

DO EXCHANGE RATE AND OIL PRICE SHOCKS HAVE ASYMMETRIC EFFECT ON INFLATION? EVIDENCE FROM NIGERIA

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ABSTRACT

This study investigates the asymmetric effects of exchange rate and oil price shocks on inflation in Nigeria, using monthly data for the period 2006-2016 and the impulse response from an estimated vector autoregressive error correction (VECM) model. The empirical analysis uncovers evidence of asymmetries. The results suggest that the immediate effect of a shock to the exchange rate in 12 months is about 50% increase in the price level. While the effect of an exchange rate depreciation shock is about 41% increase in the price level, the effect of an exchange rate appreciation is about 14% decrease in the price level. Similarly, the immediate effect of a shock to the oil price in 12 months is about 52% increase in the price level. While the effect of an increase in oil price in 12 months is about 43% increase in the price level, the effect of a decrease in oil price is surprisingly about 29% increase in the price level. Moreover, there is an evidence of significant effects of exchange rate and oil price shocks on inflation in the long run.

JEL classification codes: E32, F31, F41, O53, Q43

Key words: Oil Price Shocks; Inflation; Exchange Rates Pass-through, Vector Autoregression

INTRODUCTION

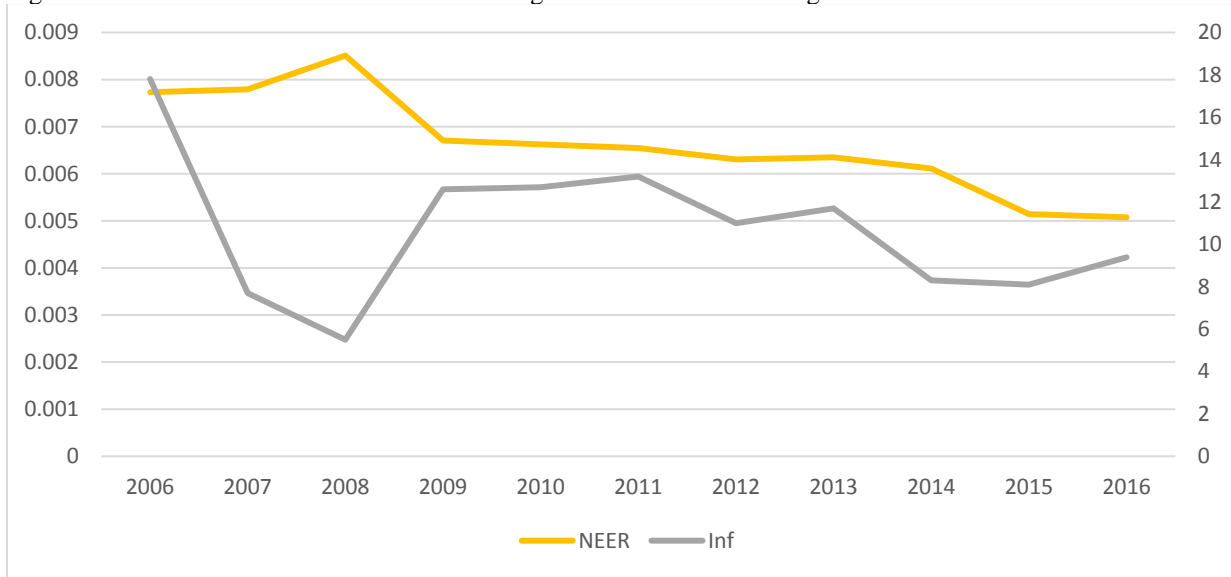
Questions regarding the effects of exchange rate and oil prices on inflation are fundamental empirical issues in the macroeconomic literature. For that reason, a great number of studies has been devoted to the effects of exchange rate and oil prices on inflation (see Calvo and Reinhart, 2000; Taylor, 2000; Hooker, 2002; Cunado & De Gracia, 2005; Liu and Tsang, 2008). Researchers have employed a variety of econometric approaches to measure the effects. However, a great majority of the empirical studies employs restrictive models. One common assumption used in the studies is symmetry of responses to shocks. In other words, the studies assumed that the magnitude of exchange rate (or oil price) transmission to inflation does not depend on the direction (increase or decrease) of the initial exchange rate (or oil price) shocks. This study fills that gap, by studying the asymmetric effects of exchange rate and oil price shocks (i.e. increase or decrease) on inflation.

With increasing trade and financial openness in Nigeria and consistent with the orientation towards more flexible exchange rate regimes, the Nigerian central bank has been anxious about the potential effects of more volatile exchange rates on price stability in the country. This question is especially crucial for Nigeria, where prices have been historically and highly sensitive to exchange rate shocks. Besides, this volatile exchange rates have been accompanied in the recent years by an upward trend in inflation, suggesting a potential increase in the degree of pass-through.

