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Abstract
The present study investigated the existence of asymmetry in exchange rate pass-through to consumer prices in Nigeria by collecting monthly data over the period of 2001 to 2015 from various sources. Owing to the absence of a long-run relationship, results showed that, over the short term, consumer prices in Nigeria have adaptive expectations; the case of imported inflation was also found; partial/incomplete exchange rate pass-through was found over the short term and the pass-through estimates became larger when the asymmetric effect of exchange rate changes was considered; differences in the responsiveness of consumer prices to exchange rate appreciation and depreciation were also registered. However, industrial production index had no significant role in the determination of consumer prices in Nigeria. The prevalence of imported inflation in the Nigerian economy reflects the larger proportion of imported goods in the consumption baskets of Nigerians. To this end, it is suggested that governments at all levels should give adequate and timely incentives to local producers so that their products could become affordable. Nigerians are also encouraged to patronize "Made-in-Nigeria" products so as to make government policy initiatives effective.

Key words: Exchange rate pass-through, consumer prices, Non-linear ARDL.

1. Introduction

Exchange rate pass-through is defined as the percentage change in import price attributed to a certain percentage change in exchange rate. The extent to which changes in exchange rate affect the domestic price indices, majorly, the consumer price index, depends on the degree of openness, inflation environment, the credibility of the monetary policy, and exchange rate volatility, among others[1]. There is, however, a growing argument in the literature that exchange rate pass-through is higher in developing and emerging economies than in developed countries. Previous empirical studies have rather found otherwise[2].

Both micro and macro channels of exchange rate pass-through have different implications for the effectiveness of exchange rate depreciations in improving the external balance position. On the one hand, microeconomic factors ensure that a high level of exchange rate pass-through makes exchange rate depreciations more effective because they create a competitive advantage for domestic producers that can gain market share at the expense of imports. On the other hand, a higher level of pass-through owing to macroeconomic factors makes

[1]See Taylor (2000); Choudhri and Hakura (2006); Frimpong and Adam (2010).
[2]Ca 'Zorzi, *et al* (2007) and Aliyu, *et al* (2009).

exchange rate depreciations less effective because it results in higher increases in the prices of non-traded goods and wages, and frustrates any gain in competitiveness brought about by the exchange rate change (Borensztein and von Heideken, 2006).

Moreover, the next strand of argument is the possibility of an asymmetric effect of exchange rate movement on domestic price level. As observed by Ghosh and Rajan (2007), the existing literature suggests that the response of exporters to exchange rate changes is often asymmetric, depending on whether the exchange rate appreciates or depreciates. Also, as noted by Aron, *et al* (2012), the import price may not fall as far with an appreciation, but could rise with depreciation as reflected in scarce, but mounting, evidence of various types of nonlinearities in the pass-through literature.

A number of studies have been carried out to examine the extent of pass-through to price indices such as trade prices (import or export prices) and consumer prices. Virtually, all the studies found an incomplete or partial pass-through and most of the studies concluded that exchange rate pass-through has been declining over time along the price chain, that is, from import prices to domestic consumer prices[3]. While the majority of the empirical studies on exchange rate pass-through ignored the possibility of asymmetric effect of exchange rate depreciation and appreciation on price indexes, only few studies captured this effect[4]. Almost all the studies (especially those focused on Nigeria)[5] looked at the linear/symmetric effect of exchange rate depreciation and appreciation on price indexes while ignoring the possibilities of asymmetric effect of exchange rate changes.

The present study adds to the literature on accounting for asymmetry in exchange rate pass-through to consumer prices with reference to the Nigerian economy. To this end, the rest of the study is structured as follows: section two discusses theoretical issues; section three contains a review of the empirical literature; section four uncovers the methodology and data issues; section five entails the results of empirical analysis, and section six concludes.

2. Theoretical Issues

The literature on exchange rate pass through to consumer prices relies majorly on the law of one price (LOP) and the purchasing power parity theory (PPP). The purchasing power parity (PPP, subsequently) doctrine, in absolute version, states that the equilibrium exchange rate equals the ratio of domestic to foreign prices. The relative version of the theory relates changes in the exchange rate to changes in price ratios, that is, inflation differentials (Frenkel, 1976). The law of one price underlies the PPP theory as the former relates to individual commodity whereas the latter relates to a bundle of commodities. The law of one price states that once prices are converted to a common currency, the same good should sell for the same price in different countries (Rogoff, 1996).

