Pakistan Journal of Applied Economics, Vol. 20 Nos. 1 & 2, (47-65), 2010

MACROECONOMIC UNCERTAINTY AND PRIVATE INVESTMENT IN NIGERIA

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The paper investigates the determinants of aggregate private investment and determines the long-run relationship between macroeconomic uncertainty and aggregate private investment decisions in Nigeria between 1970 and 2006. Cointegration and error correction modeling techniques is adopted in the estimation of aggregate private investment models. The results show that private investment in Nigeria is significantly and positively affected by income, public investment and credit to private sector while it is negatively affected by real interest rates and the size of debt. The paper further reveals that inflation rate, exchange rate and fiscal deficit uncertainties are most detrimental to private investment recovery in Nigeria. The paper concludes that the key to private investment recovery and economic growth in Nigeria is in reducing the overall level of macroeconomic uncertainty.

I. Introduction

One central problem confronting Nigeria is that of unsustainable economic development. The country's economic situation has also been very disappointing. After almost five decades of political independence the country is still being confronted with severe economic problems. These include reduced export earnings, heavy internal debt burden, low savings and investment, growing and disturbing rates of inflation and unemployment, low productivity, fiscal crises and low purchasing power of currency [Ndebbio and Ekpo (1991)]. These problems have also brought about a rapid decline in the overall economy and the standard of living of people in Nigeria.

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Nigeria, like most other developing countries, is in an urgent need of development. Any effort to promote economic development in the country requires that private investment be encouraged. Recovery in private investment has been described as a key factor in sustaining future growth in other developing countries [Levine and Renelt (1992), Chhibber and Pahwa (1994), Schmidt-Hebbel et al. (1996), Chete and Akpokodje (1997), Folorunso and Akinlo (1999)]. Evidence from development experiences also strongly suggests that the best performing countries, even among the developing countries, have achieved better status because of high rates of saving and private investment [Odedokun (1993), Oyejide (1998)]. This finding, in particular, calls for an investigation into the determinants of private investment in developing countries as well as in Nigeria.

The Nigerian government, in an effort to achieve sustainable economic development and for the purpose of attracting private investment, introduced economic reforms through the Structural Adjustment Programme (SAP) of July 1986. The aspects of SAP policy reforms that affected the private investment decisions are exchange rate liberalization, trade liberalization, financial liberalization and price stabilization. Public reforms concerning taxes and public investment were also put in place. For instance, in order to encourage production and actualize investment projects, the government lowered taxes and increased incentives for the productive sector of the economy. In addition to this, the government has also divested and is still divesting its interest in key public sector enterprises.

In recent years, most studies have described uncertainty and instability as major obstacles to investment decisions [Bertola (1988), Pindyck (1991), Rodrik (1991), Bertola and Caballero (1994), Abel and Eberly (1994), Servén (1997)] but the conventional investment theory paid little attention to this fact and to the links between them. In the most recent empirical literature on investment, evidence shows that if investment is costly or impossible to reverse, investors have an incentive to wait by postponing commitment in order to avoid costly mistakes [Dixit and Pindyck (1994), Kumar and Mlambo (1997), Hadjimichael and Ghura (1995), and Servén (2002)]. The empirical evidence, therefore, indicates that no matter how uncertainty is defined, it is a strong obstacle to investment decisions.

The above has important implications for Nigeria in its drive for private investment recovery during the 2010-2020 decade. Given that the optimal investment decisions are determined by the interaction between irreversibility, uncertainty and value option of waiting, the question that readily comes to mind is how private investment decision in Nigeria is influenced by uncertainty. The present study applies a new theoretical approach to private investment decisions which emphasises the effect of macroeconomic uncertainty on aggregate private investment decisions in Nigeria.

The study is organized into five sections. Section II focuses on the review of empirical literature on the effect of uncertainty on investment in both developed and developing countries. Section III presents a model of private investment and discusses the research methodology. Section IV presents the analysis of results while Section V summarizes the conclusions of the study.

II. Review of the Literature

The uncertainty-investment relationship has attracted considerable attention in the theoretical and empirical literature. It has been argued from the theoretical point of view that uncertainty affects investment via different channels, some of which operate in opposing directions. Relative to the theoretical literature, empirical investigations on uncertainty-investment nexus are scanty. In general, empirical studies acknowledge an inverse relationship between uncertainty and investment with some evidence of positive relationships. The overall effect of uncertainty on investment is viewed as ambiguous and indeterminate.

For instance, Hartman (1972) and Abel (1983) find that for a perfectly competitive firm, with a linear homogeneous production function and strictly convex adjustment costs, increased demand uncertainty increases investment. Caballero (1991) views the empirical sign of the relationship between investment and uncertainty as being strongly dependent on the assumptions made. Under the assumptions of asymmetric adjustment costs and irreversibility, the paper establishes that with an infinite industry elasticity of demand, the value of the option to delay disappears and increased firm-specific uncertainty raises investment.

These studies indicate that uncertainty bears a positive relationship with investment at the firm-specific level. Pindyck (1993) reveals that industry-wide, rather than firm-specific uncertainty, may affect the prediction of the uncertainty-investment relationship. Contrary to Caballero (1991) the paper explains that if shocks are industry-wide, the value of the option to delay will no longer be zero and the sign of uncertainty-investment relationship will remain indeterminate.