In Nigeria, headline inflation is highly volatile considering the high share of food in the consumer price index and more volatile relative food prices (due to unstable agricultural production). Besides, 95% of foreign exchange earnings in Nigeria is tied to oil and with shortened oil revenue in dollars' terms, the naira is under continuous pressure. As the international oil price fell precipitously in 2015, Nigeria's external reserves dwindled as well, intensifying inflationary pressures and forcing the authorities into exchange rate targeting. Despite attempts to keep the official naira exchange rate unchanged, prices are rising and the single-digit inflation goal has been elusive (as shown in Figure 1 and Figure 2). For example, inflation rate was 12.5% in 2016Q1 and 13.2% in 2016Q2 (CBN, 2016). During this period, therefore, the major sources of inflationary pressure were oil price and exchange rate shocks. Although the Nigerian inflation process is driven by multiple factors, among others, oil price and exchange shocks rate are thought to play important roles (Sanusi, 2010; Zubair et al, 2013).

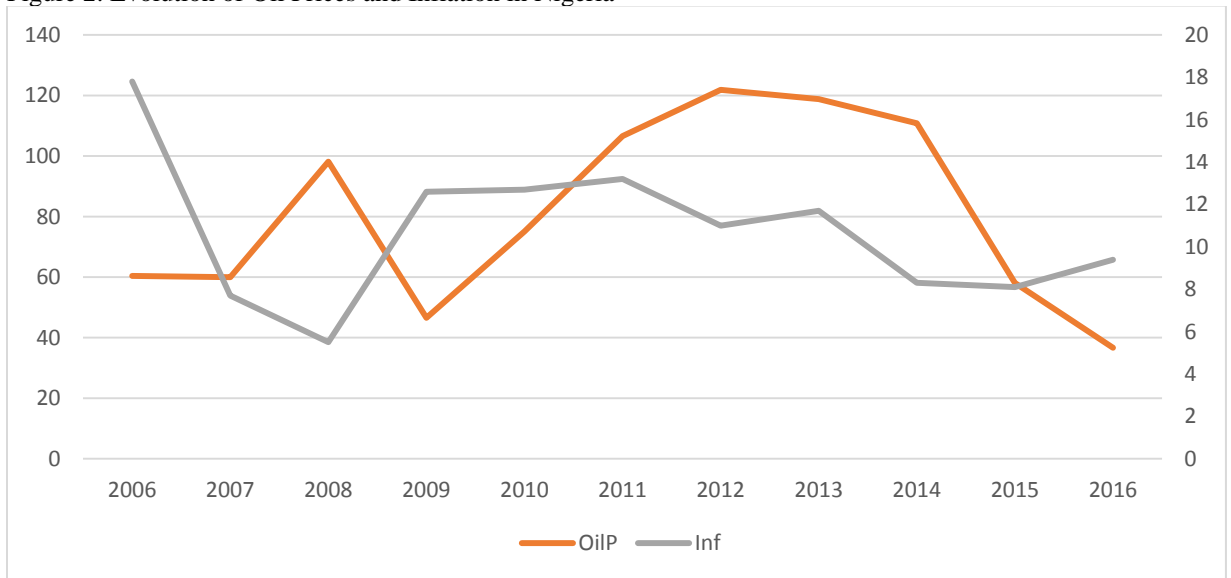
A preliminary look at the exchange rate, oil prices and inflation data for Nigeria suggests a linkage (Figure 1 and 2). Figure 1 shows that trend decline (depreciation) in the nominal effective exchange rate is associated with a trend increase in inflation. That is, there is a positive relationship between the nominal effective exchange rate and inflation. The general trend relationship seems to be negative between oil prices and inflation, but difficult to determine, without a formal investigation.

Figure 1. Evolution of Nominal Effective exchange rate and Inflation in Nigeria



Data Source: CBN (2016)

Figure 2. Evolution of Oil Prices and Inflation in Nigeria



Data Source: CBN (2016)

There are quite a few reasons that justify the interest in the asymmetry of exchange rate and oil price shocks transmission to inflation in Nigeria. First, it is becoming ever more key to unravel the macroeconomic behavior in Nigeria, as recognized by the current economic crises. Interest in inflation-related questions has been intensified in Nigeria due to the current high inflation as a result of the oil price fall and the resulting exchange rate depreciation. Handling inflation pressures is one of the main challenges facing policymakers in Nigeria (Kelikume and Evans, 2015).

Secondly, most of the existing studies on the asymmetry of exchange rate and oil price shocks transmission to inflation are applied to the OECD countries and none has studied the Nigerian case. In our sample we consider periods of exchange rate depreciation and appreciation, as well as periods of increases and decreases in oil price, which could help us to determine whether the empirical relationship in Nigeria is asymmetric.

Third, for successful conduct of monetary policy, a clear empirical knowledge of the oil price and exchange rate pass-through to domestic inflation is important.¹ The knowledge of the degree of oil price and exchange rate pass-through to domestic prices would provide insights into the international transmission of shocks and the efficacy of measures on external adjustment.

This empirical analysis has been done in the framework of a cointegrated vector autoregression. Models of this type have been used extensively in empirical analysis during the last two decades and, in particular, in order to analyze the causes of unemployment (Dolado and Jimeno, 1997), the effects of monetary shocks (Eichenbaum and Evans, 1995), and to explain exchange rates anomalies (Kim and Roubini, 2000). Thus, we formally test the asymmetry of exchange rate and oil price shocks transmission to inflation, using Nigerian monthly data spanning from 2006 to 2016. The model incorporates the country-specific features of the Nigerian economy important to the inflation process. In addition, this approach allows the investigation of the relative importance of the various sources of inflationary pressures in Nigeria.

