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Real Exchange Rate, Innovation and Productivity in Nigeria

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ABSTRACT

This study analyzes the misalignment of real exchange rate and output of the Nigeria industrial sector. Following the objectives of the study, we formulated three research questions and three hypotheses to guide the study. Data were secondarily sourced from the Central Bank of Nigeria Annual Reports. Data collected were analyzed using the Ordinary Least Square method of analysis. The study employed econometric technique involving Augumented Dickey fuller (ADF) for unit root test. Our findings revealed that real exchange rate had significant influence on industrial output. Again, foreign exchanges with contentious export drive from both oil and non-oil products contribute enormously to increase industrial output. The study further reveals that the capacity utilization ratio is low, this may not be too far away from, partly epileptic power supply, lack of adequate and appropriate technology.

INTRODUCTION

The aftermath of the global financial crisis, the expansionary policies implemented therein, and the end of the commodity cycle in emerging markets have renewed the debate on the effects of real exchange rate (RER) movements on the economy. Policy-makers in Asia and Latin America have expressed concerns that large capital inflows can bring about the appreciation of their RER and subsequent losses of competitiveness. Similarly, in rich countries, concerns about appreciated RER and their impact on economic activity, mainly in the manufacturing industry, have made recent headlines (Alfaro, Cunat, Fadinger & Liu 2018).

At the aggregate level, for example, there has been much talk about reserve accumulation and capital controls to limit exchange rate appreciations. At the micro-economic level, the idea of governments defining interventionist industrial policies has ceased to be taboo even in the political debate of market-friendly countries (Rodrik, 2008).

The growing potentials of Industrial sector of an economy is strategic to the macro-economic framework of such a nation, to the extent that the sector plays a catalytic role and has many dynamic benefits that are crucial for economic transformation. It is an avenue for increasing productivity in relation to import substitution and export expansion, creating foreign exchange earning capacity, raising employment, promoting the growth of investment at a faster rate than any other sector of the economy, as well as wider and more efficient linkage among different sectors (Fakiyesi, 2005). In many economies, the performance of the Industrial Sector is the gauge for assessing the effectiveness of macroeconomic policies. Government policies; particularly exchange rate

policies can only be deemed successful if they impact positively on the production and distribution of goods and services. A vibrant and productive Industrial arm of the economy creates more linkages in the economy and promotes internal and external balance. Variation in exchange rate is an important endogenous factor that affects economic performance, due to its impact on macroeconomic variables like outputs, imports, export, prices, and interest rate and inflation rate. A sound and appropriate exchange rate policy is crucial condition for improving economic performance (Chang & Tan, 2008).

In practice, however, no exchange rate is pure float or completely determined by market forces. Rather, the prevailing system is the managed float type, whereby there is periodic intervention by monetary authorities in the foreign exchange market to attain strategic objectives (Mordi, 2006). A managed floating exchange rate regime has been the most predominant in Nigeria since the introduction of Structural Adjustment Programme in 1986.

Similarly, a positive productivity shock in the tradable sector stimulates expansion in output in the sector relative to the non-tradable sector and the exchange rate appreciation. Positive productivity shock improves the trade balances, which also requires a real appreciation to maintain the current account at a sustainable level.

Recently, there is much debate regarding the policies needed to sustain rapid growth and promote productivity in the industrial sector in Nigeria. Questions about external competitiveness, exchange rate, and the appropriate exchange rate policy have featured prominently in this debate on innovative basesThe evidence from the previous studies, (Akinmulegun & Falana, 2018) is on real exchange rate fluctuation and industrial output. It indicates that variance in output are own shocks, innovation in the exchange rate accounted for a higher proportion in the variation of industrial output than other variables (i.e. interest rate , inflation rate and net export).

