

DYNAMIC INTERACTIONS AMONG EXCHANGE RATE, PERFORMANCE OF MANUFACTURING SECTOR AND INFLATION IN NIGERIA: AN ARDL APPROACH

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Abstract

The manufacturing sector is the hub for the transformation of raw materials to finished or semi-finished goods. By engaging in both international and domestic markets, macro-prices are likely going to interplay with the behavior of the sector. This study determines the direction of causality among exchange rate, inflation and manufacturing sector (MS) performance. It further analyzes the effect of exchange rate on inflation and MS performance in Nigeria. Secondary and annual time series data that covered 1981 to 2018 are sourced from World Development Indicator (WDI) published by World Bank Organization. This study employed the Augmented Dickey Fuller (ADF), Philip-Perron (PP), Johanson cointegration, VEC multivariate Granger causality/Exogeneity and Autoregressive Distributed Lags (ARDL) bounds tests. The findings revealed that a long run relationship exists among MS performance, exchange rate and inflation, but only inflation has a statistically significant positive effect on MS performance in the long run. Also, a unidirectional causality runs from exchange rate to MS performance and from inflation to MS performance, while bidirectional causality runs between exchange rate and inflation. In the short run, exchange rate has a negative effect on MS performance in the current year, but positive effect in the previous year. The effect of inflation on MS performance is positive in both the short and long run. This study recommends that both exchange rate and inflation should be regulated by the monetary authority through appropriate monetary policies like low rate of interest and rejection of further currency devaluation measures to promote the performance of the MS without jeopardizing the welfare of the citizenry in Nigeria, since both high exchange and inflation rates are characterized by adverse welfare effects.

Keywords: exchange rate, inflation, Manufacturing, ARDL, Causality

INTRODUCTION

The subject of exchange rate changes has become a topical issue in Nigeria since the floating of the Naira in 1986 because of a strategy initiated by the Structural Adjustment Program (SAP). Price stability is one of the macroeconomic targets and it is the objective of each economy to have a relatively stable rate of exchange with its trading partners (Opaluwa, Umeh and Abu, 2010). In Nigeria, a flexible exchange rate was presented following the implementation of the Structural Adjustment Program (SAP). The inability to understand the objective of stable exchange rate exposed the Nigerian manufacturing sector to the

difficulties associated with a fluctuating exchange rate. Such issue as the powerless and limited gainful base of the part and the rising import bills among other are noticeable (Opaluwa *et al*, 2010).

In a country in which the majority of the residents appreciates imported goods at the expense of locally made goods, increase in exchange rate usually transforms to inflation as imported goods become more expensive in the domestic market. In an inflationary period, price level ascends, which implies that the buying influence of cash falls and cash as a mechanism of exchange deteriorates in genuine worth (Modebe and Ekeazu, 2016).

Generally, the manufacturing segment of the economy assumes a crucial role in advanced economies and has numerous unique advantages vital for economic transformation. In developed or developing economies, the manufacturing segment is a main part in numerous regards. It is a medium for expanding productivity according to import substitution and export increase. It also enhances the capacity to earn higher foreign exchange and increases job opportunities and income per capita which causes remarkable consumption designs (Loto, 2012). The recession brought about by the fall in oil prices in the 1980s activated policy considerations regarding turn around to the manufacturing sector with the production of steel picking up as the prime interest. In 1987, import bans on raw materials were forced under the World Bank Structural Adjustment Program (SAP), empowering import substitution. From that time, the manufacturing sector was expected to move to local sourcing of input. The deregulation of the foreign exchange was likewise affected to make non-oil exports increasingly competitive, leading to enormous heightening of input costs.

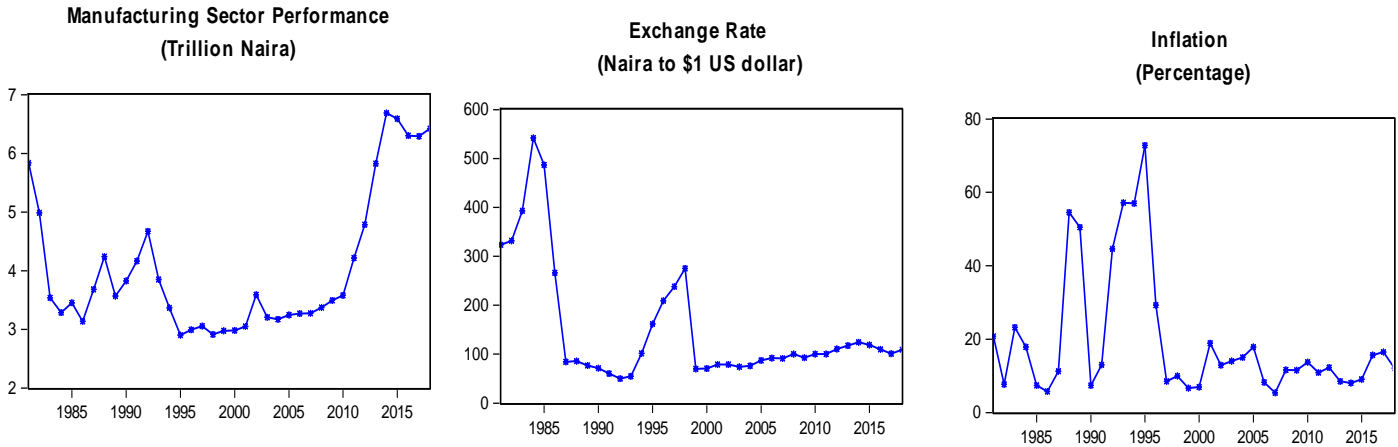
Over the years, the question of the existence and nature of the link between inflation and economic growth has been the subject of interest and debate. Despite the fact that inflation increases investment which in turn creates employment of production resources and hence greater output, there are indications that discourage savings. During inflationary periods, the value of money i.e. the buying-ability of money falls, inflation increases the earnings of business shareholders and others whose income are fixed in money terms (Imimole and Enoma, 2011).