The rest of this paper is organized as follows. The next section reviews the literature. The third section discusses the data and the empirical models. The fourth section reports the model estimation results. The last section concludes the paper with a summary and implications.

LITERATURE REVIEW

The literature shows that inflation is the outcome of complex and continuous interactions of supply-side (or real) shocks, demand-side (or monetary) shocks, price-adjustment (or inertial) factors and institutional factors (Whitehead, 1979; Wehinger, 2000; Kibritçioğlu, 2002; Egert, Ritzberger-Grünwald & Silgoner, 2004; Khan, Hyder & Ahmed, 2004; Salami & Kelikume, 2013). However, some of these factors are closely related, or stem from the same macroeconomic category. Some other factors cannot be completely accepted as real sources of inflation if we consider the germane debates in the theory of inflation. Given the current focus of this study, it seems very appropriate to survey the main developments in the exchange rate-inflation and the oil price-inflation empirical studies.

Oil Price and Inflation

Oil price has been included in many models (i.e. Rasche and Tatom, 1981; Bruno and Sachs, 1982; Hamilton, 1988; Jebabli, Aroui and Teulon, 2014; Maghyereh, Awartani and Sweidan, 2016), as it is known to reduce the role of technology shocks in real business cycle models (Davis, 1986), influence the natural rate of unemployment (Caruth, Hooker, & Oswald, 1998; Phelps, 1994), and depress irreversible investment via their impacts on uncertainty (Ferderer, 1996). Vast research finds that oil price shocks significantly affects output and inflation (e.g., Hamilton, 1988, 2000; Hooker, 1999, 2002; Tatom, 1988; Kahn & Hampton, 1990; Jones and Olson, 2013; Cashin et al. 2014). The literature also upholds the view that these shocks have been a significant source of economic volatilities (Kim & Loungani, 1992; Baumeister and Peersman, 2013).

The asymmetric relation between oil price shocks and macroeconomic variables has been investigated in many studies. For example, several authors find that rising oil prices tend to reduce economic activity by more than falling oil prices fuel it (e.g., Mork, Olsen, and Mysen, 1994; Lee, Ni and Ratti, 1995; Davis & Haltiwanger, 2001). Hooker (2002) investigated the impact of oil price changes on U.S. inflation in a Phillips curve framework, in an attempt to determine the non-linearities, asymmetries and structural breaks. However the evidence does not support any of the three investigated, though he finds an evidence of a structural break, with oil price changes having a significant impact on core inflation before 1981 but little or no pass-through since that time.

Cognigni & Manera (2008), using a structural cointegrated VAR model for the G-7 countries, show that, for most of the countries, there seems to be an impact of unexpected oil price shocks on interest rates, suggestive of a contractionary monetary policy response aimed at fighting inflation. Cunado & De Gracia (2005) analyzes the oil prices-macroeconomy nexus by studying the effects of oil price shocks on inflation and economic growth for Asian countries for the period 1975Q1–2002Q2. First, they could not obtain any cointegrating long-run relationship between oil prices and economic activity, meaning the effect of oil shocks on inflation is limited to the short run. Second, they found that oil price shocks Granger-cause economic growth rates in Japan, South Korea and Thailand when non-linear specifications are used. Third, they found that oil price shocks have a significant impact on inflation in all countries, though the oil prices-consumer prices relationship appears limited to the short run. Fourth, they

¹ Oil price and exchange rate pass-through refers to the extent to which changes in the oil price and exchange rate translate into domestic price changes.

found evidence of asymmetries in the oil price changes–inflation rate nexus for the cases of South Korea, Japan, Thailand, and Malaysia.

Exchange Rate and Inflation

The impact of exchange rate on domestic prices, commonly termed as "exchange rate passthrough" is of particular interest to economists and central bank policy makers. An abundant literature has addressed the issue of exchange rate pass-through to domestic prices. According to Calvo and Reinhart (2000), the degree of exchange rate pass-through to consumer prices in developing countries is 43%, four times higher than the 13% found for developed countries. Taylor (2000) examined the relationship between the inflationary environment and the level of exchange rate pass-through and found a declining pass-through to a more moderate inflationary environment, linked to more credible and predictable monetary and fiscal policies.

Ito and Sato (2007) analyzed the extent of domestic price responses to exchange rate changes in East Asian and Latin American countries using the Structural Vector Autoregression (SVAR) model and monthly data consisting of nominal effective exchange rate, domestic prices, oil prices, money supply, and the output gap for 1990 to 2006,. Their results indicate that the degree of exchange rate pass-through is higher in Latin Americas than in East Asia.

Using a Phillips-Curve model for quarterly Hong Kong data from 1984 to 2007, Liu and Tsang (2008) find that a 10% depreciation of the US dollar would lead domestic prices to increase by 0.82 and 1.61 per cent in the short run and medium run, respectively. In India, Raj, et al. (2008) using correlation analysis, granger causality and cointegration and error correction analysis, show that inflation is positively influenced by three external dynamics: exchange rate changes, capital inflows, and import price.

