



CALMING THE TIDE: PRIVATE INVESTMENT AND MACROECONOMIC UNCERTAINTY IN NIGERIA

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ABSTRACT

This study is undertaken to determine the relative impacts of the uncertainty of macroeconomic variables on investment and make policy recommendations that may help dampen their fluctuations. In the study, generalized autoregressive conditional heteroscedasticity (GARCH) model was applied in the estimation of uncertainty of the macroeconomic variables. In the analysis of the data, econometric results were obtained from cointegration test and ordinary least squares. Thus, the study revealed the following: (1) existence of long run relationship between some of the macroeconomic variables and investment, (2) possibility of convergence of the variables from the short run to the long run with slow speed of adjustment and (3) the uncertainty of most of the macroeconomic variables impact negatively on investment in Nigeria. The study recommends the use of appropriate policy instruments that will bring about macroeconomic stability which provide conducive and enabling environment for private investment to thrive.

Keywords: Private investment, Volatility, Inflation, Exchange rate, Economic growth

INTRODUCTION

Theoretically and empirically, the concept of investment and uncertainty has attracted reasonable attention in macroeconomic literature. Investment is the most volatile of the major components of aggregate expenditure. After consumption, investment constitutes one of the most important and yet unstable part of total demand in every country, which is considered as one of the causes of cyclical fluctuations. Most of the relevant theories point to the instability of this variable on the one hand, and on the other hand, they emphasize the undeniable impact of this parameter on economic growth (Rexford, 2012; Leila *et al.* 2012 and World Bank, 2012). Dornbush *et al.* (1996) were of

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the view that investment spending is usually volatile, because it depends on multiple factors, and is responsible for much of the fluctuations of GDP over the business cycle. The instability of investment led Keynes, (1936) to conclude that the economy is inherently unstable, and there is need for government intervention to activate and regulate the saving and investment behavior of the society. The great depression of the 1930s left in its wake, the break-down of autarky and subsequent global financial liberalization. Demir, (2009) found that, in most developing countries, financial liberalization processes gradually led to sharp fluctuations in key macroeconomic indicators, over the years. NBS, (2004) asserts that Nigeria's macroeconomic indicators have been fluctuating since 1980. From early 1980s to the second half of the 1990s, annual inflation has averaged around 30 percent. Subsequently, average inflation came down to one -digit rate. However, since 2001, inflation is back in the two-digit domain, with an average of about 18 percent within 2000-2002. While, average inflation between 2004 and 2008 is about 10 percent.

When we take a cursory look at the performance of the Nigerian economy vis-à-vis other economies, we see some puzzling outcomes. For instance as presented in Table -1, available statistics reveal that averagely, interest rate, inflation rate, exchange rate and GDP growth volatilities are lesser in developed economies but more severe in emerging economies. Also, we see on the average, lower GDP growth rate and higher inflation rate among the emerging economies. As it were, when compared with some other emerging and developed countries, Nigeria's data show serious volatilities of some macroeconomic variables like exchange rate and inflation rate. Although, within the period under review, GDP growth rate and interest rate variability in Nigeria is lower than that of Chile, Brazil and South Africa, inflation rate in Nigeria, on the average is the fourth highest among the emerging countries with Hungary, Mexico and Columbia, taking the lead. That notwithstanding, among the emerging economies, Nigeria recorded some appreciable levels of GDP growth rate, coming second only to Poland, Mexico and South Korea which all grew around 4 per cent a year between 1997 to 2002 on the average. The statistics below therefore shows that as an emerging country, Nigeria's macroeconomic environment (at least in terms of Inflation and exchange rates) is more volatile than say South Africa, Brazil and Chile. This further corroborates the words Batini that "emerging market economies like Nigeria face more volatile macroeconomic environment, and typically have weaker institutions that enjoy less credibility than their developed economies counterparts". It has also been observed that some aggregate macroeconomic variables in Nigeria such as real exchange rate (RER), government revenue and spending and terms of trade (TOT), were among the most volatile in the developing world between 1980-2002 (NBS, 2004). This has made the economy to be in a low growth trap, made up of low savings-investment equilibrium. Hence, our economy is still far below the minimum investment rate of about 30 percent of GDP required for significant economic development (CBN, 2004). Addison and Quentin, (2007) opined that "when comparing Nigeria to other developed economies, it can be found that most of the GDP differentials can be attributed to Nigeria's higher macroeconomic uncertainty". They also noted that this high level of under-development in Nigeria was due in large

part to macroeconomic uncertainty that depressed investment and economic growth. Investment as it were, is the most volatile of the major components of aggregate expenditure. Dornbush *et al.* (1996) were of the view that investment spending is usually volatile, because it depends on multiple factors, and is responsible for much of the fluctuations of GDP over the business cycle. To this end, Keynes (1936) therefore asserts that there is need for government intervention to activate and regulate the saving and investment behavior of the society because the erratic nature of investment sometimes makes the economy inherently unstable.

Table 1: Volatility and average of selected macro economic variables for 1997 q1 – 2002 q2

Volatility of Basic Variables						Average
	Inflation	Exchange Rate 1/	GDP Growth 2/	Interest Rate	GDP Growth	Inflation
Developed Economies						
Australia	2.05	0.07	1.31	0.58	3.85	2.34
Canada	0.83	0.04	0.93	1.14	3.82	1.88
Iceland	2.45	0.15	3.13	3.02	4.17	4.05
New Zealand	1.21	0.08	2.25	1.47	2.83	1.62
Norway	0.77	0.10	2.25	1.46	2.66	2.44
Sweden	1.11	0.12	2.41	0.44	2.58	1.24
Switzerland	0.54	0.08	1.14	0.92	1.79	0.85
United Kingdom	0.92	0.06	1.45	1.13	2.70	2.45
Average	1.24	0.09	1.86	1.27	3.05	2.11
Median	1.02	0.08	1.85	1.14	2.77	2.11
Emerging Market Economies						
Brazil	2.11	0.23	2.06	7.06	1.83	5.99
Chile	1.30	0.06	3.14	2.32	3.12	4.21
Colombia	5.43	0.25	3.30	10.02	0.81	12.51
Czech Republic	3.46	0.09	2.73	5.81	1.18	5.31
Hungary	4.09	0.16	-	1.13	-	11.21
Israel	3.18	0.10	3.36	3.34	2.98	4.35
Nigeria	6.49	0.31	0.58	3.45	3.28	10.71
Mexico	5.98	0.07	3.17	7.26	4.05	11.72
Peru	3.04	0.11	3.45	5.50	2.11	3.89
Poland	4.13	0.11	2.40	4.14	3.85	8.40
South Africa	2.14	0.15	1.12	3.65	2.40	6.39
South Korea	2.36	0.14	6.38	5.52	4.31	3.73
Thailand	3.25	0.14	6.13	6.72	0.08	2.88
Average	3.61	0.14	3.15	5.07	2.50	7.02
Median	3.25	0.13	3.16	3.50	2.69	5.99

