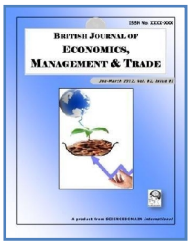

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Are Exchange Rates in Nigeria Useful in Predicting Global Commodity Prices?

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Authors' contributions

This work was carried out in collaboration between both authors. Author DOY designed the study, conducted the background to the study and provided required guide throughout the research process. Author AA performed the statistical analysis and wrote the draft manuscript. Both authors jointly read and approved the final manuscript.

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ABSTRACT

In this paper, we explore granger causality between the global commodity prices and exchange rate of Nigerian 'Naira'. The analysis through the use of Vector Error Correction (VEC) Granger Causality/Block Exogeneity Wald Test shows that the long run pattern of crude oil prices at the international market could be largely predicted given the basic information on real exchange rate of Naira. The same applies to the long-run predictability of the real exchange rate given basic information on the price of crude oil. Meanwhile, the information on the nominal exchange rate of Naira could only assist in the short-run prediction of the global prices of crude oil and other commodity prices. Consequently, given that Nigeria, like many other countries do not have control over world commodity prices, since they are determined competitively, the outcome of this analysis will enable policy makers to adapt domestic policies to curtail adverse consequences of unexpected movement in world commodity prices. It is especially useful in predicting the volatile crude oil price which is the economic nerve of Nigeria economy, based on the prior information from domestic real exchange rates.

Keywords: Crude oil prices; global commodity prices; Nigeria exchange rate.

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1. INTRODUCTION

Despite the growing global interests on the causal relationship between exchange rates and global commodity prices and its implications for public policy [1-6], similar efforts are currently lacking in Nigeria. In short research on exchange rate and global commodity pricing from Nigeria perspective is limited. While none of the studies explore the causality of exchange rates and commodity prices, few existing literatures focus on either internal stabilisation of output through foreign exchange [7], convergence and divergence of exchange rate towards equilibrium [8], causal relationship between exchange rate volatility and dollarization in Nigeria [9] and closely related to the aim of this paper is the work of Adubi and Okunmadewa who researched the effects of exchange rate fluctuations on Nigerian agricultural export markets [10]. However, while the work of Adubi and Okunmadewa tried to find the connection between the exchange rate and price of agricultural products in Nigerian, it avoids investigating its causality. Rather, it focused on the effect of both the price change and exchange rate volatility on the volume of agricultural export. The paper also emphasise non-oil product and less emphasis on crude oil, from where the bulk of foreign exchange to Nigeria emanate. The peculiarity of Nigeria situation as against the existing studies in other countries is not only the incessant change in the exchange rate regime but also high dependency of Nigeria foreign earning on crude oil which has very high volatile pricing in the global market. Hence, while it is important for any open economy operating a market determined exchange rate regime and at the same time involved in buying and selling of commodities in the global world market to have a clear understanding of this causal relationship for the purpose of macroeconomic policy design and implementation, it is particularly very crucial for Nigeria with over 90 percent of its revenue coming from commodity (crude oil) whose price volatility can make or mal its budget implementation. As such it may complicate its set macroeconomic objectives.

Theoretically, a country that exports a great deal of her commodity to another country, causes the price of that good to rise and the quantity consumed of that good to go up. When the country sells more goods at a higher price, it causes the local currency to gain value relative to the foreign currency through one of two mechanisms; foreign buyers may decide to pay in local currency, in such case the buyers need to sell foreign currency on the foreign exchange market and purchase local currency to facilitate the transaction. This causes the quantity of foreign currency to rise in the market and the quantity of local currency to fall. To keep the market in equilibrium, the value of the foreign currency must depreciate and that of the local currency appreciate. Alternatively, foreign buyers may decide to pay in foreign currency. However in such case, because all factors of production are paid in local currency, the foreign currency would be sold in the foreign exchange market in exchange for local currency. The effect remains the same as the first mechanism. Further to the value rise in the local currency, the increase in the demand for the commodity especially where the country occupy dominant position in the world market has strong tendency to facilitate the corresponding rise in the price of the commodity at the international commodity market. However, if the country occupy insignificant position in the world commodity market, the analysis only hold in two currencies bi-lateral relationship.

