Exchange Rate and Inflation: Is there a Relationship in Nigeria?

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Abstract

The paper attempts to examine the link between exchange rate and domestic price level in Nigeria. Employing the VAR technique, the study used monthly series of inter-bank exchange rate, world export prices, real gross domestic product, oil prices and consumer price index from 2000M1 to 2015M1. The results from the study show that exchange rate pass-through to price level is high. A shock to exchange rate (depreciation) would increase domestic price by 0.72 per cent in the first month. The effect rose to 0.82, 0.85 and 0.86 per cent in month 2, 4 and 6, respectively, before it began to fall. By the sixth month, it stood at around 0.84 per cent, on the average. Also, the results of the VAR model and exchange rate pass-through coefficients indicate that pass-through to price level in Nigeria is partial or incomplete.

I. Introduction

The relationship between exchange rate and inflation is crucial for appropriate exchange rate and monetary policy formulation to achieve internal and external balance. Exchange rate is a forward looking variable that responds to the prevailing economic fundamentals and future expectations (Hafer, 1989). Its importance is reflected on the impact it has on foreign exchange markets, financial stability and the external sector (Ho and McCauley, 2003). Inflation is the result of a general increase in price level. The effect is more pronounced and last longer where the expectation of a future increase is high.

In the literature, various co-integrating models have been adopted to test the relationship between inflation and exchange rate with varying outcomes which largely results from inefficient estimations and test of hypotheses (Kim, 1998; Ramos, 2012). Generally, in open economies, exchange rate and inflation are largely inversely related and exhibits reverse causality. The following theoretical underpinning further highlights these theories.

The literature treats the link between exchange rate and inflation under various theoretical framework including the exchange rate pass-through (ERPT) where movements in the rate of exchange affects the price of imports and tradable (exports of goods and services) resulting in the change in the general price level (Kim, 1998). This could occur where the exporter is a price taker and the depreciation in the exchange rate of its trading partner would lead to a reduction in production in the home economy that would eventually raise prices of its trading partner as demand exceed supply (Hafer, 1989). Developing countries exhibit higher pass-through than advanced economies due to higher exchange rate

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volatility, and weak monetary policy transmission mechanism (Ramos, 2012). Under a high pass-through regime therefore, policies are more focused to maintaining exchange rate stability to reduce expectation of high inflation rate. In developing economies, exchange rate depreciation increase the cost of purchase of foreign goods that most often represent a high proportion of Consumer Price Index (CPI) basket leading to a general increase in price level which would eventually be passed on to consumers (Hafer, 1989). When ERPT coefficient is one (1) it shows an equi-proportionate change in price with exchange rate and when less than one, it is asymmetric (partial or incomplete) pass-through to prices (Aron et. al., 2012).

The relationship is also viewed under the Purchasing Power Parity (PPP). When PPP holds, the rate of change in exchange rate should be symmetric in an inverse relationship with inflation. A change in the price level therefore results in an adjustment of the exchange rate that moves to equate the growth rate of inflation (Ahma and Ali, 1999).

Exchange rate indices that measures trade weighted exchange rates deflated by inflation such as the real effective exchange rate (REER) is also indicative of the relationship between the exchange rate and inflation in the domestic economy in comparison with those of foreign economies. The lower domestic inflation compared to foreign inflation and a strong domestic currency results in the appreciation of the REER index. This signifies loss of external competitiveness of the domestic economy. In contrast, a depreciating REER reflects higher domestic inflation or a depreciating domestic currency signifying increased competitiveness.

Several empirical literature have investigated the relationship between exchange rate and inflation in Nigeria using the ERPT, especially the period of transition from a fixed exchange rate to a flexible regime. A fall out from this reform was the emergence of rising volatility of the exchange rate. Policy focus since then has been on the maintenance of relative stability of the exchange rate to ameliorate the pass-through effect on domestic prices particularly against the backdrop of the high import dependent nature of the Nigerian economy.

Various exchange rate regimes were introduced to manage the foreign exchange market to ameliorate ERPT. The result of the empirical work on the relationship between exchange rate and inflation has been mixed.

Against this background, this paper would examine the relationship between exchange rate and inflation in Nigeria by adopting the exchange rate pass-through model using the Johansen Cointegration technique and monthly data during 2000M1 – 2015M1. The paper would thus extends the literature on the determination of ERPT in Nigeria by focusing on how prices such as exchange rate, import prices and oil prices pass-through to domestic price level in comparison with previous studies. The paper is divided into six sections. A brief review of the literature and empirical framework follows the introduction in Section two. Section three discusses the trend analysis of the nominal exchange rate and inflation, and previous empirical work on ERPT in Nigeria. Section four focuses on data and methodology,

while Section five presents the results of the model. Section six concludes and proffers some policy recommendations.