1/ Units of US\$ to domestic currency. 2/SD of growth in GDP at constant prices (1995Q1 = 100)

Source: Authors' calculation based on IFS data

Addison and Quentin, (2007) maintained that high macroeconomic uncertainty has become a key determinant, as well as consequence of poor investment and economic growth. How these macroeconomic uncertainties affect investment, is an interesting question for many under-developed economies especially Nigeria. Nnanna *et al.* (2004) pointed out that macroeconomic

uncertainty in Nigeria is manifested in high inflation, high interest rates, and high degree of volatility in exchange rates. He stressed that these problems create unfavorable investment climate as investors find it difficult to forecast their rate of returns. Ariyo, (1998) indicated that “our investment climate is characterized by high production costs, inadequate infrastructure and corruption, high rate of crime, spiraling inflation, political and macroeconomic uncertainty”. In line with this, NBS, (2004) and Ukwu, (2005), cited in Asogwa, (2007) emphasized that “Nigeria has continued to experience inconsistent macroeconomic policy, instability and policy reversals, public sector dominance in production and consumption, pervasive rent-seeking, decaying infrastructure and high volatility of macroeconomic aggregates”. The movement of these macroeconomic indicators is shown with the aid of a Table-2.

Table 2: Selected macroeconomic indicators

YEAR	Real GDP Growth	Real Investment Of GDP)	External Debt(% Of GDP)	Interest Rate	Non Oil A % GDP	As Of	Inflation Rate	Market Capitalization As % Of GDP
2004	6.6	7.4	41.9	18	7.8		10.0	16.5
2005	6.5	5.5	18.3	16.2	8.6		11.6	19.5
2006	6.0	8.3	2.4	19.4	9.4		8.5	28.1
2007	6.5	15.3	2.1	17.5	9.5		6.6	56.0
2008	6.4	15.9	2.0	18.6	9.1		15.1	39.7

Source: CBN (2008)

The selected macroeconomic indicators reveal that despite the fact that the average external debt from 2004-2008 dropped to 13%, as a result of debt relief, and average market capitalization increased to 32 %, average non-oil GDP, average real GDP, average inflationary rate and average interest rate have remained at 9%, 6%, 10% and 16%. We also observe that average real investment from 2004-2008 as a percentage of GDP is 10 percent, which is below the minimum investment rate of about 30 percent of GDP required for significant economic development according to CBN, (2004). Addison and Quentin, (2007) also pointed out that “Nigeria’s private sector invested an average only 9 percent of GDP per annum between 1990 and 2005, which is well below the average of 20 percent invested by the world’s fastest growing economies, leading to an average year to year growth in per capita GDP of only 0.2 percent, and a drop in GDP over the period as a whole due to severe losses in the early 1990s”. Bawa and Jibrin, (2007) asserted that the performance of investment and economic growth in Nigeria is abysmally low via the Dutch disease, rent-seeking and corruption. The oil sector still accounts for 90 percent of GDP, while the non-oil sector grows at a marginal rate. These fluctuations in investment and other macroeconomic indicators, combined with lack of diversification for the economy, have raised many questions for economic research. Iyoha, (1998) in his work on determinants of private investment in Nigeria asserted that “private investment can be significantly affected by such factors as macroeconomic instability, macroeconomic policy (monetary, fiscal and exchange rate), the incentive structure and

response to it, uncertainty, irreversibility, and credibility of policy reforms". Furthermore, he asserts that in particular a stable exchange rate regime, will lead to macroeconomic stability, encourage investment and growth. Olaniyan, (2000) in his study of the effects of instability on aggregate investment in Nigeria showed that inflation and the variability of inflation rate are part of the important indicators of macroeconomic instability in Nigeria. The study showed that inflation has a negative and significant impact on investment in Nigeria, and therefore advocates that appropriate measures be taken not only to stem the trend of rising inflation, but also its variability. Okoro, (2006) focused on the impact of inflation uncertainty on private investment in Nigeria and noted that macroeconomic uncertainty as evidenced by a high inflation rate is often correlated with higher variance in relative prices. He stressed that, if this is the case, episodes of high inflation may lead to the misallocation of investment across different sectors in the economy, and consequently impact negatively on the efficiency of investment.

Many researchers have studied private investment and inflation uncertainty, but this work will take a holistic view of other macroeconomic variables like exchange rate, inflation, GDP, interest rate and evaluate their various impacts on private investment in Nigeria. Also, it is yet to be established if the increasing macroeconomic uncertainty on private investment in Nigeria is a short or long-run phenomenon. It is also recorded that Nigeria has implemented some interesting policy reforms like Import Substitution Strategy (ISS), Export Promotion Policy (EPP), Structural Adjustment Program (SAP), National Economic Empowerment Development Strategy (NEEDS) etc., with the hope that non-oil exports and investment will increase and subsequently lead to greater economic growth. However, the outcomes have not been quite encouraging. It seems that some other factors affect investment, beyond the traditional determinants of investment, hence, the need to examine the behavior of private investment in the midst of macroeconomic uncertainty. From the above arguments, this research work will address the following pertinent questions: (a) Does macroeconomic uncertainty affect private investment volatility in Nigeria? (b) Is the impact of macroeconomic uncertainty on the level of private investment in Nigeria a chance variation? The specific objectives of this study are: (1) To estimate the impact of macroeconomic uncertainty on private investment volatility in Nigeria. (2) To estimate the impact of macroeconomic uncertainty on the level of private investment in Nigeria.

WHY THIS STUDY?