In Nigeria, Zubair, George & Sanusi, (2013) uses the impulse response from an estimated SVAR model of the inflation process in Nigeria to estimate the dynamic exchange rate pass-through to consumer prices for the period 1986 to 2010. The evidence shows that the elasticity of inflation to exchange rate changes is about 0.02, and it takes about eight quarters to reach its full-impact of only 0.26.

Following this line of literature, the present study investigates the effects of exchange rate and oil price shocks on inflation in Nigeria. Using a VECM framework, we examine short-term as well as cumulative responses of inflation to changes in exchange rate and oil prices.

METHODOLOGY

The monthly data used in this study are obtained from the Central Bank of Nigeria and cover the period 2006M1–2016M6. The estimation process involves three steps: (1) testing for the unit root properties of the variables; (2) testing for the number of cointegrating vectors; and (3) testing for asymmetric effects in the multi-variate vector error-correction model (VECM) framework.

The first step in the estimation of the VECM is the stationarity tests. The augmented Dickey-Fuller (ADF) methodology (see Dickey-Fuller, 1981) is used to test for the unit root properties of the variables. The ADF test is estimated by the following regression:

$$\Delta Y_t = a_0 + \alpha t + a_1 Y_{t-1} + \sum_{i=1}^p a_i \Delta Y_{t-1} + \varepsilon_t \quad (1)$$

Where; a_0 is the intercept and t the deterministic trend. The t-ratio for a_1 would be consistent with the hypothesis $a_1=0$ if the autoregressive representation of Y_t has a unit root,

If the series are stationary only after differencing, the maximum-likelihood test procedure established by Johansen and Juselius (1990) and Johansen (1991) is used to investigate the existence of a long run equilibrium relationship between exchange rate, oil price and inflation. This approach is appropriate for this study because it has large finite sample properties (see Toda, 1995). Given Y_t is a vector of n stochastic variables, a k -lag vector autoregression with Gaussian errors exists in of the form:

$$\Delta Y_t = a + \Gamma_1 \Delta Y_{t-1} + \dots + \Gamma_{k-1} \Delta Y_{t-k-1} + \Pi Y_{t-1} + \alpha_t \quad (2)$$

Where; $\Gamma_1, \dots, \Gamma_{k-1}$ and Π are coefficient matrices; α_t a vector of white noise process and Y_t encompasses the deterministic elements.

Akaike's Information Criterion (AIC) (see Akaike, 1973) is used as the basis for the selection of the number of lags in the VECM. The choice of optimal lag length minimizes AIC, in such a way that

$$AIC = \ln \det S_k^n + (2d^2k)/T \quad (3)$$

Where; $k = 1, 2, \dots, n$; n is the maximum lag length, \det is the determinant, d the number of variables in the system; and S_k the estimated residual variance-covariance matrix for lag k .

The Johansen cointegration gives two likelihood ratio test statistics, the trace test and the maximum eigenvalue test where the trace test statistic is given as:

$$TR = T \sum_{i=r+1}^N \ln(1 - \lambda_i) \quad (4)$$

And the maximum eigenvalue statistic as:

$$L_{\max} = T \ln(1 - L_{r+1}) \quad (5)$$

Where L_{r+1}, \dots, L_N are the $N-r$ smallest squared canonical correlations between LX_t and X_{t-k} series, adjusted for the influence of the lagged differences of the X_t .

The last stage involves the estimation of the VECM which adjusts to both short-run and long-run equilibrium changes in the variables. In line with Mork et al. (1994), McCarthy (2000), Sanusi (2010) and Zubair et al. (2013), the VECM is specified as follows:

$$\begin{bmatrix} INF_t \\ NEER_t \\ OILP_t \\ X_t \end{bmatrix} = \begin{bmatrix} \beta_1 \\ \beta_2 \\ \beta_3 \\ \beta_4 \end{bmatrix} + \begin{bmatrix} \beta_{11k} & \beta_{12k} & \beta_{13k} & \beta_{14k} \\ \beta_{21k} & \beta_{22k} & \beta_{23k} & \beta_{24k} \\ \beta_{31k} & \beta_{32k} & \beta_{33k} & \beta_{34k} \\ \beta_{41k} & \beta_{42k} & \beta_{43k} & \beta_{44k} \end{bmatrix} x \begin{bmatrix} INF_{t-k} \\ NEER_{t-k} \\ OILP_{t-k} \\ X_{t-k} \end{bmatrix} + \begin{bmatrix} \delta_1 \\ \delta_2 \\ \delta_3 \\ \delta_4 \end{bmatrix} x [ECT_{t-1}] + \begin{bmatrix} \xi_{1t} \\ \xi_{2t} \\ \xi_{3t} \\ \xi_{4t} \end{bmatrix} \quad (6)$$

Where INF is inflation, proxied by changes in the consumer price index; $NEER$ is the nominal effective exchange rate; $OILP$ is oil prices; and X represents the other variables in the VECM system such as $DEXCR$ (the dummy for exchange rate depreciation), $AEXCR$ (the dummy for exchange rate appreciation), $GDPGAP$ (output gap generated by applying the Hodrick-Prescott filter) and $M2$ (the money supply). ECT is the error-correction term; β the adjustment coefficients; ξ_t the disturbance term and ECT_{t-1} the lagged error-correction term. All the variables are in natural log. Exchange rate, oil price and inflation are the key variables of interest.