Most other studies have emphasized the negative effects of macroeconomic volatility on investment. For instance, Leahy and Whited (1996) find a significant negative effect of firm-specific uncertainty on firm's investment but they fail to distinguish between the effects of industry-wide and firm-specific shocks. Ghosal and Loungani (1996) analyse industry-level data and find a significantly negative relationship between uncertainty and investment for low concentrated industries. Servén (1997) also provides a thorough assessment of the uncertainty-investment association, by using a large panel data set on less developed countries. The results reveal a significantly negative relationship between the constructed measures of uncertainty and private investment.

Abel et al. (1996) also explain that investment decision involves the exercise of two options; an option to invest and an option to retain the investment for the future. The paper indicates further that the existence of both options means that a change in uncertainty has an ambiguous effect on the attractiveness of a current investment opportunity. Bohm and Funke (1999) also highlight the importance of irreversibility and uncertainty for investment demand. The paper derives a structural "q-type" investment model which contains the information on the uncertainty effects of random variables that affect the future profitability of firms. The major conclusion of the paper is that the effect of uncertainty upon investment decision is ambiguous. They observe that the necessary condition for any irreversibility-driven negative relationship between investment and uncertainty is the existence of imperfect competition.

Examining whether higher uncertainty increases or reduces the accumulation of fixed capital by firms, Henley et al. (2002) are of the opinion that the effect of the former on the latter is strongly influenced by the nature of the uncertainty in question, i.e., whether the uncertainty is industry-wide or firm-specific. Using British company-level panel data, they show that the predictions on the impact of firm-specific and industry-specific uncertainty will be different. The results also indicate that uncertainty works in an opposing direction with the effect of industry-wide uncertainty being stronger in concentrated industries.

Evidence from the literature clearly indicates that the option to invest by private sector is confirmed to be highly sensitive to a number of uncertainty measures. Nigeria, like any other developing country, is suffering from a high degree of macroeconomic uncertainty [Uchendu (1993), Servén (1997)]. Macroeconomic variables such as growth and inflation as well as relative prices such as real exchange rates and real interest rates indicate high variability. Given that the macroeconomic policy in Nigeria is particularly stable, the consequence of such volatility is very grave on the private investment decisions. The question of interest is how uncertainty affects private investment decisions in such a highly uncertain economy.

Addressing this issue, Busari and Olaniyan (1998) consider the impact of some dimensions of uncertainty on investment rates in Nigeria. The paper observes that in a bivariate framework, inflation uncertainty and fiscal deficit uncertainty impact negatively and significantly on private investment decisions. The results however show a weak negative relationship between exchange rate uncertainty and private investment. Also the results of a multivariate extension of the model adopted are not statistically different from the bivariate analysis. The Langrange Multiplier (LM) tests, F-tests and ARCH tests, to which the preferred equations were subjected, produced some conflicting results. This may be as a result of the faulty econometric approach adopted by the authors. The authors confirm the presence of unit root in all the series but fail to test for the possible existence of cointegration among the series. Also, recent advances in investment studies have been examining the uncertainty-investment nexus emphasising investment irreversibility.

Servén (2002) indicates that the effects of uncertainty operate in mutually opposing directions and the magnitudes depend on a variety of factors identified in the economic literature. The reviewed studies clearly show that the effect of uncertainty strongly depends on the type of uncertainty and how it is being measured. This finding indicates that the uncertainty-investment relationship is still ambiguous and the only way to resolve it is to verify it empirically. Empirical investigations on uncertainty-investment relationship are still scanty in Nigeria. In addition, most of the existing studies are cross-country studies and findings of studies of that nature should be interpreted with caution. One way out, as suggested by Mlambo (1997), requires more country-specific case studies. Using aggregate measures of uncertainty, this paper examines the relationship between macroeconomic uncertainty and aggregate private investment in Nigeria.

III. Research Methodology

1. The Aggregate Private Investment Model Specification

In order to determine the effect of uncertainty on private investment in Nigeria, the adopted investment model is derived from the minimization of a quadratic cost or loss function as discussed by Nickell (1985) and Henry and Minford (1988). The private sector optimisation problem is to minimize the expected costs associated with adjusting actual private investment (PINV) to the desired level of investment ($PINV^d$). Rather than the ad hoc or partial adjustment procedure, it is assumed that the process by which the private sector adjusts from actual to desired level of investment follows an error correction mechanism which is then expressed as:

$$Min \sum_{t=0}^{\infty} \left[a_1 (PINV_t - PINV_t^d)^2 + a_2 (PINV_t - PINV_{t-1})^2 \right] \qquad (1)$$

The quadratic cost or loss function adapted from the work of Nickell (1985) and Henry and Mindford (1988) as indicated in equation (1) shows that the ECM can be derived from the minimisation of inter-temporal quadratic loss function by incorporating backward-looking behaviour ($PINV_t - PINV_{t-1}$) by private investors. Equation (1) thus indicates that the private investor's inter-temporal optimisation problem is to minimise the expected costs associated with adjusting the actual private investment ($PINV_t$) to the desired level of investment ($PINV_t^d$) over an infinite horizon.[1]

The basic aggregate private investment specification considered in this study thus becomes:

$$\begin{aligned} \Delta PINV_t = {} & \beta_0 + \beta_1 \Delta GINV_t + \beta_2 \Delta GDP_t + \beta_3 \Delta RINT_t + \beta_4 \Delta CPRIV_t + \\ & \beta_5 DEBT_t + \beta_6 UNC_t + \beta_{01} ECM_t + \beta_{02} \Delta PINV_{t-1} + e_t \\ & \beta_1 > 0, \beta_2 > 0, \beta_3 < 0, \beta_4 > 0, \beta_5 < 0, \beta_6 < 0, \beta_{01} < 0, \beta_{02} > 0 \qquad (2) \end{aligned}$$

The operational definitions of the series employed (measured in logarithm form) are:

PINV is measured by the Naira value of aggregate private investment,
GINV is measured by the Naira value of aggregate government investment,
GDP is the aggregate demand measured by the real Gross Domestic Product,
RINT is measured as the real interest rate (Nominal interest rate less inflation rate),
CPRIV is the aggregate credit to the private sector by the financial institution,
DEBT is stock of both the internal and external debt outstanding.