In spite of different macroeconomic policies that have been employed to stimulate investment in Nigeria, it is still low relative to other economies. Instead, Nigeria continues to be a mono-product economy, with oil as its major revenue base. The impact of macroeconomic uncertainty on private investment is especially important for a developing economy like Nigeria, which is exposed to terms of trade and exchange rate shocks due to their total dependence on oil, which has a volatile price. It is these shocks that usually transmit into the economy, in the form of adverse investment

and unstable economic growth. In any economy, no economic problem can be solved, without identifying its specific causes. Several cross-country studies have been conducted by different researchers to address these issues but their findings may not be readily applicable in Nigeria. This is largely due to our multi-lingua and diverse socio/cultural heritage. There is therefore, a cogent need to address Nigeria's domestic investment problems by running a country-specific regression. And this will also help us to know the main transmission mechanism through which macroeconomic uncertainty affects private investment in Nigeria. As captured in the Vision 20:2020 document, Nigeria aspires to reduce poverty significantly, achieve some level of economic diversification and join the league of the top twenty most developed economies in the world by the year 2020. Since, investment is an integral component of aggregate expenditure, the result of this study will aid policy makers in formulating policies that will help in calming the tide of private investment and macroeconomic uncertainty in Nigeria. Finally, this study will contribute to existing debates among academics and researchers on the issues of private investment and macroeconomic uncertainty in Nigeria.

THEORITICAL LITERATURE

Theories of investment

There are several theories of investment that can be found in the literature. However, following Ghura and Goodwin, (2000) our theoretical discussion shall be tailored towards four categories. These include: Flexible accelerator model Keynes (1936); Neo-classical model Jorgenson (1971); Tobin's Q model (Tobin, 1969) and the expected profits model (EPM).

Accelerator principle

The accelerator theory is based on the hypothesis that in each period, business firms plan to bridge a fraction of the gap between the desired capital stock and actual capital stock. According to the theory, net investment is a catch-up response to a discrepancy between the desired stock of capital and the actual stock of capital. If output remains unchanged, there will be no need to add to the stock of capital. Net investment will therefore be zero in the absence of growth in output. The level of net investment therefore depends on changes in output. The accelerator principle is therefore, this relationship between the change in the level of net investment and change in output. The fundamental idea behind the flexible accelerator model is that the larger the gap between the desired capital stock and the existing capital stock, the greater a business firm's investment.

Keynesian investment theory and mckinnon-shaw savings-investment hypothesis

The use of interest rate policy in stimulating investment was the theoretical argument of Keynesian investment theory and the McKinnon-Shaw savings and investment hypothesis. They observed that interest rates can have a substantial influence on the rate and pattern of economic growth by

influencing the volume and productivity disposition of savings as well as the volume and productivity of investment. Keynes emphasized that low interest rates encourages people to borrow for investment. He also argued that future interest rates may be known to the wealth-holder because some wealth-holders hold bond and some cash, thereby having an idea of what a normal interest rate should be. He further argued that because of divergent expectations, wealth holders may act differently depending on their expectations about interest rate.

He formalized this relationship by saying that investment is a function of income and interest rate. That is, $I = f(Y, i)$ $F_Y > 0$, $F_i < 0$. This means that increases in income increases investment, while a rise in the rate of interest reduces the level of intended investment. Therefore, when there is an increase in the real interest rate, investment also reduces. Conversely, Mckinnon and Shaw argued that low interest rate is detrimental to savings and hence, investment demand. They also argue that high interest rates induce savings, which can be channeled into investment, while the phenomenon of negative real interest rates over a long period of time results in negative consequences of which include discouragement of savings, (as the true opportunity cost of capital is rarely affected) misallocation of resources, credit rationing by governments, and the promotion of financial or market dualism and capital flight (Onyido, 1997).

Neo-classical model

The neo-classical theory emphasizes that optimal or desired capital stock is proportional to the user cost of capital and output. While the user cost of capital also depends on the interest rate, price of capital goods, structures of tax and depreciation rate. Chrinko, (1993) find that the gap between the actual and desired capital stock results to an investment equation.

Tobin's q model of investment model

Tobin assumed that the investor is uncertain about the future movement of interest rate. He argued that holding of bonds and some other assets involves some degree of uncertainty. Even though, we do not expect either a capital gain or loss, we are nevertheless uncertain about this movement. Such uncertainty creates a real cost to the investor. He proposed that if the marginal utility of income is greater than the marginal disutility of risk, the investor continues to invest, otherwise, he disinvests. This will continue until marginal utility of income equals the marginal disutility of risk. At this point, the investor will stop to invest. He further argued that the ultimate driving force of investment is the ratio of the market value of the existing capital stock to the replacement cost (that is the Q ratio). He maintained that Q depends current and future profits expected from installed capital and that Q is an ideal and sufficient statistic for summarizing all information relevant to a firm's investment decision. Q is calculated by dividing the market value of installed capital by replacement cost of installed capital. If Q is greater than unity, the investor invests, otherwise, he disinvests. This therefore implies that, business firms will want to invest if the replacement cost is less than the increase in the market value of an additional unit.

EXPECTED PROFITS MODEL

The Expected Profits Model rests on the premise that businesses can make investments based on profits and not necessary output. The profit model shows that when business firms make more gross profits, the level of funds generated internally will increase and thus, the rate of investment will also be greater. This argument has also been highlighted by Chirinko, (1993) and Zebib and Muoghalu, (1998). They emphasize that the relationship between profit and investment has different facets. On one side current profit or retained profit can affect investment and on the other hand, variables like output, price and sales which reflect the profit can also affect investment.

Modern theory of investment under uncertainty

The modern theory of corporate finance predicts that when the net present value of a project is positive, such an investment can be undertaken. This is also in line with the neo-classical analysis. However, to make this argument tenable, it is assumed that the investment project must be either reversible or a “now or never” business venture. On the other hand, the value of the project must be totally independent of any known variable that changes with time. Under this theory, business investment opportunities have been known to be irreversible to some certain degrees and certain decisions can be delayed in order to get more information on the underlying uncertain factors that affect their values. The correct decision under such condition entails comparing the value of investing at all possible times in the future with the value of investing today. Since, the “old” theory ignores this comparison of mutually exclusive alternatives; its relevance has been questioned. It is pertinent to note here that Chen, (2003) had argued that the basic issue about this proposition is that the application of the net present value rule to the expected cash flows of the business firm will likely give results that are sub-optimal. The main insight in the new theory of investment is that due to the option value inherent in an investment opportunity, it is not optimal to invest until the present value of the expected cash flows exceed the cost of investment by a strictly positive amount to compensate for the loss of the option. In the literature, the Real Options Approach is another name for this new theory of irreversible investment.