Following this argument, there are limitations to the application of the theoretical basis of free market operation of foreign exchange market in Nigeria where quasi or otherwise managed floating exchange rate is dominant. It therefore questions any univestigated submission to the existence of causal relationship between the global commodity price and exchange rate, even those of non-oil products. Deliberate devaluation of currency to stabilise the international trade and the economic activity may promote export through the increase in

the income of the export commodities and also enhance foreign investment. The effect of such interference on the structure and volume of export in Nigeria has been empirically affirmed in literature [10,11].

More so, frequent change in exchange rate regime and instability of the exchange rate movements since late '70s poses sceptic on the implication of exchange rate on the global price determination of the export commodities from Nigeria. While the changes in income earnings of exporters come through either changes in international world price of exports or changes in currency valuation, such changes however, might lead to a major decline in future transaction if it is unpredictable and erratic. Fluctuation, positive or negative has been argued to be undesirable as it increases risk and uncertainty in international transactions, thus may discourage trade [10]. This also questions the generalisation of previous findings on Nigeria economy. Focus study on the empirical findings, which aims at establishing direction of causation between the exchange rate and global commodity prices in Nigeria is therefore timely and very critical.

2. RECENT LITERATURE REVIEW

It is demonstrated in [12] that exchange rates have remarkably robust power in predicting future global commodity prices using data from Australia, Canada, Chile, New Zealand and South Africa. They also find that the reverse relationship holds; that is commodity prices Granger-cause exchange rates. Another related study by [13] found the co-movement in the exchange rate and commodity price, although the studies did not explore the causality between the two variables, it rather emphasises their convergence point of equilibrium. However, it could be inferred from the study that the existence of causation could not be ruled out between the two variables although the direction of causality was left un-investigated. A recent work on the exchange rate and commodity price that centre on Nigeria is by [14] where he adopted GARCH approach to verify the nexus of the exchange rate and oil price without prior investigation of the direction of causation.

[6] Explored the relationship of oil prices–US dollar real exchange rate to investigate the linear and non-linear Granger causality between the real oil price and real effective U.S. dollar exchange rate. Meanwhile [15], using the same approach, explored linear and nonlinear Granger causalities between oil price and the real effective exchange rate of the Indian rupee. They could not find any causal relationship with their basic analysis until they revisit the relationships among the decompose series on a scale by scale basis using a battery of non-linear causality tests in the time and the frequency domain. They then discovered linear and nonlinear causal relationships between the oil price and the real effective exchange rate of Indian rupee at higher time scales with lower frequency [6]. Studies also used a continuous wavelet procedure to investigate the change in the real exchange rate and the change in the oil price differential for Bangladesh. They find a cycle of 32 months and more, though they argue for less convincing evidence of coherence sustainability between the change in real oil price and exchange rate in Bangladesh. A related study was also conducted by [16] on the relationship between oil prices and US dollar exchange rates by using the wavelet multi-resolution analysis and found non-dependent of the variables in the pre-crisis period; however, they established a negative dependence after the onset of the crisis.

[3] In their studies considered the price of crude oil as the primary variable that can explain the movements of foreign exchange rate. Also [2] established a predictability of oil (and other commodities) by using exchange rate [16]. In his study found that an increase in oil prices

and depreciations against the dollar are weakly associated with two types of causality for different currencies. He points out that such a relationship seems to be stronger for oil-exporting countries than for oil-importing countries and that the intensity of the relationship between oil prices and dollar exchange rates increased immediately after the onset of the financial crisis.

[17] While incorporating commodity price in the model of exchange rate, argued that there are sufficient evidence that factors such as movements in commodity prices and the terms of trade are statistically significant in explaining both short and long-run movements in the exchange rate using Australian dollar relative to foreign currencies. However, it limits the studies on a mono directional relationship, while it silent on their causality. Moreover, the existing studies use more of commodities with less volatile pricing such as agriculture and finished manufacturing products in various studies. The question of the generalisation of the findings in the countries that deal in the products with much volatile price such as Nigeria with about 90% of foreign exchange from crude oil is left unresolved.

