IOSR Journal of Economics and Finance (IOSR-JEF)
e-ISSN: 2321-5933, p-ISSN: 2321-5925.Volume 13, Issue 5 Ser. III (Sep. – Oct. 2022), PP 01-12
www.iosrjournals.org

Macroeconomic Variables and the Gross Fixed Capital Formation in Nigeria: An Asymmetric Analysis

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Abstract
This paper empirically investigated the asymmetric effect of macroeconomic variables on the growth rate of gross fixed capital formation in Nigeria from 1981 to 2020 with secondary data sourced from Central Bank of Nigeria statistical/annual bulletins of various years, National Bureau of Statistics and International Monetary Fund (IMF). Linear and Non linear Autoregressive Distributed Lag (ARDL) Method were employed to estimate the effect of inflation exchange rate and interest rate on the growth rate of Gross Fixed Capital formation while the Toda-Yamato causality test was used to investigate the causal effect of the variables on investment. The findings of the study show that Inflation, Exchange rate and Interest rate have negative relationship with the growth rate of gross fixed capital formation in Nigeria both in short and long run with and without structural break. While exchange rate has insignificant effect on the level of investment in Nigeria in the short run, inflation and interest rate have significant linear relationship with the growth rate of gross fixed capital formation in Nigeria both in short and long run with and without structural break. Unidirectional causal effect exists between Inflation, interest and gross fixed capital formation. The paper therefore recommends that economic managers in the country should apply measures that will keep inflation and interest rates at a lower single digit that can stimulate the inflow of both foreign and domestic investment. An investment friendly environment and well- developed capital market and other investment outlets that will attract both foreign direct investment and cross border portfolio investment is recommended. An exchange rate policy that will strengthen the naira against other currencies that will encourage both local and foreign investors is highly recommended.

Keywords*: Growth rate of Gross fixed Capital Formation, Asymmetry, Linear ARDL, NARDL*

Date of Submission: 08-09-2022 Date of Acceptance: 25-09-2022

I. Introduction

Over the years investment has been viewed as one of the major determinant of economic growth, both for the developed and developing nations around the globe. It has a strong foothold on the development of nations as it can simply be said to be spending devoted to increasing the stock of capital of nations. Empirical studies concluded in Africa, Asia and Latin America as key to economic growth have established beyond doubt the crucial connection between investment and the rate of growth of any nation (M.I.Obadan 2001).

Nigeria is one of the economies amongst others, with a great demand for goods and services thereby attracting investors both domestic and foreign over the years. Investment takes place when new physical goods are used and further production takes place, it is positively related to aggregate demand thereby an increase in demand leads to further increase in the output by multiple of the multiplier, it is financed through domestic and foreign savings and profitable investment depends on higher productivity and income of an economy. Investment in economic analysis is stated to be an injection into the circular flow of an economy national income and a component of aggregate demand. Investment is a crucial variable on the supply of an economy as it brings about changes in the real capital stock thereby causing an increase in the production capacity of an economy, (Isiwu, 2020).

Inflation is a known problem around the entire globe that both developing and developed nations undergo. It threatens all economies and high inflation tends to disrupt and destabilize the functioning of a market economy if not properly managed. Hamilton (2015) described inflation as an economic situation when the increase in money supply is faster than the new production of goods and services in the same economy. Inflation depicts an economic situation whereby there is general rise in the price of goods and services continuously, this is further describes as 'too much money chasing too few goods'. One of the major objectives of macroeconomic policies around the globe is to foster economic growth putting into consideration investment as a major trend, by keeping inflation on the low. There has been a consensus over time amongst economist over time, to keep inflation at a one digit rate in order to further improve investment rate amongst nations both at the

domestic and international level, thereby improving and sustaining high economic and global growth, (Uchendu, 2020).

The Nigerian economy has faced the issue of lack of continuity in its economic policies from one political administration to the next; this lack of continuity has proven to pull a major setback to the growth hence causing constant fluctuations in the rate of investment. Each government has tried to improve investment either by providing a bailout fund to the private sectors or initiating policies or projects that would enable the growth of its economy both on the domestic and foreign level. The present recession in the economy has also caused a drawback to investment, with both foreigners and local producers putting a standstill to production due to the fact that consumption has been at minimal over recent years. According to some economic researchers in Nigeria over fifty thousand small and medium sized industries of about five million naira each were crashed due to high rate of inflation in the economy. This crash has brought about a reduction in employment which in turn draws a setback to income and lastly brings about low investment in the economy from both the households and industries at large.

Despite the great impact of investment to the growth of the entirety of Nigeria, inflation has a strong input to the pulling down or building up of investment generally most especially to foreign investment in the nation. The national wealth of a nation is at most times ultimately determined by the ability of its economy to possess a high production capacity. Most households in developing nations, possess high desires and intentions for investment for their savings, but due to the fact their financial capability continues to depreciate and remain unstable it makes direct investment difficult for them.