II. Review of Literature

Several theories have attempted to explain the relationship that exists between exchange rate and inflation; some of these theories are discussed thus:

II.1 Theoretical Literature

II.1.1 Purchasing Power Parity (PPP) Theory

Arguably, this is the starting point of exchange rate theory, also called the inflation theory of exchange rates. This theory presupposes that exchange rates between two currencies at a given period are equal if the ratio of the price level of a fixed quantity of goods and services of the two countries and the exchange rate between those two countries are equal. This theory is grounded on the law of one price which explains that if price rises within a country's economy then the value of the currency has to depreciate to resuscitate the PPP. Thus, assuming there are no transportation cost and other outlays, the competitive market will equate the prices of goods in two countries when the prices are denoted in the same currency. However, for the law of one price to prevail the assumptions of competitive market in both countries; tradable goods between the two economies; absence of transportation cost and other related cost must hold. The practice of capturing misalignment with the level of deviation from linear trends could result in misleading inferences. The two forms of PPP are absolute and relative. Absolute PPP describes a condition of goods market equilibrium; it proposes that the domestic and foreign markets are integrated into a single market. While relative PPP expounds inflation rate; it posits that the appreciation rate of a currency is arrived at by computing the variance between the exchange rates of two countries.

II.1.2 The Monetarist Models

The monetarist models of exchange rate including sticky price model, flexible price monetary model and real interest rate differential model present the demand and supply of money as the major determinants of exchange rates. These models assume the prevalence of the uncovered interest parity theory which states that domestic interest rate is made up of the world interest rate and expected depreciation of the domestic currency. They are developed based on the assumptions of continuous validity of the purchasing power parity theory (PPP), stability in the demand for money function as well as the exogeneity of real and money income. The real interest rate differential model as developed by Frankel (1979) combines the role of inflationary expectancies of the Flexible Price Monetary Model (FPM) with the inelastic prices as assumed in the Sticky Price Monetary Model (SPM).

II.1.3 The Obstfeld and Rogoff Model

The Obstfeld and Rogoff (O&R) model was premised on PPP, it assumes that nominal prices represent producer's currency of production (PCP), thus the exchange rate variations (pass-through) one hundred per cent to consumer prices and a floating exchange rate signifies a direct substitute for flexible goods price[10]. O&R opined that the world economy comprised of a variety of different monopolistic producers producing distinctive differentiated goods with all producers domiciled locally or overseas.

The O&R theory states that exchange rate flexibility was essential for the PCP assumption to hold since flexible exchange rate depicts a perfect substitute for variable nominal prices and relative price changes was attained by exchange rate flexibility assuming PCP pricing applies.

II.2 Review of Empirical Literature

There is an extensive empirical literature on exchange rate pass-through (ERPT) to domestic prices particularly in developed countries with diverse results. The diversity arises from varying methodologies and measures of domestic prices and exchange rate. Several researchers examined the sensitivity of domestic prices to exchange rate movements with their studies divided into three categories. The first focused on examining exchange rate pass-through into disaggregated import prices (Goldberg, 1995 and Bache, 2002). The second examined exchange rate pass-through into aggregate import prices (Hooper and Mann, 1989; Webber, 1999; Campa and Goldberg, 2002). The third analysed exchange rate pass-through into consumer price index (CPI) (McCarthy, 2000; Choudri, Faruquee and Hakura, 2002; Bailliu and Fujji, 2004). The growing research on exchange rate pass-through is driven by the rise in strategic trade policy and developments in the new open economy macroeconomic models.

During the 1980's through 1990's, empirical studies on exchange rate pass-through were largely focused on the industrialised countries, in particular, the United States and Japan. This was confirmed by Menon (1995) when he surveyed 48 studies on the exchange rate pass-through and found that most of the research was carried out on U.S and Japanese data. Similarly, Goldberg and Knetter (1997) observed that, in the 1980s, research on exchange rate pass-through was dominated by the analysis of pass-through in the U.S. However, pass-through literatures on developing countries are beginning to emerge (Alba and Papell (1998), Anaya (2000) and Garcia and Restrepo (2001).