In order to test the validity of law of one price and purchasing power parity theory using empirical data set, Goldberger and Knetter (1997) developed a framework appropriate for future micro-economic studies regarding the importance of the competitive structure in international markets. Their framework is well suited for explaining price adjustments to exchange rate movements and deviations from the law of one price. The authors therefore

[3]See Sanusi (2010); Razafimahefa (2012); Dube (2016); Bada, *et al* (2016); Borensztein and Heideken (2016); Lopez-Villavicencio and Mignon (2016) and Mushendami and Namakalu (2016).

[4]See Ghosh and Rajan (2007) and Aron, *et al* (2012).

[5]The studies include, among others, Aliyu, *et al* (2009); Oyinlola and Babatunde (2009); Adetiloye (2010); Adelowokan (2012); Ogundipe and Egbetokun (2013); Zubair, *et al* (2013); and Bada, *et al* (2016).

suggested a generic regression model for measuring the price response to exchange rate changes. Following Golberger and Knetter (1997), pass-through literatures explore the following price-exchange rate relation.

$$p_t = \alpha + \delta X_t + \gamma E_t + \psi Z_t + \varepsilon_t \quad (1)$$

where subscript t denotes time; all variables are in logs; p is the local-currency import price; X is a control variable measuring the exporter's cost; E is the nominal exchange rate (defined as units of domestic currency per unit of foreign currency, so that an increase implies depreciation while a decrease appreciation) and Z is a variable controlling for shifts in import demand, such as, output/income of the importing country, among others. The coefficient of main importance is γ which captures the degree of exchange rate pass-through (ERPT): full/complete exchange rate pass-through is depicted by $\gamma = 1$ and incomplete/partial exchange rate pass-through occurs when $\gamma < 1$; ε is the error term.

The two conditions that matter for complete exchange rate pass-through are: (i) constant mark-up of price over cost (industries are perfectly competitive and mark-up is constant at zero) and (ii) constant marginal costs. Conversely, deviations from the law of one price and incomplete pass-through can to a large extent be attributed to third-degree price discrimination, which is present when different groups of consumers pay different prices for identical goods; thus, two national markets are segmented if buyers in those markets face systematically different common-currency prices for the same product (Goldberger and Knetter, 1997). The latter proposition gave rise to a hypothesis called pricing-to-market (PTM) as developed by Krugman (1986) to explain how exporters adjust their mark-ups in response to exchange rate changes. PTM generally takes two forms and they are, producer currency pricing (PCP) and local currency pricing (LCP).

Producer currency pricing is a pricing strategy where the exporter prices products in his home country currency, whereas local currency pricing refers to a pricing behaviour where the exporter prices products in the home currency of the importer. Since this particular study concentrates on investigating the response of prices in the importing country to exchange rate changes, the latter concept (that is, local currency pricing) is adopted. In that wise, if the currency of the destination market (that is, the importing country) depreciates, then exporters may be willing to absorb this exchange rate changes (by way of reducing their mark-ups) to keep local currency price of their products stable and retain market share, thereby giving rise to low or incomplete exchange rate pass-through. However, if the currency of the destination market strengthens or appreciates, the exporters leave their mark-ups the same so as not to suffer a decline in their profits, a situation which generates complete exchange rate pass-through (Zubair, *et al*, 2013). In addition, given the decision of exporters in terms of whether to adjust their mark-ups or not in response to exchange rate changes, it therefore becomes imperative to investigate the asymmetric or differential impacts of exchange rate depreciation and appreciation on the domestic prices of the importing country, and this constitutes the central contribution of the present study.

3. Review of the Empirical Literature

The study conducted by Aliyu, *et al* (2008) showed that exchange rate pass-through (ERPT) was significant in Nigeria, though found to be higher in import prices than in consumer prices during the period. Their results suggested that ERPT in Nigeria was partial and declining along the price chain contrary to the age-long belief in the literature that ERPT is much higher in developing economies than developed ones. The study by Frimpong and Adam (2010) validated the work of Aliyu, *et al* (2008). According to Frimpong and Adam (2010), exchange rate pass-through to inflation was partial and declining in Ghana. The reason for

low but persistent exchange rate pass-through could be traced to the openness of the economy and the tight monetary policy the central bank applied over the period. In the same vein, Zubair, *et al* (2013) found that exchange rate pass-through in Nigeria is incomplete and low.