In order to stem this development and ensure a stable exchange rate, the monetary authority (i.e. Central Bank of Nigeria) put in place a number of exchange rate policies. However, very little achievement was made in stabilizing the rate of exchange. Benson and Victor (2012) and Aliyu (2011) noted that despite various efforts by the government to maintain a stable exchange rate, the naira has depreciated throughout the 80‘s to date. It is sad to note that Nigerian economy is under-industrialized and its capacity utilization is also low. The industrial sector has become increasingly dependent on the external sector for import of non-labour input (Okigbo, 1993). Exchange rate reforms according to Bakare (2011) were expected to put the Nigerian economy on the path of macroeconomic stability, recovery and sustainable development.

It is therefore critical both to understand the main determinants of the real exchange rate, innovation and to distinguish between short and long term real exchange rate movements in Nigeria. Macroeconomic policies can then be used to smooth “excessive” short-term changes and to correct any emerging misalignment.

LITERATURE

The relationship between real exchange rate, innovation and productivity has attracted attention in Economics and Finance researches over the years. The introduction of Structural Adjustment Programme (SAP) in 1986 with the policy tenet of abolishing the fixed real exchange rate system being replaced with flexible exchange rate system marked the beginning of growing interest. Currency, like any traded goods, has a price. This price can undergo dramatic changes over a short period of time, as was the case for the Thai baht, which lost 56% of its value in about six months during the Asian financial crisis in 1997. Alternatively a country’s currency may remain stable relative to other currencies over a long period. The explanations for sudden extreme currency or prolonged stability are not always so esoteric. However, an understanding of the factors influencing exchange rate daily is more difficult to come by. The foreign exchange market, with roughly 200 participating countries and US $2

trillion in daily turnover is far too complex to be described neatly by a set of theories or formulas (Federal Reserves, 2005). Underscoring the evasiveness of the foreign exchange market, Former U.S. Federal Reserve Board Chairman Alan Greespan once said, "there may be more forecasting of exchange rates with less success than almost any other economic variable".

The real effects of real exchange rate relate to firm-level data that link between trade, innovation, and productivity growth. Regarding the connection between exporting and innovation activity, Lileeva and Treer (2010) and Bustos (2011) states that foreign tariffs reductions to enhance firms' incentives to innovate and export. Awet (2014) structurally estimate a dynamic framework to study the joint incentive to innovate and export for Taiwanese electronics manufacturers. Aghion (2017) states that the competition and market-size effects associated with trade shocks on innovation. In terms of the relationship between imports and innovation is concerned, Bloom, et al. (2015) uncover that European firms most affected by Chinese competition in their output markets increased their innovation activity. Autor, et al. (2016) opines that rising import competition from China has severely reduced the innovation activity of US firms. None of these papers uses cross-country firm-level data or changes in the RER to identify changes in the incentives for innovation; furthermore, none takes into account the impact of imported intermediate inputs and financial constraints.

As far as the link between imports and productivity is concerned, Amiti and Konings (2007) opines that substantial productivity gains from importing intermediates for Indonesian firms, while Halpern (2015) structurally estimate these gains for Hungarian manufacturing firms. This result evokes the statements of Gopinath and Neimann (2014), who stated that large productivity losses due to reductions in imports at the product and firm level during the Argentine crisis that followed the collapse of the currency board. Large devaluations in emerging markets have also been used to study exporting behaviour: Verhoogen (2008) analyzes the behavior of exporting manufacturing firms in Mexico following the 1994 devaluation and finds quality upgrading in response to devaluation. Firm-level evidence from rich countries suggests a much more muted impact of real exchange rate movements on exports (Berman, et al., 2012 for France; Amiti, et al., 2014, for Belgium; Fitzgerald & Haller, 2015 for Ireland, among others). Ekholm, et al. (2012) even find faster firm-level productivity growth in response to RER appreciation in Norway.