Empirical work by Campa and Goldberg (2005) found that exchange rate showed higher pass-through to import prices than to consumer price. In the finding of Menon (1995), the degree of openness of the individual economies mainly drives the degree of pass-through. Goldfajn and Werlang (2000) investigated exchange rate pass-through into consumer prices in seventy-one countries using panel estimation methods on data from 1980 to 1998.

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[10] See Obstfeld and Rogoff (1995).

They reported that the pass-through effects on consumer prices increased over time and reached its maximum after 4-quarters. The degree of pass-through was found to be substantially higher in emerging market economies than in developed economies.

Calvo and Reinhart (2000) found that exchange rate pass-through, namely, the amount of exchange rate change that translates into changes in import prices and, hence, consumer price inflation was higher in emerging markets. They rationalised that in emerging market economies, high inflation in the past promoted widespread wage and price indexation; therefore changes in CPI resulting from exchange rate changes were consequently locked in future wages and price inflation. In addition, they posited that central banks of such countries were less credible, thus temporary shocks to the exchange rate were accommodated and, hence, become permanent, and continuously impacted on inflation.

Kuijs (2002) studied inflation dynamics in Slovakia during 1993-2000 using a VAR model. The result showed a short-term pass-through of 40.0 per cent which declined gradually as the exchange rate appreciated. Also, Gueorguiev (2003) estimated the pass-through to consumer prices in Romania by using a first-difference VAR model for the period 1997-2002. His result indicated a maximum pass-through to consumer prices of around 30.0-40.0 per cent with most of the impact taking place within 4 quarters.

Part of the empirical work on exchange rate pass-through in Central European countries included the cross-country analyses by Mihaljek and Klau (2001). They estimated the exchange rate pass-through in several emerging market economies including Poland, Hungary and the Czech Republic, using a single equation estimation technique. The outcome showed, exchange rate pass-through of 6.0 per cent in the Czech Republic; Poland, 45.0 per cent; and 54.0 per cent in Hungary. However, possible endogeneity of the right-hand variables was not taken into account and the pass-through was estimated over a period that comprised different exchange rate regimes and inflationary environments.

Darvas (2001) in his study on exchange rate and price dynamics for Hungary, the Czech Republic, Poland and Slovenia used a time-varying parameters framework to account for regime shifts during the 1990s. The results showed long-run pass-through estimates ranging from 15.0 per cent for the Czech Republic; 20.0 per cent for Poland; to 40.0 per cent for both Hungary and Slovenia. The short-term pass-through estimates were lower and ranged from 0-20.0 per cent, with Poland (0 per cent); Czech and Hungary (10.0 per cent each) and Slovenia (20.0 per cent).

Further research on same countries by Coricelli et. al., (2004) used the co-integrated vector autoregressive model to estimate the long-term pass-through for four Central European countries namely Hungary, the Czech Republic, Poland and Slovenia. The results revealed a full long-term pass-through from exchange rate to domestic prices for Slovenia and Hungary, 80.0 per cent pass-through for Poland, and the Czech Republic 50.0 per cent. A major drawback of the study was that, the co-integration analysis assumed a stable long-term relationship between the variables. This assumption may not be appropriate in the

context of regime shifts, so that the estimates of long-term exchange rate pass-through were less relevant in terms of providing the information for economic policy decisions due to the sluggish adjustment process.

Mwase (2006) examined the effect of exchange rate changes on consumer prices in Tanzania using the structural vector autoregression (SVAR) model on a data set covering 1990-2005. Despite the depreciation of the local currency, the paper showed a decline in exchange rate pass-through to inflation in the late 1990s. This was due to the macroeconomic and structural reforms that were implemented during the period. The decline in the pass-through did not necessarily imply that exchange rate fluctuations were less significant in explaining macroeconomic fluctuations. The increase in the share of imports in the economy suggested that the pass-through could rise over the medium term. The author suggested that policy makers should remain vigilant in assessing the potential impact of foreign prices on the dynamics of inflation in Tanzania.

Duma (2008) investigated pass-through of external shocks (exchange rate, oil price, and import price shocks) to inflation in Sri Lanka. Using a vector autoregression (VAR) model that incorporated a distribution chain of pricing, the findings showed low and incomplete pass-through of external shocks to consumer inflation, reflecting a combination of factors including the existence of administered prices, high content of food in the consumption basket, as well as volatility of the exchange rate. External shocks explained about 25.0 per cent of the variation in consumer price inflation, thus suggesting that domestic policies would be relevant in controlling inflation.

