Investigating the Joint Impact of Exchange Rate and Foreign Direct Investment Inflows on Domestic Interest Rate in Nigeria

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ABSTRACT

The sensitive nature of interest rate has spurred empirical interests on the factors that determine it. This paper examined the joint impact of exchange rate and foreign direct investment inflows on interest rate in Nigeria over the period from 1981-2022. The study made use of the auto regressive distributed lag (ARDL) bounds test and results of findings reveal that in both the short-run and the long-run the impact of the interaction between FDI inflows and exchange rate on real interest rate was negative and significant. Also, while credit to the private sector was found to have significant positive impact on real interest rate in both the time horizons, the impact of consumer price index was negative only in the short. Oil revenue was found to impact positively on real interest rate only in the long-run, but the impact of broad money supply was negative and significant in both the short-run and the long-run. The study suggests that policies to regulate domestic interest rate should focus on joint regulation of both exchange rate and FDI inflows and this requires a synergy between monetary and fiscal policies.

KEYWORDS

Exchange rate; FDI; Interest rate; ARDL

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1. Background to the Study

The discussions on interest rate in Nigeria have become topical issues that occupy the attention of the government, investors and even the man on the street. This is because fluctuations in interest rate impact on the economy in diverse ways. The key monetary objective of the Central Bank of Nigeria (CBN) is inflation-targeting, so in each monetary policy committee (MPC) meetings of the Bank, the need to influence interest rate is usually among the major decisions as it is believed that gyrations in prices can be controlled through influencing domestic interest. The sensitive nature of interest rate has led to policy changes targeted at stabilizing it over the years. As noted by Idoko, Eche and kpeyol (2020), before the introduction of the Structural Adjustment Programme (SAP) in 1986, interest rate was fixed by the CBN with periodic adjustments depending on the priorities of each sector of the economy. However, from August 1987, the reforms introduced in the financial sector began with interest rate liberalization (Ikhinde & Alawode, 2001). Beginning from 2004, the MPC has been responsible for the fixing of interest rate in line with the direction of the economy. Prior to 2007, Minimum Rediscount Rate (MRR) was a major monetary policy tool that the CBN used in influencing the lending rate. However, the introduction and adoption of the Monetary Policy Rate (MPR) from December 11, 2006 led to the replacement of the MRR (CBN, 2006). The MRR is the official interest rate of the CBN which serves as the benchmark rate for all other interest rates in the economy.

Stabilizing the domestic exchange rate is equally among the major pre-occupation of the monetary authorities in Nigeria over the years. As such the country has implemented several exchange rate policies in order to achieve a realistic value of the local currency (naira). The country has moved from a fixed parity with the British pound around the 1970s to the era of floating of the currency (Akpan & Atan, 2012). In February 2002, the foreign exchange market was further liberalized and in a bid to address the menace of multiple exchange rate so as to achieve a convergence in the foreign exchange, the Wholesale Dutch Auction System (WDAS) was introduced in 2006 (Akanji, 2006). To prevent money laundering, the retail Dutch Auction System was introduced in 2013. As a measure to access more foreign exchange to enhance eligible transactions, the Investors and Exporters (I & E) window was introduced in April 2017 (Otiwu, 2018). From 2023, Okoukoni and Oyekan (2023) noted that the CBN announced that foreign currencies can now be bought and sold at rates determined by the market and no longer through the intervention of the central bank.

These frequent changes in exchange rate no doubt may have impact on FDI inflows. This is because of the observed intricate relationship between capital inflows and exchange rate. Froot and Stein (1991) noted that in an imperfect capital market, the depreciation of the real exchange rate of the host country stimulates FDI inflows. Under this scenario, a negative relationship between the host country's exchange rate and FDI exists. Barrel and Pain (1996) contended that if a host country's currency depreciates, such could encourage more FDI penetration into such country. The causal link between exchange rate and FDI inflows can also flow from FDI inflows to exchange rate. For instance, Fernandez-Arias and Montiel (1995) as cited in Mannathoko (2020) observed that capital inflows could pressure the real exchange rate to appreciate; thus, affecting macroeconomic variables in a way that hampers policy objectives such as price stability. In particular, FDI inflows have been observed to have either positive or negative impact on the exchange rate of the domestic currency, depending on how these inflows are used (Rehman, Ahmed & Jaffri, 2020).

In this paper, the focus is to determine the factors that influence interest rate in Nigeria with particular reference to the impact of the interaction between exchange rate and FDI inflows. Focusing on the impact of the interaction between exchange rate and FDI inflows is informed by the observations made by some scholars regarding the link between FDI inflows and interest rate on one hand and the link between exchange rate and interest rate on the other hand. It has been observed by Ojinma and Emerenini (2015) that investment decisions have direct impact on the interest rate on loan. On the other hand, Okoye, Nwakoby and Modebe (2015) observed that the rise in interest rate results into an increase in exchange rate which has the tendency to attract further FDI,

especially in developing countries. Existing papers on related topic in Nigeria focused on either the impact of exchange rate or interest rate on FDI inflows (Adu & Ntim 2014; Mokuolu, 2018; Akinlo & Onatunji, 2021; Rufai, Aworinde & Ajibola, 2022). Some studies outside Nigeria have equally examined the link between FDI inflows and exchange rate (Kilicarslan, 2018; Kiliçarslan, 2018; China, Zhao, Li & de Haan, 2022; Qabhobho, Amoah & Doku, 2022). The sensitive nature of interest rate in the economy, especially in Nigeria whose major monetary policy focus is inflation-targeting has made the present study paramount. This study contributes to the literature by examining the joint impact of FDI inflows and exchange rate on interest rate. The role played by exchange rate and FDI inflows in influencing domestic interest rate necessitated the study on their joint impact on interest rate. This is more so, considering the fact that exchange rate in Nigeria is very volatile, particularly at the parallel market segment. Outcome of such study could help equip monetary authorities with the right monetary tools to simultaneously influence the two variables in order to tame their influence on interest rate.

The rest of the paper is structured as follows: section 2 deals with stylized facts on the link among the key variables, theoretical literature and empirical literature review. Section 3 deals with empirical model as well as data and their sources. Section 4 handles results presentation and interpretation of findings while section 5 deals with conclusion.

