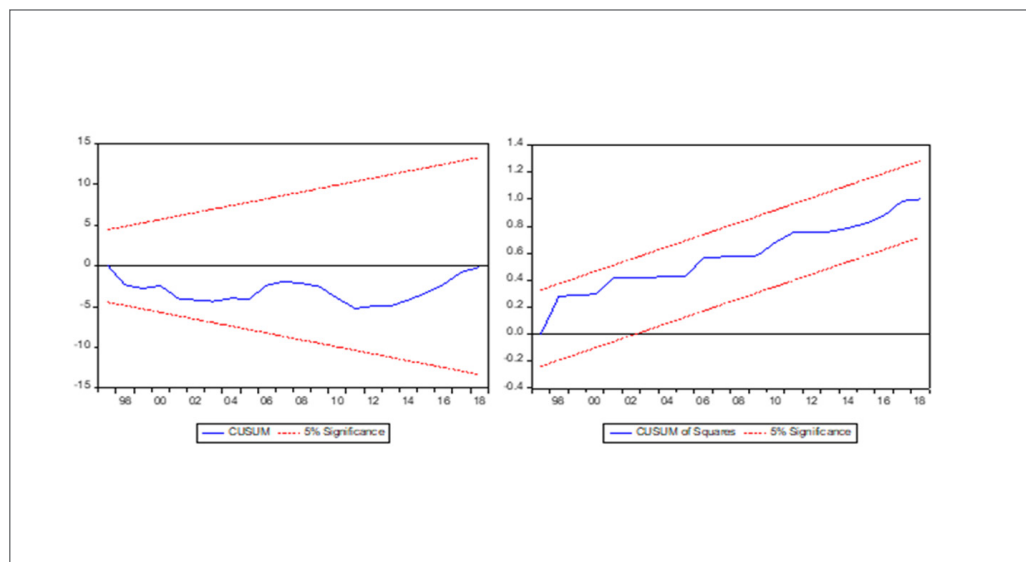
Note: The NARDL model (3,4,4,2,3) was selected based on AIC with the optimum lag of 4. Number in parenthesis are p-values. . \*\*\*, \*\*, and \* imply significance at 1%, 5%, and 10% levels, respectively.

**Table 4**  
*Wald Test*

| <b>Wald (Joint significance)</b> | <b>Wald (Short run)</b> | <b>Wald (Long run)</b> |
|----------------------------------|-------------------------|------------------------|
| 5.408***                         | 8.692***                | 7.158***               |
| (0.001)                          | (0.003)                 | (0.007)                |

Note: Number in parenthesis are p-values. \*\*\* imply a 1% significance level.

**Figure 3**  
CUSUM and CUSUMSQ test for NARDL Model



the analysis. Hence, any government intervention in the foreign exchange market will significantly influence the money demand since it affects the people's expectations and responses accordingly.

In conclusion, this study demonstrates an asymmetric impact of exchange rate changes on money demand in Malaysia whereby the effect of a negative shock (depreciation) in the currency exchange outweighs the positive shock (appreciation). Since the currency exchange that continues to decline in recent years has greatly affected the stability of money demand, therefore, the policy intervention needs to ensure the currency exchange can be strengthened and stabilized to ensure the money demand remains stable, and the effectiveness of the monetary policy can be restored.

## 6. Conclusion and Recommendation

This study provides two important insights on the relationship between exchange rate changes and money demand. Firstly, the exchange rate is found to play a significant role in affecting the stability in money demand only when the non-linearity assumption was considered in the analysis, as shown by the result of the NARDL

model, which is more robust than the linear ARDL model. This finding suggests that the failure to address the non-linearity issue in the analysis may result in biased estimation and wrong economic interpretation. Secondly, the result of the NARDL model reveals an asymmetric effect of exchange rate on the money demand with the depreciation in the local currency has a substantial impact on the money demand than the appreciation in the currency. The finding also reveals that the substitution effects dominated the exchange rate and money demand relationship, and thereby, any government intervention in the foreign exchange market will significantly influence the stability of the money demand. It can also be concluded that the continuous decline in the currency exchange observed in recent years due to the political instability in the country has greatly affected the stability of the money demand, mainly due to the expectation that the currency exchange will continue to decline. Therefore, policy intervention should be geared towards strengthening the currency exchange to ensure the stability in the money demand and the effectiveness of the monetary policy can be restored. Apparently, with the political instability continue to prolong, it is crucial to boost the investor's confidence in the country's future growth and explore new export market opportunities to strengthen the currency exchange.

Based on the findings of this study, future research should examine the effects of international capital flows on the money demand and determine how far the policy response to encourage capital inflows will improve the stability of the money demand.