Batini (2004) examined the importance of pass-through and the impact of external shocks for Brazil, Chile, Nigeria, and South Africa by adopting a VAR specification using quarterly data from 1990 to 2002. The result showed that exchange rate was significant in explaining around 90.0 per cent of Nigerian inflation spanning 8-12 quarter horizons, when a first difference of the exchange rate in the VAR was used. This implied that inflation in Nigeria may be highly influenced by fluctuations in the value of the naira as this translates directly, albeit, with long variable lags into consumer price changes. Importantly, high pass-through also meant that Nigeria would be more inclined to attempt to regularly stabilise the exchange rate by intervening in the foreign exchange market, the consequence of what Calvo and Reinhart (2000) dub "fear of floating".

Recent studies on exchange rate pass-through in Nigeria using dissimilar variables and methodologies revealed varying results. A recent study on Nigeria by Omisakin (2009) submits that there was no significant impact of exchange rate variations on domestic prices and output. This contrasted with the results from earlier studies by Oladipo (2007) and Oyinlola and Babatunde (2009) that found a significant impact of exchange rate on domestic prices. There is a good reason to believe that the different outcomes of these investigations might have resulted from the different methodologies used. While Oladipo (2007) and Oyinlola and Babatunde (2009) used the Johansen multivariate estimation technique, Omisakin (2009) used the vector autoregressive model which has been criticised for its inability to capture the potential long-run relation among variables.

Barhoumi (2005) had argued that the exchange rate pass-through (ERPT) concept is a long-run phenomenon, which supported Omisakin's outcome of no short-run impact.

Examining exchange rate pass-through in Nigeria, Oladipo (2006) employed Johansen technique and rejected full pass-through of exchange rate to import prices. The result showed that a 1.0 per cent increase in exchange rate and exporters foreign cost of production led to a 0.86 and 0.26 per cent increase in import prices, respectively. Also, Oyinlola and Babatunde (2009) employed an unrestricted error correction model (UECM) and a Bounds Testing Analysis (BTA) to examine the extent of pass-through of exchange rate into import prices for Nigeria using data from 1980 to 2006. The result showed that export prices had a dominant effect compared to exchange rate in the short-run; they concluded that, exogenous factors largely accounted for the changes in import prices than the country's exchange rate policy. Adetiloye (2010) adopted correlation and granger causality analysis to test the relationship that exists between official and parallel exchange rates and import prices in Nigeria. He found that the coefficient of official exchange rate was less significant than that of the parallel exchange rate. He also discovered that import prices showed a near two-way bi-causality with the consumer price index.

Furthermore, Aliyu et. al., (2009) used the Johansen cointegration method to investigate exchange rate pass-through to import and domestic prices in Nigeria using quarterly data from 1986 to 2007. The result revealed that the pass-through during the period was incomplete. A 1.0 per cent shock to exchange rate resulted in 0.143 and -0.105 per cent pass-through to import and consumer prices by the fourth quarter, respectively. The low pass-through by Aliyu et. al., (2009) might be unconnected with weakness in their methodological and estimation approaches adopted.

Leigh and Rossi (2002) applied a five variables recursive Vector Auto Regressive (VAR) model to estimate the pass-through effect from the nominal exchange rate to consumer and wholesale prices from 1994 - 2002 and concluded that the pass-through to consumer prices at 0.45 and 0.40 in the short-run and long-run, respectively was shorter and larger in Turkey compared to other emerging economies.

Frimpong and Adam (2010) examined the influence of exchange rate changes on consumer prices in Ghana using vector autoregression (VAR) models with monthly data between the periods 1990-2009 and found the exchange rate pass-through to inflation to be incomplete and falling.

Cheikh and Cheikh (2013) studied exchange rate pass-through to import prices in 27 OECD countries with quarterly data between 1994 - 2010 using the panel cointegration technique and established the existence of partial pass-through in the long-run at about 0.70.