The findings from earlier studies on the links among rate of exchange, inflation and the performance of the manufacturing sector are inconclusive. For instance, exchange rate impacted negatively on manufacturing output (Opaluwa, Umoh and Abu, 2010; and Olorunfemi, Tomola, Felix and Ogunleye, 2013), negative relationship was found in the long run between inflation and the productivity of the manufacturing sector (Bans-Akutey, Yaw and Faisal, 2016), a positive connection was noted among Gross Domestic Product and exchange rate, while the presence of liquidity shocks and inflation prompted an expansion in the exchange rate (Naser, Farshid and Elahe, 2016). Also, Simon-Oke and Aribisala (2010) found that in the short run, exchange and interest rates emerged as significant determinants of industrial productivity growth, but no short run relationship among manufacturing productivity and rate of exchange, Gross Domestic Product, money supply and rate of unemployment was found by Adegbelemi (2018).

Inflation was responsive to exchange rate, lagged inflation, money supply and import prices (Nwaru and Eke, 2017), depreciation of exchange rate, money supply and real gross domestic products were the main influencing factors of inflation (Imimole and Enoma, 2011) and exchange rate devaluation raised the general costs of production in the domestic economy, prompting an inflationary wind (Abiodun, Ajibola, Inuwa, Idowu, Sani, Anigwe and Udoko, 2016). This gave room for further research in the relationship among exchange rate, inflation and manufacturing sector performance. Besides, studies with a multivariate analysis combining exchange rate, inflation and performance of the manufacturing sector together are sparse, hence this study.

From the trend analysis of exchange rate, inflation and performance of the manufacturing sector in Nigeria as shown in figure 1, between 1981 and 1995 the productivity of the manufacturing sector was highly unstable. However, it experienced a slight increase between 1995 and 2010, and a sharp rise from then till 2013, but a slight fall till 2018. Real exchange rate was unstable between

FIG.1: TRENDS IN MANUFACTURING SECTOR PERFORMANCE, EXCHANGE RATE AND INFLATION IN NIGERIA(1981-2018)



1981 and 1999, but a steady slight upward trend was observed between 2010 and 2018. Inflation rate was highly unstable all through the study period, but it appeared to be very high between 1986 and 1997. From this trend analysis, the nature of relationship is unclear.

Therefore, this study aims at determining the direction of causation among exchange rate, inflation, and manufacturing sector performance. It analyzes the effects of exchange rate and inflation on manufacturing sector performance in Nigeria. This is with a view to provide information to policy makers and other relevant stakeholders, and increase knowledge on the relationship that exist among exchange rate, inflation and performance of the manufacturing segment in Nigeria between 1981 and 2018.

The study is in five sections. Besides this introductory section, this study reviews the empirical literature on exchange rate, manufacturing sector and inflation in the second section, while the third section reports the methodology of the study. The fourth section contains the discussions of the findings, while the fifth section contains the conclusion and recommendation.

LITERATURE REVIEW

Authors have researched the nature of links among exchange rate, inflation and the performance of the manufacturing sector. Some of these related studies are reviewed as follow:

Opaluwa, Umoh and Abu (2010) studied the effect of exchange rate fluctuations on the Nigerian manufacturing sector. They conducted this study within the scope of 1986 to 2005 and OLS regression analysis was adopted in this research. It was discovered that exchange rate and its fluctuations exerted a negative impact on manufacturing output and the effect has been empirically verified.

Naser, Farshid and Elahe (2016) conducted a research on the asymmetric effects of monetary shocks on the rate of exchange and balance of trade, focusing on inflation targeting within the scope of 2000 to 2014. The methodology used was the exponential GARCH and the result showed that there is a positive connection between Gross Domestic Product and exchange rate. Additionally, the presence of liquidity shocks and inflation prompts an expansion in the exchange rate. It was also found that exchange rate

assumes a dual impact in the economy and that expanding exchange rate improves the nation's competitiveness in the international markets.

Loto (2012) examined the global economic downturn and the performance of the manufacturing segment in Nigeria within a 33 years range i.e. 1970 to 2002 using the OLS regression. He found out that inflation rate showed an insignificant positive shock on the performance of manufacturing segment in the Nigerian economy.

Audu and Amaegberi (2013) did a research on fluctuation of exchange rate and inflation targeting an open economy. Their research was within the scope of 43 years (1970 to 2012). Using the regression analysis, they found out that interest rate positively influences the growth of the rate of inflation in the Nigerian economy while exchange rate negatively impacts the economy.

Bans-Akutey, Yaw and Faisal (2016) examined the impact of inflation on the productivity of manufacturing sector in Ghana within the scope of 1968 to 2013 using the OLS regression. The result showed a negative significant link between the productivity of the manufacturing sector and the rate of inflation. The study found a significant relationship in the long run between inflation and the productivity of the manufacturing sector.

Simon-Oke and Aribisala (2010) examined the impact of deregulation of exchange rate on industrial performance in Nigeria. Using co-integration technique and error correction model (ECM) analysis within the scope of 1975 to 2006, it was discovered that a long run relationship exists between industrial productivity growth rate, exchange rate, interest rate and terms of trade, and exchange rate deregulation had a significant impact on industrial sector performance. Also, in the short run, exchange and interest rates emerged as significant determinants of industrial productivity growth in Nigeria.

Ugwu (2017) studied the dynamics of the foreign exchange rate and the performance of manufacturing firms in Nigeria within 1986 to 2016 using the OLS multiple regression analysis. There was a significant relationship between the fluctuations of exchange rate and the profitability of manufacturing firms in Nigeria. The author suggested that Nigerian government should promote diversification of exports.

Enekwe, Ordu and Nwoha (2013) examined the impact of fluctuations in exchange rate on manufacturing sector in Nigeria. The study was within the scope 1985 to 2010 and they used the multiple regression analysis. The result revealed significant positive impact of all the independent variables on the dependent variable. The study suggested that export diversification should be encouraged by the government to improve on the fluctuations of exchange rate in impacting the manufacturing sector in Nigerian economy.

Olorunfemi, Tomola, Felix and Ogunleye (2013) studied the performance of the manufacturing segment relative to changes in some macroeconomic variables in Nigeria within the years 1980 to 2008 using OLS. The result indicated a positive relationship between each of capacity utilization and import, and the performance of the manufacturing segment. However, there was a negative relationship between investment and manufacturing sector, exchange rate and export.

Lawal (2016) analyzed the impact of fluctuations in exchange rate on output of the manufacturing sector in Nigeria within the scope 1986 to 2014 using the Autoregressive Distributive Lag (ARDL). The result showed that exchange rate had an insignificant positive effect on manufacturing output. The study suggested that the government should implement arrangements on export strategies to energize trade and discourage imports so as to accomplish a balance of payment that is favorable.