Empirical literature

There is a long standing debate regarding the relationship between macroeconomic uncertainty and private investment. Several empirical works have also been done to ascertain the size and magnitude of this relationship in other countries but no work has empirically examined these issues in Nigeria using our modelling approach. Bertola, (1988) and Pindyck, (1988) was among the early researchers to analyze the optimal irreversible investment policy of a firm facing uncertainty. In their analysis, they considered the case of a business firm operating under decreasing returns to technology, and facing a downward-sloping demand schedule. They concluded that the profitability threshold that must be reached for investment to take place exceeds the user cost of

capital as conventionally computed, and rises with the degree of uncertainty facing the firm. In a study of 47 developing countries for the period 1970-1992, Aizenman and Marion (1995) find a negative relationship private investment and indicators of macroeconomic instability. They analyze such indicators as real exchange rate volatility, inflation volatility and terms of trade volatility. Using a reduced form regression framework, they conclude that these volatility measures contribute significantly to explaining the performance of private investment in those countries studied. In another study Price, (1995) find a negative effect of macroeconomic uncertainty on United Kingdom manufacturing investment lagged twice. He uses ARCH or GARCH measures of macroeconomic variables and the conditional variance of the growth rate of GDP. Iyoha, (1998) in his work on determinants of private investment in Nigeria asserted that “private investment can be significantly affected by such factors as macroeconomic instability, macroeconomic policy (monetary, fiscal and exchange rate), the incentive structure and response to it, uncertainty, irreversibility, and credibility of policy reforms”. He further emphasized that Exchange rate stability will encourage capital inflows in form of foreign private investment and reduce capital flight. He therefore concludes that a stable exchange rate regime will improve growth, encourage investment and lead to macroeconomic stability.

Okoro, (2006) study the impact of inflation uncertainty on private investment in Nigeria. He argued that variance in relative prices is often associated and correlated with a high inflation rate and macroeconomic uncertainty. He emphasized that, if this is the case, episodes of high inflation may lead to the misallocation of investment across different sectors in the economy, and consequently impact negatively on the efficiency of investment. Bleaney and Greenaway, (2001) and Serven, (2002) observe that one of the channels through which macroeconomic shocks affect growth is through a negative impact on private investment, as firm managers are hesitant to invest if future economic conditions are uncertain. They conclude that private investment is negatively affected by real exchange rate volatility. In a sample of developing countries, Serven, (2003) find a significant negative impact of real exchange rate uncertainty on private investment. He use GARCH measures of uncertainty, and observed that the impact is larger at higher levels of uncertainty. Moreover, he argued that the effect of real exchange rate uncertainty on investment is shaped by financial development and the degree of trade openness. Ahmadi *et al.* (2012) study the effect of uncertainty of government’s current expenditures and development expenditures on Private Sector investment in Iran. The study spanned through 1959-2008 and results from the GARCH process show that in the short run, uncertainty of current government expenditures has no significant effect on private sector investment but uncertainty of development government expenditures causes private investment to increase. While in the long run both uncertainty of government’s development expenditures and governments current expenditures have significant negative effect on private investment in the long run. Also, the effect of inflation and GDP are negative and positive respectively both in the long run and in the short run.

METHODOLOGY

Theoretical framework

As argued by many theorists, the expected marginal revenue product of capital plays a significant role in determining the relationship between investment and uncertainty. In a study, Hartman (1972) under the assumption of a convex profit function and risk neutrality reveal that Jensen's inequality endures that the effect of uncertainty on investment is positive. However, Zeira (1987) demonstrate that if one introduces risk aversion, the sign on the effect is ambiguous.

Caballero (1991) derives a negative effect of uncertainty on investment by introducing imperfect competition and/or decreasing return to scale. In their own paper, Aizenmann and Marion, (1999) argue that one can derive a negative link between investment and uncertainty under disappointment aversion or generalized expected utility and/or market imperfections. That notwithstanding, in theoretical literature, there is no general theoretical prediction on the sign of the relationship. Hence, the essence of this research paper.

Variables of the model and their justification

1. Inflation: This measures general increase in price levels. Eberly, (1993) opines that this variable can be taken as a summary measure of the overall macroeconomic stance. Thus, the volatility of its unpredictable component can be used as a proxy or viewed as an indicator of overall macroeconomic uncertainty
2. The growth of output (measured by real GDP) is taken here to represent the unpredictability of demand, which has attracted attention in recent works on investment under uncertainty (Guiso and Parigi, 1998)
3. The real exchange rate is related to the relative profitability of investment in different economic sectors and home market versus foreign market oriented activities. Ceteris paribus, increased volatility of this variable makes price signals less informative about the relative profitability of investment across sectors, likely hampering investment decisions.
- 4) Interest rate: This variable represents the cost or price of borrowing and hence measures the cost of investment.

MODEL SPECIFICATIONS

Model 1: Modelling investment volatility

The GARCH variances are measures of time varying volatility and are more appropriate for modeling highly volatile series. The GARCH model was developed by Bollerslev, (1986) with further inputs by Zakoian, (1990); Nelson, (1991) and Glosten *et al.* (1993). We therefore specify the following GARCH (p, q) model of investment:

$$Y_t = \alpha + \beta X_t + \mu_t \tag{1}$$

$$\mu_t \approx iid N(0, h_t) \tag{2}$$

$$h_t = \gamma_0 + \sum_{i=1}^p \delta_i h_{t-1} + \sum_{j=1}^q \gamma_j \mu_{t-j}^2 + \sum_{m=1}^m \mu_k X_k + \tag{3}$$

Where:

Equation (1) is the mean equation and equation (3) represents the variance equation.

Y_t shows the level of private investment in Nigeria.

X_t denotes a (kx1) vector of explanatory variables, which also includes autoregressive terms of the dependent variables as well.

We note here that the variance equation underscores that the value of the variance scaling parameter h_t depends both on past values of itself, which are captured by lagged h_t terms and on the lagged squared residual terms.