However, in contrast to Aliyu, *et al* (2008), the study conducted by Ogundipe and Egbetokun (2013) found a large exchange rate pass-through to inflation in Nigeria. According to the authors, the finding is consistent with those obtained for most developing countries. For instance, Ito, *et al* (2005), Ca'Zorzi, *et al* (2007) and Sanusi (2010) found substantially large pass-through elasticities for several countries. Also, Oyinlola and Babatunde (2009) found that exchange rate shocks have a positive effect on import prices, implying that depreciation increases import prices. They also showed that world export prices had a dominant effect compared to exchange rate in explaining changes in Nigeria's import prices in the short and long run. Moreover, Adelowokan (2012) could not find any evidence of ERPT to inflation in Nigeria as neither the exchange rate of the Naira vis-à-vis the US dollar nor could its lagged value influenced consumer prices. However, it found evidence of the pass-through effect to interest rates.

Razafimahefa (2012) analyzed the exchange rate pass-through to domestic prices and its determinants in sub-Saharan African countries. The study found that pass-through is incomplete. The pass-through is larger following depreciation than after an appreciation of the local currency. The average elasticity is estimated at about 0.4. It is lower in countries with more flexible exchange rate regimes and in countries with a higher income. Also, a low inflation environment, a prudent monetary policy, and a sustainable fiscal policy are associated with a lower pass-through. Similarly, Lopez-Villavicencio and Mignon (2016) found that emerging economies share same characteristics with advanced countries in terms of declining pass-through once inflation is controlled for and that low inflation environment and transparency of monetary policy decisions clearly reduce exchange rate pass-through.

In addition, Dube (2016) showed that ERPT declined significantly for producer inflation but not for consumer inflation after the adoption of inflation targeting (IT) in South Africa. Also, Ca'Zorzi *et al*. (2007) verified that exchange rate pass-through is higher in import prices than consumer prices because of variation across the pricing chain. Furthermore, it disproved the contemplation that exchange rate pass-though is high in developing countries compared to that of developed counties by arguing that for emerging countries with single digit inflation rate entertained low rate of exchange rate pass-through which is not that far from developed world. The study also concluded a positive relationship between exchange rate pass-though and inflation rate which is in line with Taylor's hypothesis. In his own case, Maka (2013) found strong evidence of a response in CPI inflation to changes in exchange rate for Ghana. The response was not immediate but it featured prominently three months into the future and dissipates thereafter. ERPT is found to be asymmetric with depreciation having a positive effect on CPI inflation as expected within the first three months. Appreciation on the other hand has little impact on CPI inflation and has no statistical significance. To differ from the studies reviewed above, this paper offers a new approach to investigate the asymmetric behaviour of exchange rate pass-through to consumer prices drawing evidence from the Nigeria.

4. Methodology and Data Issues

4.1 Estimation Procedure and Model Specification

The study adopts the framework of non-linear autoregressive distributed lag model (NARDL) for the following reasons. *First*, NARDL model (as in eq. 3 below) allows for both the static and dynamic effect(s) of the independent variable(s) on the dependent variable unlike a static model that accounts for static or fixed effect(s) only. *Second*, NARDL framework offers a technique for checking the existence of a long-run relationship between variables, and that is referred to as the *Bounds test*. Bounds test is flexible as it accommodates both stationary and integrated series unlike other tests of cointegration, such as, Engle-Granger and Johansen tests, which considers only non-stationary series that are integrated of the same order. *Lastly*, NARDL allows one to capture the dynamic effect of both positive and negative changes in an explanatory variable on a particular dependent variable.