In another perspective, literatures on exchange rate and global commodity price determination as earlier reviewed are intense and robust [5] but the research emphasises more on the exchange rate behavior and pattern in the developed economies than it is in the developing economies. However, inferences are made to possible pattern in the developing countries [12]. Many of the researches are consistent with forward looking approach to foreign exchange as a predictor of future price determination and not the other way [12,13,18,19]. Meanwhile, few other literatures argue that most commodities are very sensitive to small shock on demand and supply which are likely to curtail its forward looking attributes. In this case, the disruption may result from local macroeconomic variability. It is assumed that certain domestic policies such as monetary policy influences the exchange rate [19], which implies that monetary policy makers respond to the exchange rate in setting the money supply. However, literature is not clear on how the local policy might bring global commodity price determination and exchange rate together. In what follows in this paper, we present a review of the exchange rate regimes and commodity price determination in Nigeria.

2.1 Nigeria Exchange Rate Regimes and Commodity Pricing

The choice of exchange rate regime varies from extreme fixed, adjustable peg, crawling peg, and managed floating to extreme floating [20]. Each of the administration has different impact on both the domestic economic activities and terms of trade at the international level. Nigeria in her quest for economic stability has also gone through different exchange rate practices. The ‘erratic’ exchange rate administration and management in Nigeria could be traced to 1960s, when fixed exchange rate was being practice. It could also be traced to the early 70s up to mid-80s when fixed exchange rate was being promoted. Thereafter, the economy retired to floating exchange rate in 1986 when the structural adjustment program was introduced.

There was no strong basis for serious exchange rate policy when Nigeria received independent in 1960s based on the economic and trade relationship between Nigeria and Britain, which allowed the adjustment of Nigeria currency to Great Britain pounds on ratio one to one. In the late 1960s fixed parity arrangement was promoted between Nigeria Naira and United States Dollars, this arrangement was modified towards the mid-1970s which pegged Naira against either Dollars or Great Britain Pounds depending on which of the currencies appeared stronger [7]. The implication of policy was to align the economy with

prevailing economic reality but at the same time to strengthen Nigeria currency and also guide against inflation in the country, although like every other fixed exchange rate policy, it subjects the economy to external shock and monetary policy dependence. More so, the policy was aimed at reducing transaction cost, promote macroeconomic discipline and economic credibility due to its accompanied exchange rate stability. It also eases the management of possible domestic shock; ultimately, the regime has strong relative potential for export commodity price stability.

The endless naira appreciation policy over the period was supported by the oil boom which promoted huge earnings from crude petroleum exports and allowed consistent balance of payments surplus. During the period, the pricing of agricultural export commodities were done by marketing boards that were responsible for fixing prices and ensuring quality of products. The prices of the agricultural products were stable except the fluctuation in connection with external factors at the international market. Sharp drop in the foreign exchange earnings in the early 1980s due to sharp collapse in the oil market which was a dominant source of foreign earning to Nigeria ushered in economic crisis.

At the end of 1985, the crisis deepened, which prompted government introduction of flexible exchange rate. The advantage of this arrangement was that changes in the demand and supply of foreign exchange could alter exchange rates but not the country's international reserves; it thus, halted rapidly depleting foreign reserve under the preceding regime. The flexible regime was also aimed at preventing the economy from external shocks which allowed the monetary authorities full discretion in the conduct of monetary policy [20]. But the major disadvantage of the flexible exchange rate which includes persistent exchange rate volatility, high inflation and increasing transaction cost, couple with government desire to manipulate domestic policy to stabilise the economy in the face of the prevailing volatility, allowed many rates that diverged widely from one another in the economy. Over the period, when the floating exchange rate was operative between 1985 and 1993, the attended distortions in the exchange rate made it difficult to predict the path towards its stability [21], the link between commodity price determination and exchange rate therefore was very difficult to establish.

The problem of floating exchange rate and its inability to achieve economic stability led to the introduction of managed floating in which government intervene to influence the market. Central Bank's course of the exchange rate depends on what it aims to achieve. The change in the supply and demand is no more a sole determinant of the exchange rate; central bank act when necessary to drawdown the external reserve in order to control the market towards a predetermined course. Different variant of managed floating has been implemented; Autonomous Foreign Exchange Market (AFEM) was introduced in 1995. Few years thereafter, the reality could not justify the initial objective for its set-up. Inter-Bank Foreign Exchange Market (IFEM) was introduced as a replacement on October 25, 1999. IFEM was intended at diversifying the supply of foreign exchange as a way to enhance funding of the inter-bank operations from privately-earned foreign exchange. It also aimed at assisting naira to achieve realistic exchange rate. IFEM however, experienced similar setbacks as the AFEM, due to supply-side rigidities, persistent expansionary fiscal operations of government and the attendant problem of persistent excess liquidity in the system contributed to failure of IFEM [20].