Table 1 : Summary of some selected Exchange Rate Pass-through Studies

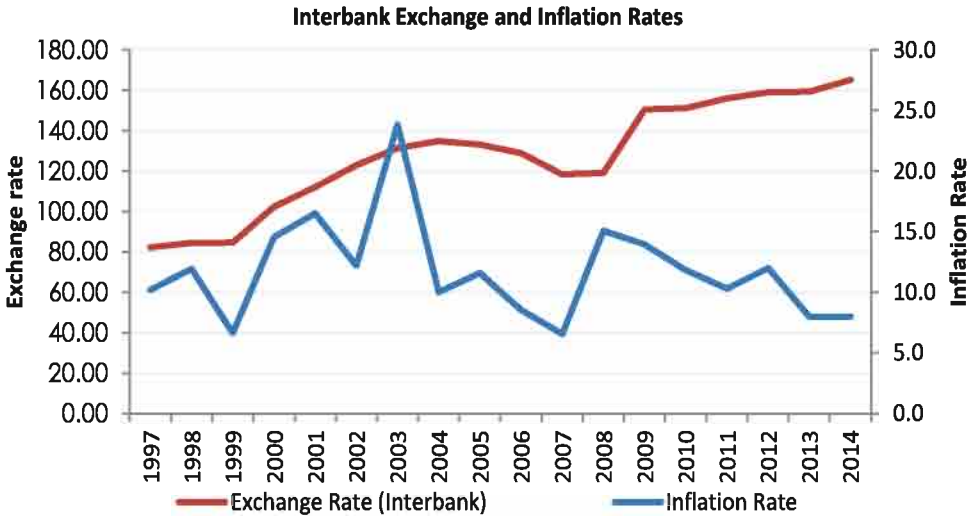
Authors	Period of estimation	Methodology applied	Exchange rate pass-through to:			
			Import prices		Consumer prices	
			Short-run	Long-run	Short-run	Long-run
Frimpong and Adam (2010)	Monthly data for the period 1990-2009;Ghana	Vector Error-Correction (VEC)	-	-	Incomplete and Low	
Campa and Goldberg (2005)	Monthly data for the euro area 1989- 2004	Vectar error correction model	0.56	~ 0.8		-
Leigh and Rossi (2002)	Jan 1994- April 2002; Turkey	Vector Autoregressive Analysis (VAR)	-	-	0.4	0.45
Kuijs (2002)	1993–2000;Slovakia	Vectar Autoregressive Analysis (VAR)	-	-	0.4	-
Darvas (2001)	1993:1- 2000:2; Czech Republic, Poland and Slovenia	Time-varying parameters framework to capture regime shifts	-	-		Complete for Slovenia and Hungary; 0.8 for Poland; 0.5 for Czech Republic
Mwase (2006)	1990:1–2005:1; Tanzania	Structural vector autoregressive (SVAR)	-	-		Incomplete and decreasing between 1990:1 - 2005:1; and zero between 1995:3 -2005:1
Oyinlola (2009)	1980 -2008; Nigeria	Vector Error Correction Model (VECM)	-	-		0.18 - 0.47
Oladipo (2006)	1970:1 - 2001:4; Nigeria	Johansen technique	Incomplete	0.86		-
Cheikh and Cheikh (2013)	1994:1-2010:4; 27 OECD countries	Panel cointegration technique	-	~ 0.70		-
Oyinlola and Babatunde (2009)	1980- 2006; Nigeria	Unrestricted error correction model (UECM)	0.09	0.121	No visible Impact	-
Omisakin (2009)	1970-2006; Nigeria	Vector autaregressive (VAR) model	-	-		No long-run relationship exist

Aliyu et al (2009)	1986:1- 2007:4; Nigeria	Vector autoregressive (VAR) model	-	0.147		Pass-through Incomplete (-0.105)
CBN (2014)	1995Q1-2013Q4: Nigeria	Vector Error Correction Model (VECM)	Pass-through Incomplete (0.35)		Pass-through Incomplete (0.93)	

III. Trend Analysis of Exchange Rate and Inflation (1997-2014)

The trend relationship between inflation and exchange rates in Nigeria showed that the two indicators trended together during 1997 - 2007. However, a divergence was noticed since 2008 when exchange rate has been depreciating but inflation rate seems to be trending downward. In 2000, the exchange rate depreciated to N107.17/$1 from N84.57/$1 in 1999, and the rate consistently and persistently depreciated in the subsequent years and eventually peaked at N134.67/$1 in 2004. Also during these periods, inflation rate systematically rose from 6.6 per cent in 1999 to 16.5 per cent in 2001, although, temporarily fell to 12.2 per cent in 2002 before it eventually peaked at 23.8 per cent in 2003.