2. Stylized Facts

This study used some diagrams to provide an insight into the link among the relevant variables for the study. It has been observed that, if a country's domestic interest rate rises, such will attract the attention of foreign investors. However, FDI inflows decline if a country's domestic interest rate falls. Also, volatility in domestic currency has been noted to influence FDI inflows. Notably, the appreciation of the domestic currency has been observed to attract FDI inflows while domestic currency depreciation retards it. Information in Fig. 1 is an attempt to provide the transmission mechanism through which such links occur. As shown in the Figure, the direction of the arrow in Box 1 shows that a fall in domestic interest rate leads to a fall in FDI inflows, while in Box 2, the arrows show that domestic currency appreciation leads to an increase in FDI inflows, while domestic currency depreciation leads to a fall in FDI inflows.
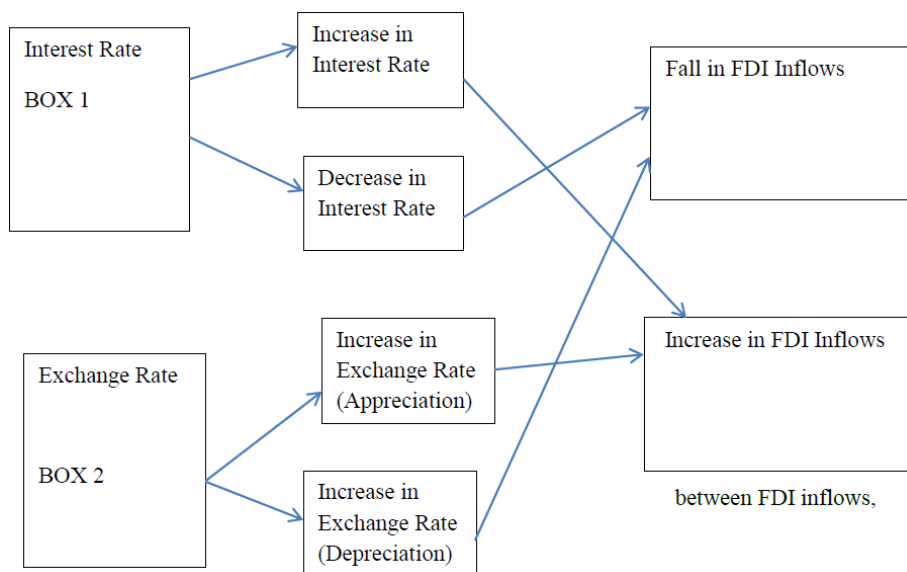

Figure 1. Link between Real Exchange Rate, Interest Rate and FDI Inflows

Source: Modified from Isiaka, Osifalujo and Taiwo (2022)

In Fig. 2, the study presents the trend in FDI inflows and real exchange rate. It is shown that as the trend in real exchange rate goes up, FDI inflows go down and vice-versa. Information on the diagram reveals that from 1990 through 1998, the trend in exchange rate was high compared to the trend in FDI inflows. What this shows is that within these periods, as FDI inflows experienced downward trend, the naira depreciated. Beginning from 1999, evidence shows that FDI inflows began to rise while exchange rate was low (appreciated). It should be noted that the year 1999 marked the beginning of a new Democratic era in Nigeria and the study is of the opinion that this new era led to an enhanced investor confidence. The aftermath of the rise in FDI inflows within this period is that exchange rate appreciated which is what the fall in the trend represents. After 2011, FDI inflows have been on the downward trend but one thing that is peculiar is the slight rise in exchange rate immediately FDI inflows began to fall after 2011. This also confirms that a fall in FDI inflows has the tendency to result into exchange rate depreciation. In summary, what the information if Fig. 2 proves is that the penetration of capital inflows into a country leads to domestic currency appreciation.
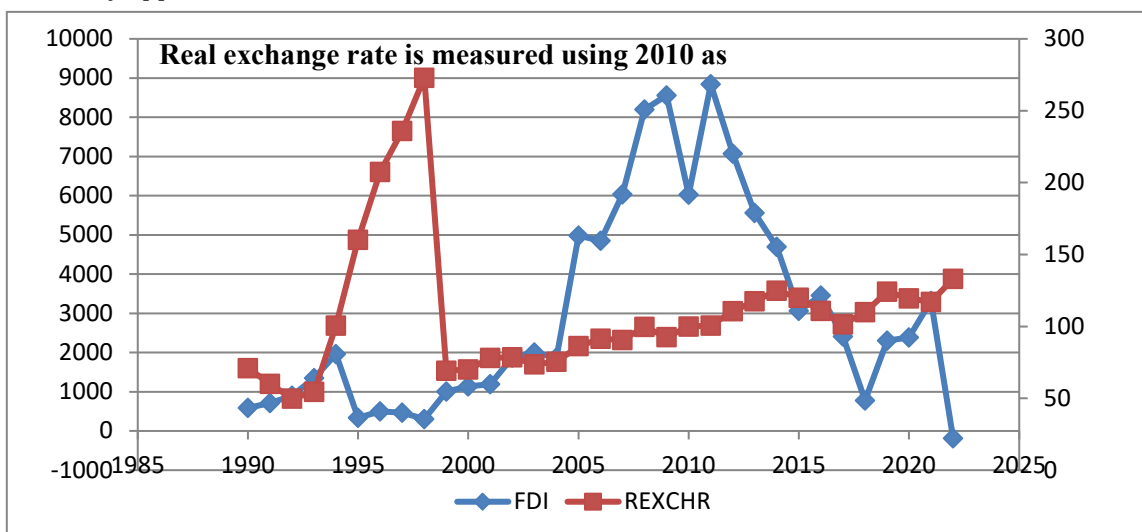

Figure 2. Trend in FDI Inflows and Real Exchange Rate

Source: WDI (2022)

Note: REXCHR = real exchange rate

2.1. Literature Review

In this section, the study provides review of relevant theoretical and empirical literature which guided the paper.

