Lapai Journal of Economics; Volume Volume 6, No.2; 2022
Print ISSN: 2659-028X
Online ISSN: 2659-0271
DOI: https://dx.doi.org/10.4314/lje.v6i2.2
Published by Department of Economics, IBB University Lapai, Niger State, Nigeria

Exchange Rate and Manufacturing Sector Performance in Nigeria

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Abstract

This study examined the impact of exchange rates on the performance of the manufacturing sector in Nigeria between 1990 and 2020. Using canonical cointegrating regression (CCR) framework, the result obtained showed that exchange rate devaluation constrains manufacturing sector while exchange rate fluctuation hampers manufacturing output. The study indicated that price increase leads to decline in the manufacturing sector, the study recommends among other things the need to formulate policies that align with the exchange rate to the actual needs of the manufacturing sector. The study further suggests that change in exchange rate management strategy should be allowed to run a reasonable course of time. Jettisoning strategies at will and on frequent basis has implication for exchange rate and obvious consequence for a sector that depends on foreign inputs.

Keywords: Nigeria, Exchange Rate, Manufacturing Sector
JEL Classification: F31, O24

1. Introduction

The manufacturing sector plays a catalytic role in a modern economy and has many dynamic benefits crucial for economic transformation (Onwuka, 2022). Mlambo,(2020) stress that the manufacturing industry has, traditionally, been one of the key drivers in most national economies. The manufacturing sector is an avenue for trade expansion and it is a vital source of innovation and competitiveness and it makes outsized contributions to exports and productivity growth. Even though the tertiary sector in most economies is currently dominant as a percentage of the economy and employment creation, most of these economies were built from a strong manufacturing base. Since the political independence of Nigeria in 1960, achieving economic growth and development through industrial transformation has remained crystal clear the prime objective and focus of various administrations in the country. This can be demonstrated with numerous development plans and policies with each having manufacturing sector reform as one of its goals. However, it is worrisome that all these development plans and policies have not yielded the required level of expectation as the industrial base of

the country is rated poor and backward World Bank 2020). The discovery of oil in the early 1970s has also worsened the situation as other sectors of the economy were neglected (including manufacturing sector) due to cheap money coming from the sales of crude oil and has affected our foreign exchange reserve. However, in the present decade, fluctuations in the oil market and activities of militants in the oil region of Nigeria have generated calls for diversification of Nigeria economy to break the culture of heavy reliance on the oil sub-sector. The link that manufacturing sector has with agriculture and other input suppliers makes the sector essential in plummeting hunger and malnourishment, reducing poverty, and creating job opportunities to the teeming unemployed youths in the country

However, the contribution of the manufacturing sector of Nigeria to the gross domestic product (GDP) has not been impressive for decades. The sector contributed a modest 4.8% in 1960, manufacturing sector's contribution to the country's GDP increased to 7.2% in 1970 and to 7.4% in 1975 (Central Bank of Nigeria, 2020). Prior to the oil boom of the 1970s, Nigeria's manufacturing sector contributed approximately 10% to Nigeria's GDP. Subsequently, increased revenues from sales of crude oil caused the sector's relative GDP share to drop. In 1980, it dropped to 5.4% but then surged to a record high of 10.7% in 1985 (CBN 2020). The fall has affected the foreign exchange reserve of Nigeria to decline tremendously. The recession caused by the fall in oil prices in the early 1980s triggered policy attention to turn back to the manufacturing sector, with steel production gaining prime focus (World Bank, 2020). In 1987, the Federal Government of Nigeria bans importation of raw materials under the World Bank Structural Adjustment Programmes (SAPs), to support import substitution strategy. Through the policy, intermediary input manufacturers in the country were able to produce competitively again, and there were fewer plant closures. This, combined with the Privatization and Commercialization Act of 1988, encouraged a higher degree of efficiency achieved in manufacturing sector of Nigeria (World Bank 2020). A slight increase in the share of manufacturing sector in economic output of 0.62% points was recorded from 1986-1988. Majority of the firms in the country were not export orientated, and lack the efficiency, causing competitive companies to relocate factories abroad (NEEDS 2005). A few key industries, such as beverages, textiles, cement and tobacco kept the sector afloat, but even these operated at under half of their capacity.

The contribution of manufacturing sector over the years continues to fluctuate from 1980s as a result of sudden diversion of interest to oil sector thereby depleting our foreign reserve. Exchange rate is a significant macroeconomic variable because its depreciation or appreciation has negative or positive repercussions on all the sectors of the economy especially the manufacturing sector (Odili, 2014; Aizenman & Marion, 1999). Through international trade among countries, economies have experienced periods of exchange rate fluctuations, slower growth among others (Todaro & Smith, 2008) and this has exposed many developing countries to periods of imbalances. Exchange rate fluctuations do not only affect economic growth but also the

performance of firms. For instance, exchange rate depreciation increases the cost of imported capital goods for manufacturing firms and this result to a fall in domestic investment among others. Given this background, this study examined the impact of exchange rate on the Nigeria's manufacturing sector. This study tries to resolve the question; if exchange rate flexibility have a significant impact on manufacturing output in Nigeria. Industrial development is regarded as bedrock for economic growth at all stages of development of both advanced and developing economies of the world (Kreuser & Newman 2018; World Bank 2020). Today, regardless of level of development, all countries around the globe continue to embark upon relevant policies and strategies to ensure stable macroeconomic policies that would guarantee a virile working environment for sustainable industrial development (Samuel & Wale-Odunaiya, 2021).). The contribution of manufacturing sector to GDP of Nigeria of 13% in 2020 is far below that of Bangladesh (19%), and Low and Middle income economies (20%). The government in recent past introduced industrial revolution package aimed at improving the industrial sector. But, given the past experience, one cannot be convinced that this is a long term solution to Nigeria's industrial development question. The issue is that the new policy may still suffer the fate of its predecessors unless immediate steps are taken to address the root problems like insufficient power and infrastructural facilities, inadequate long term loanable funds, unstable macroeconomic environment, among others, that made the previous policies unsuccessful.

