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Macroeconomic Uncertainty and Private Investment in Ghana: An Empirical Investigation

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ABSTRACT: In spite of the progress made in economic performance over the years, the Ghanaian economy continues to be bedevilled by a host of constraints. Among these constraints are low levels of savings and investments which have raised serious concerns among economists and policy makers with respect to the sustainability of the achievements attained so far. This study attempts to investigate empirically the link between investments and uncertainty using dataset from Ghana covering the period 1975 to 2008. In the empirical analysis, the paper aims at separating ordinary variability from uncertainty by the construction of measures of uncertainty for some key macroeconomic indicators and using them to assess their impact on investment behaviour within an econometric framework including other acceptable determinants of investment. The Phillip-Hansen cointegration test confirms the existence of long-run equilibrium relationship between private investment, standard determinants of investment, and macroeconomic uncertainty. Result from the study shows that on the whole the investment-uncertainty link reveals a significant negative effect of all macroeconomic uncertainty indicator variables on private investment with the exception of real exchange rate volatility. The values for price of capital uncertainty, real GDP growth uncertainty, and terms of trade uncertainty are large in absolute terms. The regression result further reveals that private investment displays important inertia and shows slow adjustment process towards long-run equilibrium. Lastly, the summary measure of macroeconomic uncertainty which encompasses the first principal components of the conditional variances of the five macroeconomic variables shows a consistent indirect effect on private investment. Generally we found macroeconomic uncertainties to be more detrimental to private investment growth in the long-run relative to the short-run.

Keywords: Macroeconomic Uncertainty; Private Investment behaviour; Fully Modified Ordinary Least Square technique; partial adjustment model; Ghana
JEL Classifications: E22; C22

1. Introduction

In 1983, the already deteriorating economic situation in Ghana was worsened by natural disasters such as prolonged drought and bush fires and the expelling of about a million Ghanaians from Nigeria. In an attempt to arrest the continuous economic decline, the government in April 1983, launched the economic resuscitation programme dubbed "Economic Recovery Programme (ERP)" under the auspices of the International Monetary Fund (IMF) and the World Bank which was later succeeded by the Structural Adjustment Programme (SAP)[1].

[1] The IMF's analytical framework was underpinned by a financial programming model, which draws strongly on the monetary disequilibrium model of the Polak (1957). Similarly, the analytical framework underling the SAP was the two-gap model of Chenery and Bruno (1962), Mckinnon (1964), Chenery and Strout (1966). This frame work which is supply-sided is usually used in the determination of the levels of investment, imports and external finance needed to achieve certain targeted growth rates in output. The key policy reforms that were taken during

The stabilization policies of the IMF were theoretically underpinned by demand management and apparently to reduce external, fiscal, banking, exchange rate and price imbalances. The structural adjustment measures on the other hand, were designed to establish a market friendly set of incentive that could encourage the accumulation of capital and ensure more efficient allocation of resources, increase economic efficiency, expand growth and increase resilience to shocks. This was predicated upon the assumption that once equilibrium is attained through stabilization policies of the IMF, the way forward for preventing future imbalances was only going to be possible through the removal of all structural bottlenecks and macroeconomic distortions that could retard growth.

In the first ten years of the ERP, economic progress in the country was remarkable, with almost all macroeconomic indicators showing strong positive growth or response in the appropriate direction. The recovery in GDP in the immediate post ERP era was partly attributed to favourable weather conditions after the droughts and good cocoa prices in the world market, which further improved the terms of trade by 37 per cent (Toye, 1991 and Aryeetey et al., 2000). Subsequent implemented poverty reduction and growth strategies include the Ghana Vision 2020, the Interim Poverty Reduction Strategy (IPRS), and the Growth and Poverty Reduction Strategy (GPRS 1 &II) policy framework. By and large, the general impact of these structural reform programmes on Ghana´s economic performance has been broadly satisfactory.