[1]Detail of derivation of estimated specification of Aggregate Private Investment Function are presented in Appendix-A.

2. The Estimation Techniques

The annual time series data employed in the estimation of equation (2) covers the period 1970 to 2006. Data were gathered mainly from the Statistical Bulletin published by the Central Bank of Nigeria and the International Finance Corporation (IFC) publication. The properties of the time series were first examined in order to avoid cases of spurious regressions [Engle and Granger (1987)]. Both the Augmented Dickey-Fuller (ADF) and Phillip-Perron (PP) unit root tests were applied to each of the time series.

Following the unit root tests, cointegration tests were conducted. The intuition behind cointegration is that even if time series are non-stationary, there may still exist a set of linear combinations of such time series that are stationary. Cointegration tests were applied to the residuals of the static long run regressions with the use of ADF and PP tests. If cointegration exists among time series, then the deviations from the long run path are stationary and this implies the existence of a long run relationship. The evidence of stationarity of the residuals indicates that the variables in the model are indeed cointegrated. However, time series can only be cointegrated if they are integrated of the same order. The next step was the estimation of error correction modeling suggested by Engle and Granger (1987). The authors have shown that any cointegrated series have an error correction mechanism (ECM) representation. The study therefore employed ECM techniques by combining both the short run and long run model specification of the form in equation (2) above.

Rather than using simple sample variability as measure of uncertainty, uncertainty measures using Auto Regressive Conditional Heteroscedastic (ARCH) models introduced by Engle (1983), which explicitly recognize the difference between the conditional and the unconditional variance; were employed. In this case, the conditional variance consists of random variables in the conditioning set, such as past variances while, unconditional variance being equal to the conditional variance plus error term. Specifically, the p^{th} order of ARCH model of a data generating process can be formulated using the relations below:

$$\pi_t = \pi_{t-1} + \varepsilon_t \tag{3}$$

$$\varepsilon_t^2 = h_t + e_t \tag{4}$$

$$h_t = E(\varepsilon_t^2 \backslash I_{t-1}) = \alpha_0 + \alpha_1\varepsilon_{t-1}^2 + \alpha_2\varepsilon_{t-2}^2 + \ldots + \alpha_p\varepsilon_{t-p}^2 \tag{5}$$

where the information set, I_{t-1}, includes all information available through time t-1 and it is assumed to be white noise. The unconditional variance, ε_t^2, is interpreted as variability measure and the conditional variance, h_t, is interpreted as an uncertainty measure. Final Predictive Errors (FPE) statistic was employed in determining the p^{th} order. Given the small sample size of the data used, ARCH model of order two satisfied our selection criterion.

IV. Analysis of Results

1. Unit Root and Cointegration Test Results

The results of the unit root tests are reported in Table 1. All measures of macroeconomic uncertainty; inflation rate uncertainty (UINF), exchange rate uncertainty (UEXR), broad money supply growth rate uncertainty (UMS), fiscal balance uncertainty (UFB), income growth rate uncertainty (UGDP) and real interest rates (RINT) were found to be stationary in levels. They are I(0) series as the reported t-statistics of all the six macroeconomic uncertainty proxies and real interest rates are smaller than the 5 per cent MacKinnon critical t-values for rejecting the non-stationarity hypothesis. The implication of I(0) results is that the levels, rather than the first difference values, of the series should be employed in modeling private investment. However, performing ADF and PP tests on private investment series and its identified determinants show that the null hypothesis of non-stationarity could not be rejected as these series are non-stationary at 10 per cent level of significance (Table 1). In general, the results of unit root tests are consistent with the presence of a unit root in private investment (PINV), public investment (GINV), income (GDP), credit to the private sector (CPRIV) and debt (DEBT) series (measured in log form) indicating that they are non-stationary in levels. These variables are, therefore, not regarded as I(0) series. The evidence of the non-stationarity of these series is graphically presented in Appendix-B.

The results in Table 1, however, confirm that differencing only once was all that was required to convert these non-stationary series into stationary. All series are confirmed to be stationary in first difference by the ADF and PP tests results. Specifically, private investment, public investment, income, credit to private sector and debt series achieved stationarity in first difference at 10 per cent level of significance. Thus, the variables are regarded as I(1) series implying that adequate and reliable results can only be achieved if first differences, rather than levels, of these variables are employed in aggregate private investment modeling as expressed in equation (2).

The results of applying ADF and PP tests for detecting a unit root in the residuals of the long run relationship between aggregate private investment and its identified determinants indicate that all private investment determinants cointegrated with private investment series. When uncertainty measures are included, the unit root test results indicate evidence of cointegrating vector. The reported ADF and PP t-values for detecting a unit root in the residual series of private investment regressions are –4.5465 and –7.9543 respectively. Given the 5 per cent critical t-values of –3.5514 and –3.5468 for ADF and PP respectively, the results indicate that private investment cointegrated with all the series and therefore there exists a linear combination between aggregate private investment and all the time series employed. Hence, private investment cointegrated with public investment, income, real interest rate, credit to private sector, debt and macroeconomic uncertainty indicators during the period under study.