On June 20 2016, the Nigerian currency i.e. naira plunged in value from 199 to 285 compared to the US dollar. This is seen as the double digit inflation which basically prevents investors from repatriating profits easily and puts further dents in the government coffers. This leads to an increase in domestic terrorism and destruction of local and government properties. Further effects of this is seen with the withdrawal of investors in the Nigeria economy, as most investors pull out their previous investment made within the nation to put in other nations which would bring forth an admirable returns to their investment. This paper is set out to investigate the effect of some selected macroeconomic variables (inflation rates, exchange rates and lending interest rate) on investment in Nigeria for the period 1980 – 2020.

II. Literature Review and Theoretical Framework

2.1Inflation and Investment Growth Nexus

Asymmetry of information between economic agents in the process of investment financing causes three kinds of problems: adverse selection (see Akerlof, 1970), moral hazard (see Jaffee and Russell, 1976) and costly state verification (see Townsend 1979; Gale and Hellwig, 1985). These consequences may lead to credit rationing, which limits the possibility for enterprises to obtain capital for investment, even if expected return on investment exceeds the costs of capital employment. Even if fully anticipated, inflation exacerbates the consequences of information asymmetry and hampers the development of financial institutions. Inflation, as a result of e.g. regulations determining the value of nominal interest rate, may reduce the real rate of return on savings (see e.g. Barnes et al., 1999 or Boyd et al., 2001), and, consequently, discourage people from saving and stimulate them to take out loans, including persons incapable of paying them back (see e.g. Boyd et al., 1996). Moreover, it constitutes a tax imposed on the real value of enterprises' own funds, the investment of which is often a condition for obtaining external funding (see e.g. Boyd and Smith, 1998 or Huybens and Smith, 1999). A decline in enterprises' own funds resulting from that may be, at the same time, exacerbated by enterprises' decisions aimed at avoiding this tax (see e.g. Smith and van Egteren, 2005). Inflation does not only reduce firms propensity to gather own funds but also their ability to do so, as it reduces profit margins above the unit cost3. At the same time, inflation introduces additional "noise" to investment project assessment by lenders, thus hindering the identification of profitable projects (see e.g. De Gregorio and Sturzenegger, 1994; Baum et al., 2004). Finally, inflation may enhance the moral hazard among financial institutions themselves. They may hope that their potential losses will be at least partially financed by the government, for which it will be difficult to evaluate to what extent they are the result of exposure to the financing of risky projects and to what extent they result from unstable economic conditions, mirrored in growing inflation, beyond control of financial institutions (see e.g. McKinnon, 1991; De Gregorio, 1996).

In the light of both the theories and empirical studies, changes in inflation within the range of its very low values do not affect the extent of financial intermediation, yet after exceeding a certain low threshold, further rise in inflation hinders its growth; all the negative effects of inflation on the development of the financial sector become apparent when inflation is moderate (see e.g. Boyd et al., 2001; Rousseau and Wacthel, 2002 or Khan et al., 2006).

Moreover, in the developed countries the negative impact of inflation on the financial sector and, consequently, on corporate investment becomes apparent at lower inflation levels than in the developing countries (see e.g. Cuadro et al., 2003). Higher capital per person employed in the former ones forces enterprises

to engage higher own funds in the financing of investments whose value is sensitive to changes in inflation (see e.g. Hamid and Singh, 1992; Boyd and Smith, 1998).

The second important channel of inflation impact on corporate investment it its effect on uncertainty as to the future value of variables which are of importance for investment decisions made by enterprises. The impact of inflation on investment through uncertainty depends on two, generally disjunctive, relationships.

On the one hand, it is the function of the impact of inflation on uncertainty about variables forming the basis for enterprises to formulate their assessment of future return on investment. Conclusions drawn from the review of theoretical and empirical literature are unequivocal: inflation, even within the range of low and moderate values, constitutes an important source of uncertainty. By increasing relative price variability (see e.g. Nautz and Scharff, 2006 or Banerjee et al. 2007, Caporale et al., 2010), inflation makes it difficult for entrepreneurs to assess what is worth manufacturing and what is not, as well as reduces the number of contracts and shortens the average period of contract duration (see e.g. Reagan and Stulz, 1993 and Guerrero 2005). By escalating uncertainty about future inflation (see e.g. Ball and Cecchetti, 1991; Evans, 1991; Evans and Wachtel, 1993), inflation increases uncertainty about the level of interest rates and about that part of future tax burdens affecting, directly or indirectly, the cost of capital utilization which depends on inflation. Finally, it intensifies the uncertainty stemming from relative price variability as long as nominal price rigidities emerge (Friedman, 1977).

On the other hand, the impact of inflation on investment through its effect on uncertainty is determined by the relation of investment and uncertainty. Although intuitively we are inclined to conclude that the higher the uncertainty, the lower the propensity of enterprises to embark on new investment, this relationship is not unambiguous in the light of the theory (see, on the one hand, e.g. Hartman, 1972; Abel, 1983; Lee and Shin, 2000 and, on the other hand, McDonald and Siegel, 1987 or Abel et. al, 1996). Conclusions derived from models are the function of adopted assumptions whose adequacy to reality is, in some cases, questionable (Dixit and Pindyck, 1994). The majority of empirical studies indicate, however, that a rise in inflation leading to growing uncertainty accompanying investment decisions of enterprises reduces their propensity to invest (see e.g. Ferderer, 1993; Serven and Solimano, 1993 or Pindyck and Solimano, 1993; Kalckreuth, 2000; Byrne and Davis, 2004; Fisher,2009).