Figure 1: Analysis of Inter-bank Exchange and Inflation Rates



However, from 2003 - 2008, the period which corresponded to the period of huge inflows of foreign exchange to the domestic economy occasioned by increase in crude oil price, the exchange rate persistently and consistently appreciated during the period. The exchange rate appreciated from ₦134.67/$1 in 2004 to ₦133.00/$1 in 2005, it further appreciated to ₦128.67/$1and ₦118.23/$1 in 2006 and 2007, respectively. During the period, inflation rate also assumed persistent downward trend. It fell from 10.0 per cent in 2004 to 8.6 and 6.6 per cent in 2006 and 2007, respectively. In 2008, the downward trend in inflation was reverted because of the effect of global financial crisis on oil crude prices and the attendant massive capital outflows from the domestic economy. Consequently, exchange rate depreciated from its position in 2007 to ₦150.40/$1, ₦155.89/$1, ₦159.25/$1 and ₦164.98/$1 in 2009, 2011, 2012 and 2014, respectively. Also, during the period, the inflation rate initially rose from 6.6 per cent in 2007 to 15.1 per cent in 2008. However, because of the proactive policies of monetary authorities, from 2009 despite the depreciation of exchange rate, inflation assume downward trend. It fell to 11.8 per cent in 2010, although, temporarily increased to 12.0 per cent in 2012, before it resume downward trend and remained 8.0 per cent in 2013 and 2014. In general, during the review period, inflation rate recorded major spikes when exchange rate persistently depreciated.

IV Methodology and Data

IV.1 Methodology

In this study, we applied the vector auto-regressive for our empirical framework; first, a standard reduced-form VAR model representation is expressed as follows:

$$Y_t = c + \sum \phi_i Y_{t-1} + \varepsilon_t \quad (2)$$

where Y_t represents the vector of endogenous variables, c is a vector of constants, φi denotes the matrices of autoregressive coefficients and ε_t is a vector of white noise processes. Cointegration of two or more variables implies a long-term or equilibrium relationship among them, given by their stationary linear combination. Equation (2) can be appropriately transformed into a vector error correction (VEC) model given in equation (3)

$$\Delta X_t = \mu + \sum_{i=1}^{p} \Gamma_i \Delta X_{t-i} + \Pi X_{t-p} + \varepsilon_t \quad (3)$$

Furthermore, equation 3 gives the vector error correction (VEC) representation of equation (2) which can be estimated using the Johansen (1991) maximum likelihood procedure.

where Δ is the first difference operator, X_t is a (kx1) random vector of time series variables with order of integration equal to one, $I(1)$, μ is a (kx1) vector of constants, Γ_i are (k x k) matrices of parameters, ε_t is a sequence of zero-mean p- dimensional white noise vectors, and Π is a (k x k) matrix of parameters, the rank of which contains information about long-run relationships among the variables. If the Π - matrix has reduced rank, implying that $\Pi = \alpha\beta'$, the variables are cointegrated, with β as the cointegrating vector. If the variables were stationary in levels, Π would have full rank. The cointegration rank in this study is conducted using the maximum eigenvalue and trace tests. The asymptotic critical values are given in Johansen and Juselius (1990) and MacKinnan-Haug-Michelis (1999). However, in this study we limit the analysis to VAR analysis, because the co-integration test indicated no long-run relationship among the variables of interest.

IV.2 Data

Monthly data spanning from 2000M1 to 2015M1 was used. The choice of time period for the analysis was informed by the availability of data. Four variables were used in the model namely; inter-bank exchange rate *(INTB)*, *world* export prices *(ECP)*, oil prices *(OILP)* and consumer price index *(CPI)*. World export prices was used as proxy for import prices because Nigeria's imports are priced in US dollars and, generally international transactions are denominated in US dollars. A possible limitation of the study is that import prices for Nigeria could generate different results. The inter-bank exchange rate was chosen as it was more responsive to monetary and economic fundamentals. It is measured in nominal terms where the rate reflected the value of the naira in terms of the United States (US) dollar. All the data were obtained from the CBN Statistical Bulletin and the Annual Reports of various years except for ECP. Data on ECP was sourced from the IMF, International Financial Statistics, due to the non-availability of import prices in Nigeria on quarterly basis.

IV.3 Unit Root Tests

Table 2 presents the empirical results of the Augmented Dickey Fuller and the Phillip Perron tests. The regressions were ran for all the series at both levels and first differences and, with constant and trend in the equation. We made use of the information criteria – Scwartz Information Criterion (SIC), Akaike Information Criterion (AIC) and Hannn-Quinn Information Criterion (HQ) in selecting the appropriate lag length.

From table 2, the result showed that all variables were characterised by unit root, meaning that at levels we fail to reject the null hypothesis of a unit root. At first differences, however, the result informed the rejection of the null hypothesis of a unit root in favour of the alternative, which says the variables were stationary at the 1.0 per cent level of significance.

