

Determinants Of Exchange Rate Fluctuation In Nigeria: Evidence From Sticky-Price Monetary Model

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ABSTRACT

Achieving sustainable and stable economic development requires a stability in the exchange rate movement. This is because exchange rate fluctuations are an important risk that a country experience at micro and macro levels. Existing literature on international economics argued that exchange rates usually fluctuate as monetary variables increase or decrease. This study examined the determinants of exchange rate fluctuation using Sticky-Price Monetary model in Nigeria. The paper employed correlational research design using secondary quarterly data for a period 20016Q1 to 2017Q1. The techniques of data analysis adopted is Autoregressive Integrated Moving Average (ARIMA) regression technique. The study found that monetary variables significantly affect exchange rate fluctuations in Nigeria during the period under review. The findings indicate that interest rate and levels of inflation significantly and positively impacted on the exchange rate fluctuations in Nigeria. While money supply has an insignificant negative effect on the fluctuations of exchange rate, and productivity has an insignificant positive effect on the exchange rate fluctuation. The paper recommends that to achieve the goal of stable economic growth in Nigeria, governments as well as its policy-makers should consider exchange rate fluctuations when design monetary policies. That is, money supply, interest rate, inflation and productivity should be consider in relation to exchange rate movements.

1.1 Introduction

Achieving sustainable and stable economic development is the main objective of any country, as well as policy-makers at micro levels. One of the pending research problem in the macroeconomic literature is the choice of exchange rate regime. This is due to the fluctuations in the exchange rates movement with respect to exchange rate regime (fixed or float) in use. According to Demirhan and Atis (2013), exchange rate fluctuations are an important risk that a country experience at micro and macro levels. For example, at micro levels a key component of a firm's aggregate demand is the import and export of its goods and services, which is affected by exchange rate fluctuation (Were, Kamau, & Kisinguh, 2013). That is, as exchange rates increase and decrease, the prices that firms are able to charge for goods and services may become more or less attractive to their customers.

Firms that engaged in foreign and local trade are both affected by the fluctuations in exchange rates. Thus, exchange rate volatility affects a firm's bottom line and overall financial performance. Moreover, fluctuations in exchange rates changes the economic conditions and competitiveness of a firm, as well as its cash flow. At macro levels for instance, higher levels of inflation rates increases production costs, and leads to an increase of imported foreign goods and depreciating the domestic currency.

According to Cuiobano and Divino (2010) existing empirical evidences on the main determinants of fluctuations in rates of exchange suggest that monetary factors are most often responsible for influencing movements. These macroeconomic variables according to Hassan and Simone (2013) include gross domestic product, inflation, interest, and money supply. That is, exchange rates usually fluctuate as monetary variables increase or decrease. This is a clear indication that there is need for understanding the relationships and the certain monetary factors that affect exchange rate fluctuations.

Several empirical studies on determinants of exchange rate fluctuations have occurred since the seminal work of Meese and Rogoff in 1983. More recent studies like Liew, Baharumshah, and Puah (2009) studied long-run relations among determinants of movements with rates of exchange and the Japanese yen, they found that movements within exchange rates might be forecasted using money supply, interest rates, and income as indicating variables. Khan and Qayyum (2011) investigated how monetary fundamentals influenced exchange rates in Pakistan. Their findings suggested that monetary variables were able to forecast movements in the

exchange rate. Moreover, Craigwell, Wright, and Ramjeesing (2011) found similar results studying exchange rate behaviors between the U.S. and Jamaica with respect to money supply, inflation, and the rate of interest. Generally, these studies conclude that exchange rates fluctuations are predictable (Austin & Dutt, 2014).

This study is motivated by two factors in Nigeria; one the study is prompted by absence of empirical studies on the determinants of exchange rate fluctuation in developing economies like Nigeria. As most of the studies are carried out in developed economies, so this study is an effort towards addressing this gap, using data from developing economy. Secondly, the findings from the previous studies on the determinants are mixed and inconclusive. Moreover, there is lack of consensus regarding the general effects that monetary variables may have on exchange rate movements in spite of the volume of research on exchange rate fluctuations. Therefore, it is largely unknown if monetary variables in Nigeria might affect differently the exchange rates fluctuations. As such a scientific study into the determinants of exchange rate fluctuations in Nigeria is needed.