The third important channel of inflation impact on corporate investment is the interaction between inflation and the tax system. If it is not fully indexed, inflation affects the cost of capital utilization. It may also differentiate this cost, depending on the type of capital asset (length of depreciation period) or the structure of investment financing (see e.g. Feldstein et al., 1978). As a result, this leads to a change in both the level and direction of capital allocation. However, the sign and the strength of this impact depend on many assumptions concerning, inter alia, detailed solutions of the tax system (see e.g. Sorensen, 1986; Cohen et al., 1999), free capital flow (see, on the one hand, Hartman 1980, and, on the other hand, Desai and Hines, 1997) or the manner the government uses additional (stemming from lack of full indexation) tax revenues (see e.g. Bullard and Russell, 2004). Consequently, they cannot be unambiguously identified on the grounds of the theory. However, models unequivocally suggest that changes in inflation through interactions with the tax system are not neutral for investment decisions made by enterprises.

2.2 Empirical Review

Badawi (2021) investigated the impact of macroeconomic policies on private investment in Sudan employing annual data over the period 1969-2018. One of the independent variables, that is real interest rate, impacts negatively on private investment. Interest rate was also found to be less important in determining the level of private investment in Kenya (Frimpong and Marbuah, 2021).

Eregha (2020) examined variations in interest rate and investment determination in Nigeria. The study employed dynamic model of two equations using instrumental variable technique of estimation. The study revealed that variations in interest rate posits negative but highly significant role in investment decision in Nigeria and demand for credit had a negative significant influence on interest rate variations in both the short-run and the long-run.

Ojima and Emerenini (2020) in their own study of interest rate and investment in Nigeria applied the ordinary least square method (OLS). Their study revealed that high interest rate and inflation affect investment negatively. The study therefore suggested that the monetary authority should evolve policies that will encourage savings and reduce prime lending rate to genuine investors and others. They further recommended that since there is a link between income and savings, relevant authorities should consider economic policies that will increase income level of the people in order to mobilize investments.

Omole and Falokun (2019) tested the relationship between money, inflation and output by employing co integration and Granger-causality test analysis. The findings revealed no existence of a co integrating vector in the series used. Money supply was seen to Granger cause both output and inflation. The result suggest that monetary stability can contribute towards price stability in Nigerian economy since the variation in price level is

mainly caused by money supply and also conclude that inflation in Nigeria is to a large extent a monetary phenomenon. They find empirical support in context of the money-price-output hypothesis for Nigerian economy. M2 appears to have a strong causal effect on the real output as well as prices.

Using Okun's law, "each percentage point of cyclical unemployment is associated with a loss equal to 2% of full-employment output; if full-employment output is $10 trillion, each percentage point of unemployment sustained for one year costs $200 billion".

Williams and Adedeji (2019) examined price dynamics in the Dominican Republic by exploring the joint effects of distortions in the money and traded-goods markets on inflation, holding other potential influences constant. The study captured the remarkable macroeconomic stability and growth for period 1991 to 2012. Using a parsimonious and empirically stable error-correction model, the paper found that the major determinants of inflation were changes in monetary aggregates, real output, foreign inflation, and the exchange rate. However, there was an incomplete pass-through of depreciation from the exchange rate to inflation. The authors established a long-run relationship in the money and traded-goods markets, observing that inflation was influenced only by disequilibrium in the money market.

The theories of investment date back to Keynes in 1936, who first called attention to the existence of an independent investment function in the economy, and the empirical literature on private investment behavior is vast. For instance, private investment in the developing countries has faced many economic problems such as low growth rate, inflation and foreign debt, deficit in trade balance and low standard of living. Private and public investment could complement each other rather than compete with each other and private investment had larger impact than public investment on economic growth (Admasu, 2012; Khan and Rinluhart, 2015).

A World Bank Study (2018) empirically examined the link between real private investment and other variables such as real public investment, credit to the private sector, real rate of interest and a dummy for 1976 in Ghana. Public investment was found to crowd-in private investment, and real interest rate was found not have a substantial effect on private investment (Islam and Wetzel, 1991).

Oshikoyo (2018) analyzed the determinants of domestic private investment in eight African countries during 1970-2015. He estimated impact of domestic inflation rate on private investment behavior in middle income countries is positive and insignificant.

Abbas (2018) studied the determinants of private investment in Iran and found a negative relationship between inflation and private investment and that a 1 percent increase in inflation in the long run would result in 1 percent decline in investment in the short run.

2.3 Theoretical Framework

The theoretical underpin of this study is the Jorgenson's Neoclassical Theory of Investment propounded by Dale W. Jorgenson in 1967. This theory of investment behaviour is based on the determination of the optimal capital stock. His investment equation has been derived from the profit maximization theory of the firm. Jorgenson's theory is based on the following assumptions: the firm operates under perfect competition; there is no uncertainty; there are no adjustment costs; there is full employment in the economy where prices of labour and capital are perfectly flexible; there is perfect financial market which means the firm can borrow or lend at a given rate of interest; the production function relates output to the inputs of labour and capital; labour and capital are homogenous inputs producing a homogenous output; inputs are employed up to a point at which their MPPs are equal to their real unit costs; there are diminishing returns to scale; there is the existence of "putty-putty" capital which means that even after investment is made, it is instantly adapted without any costs to a different technology; the capital stock is fully utilized; changes in current prices always produce, ceteris paribus, proportional changes in future prices; the price of capital goods equals the discounted value of the rental charges; and the firm maximizes the present value of its current and future profits with perfect foresight in relation to all future values.

