The Asymmetric Effect of Currency Devaluation on Inflation in Malaysia; Evidence from Non-Linear ARDL

Ahmed Balarabe Musa, Ibrahim Abdulhamid Danlami, Sunday Elijah

Abstract: ***This research is intended to investigate the effects of currency devaluation on inflation and the existence of asymmetry on such effect, in Malaysia. Given the nature of the research's variables features (mixed stationary) and the objective of the study, the research employs non-linear autoregressive distributed lag (NARDL) model as the econometrics techniques of the study. The results show that currency devaluations are inflationary in the short run and also in the long run. Meanwhile, currency revaluations have no significant effect on inflation in the two periods. The implication of the findings is that; changes in the exchange rate, are flexible upward, but they are resistant to downward pressures. The research recommends implementations of policies that can trim down the demand for foreign exchange to reduce currency devaluation pressures.***

Index Terms: : Asymmetry, currency devaluation, inflation, Malaysia, NARDL
JEL: C01; C30; D82; N15

I. INTRODUCTION

The longstanding debate of either currency devaluation is inflationary or not, is yet to be settled. Several scholars perceived currency devaluation to be inflationary. They believed that in most developing nations, high rate of inflation is caused and explained by the excessive devaluation of their local currencies (Karagöz, Demirel et al. 2016) (Rossi and Leigh 2002) (Ogundipe 2013). On the other hand, some researchers are on the opinion that currency devaluation is disinflationary. Their argument is based on the fact that some emerging economies and industrialized nations have lower rates of inflation after their currency being devalued, and therefore, they recommend such to developing countries (Yanamandra 2015) (McCarthy 2007). Meanwhile, Campa and Goldberg (2005) stressed that the consequence of currency devaluation on inflation is not unique across countries; it depends on the nature and features as well as the economic conditions and policies of a country. To them, countries with similar features may have or may not have the same effect of currency devaluation on inflation. Hence, empirical studies are necessary before making a conclusion.

Another unsettled argument is that of the flexibility or rigidity of the prices, exchange rates and interest rates movements caused by demand and supply interaction. Classical economists believed in the flexibility of prices, exchange rates and interest rate based on the market trends of demand and supply (symmetry) (DeLong and Summers 1985). Whereas, Keynesian economist synthesized that prices, exchange rates and interest rates could be flexible upward but at the same time could be resistance to downward pressures (rigidity and asymmetry) (Ball and Romer 1987).

Malaysia is among the eight high performing Asian economies with reasonably stable inflation and exchange rates. Although, in the last seven years (2011 – 2017), the exchange rate has been on the increase, which implies that the country has been devaluing its local currency. Starting from 2011, the exchange rate of Malaysian Ringgit (MYR) about United States Dollar (USD) is around 3.06, it changed to 3.09 in 2012 and 3.15 and 3.27 in 2013 and 2014, respectively. The exchange rate further increases to 3.90 and 4.13 in 2015 and 2016, respective. Finally, it increased to approximately 4.3 in 2017. This indicates that comparing the exchange rate of 2011 and six years after (2017), the currency (RM) has been devalued by over 40%. It can be seen in Figure 1.

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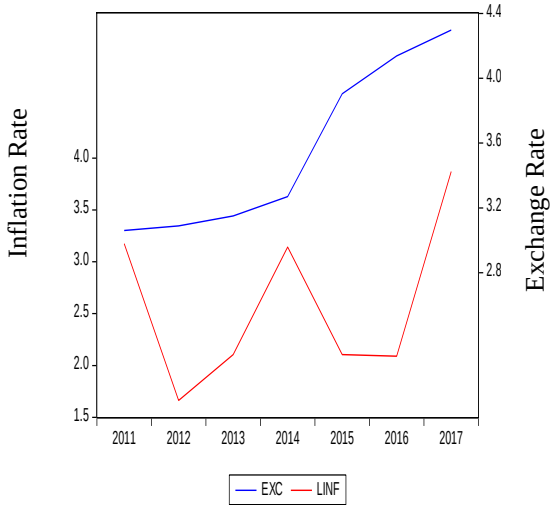

Fig 1; Inflation and Exchange Rate for Malaysia 2011 – 2017

Source: World Development Indicator, 2019

The objective of this paper is to investigate the impacts of currency devaluation on inflation in Malaysia (inflationary or deflationary) and to investigate whether the effect is symmetry (flexibility upward and downward) or asymmetry (existence of rigidity). The rest, of the paper, is distributed into the following four more sections, are as follows: a literature review is presented in section two. Section three presents the research methodology utilized by the research. The fourth section contains results obtained from the data analyzed and their discussions. The concluding remarks are presented in the section five of this paper.