In spite of the progress made in economic performance over the years, the Ghanaian economy continues to be bedevilled by a host of constraints. Among these constraints are low levels of savings and investment which have raised serious concerns among economists and policy makers with respect to the sustainability of the achievements attained so far. The level of domestic savings and investment has been inadequate to propel growth to appreciable levels needed to raise welfare levels and generate sufficient employment opportunities that could enable the economy meet the first target of the Millennium Development Goals of eradicating extreme poverty and hunger.

Standard neoclassical investment models provide unambiguous conclusions that an economic agent must invest when the present value of a project's expected cash flow is at least as large as its costs. Existing literature using options models has however, shown that this rule is incorrect and that when investment is irreversible, uncertainty is resolved through time and investment can be postponed (Dixit, 1989, 1992; Pindyck, 1991; Dixit and Pindyck, 1994). Under such circumstances, the standard investment model ignores the opportunity cost of investing today—that is, current investment excludes not investing if bad news is expected, and therefore potentially provides an inferior decision rule.

Many economists have tackled this important issue of investment behaviour under uncertainty and yet no consensus has been reached at least in theory, on the uncertainty – investment nexus. Despite the different strand of views that exist in the literature on the investment-uncertainty link, the following questions remain to be fully answered. Does an increase in uncertainty induce firms to suspend their investment plans in the long-run and short-run? Would a permanently higher level of uncertainty provoke firms to reduce their capital intensive technologies in the long run and short-run? And more importantly, does an increase in uncertainty affect the sensitivity of investment to policy interventions?

It is against this background that this study attempts to investigate empirically the link between investments and macroeconomic uncertainty using dataset from Ghana. In the empirical analysis, the study investigates the effect of uncertainty using some key macroeconomic indicators and other standard investment determinants on aggregate private investment rates.

Despite the recent surge in studies on the effect of uncertainty on fixed investment decisions of private firms, available evidence indicate that very little has been written about short-term and long-term effects of increasing uncertainty in macroeconomic environment on the investment performances in developing countries. Majority of such studies continue to focus on developed countries' experiences instead -the U.S and the U.K (see Darby et al., 1999; Huizinga, 1993; Goldberg, 1993; Price, 1995; Episcopes, 1995 and Byrne and Davis, 2002). This study is therefore

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the implementation of the ERP and the SAP included exchange rate reforms, price decontrol reforms, monetary and fiscal policy reforms, export sector rehabilitation programme, public sector investment programme, state enterprise and public sector reforms (divestiture programme) and financial sector reforms (Toye, 1991; Ahortor, 2003).

intended to widen our knowledge on the subject matter by adding to the literature evidence from the developing world.

Theoretical literature on the effect of uncertainty on investment remains inconclusive. The strand of literature that assumes reversibility of investment supports a positive link between uncertainty and investment spending (see Hartman, 1972 and Abel, 1983). Other studies assuming irreversibility of investment and using the option theory propose a cost to committing an investment project and a benefit to reducing investment within an uncertain environment (see Bernanke, 1983; Pindyck, 1988; Dixit and Pindyck, 1994 and Akkina and Celibi, 2002). This study therefore, attempts to provide an empirical re-examination of the relationship between macroeconomic uncertainty and investment. Investment tends to be more volatile than other determinants of aggregate demand and has proved to be difficult to forecast (Bernanke, 2003). An investigation into the effect of uncertainty on investment may help unravel the fluctuations in investment. This issue undoubtedly is relevant for policy makers.

Most studies on the uncertainty-investment link use simple measures of variability rather than uncertainty, whereas others exclude important investment determinant (Seven, 1998). This paper attempts to separate ordinary variability from uncertainty by constructing measures of uncertainty for a host of macroeconomic variables using the GARCH (1, 1) and the recursive estimate of the time varying conditional standard deviation.

The rest of the study is organized as follows: section II presents an overview of the Ghanaian economy. Theoretical and empirical literature review on uncertainty and investment has been presented in the section III. Section IV is devoted to methodology and model specification. The fifth section focuses on the presentation and discussion of empirical results. Section six completes the study with conclusions.