TABLE 1

Unit Root Test Results for Annual Series

Series	Level		First Difference		Remarks
	ADF	PP	ADF	PP	
Private Investment (PINV)	-2.0576	-1.7920	-3.6157**	-3.7445**	I(1)
Public Investment (GINV)	-1.7353	-1.8495	-3.6640**	-5.4574***	I(1)
Income (GDP)	-2.0258	-3.0569	-7.0432***	-9.3649***	I(1)
Real Interest Rate (RINT)	-3.7191**	-3.6874**	–	–	I(0)
Credit to Private Sector (CPRIV)	-2.2278	-2.2187	-3.7984**	-4.8858***	I(1)
Debt (DEBT)	0.4832	0.5895	-3.3067*	-3.3330*	I(1)
Level of Significance	MacKinnon critical values for rejection of a unit root hypothesis				
1 per cent	-4.2412	-4.2324	-4.2505	-4.2412	–
5 per cent	-3.5426	-3.5386	-3.5468	-3.5426	–
10 per cent	-3.2032	-3.2009	-3.2056	-3.2032	–
N	35	36	34	35	–
Inflation Uncertainty (UINF)	-3.6536**	-5.0581***	–	–	I(0)
Exchange Rate Uncertainty (UEXR)	-4.1308**	-5.8973***	–	–	I(0)
Money Supply Uncertainty (UMS)	-4.9082***	-3.8929**	–	–	I(0)
Fiscal Balance Uncertainty (UFB)	-5.2293***	-5.8663***	–	–	I(0)
GDP Growth Uncertainty (UGDP)	-4.9692***	-6.3848***	–	–	I(0)
Interest Rate Uncertainty (UINT)	-4.0294**	-4.1315**	–	–	I(0)
Level of Significance	MacKinnon critical values for rejection of a unit root hypothesis				
1 per cent	-4.2605	-4.2505	–	–	–
5 per cent	-3.5514	-3.5468	–	–	–
10 per cent	-3.2081	-3.2056	–	–	–
N	33	34	–	–	–

***significant at 1% level of significance, **significant at 5% level of significance,
* significant at 10% level of significance.

2. Error Correction Modeling Results

The results of the estimated ECM models reported in Table 2 clearly show a well-defined error correction term (ECM) which indicates a feedback of close to unity of the past level's disequilibrium from the long run elasticity of aggregate

TABLE 2

Modeling Aggregate Private Investment ($\Delta PINV_t$)

VARIABLES	MODEL 1	MODEL 2	MODEL 3	MODEL 4	MODEL 5	MODEL 6
$\Delta PINV_{t-1}$	1.01 (4.97)***	0.80 (4.89)***	0.97 (4.67)***	1.06 (4.36)***	1.02 (4.99)***	0.98 (4.56)***
CONSTANT	0.49 (0.65)	-0.68 (1.05)	0.05 (0.20)	0.24 (0.90)	0.49 (1.35)	0.09 (0.32)
$\Delta GINV_t$	0.75 (3.72)***	0.54 (3.57)***	0.56 (4.01)***	0.50 (3.40)***	0.53 (3.59)***	0.49 (3.19)***
$\Delta GINV_{t-1}$	-0.42 (2.14)**	-0.36 (2.01)**	-0.09 (0.49)	-0.25 (1.28)	-0.31 (1.87)*	-0.33 (1.86)*
ΔGDP_t	-0.30 (1.18)	0.24 (0.82)	-0.28 (0.89)	0.37 (1.28)	0.32 (1.17)	-0.45 (1.68)*
ΔGDP_{t-1}	0.92 (2.72)**	0.96 (2.74)**	0.58 (1.78)*	0.95 (2.75)**	0.55 (1.29)	0.97 (2.78)**
$RINT_t$	0.006 (2.34)**	0.008 (3.06)**	0.009 (3.12)***	0.007 (2.75)**	0.008 (3.05)**	0.008 (2.10)**
$RINT_{t-1}$	-0.009 (2.83)**	-0.011 (3.10)**	-0.01 (3.53)***	-0.008 (2.87)**	-0.009 (3.09)**	-0.009 (2.82)**
$\Delta CPRIV_t$	-0.03 (0.09)	0.04 (0.12)	-0.39 (1.03)	0.04 (0.12)	-0.13 (0.39)	-0.05 (0.15)
$\Delta CPRIV_{t-1}$	0.31 (1.94)*	0.25 (1.80)*	-0.12 (0.31)	0.21 (0.64)	0.29 (1.96)*	0.12 (0.38)
$\Delta DEBT_t$	0.10 (0.84)	-0.07 (0.57)	0.05 (0.43)	-0.005 (0.05)	-0.009 (0.08)	0.02 (0.21)
$\Delta DEBT_{t-1}$	-0.08 (1.89)*	-0.14 (1.66)*	-0.08 (1.97)*	-0.11 (1.69)*	-0.10 (1.98)*	-0.18 (1.80)*
$UINF_t$	0.0001 (0.15)	–	–	–	–	–
$UINF_{t-1}$	-0.0015 (1.67)*	–	–	–	–	–
$UEXR_t$	–	0.29 (1.15)	–	–	–	–
$UEXR_{t-1}$	–	-0.31 (1.76)*	–	–	–	–
$UINT_t$	–	–	0.002 (1.01)	–	–	–
$UINT_{t-1}$	–	–	-0.015 (2.01)**	–	–	–

(continued)

TABLE 2
(continued)