Table 2: Unit Root Tests

	Level		*First Difference*		
Model	ADF Test Statistic	PP Test Statistic	ADF Test Statistic	PP Test Statistic	ADF/PP C.V
LCPI	-2.85	-2.99	-11.70*	-6.93*	-4.01
LWCP	-1.77	-1.33	-8.83*	-5.20*	-4.01
LINTB	-2.32	-2.30	-6.99*	-7.61*	-4.01
LOILP	-1.65	-1.22	-6.15*	-12.22*	-4.01

* indicates significance at 1.0 per cent level using MacKinnon critical values.
Note: Lag length was chosen in line with the Schwarz information criterion which imposes a larger penalty for additional coefficients. It is given by SC = 2*l*/*T* + (*k* log *T*)/T. where *l* is the log likelihood, *T* is the number of observations and *k* is the number of coefficients.

To determine the appropriate lag length structure and stability of the model, we choose the lag length of two as indicated by the Hannan-Quin Information criterion (HQ) in table 3 below. We observed that at the lag length of two, the model exhibits stability as shown in table 4.

Table 3: VAR Lag Order Selection Criteria

Lag	LogL	LR	FPE	AIC	SC	HQ
0	475.2503	NA	5.06E-08	-5.44798	-5.375072	-5.418402
1	1555.058	2097.199	2.31E-13	-17.74634	-17.38179*	-17.59844
2	1586.619	59.83755	1.93E-13	-17.92623	-17.27005	-17.66002*
3	1608.628	40.71096*	1.80e-13*	-17.99570*	-17.04789	-17.61118

4	1616.994	15.08688	1.97E-13	-17.90744	-16.668	-17.40461
5	1627.766	18.92907	2.10E-13	-17.847	-16.31592	-17.22585
6	1634.519	11.55392	2.34E-13	-17.7401	-15.91739	-17.00064
7	1642.167	12.73198	2.59E-13	-17.64354	-15.5292	-16.78577
8	1652.264	16.34236	2.79E-13	-17.5753	-15.16932	-16.59921

Table 4: Roots of Characteristic Polynomial

Root	Modulus
0.996314	0.996314
0.927295	0.927295
0.833138 - 0.119912i	0.841723
0.833138 + 0.119912i	0.841723
0.419294	0.419294
0.273672	0.273672
-0.240912	0.240912
0.121545	0.121545

No root lies outside the unit circle.
VAR satisfies the stability condition.

V. Analysis of Results and Findings

This section of the paper analyses the results and policy implications. First, we derived exchange rate pass-through from the impulse responses generated from the VAR model and present the result below. Also, we examine the drivers of the domestic price, we present variance decomposition of exchange rate from the model.

V.1 Pass-through of Exchange Rate to Domestic Prices

Pass-through coefficients show the predictive adjustment of domestic prices to a shock in exchange rate after accounting for the effects of other endogenous variables in the model. Following Wimalasuriya (2007) and Duma (2008), exchange rate pass-through is therefore generated using estimates of cumulative impulse responses of CPI after j period divided by cumulative response of exchange rate (EXC) to the exchange rate shock after j-periods. It is specifies as follows:

$$PT = CPI_{t,t+m} / EXC_{t,t+m} \quad \text{.....(8)}$$

Where $CPI_{t,t+m}$ is the cumulative change in the price level and $EXC_{t,t+m}$ is the cumulative change in the nominal exchange rate.