Changes in inflation represents the short run causal impact while ECT_{t-1} gives the adjustment of exchange rate, oil price and inflation to their long run equilibrium. Hence, the VECM model aids differentiation between the short- and long-run dynamic relationships.

In this study, in order to test for asymmetries and consistent with Mork et al. (1994), we enter in the same equation oil price increases and decreases as well as exchange rate appreciation and depreciation as dummy variables determining inflation rates.

The analysis is on the basis of the impulse-response functions (IRFs) of the VECM estimations. The IRFs will be used to describe the reaction of the variables to the shocks from other variables in the system.

EMPIRICAL RESULTS

As a first step, unit-root tests are carried out for all of the variables. Table 1 shows the results from applying the ADF unit-root tests for each of the variables. An inspection of the results in Table 1 allows us to conclude that the variables are integrated of order one. As shown in the table, we cannot reject the null hypothesis of unit-root.

Table 1. The ADF Unit Root Test

Variable	Without trend		With trend		Decision
	I(0)	I(1)	I(0)	I(1)	I(1)
$NEER_t$	-0.23	-4.97*	-2.38	-5.01*	I(1)
INF_t	-1.05	-3.13*	-1.26	-3.12**	I(1)
$OILP_t$	-2.40	-5.24*	-2.23	-5.30*	I(1)
$GDPGAP_t$	-0.52	-4.25*	-1.90	-4.22*	I(1)
$M2_t$	-0.27	-6.34*	-2.83	-6.30*	I(1)

Note: ** and * denote statistical significance at the 5% and 1% level.

Since all the variables have a unit-root, using the Johansen cointegration test, we tested for multivariate cointegration. Table 2 shows the results from applying the Johansen cointegration test for the variables. The trace test and max Eigen statistic indicate the presence of five and four cointegrating relationships respectively. According to both the trace and maximum eigenvalue statistics, there is a clear evidence of cointegration among the variables.

The general result of this analysis is that there are four cointegrating long-run relationships, which suggests that the impact of exchange rate and oil price shocks on inflation is not limited to the short run. Therefore, a clear evidence of a long-run relationship is established between these variables. Therefore, we proceed to estimate the VECM of all the integrated variables.

Table 2. Johansen and Maximum Likelihood Test for Cointegration

Hypotheses	Trace Test	5 % Critical Value	Prob. #	Hypotheses	Max. Eigen Statistic	5 % Critical Value	Prob. #
$R = 0$	0.531*	187.470	0.000	$R = 0$	0.531*	56.705	0.000
$R \leq 1$	0.446*	150.558	0.000	$R \leq 1$	0.446*	50.599	0.000
$R \leq 2$	0.393*	117.708	0.000	$R \leq 2$	0.393*	44.497	0.000
$R \leq 3$	0.301*	88.803	0.001	$R \leq 3$	0.301*	38.331	0.016
$R \leq 4$	0.211*	63.876	0.036	$R \leq 4$	0.211	32.118	0.145
$R \leq 5$	0.133	42.915	0.158	$R \leq 5$	0.133	25.823	0.466
$R \leq 6$	0.117	25.872	0.199	$R \leq 6$	0.117	19.38	0.205
$R \leq 7$	0.047	12.517	0.489	$R \leq 7$	0.047	12.517	0.489

Notes: *, ** and *** denote rejection of the hypothesis at the 0.01, 0.05 and 0.10 level. # denotes MacKinnon-Haug-Michelis (1999) p-values

Prior to the conduct of the cointegration test, the optimal lag length test was used to determine the appropriate lag length. The VAR lag order selection criteria was AIC, which gives the optimal lag length of 2 (Table 3). At this lag 2, the residuals of the underlying VECM were free of autocorrelation and normally distributed.

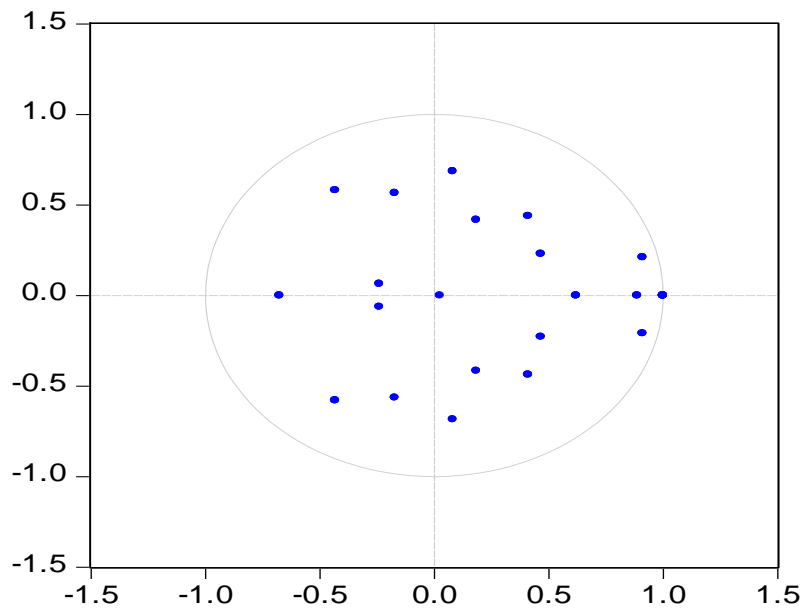
Table 3. VAR Lag Order Selection Criteria