X_t is a set of explanatory variables which includes as its argument, the conditional volatilities of the macroeconomic variables which are used as proxies for uncertainty. These are expected to assist in explaining the variance equation.

Model 2: Modelling the determinants of investment

Our second model is built to enable us estimate the determinants of private investment and also account for the impact of macroeconomic uncertainty on the level of investment. Here, we adapt and modify the regression model used by Serven, (2002) and we specify the model of investment for Nigeria as follows:

$$Inv_t = \alpha_0 + \beta_1 Int_t + \beta_2 GDP_t + \beta_3 GovExp_t + \beta_4 Infl_t + \beta_5 SharePr_t + \alpha_1 InfVol + \alpha_2 ExchVol + \alpha_3 Outputgap + \alpha_4 IntVol + \mu \tag{4}$$

Here inv = private investment at time t

Int = interest rate (measures the cost of investment)

GDP = this variable represents the gross domestic product at time t

GovExp = this stands for government expenditure at time t

Infl = inflation level at time t

Sharepr = index of share prices at time t (a measure of return on investment)

InfVol = inflation uncertainty

ExchVol = this measures exchange rate uncertainty

Outputgap = output gap uncertainty

IntVol = interest rate uncertainty.

The output gap will be calculated using the Hodrick and Prescott filter. Also, following Lee (2002), we calculate uncertainty of other macroeconomic variables from the GARCH variances (Lee, 2002).

Justification that GARCH variances are good proxy for measuring uncertainty

Several authors such as Huizinga, (1993) and Price, (1995) have used ARCH or GARCH measures of macroeconomic variances when modeling investment. For example Huizinga, (1993) considers conditional volatility of United States inflation, real wages and real profit and generally finds a negative effect on investment. Price, (1995) utilizes the conditional variance of the growth rate of GDP and finds a negative effect on United Kingdom manufacturing investment lagged twice. Serven, (2003) using GARCH measures of uncertainty finds a negative and highly significant impact of real exchange rate uncertainty on private investment in a sample of developing countries, after controlling for standard investment determinants. Conditional volatility measures such as GARCH is a better proxy for measuring volatility/uncertainty than a measure of unconditional volatility like moving average standard deviations or sample variability. GARCH models make use of future as well as past information on its construction. Serven, (2003) argued that sample variability does not amount to uncertainty, except when events are unpredictable. He stressed that sample variability may overstate uncertainty by including not only truly unpredictable innovations to the variables of interest, but possibly (cyclical) movement partly predictable from their own past. Greene, (2005) further stressed that another important usefulness of the GARCH specification is that it allows the variance to evolve over time in a way that is much more general than the simple specification of the ARCH model. Byrne and Davis, (2002) pointed out that “conditional volatility measures such as the ARCH or GARCH model highlights periods of concentrated volatility which might be expected to maximize uncertainty and hence the option value of waiting to undertake the investment, while the rolling measures could just be capturing background volatility with occasional outliers that firms learn to live with”.

Bollerslev, (1986) extended Engle’s original work by developing a technique that allows the conditional variance to be ARMA process. GARCH model allows for both autoregressive and moving average components in the Heteroskedastic variance. The rational expectation hypothesis asserts that economic agents do not waste useful information. In forecasting any time series, rational agents use the conditional (a better method of estimating volatility) rather than the unconditional distribution of the series. Thus, the proponents of the rational expectation hypothesis assume that individual economic agents use current available and relevant information in forming their expectations and do not just rely purely upon past experiences. Summarily, the rational expectation hypothesis contends that “expectations are rational” in the sense that they efficiently incorporate all information available at the time the expectation is formulated and not just the past information.

Estimation method

Equation (1.4) shall be estimated using OLS. The time series properties of the data will be examined to determine the appropriate modeling procedure. Where appropriate we shall employ instrumental variable model to reduce possible endogeneity problem. For example, the GDP variable may be correlated with the error term, thus leading to bias estimation of the coefficients. The method of maximum likelihood shall be employed to estimate the GARCH model.

Data sources

We used quarterly data spanning through 1980 -2009 for this work and they were sourced from the Central Bank of Nigeria Statistical Bulletin and other relevant agencies.

PRESENTATION OF RESEARCH RESULTS AND INTERPRETATION OF FINDINGS

In this section, the results of the ordinary least square (OLS) regression are presented. In order to obtain robust and reliable estimates, we subject our variables and parameter estimates to a battery of tests such as statistical and econometric first and second order tests respectively. Following our objectives we estimated three OLS models. These include: Model (1) to ascertain the impact of macroeconomic uncertainty on investment. Model (2) to ascertain the impact of macroeconomic uncertainty on investment uncertainty and Model (3) to estimate the short run error correction model of determinants of investment.

Table 3: Summary statistics of the variables

Variable	Obs	Mean	Std.Dev	Min	Max
Log_gdp	158	11.44543	2.607441	7.199896	15.72439
Log_invest	158	689.3551	0.311259	685.8411	689.6771
Exrate	158	35.22477	50.26176	.535	135.2255
Vol_invest	158	0.268783	2.68458	0.0001684	33.35295
Vol_gdp	158	0.0132262	0.002414	0.000725	0.014353
Vol_exrate	158	28.27066	0.548907	28.22228	35.12447
Log_volinfla	158	4.774928	1.431777	3.295948	8.601146
Log_allshare	100	8.083087	1.9182669	4.721174	11.01786
Log_volallshare	158	14.22357	3.6615464	5.130026	20.122202

Looking at the variables gdp, exrate, invest at the original form, exrate has the highest standard deviation with its mean second to investment. The variable invest has the highest mean but smallest standard deviation, while gdp has the smallest mean with its standard deviation second to exrate. On the other hand, the other variables which include Vol_gdp, Vol_exrateVol_invest, Log_volinfla and Log_vol all share are written with respect to increasing other of mean, with volatility of gdp and volatility of all share having the lowest and highest mean respectively. This also implies that gdp is least volatile while all share is the most volatile.