Before model estimation using the ordinary least squares (OLS) technique, it is important to check the time-series properties such as unit root and cointegration tests to avoid estimating spurious regression. To achieve this, the present study adopts the Augmented Dickey-Fuller (ADF) unit root test and the Bounds test for cointegration. The ADF unit root test is conducted to check if series are stationary or not. The null hypothesis is that a series has a unit root or is nonstationary. If the ADF tau stat is greater, in absolute terms, than the MacKinnon critical values at any chosen level of significance, the null hypothesis is rejected; otherwise, we will fail to reject the null hypothesis of a unit root. Similarly, the Bounds test for cointegration tests the null hypothesis that there is no cointegration between consumer prices and naira-dollar exchange rate, after controlling for other factors, such as, United States' producer price index and industrial production index in the Nigerian context. To conclude the presence or absence of cointegration, there is need to compare the computed F-stat with the critical bound values, that is, I0 bound (the lower bound) and I1 bound (the upper bound) at any chosen level of significance. If the F-stat is less than the I0 critical value at any chosen level of significance, then there is no cointegration. However, if the F-stat is greater than the I1 critical value at any chosen level of significance, then there is cointegration. However, if the F-stat lies between the I0 and I1 critical values at all levels of significance, then the test result is inconclusive.

In addition, the estimated models would be subject to post-mortem tests to check if they are adequate for valid and reliable statistical inferences to be made therefrom. In the light of this, the present study would investigate whether some assumptions underlying the CLRM hold or not, specifically, linearity, normality, serial correlation, and heteroscedasticity tests would be conducted. The associated null hypotheses are, respectively, that the estimated model is linear, have residuals that follow normal distribution, does not suffer from non-serial correlation in the residuals, and does not suffer from non-constant residual variance. The decision rule is that if the probabilities associated with the test statistics of all the tests are greater than 0.1, then the estimated models do not suffer from inadequacy, otherwise, they are said to be inadequate for policy prescription. Of major interest is the test for asymmetry (short-run and/or long-run) using the Wald test. The null hypothesis in this case is that consumer prices respond equally to exchange rate depreciation and appreciation. The decision rule is that if the probability associated with the Wald test is greater than 0.1, then null of no asymmetry is not rejected. Conversely, if the associated probability is less than or equal to 0.1, then there is evidence of asymmetric exchange rate pass-through to consumer prices in Nigeria.

To this end, the present study adopts the modeling framework of Goldberger and Knetter (1997) as follows:

$$LCPI_t = \beta_0 + \beta_1 LEXR_t + \beta_2 LUPPI_t + \beta_3 LIPI_t + \varepsilon_t \quad (2)$$

The asymmetric exchange rate pass-through to consumer prices is captured in the non-linear ARDL model developed by Shin, *et al* (2014).

$$\Delta LCPI_t = \alpha_1 LCPI_{t-1} + \alpha_2^+ EXR_{t-1}^+ + \alpha_2^- EXR_{t-1}^- + \alpha_3 LUPPI_{t-1} + \alpha_4 LIPI_{t-1} + \sum_{i=1}^{p-1} \delta_i \Delta LCPI_{t-i} + \sum_{j=0}^{q_1^+-1} \theta_j^+ \Delta EXR_{t-j}^+ + \sum_{j=0}^{q_1^--1} \theta_j^- \Delta EXR_{t-j}^- + \sum_{j=0}^{q_2-1} \gamma_j \Delta LUPPI_{t-j} + \sum_{j=0}^{q_3-1} \rho_j \Delta LIPI_{t-j} + \epsilon_t \quad (3)$$

The error correction representation is derived as follows:

$$\Delta LCPI_t = \alpha_1 \left(LCPI_{t-1} - \left[-\frac{\alpha_2^+}{\alpha_1} EXR_{t-1}^+ - \frac{\alpha_2^-}{\alpha_1} EXR_{t-1}^- - \frac{\alpha_3}{\alpha_1} LUPPI_{t-1} - \frac{\alpha_4}{\alpha_1} LIPI_{t-1} \right] \right) + \sum_{i=1}^{p-1} \delta_i \Delta LCPI_{t-i} + \sum_{j=0}^{q_1^+-1} \theta_j^+ \Delta EXR_{t-j}^+ + \sum_{j=0}^{q_1^--1} \theta_j^- \Delta EXR_{t-j}^- + \sum_{j=0}^{q_2-1} \gamma_j \Delta LUPPI_{t-j} + \sum_{j=0}^{q_3-1} \rho_j \Delta LIPI_{t-j} + \epsilon_t \quad (4)$$

By letting,

$$ECT = LCPI_{t-1} - \mu_1^+ EXR_{t-1}^+ - \mu_1^- EXR_{t-1}^- - \mu_2 LUPPI_{t-1} - \mu_3 LIPI_{t-1} \quad (5)$$