Lag	LogL	LR	FPE	AIC	SC	HQ
1	890.4921	NA	6.14e-17	-14.62818	-13.08346	-14.00135
2	1257.249	629.6541	2.93e-19	-19.98672*	-16.89729*	-18.73306*
3	1351.442	148.3741	1.78e-19*	-20.52110	-15.88695	-18.64061
4	1398.850	67.96520	2.58e-19	-20.22743	-14.04857	-17.72011
5	1464.504	84.82709	2.84e-19	-20.25670	-12.53313	-17.12255
6	1518.585	62.21698	4.16e-19	-20.08114	-10.81285	-16.32017
7	1570.534	52.40872	6.99e-19	-19.86785	-9.054844	-15.48004
8	1678.833	93.92313*	4.99e-19	-20.65191	-8.294184	-15.63727

* indicates lag order selected by the criterion
 LR: sequential modified LR test statistic (each test at 5% level)
 FPE: Final prediction error
 AIC: Akaike information criterion
 SC: Schwarz information criterion
 HQ: Hannan-Quinn information criterion

Similarly, prior to the analysis of the impulse response functions, it is important to ensure that the estimated VECM is stable. Using the inverse roots of the characteristic AR polynomial (see Lütkepohl and Poskitt, 1991) as shown in Figure 3, we found that all roots are in the unit circle, meaning that all roots have modulus less than one. This shows that the estimated VECM is stable

Figure 3. Inverse Roots of AR Characteristic Polynomial



Impulse response functions (IRF) from the VECM estimation are used to evaluate the pass-through from exchange rate and oil price shocks to inflation. Table 4 shows the accumulated response of inflation to a structural one standard deviation shock to each of the variables. The immediate effect of a shock to the exchange rate in 12 months (1 year) is about 0.50 (or 50%) increase in the price level. The effect of an exchange rate depreciation shock in 12 months is about 0.41 (or 41%) increase in the price level while the effect of an exchange rate appreciation is about 0.14 (or 14%) decrease in the price level. Exchange rate depreciation is found to have more significant impacts on inflation than appreciation has.

Table 4. Accumulated Response of INF

Period	INF	NEER	ANEER	DNEER	OILP	IOILP	DOILP	LOG(M2)	GDPGAP
1	0.19	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	0.60	0.00	-0.01	0.00	0.00	0.00	0.01	-0.03	-0.01
3	1.19	-0.01	-0.03	-0.01	0.00	0.00	0.03	-0.10	-0.03
4	1.93	-0.01	-0.03	-0.03	-0.01	-0.01	-0.05	-0.23	-0.08
5	2.80	0.00	-0.05	-0.06	-0.04	-0.03	-0.09	-0.39	-0.14
6	3.77	0.02	-0.06	-0.10	-0.09	-0.07	-0.11	-0.58	-0.23
7	4.83	0.07	-0.08	-0.14	-0.16	0.11	-0.16	-0.80	-0.33
8	5.97	0.14	-0.10	-0.19	-0.23	0.16	-0.18	1.05	-0.45
9	7.16	0.22	-0.11	0.24	-0.30	0.21	-0.21	1.31	-0.57
10	8.41	0.31	-0.12	0.30	-0.38	0.27	-0.24	1.58	-0.69
11	9.69	0.40	-0.13	0.35	0.45	0.32	0.26	1.86	-0.80
12	11.00	0.50	-0.14	0.41	0.52	0.43	0.29	2.16	-0.90

Similarly, the immediate effect of a shock to the oil price in 12 months (1 year) is about 0.52 (or 52%) increase in the price level. The effect of an increase in oil price in 12 months is about 0.43 (or 43%) increase in the price level while the effect of a decrease in oil price is surprisingly about 0.29 (or 29%) increase in the price level. Moreover, an increase in oil price has more significant impacts on inflation than a decrease in oil price has.

These results suggest that the impact of exchange rate and oil price shocks on inflation in Nigeria is fairly large. This evidence of high impacts of exchange rate shocks on inflation in Nigeria is consistent with those found in studies such as Aliyu et al (2008), Ogundipe & Egbetokun (2010), Adelowokan (2012) and Zubair et (2013). The 50% pass-through found in the current study for exchange rate shocks is higher than any in the literature, probably because the data is of higher frequency (i.e. monthly).

Moreover, there is an evidence of significant effects of exchange rate and oil price shocks on inflation in the long run. For instance, the immediate effect of a shock to the exchange rate and oil price in 60 months (5 years) is about 1.21 (or 121 percent) and 3.91 (Or 391 per cent) increase in the price level. The results suggest that there is asymmetry in the effects of exchange rate and oil price shocks on inflation. In other words, this study has established that the magnitude of exchange rate (or oil price) transmission to inflation depend on the direction (increase or decrease) of the initial exchange rate (or oil price) shocks.