Failure of the exchange rate regime could be traced to the dominant monoculture economy of Nigeria which depends largely on crude oil export with foreign exchange earning of above 90%. The volatility attributed to the crude oil pricing subjects the country to unstable

exchange rate. Foreign exchange rises with the increase in the crude oil price and vice versa. The small size of non-oil commodity export relative to crude oil makes the trajectory of foreign exchange and commodity price determination a complicated one which require sophisticated economic analysis.

3. MODEL SPECIFICATION

This paper adopts pairwise Granger Causality test between the exchange rate EXR and commodity price CP within VAR structure.

In the bi-variate VAR describing variable x and y, y does not granger cause x if the coefficient matrix $\emptyset_J$ are lower triangular for all values of J:

$$\begin{pmatrix} x_t \\ y_t \end{pmatrix} = \begin{pmatrix} \propto_1 \\ \propto_2 \end{pmatrix} + \begin{pmatrix} \emptyset_{11}^1 & 0 \\ \emptyset_{21}^1 & \emptyset_{22}^1 \end{pmatrix} \begin{pmatrix} x_{t-1} \\ y_{t-1} \end{pmatrix} + \begin{pmatrix} \emptyset_{11}^2 & 0 \\ \emptyset_{21}^2 & \emptyset_{22}^2 \end{pmatrix} \begin{pmatrix} x_{t-2} \\ y_{t-2} \end{pmatrix} + \begin{pmatrix} \emptyset_{11}^\rho & 0 \\ \emptyset_{21}^\rho & \emptyset_{22}^\rho \end{pmatrix} \begin{pmatrix} x_{t-\rho} \\ y_{t-\rho} \end{pmatrix} + \begin{pmatrix} \mu_{1t} \\ \mu_{2t} \end{pmatrix} \dots\dots\dots (1)$$

From the first row of the above system, the optimal one-period ahead forecast of x does not depend on lagged value of y but on its own lagged values, that is:

$$E(x_{t+1}|x_t, x_{t-1}, \dots y_t, y_{t-1}..) = \propto_1 + \emptyset_{11}^1 x_t + \emptyset_{11}^2 x_{t-1} + \cdots + \emptyset_{11}^\rho x_{t-\rho+1} \dots\dots\dots\dots (2)$$

To implement the test, the optimal lag length ρ suggested by various criteria is adopted and eq. 3 below is estimated within the VAR structure:

$$W_t = (CP_t, EXR_t)' \dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots (3)$$

W_t is the column vector of the variables. Explicitly:

$$CP_t = \alpha_1 + a_1 CP_{t-1} + a_2 CP_{t-2} + \cdots + a_p CP_{t-\rho} + b_1 EXR_{t-1} + b_2 EXR_{t-2} + .. + b_p EXR_{t-\rho} \dots (4)$$

$$EXR_t = \alpha_2 + a_1 EXR_{t-1} + a_2 EXR_{t-2} + .. + a_p EXR_{t-\rho} + b_1 CP_{t-1} + b_2 CP_{t-2} + .. + b_p CP_{t-\rho} \dots (5)$$

Eq. (3) and (4) shows that the optimal one-period-ahead forecast of CP_t (EXR_t) does not depends on lagged values of $EXR_t(CP_t)$ but its own lagged values.

For possible pairs of CP_t and EXR_t, ρ is the optimal lag length adopted. Reported F-Statistic are the Wald-statistic for the joint hypothesis.

$$b_1 = b_2 = \dots\dots\dots = b_\rho = 0 \qquad \dots\dots\dots (6)$$

The null hypothesis in eq. (6) states that $EXR_t(CP_t)$, does not granger cause CP_t (EXR_t) in equation (4) and (5) respectively.

If any of the coefficient b_i ; i = 1,2.....ρ is significantly different from zero, null hypothesis (6) is rejected in either or both cases in eq. (4) and (5). In case any of coefficient b_i is significantly different from zero in both equation (4) and (5), then bi-directional causality holds.