Objectives of the Study

The main objective of this research is to critically examine the determinants of exchange rate fluctuation using Sticky-Price Monetary model in Nigeria. The specific objectives are to;

- i. Examine the effect of money supply on exchange rate fluctuation in Nigeria.
- ii. Assess the effect of interest rate on exchange rate fluctuation in Nigeria.
- iii. Determine the impact of inflation level on exchange rate fluctuation in Nigeria.
- iv. Evaluate the effect of productivity on exchange rate fluctuation in Nigeria.

Hypotheses of the Study

The following research hypotheses are formulated in null form for the study;

- H₀₁: Money supply has no significant effect on exchange rate fluctuation in Nigeria.
- H₀₂: Interest rate has no significant effect on exchange rate fluctuation in Nigeria.
- H₀₃: Inflation level has no significant effect on exchange rate fluctuation in Nigeria.
- H₀₄: Productivity has no significant effect on exchange rate fluctuation in Nigeria.

Scope and Significance of the Study

This study is restricted to monetary variables determinants as in the Sticky-Price Monetary Model that are closely related to financial markets, such as money supply, interest rate, inflation and productivity. Exchange rate fluctuation in the context of this paper refers to the quarterly exchange rate movements. The study covers the period of 2006Q1 to 2017Q1 that is 11 years and the first quarter of 2017.

The study is significant in many ways; firstly, the study will add to the existing body of literature on exchange rate fluctuations determinants from a developing economy, which is very rare. Moreover, the study will provide an empirical evidence on the determinants of exchange rate fluctuations from the monetary perspective. Hence, the findings will be useful to policy makers in Nigeria, investors and researchers.

2.1 Literature Review and Theoretical Analysis

Sticky-Price Monetary theory has been one of the major theories that explain the movement in exchange rates in relation to monetary indicators. According to Dornbusch, Fischer, and Startz (2011), Sticky-price model holds that capital is perfectly mobile when it has the ability to move instantly, and with a minimum of transactions costs, across national borders in search of the highest return. The monetary theory is an outgrowth of the purchasing power parity that emerged post Bretton Woods and revitalized long-run equilibrium interpretations (Beckmann, 2013). Many studies favor the relationship between macroeconomic fundamentals and exchange rates (Kim & Mo, 1995; Choudhry & Lawler, 1997), while others indicate unclear results (Chinn & Meese, 1998; Goldberg & Frydman, 2007). Research using the monetary approach on advanced markets is widespread and covers co-integration and causality among monetary fundamentals and rates of exchange (Dabrowski, Papiez, & Smiech, 2015).

According to Khan and Qayyum (2011), the monetary exchange rate theory suggests that the demand for as well as the supply of money determines exchange rates. This theory holds that monetary policy underlies exchange rate movements, thus joining the theory of purchasing power parity with the quantity theory of money. This approach hypothesizes that a reduction in relative purchasing power will yield from increasing the domestic supply of money. Monetary models determining rates of exchange were the backbone of international finance in the 1970s (Neely & Sarno, 2002), and the recent resurgence of empirical work examine these models using new methods (Abbasi & Safdar, 2014). The premise of the monetary model is that a nation's monetary policy determines the exchange rates. According to

MacDonald and Taylor (1992), the monetary approach has produced a wide range of models to explain exchange rate flexibility.

The theory of chaos models suggest exchange rates have a non-linear relationship with determinant variables (Macerinskiene & Balciunas, 2013). However, Gilmore (2001) argues that exchanges are not chaotic, while Hantias and Curtis (2008) argues for in support for chaotic behaviour.

Review of Empirical Studies

Following the work of Meese and Rogoff (1983) a large volume of empirical studies were conducted on the determinants of exchange rate fluctuations, but the findings are mixed and inconclusive. For instance, Dong (2013) used regression analyses to examine how prices that deviate from the purchasing power parity theory explain movements in the nominal rate of exchange. The study investigated whether price misalignments influence future fluctuations in exchange rates between Japan, United Kingdom, and U.S. The results indicate price deviations have predictive power for fluctuations in future exchange rates.

On relative changes in commodity prices, causal factor in exchange rate determination has been found by Cayen, Coletti, Lalonde, and Maier (2010). They found that commodity prices have a central role in shaping rates of exchange for commodity importers and exporters. This confirmed the findings of Chen and Rogoff (2003) that found that world prices of commodities from major exporters were key determinants of respective exchange rates. Camarero (2008) examined the effects that productivity and interest rate differentials had on exchange rate movements, and found that those variables only provided a partial explanation. Khan and Qayyum (2011) examined how monetary fundamentals influenced exchange rates in Pakistan, and found that monetary variables were able to forecast movements in the exchange rate.