III. Model Specifications

The model for this study was specified in line with the work done by Ojima and Emerenini (2020) in their own study of interest rate and investment in Nigeria applied the ordinary least square method (OLS). Their study revealed that high interest rate and inflation affect investment negatively. The study therefore suggested that the monetary authority should evolve policies that will encourage savings and reduce prime lending rate to genuine investors and others.

Hence, the model for this study was developed to assess this using the period 1980 to 2020. The model is therefore specified thus:

$$GRGFCF = a_0 + b_1INFL + b_2EXR + b_3INTR + U_t \quad \text{——————} \quad (1)$$

Where GRGFCF is the growth rate of gross fixed capital formation, INFL is inflation rate (measuring macroeconomic instability), EXR is real exchange rate, INTR is interest rate and μ_t is a white noise

disturbance term and b_1, b_2 and b_3 are parameters to be estimated. The apriori expectation is summarized as follows:

$b_1 < 0, b_2 < 0\ b_3 < 0$

This study employed the autoregressive distributed lag (ARDL) technique for the analysis due to its ability to analyse dynamic relationships with time series data in a single-equation framework where the current value of the dependent variable is influenced by its own past values as well as the current and past values of other explanatory variables. Furthermore, the variables can be stationary, non stationary, or a mixture of the two types. In addition, in its equilibrium correction (EC) representation, the ARDL model can be used to separate the long-run and short-run effects, and to test for cointegration or, more generally, for the existence of a long-run relationship among the variables of interest(Kripfganz& Schneider, 2018).

The model has been explicitly stated as:

$$\Delta GRGFCF_t = a_1 + \beta_{11}\Delta GRGFCF_{t-1} + \beta_{12}\Delta INFL_{t-1} + \beta_{13}\Delta EXR_{t-1} + \beta_{14}\Delta INTR_{t-1} + \sum_{i=1}^{n}\beta_{11}\Delta GRGFCF_{t-1} + \sum_{i=1}^{n}\beta_{12}\Delta INFL_{t-1} + \sum_{i=1}^{n}\beta_{13}\Delta EXR_{t-1} + \sum_{i=1}^{n}\beta_{14}\Delta INTR_{t-1} + \varepsilon_{1t}$$

IV. Data Analysis and Discussion of Findings

4.1 Descriptive Statistics of the Variables

Table 4.1: Summary Statistics

Statistics	GRGFCF	INFL	EXR	INTR
Mean	-0.61625	19.09275	102.0125	17.595
Median	0.95	12.885	106.465	17.245
Maximum	40.39	72.84	358.81	31.65
Minimum	-30.17	5.38	0.62	8.92
Std. Dev.	13.57631	16.84338	103.6262	4.774697
Skewness	0.131205	1.816378	0.967676	0.290948
Kurtosis	3.917647	5.149349	3.196622	3.748389
Jarque-Bera	1.518224	29.69437	6.307076	1.497816
Probability	0.468082	0.0000	0.042701	0.472883
Sum	-24.65	763.71	4080.5	703.8
Sum Sq. Dev.	7188.329	11064.28	418796.9	889.1114
Observations	40	40	40	40

Source: *Researcher's Computation using Stata 15*

Table 4.1 above showed that the mean of gross fixed capital formation, inflation and Exchange Rate were 24.37, 2.68 and 3.41 respectively. Given above, we can make conclusion that the average gross fixed capital formation, inflation and exchange rate were moderately high between 1994 and 2018. The minimum, maximum and standard deviation values of the variables are shown in the table.

4.2 Unit Root Test

Table 4.2 Unit Root Test with and without Structural Break

	ADF Unit root Without Structural Break			Zivolt and Andrews Unit root With Structural Break		
Variable	Levels(Cons&Trend)	1st diff(Cons&Trend)	Order of Integration	Levels(Cons&Trend)	1st diff(Cons&Trend)	Order of Integration
GRGFCF	-4.886***	-	I(0)	-6.120*** (1990)	-	I(0)
INFL	-3.580**	-	I(0)	-4.372 (1993)	-6.372*** (1989)	I(1)
EXR	-1.417	-3.059**	I(1)	-3.221 (2014)	-6.232*** (2011)	I(1)
INTR	-2.301	-5.353***	I(1)	-4.576 (1991)	-5.633*** (2012)	I(1)

Source: Extract from Regression Printout using Stata 15

*Note: The statistics reported are the t - Statistics with the associated break points in brackets. GRGFCF: Growth Rate of Gross fixed Capital formation, INFL: Inflation, EXR and INTR: interest rate: exchange rate. ***, **, * signify 1%, 5% and 10% significance levels respectively. Values in "( )" are the break dates revealed by the unit root tests with structural break. Zandrews Unit root Critical values: 1%: -4.93 5%: -4.42 10%: -4.11. ADF Critical values at levels: -3.668 -2.966 -2.614 @ 1% 5% 10% resp. ADF Critical values at 1st Diff: -3.662 -2.964 -2.617 @ 1% 5% 10% resp*

The unit root test was carried out on the variables using the Augmented Dickey-Fuller (ADF) without structural break at constant and trend and Zivolt and Andrews (1995) with structural break at both constant and trend. The results below show that all the variables tested with or without Structural break were not stationary at level except inflation and others were stationary only at first difference. The fact that the variables were stationary at different order of integration however connotes the likely existence of long run relationship among the variables. The paper therefore tested for cointegration using the autoregressive distributed lag (ARDL) cointegration bound test.