4. DATA: SOURCES AND MEASUREMENT

Monthly time series data on official exchange rate is collected from 2010 edition of statistical bulletin of Central Bank of Nigeria. The nominal exchange rate (NEXR) is deflated by the price index to arrive at the real exchange rate (REXR). The commodity price index; crude oil price and Non-Oil Commodity price are collected from the International Monetary Fund (IMF) as published in the Index Mundi database. United State Consumer Price Index is drawn from the US Burau of Labour Statistics database, while the Consumer Price Index of Nigeria are drawn from the National Bureau of Statistics. United States Dollar (USD) is used as proxy for the global currency. The quarterly data for the analysis covers from the first quarters of 1995 to the fourth quarters of 2009 being the limit of the available data for all the variables as at the time of the analysis. The periods exclude the earlier years when the fixed and managed floating exchange rate were being practiced in Nigeria. In other words, the analysis covers the period of floating exchange rate regime in Nigeria.

5. ESTIMATION AND ANALYSIS

5.1 Unit Root Test

Unit root test is used to verify the stationary of time series data. It is required that time series data be stationary to prevent spurious rejection or acceptance of null hypothesis or otherwise making meaningless statistical inference from the result of the analysis. If the data are therefore trending, the trend removal are required [22]. Two common trend removal or de-trending procedures are first differencing and time-trend regression. First differencing is appropriate for I(1) time series and time-trend regression is appropriate for trend stationary I(0) time series. Unit root tests can be used to determine if trending data should be first differenced or regressed on deterministic functions of time to render the data stationary.

Philips and Perron, Augmented Dickey Fuller (ADF) and Ng and Perron unit root tests were adopted for this analysis. The Phillips-Perron (PP) unit root tests only differ from the ADF tests, mainly in how they deal with serial correlation and heteroskedasticity in the errors. While the ADF tests use a parametric autoregression to approximate the structure of the errors in the test regression, the PP tests ignore any serial correlation in the test regression using non-parametric method.

Ng Perron unit root test differ from other unit root test for its robustness to size distortions when the residual have negative serial correlation [23]. Ng-Perron test procedure was built on the findings in [24] that local GLS detrending of the data yields substantial power gains. Ng Perron test using GLS detrending procedure therefore argued that non-negligible size and power gains can be made when used in conjunction with an autoregressive spectral density estimator at frequency zero, provided that the selection of truncation lag is appropriate. In other words, Ng Perron adjusts for the under fitting and over fitting that may arise from inappropriate lag length selection in information criteria. For instance, AIC under-estimates by selecting too small lag length when unit root has negative moving-average root. Hence, this study used ADF, PP and Ng-Perron tests. The results of ADF and Philip Perron Unit Root Tests are presented in Table 1, while that of the Ng-Perron are presented in Table 2.

Table 1. ADF and Philip perron unit root tests on real and nominal exchange rate and crude oil and commodity prices

Variable	Unit Root Tests			
	ADF		PP	
	Level	1st diff.	Level	1st diff.
With intercept only				
REXR	1.6411	-5.5625*	1.2709	-5.5444*
NEXR	-0.2842	-5.9624*	-0.4357	-5.9624*
COILPI	-0.9956	-7.6875*	-1.1546	-8.5885*
COPI	-0.7387	-7.4707*	-0.883	-6.6701*
With Intercept and Trend				
REXR	-1.868	-5.815*	-1.3972	-5.8150*
NEXR	-2.0365	-5.8993*	-1.913	-5.8993*
COILPI	-4.134*	-4.9511*	-2.804	-9.7183*
COPI	2.3184	-4.698*	-2.3571	-8.6530*

ADF is the Augmented Dickey-Fuller test and PP is the Phillips-Perron test. *Indicate rejection of the null hypothesis of non-stationary at 1%, and **indicates stationary at 5% critical values.

The result of ADF as presented in Table 1 shows that the presence of unit root hypothesis for all variables are not rejected at level I(0) in both the intercept and intercept with trend tests, except COILPI which rejects null hypothesis at 1% significant level when tested for intercept and trend. However, the presence of Unit roots are rejected for all the variables when tested at first difference I(1). Philip Perron unit root test confirms the ADF test for all variables at first difference, both with intercept and intercept and trend.