2.1.1. Theoretical Literature

This work is guided by the FDI theory based on the strength of the domestic currency propounded by Aliber (1970). The theory is anchored on the purchasing power of the currencies of different countries and it is based on the differences on the strength of the currency of the investing country in relation to the currency of the host country. Aliber hypothesized that countries that have strong and stable currencies are in better position to attract more FDI in relation to countries with weak and unstable currencies. This theory involved developed countries such as Canada, United Kingdom and the United States of America with the argument that when there is a risk of exchange rate volatility, firms in countries with strong currency are encouraged to invest more in countries with weaker currency. The implication of this theory is that the strength of the currency of the foreign firms guarantees them the opportunity to have high purchasing power in local economy, thus enabling them to invest more in the host

countries. The assumptions underlying this theory are: (1) there should be perfect market condition, (2) countries with weaker currencies have higher ability to attract FDI and (3) foreign Multinational National Countries (MNCs) whose home country's currency is strong can borrow at a lower interest rate than firms in the host country. A major limitation of the theory is that even though it may be relevant in explaining FDI inflows in developed countries, it's relevance in the less developed countries with imperfect and under-developed capital markets in addition to heavily regulated foreign exchanges is in doubt. For instance, the theory can hardly explain the investments in developed countries that have strong currencies by the MNCs of developing countries whose currency is weak. Notwithstanding the aforesaid limitation, the theory is still relevant in the explanation of the strength of a country's currency in attracting FDI and such makes it relevant to this study.

2.1.2. Empirical Literature Review

In literature, the link between FDI inflows, exchange rate and interest rate has received ample attention in recent times. A cross-country study involving developing and emerging countries by Adu and Ntim (2014) revealed that a stable exchange rate improved FDI inflows into the sampled countries and as well high FDI inflows was shown to encourage exchange rate stability. Findings equally show that volatility in interest rate directly affects exchange rate and market attractiveness which in the long run affects FDI inflows. In Turkey, Cambazoğlu and Güneş (2016) used the ARDL to show that the domestic currency appreciation resulted in a decrease in FDI inflows. However, a study in Pakistan by Ali and Nazar (2017) indicated that remittances and FDI inflows led to the appreciation of exchange rate. In another study for Turkey, Kilicarslan (2018) used the Fully Modified Ordinary Least Squares (FMOLS) to show that the impact of FDI inflows on exchange rate was negative. This finding is similar to the finding by Cambazoğlu and Güneş (2016) as both indicated that an inverse relationship existed between FDI inflows and exchange rate.

In Nigeria, Mokuolu (2018) revealed that while interest rate had a negative impact on FDI, the impact of exchange rate was positive. In another study for Turkey, Kiliçarslan (2018) showed that a uni-directional causality running from FDI inflows to exchange rate volatility existed. In Nigeria, Aribatise, Adeyemi and Adeseke (2019) revealed a two-way causality between FDI inflows and exchange rate. In Bangladesh, Mostafa (2020) showed that exchange rate had a significant positive link with FDI both in the long-run and short-run. In another study for Nigeria Adebayo, Abolaji, Akinsola and Olanrewaju (2020) found that exchange rate played major role in attracting FDI inflows in Nigeria which finds support in Mokuolu (2018). In a study involving some African countries, Akinlo and Onatunji (2021) found that exchange rate volatility had a negative and significant impact on FDI inflows in Cote d'Ivore, Sierra Leone, Nigeria and Togo. Result of Granger causality showed that exchange rate volatility Granger caused FDI inflows in all the selected countries except Ghana. In China, Tan, Xu and Gashaw (2021) observed that continuous appreciation of the domestic currency discouraged FDI inflows and that exchange rate did not have a significant impact on FDI inflows. In another study in Nigeria, Rufai, Aworinde and Ajibola (2022) observed that a rise in FDI inflows led to domestic currency appreciated and vice versa. In another study in China, Zhao, Li and de Haan (2022) revealed that a bi-directional Granger causality existed between real exchange rate and FDI inflows. Qabhobho, Amoah and Doku (2022) found a uni-directional Granger causality running from FDI inflows to exchange rate. In Nigeria, Nwagu (2023) indicated that exchange rate significantly retarded FDI inflows.

From the foregoing extant literature reviewed, it is found that the focus of past studies is majorly on the factors that influence FDI inflows. Notably, the impact of exchange rate and interest rate on FDI inflows has been the major attention of past studies which implies that the link between FDI inflows and these two variables is a uni-directional running from them to FDI inflows. However, emerging conceptual views have been raised concerning the fact that capital inflows such as FDI inflows lead to domestic currency appreciation as well as leading to a fall in interest rate

as it raises domestic money supply (Ali & Nazar, 2017; Adrian, 2018). Thus, there is need to deepen the study by examining the joint impact of FDI inflows and exchange rate on interest rate considering the sensitivity of interest rate on the economy.

3. Empirical Model

This study used the auto regressive distributed lag (ARDL) bounds to investigate the impact of FDI inflows on exchange rate and other relevant explanatory variables. The choice of ARDL in this study is based on its superior advantage over other conventional cointegration methods such as the Johansen cointegration test. First, the ARDL is suitable even when the series are integrated of order one, that is $I(1)$ or integrated of order zero, that is $I(0)$. Second, according to Pesaran and Shin (1999), the ARDL approach has superior properties in small sample. Third, the technique provides unbiased long-run estimates and valid t-statistics even in the presence of endogeneity in the model (Narayan, 2005). Finally, the ARDL provides a simultaneously means of evaluating both the short and long-run impact of one variable on the other (Bentzen & Engsted, 2001). Thus, the ARDL form of model is specified as follows:

$$\Delta RINTR_t = \delta_0 + \sum_{j=1}^{k} \lambda_i \Delta RINTR_{t-1} + \sum_{j=1}^{k} \gamma_i (\Delta LFDII_{t-1} * \Delta REXCHR_{t-1}) + \sum_{j=1}^{k} \varphi_i \Delta CPI_{t-1} + \sum_{j=1}^{k} \eta_i CRPRV +$$

$$\sum_{j=1}^{k} \kappa_i \Delta LOILR_{t-1} + \sum_{j=1}^{k} \tau_i \Delta LM2_{t-1} + \Im_1 RINTR_{t-1} + \Im_2 (LFDII_{t-1} * REXCHR_{t-1}) + \Im_3 CPI_{t-1} +$$

$$\Im_4 CRPRV_{t-1} + \Im_5 LOILR_{t-1} + \Im_6 LM2_{t-1} + \mu_t$$

$$(1)$$

where

$RINTR$ = real interest rate, $LFDII$ = log of foreign direct investment inflows, $REXCHR$ = real exchange rate, CPI = consumer price index, $CRPRV$ = credit to the private sector, $LOILR$ = log of oil revenue, $LM2$ = log of broad money supply, $LFDII * REXCHR$ = interaction of FDI and exchange rate, μ = error term. To take care of the usual volatility in exchange rate, the series for real exchange rate were generated to reflect such changes with the following formula:

$$\Delta REXCHR_t = REXCHR_t - REXCHR_{t-1}$$

(2)