Theoretical Framework

The study is anchored on the Dynamic productivity theory of trade was propounded by Hia Myint. It states that foreign trade by widening the size of the market improves the division of labour and thereby raises productivity within the trading country. The theory interprets trade as a dynamic forces: division of labour permit greater use of the machinery, stimulates innovation, overcome technical indivisibilities, raises productivity of labour and enable countries to enjoy increasing returns to scale and further growth.

Harvey Leibensatein (1966) extended the theory to include x-efficiency. According to him free trade also provides x-efficiency. By x-efficiency it means the pressure of some forces as motivations and so on that causes the firm to purchase and utilize all efficiency inputs so as to reduce cost per unit output. X-efficiency emphasized the importance of motivational elements to increased productivity which enables the firm to produce close to its minimum cost equilibrium.

Whereas allocation efficiency improves resources allocation among firms, x-efficiency improved resources allocation within a firm. The x-efficiency argument implies that free trade stimulates firm's production of increased output at minimum cost. It points attention to efficient utilization of factors of production.

Empirical Studies

Empirical evidence has shown strong effect of short-run and long-run adverse effect of exchange rate swings on economic growth performance through the trade channel. The nature of the effect, however, runs in either position or negative direction. According to IMF

(1984) and European commission (1990) empirical evidence in favour of a systematic positive (or negative) effect of exchange rate stability on trade (and thereby growth) in small open economies has remained mixes. Bachetta and van Wincoop (2000) found based on a general equilibrium framework that exchange rate stability on trade.

In most empirical studies, the Gravity models have been used as frame work to quantify the impact of exchange rate stability on trade and growth, in particular in the context of monetary union. Using panel estimations for more than 180 countries Edwards and Levy Yeyati (2003) found evidence that countries with more flexible exchange rate grow faster. Eichengreen and Lablang (2003) found strong negative relationship between exchange rate stability and growth for 12 countries over a period of 120 years. They conclude that the results of such estimations strongly depend on the time period and the sample. Schnabel (2003) found robust evidence that exchange rate stability is associated with more growth in the EMU periphery. The evidence, according to him, is strong for Emerging Europe which has moved from an environment of high macro-economic instability to macro-economic stability during the observation period. Other empirical studies examine the role of capital market in ensuring exchange stability and economic growth.

Vamvakidis (1998) study undertook an investigation aimed at finding any relationship between regional trade agreement (RTA) and growth. He focused on whether openness size of population and the gross domestic product (GDP) affect growth of countries that have entered into RTA. The results show that economies with open economics grow faster. He also provided evidence that the level of development on neighbouring open economies have some spillover effect. By contrast, the lead level of development in open economics has no little on domestic growth. Similar studies were done by Langhammer and Heinmenz (1990). Their empirical work found out that regional agreement made up of developing nations has had no significance contributions to trade expansion.

Barren and Sala-Martins (1995) estimated the impact of trade protection on growth. Using tariff on capital goods and intermediate goods as a measure of protect their result indicated negative impact between trade liberalization and growth. Countries with low results according to them grow faster than those with high tariff. This confirms the earlier theoretical literature in favour of trade liberalization.

Boadiary and Trendenick (1978) using static applied general equilibrium (first generation) found that remove or tariff in Canada would cause welfare to decline by trade deterioration resulting from an import tariff reduction, as implied by national product differentiation assumption has lid Broom (1987) to conclude rather categorically that unilateral trade liberalization is and E (>0) and (<0) - the income elasticities of demand for exports and imports respectively.

Onah (2002) has it that with trade liberalization, the structure of the export trade of developing countries has however, undergone a substantial transformation. Since 1990's, with rapid growth in the export of manufacturers, this by the early 1990's have come to be the dominant flow of merchandise from developing to developed countries represented three times the values of non-oil commodities had exceeded the value of manufactured exports.