VARIABLES	MODEL1	MODEL2	MODEL3	MODEL4	MODEL5	MODEL6
UMS	–	–	–	0.06 (0.57)	–	–
UMS_{t-1}	–	–	–	-0.07 (1.76)*	–	–
$UGDP_t$	–	–	–	–	-0.0005 (1.68)*	–
$UGDP_{t-1}$	–	–	–	–	0.0001 (0.19)	–
UFB_t	–	–	–	–	–	0.00002 (0.53)
UFB_{t-1}	–	–	–	–	–	-0.00005 (1.75)*
ECM_{t-1}	-0.93 (3.71)***	-0.95 (3.78)***	-0.96 (3.45)***	-0.94 (3.62)***	-0.89 (3.64)***	-0.86 (3.53)***
R^2	0.84	0.84	0.86	0.83	0.85	0.83
F-Ratio	4.41 (0.047)	4.25 (0.006)	5.10 (0.003)	4.04 (0.007)	4.54 (0.004)	4.04 (0.007)
Σ	0.1683	0.1718	0.1589	0.1754	0.1671	0.1754
DW	1.89	1.91	2.05	2.20	1.86	1.95

Absolute t-values in parentheses. *** significant at 1% level of significance. ** significant at 5% level of significance. * significant at 10% level significance.

private investment (PINV). The implication of this is that income (GDP), user cost of capital (RINT), public investment (GINV), credit to private sector (CPRIV), debt (DEBT) and uncertainty variables maintain private investment equilibrium through time. The effects of these "disequilibrium" error corrections are not only large but also have negative sign as expected [Engle and Granger (1987), Henry and Minford (1988), Servén (2002)]. The strong significance of the coefficient of lagged-ECM supports the earlier assertion that the private investment series and all the standard private investment determinants are cointegrated. The coefficient of determination (R^2) is as high as 0.83 for all models while the F-statistics also show that the private investment series and its determinants are linearly related, indicating the overall high explanatory power of the models. The Durbin-Watson (DW) statistics show no evidence of autocorrelation in the residuals.

The results in Table 2 indicate that the current level of public investment ($\Delta GINV_t$) has a significant positive coefficient while its lagged value ($\Delta GINV_{t-1}$) has a significant negative coefficient in all models. The positive effect of the current value, however, outweighs the negative effect of its lagged value. This result partially suggests a "crowding in" effect of public investment, indicating that public sector, concentrated on investment projects that complement private investment projects in Nigeria. The result of the study also show that the coefficient of the cost of capital variable, is statistically significant. The measure of user cost of capital, proxied by real interest rate (RINT), has the expected negative sign for its lagged level ($RINT_{t-1}$) while it has a positive sign on its current level ($RINT_t$) which is significant at the 5 per cent level of significance. The negative lagged effect marginally outweighs the positive current effect for all models. It follows, therefore, that lower real costs of capital stimulate private investment while higher costs discourage private investors.

The coefficients of income variable indicate that lagged income (ΔGDP_{t-1}) variable has the right positive sign and is statistically significant at 5 per cent level of significance while the coefficient of the current income variable is insignificant negative sign in all models. The results, therefore, confirm the significance of income variable as one of the determinants of investment in Nigeria. The coefficients on lagged private investment ($\Delta PINV_{t-1}$) was also found to be positive and highly significant in all the models. Thus, the investment climate, measured by past investment, constitutes a good indicator for current private investment decisions in Nigeria.

The effect of credit to the private sector is mixed. For instance, the coefficient of lagged credit to the private sector ($\Delta CPRIV_{t-1}$) has a positive sign which is significant at 10 per cent level in some models and insignificant in others. The coefficients of the current levels ($\Delta CPRIV_t$) are negative in some models and positive in others but these effects are insignificant in all models. This implies that it takes sometime before the availability of credit to private sector, impacts positively on private investment spending. The results in general strongly support the claim that the problem of getting credit by private sector is a major hindrance to private investment in Nigeria. As regards the effect of debt on private investment, the lagged value of debt variable ($\Delta DEBT_{t-1}$) has the correct negative sign which is significant at 10 per cent level of significance for models 1 and 2 only. The coefficient of its current level ($\Delta DEBT_t$) has a positive but insignificant sign in all the models.

The results in Table 2 clearly indicate that macroeconomic policy uncertainty is a major obstacle to private investment recovery in Nigeria. All individual components of the overall measure of uncertainty have significant negative sign for all lagged values at 10 per cent level of significance, except for economic growth uncertainty that bears significant negative effect at its current level. The results also show that uncertainty matters a lot, no matter how it is defined, and is a serious obstacle to private investment decisions in Nigeria. Indeed, uncertainty may matter so much as to render some of the traditional determinants of investment, like the user cost, credit to private sector and level of debt insignificant. It is also observed that individual measure of macroeconomic uncertainty may not be a powerful investment obstacle but private investment is dampened by overall macroeconomic uncertainty.

V. Conclusions

The study investigated the determinants of aggregate private investment in Nigeria, focusing on the effects of six different dimensions of macroeconomic uncertainty. Annual time series analysis was used and the analysis covered the period 1970 to 2006. The data used in the analysis were obtained from the Statistical Bulletin of the Central Bank Nigeria and the International Finance Corporation. Error Correction Modeling (ECM) techniques were adopted in the estimation of the specified private investment models. Rather than sample variability or standard variations, the study relied on approximating indicators for uncertainty as determined by the conditional variance from uni-variate ARCH procedure for six macroeconomic variables; inflation rate, exchange rate, interest rate, GDP growth rate, money supply growth rate and fiscal balance.