In equation 1, the coefficients of the short-run parameters are: λ, γ, φ, η, κ and τ while the parameters of the long-run coefficients are: $\Im_1, \Im_2, \Im_3, \Im_4, \Im_5$ and $\Im_6$. The long-run relationship is determined by the following null hypotheses:

$H_0 : \Im_1 = \Im_2 = \Im_3 = \Im_4 = \Im_5 = \Im_6 = 0$ (co-integration exists). This is tested against the following alternative hypotheses:

$H_1 : \Im_1 \neq \Im_2 \neq \Im_3 \neq \Im_4 \neq \Im_5 \neq \Im_6 \neq 0$ (co-integration does not exist)

The existence of cointegration among the series will lead to the specification of the following error correction model (ECM):

$$\Delta RINTR_t = \delta_0 + \sum_{j=1}^{k} \lambda_i \Delta RINTR_{t-1} + \sum_{j=1}^{k} \gamma(_i \Delta LFDII_{t-1} * \Delta REXCHR_{t-1}) + \sum_{j=1}^{k} \varphi_i \Delta CPI_{t-1} + \sum_{j=1}^{k} \eta_i CRPRV +$$

$$\sum_{j=1}^{k} \kappa_i \Delta LOILR_{t-1} + \sum_{j=1}^{k} \tau_i \Delta LM2_{t-1} + \Omega ECM_{t-1} + \mu_t$$

where   (3)

ECM_{t-1} = Error correction model and Ω = coefficient of Error correction model

3.1. Data and Sources

In this study, annual dataset that covers the period from 1981-2022 was used. Table 1 shows the variables used in the study, their measurement and sources.

Table 1. Variables, Measurement and Sources

Variables	Definition	Measurements	Sources
RINTR	Real interest rate	Real interest rate in Percentage	WDI (2022)
FDII	Foreign direct investment inflows	Net inflows in current USA Dollars	WDI (2022)
REXCHR	Real effective exchange rate	Exchange rate of naira to Dollar using 2010 as the base year	WDI (2022)
CPI	Consumer price index	CPI using 2010 base year	WDI (2022)
CRPRV	Credit to the private sector	Percentage of GDP	WDI (2022)
OILR	Oil revenue	Billions of Naira	CBN Bulletin (2021)
M2	Broad money supply	M2 in current local currency unit	WDI (2022)

4. Results and Findings

This section provides the results of the study beginning with pre-diagnostic results.

4.1. Descriptive Statistics

This study used the descriptive statistics to examine the behaviour of the variables included in the model. Results in Table 2 reveals that the mean and median of all the variables are close, implying that they are symmetric. Consumer price index has the highest mean value of 82.72 and a standard deviation of 105.56. However, real interest rate has the least mean value of 0.46 and a standard deviation of 14.08. Also, the consumer price index has the highest range, implying that it was more volatile than other series within the period of study. Only exchange rate

and CPI were found to be positively skewed (skewed to the right), while other variables were negatively skewed (skewed to the left). On the other hand, result of the Kurtosis shows that all the series are heavy-tailed since they have positive values.

Table 2. Descriptive Statistics

	RINTR	FDII	OILR	EXCHR	CPI	CRPRV	M2
Mean	0.46	8.94	2.59	2.08	82.72	30.61	11.72
Median	3.66	9.20	2.97	2.00	37.45	28.18	12.06
Maximum	18.18	9.94	3.94	2.72	421.07	46.30	13.64
Minimum	-65.85	0.00	0.00	1.69	0.48	0.00	0.00
Std. Dev.	14.08	1.49	1.19	0.25	105.56	9.85	2.18
Skewness	-2.75	-5.24	-0.63	1.02	1.57	-0.37	-3.70
Kurtosis	13.23	32.12	2.10	3.21	4.79	3.30	20.73
Jarque-Bera	236.32	1676.7	4.22	7.40	23.00	1.15	646.2
Probability	0.00	0.00	0.12	0.02	0.00	0.56	0.00
Sum	19.51	375.72	109.01	87.36	3474.3	1285.7	492.5
Sum Sq. Dev.	8133.17	91.56	58.86	2.68	456898.7	3984.8	196.4
Observations	42	42	42	42	42	42	42

4.2. Correlation Matrix

The correlation matrix test was conducted so as to examine the degree of correlation among the variables. Findings in Table 3 show that real interest rate has low positive correlation with other variables, but has weak negative correlation with real exchange rate. FDI inflows has weak negative correlation with the CPI and real exchange rate but it has a strong positive correlation with credit to the private sector and broad money supply. Real exchange rate was found to have weak and negative correlation with all the variables. Credit to the private sector has relatively strong positive correlation with FDI inflows, oil revenue and broad money supply but its correlation with real exchange rate is weak and negative. Oil revenue has fairly strong positive correlation with credit to the private sector and broad money supply, while its correlation with real exchange rate is weak and negative. There is a weak and positive correlation between consumer price index and real interest rate, credit to the private sector and oil revenue, but its correlation with FDI inflows, real exchange rate and broad money supply is weak and negative. Finally, broad money supply has strong positive correlation with FDI inflows, credit to the private sector and oil revenue but its correlation with real exchange rate and consumer price index is weak and negative.