The critical challenge faced by Nigerian manufacturing industry is inadequate raw material for production of finished products. This condition tends to affect negatively the productivity level of the sector (Okorontah & Odoemena, 2016). The ability of the manufacturing industry to imports input materials depend on the level of the exchange rates. It is evident that most organizations source their inputs externally. Hence, the devaluation or depreciation of exchange rate tends to impede the performance of the sector (Nsofo, Takson & Ugwuegbe, 2017). Although there have been studies on the exchange rate-manufacturing sector nexus in Nigeria, there is hardly any study (to our knowledge) that have investigated the impact of exchange rate regimes on manufacturing sector performance. This study is believed to supplement the literature by bringing additional evidences from a developing economy which is quite vulnerable, open and dependent on international trade. Secondly, the present study uses a relatively current and larger sample period from 1990 to 2020. This large sample reflects the several changes that have occurred in the economy over the years. Third, unlike Nigeria studies (Ugwu, 2017; Williams 2018; Orji et al. (2018) that have utilized ordinary least square (OLS) estimation technique, we employed the Canonical Cointegrating Regression (CCR) which side-steps the shortcomings of OLS, yields asymptotically efficient estimators and provides asymptotic chi-square tests that are free from nuisance parameters. Fourth to ensure the robustness of the study and unlike related studies, we employed several control variables namely price level, capital accumulation and labour which have diverse implications on the manufacturing sector performance. We pay attention to the manufacturing sector with the reasons that, averagely they contribute

13% to Gross Domestic product in Nigeria (World Bank 2020), exchange rate fluctuations affect manufacturing sectors mostly in all economies as they contribute largely to employment creation, foreign exchange creation, promotion of investment and in all to the socio-economic welfare of the populace.

The study extends the literature in the following ways. First, although there have been studies on the exchange rate-manufacturing sector nexus in Nigeria, there is hardly any study (to our knowledge) that have investigated the impact of exchange rate regimes on manufacturing sector performance. This study is believed to supplement the literature by bringing additional evidences from a developing economy which is quite vulnerable, open and dependent on international trade. Secondly, the present study uses a relatively current and larger sample period from 1990 to 2020 as compared to various Nigerian studies. This large sample reflects the several changes that have occurred in the economy over the years. Third, unlike Nigeria studies (Ugwu, 2017; Williams 2018; Orji et al. (2018) that have utilized ordinary least square (OLS) estimation technique, we employed the Canonical Cointegrating Regression (CCR) which side-steps the shortcomings of OLS, yields asymptotically efficient estimators and provides asymptotic chi-square tests that are free from nuisance parameters. Fourth to ensure the robustness of the study and unlike related studies, we employed several control variables namely price level, capital accumulation and labour which have diverse implications on the manufacturing sector performance. We pay attention to the manufacturing sector with the reasons that, averagely they contribute 13% to Gross Domestic product in Nigeria (World Bank 2020), exchange rate fluctuations affect manufacturing sectors mostly in all economies as they contribute largely to employment creation, foreign exchange creation, promoting of investment and over all to the socio-economic welfare of the populace, exchange rate fluctuations affect adversely the ability of manufacturing sectors to import capital goods and raw materials leading to a reduction in performance and exchange rate fluctuation which affects the income and profitability of firms thereby reducing their contribution to GDP. In view of the above introduction the objective of this study is to ascertain the impact of exchange rate on the manufacturing output in Nigeria, and to examine the effect of exchange rate fluctuations on the manufacturing sector in Nigeria.

2. Literature Review

Conceptual literature

The exchange rate is the price of one currency in terms of another currency, that is, the current market price for which one national currency can be exchanged for another. It is normally expressed as the number of units of a domestic currency that will purchase one unit of a foreign currency or the number of units of a foreign currency that will purchase one unit of a domestic currency. For example,if,1 US Dollar can be exchanged for ₦240, then one naira can be exchanged for US$0.0042. An exchange rate regime/flexibility refers to the method or system adopted by a country's monetary authority (usually the Central Bank) to determine the value of its currency in relation to

other currencies. It can also be defined as the exchange rate system by which the value of a domestic currency is determined vis-à-vis foreign currencies (CBN, 2016).

On the other hand, manufacturing refers to a spectrum of human activity, from craftsmanship to high-tech, but is most frequently used in industrial production, where raw materials are converted on a big scale into finished goods (Ademu & Ezie, 2017). Similarly, the manufacturing sector can be described as those activities and industries engaged in the manufacture and processing of articles and indulges in either creating new commodities or adding value (Falade & Olagbaju, 2015).

Neoclassical Growth Theory

The neoclassical growth theory was advanced by Solow (1956) and Swan (1956). Hence it is also known as Solow-Swan theory. It is an economic model of long-run economic growth set within the framework of neoclassical economics. It attempts to explain long-run economic growth by looking at capital accumulation, labor or population growth, and increases in productivity, commonly referred to as technological progress. At its core is a neoclassical (aggregate) production function, often specified to be of Cobb-Douglas type, which enables the model "to make contact with microeconomics" (Acemoglu, 2014; Haines & Sharif, 2016). The neoclassical growth theory is predicated on the following assumptions. First, given a fixed stock of labour, the impact on output of the last unit of capital accumulated will always be less than the one before. Second, there is diminishing return to the fixed factor. Assuming for simplicity no technological progress or population growth, diminishing returns implies that at some point the amount of new capital produced is only just enough to make up for the amount of existing capital lost due to depreciation. Third, population growth equals labour force growth which is a positive rate at the steady-state equilibrium. This implies that given a non-zero technological, a new steady state is reached with constant output per worker-hour required for a unit of output.