CONCLUSION AND IMPLICATIONS

In this study, we have estimated a vector autoregressive error correction (VECM) model for Nigeria in order to verify if exchange rate and oil price shocks of the last decade have been significantly transmitted to inflation. In order to do this, we have introduced both long-run and short-run relationships. The results suggest that the immediate effect of a shock to the exchange rate in 12 months (1 year) is about 0.50 (or 50%) increase in the price level. The effect of an exchange rate depreciation shock in 12 months is about 0.41 (or 41%) increase in the price level while the effect of an exchange rate appreciation is about 0.14 (or 14%) decrease in the price level.

Exchange rate depreciation is found to have more significant impacts on inflation than appreciation has. Similarly, the immediate effect of a shock to the oil price in 12 months (1 year) is about 0.52 (or 52%) increase in the price level. The effect of an increase in oil price in 12 months is about 0.43 (or 43%) increase in the price level while the effect of a decrease in oil price is surprisingly about 0.29 (or 29%) increase in the price level. Moreover, an increase in oil price has more significant impacts on inflation than a decrease in oil price has.

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established that the magnitude of exchange rate (or oil price) transmission to inflation depend on the direction (increase or decrease) of the initial exchange rate (or oil price) shocks.

Falling crude oil prices is currently impacting decision making in monetary, fiscal, trade and structural policies in Nigeria. For an oil exporter such as Nigeria, monetary policymakers will have to keep the inflation rate at the comfort zone and stabilize the Nigerian currency. From a structural policy perspective, the falling crude oil prices has certainly strained Nigeria. Nigeria must reshape its policy to redouble efforts to diversify its trade activities from oil.

REFERENCES

- Akaike, H. 1973, 'Maximum likelihood identification of Gaussian autoregressive moving average models.' *Biometrika*, 60(2), 255-265.
- Baumeister, C., & Peersman, G. 2013. 'The role of time-varying price elasticities in accounting for volatility changes in the crude oil market' *Journal of Applied Econometrics*, 28(7), 1087-1109.
- Bruno, M., & Sachs, J. 1982, 'Input price shocks and the slowdown in economic growth: The case of U.K. manufacturing', *Review of Economic Studies*, 49, 679-705.
- Calvo, G. A. and C. M. Reinhart, 2000, 'Fear of Floating', NBER Working Paper', No. 7993.
- Campa, J. M. and L. S. Goldberg 2006, 'Pass-Through of Exchange Rates to Consumer Prices: What Has Changed and Why?', NBER Working Paper, No. 12547.
- Caruth, A. A., Hooker, M. A., & Oswald, A. J. 1998, 'Unemployment equilibria and input prices: Theory and evidence from the United States', *Review of Economics and Statistics*, 80, 621-628.
- Cashin, P., Mohaddes, K., Raissi, M., & Raissi, M. 2014, 'The differential effects of oil demand and supply shocks on the global economy. *Energy Economics*', 44, 113-134.
- CBN 2016, 'Central Bank of Nigeria Statistical Bulletin', CBN, Abuja
- Cognigni, A., & Manera, M. 2008, 'Oil prices, inflation and interest rates in a structural cointegrated VAR model for the G-7 countries', *Energy economics*, 30(3), 856-888.
- Comparison between East Asia and Latin American Countries, RIETI *Discussion Paper series* 07-E-040
- Cunado, J., & De Gracia, F. P. 2005, 'Oil prices, economic activity and inflation: evidence for some Asian countries', *The Quarterly Review of Economics and Finance*, 45(1), 65-83.
- Davis, S. J., & Haltiwanger, J. 2001, 'Sectoral job creation and destruction responses to oil price changes', *Journal of Monetary Economics*, 48, 465-512.
- Dickey, D. A., & Fuller, W. A. 1981, 'Likelihood ratio statistics for autoregressive time series with a unit root. *Econometrica*', *Journal of the Econometric Society*, 1057-1072.
- Dolado J. J., and Jimeno J. F. 1997, 'The Causes of Spanish Unemployment: A Structural VAR Approach', *European Economic Review*, 41, pp. 1281-1307.
- Égert, B., Ritzberger-Grünwald, D., & Silgoner, M. A. 2004, 'Inflation differentials in Europe: past experience and future prospects', *Monetary Policy & The Economy*, (1).
- Eichenbaum M., and Evans C. L. (1995). Some Empirical Evidence on the Effects of Shocks to Monetary Policy on Exchange Rates. *Quarterly Journal of Economics*, 110, pp. 975-1009.
- Ferderer, J. P. 1996, 'Oil price volatility and the macroeconomy: A solution to the asymmetry puzzle', *Journal of Macroeconomics*, 18, 1-16.
- Hamilton, J. 1988, 'A neoclassical model of unemployment and the business cycle', *Journal of Political Economy*, 96, 593-617.
- Hamilton, J. 2000, 'What is an oil shock?', (NBER working paper 7755).
- Hooker, M. 1999, 'Oil and the macroeconomy revisited [mimeo]', Federal Reserve Board.
- Hooker, M. 2002, 'Are oil shocks inflationary? Asymmetric and nonlinear specifications versus change in regime', *Journal of Money, Credit and Banking*, 34, 540-561.
- Hooker, M. A. 2002, 'Are oil shocks inflationary? Asymmetric and nonlinear specifications versus changes in regime', *Journal of Money, Credit, and Banking*, 34(2), 540-561.
- Ito, T. and K. Sato, 2007, '—Exchange Rate Pass-Through and Domestic Inflation: A
- Jebabli, I., Arouri, M., & Teulon, F. 2014, 'On the effects of world stock market and oil price shocks on food prices: An empirical investigation based on TVP-VAR models with stochastic volatility', *Energy Economics*, 45, 66-98.
- Johansen, S. 1991, 'Estimation and hypothesis testing of cointegration vectors in Gaussian vector autoregressive models', *Econometrica: Journal of the Econometric Society*, 1551-1580.