II. LITERATURE REVIEW

The term currency devaluation, which is unanimous with currency depreciation, is simply defined as the increase in the rate at which local currency, of a country, is being exchanged with foreign currency, usually USD (McKinnon 1963) (Cooper 1992).

Several studies exist that have been done to evaluate the effect of currency devaluation on inflation empirically. Such studies reported different and inconclusive findings that are not possible to make use of them for generalization purposes. Some reviews reported in their finding that the effect of the devaluation of local currency on inflation is positive while it is negative in some studies in some areas. In their study, Karagöz, Demirel et al. (2016) examined the effect of currency devaluation on inflation in Asia, Latin America and Turkey, and confirmed that the effects differ from country to country. Though, the effect of the depreciation of legal tender in Asia is lower than those of Latin America and Turkey. Yanamandra (2015) maintained that the impact of currency devaluation on inflation in India is -1.16. It indeed exists, and it is negative, which simply indicate that one percent currency devaluation decreases inflation by 1.16%. In a similar study, Savoie-Chabot (2015) confirmed that the consequence of currency devaluation on inflation is positive n Canada which is between 0.5 to 0.7 percentage points in a rate of inflation ranged from 0.9 to 1.1 percentage points. Rossi and Leigh (2002) maintained that the effect of currency devaluation on inflation in Turkey is positive, using monthly data. They showed that the level of the effect is high during the first four months and therefore, its effects are seeing mostly in the short run.

In the same vein, McCarthy (2007) examined and established the existence of an adverse effect of currency devaluation on inflation in industrialized economies. The result implies that currency depreciation is modest but has disinflationary effects. Ogundipe (2013) investigated the level of currency devaluation on consumer prices in Nigeria. To him, the level of the effect is large and can explain the inflationary situations of the country than does the money supply. The positive effect of currency devaluation was reported by Campa and Goldberg (2005) in the findings of their research in the euro area. The result shows that the effect is high in the short run even though it is incomplete and not unique across countries and industries. It is higher and close to unity (close to completeness) during the long run. Mawejje (2016) analyzed the level of the effect currency depreciation on inflation in Uganda in a multi-stage analysis. At the level of the external sector, the effect is positive with a 1% increase in exchange rate resulting in 0.909% rise in the consumer price index. In contrast, in their final (general) result (what they termed as single equation model), it has been reported that one percent increase in the exchange rate will increase CPI by 0.153% after three periods (three lags). Usman (2018) using the Vector Error Correction Model, discovered that the impacts of currency devaluation on inflation are positive in both short-run and long-run of Nigeria, based on 1960 – 2015 data.

III. METHODOLOGY

It highlights the approaches used in the research. It began by explaining the theoretical backing – which is the theoretical framework, whereupon, the source of data and variable measurements are explained. Later on, the model was specified.

A. Theoretical Framework:

Monetarist theory of inflation believe that inflation everywhere is solely instigated by an increase in money supply beyond what is required by the economy (Ball and Romer 1987). Whereas, the Keynesian strand of thought maintain the existence of excess demand over supply as the sole cause of inflation (Keynes 1936). The choice of variables in this study can best be explained by the combination of the two theories, bearing in mind their believed in a capitalist open-economy that encourages exchange and international trade among countries.

B. Source of Data:

The data utilized by this study are sourced from World Development Indicator (WDI) of World Bank (worldbank.org) and a few missing data were sourced from Federal Reserve Economic Data (fred.stlouisfed.org). To simplify the interpretation and

unify their measurements, all data are transformed to the logarithm.