The study concluded that significant macroeconomic variables that affected private investments include the previous private investment level, income, public investment, real interest rates, credit to private sector and debt variables. In addition, the availability of credit to private sector of the Nigerian economy has been a major obstacle to private investment. Also, private and public investments were found to be complementary. However, the high debt value and the accumulation of high level of external debt constituted a strong deterrent to the recovery of private investment in Nigeria. These macroeconomic factors were, however, not sufficient enough to explain the private investment trend witnessed during the 1970-2006 period.

The major conclusion of the study is that the macroeconomic uncertainty indicator is an additional determinant of the aggregate private investment level in Nigeria. Uncertainty negatively affected investment expectations of the private sector. Frequent changes and inconsistencies in macroeconomic policies created real and imaginary fears in the mind of private investors. The overall state of mistrust and uncertainty in the country strongly deterred the investment conditions and climate. The overall effect of uncertainty on private investment is, therefore, negative. The effect and magnitude of uncertainty, however, largely depend on the way in which the uncertainty indicators are defined.

The study concluded that the negative relationship between uncertainty and private investment is causal rather than coincidental and so higher uncertainty will usually lead to lower private investment. Public sector would only promote growth by providing a lead as well as creating conducive environment for private investors to come forward and invest. The key to future recovery in investment from private sector and growth, to a larger extent, lies in the reduction of macroeconomic uncertainty.

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References

Abel, A.B., 1983, Optimal investment under uncertainty, The American Economic Review, 73: 228-233.

Abel, A.B., and J. C. Eberly, 1994, A unified model of investment under uncertainty, The American Economic Review, 84: 1369-1384.

Abel, A.B., A. Dixit, J.C. Eberly and R.S. Pindyck, 1996, Options, the value of capital and investment, Quarterly Journal of Economics, 111(3): 753-777.

Asogu, J.O., 1997, Quarterly interpolation of Annual Statistical Series using robust non-parametric methods, CBN Economic and Financial Review, 35(2): 154-170.

Bertola, G., 1988, Adjustment costs and dynamic factor demands: Investment and employment under uncertainty, Ph.D. Dissertation, Cambridge: Massachusetts Institute of Technology.

Bertola, G., and R.J. Caballero, 1994, Irreversibility and aggregate investment, Review of Economic Studies, 61: 223-246.

Bohm, H., and M. Funke, 1999, The uncertainty-investment relationship, Quantitative Macroeconomics working papers series, Hamburg: Hamburg University.

Busari, T.D., and O. Olaniyanm 1998, Aggregate investment and policy uncertainty: Evidence from Nigeria, in: Rekindling investment for economic development in Nigeria, NES selected papers for the 1998 Annual Conference, : 457-473.

Caballero, R.J., 1991, On the sign of the investment-uncertainty relationship, American Economic Review, 81: 279-288.

Central Bank of Nigeria, 2007, Statistical Bulletin, CBN, Nigeria.

Chete, L.N., and G. Akpokodje, 1997, Macroeconomic determinants of domestic private investment in Nigeria: An empirical exploration, CBN Economic and Financial Review, 35(1): 43-57.

Chhibber, A., and S. Pahwa, 1994, Investment recovery and growth in Nigeria: The case for debt relief, in: African debt burden and economic development, NES selected papers for the 1994 Annual Conference, : 115-140.

Dixit, A., and R.S. Pindyck, 1994, Investment under uncertainty, Princeton, New Jersey: Princeton University Press.

Engle, R.F., 1983, Estimates of the variance of US inflation based upon the ARCH model, Journal of Money, Credit, and Banking, 11: 122-150.

Engle, R.F., and C.W.J. Granger, 1987, Cointegration and Error-Correction: Representation, estimation and testing, Econometrica, 55: 251-276.

Folorunso, B.A., and A.E. Akinlo, 1999, Determinants of private investment in Nigeria: Statistical evidence, Ife Social Sciences Review, 17(2): 137-145.

Ghosal, R., and P. Loungani, 1996, Product market competition and impact of price uncertainty on investment: Some evidence from US manufacturing industries, Journal of Industrial Economics, 44(2): 217-228.

Hadjimichael, M.T., and D. Ghura, 1995, Public policies and private savings and investment in Sub-Saharan Africa: An empirical investigation, IMF working paper WP/95/19.

Hartman, R., 1972, The effects of price and cost uncertainty on investment, Journal of Economic Theory, 5: 258-266.