Where,

$$\mu_1^+ = -\frac{\alpha_2^+}{\alpha_1}, \quad \mu_1^- = -\frac{\alpha_2^-}{\alpha_1}, \quad \mu_2 = -\frac{\alpha_3}{\alpha_1}, \quad \mu_3 = -\frac{\alpha_4}{\alpha_1} \quad (6)$$

Eq. (4) therefore becomes

$$\Delta LCPI_t = \alpha_1 ECT + \sum_{i=1}^{p-1} \delta_i \Delta LCPI_{t-i} + \sum_{j=0}^{q_1^+-1} \theta_j^+ \Delta EXR_{t-j}^+ + \sum_{j=0}^{q_1^--1} \theta_j^- 4\Delta EXR_{t-j}^- + \sum_{j=0}^{q_2-1} \gamma_j \Delta LUPPI_{t-j} + \sum_{j=0}^{q_3-1} \rho_j \Delta LIPI_{t-j} + \epsilon_t \quad (7)$$

Description of Terms

ECT is the error correction term, with its associated coefficient (α_1) being the adjustment parameter. It measures the speed at which the dependent variable (which in this case is Nigeria's consumer price index) adjusts from its short-run fluctuations to its long-run equilibrium value. The convergence criteria hold that the adjustment parameter is negative, less than 1 in absolute value, and statistically significant at any of the conventional levels. $LCPI$ is the natural log of Nigeria's consumer price index, $LEXR$ is the natural log of Naira/US dollar exchange rate, $EXR^+$and $EXR^-$are, respectively, the positive and negative changes in exchange rate (which indicate exchange rate depreciation and appreciation, respectively), $LUPPI$ is the natural log of United States' producer price index (a proxy for cost conditions in the exporting country, in this case US), $LUPPI$ is the natural log of industrial production index (a proxy for domestic demand conditions), Δ is the first difference operator, δ_i, θ_j^+, θ_j^-, γ_j $\rho_j$are short-run parameters while μ_1^+, μ_1^-, μ_2, μ_3 are long-run parameters, $p-1$ is the maximum lag length for the dependent variable whereas $q_j - 1$ for $j = 1,2,3$ are the maximum lag lengths for the explanatory variables, and ϵ_t is the error term, with "t" signifying the time dimension.

A priori Expectation

$\delta_i >$ or < 0; $\theta_j^+ > 0$ and $\mu_1^+ > 0$; $\theta_j^- < 0$ and $\mu_1^- < 0$; $\gamma_j > 0$ and $\mu_2 > 0$; $\rho_j > 0$ and $\mu_3 > 0$.

4.2 Data Scope and Source

The study collected monthly data on relevant variables covering the period starting from January, 2001 to December, 2015 (that is, 2001:M01 to 2015:M12) from various sources. The data on Nigeria's consumer price index (CPI) and the Naira/dollar exchange rate were obtained from the Central Bank of Nigeria's Statistical Bulletin (CBN, 2015), The data on United States' producer price index were sourced from the United States' Bureau of Labour Statistics (BLS) website, while the data on industrial production index were collected from the International Monetary Fund International Financial Statistics (IMF-IFS).

5. Empirical Analysis

5.1 Preliminary Analysis

5.1.1 Descriptive Statistics

Table 1 presents a summary statistics on the six variables used throughout this study, including industrial production index, Nigeria's consumer price index (CPI), Naira/Dollar exchange rate and US producer price index (PPI), all in their natural log forms, and negative and positive changes in exchange rate (representing exchange appreciation and depreciation, respectively). Though the mean values of the first three variables are close to one another, with the mean of US PPI ranking the highest and the lowest mean is recorded in favour of negative changes in exchange rate. In terms of standard deviation and coefficient of variation, the most volatile series are positive and negative changes in exchange rate and the least volatile is the US producer price index. Lastly, in terms of probability distribution as indicated by the Jarque-Bera statistic, all the six variables do not follow normal distribution. This result has implications for the stationarity status of the variables.

Table 1: Summary Statistics

Variable	No. of Observation	Mean	Std. Deviation	Coefficient of variation (%)	Jarque-Bera statistic
$LCPI$	180	4.452	0.469	10.535	10.559[0.005]
$LEXR$	180	4.941	0.142	2.874	6.381[0.041]
EXR^{+}	180	0.005	0.016	320	10575.66[0.000]
EXR^{-}	180	-0.002	0.004	-200	5532.78[0.000]
$LUPPI$	180	5.128	0.122	2.379	16.564[0.000]
$LIPI$	180	4.561	0.149	3.267	15.312[0.001]

Note: The values in block bracket [ ] are probabilities.