Nwaru and Eke (2017) examined an econometric analysis of the impact of rate of exchange on inflation in Nigeria within the scope 1970 to 2014 using the multiple regression analysis. The findings showed that

the rate of exchange is a veritable tool to manage inflation in the country and that inflation was responsive to exchange rate, lagged inflation, money supply and import prices.

Imimole and Enoma (2011) studied the depreciation of exchange rate and inflation in Nigeria. The scope of the study spanned between 1986 and 2008; 23 years, using the ARLD method of analysis. The result showed that the depreciation of exchange rate, money supply and real gross domestic products were the main influencing factors of inflation in Nigeria. The exchange rate of naira to dollar had a significant positive long run effect on inflation. They also discovered that depreciation of exchange rate could lead to an increase in inflation rate in Nigeria.

Abiodun, Ajibola, Inuwa, Idowu, Sani, Anigwe and Udoko (2016) studied the exchange rate pass-through to inflation in Nigeria. They used a quarterly data within 1995 Q1 to 2015 Q1 and also made use of the Johansen approach. The impact was found to be higher in import than in consumer prices, suggesting that the go-through impact decreases along the pricing chain. Enormous price increments came about because of exchange rate devaluation which could overflow to different divisions of the economy, raise the general costs of production in the domestic economy, and may prompt an inflationary winding.

Adegbemi (2018) studied the macroeconomic dynamics and the output of the manufacturing sector in Nigeria within 1981 to 2015 using the cointegration test of Johansen. The result showed a negative relationship among inflation rate, rate of interest, exchange rate, money supply on one hand, and manufacturing yield. No short run relationship was found among manufacturing productivity and every one of Gross Domestic Product, money supply, rate of exchange and rate of unemployment.

METHODOLOGY

Specification of Models

Model for Causality (Vector Auto-Regressive Model VAR)

The VAR models were introduced by Sims (1980) to model joint dynamics and causal relations among macroeconomic variables. It is a stochastic process model. In this study, it would be used to capture the interdependencies among the three variables. Auto-Regression (VAR) procedure will be used to establish the dynamic relationships between inflation, rate of exchange and performance of the manufacturing sector. These three variables are treated as endogenous jointly. The VAR is generally utilized for forecasting frameworks of interrelated time series and for analyzing the dynamic effect of random disturbances on an arrangement of variables. The VAR methodology treats each endogenous variable in the framework as a component of the slacked estimations of all the endogenous variables in the framework.

The mathematical representation of a VAR model is;

$$y_t = A_1 y_{t-1} + \dots + A_p y_{t-p} + B_q x_t + \mu_t \quad (3.1)$$

In which y_t is a k vector of dependent variables, x_t is a q vector of independent variables, A_1, \dots, A_p and B are matrices of coefficients to be estimated. μ_t is a vector of innovations that may be contemporaneously correlated but are uncorrelated with their own lagged values and uncorrelated with all of the right hand side variables. In the estimation of a VAR model, this study specifies the model as thus assuming the series are stationary at level and are cointegrated;

$$INF_t = \delta_0 + \sum_{i=1}^k \delta_{1i} INF_{t-i} + \sum_{i=1}^k \delta_{2i} EXR_{t-i} + \sum_{i=1}^k \delta_{3i} MSP_{t-i} + \varepsilon_{1t} \quad (3.2)$$

$$EXR_t = \alpha_0 + \sum_{i=1}^k \alpha_{1i} INF_{t-i} + \sum_{i=1}^k \alpha_{2i} EXR_{t-i} + \sum_{i=1}^k \alpha_{3i} MSP_{t-i} + \varepsilon_{2t} \quad (3.3)$$

$$MSP_t = \beta_0 + \sum_{i=1}^k \beta_{1i} INF_{t-i} + \sum_{i=1}^k \beta_{2i} EXR_{t-i} + \sum_{i=1}^k \beta_{3i} MSP_{t-i} + \varepsilon_{3t} \quad (3.4)$$

Where *INF* is inflation, *EXR* is exchange rate and *MSP* is manufacturing sector performance. If all the series are non-stationary at levels but stationary at first difference i.e. I(1) and are co-integrated then a VEC multivariate Granger causality model is specified;

$$\Delta INF_t = \delta_0 + \sum_{i=1}^k \delta_{1i} \Delta INF_{t-i} + \sum_{i=1}^k \delta_{2i} \Delta EXR_{t-i} + \sum_{i=1}^k \alpha_{1i} \Delta MSP_{t-i} + \lambda_3 ecm_{t-1} + \varepsilon_{1t} \quad (3.5)$$

$$\Delta EX_t = \alpha_0 + \sum_{i=1}^k \alpha_{1i} \Delta INF_{t-i} + \sum_{i=1}^k \alpha_{2i} \Delta EXR_{t-i} + \sum_{i=1}^k \alpha_{3i} \Delta MSP_{t-i} + \lambda_1 ecm_{t-1} + \varepsilon_{2t} \quad (3.6)$$

$$\Delta MSP_t = \beta_0 + \sum_{i=1}^k \beta_{1i} \Delta INF_{t-i} + \sum_{i=1}^k \beta_{2i} \Delta EXR_{t-i} + \sum_{i=1}^k \beta_{3i} \Delta MSP_{t-i} + \lambda_2 ecm_{t-1} + \varepsilon_{3t} \quad (3.7)$$

Effect Model

To evaluate the effect of exchange rate and inflation on manufacturing sector performance, the manufacturing sector performance (*MSP*), which is in logarithm, is expressed as a function of exchange rate (*EXR*) and inflation (*INF*):

$$MSP_t = f(EXR_t, INF_t, G_t) \dots \dots \dots \quad (3.8)$$

G_t represents a vector of control variables that can also influence *MSP* as identified by some the empirical review, Olorunfemi *et al* (2013) stated that export (EXP) and import (IMP) can affect manufacturing sector performance. Also, Adegbelemi (2018) adopted interest rate (INT) as one of the determinants of manufacturing sector output. Eze, Nnaji and Nkaku (2019) found FDI relating with manufacturing sector output in the long run. From the theory of production, the role of capital stock (CAP) is vital in producing goods and providing services. Therefore, the control variables represented by G_t are export (EXP), import (IMP), interest rate (INT), foreign direct investment (FDI) and capital sock (CAP). All the variables are in natural logarithm form.