METHODOLOGY

An ex-post facto research design is adopted for this study because the data are time series data that already exist in various financial publications and reports of various issues. Secondary data was collected from Central Bank of Nigeria annual reports and National Bureau of Statistics (N.B.S), which form the data base for this study. Independent variables log of real exchange rate, capital utilization rate, export, and innovation (X) while productivity is the dependent variable (Y) which is proxied by log of industrial output (LINDOUT)

Model Specification

The model to be used for the study is the adaptation and modifications from the work ofElizabeth (2015) which examined the real exchange rate on industrial output in Kenya

The model is stated thus:

LINDOUT = f (LRER, CUR, LEXPTS, TECHY)..... (i)

Where:

LINDOUT = log of industrial output

LRER = log of real exchange rate

CUR = Capital utilization rate

LEXPTS (-1) = log of one year lag of exports as proxy for available foreign exchange.

TECHY = Technology

The model is further specified in linear form as follows:

$LINDOUT = \alpha + \beta 1LRER + \beta 2CUR + \beta 3LEXPTS\ (-1) + \beta 4TECHY + \mu$..... (ii)

Where:

α = Intercept of the entire regression model

$\beta 1$ = Slope of LRER

$\beta 2$ = Slope of CUR

$\beta 3$ = Slope of LEXPTS (-1)

$\beta 4$ = Slope of TECHY

μ = Stochastic error term

The model was adapted and modified.

The model is stated thus:

$LINDOUT = \alpha + \beta_1 LRER + \beta_2 CUR + \beta_3 LEXPTS\ (-1) + \beta_4 INNOV + \mu$..... (iii)

Where:

α = Intercept of the entire regression model

β_1 = Slope of LRER

β_2 = Slope of CUR

β_3 = Slope of LEXPTS (-1)

β_4 = Slope of INNOV

μ = Stochastic error term

β_0 and μ are the constant and error term respectively while β_1, β_2, β_3, and β_4 are the coefficient of real exchange rate, innovation and productivity in Nigeria

Method of Analyses

The data are analyzed with econometric techniques involving Augmented Dicker Fuller and Philip Perron tests for Unit Roots, Johansson technique for co-integration test for long run relationship, Granger causality test and the Ordinary Least Square (OLS), for test of hypotheses. The descriptive statistics reveals the individual characteristics of the variables used in this study highlighting their median, mean, maximum and minimum values, standard deviation, skewness, kurtosis, Jarque-Bera and probability.

Table 4.1 Summary of Descriptive Statistics

	LINDOUT	LRER	CUR	LEXPTS	INNOV
Mean	496.6896	1783.617	105.7372	59.11440	19.45120
Median	433.2000	1018.160	64.78000	33.27000	12.50000
Maximum	987.8800	5185.320	390.4200	231.0000	72.81000
Minimum	265.3800	60.27000	0.290000	0.150000	5.380000
Std. Dev.	231.6730	1738.121	120.1808	71.28838	18.27652
Skewness	0.635811	0.754981	1.212994	1.210023	1.804308

Kurtosis	2.076327	2.073046	3.232467	3.203883	4.954637
Jarque-Bera	2.573117	3.270032	6.186933	6.143944	17.54450

Source: E-view Version 8.0

The table above reveals the mean values for log of industrial output (LINDOUT), log of real exchange rate, capital utilization rate, export, and innovation as 496.6896, 1783.617, 105.7372, 59.45120 and 19.45120 respectively. The median value for the series are 433.2, 1018.2, 64.7, 33.3 and 12.5 respectively for log of industrial output (LINDOUT), log of real exchange rate, capital utilization rate, export, and innovation. It should be noted that the median is a robust measure of the centre of the distribution that is less sensitive to outliers than the mean. The maximum for the series are 987.9, 5185.3, 390.4, 231.0 and 72.8 for log of industrial output (LINDOUT), log of real exchange rate, capital utilization rate, export, and innovation respectively. The minimum values are 265.4, 60.3, 0.29, 0.2 and 5.4 for log of industrial output (LINDOUT), log of real exchange rate, capital utilization rate, export, and innovation respectively.