4.3. Unit Root Results

The unit root test was conducted in order to confirm the order of integration of the variable so as to avoid obtaining spurious results. Both the augmented Dickey Fuller (ADF) and Phillip-Perron (PP) tests were used for the test. The results were analyzed at both level and at first difference and under the null hypothesis that the series are not stationarity (have unit root). This is evaluated at the 5% level of significance. If the t-statistics is less than the critical value at the chosen level of significance, the null hypothesis is accepted, otherwise it is rejected. In Table (4), findings indicate that under the ADF, while real interest rate and the CPI achieved stationarity at level, that is they are *I(0)*; other variables became stationary at first difference, that is they are *I(1).* Under the PP test in Tables 5, evidence also shows that while real interest rate and CPI achieved stationarity at level I(0), other series achieved stationarity at first difference I(1) with the exception of broad money supply which did not achieve stationarity

either at level or at first difference. Thus, the unit root test indicates that the variables have a mixture of order of integration which implies that the ARDL will be more appropriate for the examination of the long-run relationship (cointegration) among the variables.

Table 3. Correlation Matrix

	RINTR	LFDII	LREXCHR	CRPRV	LOILR	CPI	LM2
RINTR	1	0.09	-0.19	0.40	0.37	0.25	0.23
LFDI	0.09	1	-0.19	0.67	0.53	-0.33	0.93
LREXCHR	-0.19	-0.19	1	-0.19	-0.44	-0.09	-0.21
CRPRV	0.40	0.67	-0.19	1	0.66	0.40	0.83
LOILR	0.37	0.53	-0.44	0.66	1	0.13	0.68
CPI	0.25	-0.33	-0.09	0.40	0.13	1	-0.04
LM2	0.23	0.93	-0.21	0.83	0.68	-0.04	1

Table 4. ADF Test of Stationarity at both Level and First Difference

Variable	ADF Level t-stat	ADF Level Critical value at 5%	ADF First Diff. t-stat	ADF First Diff. Critical value at 5%	Order of Integration
RINTR	-7.57	-2.93*	-10.22	-2.93*	I(0)
LFDI	-1.55	-2.93	-7.14	-2.93*	I(1)
REXCHR	-2.15	-2.93	-4.29	-2.93*	I(1)
CRPRV	-1.39	-2.93	-5.23	-2.93*	I(1)
LOILR	-1.66	-2.93	-6.11	-2.93*	I(1)
CPI	-3.55	-2.93*	-20.33	-2.93*	I(0)
LM2	-1.65	-2.93	-2.94	-2.93*	I(1)

Table 5. PP Test of Stationarity at both Level and First Difference

Variable	PP Level t-stat	PP Level Critical value at 5%	PP First Diff. t-stat	PP First Diff. Critical value at 5%	Order of Integration
RINTR	-7.34	-2.93*	-25.21	-2.93*	I(0)
LFDI	-1.54	-2.93	-7.14	-2.93*	I(1)
REXCHR	-2.04	-2.93	-4.29	-2.93*	I(1)
CRPRV	-1.60	-2.93	-4.24	-2.93*	I(1)
LOILR	-1.67	-2.94	-6.18	-2.93*	I(1)
CPI	-3.87	-2.94*	-10.78	-2.93*	I(0)
LM2	-1.96	-2.93	-1.18	-2.93	Nil

4.4. Results of Short-run ARDL

The results of the short-run ARDL in Table 6 reveal that the impact of the interaction between real exchange rate and FDI inflows on real interest rate is negative and significant at the 10% level of significance. Finding indicates that real interest rate marginally declined by 0.004 percent if real exchange rate and FDI inflows interacted. However, credit to the private sector was found to impact on real interest rate positively and the result is significant at the 10

percent level. If credit to the private sector is raised by one unit, real interest rate rose by 0.73 percent. While oil revenue was found to have negative and non-significant impact on real interest rate, the impact of CPI was also negative though significant. Rise in CPI by one unit led to a fall in real interest rate by 1.003 percent. Result indicates that broad money supply has a negative and significant impact on real interest rate at the 5% level of significant. If broad money supply rose by one unit, real interest rate declined by 4.9 percent. The coefficient of the error correction term is negative and significant at the 5% level of significance. The negative and significant result of the error correction model reveals that the series are cointegrated and the result also implies that about .97% . of errors generated in each period is automatically corrected by the system in the subsequent period.

Table 6. Results of Short-run

Variable	Coefficient	Std. Error	t-Statistic	Prob.
Short-run Results				
D(REXCHR * LFDI)	-0.004	0.002	-1.820	0.07
D(CRPRV)	0.732	0.415	1.764	0.08
D(LOILR)	-3.192	2.646	-1.206	0.23
D(CPI)	-1.003	0.450	-2.225	0.03
D(LM2)	-4.992	1.997	-2.500	0.01
ECM(-1)	-0.970	0.104	-9.258	0.00

4.5. Results of Long-run ARDL

The long-run results in Table 7 reveal that the impact of the interaction between real exchange rate and FDI inflows on real interest rate is negative and significant at the 10% level of significance and this result is in line with the result of the short-run in Table 5. Also, credit to the private sector was found to exert an upward pressure on real interest rate and the result is significant at the 10% level which also finds support in the short-run result. However, oil revenue was shown to have a positive and significant impact on real interest rate at the 10% level of significant. If oil revenue rose by one unit, real interest rate increased by 4.5%. While CPI did not have any significant impact on real interest rate, broad money supply impacted negatively and the impact was significant at the 5% level.

Table 7. Results of Long-run

Variable	Coefficient	Std. Error	t-Statistic	Prob.
			Long Run Coefficients	
LFDI*REXCHR	-0.004	0.002	-1.93	0.06
CRPRV	0.754	0.423	1.78	0.08
LOILR	4.523	2.469	1.83	0.07
CPI	0.115	0.078	1.46	0.15
LM2	-5.145	2.055	-2.50	0.01
C	29.118	14.28	2.03	0.04

4.6. Post-diagnostic Results

The results of the post-diagnostics in Table 7 indicate that under the null hypothesis that the series are not heteroskedastic, the Breusch-Pagan-Godfrey result indicates that the study cannot reject the null hypothesis since the p-value is 0.60 which is higher than the 5% level of significance. The implication of this result is that the model does not suffer from the problem of heteroskedasticity. Result of Breusch-Godfrey LM Test shows that under the

null hypothesis of no serial correlation, the study cannot reject the null hypothesis since the p-value of 0.85 is higher than the 5% level, indicating that the model does not suffer from serial correlation. The Ramsey RESET test reveals that the study cannot reject the null hypothesis that the model is well specified since the p-value of 0.19 is higher than the 5% level of significance. This result indicates that the ARDL model used in this study is well specified. The Jarque-Bera test of normality reveals that the study cannot reject the hypothesis that the error term is normally distributed since the p-value of 0.19 is higher than the 5% level of significance. In appendixes ii and iii, the result of the CUSUM and cumulative sum of squares (CUSUMSQ) tests indicate that the parameter estimates are stable since their coefficients fall inside the critical bands of the 5% confidence interval.