Empirical Literature

In Canada, Baggs et al. (2009) investigate the effect of exchange rate on firm performance for the period 1986 to 1997. The study employs the ordinary least square regression as the estimation strategy. The result from their study reveals that exchange rate has a negative and significant effect on firm's performance. Specifically, the probability that Canadian firms survive from one period to the next period was found to be negatively related to exchange rate appreciation. Enekwe, Ordu, and Nwoha (2013) examined the effect of exchange rate fluctuations on the manufacturing sector in Nigeria from 1985 to 2010 using regression analysis. The results showed that exchange rate fluctuation has a significant positive relationship with the manufacturing sector of Nigeria. In a related study, Lotfalipour et al. (2013) investigated the effect of exchange rate on manufacturing sectors investment in Iran spanning the period 1995 to 2009. The study used annual industry level data and employed the Generalized Method of Moments (GMM) as the estimation strategy. The study revealed a negative and significant relationship between exchange rate and manufacturing sector investment.

Using the Vector Error Correction Model (VECM) as the estimation strategy, Akinlo and Lawal (2015) examined the impact of exchange rate instabilities on industrial production in Nigeria between 1986 and 2010. The study revealed that currency depreciation had no appreciable short-run effects on industrial production but had long-run positive effects on industrial production. Nwokoro (2017) assessed the effect of exchange rate and interest rates fluctuations on the manufacturing output in Nigeria from the period 1983-2014 using Error Correction Modeling (ECM). The findings showed that exchange rate and interest rates have negative and significant influence on manufacturing output. Ugwu (2017) investigate the impact of exchange rate fluctuation on manufacturing performance in Nigeria using Ordinary Least Squares (OLS) technique. The findings revealed that a significant relationship exists between exchange rate fluctuations and manufacturing performance in Nigeria. Adegbemi (2018) examined the effect of the changes in the macroeconomic factors on the manufacturing sector performance in Nigeria for the period 1981 to 2015. The findings indicated a negative relationship among interest rate, inflation rate, broad money supply, exchange rate and manufacturing performance.

Williams (2018) examined the impact of exchange rate fluctuations on the performance of some selected listed firms in Nigeria for the period 2012 to 2016. The study employed the ordinary least square regression as the estimation technique and the study revealed that exchange rate has a positive and significant effect on firms' performance. In addition, the results from the study also show that there is a positive and significant association between inflation and firms' performance. Tams-alasia, Olokoyo, Okoye, and Ejemeyovwi (2018) examined the impact of exchange rate deregulation on manufacturing output performance in Nigeria over the period 1980 to 2016. The empirical findings revealed that exchange rate has non-significant positive long-run effect on manufacturing industry output. However, unidirectional causal impact of exchange rate on manufacturing output was established using the pairwise granger causality test. Falaye et al. (2019) assessed the impact of exchange rates on the performance of the Nigerian manufacturing sector using Error Correction Model (ECM). The empirical findings showed that devaluation of the Naira had a negative impact on the performance of the Nigerian manufacturing sector. Orji et al. (2018) examined the impact of exchange rate movements on the manufacturing sector in Nigeria. Applying ordinary least square estimation technique was employed and the study concluded that exchange rate, government capital expenditure, imports and foreign direct investment were positively related to manufacturing output. Ayobami (2019) examined the effect of exchange rate fluctuation on the performance of manufacturing firms in Nigeria for the period 1981 to 2016. The study applied the auto-regressive distributed lag model as the estimation strategy and the study revealed that the growth of manufacturing firms' in Nigeria is positively related with exchange rate fluctuations but insignificant.

Abdul-Mumuni (2019) examined the impact of exchange rate on the performance of manufacturing sector in Ghana for the period 1986 to 2013. The study applies the autoregressive distributed lag (ARDL) as the estimation technique and the study found that the performance of manufacturing firms is positively related with exchange rate significantly. In a related study Boateng (2019) investigated the effect of exchange rate on the financial performance of manufacturing firms in Ghana using return on asset and equity as the dependent variable for the period 2009 to 2017. The study used imports, foreign direct investment and nominal interest rate as control variables and applies the panel regression as the estimation. The results from the study showed that the growth of manufacturing firms' financial performance is negatively associated with exchange rate

Ali (2020) examined the effect of exchange rate fluctuations on manufacturing performance in Nigeria and the results showed that an exchange rate volatility has negatively affected the performance of the Nigerian manufacturing sector. Mlambo (2020) examined the impact of the exchange rate on manufacturing performance in the Southern African Customs Union (SACU) states using the panel group FMOLS and PMG approaches for the period 1995 to 2016. The results showed that the exchange rate, imports and foreign direct investments have a negative relationship with manufacturing performance. Exports and inflation had a positive relationship with manufacturing performance. Asaleye et al (2021) investigated the effect of exchange rate on manufacturing performance in Nigeria. The study employed Structural Vector Auto regression (SVAR), ECM and Canonical Co-Integrating regression to examine the shock effect, short and long-run elasticities of exchange rate on the manufacturing performance.While employment and output were used as a proxy for manufacturing sector performance. The findings showed that changes in the exchange rate are fairly elastic with output and employment both in short and long-run. However, changes in the exchange rate are insignificant with employment in the short run. The variance decomposition form the SVAR showed that forecast error shock of the exchange rate is more prolong on employment than output. The outcome of the result indicated that the Nigerian exchange rate has not improved output and employment in the manufacturing sector. Samuel and Wale-Odunaiya (2021) investigated the consequences of undervaluation of exchange rate in Nigeria on the manufacturing output and economic growth between 1981 and 2019. The Vector Error Correction Mechanism was employed and it was found from the impulse response function that real effective exchange rate does not significantly affect economic growth and it is negatively related with manufacturing output. Onwuka (2022) examined the impact of exchange rate volatility on the performance of manufacturing sector in Nigeria using ARCH/GARCH model and Autoregressive Distributed Lag Model (ARDL). The ARDL results show that exchange rate volatility; interest rate and inflation rate has a negative impact on the performance of manufacturing sector in the long run while import and gross capital formation have a positive effect on manufacturing performance in the long run. Also, exchange rate volatility, gross capital formation and interest rate were found to have a