## References

- Alsamara, M., & Mrabet, Z. (2019). Asymmetric impacts of foreign exchange rate on the demand for money in Turkey: New evidence from nonlinear ARDL. *International Economics and Economic Policy*, 16(2), 335-356. <https://doi.org/10.1007/s10368-018-0421-y>
- Arango, S., & Nadiri, M. I. (1981). Demand for money in open economies. *Journal of Monetary Economics*, 7(1), 69-83. [https://doi.org/10.1016/0304-3932\(81\)90052-0](https://doi.org/10.1016/0304-3932(81)90052-0)
- Arize, A. C., & Nam, K. (2012). The demand for money in Asia: Some further evidence. *International Journal of Economics and Finance*, 4(8), 59-72. <https://doi.org/10.5539/ijef.v4n8p59>
- Azali, M., Baharumshah, A. Z., & Habibullah, M. S. (2000). Exchange rate and the demand for money in Malaysia. *Pertanika J. Soc. Sci. & Hum*, 8(2), 71-75.
- Bahmani-Oskooee, M., & Baek, J. (2017). Do exchange rate changes have symmetric or asymmetric effects on the demand for money in Korea? *Review of Economic Analysis*, 9(2), 155-168.
- Bahmani-Oskooee, M., & Bahmani, S. (2015). Nonlinear ARDL approach and the demand for money in Iran. *Economics Bulletin*, 35(1), 381-391.
- Bahmani-Oskooee, M., Bahmani, S., Kutan, A. M., & Xi, D. (2019). On the Asymmetric Effects of Exchange Rate Changes on the Demand for Money: Evidence from Emerging Economies. *Journal of Emerging Market Finance*, 18(1), 1-22. <https://doi.org/10.1177/0972652719831523>
- Bahmani-Oskooee, M., & Gelan, A. (2019). Asymmetric effects of exchange rate changes on the demand for money in Africa. *Applied Economics*, 51(31), 3365-3375. <https://doi.org/10.1080/00036846.2019.1578854>
- Bahmani-Oskooee, M., & Nayeri, M. M. (2018). Policy Uncertainty and the demand for money in Australia: An asymmetry analysis. *Australian Economic Papers*, 57(4), 456-469. <https://doi.org/10.1111/1467-8454.12127>
- Bahmani-Oskooee, M., & Rehman, H. (2005). Stability of the money demand function in Asian developing countries. *Applied Economics*, 37(7), 773-792. <https://doi.org/10.1080/0003684042000337424>
- Bahmani-Oskooee, M., & Rhee, H. J. (1994). Long-run elasticities of the demand for money in Korea: evidence from cointegration analysis. *International Economic Journal*, 8(2), 83-93. <https://doi.org/10.1080/10168739400000015>
- Bahmani-Oskooee, M., & Wang, Y. (2007). How stable is the demand for money in China? *Journal of Economic Development*, 32(1), 21. <https://doi.org/10.35866/caujed.2007.32.1.002>
- Bahmani-Oskooee, M., Xi, D., & Bahmani, S. (2016). Asymmetric effects of exchange rate changes on the demand for money in China. *Applied Economics Letters*, 23(15), 1104-1109. <https://doi.org/10.1080/13504851.2015.1137540>
- Bank Negara Malaysia (2018a). *Annual Report 2018*. Bank Negara Malaysia, Kuala Lumpur, Malaysia. [https://www.bnm.gov.my/documents/20124/791626/ar2018\\_book.pdf](https://www.bnm.gov.my/documents/20124/791626/ar2018_book.pdf)
- Bank Negara Malaysia (2018b). *Financial Stability and Payment Systems Report 2018*. Bank Negara Malaysia, Kuala Lumpur, Malaysia. [https://www.bnm.gov.my/documents/20124/856365/fs2018\\_book.pdf](https://www.bnm.gov.my/documents/20124/856365/fs2018_book.pdf)
- Bhatta, S. R. (2013). Stability of money demand function in Nepal. *Banking Journal*, 3(1), 1-27. <https://doi.org/10.3126/bj.v3i1.7508>
- Dickey, D. A., & Fuller, W. A. (1979). Distribution of the estimators for autoregressive time series with a unit root. *Journal of the American statistical association*, 74(366a), 427-431.
- Domowitz, I., & Elbadawi, I. (1987). An error-correction approach to money demand: The case of Sudan. *Journal of Development Economics*, 26(2), 257-275. [https://doi.org/10.1016/0304-3878\(87\)90029-0](https://doi.org/10.1016/0304-3878(87)90029-0)
- Fousekis, P., Katrakilidis, C., & Trachanas, E. (2016). Vertical price transmission in the US beef sector: Evidence from the nonlinear ARDL model. *Economic Modelling*, 52, 499-506. <https://doi.org/10.1016/j.econmod.2015.09.030>
- Ibrahim, M. H. (2001). Financial factors and the empirical behavior of money demand: A case study of Malaysia. *International Economic Journal*, 15(3), 55-72. <https://doi.org/10.1080/10168730100000043>
- Jawadi, F., & Sousa, R. M. (2013). Money demand in the euro area, the US and the UK: Assessing the role of nonlinearity. *Economic Modelling*, 32, 507-515. <https://doi.org/10.1016/j.econmod.2013.02.009>
- Kandil, M., Berument, H., & Dincer, N. N. (2007).