Table 8. Results of Post-diagnostics

Test	P-value
Heteroskedasticity Test: Breusch-Pagan-odfrey	0.60
Serial Correlation: Breusch-odfrey LM Test	0.85
Model Specification: Ramsey RESET Test	0.19
Normality Test: Jarcue-Bera	0.19

4.7. Discussion of Findings

In both the short and long-run, findings reveal that the impact of the interaction between real exchange rate and FDI inflows on real interest rate is negative and significant. It is believed that since FDI inflows raise money supply, there is the tendency that they should lower domestic interest rate. In another vein, exchange rate has been noted to be one of the major determinants of FDI inflows as it has been observed that domestic currency appreciation is expected to attract FDI inflows into an economy. Therefore, the negative and significant impact of FDI inflows-exchange rate interaction on real interest rate is in line with expectation. Empirically, some studies have found a negative link between FDI inflows and interest rate on one hand and exchange rate and interest rate on the other hand. Such studies include Siddiqui and Aumeboonsuke (2014) which revealed that in Thailand, Indonesia and Malaysia, interest rates have negative relationship with FDI inflows. In Romania, Andrieş *et al.* (2017) have revealed that a negative relationship exists between exchange rate and interest rate. The result of this present study indicates that within the study period, foreign investors took advantage of the fluctuations in exchange rate to push more FDI into the economy, resulting in rising money supply and eventually lowering the real interest rate. In this paper, the study provided abridged results of the impact of exchange rate and FDI inflows on real interest rate without an interaction effect which is shown in Appendix iv. Findings indicate that while exchange rate had non-significant negative impact on real interest rate both in the short-run and in the long-run, the impact of FDI inflows was negative in both the time horizons but was significant only in the long-run. The study therefore contends that in Nigeria, FDI inflows play more roles in pushing domestic interest rate downward but this is more so when the former interacts with exchange rate.

In another vein, finding reveals that credit to the private sector impacted positively on real interest rate in both the short-run and in the long-run. This result is in line with apriori expectation since the monetary authorities usually reduce rapid credit expansion using some monetary policy instruments. In Nigeria, monetary policy instruments such as the monetary policy rate, bank reserves and open market operations are used to influence credit expansion and their implementation results into rising domestic interest rate. It was also found that while oil revenue did not have significant impact on real interest rate in the short-run, the impact was positive and significant in the ling-run. The oil sector is a major revenue source in Nigeria such that in any period its price rises, monetary authorities anticipate rise in inflationary trend and so will implement policies to curtail the inflationary impact. Such policy implementations usually result into rising domestic interest rate. In Nigeria, Onakoya and

Agunbiade (2020) found that oil revenue had an inverse relationship with interest rate which contradicts the result of this present study and it is the contention of this study that the reason for the discrepancy could be because of the different periods the two studies covered. Consumer price index was found to impact real interest rate negatively and significantly in the short-run. It is expected that during periods of rising prices, the monetary policy choice implemented to check the rising prices usually leads to rising domestic interest rate and as such the short-run result contradicts the apriori expectation. However, the result of this present study finds support in the findings in Jordan by Al-Attar *et al.* (2019) and in China by Ding *et al.* (2023) which found consumer price index to impact negatively on interest rate. In both the short-run and the long-run, broad money supply was found to impact negatively on real interest rate with significant outcomes which is in line with apriori expectation.

5. Conclusion

This study used annual dataset that spanned the period from 1981 to 2022 to examine the impact of the interaction between FDI inflows and exchange rate on real interest rate in Nigeria. The study employed the ARDL framework to show that in both the short-run and the long-run the impact of the interaction between FDI inflows and exchange rate on real interest rate was negative and significant. While credit to the private sector was found to have significant positive impact on real interest rate in both time horizons, the impact of consumer price index was negative only in the short. Oil revenue was found to impact positively on real interest rate only in the long-run, but the impact of broad money supply was negative and significant in both the short-run and the long-run. These findings have some policy implications in Nigeria and one of the implications is that the effort of government to boost the value of the domestic currency has the potential to increase FDI inflows. With increase in FDI inflows, domestic interest rate may decline which though is good for domestic investment but portends grave danger for portfolio investment as it could lower foreign capital inflows in the long-run as well as leading to capital outflows. The decrease in capital inflows may at the end lead to domestic capital depreciation which takes the country back to the original condition. In the face of these possibilities, the question that requires answer is what should be the right policy approach to handle such eventualities. The study contends that policies to regulate interest rate should focus on joint regulation of both exchange rate and FDI inflows. This requires that several measures that involve both monetary and fiscal approaches have to be adopted to stabilize the domestic interest rate.
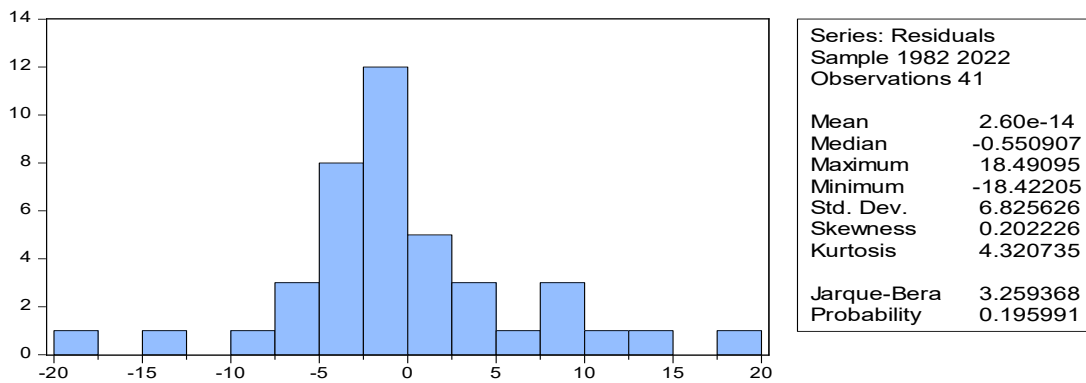
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Conflict of interest