The result of Ng-Perron test as presented in Table 2 and Philip-Perron test are identical for all variables. At 1% significant level, all variables are non-stationary at I(0) but stationary at first difference I(1).

Table 2. Ng-perron unit root test on real exchange rate, nominal exchange rate, cruide oil and commodity

Variable	**Unit Root Tests**							
	Ng- Perron							
	Level				1st diff.			
	Mza	MZt	MSB	MPT	Mza	MZt	MSB	MPT
With intercept only								
REXR	2.7348	2.2789	0.8333	67.049	-26.5525*	-3.6314*	0.1368*	0.9628*
NEXR	0.6084	0.3522	0.5789	26.1106	-25.3298*	-3.5539*	0.1403*	0.9835*
COILPI	-1.6293	-0.6639	0.4075	11.295	-77.6383*	-6.2249*	0.0802*	0.3274*
COPI	-1.2848	-0.5493	0.4275	12.6066	-79.3101*	-6.2834*	0.0792*	0.3377*
With Intercept and Trend								
REXR	-10.6947	-2.0562	0.1923	9.7217	-26.8608*	-3.6502*	0.1359*	3.4785*
NEXR	-8.8074	-2.0871	0.237	10.389	-27.1565*	-3.6571*	0.1347*	3.5194*
COILPI	-11.7816	-2.4252	0.2058	7.7448	-77.3674*	-6.2170*	0.0804*	1.1889*
COPI	-7.7871	-1.9624	0.252	11.7299	-78.7513*	-6.2677*	0.0796*	1.1875*

M-test (MZa, MZt, MSB and MPT) statistic of Unit Roots are rejected based on the p-value computed by Ng_Perron (2001; Table 1). *Indicate rejection of the null hypothesis of non-stationary at 1%, and **indicates stationary at 5% critical values.

5.2 Co-integration

The result of unit root tests above requires the test of co-integration to verify a long-run relationship among the variables. Co-integration involves testing the relationship among the variables, since the verification of the data stationary has been made. Theoretically, If non-stationary time series data have the same order of integration and there exist linear combination of the series that is stationary, the series is referred as being stationary [25]. Co integration means that time series move together in the long run, which implies that the error term resulting from the linear combination of time series quantifies the deviation of the time series from their common long-run relationship and can therefore be used to predict their future values [26]. Johansen technique is used to test for co-integration among the variables in this paper. The result of the "trace statistic" and the "maximum Eigen value test" as proposed by [27] is presented in Table 3 below:

Table 3. Trace and maximum Eigen value co-integration test among the indexes and exchange rate variables

			Trace Test		Max. Eigen Value Test	
	Ho: No of CE	Eigen Value	Statistic	**Prob.	Statistic	**Prob.
COILPI & REXR	0	0.2372	19.3322	0.0125*	15.7066	0.0294*
	1	0.0606	3.6256	0.0569	3.6256	0.0569
COPI & REXR	0	0.2134	18.2527	0.0187*	13.9213	0.0566
	1	0.072	4.3314	0.0374*	4.3314	0.0374*
COILPI & NEXR	0	0.1263	7.8318	0.4835	7.8317	0.396
	1	1.28E-06	7.42E-05	0.9942	7.42E-05	0.9942
COPI & NEXR	0	0.1097	6.7691	0.6046	6.7423	0.5201
	1	0.0005	0.0269	0.8698	0.0269	0.8698

*Rejection of the hypothesis at 5% significance level for both the Trace and Maximum Eigen Value Tests. **MacKinnon-Haug-Michelis (1999) *p* -values.

Both Trace and Maximum Eigen Value reveals that one co-integrating relationship exists between the Real Exchange Rate (REXR) and Crude Oil Price Index (COILPI). Trace Test reveals two co-integration equation between Real Exchange Rate (REXR) and Commodity Price Index (COPI), while Maximum Eigen Value Test reveals no co-integration. The Trace and Maximum Eigen Tests shows no co-integration between the Nominal Exchange Rate (NEXR) and Crude Oil Price Index (COILPI) and also Nominal Exchange Rate (NEXR) and Commodity Price Index (COPI)

The above co-integration test shows that long-run relationship exist between the real exchange rate and crude oil price (COILPI) on one hand and commodity prices (COPI) on the other hand. However, the absence of the co-integration between the nominal exchange rate (NEXR) and commodity price (COPI) and crude oil prices (COILPI) is an indication of absence of long run relationship, thus the causality test could only be verified for the short-run relationship.