We generated the stochastic form of our model by introducing the random error (V_t), and the vector of the control variable represented by G_t , hence our equation:

$$MSP_t = \beta_0 + \beta_1 EXR_t + \beta_2 INF_t + \beta_3 EXP_t + \beta_4 IMP_t + \beta_5 INT_t + \beta_6 FDI_t + \beta_7 CAP_t + V_t \dots \dots \dots \quad (3.9)$$

Therefore, equations 3.2 to 3.4 or 3.5 to 3.7 are estimated to determine the direction of causation among exchange rate, inflation and the performance of the manufacturing sector, while equation 3.9 is evaluated to analyze the effects of exchange rate and inflation on manufacturing sector performance.

3.2 Estimation Techniques

In this study, the unit root test is used in discovering the order of integration [I(0) or I(1)] of the variables which helps to choose the appropriate method of estimation. Philip-Perron (PP) and Augmented Dickey Fuller (ADF) tests were adopted for the stationarity test. The issue of stationarity has become important, especially when dealing with time series data. It is expected that the series must exhibit stationarity so it does not yield unreliable and misleading results. Unit root test is a common test in econometric analysis to check whether a series is time invariant or not. That is, whether the series properties; mean, variance and auto covariance are constant over time. If, the outcome of the unit root tests revealed a mixed results of stationarity at level I(0) and stationarity at first difference, I(1), the Autoregressive Distributed Lags (ARDL) bounds test would be adoptable. Other techniques of estimation include Johanson cointegration and VEC multivariate Granger causality/Exogeneity tests.

3.3 Sources of Data and Explanation of Variables

The main source of data used in this study is from World Development Indicator (WDI), an online database published by World Bank Organization, and accessed in 2019. The variables used in this study include inflation (INF) which is proxy by the consumer price index (CPI). CPI shows the yearly rate change in the expense to the normal customer of obtaining a bushel of merchandise and enterprises that might be fixed or changed at determined interims. The variable is in percentage.

Exchange rate (EXR) which is a relative price of one currency in terms of another currency (or group of currencies) is measured using the real effect exchange rate indices. One of the main variables of interest in this study is the performance of the manufacturing sector (MSP), which is the manufacturing value added and measured in constant local currency unit. The natural logarithm of the variable is used in the analysis. Foreign Direct Investment (FDI) is the net inflows of investment. It is the entirety of value capital, reinvestment of profit, other long term capital, and momentary capital as appeared in the balance of payments. The essence of including this variable in the model is that a long run relationship was found between foreign direct investment and the manufacturing sector output (Eze, Nnaji and Nkalu, 2019). Besides, a country like Nigeria that encourages the inflow of FDI and job creation will not debar the manufacturing sector from the possible stimulus from FDI inflow. The natural logarithm of FDI is adopted in the analysis.

Real interest rate (INT) is the lending interest rate adjusted for inflation as calculated by the GDP deflator. The terms and conditions attached to lending. The level of interest rate can either encourage or discourage investors from obtaining loan to boost the growth of the manufacturing sector. The variable is in percentage. Capital stock (CAP) is the Gross fixed capital formation which incorporates land enhancements; plant, hardware, and gear buys; and the development of streets, railroads, and such, including schools, workplaces, emergency clinics, private homes, and business and mechanical structures. Capital has remained vital in the production process and the natural logarithm of the variable is used in the analysis. Exports (EXP) represent the export of goods and services as a percentage of the GDP, and imports (IMP) is import of goods and services as a percentage of the GDP. The volume of imports and exports give information on the extent of involvement of an economy in international trade. The inclusion of these variables is premised on the perceived involvement of the manufacturing sector in imports and exports activities.

RESULTS AND DISCUSSIONS

Unit Root Tests

Two unit root tests were employed: the Augmented Dickey Fuller (ADF) and Philip-Perron (PP) tests. The results are presented in table 4.1

From table 4.1, the findings revealed that the series in the manufacturing sector performance (MSP), exchange rate (EXR), inflation (INF), exports (EXP) and imports (IMP) are consistently stationary at first difference, I(1), at 5 percent in both Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) tests, while interest rate (INT) and foreign direct investment (FDI) are consistently stationary at level I(0), at 5 percent in both ADF and PP tests. In the case of Capital stock (CAP), it is stationary at 5 percent at level in PP test but stationary at first difference under ADF test. However, in the overall decision, the ADF position is sustained.

Table 4.1: Results of Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) Stationarity Tests

Variables	Augmented Dickey-Fuller (ADF)			Phillips-Perron (PP)			Overall Decision
	Level (with C)	1 st Diff (with C)	Order of Integration	Level (with C)	1 st Diff (with C)	Order of Integration	
<i>MSP</i>	-0.7249 (0.8280)	-8.1724* (0.0000)	I(1)	-0.5934 (0.8601)	-7.9693* (0.0000)	I(1)	I(1)
<i>EXR</i>	-2.0268 (0.2746)	-4.1584* (0.0025)	I(1)	-1.9185 (0.3205)	-4.0815* (0.0031)	I(1)	I(1)
<i>INF</i>	-2.8975 (0.0553)	-5.5983* (0.0000)	I(1)	-2.7690 (0.0726)	-9.6243* (0.0000)	I(1)	I(1)
<i>CAP</i>	-2.5117 (0.1214)	-4.8730* (0.0004)	I(1)	-3.5851* (0.0110)	---	I(0)	I(1)
<i>INT</i>	-7.1509* (0.0000)	---	I(0)	-6.9324* (0.0000)	---	I(0)	I(0)
<i>EXP</i>	-0.9267 (0.7684)	-7.0246* (0.0000)	I(1)	-0.9318 (0.7667)	-7.0246* (0.0000)	I(1)	I(1)
<i>IMP</i>	-0.7045 (0.8333)	-5.2633* (0.0001)	I(1)	-0.7072 (0.8326)	-5.2646* (0.0001)	I(1)	I(1)
<i>FDI</i>	-3.3938* (0.0176)	---	I(0)	-3.3116* (0.0215)	---	I(0)	I(0)

NB: * represents significance 5%. The probability of the statistic is in parenthesis. C represents intercept. I(0) and I(1) indicate stationarity at level and at first difference respectively.