All the authors declare that the manuscript is completely original and that there is also no conflict of interest.
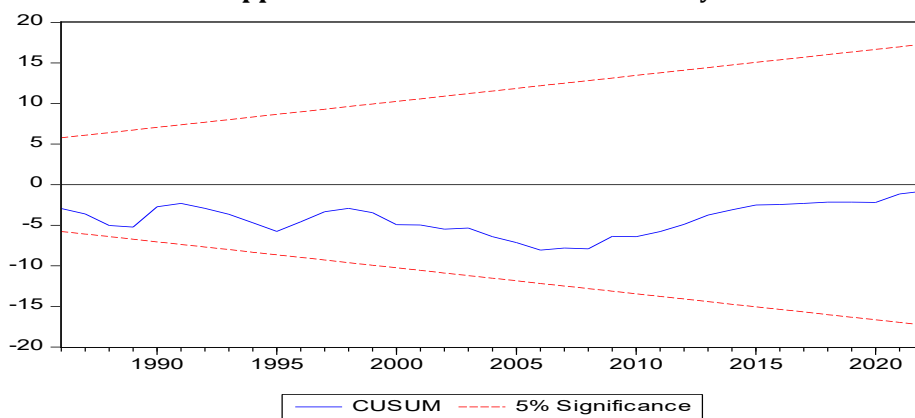
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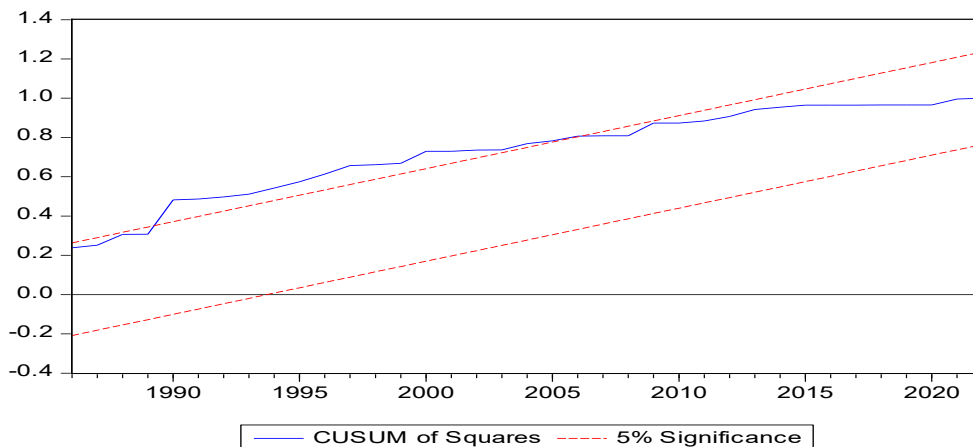
Appendix

Appendix A1. Normality Test Result

Series: Residuals
Sample 1982 2022
Observations 41

Mean	2.60e-14
Median	-0.550907
Maximum	18.49095
Minimum	-18.42205
Std. Dev.	6.825626
Skewness	0.202226
Kurtosis	4.320735
Jarque-Bera	3.259368
Probability	0.195991

Appendix A2. CUMSUM Test for Stability

Appendix A3. CUMSUM of Square Test for Stability

Appendix A4. Abridged ARDL Results without an Interaction Effect

Variable	Coefficient	Std. Error	t-Statistic	Prob.
Short Run Coefficients				
D(LFDII)	-10.07	6.08	-1.65	0.10
D(LREXCHR)	-0.33	7.07	-0.04	0.96
Long Run Coefficients				
LFDII	-19.41	7.17	-2.70	0.01
LREXCHR	-0.32	6.97	-0.04	0.96

References

Adebayo, T. S., Abolaji, A., Akinsola, G. D, and Olanrewaju, V. O. (2020). Asymmetric Impact of Inflation on Foreign Direct Investment in Nigeria: An Application of the Non-linear Autoregressive Distributed Lag (NARDL) Model. Timisoara Journal of Economics and Business, 13(2), 87-106. https://www.tjeb.ro/index.php/tjeb/article/view/338

Adrian, T. (2018). Policy responses to capital flows. Speech delivered at LIII Meeting of Governors of Latin America, Spain and the Philippines at the IMF-World Bank Annual Meetings in Bali, Indonesia, October 11. Retrieved from https://www.imf.org/en/News/Articles/2018/11/15/sp101118-policy-responses-to-capitalflows.

Adu, B. E. and Ntim, A. L. (2014). Causality Analysis of Foreign Direct Investment, Exchange Rate and Interest Rate Volatility in Ghana. Journal of economics and sustainable development, 5, 17-25. https://www.iiste.org/Journals/index.php/JEDS/article/view/13208

Akanji, O. O. (2006). The Achievement of Convergence in the Nigeria Foreign Exchange Market, *Bullion*, *30(3)*, Article 2. https://dc.cbn.gov.ng/bullion/vol30/iss3/2/

Akinlo, A. E. and Onatunji, O. G. (2021). Exchange Rate Volatility and Foreign Direct Investment in Selected West African Countries. *The International Journal of Business and Finance Research, 15(1), 77-88.*

Akpan, E. O. and Atan, J. A. (2012). Effect of Exchange Rate Movements on Economic Growth in Nigeria. *CBN Journal of Applied Statistics, 2 (2). 1-14. https://www.semanticscholar.org/paper/Effects-of-exchange-rate-movements-on-economic-in-Akpan-Atan/fc62ee384b02c576e892db41b70b03978799a6d6*

Ali, S. and Nazar, R. (2017). Impact of Foreign Capital Inflows and Money Supply on Exchange Rate: A Case Study of Pakistan. *Review of Economics and Development Studies, 3(1), 83-90.*

Aliber, R. Z. (1970). *A theory of direct foreign investment.* In C. P. Kindleberger, The International Corporation, a symposium. Combrite MA: MIT Press.