4.3 Cointegration Test

The Auto-Regressive Distributed Lag Bound Co-integration test

Table 4.3: ARDL Bound Co-Integration Test

Estimated Model	F-Statistics	
	K_3 10.636	
Critical Values	**Lower Bound I(0)**	**Upper Bound I(1)**
1%	4.29	5.61
5%	3.23	4.35
10%	2.72	3.77

Source: Authors' computation using Stata 15 2022.

Sequel to the mix in the result of the unit root tests presented in table 4.3 above, this study carried out the co-integration test using the Auto-Regressive Distributed Lag Bound Co-integration test. Pesaran, Shin and Smith (2001) provide two asymptotic critical values (lower and upper) bounds for testing the existence of co-integration when the regressors are purely I(0) or I(1). The results presented above show that the F-statistics of 10.636 is higher than the upper bound critical value at 5% level of significance and therefore the null hypothesis of no cointegration can be rejected thus the study proceed to estimate the short and long run ARDL model with structural break and without structural break.

4.4 Linear ARDL without and with Structural Breaks

This study at this point carried out structural break test with unknown break date to verify if there is a structural break and if the break points identified in the unit root has significant effect on the model to avoid making a wrong inference that are not best fit for the model. The result indicated a structural break with a single break point date in 2001. Dummy coefficient for the break point was generated and used to estimate the ARDL both with structural break and without structural break to ascertain if the break point has influence on the results. The results are presented below;

4.5 Test for a structural break: Unknown break date

Estimated break date: **2001**

Ho: No structural break

Test Statistic P-value

swald 65.0279 0.0000

From the above, the null hypothesis of no structural break can be rejected since the P-value of 0.0000 is less than 0.05 at 5% level of significant.

Table 4.4: ARDL Without and With Structural Break

Variables	ARDL Without Structural Break		ARDL With Structural Break	
D.GRGFCF	Short-run	Long-run	Short-run	Long-run
ADJUSTED	-0.1448		-0.2008	
LGRGFCF	(0.000***)	-	(0.025**)	-
LINFL				
	-0.131	-0.063	-0.089	-0.204
LEXR	(0.064*)	(0.665)	(0.077*)	(0.414)
INTR				

	-0.060 (0.648)	0.026 (0.032**)	-0.082 (0.424)	0.122 (0.586)
	-0.228 (0.771)	-I.296 (0.009***)	-0.135 (0.245)	-0.342 (0.002***)

Source: Extract from Regression Printout using Stata 15

***Note: Break Date: 2001. ***, **, * signify 1%, 5% and 10% significance levels respectively. Adjusted GRGFCF is the error correction term that is expected to be negative and statistically significant. The statistics reported are the parameters with the associated probability values in brackets*. See the discussion of findings.**

4.6 Long run Increasing and Decreasing Non Linear ARDL (NARDL)

In order test for the asymmetric effect of the exogenous variables on growth rate of gross fixed capital formation, the study carried out the NARDL test and the results is presented in table 4.5.

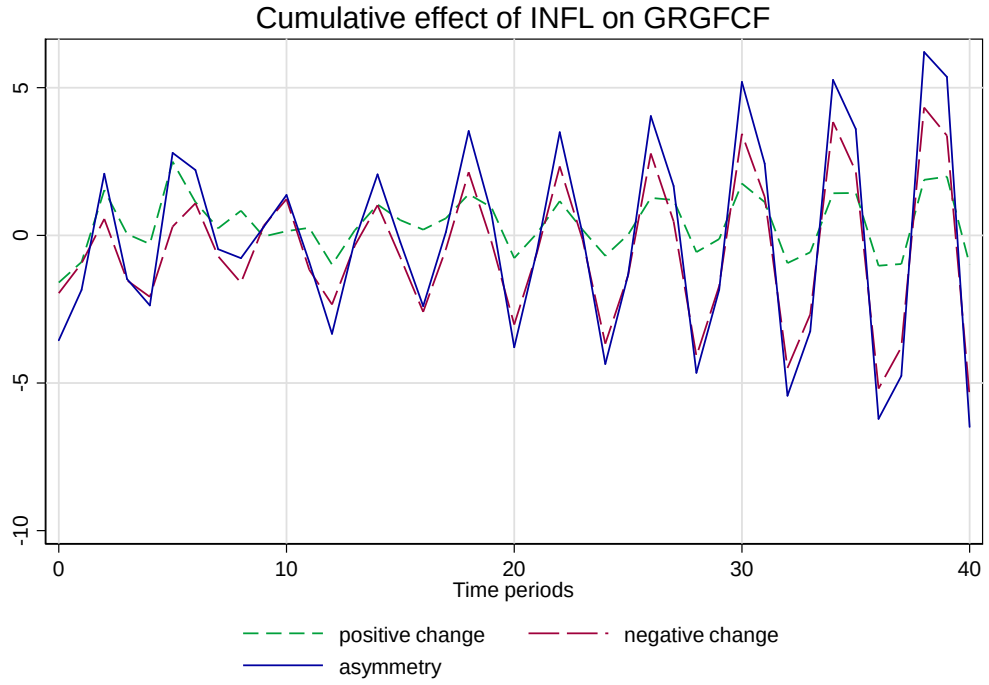
Table 4.5 Asymmetry Statistics of NARDL Model