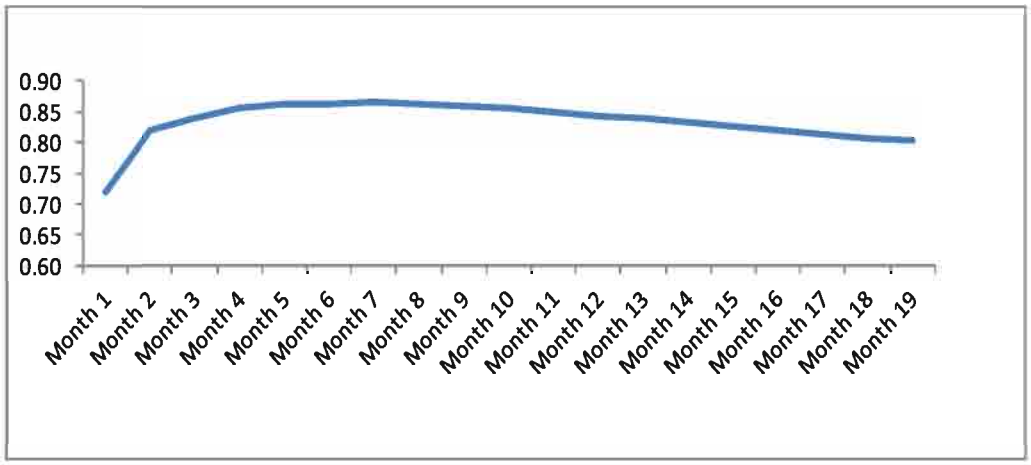
The results from table 5 show that the effect of exchange rate pass-through to price level is high. A shock to exchange rate (depreciation) would increase domestic price by 0.72 per cent at the first month. Also, the effect on the price level rose to 0.82, 0.85 and 0.86 per cent in month 2, 4 and 6, respectively before it began to fall. The marginal fall after the sixth month hovers around 0.84 per cent, on the average. This implies that exchange rate pass-through, though, is high, is incomplete in Nigeria. The graphical illustration also indicates the process of adjustment to shock is slow in Nigeria.

Table 5: Exchange Rate Pass-through

	Month 1	Month 2	Month 4	Month 6	Month 8	Month 10	Month 12	Month 14	Month 16	Month 18
Pass-through to Domestic Prices	0.718	0.821	0.854	0.864	0.862	0.854	0.844	0.832	0.820	0.808

Source: Based on the Authors' calculation

Figure 2: Exchange Rate Pass-Through to Inflation



V.2 Variance Decomposition

The result in table 6 below shows the variance decomposition of domestic prices. The result indicated that innovations in domestic prices accounted from the largest share during the study period.

Table 6: Variance Decomposition of LCPI:

Period	S.E.	LOILP	LINTB	LWCP	LCPI
1	0.01	0.58	1.71	0.01	97.70
2	0.02	1.13	2.99	0.03	95.84
3	0.03	1.04	3.62	0.24	95.09
4	0.03	0.85	4.08	0.51	94.56
5	0.04	0.68	4.43	0.81	94.08
6	0.04	0.57	4.73	1.12	93.57
7	0.04	0.54	4.99	1.45	93.03
8	0.05	0.55	5.22	1.77	92.46
9	0.05	0.59	5.44	2.11	91.86
10	0.05	0.65	5.65	2.44	91.26

Source: Authors' calculation

The share of exchange rate in the variance decomposition for domestic price increases from 1.7 per cent in the first month onwards to 3.0 per cent in the second month, and further to 3.6, 4.1, 4.4 and 4.7 per cent, in months 3, 4, 5 and 6, respectively. The effect seems to last for a long period beyond month eighteen, even though its impact begins to taper off marginally in the subsequent months. The innovation in import prices in period one accounting for 0.01 per cent and then rose marginally to 0.2, 0.5, 0.8 and 1.1 per cent in quarters 3, 4, 5 and 6, respectively. It peaked at 2.4 per cent in period 10. Surprisingly, the variance decomposition of oil prices in domestic price level was also low despite Nigeria been an oil-dependent country. The innovation in LOILP accounted for 0.6, 1.1, 1.0, 0.9 and 0.7 per cent in periods 1, 2, 3, 4 and 5, respectively. It further fell to 0.6 and 0.5 per cent in periods 6 and 7, respectively; and hovered around 0.6 per cent in periods 8 - 10.

V. Conclusion, Policy Implications and Recommendations

The paper examined the link between exchange rate and inflation in Nigeria using the VAR method. A positive shock to exchange rate (depreciation) would translate to a gradual and steady increase in the domestic price level. The pass-through from import prices to domestic price level was moderate as revealed by the impulse response. Furthermore, the effect of oil prices pass-through to domestic price level was relatively low compared with that from the inter-bank exchange rate.

The result of the model has implications for policy. Firstly, it established that there exists a link between exchange rate and inflation in Nigeria. Secondly, the effect of exchange rate pass-through to domestic prices was significant and the pass-through was not complete.

These imply that developments in the exchange rate influence the level of inflation in the economy and its effect lasts for a long period. The policy implication of these is that significant depreciation of nominal exchange rate would have a pronounced effect on the domestic level. In the light of these results, the study recommends that in the management of exchange rate, sharp depreciation should be avoided due to its impact on domestic prices. The use of administrative measures to reduce exchange rate volatility should be encouraged, in view of the high pass-through of exchange rate to inflation.

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