Andrieş, A. M., Căpraru, B., Ihnatov, I. and Tiwari, A. K. (2017). The Relationship between Exchange Rates and Interest Rates in a Small Open Emerging Economy: The Case of Romania. *Economic Modelling, 67, 261-274.* https://doi.org/10.1016/j.econmod.2016.12.025

Aribatise, A., Adeyemi, . and Adeseke, A. S. (2019). The Causal Relationship between Foreign Direct Investment and Exchange Rate In Nigeria (1986-2017). *International Journal of Innovative Finance and Economics Research 7(2):67-75.*https://www.semanticscholar.org/paper/The-Causal-Relationship-Between-Foreign-Direct-And-Aribatise-Adeyemi/9a1728e488004a6f672552ccbfcad72ed4cd6eac

Bentzen, J. & T. Engsted (2001). A revival of the autoregressive distributed lag model in estimating energy demand relationships. *Energy, 26(1), 45–55.* https://doi.org/10.1016/S0360-5442(00)00052-9

Cambazoğlu, B. and üneş, S. (2016). The Relationship between Foreign Exchange Rate and Foreign Direct Investment in Turkey. *Economics, Management, and Financial Markets 11(1), 284-293.* https://core.ac.uk/download/pdf/250317807.pdf

Central Bank of Nigeria, CBN (2006). Statistical Bulletin and Annual Report.

Ding, S., Pan, Q., Zhang, Y., Zhang, J., Yang and Luan, J. (2023). Study on the China's Real Interest Rate after Including Housing Price Factor into CPI. *PLoS One, 18(8), e0290079.*

Faroh, A. and Shen, H. (2015). Impact of Interest Rates on Foreign Direct Investment: Case Study Sierra Leone Economy. *International Journal of Business Management and Economic Research, 6(1), 124-132.*

Idoko. I. A., Eche, E. and kpeyol, K. (2020). An Assessment of the Impact of Interest Rates Deregulation on Economic Growth in Nigeria. *International Journal of Economics, 14(2), 143-156.*

Ikhinde, S, I. and Alawode, A. A. (2001). Financial Sector Reforms, Micro Economic Instability and the Order of Economic Liberation: The Evidence from Nigeria. African. Economic Research Paper No 112.

Isiaka, N. A., Osifalujo, B. B. and Taiwo, O. K. (2022). Interest Rate and Foreign Direct Investment in Sub-Sahara African Countries: The Comparison between Asymmetric and Symmetric Effects (ARDL and NARDL approach). *International Journal of Economics, Social Science, Entrepreneurship and Technology, 1(3), 186-200.*

Kilicarslan, Z. (2018). Determinants of Exchange Rate Volatility: Empirical Evidence for Turkey. *Journal of Economics, Finance and Accounting,.5(2), 204-213.* http://dx.doi.org/10.17261/Pressacademia.2018.825

Mannathoko, I. (2020). Sterilization in Botswana: Cost, Sustainability and Efficiency. Policy Review No 690.

Mokuolu J. O. (2018). Effect of Exchange Rate and Interest Rate on FDI and its Relationship with Economic Growth in Nigeria*. European Journal of Economic and Financial Research, 3(1), 33-47.*

Mostafa, M. M. (2020). Impacts of Inflation and Exchange Rate on Foreign Direct Investment in Bangladesh. *International Journal of Science and Business, 4(11), 53-69.* https://ijsab.com/volume-4-issue-11/3282

Narayan, P. K. (2005). The saving and investment nexus for China: Evidence from co-integration tests. *Applied Economics, 37(17), 1979-1990.*

Nwagu, K (2023). The Impact of Macroeconomic Variables on Foreign Direct Investment in Nigeria. *Journal of Accounting, Business and Finance Research, 16(1), 30-35.*

Ojinma, D. and Emerenini, F. M. (2015). Impact of Interest Rate on Investment in Nigeria. *Journal of Developing Countries, 5(3), 103-109.*

Okoye, L. U., Nwakoby, C. I. N. and Modebe, N. J. (2015). Interest Rate Reform and Real Sector Performance: Evidence from Nigeria. *African Banking and Finance Review, 2(1), 97-114.*

Okoukoni, V. and Oyekan, M. (2023). Nigeria's Floating Exchange Rate Regime: Potential Tax Implications and Management Strategies for Businesses. BusinesDay, Tuesday, August, 2023. Retrieved from: https://ng.andersen.com/nigerias-floating-exchange-rate-regime-potential-tax-implications-management-strategies-for-businesses/

Onakoya, A. B. and Agunbiade, O. A. (2020) Oil Sector Performance and Nigerian Macroeconomic Variables. *International Journal of Economics, Management and Accounting 28(1), 35-62.*

Otiwu, K. C. (2018). Foreign Exchange Rate Policies and Economic Growth Nexus in Nigeria. *Emerald International Journal of Scientific and Contemporary Studies, 1(1), 84-112.*

Pesaran, M. & Shin, Y. (1999). *An Autoregressive Distributed-lag Modelling Approach to Co- integration Analysis.* Cambridge: Cambridge University Press.

Qabhobho, T., Amoah, E. V. and Doku, I. (2022). Linkages between Foreign Direct Investment, Trade Openness and Economic Growth in South Africa: Does Exchange Rate Regime Choice Matter? *Latin American Journal of Trade Policy, 13, 60-86.* https://doi.org/10.5354/0719-9368.2022.66007

Rehman, H. U., Ahmed, D. I., and Jaffri, D. A. A. (2020). Impact of Foreign Direct Investment (FDI) Inflows on Equilibrium Real Exchange Rate of Pakistan. *South Asian Studies, 25(1), 125-141.*

Rufai, A. A., Aworinde, O. B. and Ajibola, O. (2022). Impact of FDI on Exchange Rate in Nigeria: A Combined Cointegration Approach. *Journal of Economics and Allied Research, 7(1), 141-158.*

Tan, L., Xu, Y. and ashaw, A. (2021). Influence of Exchange Rate on Foreign Direct Investment Inflows: An Empirical Analysis based on Co-integration and ranger Causality Test. *Hindawi Mathematical Problems in Engineering Volume 2021.* Retrieved from: https://doi.org/10.1155/2021/7280879.

Zhao, Y., Li, X., and de Haan, J. (2022). The Time Varying Causal Relationship between International Capital Flows and the Real Effective Exchange Rate: New Evidence for China. *The Singapore Economic Review, 67(4), 1253-1274.* https://doi.org/10.1142/S0217590819500097