significant impact on manufacturing performance while import and inflation were found to be non-significant.

3. Methodology

In achieving the objective, this study use quarterly time series data spanning from 1990 to 2020, obtained from CBN Statistical Bulletin (various Issues). Variables such as Capital Accumulation (CAP) measured as the ratio of gross fixed capital to GDP. It is a measure of the capital stock in the economy. Price level (PL) was measured using consumer price index. It is a measure of the general price level. It is a measure of the average current prices across the entire spectrum of goods and services produced in an economy. In more general terms, price level refers to the price or cost of a good, service, or security in the economy. Labour (LAB) refers to the proportion of the labour force that is employed at the prevailing wage rate. In neoclassical production function, labour is a key variable in the growth model. Thus, it entered the model as a control variable. Manufacturing Output (MO) as dependent variable measured as manufacturing sector performance. It represents the aggregate monetary value of goods produced by all the manufacturing firms in the economy per annum. Exchange Rate (ER) is a bilateral exchange of the naira to dollar. In emerging and developing economies characterized by unstable exchange rate, exchange rate is considered as a critical open economy variable for domestic firms (Igbanugo & Eze, 2017). Exchange Rate Regime Slope dummy variables were used to measure exchange rate regime. Exchange rate regime could be fixed regime (FR), full-floating regime (FFR) or managed floating regime (MFR). Igbanugo and Eze (2017) were followed in measuring the slope dummies.

The theoretical framework is anchored on neoclassical growth theory as proposed by Solow (1956). Solow (1956) set out an aggregative and competitive general equilibrium growth model built around the assumption of constant returns to scale. The theory states that short-term equilibrium results from varying amounts of labor and capital in the production function as well as other unexplained factors (which in this study, we shall assume to be exchange rate). The model economy has a single produced good ("output") whose production per unit time is Y(t). The available technology allows output to be produced from current inputs of labor, L(t), and the services of a stock of "capital" that consists of previously accumulated and partially depreciated quantities of the good itself, according to the production function

$$Y = F(K, L, z) \quad \ldots\ldots 1$$

Where, z refers to vector of residual factors which exogenously determined. The production function exhibits (strictly) diminishing returns to capital and labour separately, and constant returns to scale. Suppose we assume that the economy has only one sector, namely, the manufacturing sector (MO). Suppose we further assume that z = ER, FR, FFR and MFR. Then, Equation 3.1 would be rewritten as:

$$MO = F_{mo}(K, L, ER, FR, FFR, MFR) \quad \ldots\ldots 2$$

Where K = capital accumulation and $\frac{\partial MO}{\partial K} > 0$, L = labour and $\frac{\partial MO}{\partial L} > 0$, ER = exchange rate and $\frac{\partial MO}{\partial ER} > 0$, FR = fixed exchange rate regime and $\frac{\partial MO}{\partial FR} > 0$, FFR = Full-floating exchange rate regime and $\frac{\partial MO}{\partial FFR} > 0$, MFR = managed floating exchange rate and $\frac{\partial MO}{\partial MFR} > 0$. We also assume that the production function well-behaved, being concave such that and $F'_{mo}"(.)<0$ $F'_{mo}(.) > 0$.

The main thrust of this study is to examine the impact of exchange rate on the manufacturing sector. From Equation 3.2, we established mapping relationship between manufacturing outcome and exchange rate. Suppose we relax the assumptions of Equation 3.2 to include price level (PL) as suggested by Adofu, Taiga and Tijani (2015) the model of manufacturing sector output would be specified as follows:

$MO = f(K, L, ER, FR, FFR, MFR, PL)$……... 3

Specifying Equation 3.3 in econometric form within the framework of canonical integrating regression (CCR), Equation (3.3) specified as:

$MO_t = \alpha_0 + \alpha_1 t + \alpha_2 t^2 + \prod_1 ER_t + \prod_2 FR_t + \prod_3 FFR_t + \prod_4 MFR_t + \prod_5 PL_t + \prod_6 CAP_t + \prod_7 LAB_t + \varepsilon_t$…….…… 4

Where $\alpha_0, \alpha_1, \alpha_2$ are the parameter estimates for intercept, linear and quadratic trend respectively; $\prod_i$ is the coefficience for the i^{th} explanatory variables; and $\mathcal{E}$ is the white noise with zero mean and constant covariance (i.e $\varepsilon \sim i.i.i[0, \Phi])$.