Table 4: Unit root test of variables used in the model

Variables	Variables at level form			Variables at first difference			Order of integration
Variables	ADF.Stat	Lag	5%	ADF.Stat.	Lag	5%	
Infla	-3.908	1	-2.886	Na	na	na	I(0)
Log_invest	-14.138	1	-2.886	Na	na	na	I(0)
Log_gdp	-0.225	1	-2.886	-11.542	1	-2.886	I(1)
Exrate	0.079	1	-2.886	-8.173	1	-3.492	I(1)
Allshare	-1.899	1	-2.886	-5.306	1	-2.892	I(1)

Table 5: Impact of macroeconomic uncertainty on investment (OLS)

Variable	Coef	Std Err	t	P> t	{ 95% Conf. Interval }	
log invest						
Exrate	-.0001506	.0009052	-0.17	0.868	-.0019391	.0016379
log_volinf	-.0010169	.003374	-0.30	0.764	-.0076836	.005649
vol_gdp	9.141218	1.997552	4.58	0.000***	5.194244	13.08819
vol_exrate	.0068334	.0085639	0.80	0.426	-.0100881	.0237549
vol_invest	-.0398868	.0017407	-22.91	0.000***	-.0433263	-.036447
log_gdp	.4075365	.0415286	9.81	0.000***	.3254799	.4895932
Cons	689.0566	.2455987	2805.62	0.000***	688.5713	689.542
Observation	157					
R2	0.816					
Adjusted R2	0809					
AIC	-439.5					
BIC	-418.1					
F	111.1					

P-values in parentheses

P<0.05, ** p< 0.01, *** p<0.001*

Durbin- Watson d-statistic (7, 157)=1.620594

The unit root test on the variables used is shown in the above Table-4 with some of the variables being integrated at level form while others at their first difference. Inflation and investment are both integrated at their level form because their ADF statistics in absolute forms are greater than their critical values at 5 per cent level of significant. Some other variables such as exchange rate, gdp and all shares appear to have unit root because the absolute values of their ADF statistics are lesser than their critical values at 5 per cent level. At their first difference, they became stationary as their ADF statistics became greater than their critical values at 5 per cent. The result in Table-5 above shows the impact of macroeconomic uncertainty on investment. The result shows that there is a negative relationship between exchange rate and investment though exchange rate did not significantly impact on investment within the period under study. Similarly, the result shows that there is a negative relationship between investment and price fluctuation. As it were, the results show that both output and fluctuation in output impact on investment positively. From the result, for example, we see that 1% increase in the fluctuation of output will lead to approximately 9.3% increase in investment while a 100% increase in output will lead to 40% increase in the level of investment. The result further revealed that fluctuation

in the exchange rate impact positively on investment though negligible. Furthermore, the results reveal that a 100% increase in the fluctuation of exchange rate will lead to approximately 1% increase in investment. Investment volatility (fluctuation in investment) has shown to have negative impact on investment within the period under study. Also, the result indicates that other non- macroeconomic factors impacted positively on investment.

Tests on the Significance of each macroeconomic variable in the model

Table-3 result shows that both output and output volatility (fluctuation in output) have the highest explanatory powers to determine the magnitude of impact of macroeconomic variables on investment. Output and output volatility with positive impact were statistically significant even at 1%. This indicates that there is 100 percent policy relevance of the impact of output volatility on investment. This has policy implications. Although fluctuation in exchange rate impacted positively on investment as shown in the result, it did not significantly affect investment within the period. Hence it has a weak explanatory power. On the other hand, exchange rate and price fluctuation though have negative impact on investment have no significant influence on investment. The R² value of 0.82 shows that fluctuations in exchange rate, price, and output accounted for at least 82% of the variations in investment within the period of study.

The result in Table-6 above shows the impact of macroeconomic uncertainty on investment uncertainty. The result shows that fluctuation in inflation has negative impact on investment. In essence, the result shows that a unit increase in the fluctuation in price will lead to approximately 0.2 unit decrease in the investment uncertainty. Fluctuation in output has also been revealed to have negative impact on the investment uncertainty. For instance, a unit increase in the fluctuation in output will lead to 61.8 unit decrease in the investment uncertainty. Also, the result revealed further that fluctuation in exchange rate has positive impact on investment in uncertainty. The result shows that a unit increase in the fluctuation in exchange rate will lead to an increase in the unpredictability of investment. This implies that as exchange rate becomes more unpredictable, investment equally becomes more unpredictable as well. On the other hand, investment has shown to have negative impact on the unpredictability of investment. In other words, a unit increase in the rate of investment will lead to 8.7 unit decrease in the unpredictability of investment. However, the result revealed that other non-macroeconomic factors impacted positively on the unpredictability of investment.

Table 6: Impact of macroeconomic uncertainty on investment uncertainty

	Investment uncertainty	p-values
Vol_inf.	-0.191	(0,000)***
Log_volinf	-0.00581	(0.928)
vol_gdp	-61.79	(0.013)*

vol_exrate	0.146	(0.170)
infla	-0.00133	(0.788)
log_gdp	-0.0265	(0.249)
L.log_invest	-8.734	(0.000)***
constant	6017.9	(0.000)***
Observations	157	
R2	0.933	
Adjusted R2	0.930	
AIC	347.5	
BIC	371.9	
F	295.9	
P-values in parentheses		
P<0.05,** p< 0.01,*** p<0.001*		
Durbin- Watson d-statistic (8, 157)=1.754828		

In order to examine the explanatory power of the variables included in the model, statistical test of significance was carried out on the variables of study. The result of the statistical test of significance is contained in the third column of Table-3. The result shows that output fluctuation has the highest explanatory variable among the variables under consideration. The result shows that output fluctuation significantly reduces the magnitude of unpredictability of investment at 5%. This shows a 95 percent policy relevance of the impact of output fluctuation on the unpredictability of investment. In the same vein, the result revealed that fluctuation in the price level and investments both significantly reduce investment uncertainty. The result indicates that fluctuation in investment and inflation significantly reduces investment uncertainty even at 1%. This has policy implications. Though exchange rate fluctuation is shown to have positive impact on unpredictability of investment within the period under review, it did not show significant influence. The R² value of 0.933 shows that investment uncertainty, inflation, output volatility and exchange rate fluctuation accounted for about 93% variations in the unpredictability of investment.

The Table-7 above depicts the short run determinants of investment. As shown, interest rate has a positive and significant impact on investment. The coefficient of 0.00337 is the increase in investment resulting from a unit increase in interest rate. Inflation impact on investment is significantly negative, showing that inflation to a certain level is detrimental to investment. As the data show, a 100 per cent increase in inflation lowers investment by 0.102 per cent in the short run. The effect of GDP on investment is significantly positive, showing that higher income enhances investment. A coefficient of 0.731 is the rise in investment following a unit increase in income. The sign of exchange rate suggests that it has a negative impact on investment in the short run but with a very low explanatory power. This implies that exchange rate has no significant impact on investment.