C. Variables:

The inflation used by this research is based on consumer price as against the producer price as the consumer price encapsulates both the producer prices and service (the services are not included in producer price). Fluctuations in the exchange rate are used to derive the currency devaluation. Broad Money supply is used as the stock of money in the country, whereas Gross Domestic Products (GDP) and lending interest rates are applied as GDP and interest rates of the economy. A dummy variable is also utilized to capture the structural break observed in the data. Thus, the whole data sample is divided into two; taking 1970 – 1987 as zero (1970 – 1987=0) and 1988 – 2017 as one (1988 – 2017=1).

D. Model Specification:

Having the intention of investigating the asymmetric effect of the devaluation of currency on inflation in addition to the nature of the variables of the study, the paper employs non-linear autoregressive distributed lag model (NARDL) as the econometric tool of analysis. The chosen econometric tool has several advantages over others as it can measure the existence of an asymmetric relationship among variables in addition to being robust to all forms of endogeneity (Jalil 2014). The method also provides an efficiently estimated coefficient even on small samples. Moreover, it accommodates mixed stationary variables (stationary at level and stationary at first difference). Therefore, following Amoah (2018) and Usman (2018), the function is specified as follows:

$$INF = f(EXC, BROD, GDP\ INT) \qquad [1]$$

Where INF is inflation, EXC is exchange rate, GDP is Gross Domestic Products, and INT is the interest rate. Hence the NARDL general model function can be presented as:

$$\Delta LINF_t = \beta_0 + \sum_{i=1}^{p} \beta_1 \Delta LINF_{t-k} + \sum_{k=0}^{q_1} \left(\beta_2^+ \Delta CLEXC_{t-k}^+ + \beta_2^- \Delta CLEXC_{t-k}^-\right) + \sum_{k=0}^{q_2} \beta_3 \Delta LBROD_{t-k} + \sum_{k=0}^{q_3} \beta_4 \Delta LGDP_{t-k} + \sum_{k=0}^{q_4} \beta_5 \Delta LINT_{t-k} + \beta_6 LINF_t + \left[\beta_7^+ CLEXC_t^+ + \beta_7^- CLEXC_t^-\right] + \beta_8 LBROD_t + \beta_9 LGDP_t + \beta_{10} LINT_t + \varepsilon_t \qquad [2]$$

where Δ is a difference operator, β_{is} are coefficients with β_2^+ being coefficients of the positive shocks and $\propto \beta_2^-$ the coefficient of the negative shocks, p and q are the lag length for the dependent variable and independent variables, respectively. t implies the data is time series and ε is the error term with white noise properties $\varepsilon \sim iid\ (0, \delta_\varepsilon^2)$.

The Short Run function of the NARDL is presented as:

$$\Delta LINF_t = \propto_0 + \sum_{k=1}^{p} \propto_1 \Delta LINF_{t-k} + \sum_{k=0}^{q_1} \left(\propto_2^+ \Delta CLEXC_{t-k}^+ + \propto_2^- \Delta CLEXC_{t-k}^-\right) + \sum_{k=0}^{q_2} \propto_3 \Delta LBROD_{t-k} + \sum_{k=0}^{q_3} \propto_4 \Delta LGDP_{t-k} + \sum_{k=0}^{q_4} \propto_5 \Delta LINT_{t-k} + \mu_0 ECT_{t-1} + \varepsilon_t \qquad [3]$$

where: $\propto_{is}$ are short run coefficients, ECT is the error correction term and μ_0 is the speed of adjustment towards long-run equilibrium

The Long Run function of the NARDL is presented as:

$$LINF_t = \gamma_0 + \sum_{i=1}^{p} \gamma_1 LINF_{t-k} + \sum_{k=0}^{q_1} \left(\gamma_2^+ CLEXC_{t-k}^+ + \gamma_2^- CLEXC_{t-k}^-\right) + \sum_{k=0}^{q_2} \gamma_3 LBROD_{t-k} + \sum_{k=0}^{q_3} \propto_4 LGDP_{t-k} + \sum_{k=0}^{q_4} \gamma_5 LINT_{t-k} + \varepsilon_t \qquad [4]$$

where: γ_{is} are the long run coefficients.

IV. RESULTS AND DISCUSSIONS

The findings of the research based on the methodology employed are presented in this section. The section is opened by presenting the descriptive statistics of the variables of the study, followed by the results of the unit root test, and finally, the results of the NARDL are presented.