Exogenous Variable	Long-run effect (+)			Long-run effect (-)		
	Coef	F-statistic	P>F	Coef	F-statistic	P>F
INFL	0.382	35.18	0.001	-0.488	23.8	0.002
EXR	0.021	1.093	0.331	-0.082	0.164	0.697
INTR	0.213	0.861	0.384	-0.056	0.136	0.723
	Long-run Asymmetry			Short-run Asymmetry		
	F-statistic		P>F	F-statistic		P>F
INFL	4.616		0.069	12.74		0.009
EXR	0.112		0.747	0.525		0.492
INTR	2.226		0.179	0.005		0.944

Source: Extract from Regression Printout using Stata 15

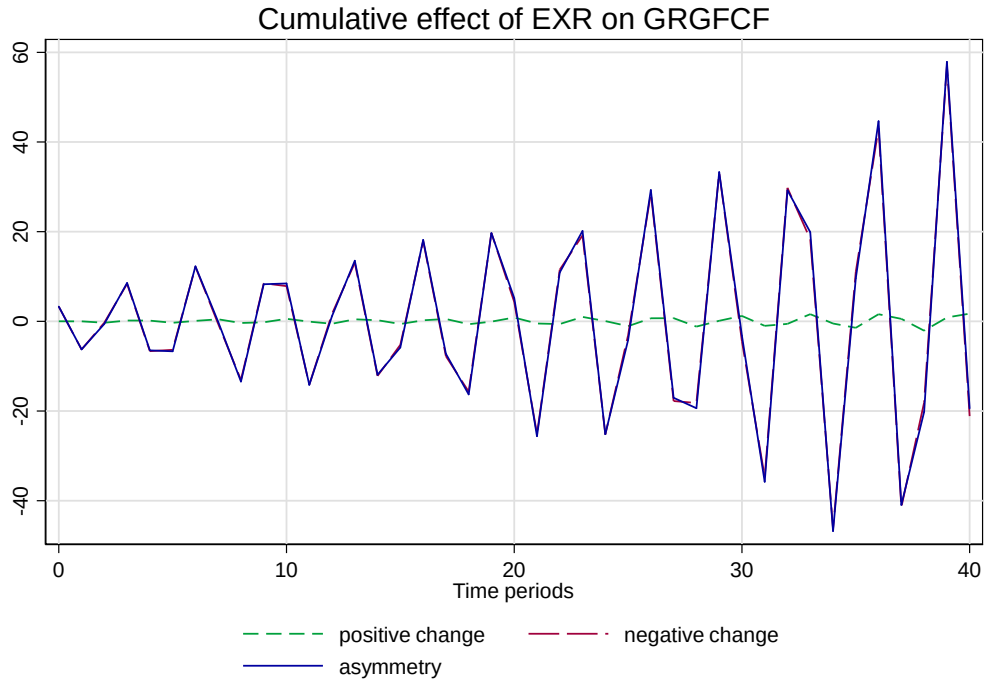
From table 4.5, a positive change in inflation, exchange rate and interest rate result to increase in the growth rate of gross fixed capital formation in the long run at confidence level of 95% and for a forecast period of forty. The asymmetry for all the exogenous variables showed a mean revert trend. See fig 5, 6 and 7