Source: Author's Compilation, 2019

4.2 Cointegration Test among Manufacturing Sector Performance, Exchange Rate and Inflation

It is noted that the three main variables of interest in this study; manufacturing sector performance (MSP), exchange rate (EXR) and inflation (INF), are stationary at first difference I(1), this study proceeded to test for cointegration among the three variables using the Johanson test. The result is reported in table 4.2. The results in table 4.2 revealed that there is a long run relationship among the three main variables; manufacturing sector performance (MSP), exchange rate (EXR) and inflation (INF). This is reported by Trace test which indicated 1 cointegrating equation at the 0.05 level and the Maximum-eigenvalue test which also indicates 1 cointegrating equation at the 0.05 level. Thus, a long run relationship exists among manufacturing sector performance, exchange rate and inflation in Nigeria over the study period.

Table 4.2: Result of Johanson Cointegration Test among Manufacturing Sector Performance, Exchange rate and Inflation

Sample (adjusted): 1983-2018, Included observations: 36 after adjustments, Trend assumption: Linear deterministic trend, Series: <i>MSP INF EXR</i> Lags interval (in first differences): 1 to 1							
Hypothesized No. of CE(s)	<i>Eigen Value</i>	<i>Trace Statistic</i>	<i>0.05 Critical Value</i>	<i>Prob.*</i>	<i>Max-Eigen Statistic</i>	<i>0.05 Critical Value</i>	<i>Prob.*</i>
None *	0.6839	50.6650	29.7971	0.0001	41.4602	21.1316	0.0000
At most 1	0.2188	9.2048	15.4947	0.3468	8.8882	14.2646	0.2956
At most 2	0.0088	0.3167	3.8415	0.5736	0.3167	3.8415	0.5736
<p><i>Trace test indicates 1 cointegrating eqn(s) at the 0.05 level</i></p> <p><i>Max-eigenvalue test indicates 1 cointegrating eqn(s) at the 0.05 level</i></p> <p><i>* denotes rejection of the hypothesis at the 0.05 level and **MacKinnon-Haug-Michelis (1999) p-values</i></p>							

Source: Author's Computation, 2019

4.3 Direction of Causation among Manufacturing Sector Performance, Exchange Rate and Inflation

To determine the direction of causation among manufacturing sector performance, exchange rate and inflation in Nigeria over the study period, the VEC multivariate Granger causality/Exogeneity test was carried out using equations 3.5 to 3.7 in section 3. The choice of this method is informed by the existence

of long run relationship among the three variables as earlier reported by Johanson test in table 4.2. Using lag 3 and one cointegration equation, the VEC multivariate Granger causality/Exogeneity test was carried out and the results shown in table 4.3. The stability test of the VEC multivariate Granger causality model was carried out using the Roots of Characteristic Polynomial and Inverse Roots of AR characteristic Polynomial. The results show that the VEC multivariate Granger causality model is stable (see appendix A)

Table 4.3: Result of VEC Multivariate Granger Causality/Exogeneity Test among Manufacturing Sector Performance, Exchange rate and Inflation

		Dependent Variables			Decision
		<i>D(MSP)</i>	<i>D(INF)</i>	<i>D(EXR)</i>	
Exogenous Variables	<i>D(MSP)</i>	---	3.854611 (0.2776)	1.409790 (0.7032)	<i>No Causality</i>
	<i>D(INF)</i>	7.883624* (0.0485)	---	12.97221* (0.0047)	<i>Unidirectional from D(INF) to D(MSP) and from D(INF) to D(EXR)</i>
	<i>D(EXR)</i>	8.973043* (0.0297)	11.40451* (0.0097)	---	<i>Unidirectional from D(EXR) to D(MSP) and from D(EXR) to D(INF)</i>

Source: Author's Computation, 2019

From the results in table 4.3, when manufacturing sector performance (MSP) is endogenous, exchange rate (EXR) and inflation (INF) Granger cause manufacturing sector performance (MSP). When inflation (INF) is endogenous, exchange rate (EXR) Granger causes inflation (INF), but manufacturing sector performance (MSP) does not. Also, exchange rate (EXR) is endogenous, inflation (INF) Granger causes exchange rate (EXR), but manufacturing sector performance (MSP) does not.

Thus, this study found a unidirectional causality running from exchange rate (EXR) to manufacturing sector performance (MSP), a unidirectional causality running from inflation (INF) to manufacturing sector performance (MSP), and bidirectional causality between exchange rate (EXR) and inflation (INF).

ARDL Cointegration Test and Estimation

Having established that some variables are not stationary at a level while others are stationary at first difference from the unit root tests results, there is need to check whether there is existence of similar trend properties between the series as a model. Given that the order of integration of the variables are I(0) and I(1), the most appropriate cointegration test is the Autoregressive Distributed Lags (ARDL) bounds test. This technique allows for the combination of variables with such different orders of integration. The ARDL bounds test result is provided in Table 4.4;

Table 4.4 ARDL Bounds Test

F-Bounds Test		Null Hypothesis: No levels relationship		
F-Statistic		5.378526		
Critical Value Bounds				
Significance	10%	5%	2.5%	1%
I(0)	2.03	2.32	2.6	2.96
I(1)	3.13	3.5	3.84	4.26

Source: Author's Compilation, 2019

The decision on ARDL bounds test inferred that, when the value of the F-statistic is greater than the value of the upper bound (that is, 1(1)), then there is cointegration, if the value of the F-statistic is less than the value of the lower bound (that is, 1(0)), then there is no cointegration, but if the value of the F-statistic is between the values of the upper bound (that is, 1(1)) and lower bound (that is, 1(0)), then the result is inconclusive. Therefore, from table 4.4, the value of the F-statistic (5.378526) which is greater than the value of the upper bound (that is, 1(1)), at 5 percent then we reject the null hypothesis of no cointegration. Thus, the variables are cointegrated at 5 percent level of significance. Therefore, we present the short run dynamics and the long run results of the effects of exchange rate and inflation on manufacturing sector performance in sections 4.4.1 and 4.4.2 respectively.

Short Run Dynamics of the Effects of Exchange Rate and Inflation on Manufacturing Sector Performance
Determining the effects of exchange rate and inflation on manufacturing sector performance in the short run, the short run dynamic model using the Autoregressive Distributed Lagged (ARDL) estimate and the results reported in table 4.5. The statistical level of significance reported in this section is based on 5 percent, but if otherwise will be stated. Also, a series of post estimation diagnostics tests were carried-out and reported in Appendix B.