- The effects of exchange rate fluctuations on economic activity in Turkey. *Journal of Asian Economics*, 18(3), 466-489. <https://doi.org/10.1016/j.asieco.2006.12.015>
- Kandil, M., & Dincer, N. N. (2008). A comparative analysis of exchange rate fluctuations and economic activity: The cases of Egypt and Turkey. *International Journal of Development Issues*, 7(2), 136-159. <https://doi.org/10.1108/14468950810909114>
- Katrakilidis, C., & Trachanas, E. (2012). What drives housing price dynamics in Greece: New evidence from asymmetric ARDL cointegration. *Economic Modelling*, 29(4), 1064-1069. <https://doi.org/10.1016/j.econmod.2012.03.029>
- Keynes, J. M. (1936). *The general theory of employment, interest, and money*. Macmillan.
- Kumar, S., & Rao, B. B. (2012). Error-correction based panel estimates of the demand for money of selected Asian countries with the extreme bounds analysis. *Economic Modelling*, 29(4), 1181-1188. <https://doi.org/10.1016/j.econmod.2012.04.008>
- Kumar, S., Webber, D. J., & Fargher, S. (2013). Money demand stability: A case study of Nigeria. *Journal of Policy Modeling*, 35(6), 978-991. <https://doi.org/10.1016/j.jpolmod.2013.03.012>
- Mahmood, H., & Alkhateeb, T. T. Y. (2018). Asymmetrical effects of real exchange rate on the money demand in Saudi Arabia: A nonlinear ARDL approach. *PLoS one*, 13(11), e0207598. <https://doi.org/10.1371/journal.pone.0207598>
- Marashdeh, O. (1998). The demand for money in an open economy: The case of Malaysia. In *Southern Finance Association Annual Meeting* (pp. 19-22). <https://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.201.3357&rep=rep1&type=pdf>
- McNown, R., & Wallace, M. S. (1992). Cointegration tests of a long-run relation between money demand and the effective exchange rate. *Journal of International Money and Finance*, 11(1), 107-114. [https://doi.org/10.1016/0261-5606\(92\)90024-R](https://doi.org/10.1016/0261-5606(92)90024-R)
- Mundell, R. A. (1963). Capital mobility and stabilization policy under fixed and flexible exchange rates. *Canadian Journal of Economics and Political Science/Revue canadienne de economiques et science politique*, 29(4), 475-485.
- Pesaran, M. H., Shin, Y., & Smith, R. J. (2001). Bounds testing approaches to the analysis of level relationships. *Journal of Applied Econometrics*, 16(3), 289-326. <https://doi.org/10.1002/jae.616>
- Phillips, P. C., & Perron, P. (1988). Testing for a unit root in time series regression. *Biometrika*, 75(2), 335-346. <https://doi.org/10.1093/biomet/75.2.335>
- Shahbaz, M., Mallick, H., Mahalik, M. K., & Sadorsky, P. (2016). The role of globalization on the recent evolution of energy demand in India: Implications for sustainable development. *Energy Economics*, 55, 52-68. <https://doi.org/10.1016/j.eneco.2016.01.013>
- Shin, Y., Yu, B., & Greenwood-Nimmo, M. (2014). Modelling asymmetric cointegration and dynamic multipliers in a nonlinear ARDL framework. In R. C. Sickles, & W. C. Horace (Eds.), *Festschrift in Honor of Peter Schmidt* (281-314). Springer.
- Suliman, S. Z., & Dafaalla, H. A. (2011). An econometric analysis of money demand function in Sudan, 1960 to 2010. *Journal of Economics and International Finance*, 3(16), 793-800. <https://doi.org/10.5897/JEIF11.122>
- Tan, E. C. (1997). Money demand amid financial sector developments in Malaysia. *Applied Economics*, 29(9), 1201-1215. <https://doi.org/10.1080/00036849700000011>
- Thornton, D. L. (2014). Monetary policy: Why money matters (and interest rates don't). *Journal of Macroeconomics*, 40, 202-213. <https://doi.org/10.1016/j.jmacro.2013.12.005>