- Johansen, S., & Juselius, K. 1990, 'Maximum likelihood estimation and inference on cointegration—with applications to the demand for money', *Oxford Bulletin of Economics and statistics*, 52(2), 169-210.
- Jones, P. M., & Olson, E. 2013, 'The time-varying correlation between uncertainty, output, and inflation: Evidence from a DCC-GARCH model', *Economics Letters*, 118(1), 33-37.
- Kahn, G., & Hampton, R. 1990, 'Possible monetary policy responses to the Iraqi oil shock', *Federal Reserve Bank of Kansas City Economic Review*, 2, 19-32.
- Khan, A. A., Hyder, K., & Ahmed, Q. M. 2007, 'Determinants of recent inflation in Pakistan', *Social Policy and Development Centre*.
- Kibritçioglu, Aykut 2002, 'Causes of Inflation in Turkey: A Literature Survey with Special Reference to Theories of Inflation', In: *Inflation and Disinflation in Turkey*, ed. by Kibritçioglu, A., L. Rittenberg, and F. Selçuk, Aldershot: Ashgate, pp. 43-76.
- Kim S., and Roubini N. 2000, 'Exchange Rate Anomalies in the Industrial Countries: A Solution with a Structural VAR Approach', *Journal of Monetary Economics*, 45, pp. 561– 86.
- Kim, I., & Loungani, P. 1992, 'The role of energy in real business cycle models', *Journal of Monetary Economics*, 29, 173-189.
- Lee, K., Ni, S., & Ratti, R. A. 1995, 'Oil shocks and the macroeconomy: The role of price variability', *Energy Journal*, 16, 39-56.
- Liu, L. and A. Tsang 2008, '—Exchange Rate Pass-Through to Domestic Inflation in Hong Kong', *Hong Kong Monetary Authority Working Paper*.
- Lütkepohl, H., & Poskitt, D. S. 1991, 'Estimating orthogonal impulse responses via vector autoregressive models', *Econometric Theory*, 7(04), 487-496.
- Maghyereh, A. I., Awartani, B., & Sweidan, O. D. 2016, 'The Impact of Oil Price Uncertainty on Real Output Growth in the Middle East Oil-Importing Countries: An Empirical Investigation', Available at SSRN.
- Mork, K., Olsen, O., & Mysen, H. T. 1994, 'Macroeconomic responses to oil price increases and decreases in seven OECD countries', *Energy Journal*, 15, 15-38.
- Phelps, E. S. 1994, '*Structural slumps*', Cambridge: Harvard University Press.
- Rasche, R. H., & Tatom, J. A. 1981, 'Energy price shocks, aggregate supply and monetary policy: The theory and international evidence', *Carnegie—Rochester Conference Series on Public Policy*, 14, 125– 142.
- Salami, A., & Kelikume, I. 2013, 'Is inflation always and everywhere a monetary phenomenon? The case of Nigeria.', *The International Journal of Business and Finance Research*, 7(2), 105-114.
- Tatom J. 1988, 'Are the macroeconomic effects of oil price changes symmetric?' *Carnegie—Rochester Conference Series on Public Policy*, 28, 325-368.
- Taylor, J. B. 2000, '—Low Inflation, Pass-through, and the Pricing Power of Firms', *European Economic Review*, 44(7): 1389-1408
- Taylor, J., 2000, 'Low Inflation, Pass-Through and the Pricing Power of Firms', *European Economic Review*, Vol. 44, pp. 1389-1408.
- Toda, H. Y. 1995, 'Finite sample performance of likelihood ratio tests for cointegrating ranks in vector auto regressions', *Econometric theory*, 11(05), 1015-1032.
- Wehinger, G. D. 2000, 'Causes of inflation in Europe, the United States and Japan: Some lessons for maintaining price stability in the EMU from a structural VAR approach', *Empirica*, 27(1), 83-107.
- Whitehead, L. 1979, 'The political causes of inflation. *Political Studies*', 27(4), 564-577.
- Zubair, A., George, O., & Sanusi, A. R. 2013, 'Exchange Rate Pass-Through to Domestic Prices in Nigeria: An Empirical Investigation', *Central Bank of Nigeria Economic and Financial Review*, 51(1).