Specifically, as shown in Appendix B, the probability value of F-statistic (1.364684) for heteroskedasticity test: Breusch-Pagan-Godfrey test is 25.7% which is greater than 5%, the chosen level of significance, hence we do not reject the null hypothesis of homoskedasticity. Also, the probability value of F-statistic (0.127509) for Breusch-Godfrey serial correlation LM test is 88.1% which is greater than 5% the chosen significance level. This means that we cannot reject the null hypothesis of no serial correlation in the model. The result of the Ramsey RESET test revealed that the probability value of the F-statistic (2.486861) is 13.2%, which is greater than 5% level of significance. This implies that the null hypothesis of no misspecification error in the model cannot be rejected. Thus, our linear model is appropriate. Also, the Jarque-Bera statistic value of normal distribution of residual series is 0.942245 with the probability value $0.624301 > 0.05$ revealed that the residual series is normally distributed at 5 percent level of significance. This is further buttressed by CUSUM and CUSUM of squares graphs (see Appendix B)

From the table, the value of the F-statistic is 60.85658 and its probability value $0.0000 < 0.05$ implies that the model is statistically significant at 5 percent. This means that all the explanatory variables put together, significantly explained the dependent variable (manufacturing sector performance). The adjusted R-

square which reports the percentage of variation in dependent variable, having control for the degree of freedom, explained by the independent variables put-together shows that 96% of the variation in manufacturing sector performance is explained by the independent variables engaged in the estimated model. Also, the Durbin Watson statistic value of 2.08 shows the absence of severe autocorrelation problem.

From table 4.5, the manufacturing sector performance (MSP) in the previous period [MSP(-1)] highly and significantly affects MSP positively in the current period. Also, the current value of exchange rate (EXR) has a negative and statistically significant effect on MSP. A naira increase in EXR will reduce MSP by 0.008 percent. However, a year lag value of exchange rate, EXR(-1), has a positive and statistically significant effect on MSP. A naira increase in EXR(-1) will increase MSP by 0.012 percent. The current value (INF) and two years lagged value [INF(-2)] of inflation have positive and statistically significant effects on MSP. One percent increase in INF and INF(-2) will increase MSP by 0.096 percent and 0.081 percent respectively. One year lagged value of inflation [INF(-1)] has a negative and statistically insignificant effect on MSP.

Table 4.5 Short run Dynamic Model Results

		Dependent Variable: <i>MSP</i>	Method: <i>ARDL</i>		
Sample (adjusted): <i>1983 2018</i>		Maximum dependent lags: <i>1 (Automatic selection)</i>			
Variable	Coefficient	Std. Error	t-Statistic	Prob.*	
<i>MSP(-1)</i>	0.627797	0.094174	6.666323	0.0000	
<i>EXR</i>	-0.007552	0.003487	-2.165627	0.0433	
<i>EXR(-1)</i>	0.012219	0.003880	3.148904	0.0053	
<i>INF</i>	0.095547	0.021308	4.484015	0.0003	
<i>INF(-1)</i>	-0.032094	0.021519	-1.491421	0.1523	
<i>INF(-2)</i>	0.081646	0.019245	4.242465	0.0004	
<i>CAP</i>	-0.489428	2.408197	-0.203234	0.8411	
<i>INT</i>	0.047843	0.031719	1.508348	0.1479	
<i>INT(-1)</i>	0.064146	0.036878	1.739431	0.0981	
<i>INT(-2)</i>	-0.041988	0.023722	-1.770012	0.0928	
<i>EXP</i>	1.813341	0.948530	1.911737	0.0711	
<i>EXP(-1)</i>	-1.850443	0.819385	-2.258332	0.0359	
<i>EXP(-2)</i>	1.522033	0.878953	1.731644	0.0995	
<i>IMP</i>	-1.700704	0.832548	-2.042770	0.0552	
<i>FDI</i>	0.407907	0.238085	1.713286	0.1029	
<i>FDI(-1)</i>	-0.380986	0.230692	-1.651494	0.1151	
<i>C</i>	21.13573	68.33394	0.309301	0.7605	
R-squared	0.980860	Akaike info criterion	3.100053		
Adjusted R-squared	0.964743	Schwarz criterion	3.847826		
F-statistic	60.85658	Hannan-Quinn criter.	3.361046		
Prob(F-statistic)	0.000000	Durbin-Watson stat	2.079966		

Source: Author's Compilation, 2019

In addition, Capital stock (CAP) has a negative and statistically insignificant effect on MSP, while the current value (INT) and one year lagged value [INT(-1)] of interest rate have positively, but statistically insignificant effect on MSP. Also, only a year lagged of exports [EXP(-1)] has negative and statistically significant effect on MSP, while the current value (EXP) and two years lagged value [EXP(-2)] of exports have positive but statistically insignificant effects on MSP. The effect of imports (IMP) on MSP is negative and statistically significant at about 5.5 percent. Also, the effect of the current value of foreign direct investment (FDI) on MSP is positive, while the effect of its one year lagged value [FDI(-1)] is negative, but both effects are not statistically significant.

Long Run Model Analysis

The long run static model result is reported in table 4.6 as the variables are cointegrated according to ARDL bounds test. From table 4.6, exchange rate (EXR), inflation (INF), interest rate (INTR), exports (EXP) and foreign direct investment (FDI) have positive effects on manufacturing sector performance (MSP) in the long run. Out of all these explanatory variables, only inflation has statistically significant effect on MSP at 5 percent level of significance with the t-statistic value as 3.317596 and probability value of $0.0036 < 0.05$. It further shows that a 1 percent increase in inflation will raise the MSP by 0.39 percent in the long run.

Table 4.6: Long run Levels Equation Results
Case 3: Unrestricted Constant and No Trend

Variable	Coefficient	Std. Error	t-Statistic	Prob.
<i>EXR</i>	0.012539	0.008316	1.507765	0.1481
<i>INF</i>	0.389838	0.117506	3.317596	0.0036
<i>CAP</i>	-1.314948	6.530939	-0.201341	0.8426
<i>INT</i>	0.188073	0.118151	1.591804	0.1279
<i>EXP</i>	3.989573	3.170491	1.258345	0.2235
<i>IMP</i>	-4.569290	2.799497	-1.632182	0.1191
<i>FDI</i>	0.072331	0.781362	0.092570	0.9272

$$EC = MSP - (0.0125 * EXR + 0.3898 * INF - 1.3149 * CAP + 0.1881 * INT + 3.9896 * EXP - 4.5693 * IMP + 0.0723 * FDI)$$

Source: Author's Compilation, 2019

Also, from table 4.6, capital stock (CAP) and imports (IMP) have negative effects on MSP but the effects are not statistically significant at 5 percent level of significance. The negative effect of CAP is reflecting the counterproductive effect of capital in the manufacturing sector in Nigeria when the long run is considered. Similarly, the negative effect of imports is a signal of retarding effect of importation on the performance of the manufacturing sector in Nigeria in the long run.