Liew, Baharumshah, and Puah (2009) studied long-run relations among determinants of movements with rates of exchange and the Japanese yen. They found that movements within exchange rates might be forecasted using money supply, interest rates, and income as indicating variables. In another effort, Craigwell, Wright, and Ramjeesing (2011) found similar results studying exchange rate behaviors between the U.S. and Jamaica with respect to money supply, inflation, and the rate of interest. Olson (2010) found that the impact for each percentage point in the productivity differential between the United States and Euro area was three percentage points on the exchange rate.

Kuepper (2008) opined that the gross domestic product is a comprehensive economic indicator and is an undeniable important fundamental for growth. While the per capita gross domestic product is a substantial driver of exchange rate fluctuations (Afzal & Hamid, 2013; Chen, Mancini-Griffoli, & Sahay, 2015), and study has shown that the growth in GDP has adverse effects on exchange rates as a result of decreasing prices (Cuiabano & Divino, 2010). Tille, Stoffels, and Gorbachev (2001) and Schnatz, Vjjselaar, and Osbat (2004) studied links between exchange rate movements and output and found that changes in output can be utilized in determining exchange rate movements.

3.1 Methodology

This paper employed correlational research design to examine the determinants of exchange rate fluctuations in Nigeria. The choice of this design is informed by the effectiveness of the method in investigating the relationships among theoretically related variables. The study used secondary data from different sources: CBN Statistical Bulletin, and the National Bureau of Statistics Economic reports. The data collected from the sources is a quarterly time-series for the 2006Q1 to 2017Q1.

Technique of Data Analysis

The technique of data analysis adopted for the study is Autoregressive Integrated Moving Average (ARIMA) regression technique. The choice of the model is informed by the fact that the time series has unit root and the disturbances are autocorrelated; thus, OLS regression estimators' model may be biased. ARIMA model in this regard is very efficient for providing the means to fit linear models with non-stationary time series and serially correlated

disturbances. The paper on the also conducted some robustness tests to ensure the reliability of the results. These tests include the test of heteroskedasticity, and the data normality and unit root tests. The analysis is conducted using Statistics/Data Analysis Software (STATA 11.2).

Variables Measurement and Models Specification

The variables of the study are the exchange rate fluctuations (dependent variable); while the explanatory variables of the study are the money supply, inflation, interest rate and productivity (proxy by GDP). Therefore, the model of the study is mathematically expressed as follows;

$$exr_t = \gamma_0 + \gamma_1 msp_t + \gamma_2 inr_t + \gamma_3 inf_t + \gamma_4 pd_t + \mu_t \dots i$$

Where; EXR_t is the exchange rate at time t , measured by quarterly exchange rate movement; MSP_t is the money supply at time, measured by M1 over GDP; inr_t is the interest rate at time t , measured by treasury bill rate; INF_t is the inflation rate at time t , measured by consumer price index; PD_t is the productivity at time t , measured by GDP at basic price; γ_0 is the intercept, γ_1 to γ_4 are the coefficients and μ_t is the error term/disturbances.

4.1 Results and Discussions

This section presents and discusses the results obtained from the tests conducted on the data collected for the study. The section begins with the description of the data collected for the study and then the inferential statistics.

Descriptive Statistics

The descriptive statistics of the data collected for the study is presented in Table 1;

Table 1: Descriptive Statistics

Variables	Mean	SD	Min.	Max	N
EXR	163.290	45.542	117.73	305.23	45
MSP	0.566	0.199	0.29	0.97	45
INR	8.86	3.482	1.04	14.49	45
INF	10.811	3.390	4.1	18.55	45
PD	9.227	0.743	7.542	10.281	45

Source: STATA Output (Appendix)

Table 2 indicates that the mean of exchange rate fluctuations (EXR) during the period covered by the study is N163.29 with standard deviation of 45.542, implying that the data deviate from the both sides of mean by N45.542. This suggests that there were high fluctuations in the rate of exchange in Nigeria during the period under review, because there was a higher

deviation from the mean value. Moreover, the results from the table shows a wide range between the minimum and maximum values of exchange rate, N117.73 and N305.23 respectively. The Table indicates that the money supply (MSP) has a mean of 0.566, with standard deviation of 0.199 and a minimum and maximum values of 0.29 and 0.97

respectively. This suggested that the ratio of money supply as a percentage of GDP is 56.6% on average during the period, while the minimum and maximum are 29% and 97% respectively, during the period covered by the study. However, the average interest rate (INR) during the period is 8.86% with standard deviation of 3.48%, implying that the deviation from the mean is wide. The minimum rate of interest is 1.04%, while the maximum is 14.49% during the period.