It is always traditional for a study to justify the adoption of any model for the purpose of empirical investigation. In this study, both the inclusion of the variables of the model and the use of cointegrating regression framework are justified in this subsection. First, manufacturing sector output was used to capture the performance of the manufacturing sector. Both Obamuyi, Edun and Kayode (2012) and Adofu, Taiga and Tijani (2015) utilized the measure in models of manufacturing sector. We used dummy variables to represent exchange rate regime. As opined by Igbanugo and Eze (2017), if one can accurately identify episodes of varying regimes, dummy representation will engender consistent outcome. Labour and capital entered the model as suggested by Solow (1956) and other neoclassical economists. Also, following Adofu et al (2015), price level entered the model as a control variable. Adofu et al (2015) opined that, in both short and long-run, manufacturing output has consistent relationship with the price level. The use of canonical cointegrating regression (CCR) framework of Park (1992) is based on its appealing attributes in empirical estimations. CCR is considered efficient in estimating a long-term cointegrated function. It produces consistent, unbiased and efficient estimates even when the data are multicollinear or serially correlated. This efficiency is achieved through asymptotical transformations that eliminate the

endogeneity caused by the long run correlation of the cointegrating equation errors and the stochastic innovations.

The main estimation technique is the canonical cointegrating regression (CCR) framework. However, before estimating both models, the time series properties of the data were investigated using unit root test and cointegration test. The subsections that follows shows brief discussion of econometric procedure and methods used in the study. A series is said to be (weakly or covariance) stationary if the mean and autocovariances of the series do not depend on time. Any series that is not stationary is said to be nonstationary. A common example of a nonstationary series is the random walk:

$Y_t = Y_{t-1} + \varepsilon_t$ ……..... 5

Where ε is random disturbance term. The series has a constant forecast value, conditional on Y, and the variance is increasing over time. A difference stationary series is said to be integrated and is denoted as I (d) where d is the order of integration. The order of integration is the number of unit roots contained in the series, or the number of differencing operations it takes to make the series stationary. For the random walk above, there is one-unit root, so it is an I (1) series. Similarly, a stationary series is I (0). The study examined the random nature of the variables by testing for stationarity using the augmented Dickey Fuller (ADF) test. The decision rule was based on 5% level of significance for acceptance or rejection of the null hypothesis ($\beta i = 0$; has unit root: i = 1, 2, 3 ….. k). At this level, the study tests for the stationary or otherwise of each of the explanatory variables and also examines the order of integration of each of them (Asteriou & Hall, 2015; Enders, 2015).

The notion of integration among variables has introduced a new flexibility into the modeling of economic time series. As defined by Engle and Granger (1987), two variables are co-integrated (of order (1, 1)) if each variable individually is stationery in first differences (integrated of order 1), but some linear combination of the variables is stationary in levels (integrated of order 0). Many economic variables might plausibly be co-integrated when correctly measured, sometimes in natural or sometimes in log units; examples are consumption and income, short and long term interest rates, and stock prices and dividends. This study also estimated the long run relationships among variables using the Johansen maximum likelihood cointegration analysis. The essence of this is to test for the presence of cointegrating vectors in the model and the rejection of the null hypothesis of no cointegrating vector in the model, at 5% level of significance. Furthermore, the normalized adjusted coefficients from cointegration result was used to analyse the long run relationship of the variables in the model and statistical significance determined using t – statistic values at 95% confidence level. Canonical Co-integrating Regression (CCR) was introduced by Park (1992). The CCR procedure involves data transformation that uses only the stationary component of a co-integrating model. A co-integrating relationship supported by the co-integrating model

would remain unchanged after such data transformation. The CCR transformation makes the error term in a co-integrating model uncorrelated at the zero frequency with repressors. Therefore, the CCR procedure yields asymptotically efficient estimators and provides asymptotic chi-square tests that are free from nuisance parameters (Park, 1992). According to Park (1992), the CCR transformations asymptotically eliminate the endogeneity caused by the long run correlation of the co-integrating equation errors and the stochastic regressors innovations, and simultaneously correct for asymptotic bias resulting from the contemporaneous correlation between the regression and stochastic regressor errors. In other words, CCR generates efficient estimates in the face of multicollinearity. Estimates based on the CCR are therefore fully efficient and have the same unbiased, mixture normal asymptotic (Nkoro & Uko, 2019)

The parameter estimates of the model is evaluated under three sub-headings: Economic apriori criterion seeks to ascertain whether the parameter estimates comply predicted theoretical behavior. According to Koutsoyiannis (1973), apriori criterion is one of the criteria used in determining whether parameter estimates are theoretically meaningful. Therefore, based on economic theory, the independent variables are expected to take the signs discussed earlier in relation to the dependent variables in their respective functions. The summary of apriori expectation is presented in Table 1

Table 1: Apriori Expectations

Explanatory Variable	Apriori Expectation	Remarks
ER	$\theta_1 > 0$	Positively related with MO
FR	$\theta_2 > 0$	Positively related with MO
FFR	$\theta_6 > 0$	Positively related with MO
MFR	$\theta_6 > 0$	Positively related with MO
PL	$\theta_6 > 0$	Positively related with MO
CAP	$\theta_6 <> 0$	Positively related with MO
LAB	$\theta_7 > 0$	Positively related with MO

Source: Authors Computation

Statistical criterion is also referred to as first order test. It seeks to ascertain whether the parameter estimates and the regression models are statistically robust. To ascertain the statistical significance of variables of a regression model, t-test was used. F-test and R-squared (R^2) were employed to ascertain the statistical significance and robustness of the regression equations. Econometric criterion is also known as second-order test. This aims at investigating whether the assumptions of classical regression function are met. They determine the reliability, consistency and unbiasness of the regression models. Under the econometric criterion, normality test, serial correlation test and heteroscedascity test were utilized

The study hypotheses are tested using the confidence interval approach instead of the commonly used point estimate approach. Instead of relying on point estimates alone, we constructed an interval around the point estimate such that the interval has 95% probability of including the true population value(s). To construct a 100 (1-α) %

confidence interval for the parameters, we take$\widehat{\prod}_j \pm t_{\alpha/2} Se(\prod_j)$. Where t $\alpha_{/2}$ is the critical value of t with n-2 d egree of freedom and a probability to the right. The decision rule is that we reject the null hypothesis if the true population parameter ($\prod_j$) falls within the limits, otherwise accept.