Discussion of Findings

The results from this study a unidirectional causality running, from exchange rate to manufacturing sector performance, from inflation to manufacturing sector performance, and a bidirectional causality between exchange rate and inflation were found. The result of ARDL bounds test revealed that the variables are

cointegrated. The lagged value of manufacturing sector performance significantly affects MSP positively in the current year.

Also, the current value of exchange rate has a negative and statistically significant effect on MSP. This result supported by the report of Opaluwa, Umoh and Abu (2010) and Olorunfemi, Tomola, Felix and Ogunleye (2013). However, lagged value of exchange rate has a significant positive effect on MSP. Inflation has a significant positive effect on MSP. In addition, lagged value of exports has negative and statistically significant effect on MSP, The imports has negative effect on MSP. Also, a long run relationship was found among manufacturing sector performance (MSP), exchange rate and inflation. This result is corroborated by Bans-Akutey, Yaw and Faisal (2016) who also found long run relationship among the variables. In the long run, exchange rate, inflation, interest rate, exports and foreign direct investment have positive effects on manufacturing sector performance. Out of all these explanatory variables, only inflation has statistically significant effect on MSP

CONCLUSION AND RECOMMENDATIONS

This study determines the direction of causation among exchange rate, inflation and manufacturing sector performance and further analyzed the effect of exchange rate and inflation on manufacturing sector performance in Nigeria using secondary and annual time series data that spanned between 1981 and 2018. This study engages the Augmented Dickey Fuller (ADF), Philip-Perron (PP), Johanson cointegration, VEC multivariate Granger causality/Exogeneity and Autoregressive Distributed Lags (ARDL) bounds tests.

From the findings, the series in all the variables are stationary at first difference except interest rate and foreign direct investment, which are stationary at levels. A long run relationship is found among manufacturing sector performance, exchange rate and inflation. Also, a unidirectional causality runs from exchange rate to manufacturing sector performance, a unidirectional causality runs from inflation to manufacturing sector performance, and bidirectional causality runs between exchange rate and inflation. This implies that as both exchange rate and inflation influence each other, they both influence the behavior of the performance of the manufacturing sector.

In the short run, exchange rate has a negative effect on manufacturing sector performance in the current year, but positive effect in the previous year. This reflects the inconsistency of the impact of exchange rate relative to the behavior of the manufacturing sector in Nigeria. Intuitively, the negative effect of exchange rate on the manufacturing sector performance reflects a scenario in which importing raw materials and machinery/equipment at the time of exchange rate depreciation is a necessity, but the positive effect reflects the benefits of exporting the manufacturing sector produce during exchange rate depreciation. The results further show that the current and two years lagged values of inflation have positive effects on manufacturing sector performance, while a year lagged of exports has negative effect on manufacturing sector performance.

In the long run, inflation has a positive effect on manufacturing sector performance in Nigeria. As earlier found in the short run, inflation is positively impacting on manufacturing sector performance. Thus, the effect of inflation on the manufacturing sector is consistently (in both short and long run) positive. These findings reflect the fact that inflation favors producers as supply of goods and services yield more revenue. However, the consumers are adversely affected during inflation as their real income reduce, consequently reducing their consumption of goods and service.

On the relationship between exchange rate and inflation, when there is increase in exchange rate, for a country like Nigeria in which imported goods are popularly in demand, inflation rate will increase as imported goods become more expensive. Also, imported commodities that are raw materials for the manufacturing and the industrial sectors will also influence the prices of locally produced goods. Therefore, this study conclude that increase in exchange rate in Nigeria leads to high inflation as the imported consumer and producer goods become expensive in the domestic market, consequently leading to low performance of the manufacturing sector.

Based on the findings, this study recommends that the government should regulate exchange rate and inflation through appropriate policies to promote the performance of the manufacturing sector. Precisely, exchange rate and inflation should be regulated by the monetary authority through appropriate monetary policies like low rate of interest and rejection of further currency devaluation measures, to promote the performance of the MS without jeopardizing the welfare of the citizenry in Nigeria, since both high exchange and inflation rates are characterized by adverse welfare effects.

REFERENCES

- Abiodun, S. B., Ajibola, I. O., Inuwa, A. T., Idowu, P., Sani, B., Anigwe, J. O., Udoko, C. O. (2016), "Exchange Rate Passthrough to Inflation in Nigeri", *CBN Journal of Applied Statistics*, 7(1a).
- Adegbemi, B. O. (2018), "Macroeconomic Dynamics and the Manufacturing Output in Nigeria", *Mediterranean Journal of Social Sciences*, 2039-9340.
- Audu , N. P., & Amaegberi, M. (2013), "Exchange Rate Fluctuation and Inflation Targetting in An Open Economy: Econometric Approach", *European Centre for Research Training and Development UK*.
- Eneke, C. I., Ordu, M. M., & Nwoha, C. (2013), "Effect of Exchange Rate Fluctuation on Manufacturing Sector Performance in Nigeria" *European Journal of Business and Management*, Vol. 5, pp 222-2839.
- Eze, Afamefuna A., Nnaji Moses and Nkalu, C. Nelson (2019), "Impact of Foreign Direct Investment on Manufacturing Output Growth in Nigeria", *International Journal of Applied Economics, Finance and Accounting*, Vol. 5, No 2, pp 55 - 64
- Imimole, B., & Enoma, A. (2011), "Exchange Rate Depreciation and Inflation in Nigeria", *Business and Economics Journal*, Vol 2011, BEJ-28.
- Lawal, E. O. (2016), "Effect of Exchange Rate Fluctuations on Manufacturing Sector Output in Nigeria", *Journal of Research in Business and Management*, 4(10), 32-39.
- Loto, M. A. (2012), "Global Economic Downturn and the Manufacturing Sector Performance in the Nigerian Economy (A Quarterly Empirical Analysis), *Journal of Emerging Trends in Economics and Management Sciences*, Vol. 3, Issue 1, pp 38 - 45.
- Bans-Akutey, Maufemor, Yaw Deh Isaac & Faisal, M. (2016), "What is the effect of Inflation on Manufacturing Sector Productivity in Ghana?", *MPRA Paper No 75145*, <https://mpra.ub.uni-muen.de/75145/>
- Modebe, N. J., & Ezeaku, H. C. (2016), "Dynamics of Inflation and Manufacturing Sector Performance in Nigeria: Analysis of Effect and Causality", *International Journal of Economics and Financial Issues*, 6(4), pp1400-1406.
- Naser, E., Farshid, S., & Elahe, M. (2016), "Investigating Assymmetric Effects of Monetary Shocks on the Exchange Rate and Trade Balance, with an Emphasis on Inflation Targetting", *Procedia Economics and Finance*, 36, 165-176.