Henley, A., A.A. Carruth and A.P. Dickerson, 2002, Industry-wide versus firm-specific uncertainty and investment: British company panel data evidence, Working paper, : 1-10.
Henry, S., and M. Minford, 1988, United Kingdom manufacturing investment in the 1980's: Some estimates using error correction model, National Institute of Economic Research, Discussion paper no. 137.
International Finance Corporation (IFC), Annual reports, various years.
Jorgensen, R.G., 1963, Capital theory and investment behavior, American Economic Review, 53: 247-259.
Khan, M., and C. Reinhart, 1990, Private investment and economic growth in developing countries, World Development, 18: 19-27.
King, R.G., and R. Levine, 1994, Capital fundamentalism, Economic development and economic growth, Carnegie-Rochester conference series on public policy, 40: 258-300.
Kumar, M.S., and K. Mlambo, 1997, Determinants of private investment in Sub-Saharan Africa: An empirical investigation, Journal of African Economies, 6(2): 231-254.
Leahy, J.V., and T.M. Whited, 1996, The effects of uncertainty on investment: Some stylized facts, NBER working paper no.4986.
Levine, R., and D. Renelt, 1992, Sensitivity analysis of cross-country growth regressions, American Economic Review, 82(4): 942-963.
Mlambo, K., 1997, Comments on irreversibility, uncertainty and private investment: Analytical issues and some lessons for Africa, by L. Servén, Journal of African Economies, AERC Supplement, 6(3): 269-271.
Ndebbio, J.E.U., and A.H. Ekpo, 1991, Periscoping the Nigerian economy: The Nigerian economy at the crossroads: Policies and their effectiveness, Calabar, Nigeria: University of Calabar Press.
Nickell, S., 1985, Error correction, partial adjustment and all that: An expository note, Oxford Bulletin of Economics and Statistics, 47(2): 119-129.
Odedokun, M.O., 1993, Factors responsible for the poor performance of Africa in the 1970s and 1980s: A cross-sectional evidence from 42 countries, African Development Review, 5(1): 23-61.
Oyejide, T.A., 1998, Using trade and industrial policies to foster African development: Some perspective on issues and modalities, Journal of African Economies, 7: 34-42.
Pindyck, R.S., 1991, Irreversibility, uncertainty and investment, Journal of Economic Literature, 29: 1110-1148.
Pindyck, R.S., 1993, A note on competitive investment under uncertainty, American Economic Review, 83(1): 273-277.
Rodrik, D., 1991, Policy uncertainty and private investment in developing countries, Journal of Development Economics, 36: 229-242.
Schmidt-Hebbel, K., L. Servén and K. Solimano, 1996, Saving and investment: Paradigms, puzzles, policies, The World Bank Research Observer, 11: 87-117.
Servén, L., 1997, Irreversibility, uncertainty and private investment: Analytical issues and some lessons for Africa, Journal of African Economies, AERC supplement, 6(3): 229-268.

Servén, L., 2002, Real exchange rate uncertainty and private investment in developing countries, World Bank policy research paper 2823.
Uchendu, A.D., 1993), Interest rate policy, savings and investment in Nigeria, CBN Economic and Financial Review, 31(1): 34-52.

APPENDIX - A

The Aggregate Private Investment Model Specification

In order to determine the effect of uncertainty on private investment in Nigeria, the investment model adopted is derived from the minimization of a quadratic cost or loss function as discussed by Nickell (1985) and Henry and Minford (1988). The private sector optimization problem is to minimize the expected costs associated with adjusting actual private investment (PINV) to the desired level of investment (*PINVd*). Rather than the adhoc or partial adjustment procedure, it is assumed that the process by which the private sector adjusts from actual to desired level of investment follows is an error correction mechanism which is then expressed as:

$$Min \sum_{t=0}^{\infty} \left[a_1 (PINV_t - PINV_t^d)^2 + a_2 (PINV_t - PINV_{t-1})^2 \right] \qquad (1)$$

The quadratic cost or loss function adapted from the work of Nickell (1985) and Henry and Mindford (1988) as indicated in equation (1) shows that the ECM can be derived from the minimization of inter-temporal quadratic loss function by incorporating backward-looking behaviour ($PINV_t - PINV_{t-1}$) by private investors. Equation (1) thus indicates that the private investor's inter-temporal optimization problem is to minimize the expected costs associated with adjusting the actual private investment ($PINV_t$) to the desired level of investment ($PINV_t^d$) over an infinite horizon.

Differentiating equation (1) with respect to private investment in a single-period t, ($PINV_t$) and backward single-period *t-1*,($PINV_{t-1}$) and equating the sum of the derivative to zero will yield the following:

$$2a_1(PINV_t - PINV_t^d) + 2a_2(PINV_t - PINV_{t-1}) + 2a_1(PINV_{t-1} - PINV_{t-1}^d) + 2a_2(PINV_{t-1} - PINV_{t-2}) = 0$$

Dividing through by 2, we have:

$$a_1(PINV_t - PINV_t^d) + a_2(PINV_t - PINV_{t-1}) + a_1(PINV_{t-1} - PINV_{t-1}^d) + a_2(PINV_{t-1} - PINV_{t-2}) = 0$$

Defining Δ as difference operator, we have:

$$a_1 \Delta PINV_t^d + a_2 \Delta PINV_t + a_1(PINV_{t-1} - PINV_{t-1}^d) + a_2 \Delta PINV_{t-1} = 0$$

Rearranging the above equation by making $\Delta PINV_t$ as the subject of formula yields the following error correction model:

$$\Delta PINV_t = -\frac{a_1}{a_2} \Delta PINV_t^d - \frac{a_1}{a_2} (PINV_{t-1} - PINV_{t-1}^d) - \frac{a_2}{a_2} \Delta PINV_{t-1}$$

Taking $a_0 = -\frac{a_1}{a_2}$; $a_1 = -\frac{a_1}{a_2}$; and $a_2 = -\frac{a_2}{a_2}$ we have:

$$\Delta PINV_t = a_0 \Delta PINV_t^d + a_1 (PINV_{t-1} - PINV_{t-1}^d) + a_2 \Delta PINV_{t-1} \qquad (2)$$

Equation (2) implies that private investment responds to changes that occurred in the previous period ($\Delta PINV_{t-1}$), as in the case of partial adjustment models, and to changes in the desired level of investment ($\Delta PINV_t^d$). The second term, ($PINV_{t-1} - PINV_{t-1}^d$), captures the divergence from the long run equilibrium as private sector responds to new information due to uncertainty and irreversibility of most private investment projects.