Table 7: Short run error correction model of determinants of investment

	D.Log_Investment	t-statistics
D.Interest	0.00337	(2.02)
Infla	-0.00102	(-5.55)
D.log_gdp	0.731	(17.01)
D.exrate	-0000958	(-1.56)
L.Residual	-0.385	(-6.33)
Constant	-0.0150	(-2.80)
Observations	119	
R ²	0.872	
Adjusted R ²	0.866	
AIC	-431.9	
BIC	-415.3	
F	153.6	

The adjustment parameter which is the coefficient of first lag of the error term (ECM (-1)) and measures the long run equilibrium relationship between the dependent and independent variables is significantly negative as required. It tells how quickly disequilibrium of investment is being restored in the long run. The coefficient of 0.385 for the first lag of the error term indicates that approximately 39 per cent disequilibrium is being corrected at each period. Our research and analysis reveal that exchange rate uncertainty has a negative relationship with investment though its impact is not significant. Inflation uncertainty has a negative relationship with investment but its impact is not significant. Both the output and the fluctuations in output have positive impacts on investment uncertainty. The result shows that investment will rise by 9.3 per cent and approximately 40 per cent following 1 per cent and 100 per cent increase in fluctuation in output and output respectively. Fluctuation in the exchange rate raises investment uncertainty by 1 per cent when it rises by 100 per cent. An increase in the price fluctuation by a unit reduces the uncertainty of investment by 0.2 units. An increase in the fluctuation of output leads to a reduction in the uncertainty of investment. For instance, a unit increase in the fluctuation in output will lead to 61.8 unit decrease in the investment uncertainty. Fluctuation in exchange rate has a negative relationship with investment uncertainty though its impact is not significant. A unit increase in the rate of investment will lead to 8.7 unit decrease in the unpredictability of investment. Interest rate has a positive and significant impact on investment in the short run. If interest rate rises by a unit, investment goes up by 0.00337 units. As inflation rises by 100 per cent in the short run, investment is lowered by 0.102 per cent. Increase in GDP increases investment. For instance, investment rises by 0.731 when GDP increased by 1 unit in the short run.

CONCLUSIONS AND POLICY RECOMMENDATIONS

The study tried to ascertain the impact macroeconomic uncertainty on private investment in Nigeria. This study employed the GARCH model as a proxy for measuring volatility/uncertainty rather than using unconditional volatility. From the models estimated, it was revealed that

uncertainty of most of the macroeconomic variables impact negatively on the private investment except for that of GDP. For instance, the result shows that Exchange rate uncertainty has a negative relationship with investment. Similarly, Ghurra and Grennes, (1993), Pindyck and Solimano, (1993) and Darby *et al.* (1998) in their different works found that exchange rate volatility has a strong adverse impact on the investment/GDP ratio, confirming the fact that uncertainty in exchange rate is detrimental to investment.

Inflation uncertainty has a negative relationship with investment. This result conforms to that of Olaniyan, (2000) and Okoro, (2006) which show that inflation and the variability of inflation rate are part of the important indicators of macroeconomic instability in Nigeria. These studies confirm that inflation has a negative effect on investment in Nigeria. Output and its variability affect investment positively. This did not agree with study by Price, (1995) and Driver and Moreton, (1991) that found negative relationship between investment and output growth. However, the study revealed that inflation rate, interest rate and output are among the factors that determine private investment in Nigeria. Olaniyan, (2000) in his recommendation advocates that appropriate measures be taken not only to stem the trend of rising inflation, but also its variability. Ingersoll and Ross, (1992) suggested that in order to promote investment, the stability of interest rates might be more important than their level. These imply that the stability of the macroeconomic variables provide conducive and enabling environment for private investment to thrive. It is therefore recommended that the monetary authority should review the policy instruments such that appropriate monetary and fiscal policies are adapted to this effect. Also, political stability is highly recommended for macroeconomic stability. This not only stabilizes exchange rate and interest but enhances the flow of foreign direct investment.

REFERENCES

- Addison, D. and Quentin, W. (2007). Macroeconomic Volatility, Private Investment, Growth, and Poverty in Nigeria. World Bank working paper. Washington D. C.
- Ahmadi, L, Samaei, R. T and Alali, S (2012). Uncertainty and Private Investment: Evidence from Iran. *Australian Journal of Basic and Applied Sciences*, Vol. 6, No. 12, pp. 436-444, 2012
- Aizenman, J. and Marion, N. P. (1995). Volatility, Investment and Disappointment Aversion. NBER working paper No. 5386
- Aizenman, J. and Marion, N. P. (1999). Volatility and Investment: Interpreting Evidence from Developing Countries. *Economical Journal*, Vol. 106, pp. 92-105.
- Ariyo, A. (1998). Economic reform and Macroeconomic Management in Nigeria Ibadan: Ibadan University Press.
- Asogwa, F. (2007). Growth and Volatility “Doctoral Dissertation, Department of Economics, University of Nigeria, Nsukka.
- Batini, N. (2004). Achieving and Maintaining Price Stability in Nigeria. IMF working paper