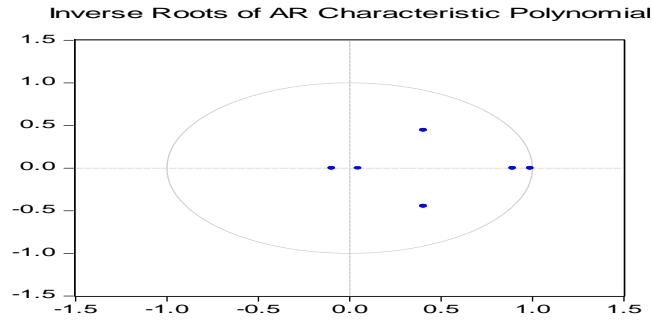
- Nwaru, Ndubuisi M., & Eke Charles N. (2017), “An Econometric Analysis of the Effect of Exchange Rate on Inflation in Nigeria”, *International Journal of Innovative Finance and Economics Research*, 5(1), pp76-91.
- Simon-Oke, O.O. and Aribisala S.E. (2010), “Exchange rate Deregulation and Industrial Performance: An Assessment”, *African Research Review*, Vol. 4(2), pp 236-251.
- Olorunfemi, S., Tomola, M. O., Felix, O. A., & Ogunleye, E. O. (2013), “Manufacturing Performance in Nigeria: Implication for Sustainable Development” *Asian Economic and Financial Review*, Vol. 3(9), pp 1195-1213.
- Opaluwa, D., Umeh, J. C., & Abu, A. A. (2010), “Effect of Exchange Rate Fluctuations on the Nigerian Manufacturing Sector”, *African Journal of Business Management*, 4(14), 2994-2998.
- Sims, C.A. (1980), 'Macroeconomics and Reality', *Econometrica*, Vol. 48, N01.
- Ugwu, J. O. (2017), “Foreign Exchange Rate Dynamics and Manufacturing Firms' Performance in Nigeria”. *International Journal of Humanities and Social Sciences Invention*, Vol. 6, Issue 9, pp 9-14.
- World Bank, (2019), “World Development Indicators” The World Bank Online databank, Accessed in December.2019, <https://databank.worldbank.org/source/world-development-indicators>

APPENDIX A
VEC STABILITY TEST

Roots of Characteristic Polynomial
Endogenous variables: *MSP INF EX*

Root	Modulus
1.000000 - 4.64e-16i	1.000000
1.000000 + 4.64e-16i	1.000000
-0.450469 - 0.716833i	0.846624
-0.450469 + 0.716833i	0.846624
0.484828 - 0.663436i	0.821709
0.484828 + 0.663436i	0.821709
0.706342	0.706342
0.673340	0.673340
-0.672702	0.672702
-0.034084 - 0.613672i	0.614618
-0.034084 + 0.613672i	0.614618
-0.121653	0.121653

VEC specification imposes 2 unit root(s).

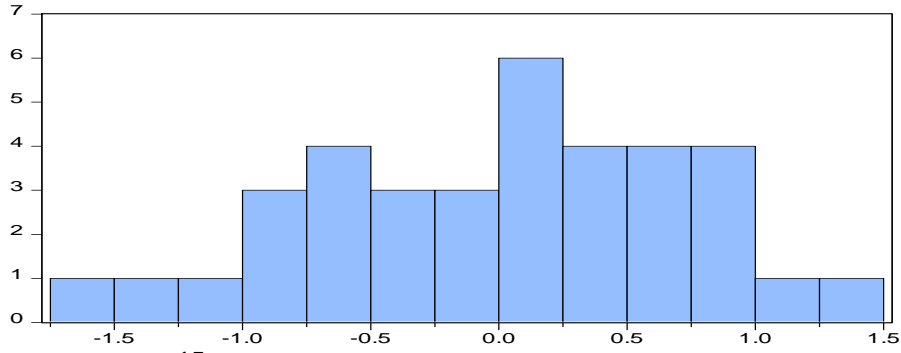


APPENDIX B
SHORT RUN DYNAMIC MODEL POST ESTIMATION TESTS

<i>Heteroskedasticity Test: Breusch-Pagan-Godfrey</i>			
F-statistic	1.364684	Prob. F(16,19)	0.2565
Obs*R-squared	19.24964	Prob. Chi-Square(16)	0.2559
Scaled explained SS	3.508210	Prob. Chi-Square(16)	0.9995

<i>Breusch-Godfrey Serial Correlation LM Test:</i>			
F-statistic	0.127509	Prob. F(2,17)	0.8811
Obs*R-squared	0.532058	Prob. Chi-Square(2)	0.7664

Ramsey RESET Test		Equation: EQ04	Omitted Variables: Squares of fitted values	
Specification: <i>MANP MANP(-1) REXCHR REXCHR(-1) INFLAT INFLAT(-1) INFLAT(-2) LCAPITA INTR INTR(-1) INTR(-2) LEXPORT LEXPORT(-1) LEXPORT(-2) LIMPORT FDI FDI(-1) C</i>				
	Value	Df	Probability	
t-statistic	1.576979	18	0.1322	
F-statistic	2.486861	(1, 18)	0.1322	



Series: Residuals	
Sample 1983 2018	
Observations 36	
Mean	9.97e-15
Median	0.063638
Maximum	1.277330
Minimum	-1.549401
Std. Dev.	0.721049
Skewness	-0.193689
Kurtosis	2.308551
Jarque-Bera	0.942245
Probability	0.624301