It is further assumed that the private sector chooses a desired level of investment ($PINV_t^d$) that will meet the desired level of private capital stock (KP_t^d) where the relationship between the desired level of investment and the desired capital stock by private sector is defined conventionally as:

$$PINV_t^d = Kp_t^d - (1 - \delta) K_{t-1}, \text{ where } \delta = \text{rate of depreciation} \qquad (2a)$$

Actual private capital stock (KP), however, depends on a distributed lag of the past determinants of desired private investment ($PINV^d$). At the aggregate level, the major hypothesized determinant of desired private investment, according to both the Keynesian and Neoclassical view, is expected profit (P^e) which in turn, as it has been found in empirical literature, is a function of aggregate demand (GDP) and the user cost of capital (COST) which is expressed as:

$$PINV^d = f(P^e) = f(GDP, COST) \qquad (2b)$$

User cost of capital is a function of the domestic real interest rate *(RINT)*, credit available to the private sector *(CPRIV)* and the level of public sector investment *(GINV)* which is expressed as:

$$COST = f(FINT, CPRIV, GDP, GINV) \qquad (2c)$$

Substituting equation (2c) into (2b) yields:

$$PINV^d = f(GDP, GINV, RINT, CPRIV) \qquad (3a)$$

Several attempts have also been made to incorporate different measures of uncertainty *(UNC)* in aggregate desired private investment equation [(Busari and Olaniyan (1998), Servén (1997) and (2002)] and making allowance for the effect of debt burden *(DEDT)* to the private sector (Chhibber and Pahwa, 1994). Incorporating these two variables into equation (3a), we obtain:

$$PINV^d = f(GDP, GINV, RINT, CPRIV, DEBT, UNC) \qquad (3b)$$

Using equation (3b) that defines the stochastic process generating the optimal target of aggregate private investment and substituting into equation (2) and assuming that expectations are realized, one obtains the dynamic reduced model of aggregate private investment of an error correction form:

$$\Delta PINV_t = \beta_0 + \beta_1 GINV_t + \beta_2 GDP_t + \beta_3 RINT_t + \beta_4 CPRIV_t + \beta_5 DEBT_t + \beta_6 UNC_t + a_1(PINV_{t-1} - \beta_7 GINV_{t-1} - \beta_8 GDP_{t-1} - \beta_9 RINT_{t-1} - \beta_{10} CPRIV_{t-1} - \beta_{11} DBT_{t-1} - \beta_{12} UNC_{t-1}) + a_{13} PINV_{t-1} + e_t \quad (4)$$

Defining $Z_{t-1} = - \beta_7 GINV_{t-1} - \beta_8 GDP_{t-1} - \beta_9 RINT_{t-1} - \beta_{10} CPRIV_{t-1} - \beta_{11} DBT_{t-1}\ \beta_{12} UNC_{t-1}$ as the set of all variables that cointegrates with aggregate private investment, equation (4) thus becomes:

$$\Delta PINV_t = \beta_0 + \beta_1 GINV_t + \beta_2 GDP_t + \beta_3 RINT_t + \beta_4 CPRIV_t + \beta_5 DEBT_t + \beta_6 UNC_t + a_1(PINV_{t-1} - Z_{t-1}) + a_2 \Delta PINV_{t-1} + e_t \quad (5)$$

The term $(PINV_{t-1} - Z_{t-1})$ is referred to the error correction term (ECM_{t-1}) and the basic aggregate private investment specification considered in this study thus becomes:

$$\Delta PINV_t = \beta_0 + \beta_1 GINV_t + \beta_2 GDP_t + \beta_3 RINT_t + \beta_4 CPRIV_t + \beta_5 DEBT_t + \beta_6 UNC_t + \beta_{01} ECM_{t-1} + \beta_{02} \Delta PINV_{t-1} + e_t$$

$$\beta_1 > 0, \beta_2 > 0, \beta_3 < 0, \beta_4 > 0, \beta_5 < 0, \beta_6 < 0, \beta_{01} < 0, \beta_{02} > 0 \quad (6)$$

APPENDIX - B

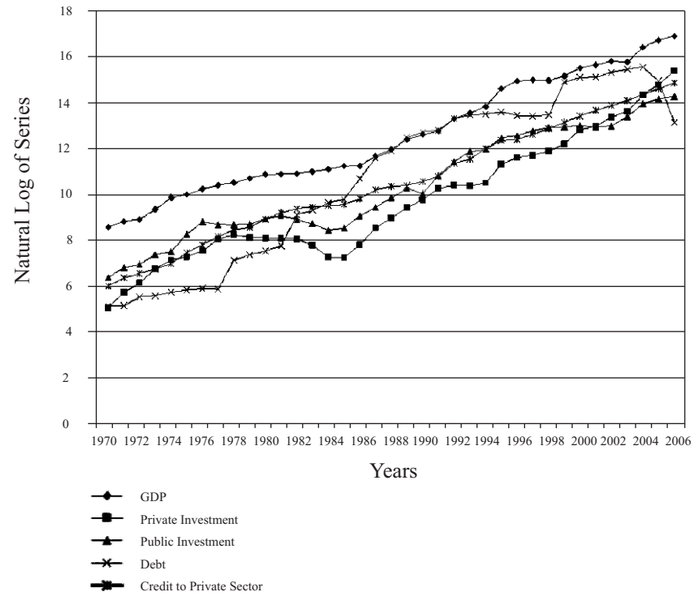

Figure 1

Nigeria GDP, Investment, DEBT and Credit to the Private Sector (1970 - 2006)