5.3 The Causality Test

The non-stationary of data at level prevents the use of VAR for the estimation. Instead the Error Correction Model (VECM) is adopted. Meanwhile, carrying out the estimation of

causality test requires a selection of appropriate lag length. To actualise this in the presence of weaknesses attributed to various individual lag selection criteria, automatic lag length suggested by the data is used. The results of ECM Causality test/Block Exogeneity Wald tests are reported in the Tables 4-7. However, robustness check through stabilisation test using CUSUM recursive test of structural break to discover any possible break point in the data are carried out. This is conducted to prevent a spurious conclusion. The result of the stability test as presented in the appendix shows that all the variables for the VEC analysis are stable. Thus, the results of the causality test presented below are reliable.

Table 4. Crude oil price and real exchange rate VEC granger causality test/block exogeneity wald test

Dependent Variable: D(COILPI)			
Excluded	Chi-sq	df	Prob.
D(REXR)	23.0148	2	0.0000*
Dependent Variable: D(REXR)			
Excluded	Chi-sq	df	Prob.
D(COILPI)	11.974	2	0.0025*

*indicates the rejection of null hypothesis of no causality at 1% significant level

From the result presented in the Table 4 above, hypothesis that real exchange rate (REXR) does not granger cause crude oil price (COILPI) could be rejected, the same applies to the Crude Oil Price to Real Exchange Rate (REXR). The same result applies to the causality between Real Exchange Rate (REXR) and Commodity Price Index as presented in Table 5. This implies that there exists two ways causality between the real exchange rate and crude oil prices. The same exist between the real exchange rate and commodity prices. In other words, there exists sustainable long run causality among the variables.

Table 5. Commodity price and real exchange rate VEC granger causality test/block exogeneity wald test

Dependent Variable: D(COPI)			
Excluded	Chi-sq	df	Prob.
D(REXR)	22.2507	2	0.0000*
Dependent Variable: D(REXR)			
Excluded	Chi-sq	df	Prob.
D(COPI)	9.5796	2	0.0083*

*indicates the rejection of null hypothesis of no causality at 1% significant level

The causality test is also carried out on the nominal exchange rate and both the crude oil prices and commodity prices. However, the test is based on the short-run relationship as against the long-run relationship under the real exchange rate with the crude oil price and commodity price. This is because of the absence of long-run relationship between the

nominal exchange rate and the two price index variables. From the result of the short-run causality test, as presented in the Table 6 and 7 below, there are two-way causality between nominal exchange rate (NEXR) and crude oil prices (COILPI), though the causality is stronger from the crude oil price to nominal exchange rate than it is from the nominal exchange rate to the crude oil price. The same result is established between the nominal exchange rate (NEXR) and the Commodity Prices (COPI). In other words, both the crude oil price and commodity price granger cause the nominal exchange rate, than how the nominal exchange rate causes either of the crude oil price or commodity price.

Table 6. Crude oil price and nominal exchange rate VEC granger causality test/block exogeneity wald test

Dependent Variable: D(COILPI)			
Excluded	Chi-sq	df	Prob.
D(NEXR)	7.5338	2	0.0231**
Dependent Variable: D(NEXR)			
Excluded	Chi-sq	df	Prob.
D(COILPI)	26.3308	2	0.0000*

*indicates the rejection of null hypothesis of no causality at 1% significant level; **rejection at 5%

Table 7. Commodity price and real exchange rate VEC granger causality test/block exogeneity wald test

Dependent Variable: D(COPI)			
Excluded	Chi-sq	df	Prob.
D(NEXR)	9.2548	2	0.0098*
Dependent Variable: D(NEXR)			
Excluded	Chi-sq	df	Prob.
D(COPI)	24.6851	2	0.0000*

*indicates the rejection of null hypothesis of no causality at 1% significant level

6. DISCUSSION OF RESULTS AND POLICY IMPLICATION

The results from the analysis have implication for the Nigerian economy and international trade activities grappling from the broad perspectives on which the analysis is based. The nominal exchange rate analysis assist in understanding the periodic fluctuation of the pricing mechanism of the domestic currency as the exchange fluctuate in the currency market. Meanwhile the result from this research work is discussed in variances as the outcome is multi faceted. The short run relationship exists among some of the variables while some exhibit long-run relationship. Also causalities are stronger from some variables that it is for some other variables.