Fig 4.1 Cumulative effect of Inflation on Growth Rate of GFCF



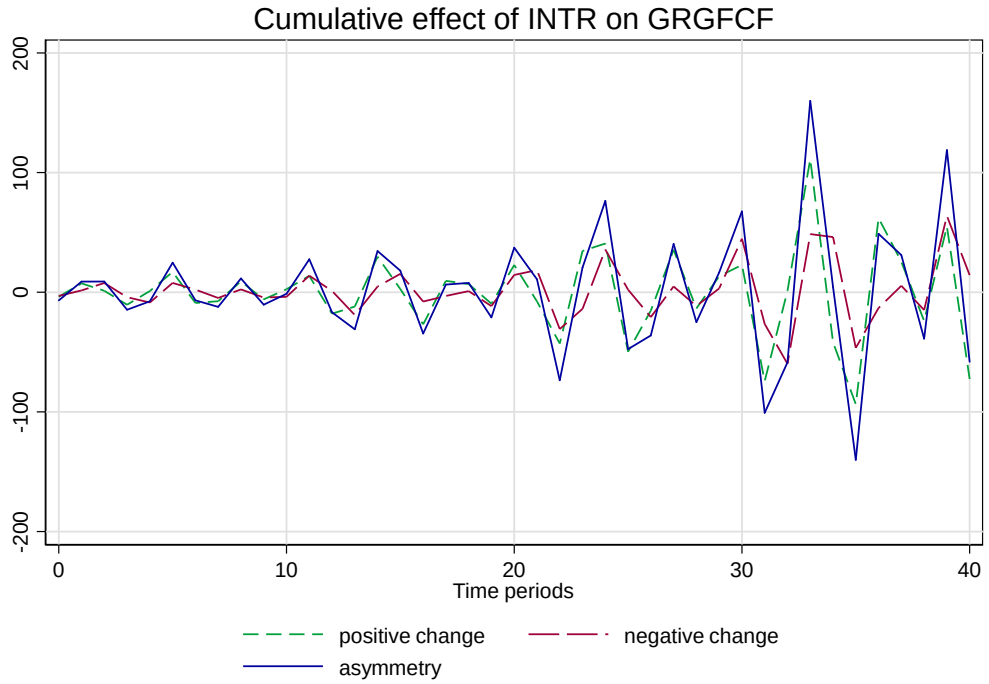
Source: Extract from Regression Printout using Stata 15

Fig 4.2 Cumulative effect of Exchange rate on Growth Rate of GFCF



Source: Extract from Regression Printout using Stata 15

Fig 4.3 Cumulative effect of Interest rate on Growth Rate of GFCF



Source: Extract from Regression Printout using Stata 15

4.7 Toda-Yamamoto Causality Test

Table 4.6: Toda-Yamamoto model with structural breaks

Null Hypothesis	Chi-Square	Probability	Direction of Causality
GRGFCF does not cause INFL	0.67	0.955	No Causality
INFL does not cause GRGFCF	2.08	0.020**	INFL → GRGFCF
GRGFCF does not cause EXR	6.47	0.166	No Causality
EXR does not cause GRGFCF	3.60	0.462	No Causality
GRGFCF does not cause INTR	3.86	0.425	No Causality
INTR does not cause GRGFCF	33.96	0.000***	INTR → GRGFCF

Source: Extract from Regression Printout using Stata 15
Note: Break Date: 2001. The statistics reported are Chi-square statistics with the associated probability values. The break dates included in the estimation are the dates obtained for the series from the unit root analyses conducted with structural breaks. See Discussion of Findings.

4.8 Discussion of Findings

The positive break point coefficient with the probability value of 0.890 indicated that the structural break has no effect on the result of the model. The ARDL regression estimates on the long and short run relationship of the model is presented on table 4.4 above show that inflation (LINFL) is a significant determinant of GRGFCF at 10% level of significance though negatively related to it both in the long and short run with and without break. Exchange rate (EXR) is not a significant determinant of growth rate of gross fixed capital formation (GRGFCF) at 5% level of significance although negatively related to it in the short run with and without break and positively related to it in the long run insignificantly with and without break. The study however found that a unit increase in LINFL is expected to decrease the GRGFCF by 0.131 and 0.063 units respectively in the short and long run with structural break while a unit increase in exchange rate is expected to decrease the GRGFCF by 0.060 unit in the short run and increase it by 0.026 in the long run. A negative and insignificant relationship exists between interest rate and GRGFCF in the short run while a negative and significant relationship exists between them in the long run. A unit change in interest rate will decrease GRGFCF by 0,228 and 1.296 in the short and long run respectively.

The negative relationship between inflation, exchange rate, interest rate and growth rate of gross fixed capital formation will ultimately lead to decline in economic growth since investment is the most sensitive and influential component of aggregate demand. EXR with negative relationship with GRGFCF on the other hand is an indication of loss in value of the naira against other currencies in the period of study. An appreciation of the naira will stimulate investment which will improve economic growth.

The causality effect of inflation, exchange rate and interest rate on the growth rate of gross fixed capital formation was carried out using the Toda-Yamamoto Causality test. The results show a unidirectional causality between inflation and GRGFCF and interest rate and GRGFCF. Inflation granger caused GRGFCF while GRGFCF did not granger cause inflation at 5% level of significance. Interest rate granger caused GRGFCF while GRGFCF did not granger cause interest rate at 5% level of significance. There is no causality between exchange rate and GRGFCF.

From the estimate, the coefficient of the error correction term was correctly signed (-0.1427) and statistically significant. The coefficient estimate of the error correction term of -0.1427 indicated that the model corrected its short-run disequilibrium at a speed of adjustment of 14.27 percent to return to the long-run equilibrium. Also the Durbin-Watson Stat of 2.0115 indicated that the estimation is free from the problem of serial autocorrelation and that the model estimate is appropriate and can be used for policy recommendation.

4.9 Post Estimation Diagnostic Tests

Table 4.7 Breusch-Godfrey LM test for autocorrelation

lags(*p*)	chi2	Df	Prob > chi2
1	**0.107**	1	**0.7430**

Source: Author's Computation using STATA 15 DW = 2.0115

The null hypothesis of the above test in table 4.7 is that there is no serial correlation in the residuals up to the specified lag order. The prob>chi2 of 0.7430 greater than 0.05 indicate that there is no presence of serial correlation.