The descriptive statistics of the variables employed by the study are presented in Table 1. The table shows that the average inflation rate (LINF) is unity (one) while the average exchange rate (LEXC) is 1.08. Money supply (LBROD) and GDP (LGDP) have 25.85 and 24.75 as their respective averages. Conversely, the interest rate (LINT) has an average value of 2.09. Taking into cognizance the values of the standard deviation of the respective variables are less than their respective means (averages), it implies that the distributions of each series are closer to their respective means and therefore, could be normally distributed sample. The Jarque-Bera statistics and its corresponding probability confirm that the distributions are normally distributed with probability values over 5% except that of LINF that has a probability value of3%.

Table 1: Descriptive Statistics

	LINF	LEXC	LBROD	LGDP	LINT
Mean	1.00	1.08	25.85	24.75	2.09
Median	1.12	1.02	26.05	24.96	2.20
Maximum	2.85	1.46	28.15	26.55	2.53
Minimum	-1.24	0.78	22.30	22.08	1.51
Std. Dev.	0.78	0.20	1.70	1.26	0.33
Skewness	-0.66	0.31	-0.43	-0.37	-0.53
Kurtosis	4.37	1.71	2.15	2.26	1.96
Jarque-Bera	7.25	4.08	2.95	2.18	4.37
Probability	0.03	0.13	0.23	0.34	0.11

Sum	48.01	51.69	1240.72	1188.22	100.27
Sum Sq. Dev.	28.30	1.87	135.12	74.48	5.00
Observations	48	48	48	48	48

Table 2 presents the results of unit root test and indicates that the variables are mixed stationary as inflation rate (LINF) and currency devaluation which is the change in exchange rate (CLEXC) are stationary at level while LBROD, LGDP and LINT are stationary at first difference, showing by the results of both Augmented Dickey-Fuller (ADF) test and Phillips Peron (PP) test.

Table 2: Results of Unit Root test

	TEST TYPES			
	Augmented Dickey-Fuller – ADF test		Phillips Peron – PP Test	
Variables	**Level**	**First Difference**	**Level**	**First Difference**
LINF	-4.00*	--	-3.97*	--
	(0.00)		(0.00)	
CLEXC	-5.04*	—	-4.96*	--
	(0.00)		(0.00)	
LBROD	-2.21	-6.09*	-2.11	-6.48*
	(0.47)	(0.00)	(0.53)	(0.00)
LGDP	-3.31	-5.60*	-2.51	-5.55*
	(0.08)	(0.00)	(0.32)	(0.00)
LINT	-0.18	-5.31*	-0.15	-5.17*
	(0.93)	(0.00)	(0.94)	(0.00)

Source: Authors' 2019; Notes: * represents statistically significant at 5 percent level, Figures in Parenthesis are probability.

ARDL or NARDL can only model the mixed stationary variables; hence, this study employs NARDL to check for the existence of the asymmetry.

The result of the general modelling of the NARDL is presented in Table 3. The result is used for Bounds testing for co-integration and test of asymmetry. It also reveals that the selected lags based on Schwarz Criterion are NARDL (1, 0, 0, 1, 0, 0).

Table 3: General Modelling of the NARDL(1,0,0,1,0,0)

Variables	Coefficients	Std. Error	t-Statistics	Prob
LINF(-1)	0.083	0.135	0.614	0.543
CLEXC_POS	3.915*	1.589	2.464	0.019
CLEXC_NEG	-0.087	1.662	-0.052	0.959
LBROD	-1.053	0.837	-1.258	0.216
LBROD(-1)	-1.920*	0.666	-2.883	0.007
LGDP	2.615*	0.668	3.913	0.000
LINT	1.374	0.801	1.716	0.095
D88	0.654*	0.306	2.139	0.039
C	7.011	6.282	1.116	0.272

Source: Authors' 2019; Notes: * represents statistically significant at 5% level.

A. Bounds Test of Co-integration:

The outcomes of bounds test for co-integration reveals the existence of long-run relationship at 1% level, given the F-statistic value of 6.22 which is over the Pesaran critical values of I(0) 3.41 and I(1) 4.68 at 1% level of significance.