The descriptive results show that the average inflation (INF) during the period is 10.81% with standard deviation of 3.390% and minimum and maximum values of 4.1% and 18.55% respectively. The average value of the productivity (PD) during the period is 9.22 with standard deviation of 0.743, indicating that

the data deviate from both sides of mean by 0.743. The minimum and maximum productivity are 7.542 and 10.281 respectively. The analysis of the descriptive statistics of the data collected for the study suggested that the data is widely dispersed which is an indication that the data is not normally distributed, as pointed by the higher values of standard deviation in most of the variables. However, the Shapiro Wilk Test for Normal Data (see appendix) indicates that the data from EXR, MSP and PD do not follow the normal curve, because the null hypothesis that the data is normally distributed is rejected at 1% and 5% level of significance. This could affect OLS estimators and necessitate the use of other techniques. On the other hand, the paper employed Augmented Dickey-Fuller unit root test to investigate the stationary process of the data; the results are presented in table 2 as follows;

Table 2: Augmented Dicky -Fuller Test for Unit Root

Variables	T-Statistic	P-Values
EXR	1.722	0.9982
MSP	-2.207	0.2037
INR	-2.187	0.2108
INF	-1.400	0.5823
PD	-2.222	0.1984

Source: STATA Output (Appendix)

Table2 indicates the presence of unit root in the time series for all the variables, because the p-values of the t-statistics are not statistically significant at all levels of significance. Thus, the null hypothesis that the data has unit root is not rejected.

Correlation Results

The correlations of the variables of the study are presented in Table 3 as follows;

Table 3: Correlation Matrix

Variables	EXR	MSP	INR	INF	PD
EXR	1.0000				
MSP	-0.5337 (0.0002)	1.0000			
INR	0.3820 (0.0096)	-0.2656 (0.0778)	1.0000		
INF	0.5831 (0.0000)	0.0852 (0.5778)	0.0319 (0.8353)	1.0000	
PD	0.6918 (0.0000)	-0.9099 (0.000)	0.3512 (0.0180)	0.2103 (0.1655)	1.0000

P-Values in Parentheses

Source: STATA Output (Appendix)

Table 3 shows the degree of association between exchange rate fluctuations and the determinants (money supply, interest rate, inflation and productivity) in Nigeria. The table shows that there is a significant statistical negative relationship between EXR and money supply (MSP) during the period of the study, from the correlation coefficient of -0.5337, which is statistically significant at 1% level of significance (p-value of 0.0002). This implies that as money supply increases fluctuations in the exchange rate tend to decrease. The result from the table also indicates that there is a significant positive association between interest rate (INR) and fluctuations in exchange rate during the period of the study, from the correlation coefficient of 0.3820 which is statistically significant at 1% level of significance (p-value of 0.0096). This also implies that higher interest rate increases the fluctuations in exchange rate in Nigeria.

The table on the other hand shows a significant positive relationship between fluctuations in exchange rate and the levels of inflation (INF) during the period of the study, from the correlation coefficient of 0.5831 which is statistically significant at 1% level of significance (p-value of 0.0000). This relationship suggests that, high levels of inflation also leads to increase in fluctuations of exchange rate. Similarly, the table shows a significant statistical positive relationship between the level of productivity (PD) and exchange rate fluctuations during the period of the study, from the correlation coefficient of 0.6918, which is statistically significant at 1% level of significance (p-value of 0.0000). This also suggests that increase in productivity is associated with high fluctuations in exchange rate during the period. However, to conclude the effect of the determinants on exchange rate fluctuations, the study estimates the model of the study, the results are presented and discuss in the following section.