Table 4.8 Cameron & Trivedi's Decomposition of IM-test

Source	chi2	df	p-value
Heteroskedasticity	**33.29**	**35**	**0.5508**
Skewness	**2.21**	**7**	**0.9473**
Kurtosis	**1.97**	**1**	**0.1602**

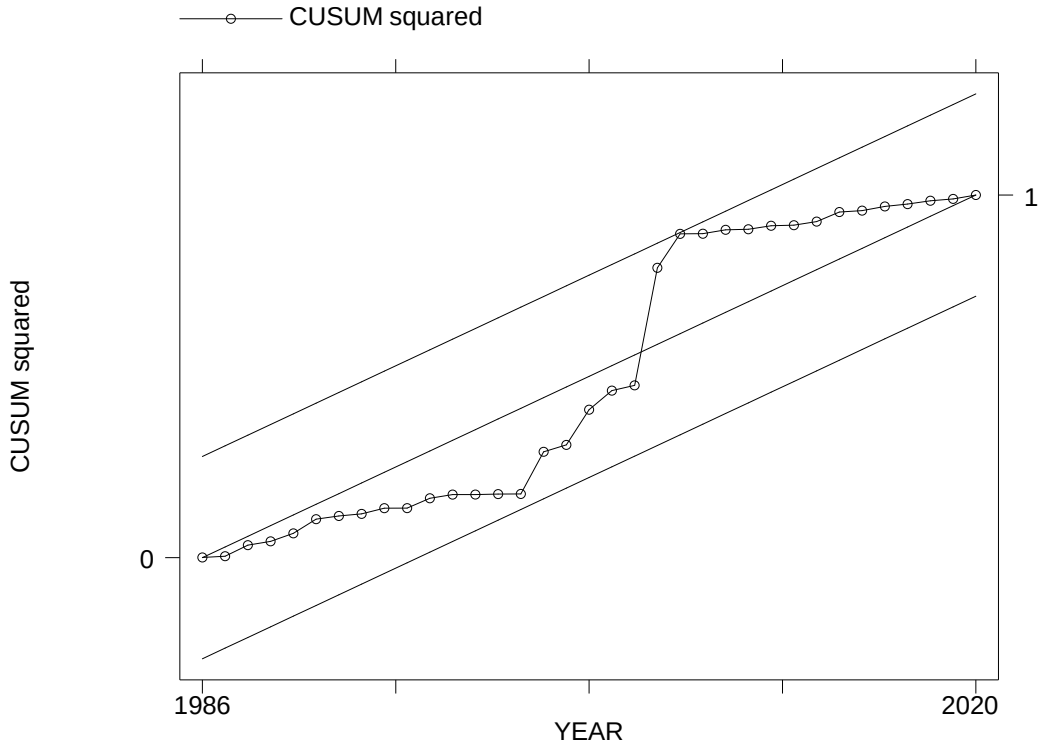
Source: Author's Computation using STATA 15

From table 4.8, the null hypothesis of homoscedasticity cannot be rejected as the probability value of 0.5508 is not statistically significant at 5%.The distribution of the data used for the variables is positively skewed (long right tail) while the kurtosis indicated platykurtic (flat) compared to normal since the chi2 value is less than three.

Stability Diagnostics Test

The stability test is carried out through the aid of the CUSUM squared test. CUSUM squared test is used to check if the parameters are stable overtime. Fig 4.5 shows that the variables are stable. That means the model exhibits stability over time order and can be used for forecasting.

Fig 4.4: Stability Diagnostics Test Result.



Source: Author's Computation using STATA 15

The cusum square result showed that the red line lie inside the bound which therefore satisfies stability condition.

4.10 Policy Implication/Recommendations

The study led to several findings and therefore several policy implications as well as recommendations are discussed below:

The results show that inflation is a negative and significant determinant of growth rate of gross fixed capital formation in Nigeria. The study therefore recommends that economic managers (The Central Bank and the Federal Ministry of Finance) in the country should apply measures that will keep inflation rate at a lower single digit that can stimulate the inflow of both foreign and domestic investment.

An investment friendly environment and well developed capital market and other investment outlets that will attract both foreign direct investment and cross border portfolio investment is recommended.

An exchange rate policy that will strengthen the naira against other currencies that will encourage both local and foreign investors is highly recommended.

4.11 Concluding Remarks

Investment is a major determinant of economic growth, both for the developed and developing nations around the globe. The crucial connection between investment and the rate of growth of any nation has long being established as a strong foothold on the development of any economy.

Despite this great influence of investment to economic growth, inflation and interest rate have a strong input to the pulling down or building up of investment most especially to foreign investment in the nation. This study investigated the effect of inflation, interest rate and exchange rate on the growth rate of gross fixed capital

formation and its findings have shown that inflation and interest rate impacted negatively on investment which has adverse effect on Nigeria economic advancement in the period of the study.

The Central Bank and the Federal Ministry of Finance should adopt stringent monetary and fiscal measures that will keep inflation and interest rates at a lower single digit that can stimulate the inflow of both foreign and domestic investment.

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