4. Results

Before the model of manufacturing output is estimated, the time series properties of the data are evaluated using unit root test and cointegration test. The results are discussed below.

Unit Root Test

Unit root tests are tests for stationarity in a time series (Table 2). To ascertain the presence of unit root, we utilize both augmented Dicker-Fuller (ADF) test and Philip-Perron (PP) test. The null hypothesis is generally defined as the presence of a unit root and the alternative hypothesis is stationarity, trend stationary or explosive root depending on the test used.

Table 2: Summary Statistics for Unit Root Test

Variable	ADF Test		Philip-Perron Test	
	ADF statistics	Order of Integration	PP statistics	Order of Integration
Manufacturing output (MO)	-4.961***	I(1)	-4.961***	I(1)
Exchange rate (ER)	-5.416***	I(1)	-5.413***	I(1)
Fixed Exchange rate regime (FR)	-8.219***	I(1)	-9.085***	I(1)
Full floating Exchange rate regime (FFR)	-5.392***	I(1)	-9.212***	I(1)
Managed floating Exchange rate regime (MFR)	-31.485***	I(1)	-22.398***	I(1)
Price level (PL)	-5.436***	I(0)	-4.373***	I(0)
Capital (CAP)	-4.159***	I(0)	15.256***	I(0)
Labour (LAB)	-4.959***	I(0)	-4.953***	I(0)

Source: Authors Computation

*** and *** indicate statistical significance at 5% and 1% respectively*

The result shown on Table 2 indicate that MO, ER, FR, FFR and MFR are integrated of order one (I(1)) while PL, CAP and LAB are integrated of order zero (I(0)). In line with Woodridge (2011) conclusion, the time series are realization of stochastic processes.

Cointegration Test

Given that most of the time series are not integrated at levels (I(0)), the study proceeded to implement cointegration test (Table 3). According to Woodridge (2011),

cointegration test is used to establish if there is a correlation between several time series in the long term. The study employed Philp-Qualiaris (PQ) technique in the test of cointegration. The null hypothesis of no cointegration is rejected if at least one cointegrating equation exists. The result obtained show that about five (5) cointegrating equations exist. The study therefore rejects the null hypothesis of no cointegration. This implies that there is existence of long run relationship among the various variables utilized in this study.

Table 3: Summary of PQ Cointegration Results

Dependent	tau-statistic	Prob.*	z-statistic*	Prob.*	Remarks
MO	-13.141033	0.0000	-29.37679	0.0000	Cointegrating eqn
ER	-4.896036	0.2243	-30.16030	0.1928	
FR	-14.68564	0.0000	-29.05299	0.0000	Cointegrating eqn
FFR	-4.747591	0.2710	-30.88064	0.1668	
MFR	-6.968996	0.0061	-41.74003	0.0073	Cointegrating eqn
PL	-6.128375	0.0313	-45.39225	0.0016	Cointegrating eqn
CAP	-5.286606	0.1290	-18.48306	0.8013	
LAB	-16.005409	0.0000	-92.66024	0.0000	Cointegrating eqn

Source: Authors Computation

Long Run Estimates of Manufacturing Output Model

The model of manufacturing output was estimated using canonical cointegrating regression (CCR) framework. The CCR was estimated with Bartlett kernel and Newey-West fixed bandwidth of 4.0.

Table 4: Summary of Long-run Estimates of the Manufacturing Output Function

Dependent Variable	Manufacturing output (MO)			
Variable	Symbols	Coefficient	Std. Error	t-Statistic
Exchange rate	ER	-0.274197	0.044933	-6.102399
Fixed Exchange rate regime	FR	0.309894	0.094928	3.264501
Full floating Exchange rate regime	FFR	-0.325891	0.059562	-5.471480
Managed floating Exchange rate regime	MFR	0.006501	0.001862	3.491863
Price level	PL	-0.223376	0.090433	2.470075
Capital	CAP	0.423566	0.056645	7.477589
Labour	LAB	0.032577	0.013397	-2.431621
Intercept	C	-0.431840	1.620054	-0.266559
	@TREND	1.546606	0.859222	1.800007
	@TREND^2	-0.001202	0.000646	1.859312
R-squared	0.878328			
Adjusted R-squared	0.810524			
Obs	48			

Source: Authors Computation

The result obtained is shown on Table 4. The result indicates the coefficient of ER as -0.274 which suggests that 10 percent increase in ER will lead to 2.74% decline in manufacturing output. Similarly, the coefficients of FR and FFR are 0.3099 and -0.3259 respectively. This suggests that while increasing FR by 10 percent could raise

manufacturing output by 3.099%, raising FFR by 10% will lead to declining of manufacturing output by 3.259%. In the same vein, the coefficient of MFR is 0.0065. This indicates that MFR could raise output, howbeit, by less than that of FR. In other words, as the economy floats its currency, the manufacturing output is constrained the more flexible the currency exchange rate becomes. In the same vein, the coefficients of PL, CAP and Lab are -0.223, 0.424 and 0.033 respectively. This equally suggests that increasing PL by 10 percent would reduce manufacturing output by 2.23% while raising labour and capital by 10% would raise manufacturing output by 0.33% and 4.24% respectively.