***Source**: Authors' computation*

5.1.2 The Unit Root Test Result

Table 2 shows the result of ADF unit root test. Only three variables including positive and negative changes in exchange rate, and log of Nigeria's CPI are stationary at levels, and hence are said to be integrated of order zero, that is, I(0). The remaining three variables including the natural logs of US PPI, exchange rate, and industrial production index become stationary only after first differencing, and hence are said to be integrated of order one, that is, I(1). The mixture of I(0) and I(1) requires the use of Bounds test to check if the series are cointegrated or not, the result of which is interpreted shortly.

Table 2: Result of the ADF Unit Root Test

Variable	Level	First Difference	Order of integration
$LCPI$	-3.188*[b]	……‡	I(0)
$LEXR$	-2.163[b]	-8.827***[b]	I(1)
EXR^{+}	-9.165***[b]	……	I(0)
EXR^{-}	-9.132***[b]	……	I(0)
$LUPPI$	-1.219[b]	-11.661***[b]	I(1)
$LIPI$	-2.485[b]	-3.371**[b]	I(1)

Note: ***, **,* indicate the rejection of the null hypothesis of a unit root at 1%, 5% and 10%, respectively; ‡ implies that a series that is stationary at levels does not require its first difference being reported; b denotes model with intercept and trend.

***Source**: Authors' computation*

5.1.3 The Bounds Cointegration Test Result

Table 3 shows the result of Bounds test for cointegration. It can be observed that irrespective of specifications (linear or non-linear), there exists no long-run relationship between consumer prices in Nigeria and its possible determinants including exchange rate, United States' producer price index and industrial production index. This conclusion is informed by the fact that the F-statistics in both specifications fall below the lower critical bound at 10% level of significance.

Table 3: Result of Bounds Cointegration Test

	Model I	**Model II**
F-statistic	2.418	1.709
	Critical Values	
Significance levels	I0 Bound	I1 Bound
10%	2.72	3.77
5%	3.23	4.35
2.5%	3.69	4.89
1%	4.29	5.61

Note: Model I is a linear/symmetric effect model of inflation while Model II is a non-linear/asymmetric effect model of inflation.

***Source**: Authors' Computation*

5.2 Discussion of Regression Results

Since the study could not establish a long-run relationship between consumer prices and its determinants in Nigeria, only short-run estimates are presented (see Table 4 below). First and foremost, the expectations about consumer prices in Nigeria were found to be adaptive in nature as the previous value of consumer prices constitutes an important determinant of its current value. Regardless of the specifications considered (that is, symmetric and asymmetric effects models), there is an evidence of imported inflation in Nigeria as the increase in production costs as measured by producer price index (PPI) of the exporting country (in this case, the United States) is well absorbed into the consumer prices in Nigeria over the short term. This finding reflects the large extent to which the Nigerian economy is vulnerable to external shocks due to its overreliance on external trade (imports and exports).

In the symmetric-effect models considered (see Models I), the presence of short-run partial or incomplete exchange rate pass-through was confirmed for the Nigerian economy. This result parallels the findings of Razafimahefa (2012); Zubair, *et al* (2013); Delatte and Lopez-Villavicencio (2012). By accounting for the asymmetric effects of exchange rate changes (see

Model II), short-run partial exchange rate pass-through was also obtained. However, exchange rate pass-through to consumer prices in Nigeria was not significantly transmitted via exchange rate depreciation but through the exchange rate appreciation channel. Besides, the pass-through estimates associated with exchange rate appreciation (0.609) are greater than those associated with exchange rate depreciation (0.028). This finding showed that exporters do not alter their mark-ups during appreciation so as not to suffer a profit decline but reduce their mark-ups during depreciation in order to maintain their market shares in the importing country (in this case Nigeria). This result contrasts with the findings of Delatte and Lopez-Villavicencio (2012) who found asymmetry in the effects of exchange rate changes on consumer prices, and the pass-through estimates were higher for depreciation than for appreciation.