N0.97

- Bawa, S and Jibrin, A. (2007). Natural Resource Abundance and Economic Growth in Nigeria. CBN Economic and Financial Review, Vol. 45, No. 3, September, 2007.
- Bleaney, M. and D. Greenaway. (2001). The Impact of Terms of Trade and Real Exchange Rate Volatility on Investment and Growth in Sub-Saharan Africa. *Journal of Development Economics*, Vol. 65, No. 2, pp. 491–500.
- Bertola, G. (1988). Adjustment Costs and Dynamic Factor Demands: Investment and Employment under Uncertainty. Ph. D. Dissertation, Cambridge, MA: Massachusetts Institute of Technology.
- Bollerslev, T. (1986). Generalized Autoregressive Conditional Heteroskedasticity. *Journal of Econometrics*, Vol. 31, pp. 307-327.
- Byrne, J. P and Davis, E. P. (2002). Investment and uncertainty in the G7, NIESR Discussion Paper. No. 198.
- Caballero, R. (1991). On the Sign of the Investment-Uncertainty Relationship. *American Economic Review*, Vol. 81, pp. 157-79.
- Central Bank of Nigeria (CBN) (2004). Annual Report and Statement of Accounts. *Federal Republic of Nigeria*.
- Chen, J. (2003). An Analytical Theory of Project Investment. A Comparison with Real Option Theory.
- Chirinko, R. (1993). Business fixed investment spending: Modeling strategies, empirical results, and policy implications. *Journal of Economic Literature*, Vol. 31, pp. 1875-1911.
- Darby, J., et al. (1998). The Impact of Exchange Rate Uncertainty on the Level of Investment. CEPR Discussion Paper 1896.
- Demir, F. (2009). Macroeconomic Uncertainty and Private Investment in Argentina, Mexico and Turkey. *Applied Economics Letters*, Vol. 16, No. 6, pp. 567-571.
- Dixit, A. and Pindyck. R. S. (1994). Investment Under Uncertainty. Princeton University Press. Princeton, New Jersey.
- Dornbusch, R., Fischer, S. and Kearney, C. (1996). Macroeconomics. Sydney: The Mc-Graw- Hill Companies Inc.
- Driver, C. and D. Moreton. (1991). The Influence of Uncertainty on UK Manufacturing Investment.” *Economic Journal*, Vol. 101, pp. 1452-1459.
- Eberly, J. (1993). Comment on Pindyck and Solimano. NBER Macroeconomics Annual, 303-312.
- Ghura, D. & Goodwin, B. (2000). Determinants of Private Investment: A Cross Regional Empirical Investigation. *Applied Economics*, Vol. 32 No. 14, pp. 1819-1829.
- Ghura, D. and Grennes, J. T. (1993). The Real Exchange Rate and Macroeconomic Performance in Sub-Saharan Africa. *Journal of Development Economics*, Vol. 42, pp. 155-174, North-Holland.
- Glosten, L. R, Ravi, J. and Runkle, D. E. (1993). On the Relationship between the Expected

- Value and the Volatility of Nominal Excess Return on Stocks. *The Journal of Finance*, Vol. XLVIII, No 5 December
- Greene, W. H (2005). *Econometric Analysis*. Pearson Education, Incorporated 5th Edition
- Guiso, L. and G. Parigi. (1998). Investment and Demand Uncertainty. Mimeo, Banca d' Italia.
- Hartman, R. (1972). The Effects of Price and Cost Uncertainty on Investment. *Journal of Economic Theory*, Vol. 5, No. 258-66.
- Huizinga, H. (1993). Inflation uncertainty, relative price uncertainty and investment in US manufacturing. *Journal of Money, Credit and Banking*, Vol. 25, pp. 521-554.
- Iyoha A. M. (1998). Rekindling Investment For Economic Development In Nigeria: The Macroeconomic Issues; Rekindling Investment For Economic Development In Nigeria. Selected papers in Annual conference, Nigerian Economic Society, Ibadan.
- Ingersoll, J. E. and Ross, A. S. (1992). Waiting to Invest: Investment and Uncertainty. *Journal of Business*, Vol. 65, pp. 1-29.
- Keynes, J. M. (1936). *The General Theory of Employment, Interest and Money*. NY: Harcourt Brace. First Harbinger Edition; Reprinted in 1994.
- Leila A., Roghayeh T. S and Simin, A (2012). Uncertainty and Private Investment: Evidence from Iran. *Australian Journal of Basic and Applied Sciences*, Vol. 6, No. 12, pp. 436-444, 2012
- National Bureau of Statistics (2004) Annual Report and Statement of Accounts. Federal Republic of Nigeria.
- Nnanna, O. J., Eglama, and Idoko, F. O (2004). *Finance, Investment and Growth in Nigeria*. Central Bank of Nigeria, Publications, 2004.
- Okoro, K. (2006). Impact of Inflation Uncertainty on Private Investment in Nigeria. Msc Thesis, Department of Economics, University of Benin.
- Olaniyan O. (2000). The Effects of Instability on Aggregate Investment in Nigeria. *The Nigerian Journal of Social and Economic Studies*, Vol. 42, No. 1, pp. 23-26.
- Onyido B. C. (1997). Interest Rate Policies In ECOWAS Countries: A Comparative Analysis, Bullion Oct. /Nov. Vol.35 No. 1, 1997, Central Bank of Nigeria
- Pindyck, R. S. (1988). Irreversible Investment, Capacity Choice, and the Value of the Firm. *American Economic Review*, Vol. 79, pp. 969-985.
- Pindyck, R. and A. Solimano. (1993). Economic Instability and Aggregate Investment. *NBER Macroeconomics Annual*, Vol. 8, pp. 259-303.
- Price, S. (1995). Aggregate Uncertainty, Capacity Utilization and Manufacturing Investment. *Applied Economics*, Vol. 27, pp. 147-54.
- Price, S. (1996). Aggregate Uncertainty, Investment and Asymmetric Adjustment in the UK Manufacturing Sector. *Applied Economics* Vol. 28, pp. 1369-79.
- Rexford A. (2012). Macroeconomic Uncertainty, Consumer Sentiments, Consumption Expenditures and US Fixed Private Investment Growth. *The Journal of Applied Business Research*, Vol. 28, No. 1, pp. 133-145

- Servén, L. and Solimano. A. (1993). Debt Crisis, Adjustment Policies and Capital Formation in Developing Countries: Where Do We Stand? *World Development*, Vol. 21, pp. 127-140.
- Serven, L. (2002). Real Exchange Rate Uncertainty and Private Investment in Developing Countries. The World Bank Policy Research Working Paper 2823. pp 1-24.
- Serven, L. (2003). Real exchange rate uncertainty and private investment in developing Countries. *Review of Economics and Statistics*, Vol. 85, pp. 212-217.
- Zakoian, J. M. (1990). Threshold ARCH Models and Asymmetries in Volatility. *Journal of Applied Econometrics*, Vol. 8, pp. 31-4.
- Zebib, M. and Muoghalu, M. (1998). Dynamic nature of private investment and its determinants in developing countries. *Studies in Economics and Finance*. Vol. 18, No. 2, pp. 100-110.
- Zeira, J. (1987). Investment as a Search Process. *Journal of Political Economy*, Vol. 95, pp. 204-10.