Regression Results and Hypotheses Testing

In this section, the hypotheses formulated for the study is tested; the section begins with the discussion

of the regression model as presented in table 4;

Table 4 presents the regression results of the model of the study, the Engle's LM test for the presence of autoregressive conditional heteroskedasticity (ARCH) provides evidence of the presence of ARCH (Archlm Chi2 of 8.264 with p-value of 0.0040), which implies that the variance of the residuals is not constant (heteroskedastic). The table on the other hand shows that the disturbances are correlated (none independent) as indicated by the Durbin's alternate test for higher orders of autocorrelation (Durbinalt), Chi2 of 35.740 with p-value of 0.0000 suggesting that the disturbances are serially correlated. To fit the model, the paper employed Autoregressive Integrated Moving Average (ARIMA) regression model, which is very efficient for providing the means to fit linear models with autocorrelated disturbances and nonstationary time series.

However, the table shows that the explanatory variables determinants (money supply, interest rate, inflation and productivity) explained 72.87% of the total variations in the dependent variable, exchange rate fluctuations in Nigeria during the period of the study, from the coefficient of determinations (R square of 0.7287). The table also shows that the model is fit at 1% level of significance as indicated by the Wald Chi2 of 293.72 with the P-value of 0.0000.

Hypotheses Testing

The results in table 4 shows that the money supply (MSP) during the period under review has an insignificant negative effect on the exchange rate fluctuations, from the coefficient of -112.17 which is not statistically significant at all levels of significance (p-value of 0.212). This implies an indirect relationship between exchange rate fluctuations and money supply. That is, a 1% increase in money supply, fluctuations in exchange rate will decrease by 1.12%. But, there is no significant evidence to reject the null hypothesis one (H_{01}), which state that Money supply has no significant effect on exchange rate fluctuations in Nigeria.

Table 4 also shows that interest rate (INR) during the period under review has a significant positive effect on the exchange rate fluctuations, from the coefficient of 2.853 which is statistically significant at 10% level of significance (p-value of 0.059). This implies a direct relationship between exchange rate fluctuations and interest rate. That is, when interest rate increases by 1%, exchange rate fluctuations increase by 0.0285%. It is statistically significant at 10%; therefore, the study rejects the null hypothesis two (H_{02}), which state that interest rate has no significant effect on exchange rate fluctuations in Nigeria. The study infers that interest rate in Nigeria is a significant determinant of fluctuations in exchange rate.

Moreover, Table 4 shows that inflation rate (INF)

Table 4: ARIMA Regression Model Summary

Variables	Statistics	P-values
R square	72.78	
F-statistic (Wald Chi2)	293.72	0.0000
Durbinalt Chi2	35.74	0.0000
Archlm	8.264	0.0040
MSP	-122.317	0.212
INR	2.853	0.059
INF	8.195	0.000
PD	2.363	0.929
CONSTANT	91.216	0.743

Source: STATA Output (Appendix)

during the period under review has a significant positive effect on the exchange rate fluctuations, from the coefficient of 8.195 which is statistically significant at 1% level of significance (p-value of 0.000). This implies a direct relationship between exchange rate fluctuations and inflation. That is, when inflation increases by 1%, exchange rate fluctuations increase by 0.0895%. This is statistically significant at 1%; therefore, the study rejects the null hypothesis three (H_{03}), which state that inflation has no significant effect on exchange rate fluctuations in Nigeria. Lastly, Table 4 indicated that productivity (PD) has a positive effect on the exchange rate fluctuations, from the coefficient of 2.362 which is not statistically significant at all levels of significance (p-value of 0.929). This suggests that exchange rate fluctuations are positively affected by productivity levels. That is, when productivity increases by 1%, exchange rate fluctuations increase by 0.0236%. But the result is not statistically significant at all levels; therefore, the study failed to reject the null hypothesis four (H_{04}), which state that productivity has no significant effect on exchange rate fluctuations in Nigeria.

In sum, these findings suggest that interest rate and levels of inflation are a significant determinants of exchange rate fluctuations in Nigeria during the period covered by the study. The findings also revealed that money supply and productivity did not significantly influence the fluctuations in exchange rate in Nigeria.

5.1 Conclusion and Recommendations

Consistent with the findings from the analysis conducted and the hypothesis, the paper concludes that the monetary variables that significantly affect exchange rate fluctuations in Nigeria are the interest rate and levels of inflation. While money supply has an insignificant negative effect on the fluctuations of exchange rate, and productivity has an insignificant positive effect on the exchange rate fluctuation.

The paper recommends that to achieve the goal of stable economic growth in Nigeria, governments as well as its policy-makers should consider exchange rate fluctuations when design monetary policies. That is, money supply, interest rate, inflation and productivity should be consider in relation to exchange rate movements.

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