B. Test of Asymmetry:

The asymmetric test conducted shows the existence of asymmetry and existence of differences between the effects of the positive shocks and the negative shocks of the devaluation of currency on inflation in Malaysia at 5%. The results of the test conducted produced an *F*-statistics value of 6.69 and *t*-statistic value of 2.59 and their corresponding probability value of 0.01.

C. The Short Run and Long Run Results:

The result presented in Table 4 is for both the short run and the long run of the estimations. The table reveals that, in the short run, positive shocks of currency devaluation (CLEXC_POS) is significant at 5%. The coefficient of 3.915 obtained implies that devaluation of the currency (MR) by 1% leads to rise in the rate of inflation in Malaysia by 3.915% while the coefficient of the negative shock is insignificant in explaining the changes of inflation rate in Malaysia. The coefficient of LGDP is surprisingly positive and significant in the short run. The coefficient of 2.615 indicates that increase in GDP by 1% results in the rise of inflation rate by 2.615% in the short run. The dummy variable (D88) is also significant at five percent. This implies that the intercept of the model from 1988 to 2017 is higher that the intercept of the model from 1970 to 1977 with 0.654 value. The speed of adjustment towards long-run equilibrium is 91.7%, and it is significant at 1%. The speed adjustment is speedy.

The table also reveals that; in the long run, the coefficient of the positive shock of currency devaluation is significant at a 5% level, in affecting the inflation rate in Malaysia. Currency devaluation of 1% increase in leads to a rise in inflation rate by 4.269% . The coefficient of the negative shocks of currency devaluation is insignificant in explaining the changes in inflation in Malaysia. LBROD and LGDP are important at 1% level in the long run, though with different signs. LBROD is disinflationary while LGDP is inflationary; the rest of the variables are insignificant in clarifying the changes in the inflation rate in Malaysia.

Table 4: Short Run and Long Run Results

Short Run Results				
Variables	Coefficients	Std. Error	t-Statistics	Prob
D(CLEXC_POS)	3.915	1.589	2.464	0.019
D(CLEXC_NEG)	-0.087	1.662	-0.052	0.959
D(LBROD)	-1.053	0.837	-1.258	0.216
D(LGDP)	2.615	0.668	3.913	0.000
D(LINT)	1.374	0.801	1.716	0.095
D(D88)	0.654	0.306	2.139	0.039
CointEq(-1)	-0.917	0.135	-6.804	0.000
Long Run Results				
CLEXC_POS	4.269	1.620	2.635130	0.012
CLEXC_NEG	-0.095	1.813	-0.052322	0.959
LBROD	-3.242	0.627	-5.173515	0.000
LGDP	2.851	0.635	4.491586	0.000
LINT	1.498	0.824	1.818791	0.077
D88	0.713	0.356	2.004219	0.052
C	7.643	6.938	1.101665	0.278

Source: Authors' 2019; Notes: * represents statistically significant at 5 percent level.

The implication of these findings is that an increase in the exchange rate (devaluation of currency) in Malaysia is inflationary while the revaluation of currency (decrease in the exchange rate) has no disinflationary effect. The asymmetry exists, and it shows that the currency devaluation

effects on inflation are flexible upward, but they are resistant to downward pressures. The findings of the study are closer to the arguments of the Keynesian inflation theory than the explanations of the classical economists on inflation. Furthermore, the negativity of LBROD coefficient during the long run could be attributed to the arguments of the Keynesian theory on the effect of money supply on inflation in emerging economies. To Keynes, an increase in the money supply might not necessarily be inflationary in emerging economies as it could lead to an increase both the level of employment and income. It is only where there is no involuntary unemployment, that increases in money supply could create inflation (Keynes 1936).

D. Post-Estimation Diagnostic Checks:

To ensure the goodness of fit of the estimated model, various post-estimation diagnostics checks are carried out, the outcomes are tendered in Table 5. The errors of the estimated model are white noise (Jarque-Bera 6.11, P=0.05), there is neither serial correlation (Breusch-Godfrey 0.04, P>0.05) no heteroskedasticity (Breusch-Pagan 0.77, p>0.05). Also, the model is correctly specified (Ramsey 3.07, p>0.09).