Evaluation of Estimates

The estimates obtained from the model of this study are evaluated using economic criterion, statistical criterion and econometric criterion. The economic criterion is used to evaluate the model estimates based on theoretical or *apriori* expectations concerning the relationships between the hypothesized variables of the model. The model estimated with CRR is evaluated under this criterion based on sign test.

Table 5: Summary of Apriori Expectation Test

Dependent/Predicted Variable: Manufacturing Output (MO)			
Explanatory/Predictor Variable	Expected sign	Obtained Sign	Remark
ER	Positive	Negative	Do not conform
FR	Positive	Positive	Conform
FFR	Positive	Negative	Do not conform
MFR	Positive	Positive	Conform
PL	Positive	Negative	Do not conform
CAP	Positive	Positive	Conform
LAB	Positive	Positive	Conform

Source: Authors Computation

As shown on Table 5, all the variables entered the model with the *apriori* expectations, except ER, FFR, and PL. Economic theories predicted that exchange rate devaluation would lead to increased demand for domestic goods which implies increased output of the production sector. However, the negative sign indicates that the reverse is the case. This could suggest that the Marshall-Lerner condition may be violated. The Marshall-Lerner condition predicts that the sum of export and import elasticities must not be less than 1 to realize the predictions of the theory. Also, the negative price effect could suggest that inflation has exceeded the threshold within which it can stimulate increased output supply from the firms.

Evaluation Based on Statistical Criteria

The statistical criterion evaluates the robustness or appropriateness of a model or its hypothesized variables to be used for statistical inference. Under this criterion, the estimates are evaluated using the R^2 and multiple parameter Wald test. The R^2 measures the goodness of fit of a regression model. The regression model has an R^2 of 0.878 which suggests that 87.8% of the variation in manufacturing output is explained by the

explanatory variables in the model. This is an indication that the model has a good fit. The joint significance of the regression model is evaluated using the multiple parameters Wald test. The Wald test is analogous to the F-test in ordinary least square (OLS) regression framework. The test statistics are F-statistics and Chi-square statistics. If the p-value of both F-statistics and Chi-square statistics are less than 0.05, the null hypothesis will be rejected at 95% confidence level. If the p-value of either of the two statistics is less than 0.05 while the other is greater than 0.05, the test is inconclusive. If the test fails to reject the null hypothesis, then we conclude that the regression model is not robust. This implies that inferences may not be reliably made from the model. The Wald test statistic is summarized on Table 6. The result shows that the F-statistics is 33.252 with (10, 38) degrees of freedom while the Chi-square is 229.268 with 10 as the degree of freedom. Since both probabilities of F-statistics and Chi-square are less than 0.05 (0.0001 for F-statistics and 0.000 for Chi-square), we conclude that the model is jointly statistically significant.

Table 6: Summary Statistics for Wald Test

Test Statistic	Value	df	Probability
F-statistic	33.252171	(10, 38)	0.0001
Chi-square	229.26954	10	0.0000

Source: Authors Computation

Evaluation Based on Econometric Criteria

The robustness, appropriateness and predictive power of the estimated econometric model is evaluated based on Serial Correlation LM test and Heteroskedasticity test. The serial correlation Langrangian Multiplier (LM) is an asymptotic test that investigates whether the OLS assumption of no serial correlation is violated. In this study we employed Breusch-Godfrey Serial Correlation LM Test. As shown on Table 7 the null hypotheses of no serial correlation and no heteroscedasticity are not rejected. We therefore conclude that there is neither serial correlation nor heteroscedasticity in the estimated model.

Table 7: Summary Statistics for Serial Correlation test and Heteroskedasticity test

	F-statistics		Obs*R-squared		Remark
	Statistics	Prob. F(10,28)	Statistics	Prob. Chi-Square(10)	
Breusch-Godfrey Serial Correlation LM Test H_0: There is no serial correlation in the residual	1.643590	0.2208	1.201934	0.7100	Do not Reject H_0
Heteroskedasticity Test: Breusch-Pagan-Godfrey H_0: The residual is homoscedastic	1.924131	0.1179	10.06866	0.1218	Do not Reject H_0

Source: Authors Computation

Test of Hypotheses

As stated earlier, the test of hypotheses was implemented using t-test. The null hypotheses are hereby restated that exchange rate does not have significant impact on manufacturing output in Nigeria, and exchange rate flexibility do not have significant impact on manufacturing output in Nigeria. The test statistic is the t-stat reported (t_α^R) in the regression output. The critical t-stat (t_α^2) as reported by Gujarati (2004) is 2.021. The decision Rule is that reject H_0 if (t_α^R) $\geq$ (t_α^2) otherwise accept H_0. From the test outcome on Table 8, the decision is that exchange rate has significant negative impact on manufacturing output in Nigeria, and exchange rate flexibility has significant impacts on manufacturing output in Nigeria.

Table 8: Summary Hypotheses Test

	Estimates	T-stat	Outcome	Remark
H_1: Exchange rate does not have significant impact on manufacturing output in Nigeria				
ER⇔MO	-0.274197	-6.102399	$(t_\alpha^R) \geq t_\alpha^C$	Reject H_0
H_2: Exchange rate flexibility do not have significant impact on manufacturing output in Nigeria				
MFR ⇔ MO	0.006501	3.491863	$(t_\alpha^R) \geq t_\alpha^C$	Reject H_0
FR ⇔ MO	0.309894	3.264501	$(t_\alpha^R) \geq t_\alpha^C$	Reject H_0
FFR ⇔ MO	-0.325891	-5.471480	$(t_\alpha^R) \geq t_\alpha^C$	Reject H_0

Source: Authors Computation

Discussion of Findings

The thrust of this study is to ascertain the impact of exchange rate on manufacturing output in Nigeria. The findings obtained are discussed concisely in this subsection. First, the result obtained show that exchange rate devaluation constrains manufacturing output. This finding is contrary to the neoclassical prediction that exchange rate devaluation would raise domestic output of firms. The neoclassical prediction is based on the assumption that exchange rate devaluation makes domestic outputs relatively cheaper while foreign goods become relatively dearer. As opine by Södersten and Reed (2014) and Zhang (2018), devaluation reduces the cost of a country's exports, rendering them more competitive in the global market, which, in turn, increases the cost of imports. If imports are more expensive, domestic consumers are less likely to purchase them, further strengthening domestic demand for firms' output.