Industrial production index (a proxy for domestic demand conditions) was found to play an insignificant role in price determination in Nigeria, even after accounting for the asymmetric effects of exchange rate changes. A possible explanation for this is that depreciation in exchange rate makes imports expensive, thereby leading to the shift in demand towards locally-made import substitutes by the Nigerian consumers. However, in the short-run, due to the J-curve effect, domestic consumers and producers do not instantaneously alter their behaviour in response to exchange rate changes, thereby lending credence to the insignificant effect of industrial production index on consumer prices in Nigeria over the short term.

Moreover, the very high adjusted R^2 and F-statistic are indicative of the greater explanatory power of both models. Also, post-estimation/diagnostic tests, including linearity, normality, serial correlation, heteroscedasticity and asymmetric tests were also conducted on the six models. Though the models generally suffer from non-normality of the residuals, the results of the other three tests (linearity, serial correlation, and heteroscedaticity tests) confirmed the adequacy of the models for policy prescription and the regression estimates are considered best linear unbiased estimators (BLUE). In the same vein, the results of Wald test for short-run asymmetry showed, in a clear-cut manner, of the presence of asymmetric effects of exchange rate changes, implying that both appreciation and depreciation of the exchange rate have dissimilar effects on consumer prices in Nigerian economy over the period considered, thereby justifying the obvious differences in pass-through estimates associated with both exchange rate appreciation and depreciation.

Table 4: ARDL and NARDL Estimates of the Determinants of Consumer prices in Nigeria

Dependent variable		$LCPI_t$
	Model I	**Model II**
$LCPI_{t-1}$	0.957***(0.019)	0.979***(0.011)
$LUPPI_t$	0.135***(0.051)	0.094**(0.043)
$LEXR_t$	0.041*(0.024)	
EXR_t^+		0.028(0.079)
EXR_t^-		0.609*(0.309)
$LIPI_t$	-0.022(0.019)	-0.026(0.019)
C	-0.595**(0.281)	-0.261(0.169)
Adj. R^2	0.999	0.999
F-statistic	35988.18[0.000]	28791.91[0.000]
Ramsey RESET linearity test	0.023[0.982]	0.206[0.837]
Jarque-Bera normality test	246.266[0.000]	255.358[0.000]
Breusch-Godfrey serial correlation LM test	0.044[0.957]	0.164[0.849]
Breusch-Pagan-Godfrey heteroscedasticity test	1.809[0.129]	1.557[0.175]
Wald test for short-run asymmetry	……	1.803[0.073]

Note: Model I is a linear/symmetric effect model of inflation while Model II is a non-linear/asymmetric effect model of inflation.; ***, **, * indicate the statistical significance of coefficients at 1%, 5% and 10% respectively; the values in parentheses and block brackets are, respectively, the standard errors and the probabilities; RESET implies Regression Error Specification Test.

***Source**: Author's Computation*

6. Conclusions

The present study has so far investigated the existence of asymmetry in exchange rate pass-through to consumer prices in Nigeria by collecting monthly data over the period of 2001 to 2015 on relevant variables from various sources. The results of model estimation showed that consumer prices in Nigeria have adaptive expectations; the case of imported inflation was also found; partial/incomplete exchange rate pass-through was found over the short term and the pass-through estimates became larger when the asymmetric effect of exchange rate changes was considered; differences in the responsiveness of consumer prices to exchange rate appreciation and depreciation were also registered, as the former exerts a significant influence on consumer prices, while the latter does not. However, industrial production index has no significant role in the determination of consumer prices in Nigeria. Similarly, the results of Wald test for short-run asymmetry showed, in a clear-cut manner, of the presence of asymmetric effects of exchange rate changes, implying that both appreciation and depreciation of the exchange rate have dissimilar effects on consumer prices in Nigerian economy over the period considered, thereby justifying the obvious differences in pass-through estimates associated with both exchange rate appreciation and depreciation.

Based on the findings of this study, a few policy options should be considered important. The prevalence of imported inflation in the Nigerian economy reflects the larger proportion of imported goods in the consumption baskets of Nigerians. To this effect, it is suggested that governments at all levels should give adequate and timely incentives to local producers so that their products could become affordable. Nigerians are also encouraged to patronize "Made-in-Nigeria" products so as to make government policy initiatives effective. Also, since exporters respond to exchange rate depreciation differently from exchange rate appreciation, the Central Bank of Nigeria is expected to live up to expectations of maintaining a stable foreign exchange management so that exchange rate volatility can be tamed.

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