The standard deviations which are a measure of dispersion spread in each of the series are 231.7, 1738.1, 120.2, 71.3 and 18.3 respectively for log of industrial out (LINDOUT), log of real exchange rate, capital utilization rate, export, and innovation respectively. Skewness which is a measure of asymmetry of the distribution of series around its mean, are all positive for the industrial layout variables which means that the distribution has a long right tail. The Kurtosis statistic that measures the peakedness or flatness of the distribution of each of the series is calculated at 2.076327, 2.073046, 3.232467, 3.203883 and 4.954637 respectively for log of industrial output (LINDOUT), log of real exchange rate, capital utilization rate, export, and innovation.

The Jarque-Bera statistic, which is a test statistic for testing whether the series is normally distributed, measuring the difference of the skewness and kurtosis of the series with those from the normal distribution is reported at 2.573117, 3.270032, 6.186933, 6.143944 and 17.54450 respectively for log of industrial output (LINDOUT), log of real exchange rate, capital utilization rate, export, and innovation.

Unit Root Test

In this study, the data used were subjected Augmented Dickey Fuller unit root test to determine the stationarity or otherwise of the variables used.

Table 4.2 Augumented Dickey Fuller Test for Stationarity

Variables	ADF Statistic	Order Of Integration	Level Of Significance
LINDOUT	-5273120	1(2)	5%
LRER	-6.168052	1(2)	5%
CUR	-4.210375	I(1)	5%
LEXPTS	-5.081791	1(0)	5%
INNOV	-3.901301	1(1)	5%

Sources: Author's Computation from the E-view 8.0

The result of Augumented Dickey Fuller test shows that LINDOUT and LRER were differenced twice to assume stationarity. CUR, LEXPTS and INNOV were differenced once to achieve stationarity.

Cointegration Test

Table 4.3 Johanson Cointegration Test

Unrestricted Cointegration Rank Test (Trace)

Hypothesized	Trace	0.05

No. of CE(s)	Eigenvalue	Statistic	Critical Value	Prob.**
None *	0.988015	225.2996	95.75366	0.0000
At most 1 *	0.896238	123.5452	69.81889	0.0000
At most 2 *	0.878666	71.43520	47.85613	0.0001
At most 3	0.493632	22.92345	29.79707	0.2499
At most 4	0.226705	7.272157	15.49471	0.5462

Trace test indicates 3 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None *	0.988015	101.7544	40.07757	0.0000
At most 1 *	0.896238	52.11002	33.87687	0.0001
At most 2 *	0.878666	48.51175	27.58434	0.0000
At most 3	0.493632	15.65130	21.13162	0.2459
At most 4	0.226705	5.913171	14.26460	0.6244

Max-eigenvalue test indicates 3 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Source: E-view 8.0

The results of the multivariate cointegration test were validated using the Johansen (1991, 1995) approach. The result of Trace and Maximum Eigen values shows that there exist three (3) conintegrating equations which is significant at 0.05 level of significance. This implies that a long-run relationship exists among the variables used in the study. That is, the linear combination of these variables cancels out the stochastic trend in the series. This will prevent the generation of spurious regression results. Hence, the implication of this result is a long run relationship between real exchange rate innovation and productivity in Nigeria.

Presentation of Regression Result

The table below shows the regression result for the model formulated in chapter three. Having verified the existence of long-run relationships among the variables in our model, we therefore, subject the model to ordinary least square (OLS) to generate the coefficients of the parameters of our regression model.