Table 5: Post-Estimation Diagnostic Checks

Test Type	Statistics	Probability
Jarque-Bera Normality Test	6.11	0.05
Breusch-Godfrey Serial Correlation Test	0.04	0.96
Breusch-Pagan Heteroskedasticity Test	0.77	0.63
Ramsey Reset Test	3.07	0.09

Furthermore, variance inflation factor (VIF) test conducted shows the absence of multicollinearity among the explanatory variables of the model as all the VIF estimated coefficients are less than 10 in value, as indicated in Table 5.

Table 6: Results of Variance Inflation Factor Test

Variables	VIF Coefficients
LINF(-1)	0.018172
CLEXC_POS	2.524773
CLEXC_NEG	2.763617
LBROD	0.701099
LBROD(-1)	0.443885
LGDP	0.446616
LINT	0.641404
D88	0.093610
C	--

The estimated model is dynamically stable, as the CUSUM and CUSUM of squares estimated, lies between the upper ridge and the lower ridge lines, as shown in Figure 3 and Figure 4.

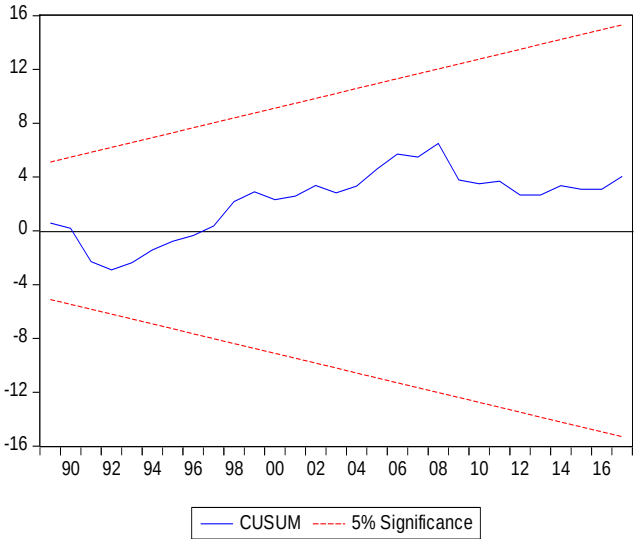

Fig 3: CUSUM Stability Indicator

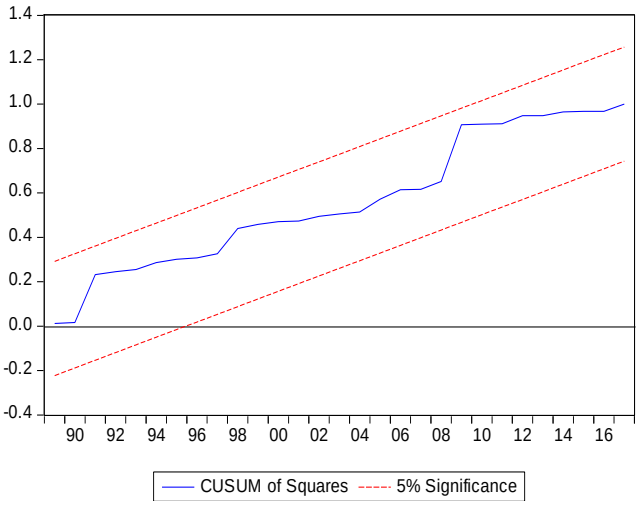

Fig 4: CUSUMSQ Stability Indicator

V. CONCLUSION

Having tested and ascertained the existence of asymmetry and long-run relationship among the variables of the study. It is concluded that positive shocks RM (currency devaluation) is inflationary in Malaysia while negative shocks of the legal tender (currency revaluation) have no disinflationary effect as only the coefficients of the positive shocks are significant in the short run and long run. The implication of this; is that the effect of shocks of exchange rate on inflation is flexible upward, but it is resistant to downward pressure as assumed by the Keynesian strand of thought. The estimated model is dynamically stable; it has no problem of heteroskedasticity and no serial correlation. The model predicted no multicollinearity problem, and it is correctly specified as shown by the various post-estimated diagnostic checks. The research recommends all policy that can reduce the demand for foreign exchange to be implemented to reduce the pressures of the need for currency devaluation, which is inflationary in Malaysia.

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