From the outcome of the real exchange rate and the commodity prices; crude oil price and non-oil (commodity) price exhibit a long-run bi-directional causality. By implication, the understanding of the behavior of the real exchange rate would assist in the prediction of the world commodity prices of both the crude oil which is the economic base of Nigeria economy and other non-oil commodity prices. In other way, if there exist information on the commodity prices, it is possible to predict the pattern and size of the real exchange rate in Nigeria.

The fundamental policy advantage of this is in the ability of the policy makers and administrators to forecast into the future of the global commodity prices base on the information on the exchange rate and vice versa. In other words, given that Nigeria, like many other countries do not have control over world commodity prices since they are determined in a competitive manner, information about the causal relationship will enable policy makers to adapt domestic policies to curtail adverse consequences of unexpected movement in world commodity prices especially the crude oil price which is the economic nerve of Nigeria economy, based on the prior information from domestic real exchange rates.

The real exchange rate and commodity prices have definite pattern of movement as such an initial understanding of one assist in the prediction of the other both in the short and long-run. The finding from this study is partly consistent with [12] studies of five developed economy in which a long-run mono directional causality is verified from the exchange rate to the commodity price. The findings however support various studies by Uddin, et al [5,6], except the study on the India Rupee where no causality was discovered until they resolve to the use of a battery of non-linear causality tests in the time and the frequency domain.

Interestingly the findings for real exchange rate is different from the behavior of the nominal exchange rate, in which the causality runs from the nominal exchange rate to both the crude oil and non-oil commodity prices but only in the short run. This implies that the price index, both the crude oil and other commodities assists in predicting the short-run nominal exchange rate and also the exchange rate assist in predicting the global crude oil and other commodity prices. The short-run phenomenon demonstrated in the study is significant to the Nigerian economy given that the nominal exchange rate, though volatile, but could be easily modeled. The findings therefore are eye opener on the short-run predictability of commodity prices, given that adequate information on the short-run foreign exchange is available. The same applied other way round.

Significant to the study is the separation of crude oil price from other commodities, knowing that Nigeria economy is mono cultural with crude oil dominated export earnings. To the effect, the analysis has a different implication on Nigeria economy compared to the previous related studies in other countries as a result of high price volatility of crude oil relative to any other commodity. For instance, if a country like Nigeria which exports a great deal of her crude oil to the world market could influence the price, selling more causes the real value of Nigeria Naira to appreciate relative to the foreign currency such as United States Dollars (USD). This happens through one of two mechanisms; foreign buyers may decide to pay in Naira, in such case the buyers need to sell USD on the foreign exchange market and purchase Naira to facilitate the transaction. Thus to keep the market at the equilibrium, the value of the foreign currency must depreciate and that of the local currency appreciate. However, in reality, the Nigeria export is insignificant in the world market without any influence on the volatile price of the crude oil. This study enables the domestic information on the exchange rate to assist in predicting the global price of crude oil.

7. CONCLUSION

This research has provided significant insight into the predictability of global commodity prices through the initial information on the exchange rate in Nigeria. It may be difficult for a single country to have control over world commodity prices, because they are determined in a competitive manner. In such circumstances, countries may suffer internal shock of adverse consequences of the global price change. To avoid this, the information about the causal relationship between the global commodity prices and domestic exchange rate, as demonstrated in this study enables policy makers to use domestic information to mitigate adverse consequences of unexpected movement in world commodity prices.

Specifically the research has demonstrated that, the causality results show that the long run pattern of crude oil prices at the international market could be largely predicted given the basic information on real exchange rate of Naira. The same applies to the long-run predictability of the real exchange rate in Nigeria given basic information on the price of crude oil. In addition the information on the nominal exchange rate of Nigerian Naira could assist in the short-run prediction of the global commodity prices, especially the crude oil which is a main stay of the Nigerian economy.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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