However, the result we obtained shows that devaluation of the naira hurts the manufacturing sector. This may be explained by several factors. The first attempt in economic literature to explain this phenomenon was made by Abba Lerner in what was later christened, "Marshall-Lerner" condition. The Marshall-Lerner condition states that if policy makers devaluate a currency in order to get a positive effect on the trade balance, the demand for the nation's exports and the nation's demand for imports need to be sufficiently elastic. The condition under the simplest of circumstances is that the two elasticities together must exceed one (Shirvani & Wilbratte, 2017). In general, if

the sum of the two elasticities is less than one then in reaction to exchange rate devaluation, the demand for domestic output would rather decline. Another explanation for this phenomenon observed in our study is the J-curve effect. The J-curve reflects how a devaluation of a country's exchange rate affects its balance of trade over time, and by extension domestic production overtime. Immediately after the devaluation, the domestic importers are facing increased import prices in terms of the domestic currency; hence, the net export initially falls, which indicates decline in domestic aggregate output of firms. In terms of foreign currency, the foreign markets faces lower export prices but since the demand for exports and imports are relatively inelastic in the short run the export and import volumes need some time to adjust to the change in price. The elasticity of demand is affected by sluggishness in change of people's consumer behavior or the lag of renegotiating contracts. When the demand patterns adjust to the new exchange rate, the trade balance will start to improve (Mackintosh et al 2016).

In addition, Nigeria is an import dependent economy. This has several implications for the manufacturing sector. First, intermediate goods, including capital goods and raw materials, used by manufacturing firms are imported. If exchange rate depreciates, the cost of importing these factor inputs hikes thereby reducing the supply of factor inputs. The obvious outcome would be decline in firms' output. Second, given that most of the imported goods do not have local alternatives, exchange rate devaluation would not lead to expenditure switching: it would rather lead to increase in domestic prices which would reduce demand for firms' output. Finally, incessant exchange rate vagaries create uncertainties in the international transaction corridors. This leads to investment paucity in the manufacturing sector. The result obtained also shows that manufacturing sector could fare better under conditions of fixed exchange rate. The result indicates that increasing exchange rate flexibility hampers manufacturing output. In developing countries, especially small open economies like Nigeria, exchange rate flexibility represents increasing vulnerability and swings of the currency rate. These swings which could be quite volatile reinforce uncertainties thereby reducing the aggregate output of the manufacturing sector. Other findings indicate that increasing general price level could lead to decline in manufacturing sector performance. This suggests that price inflation in Nigeria has become severe. As noted by Gerlach and Smets (2017), price inflation may stimulate output if it is mild. However, severe price inflation increases cost of production, reduces consumer purchasing power and therefore leads to decline. Also, in line with neoclassical wisdom, labour and capital are found to engender output growth effect.

5. Conclusion and Recommendations

The thrust of this study is to ascertain the impact of exchange rate on manufacturing output in Nigeria between 1990 and 2020. Using canonical cointegrating regression (CCR) framework, the result obtained showed that exchange rate devaluation constrains manufacturing output while exchange rate flexibility hampers manufacturing output.

Other findings indicate that increasing general price level could lead to decline in manufacturing sector performance while labour and capital are found to engender output growth effect. This is based on the objective that fluctuations of exchange rate could hamper the manufacturing output of a country

The following policy recommendations were put forward. First, there is an urgent need to design and implement an appropriate exchange rate policies and strategies capable of improving the manufacturing performance. More importantly, the government should direct it expenditure to the key productive sectors of the economy, this will go a long way in increasing the production of goods and services thereby stabilizing the prices and consequently exchange rate. Second, it is also important for the government arms to adequately monitor and address the country's budget allocation, as more of the country's budget is recurrent than capital. Theoretically and indeed practically it is not healthy for a country with 70% recurrent expenditure because it shows that, the country' expenditure is more of consumption than investment which will definitely spark up inflation rate in the country. In addition, efforts should be geared towards reducing prime lending rate to an affordable acceptable level, as that would boost the credit facilities for the productivity in the country. Third, change in exchange rate management strategy should be allowed to run a reasonable course of time. Jettisoning strategies at will and on frequent basis has implication for exchange rate and obvious consequence for a sector that depends on foreign inputs. Fourth, manufacturing activities should be encouraged by government by giving incentives and subsides to local manufacturers and improving the technological and infrastructural development so as to increase the sector's contribution to gross domestic product and employment within the country. Fifth, the central bank of Nigeria should monitor the unethical practice of some commerce bank which has resulted in much fluctuation in the rate of exchange. More stringent punitive have to be taken against the culprit banks. Sixth, policy makers should encourage and revisit the existing import-substitution industrialization strategies to encourage local manufacturers to produce those goods that are currently imported from so as to increase the demand and consumption for locally made goods. This would in turn boost the output and performance of manufacturing sector in Nigeria. Lastly, Central Bank of Nigeria should implement policies to address frequent fluctuations in exchange rate to protect the manufacturing sector from exchange rate movement.

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