Table 4.4 Regression Result

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	3.782696	0.695860	5.436004	0.0000
LRER	-0.000918	0.002074	-0.442494	0.6631
CUR	-0.152668	0.061994	-2.462625	0.0235

LEXPTS	-0.185120	0.125472	-1.475391	0.1565
INNOV	0.215338	0.147153	1.463361	0.1597
R-squared	0.904430			
Adjusted R-squared	0.879280			
F-statistic	35.96156	Durbin-Watson stat		1.825405
Prob(F-statistic)	0.000000			

Source: E-view 8.0

The regression equation can be restated as follows:

LINDOUT = 3.782696 + 0.185120LRER + 0.215338CUR – 0.152668LEXPTS – 0.000918INNOV

The table and the regression equation revealed that real exchange rate innovation have a positive and significant effect on productivity. This implies that a unit increase in real exchange rate, innovation will bring about 0.397840 increases in productivity holding other factors constant. The table also reveals that log of industrial output on capital utilization rate has a positive and insignificant effect on productivity implying that a unit increase in log of industrial output on capital utilization rate will bring about 0.215338 increases in productivity.The regression result also reveals that log of industrial output on log of export has a negative and significant effect on productivity. It also reveals that log of industrial output on innovation have a negative and insignificant effect on productivity in Nigeria.

From our regression result, the coefficient of determination (R^2) is given as 0.904430, which shows that the explanatory power of the variables is very high and/or strong. This implies that 78% of the variations in log of industrial layout are being accounted for or explained by the variations in log of real exchange rate, capital utilization rate, export, and innovation.

The adjusted R^2 supports the claim of the R^2 with a value of 0.879280 indicating that 73% of the total variation in the dependent variable (log of industrial output is explained by the independent variables). Thus, this supports the statement that the explanatory power of the variables is very high and strong.

The F-test is applied to check the overall significance of the model. The F-statistic is instrumental in verifying the overall significance of an estimated model. The f-statistics of 35.96156 and f-probability of 0.000000 implies that there is significant effect between the dependent and independent variables in the model.

Using Durbin-Watson (DW) statistics which we obtain from our regression result, it is observed that DW statistic is 1.825405 or approximately 2. This implies that there is no autocorrelation since d* is approximately equal to two.2.004310 tend towards two more than it tends towards zero. Therefore, the variables in the model are not autocorrelated and that the model is reliable for predictions.

The statistical significance of real exchange rate, capacity utilization rate, and export lag one year-as proxy for availability of foreign exchange, is an evidence that industrial output in Nigeria is strongly influence by these variable which also in agreement with previous studies. For instance Edwards (2006, 2009, 2014) had model real exchange rate specifically tailored to developing countries against economic fundamentals of which productivity is inclusive and found a positive relationship. Elbadawy (2014) develops a simplified version and Faruquee (2015), Mongardini for Egypt, De Broeck and Slok (2001) for transition economies, typical of Nigeria, Lane and Milesi-Ferreti (2012) for Ireland and MacDonald and Ricci (2002) for South Africa. In a different vein, Clark and MacDonald (2009, 2010) as well as Feyzioglu (2007) for Finland and Paiva (2001) for Costa Rica showed positive supports. Since these studies have confirmed a positive relationship between RER and productivity (output), in this

study we have further established that the positive relationship is bi-directional, that is, the real exchange rate and some other economic fundamentals also determines the industrial output, particularly in Nigeria and generally in a resource-dependent economies, where the industrial production depend on foreign intermediate good.

CONCLUSION

From the findings, it can be concluded that the movement (increase/decline) in the industrial output in Nigeria could be explained among other factors, by the movement experienced in the Real Exchange Rate (RER), the Capital Utilization Ratio (CUR), Innovation (INNOV), available foreign exchange (proxy by one year lag of export), and the level of technology.In view of the findings and conclusion therefrom, this study recommends that:

1. The effort of the government should be geared towards maintaining a stable and sustainable exchange rate, since the stability of these could enhance industrial output.
2. The availability of foreign exchange is one of the determining factor for enhanced industrial output, hence, foreign exchange should be made available to the industrial sector through conscious effort towards export drive.
3. Capacity utilization ratio and technology have to an extent, influence industrial output, the government should provide enabling environment, for instance, constant power supply, adequate security of life and property and modern technology for industrial sector to thrive.

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