2. An Overview of the Ghanaian Economy

The 1970-1982 periods was characterized by political instability and gross economic mismanagement that contributed to the worsening of the Ghanaian economy. Political upheavals characterized by military coups and counter coups were frequent. This resulted in a remarkable decline in major economic indicators. Attempts at alleviating the plight of Ghanaians led to the institution of price controls and other regulations, which eventually eroded confidence in the economy and negatively affected the banking system. The ERP and SAP programmes implemented in 1983 and 1986, respectively, were attempts to savage the poor economic state of the Ghanaian economy.

Between 1983 and 1992, average annual real GDP growth was 4.0%, real per capita GDP grew on average by 0.73 per annum; and the average annual inflation rate hovered around 23.63% with nominal interest rates recording an average of 21 % over the period. Generally, the economic situation in the 1990s showed mixed performance but revealed more of a reversal of the modest gains achieved earlier. Inflation had started rising in the midst of the rapid growth in money stock in the mid-1980s - 1990s together with the huge domestic borrowing by government which squeezed credit to the private sector. Further monetization of the foreign debt flows further put an upward pressure on prices (Aryeetey et al., 2000). Inflation rose appreciable to a peak of 59 % in 1995 recording an average of 30% over the period (Table 1). The excessive capital inflows during this period are also estimated to have had a "Dutch disease" effect on the economy through a demand-pull inflation mainly on non-tradable and real exchange appreciation (Younger 2000). For instance, Foreign Direct Investment (FDI) inflows which averaged 0.19% of GDP over the 1980s witnessed a tremendous increase to an average of 1.71 % of GDP for the 1990s (see appendix A, Table 1). Evidence from Table 1 further shows that, for much of the 1990s, Ghana experienced a real appreciation of the cedi as the nominal rate did not depreciate sufficiently to counteract the increase in inflation. This was on account of the Bank's use of the exchange rate as a nominal anchor against inflation, i.e. intervention to keep the nominal rate constant in order to keep inflation low rather than seeing the exchange rate as a tool that affects competitiveness (CEPA, 1997;1998).

An interesting trend noticed during the 1990-1999 period was the trend in the country's debt stock. From a total of US$2472 million in 1984 the debt stock more than doubled to $7191.8 million in 1998 with external debt contributing about 86 per cent of the total debt stock. On the whole, the average external debt recorded over this period was 79.83 % of GDP compared to 47.25 % of GDP being the average external debt for the previous decade. Even though these levels were not

significantly above the critical values to qualify the country for HIPC relief, the trend was worrisome since there was every indication that the country was heading for a debt crises and the possibility of increasing the debt burden on the future generation.

Table 1. Selected Macroeconomic Indicators for Ghana (1980-2008)

Year	FDI, net inflows (% of GDP)	Inflation Rate (%)	Nominal Interest rate (%)	External Debt (% of GDP)	Gross capital formation *(% of GDP)*	GDP growth (annual %)	Exchange Rate ¢/US$
1980	0.35	50.07	15.09	31.67	5.62	0.47	2.75
1981	0.39	116.50	16.10	36.56	4.57	-3.50	2.75
1982	0.40	22.30	19.52	36.87	3.38	-6.92	2.75
1983	0.06	122.87	16.34	41.43	3.75	-4.56	30.00
1984	0.05	39.67	17.25	44.89	6.88	8.65	50.00
1985	0.12	10.31	18.43	50.70	9.57	5.09	59.99
1986	0.08	24.57	19.01	49.04	9.36	5.20	90.01
1987	0.09	39.82	20.26	66.53	10.43	4.79	176.96
1988	0.10	31.36	21.35	60.36	11.30	5.63	229.89
1989	0.29	25.22	22.51	64.20	13.21	5.09	303.03
1990	0.25	37.26	23.47	64.68	14.44	3.33	344.93
1991	0.30	18.03	24.80	64.16	15.88	5.28	390.63
1992	0.35	10.06	19.74	67.21	12.80	3.88	520.83
1993	2.10	24.96	25.61	78.16	22.21	4.85	819.67
1994	4.28	24.87	29.06	95.71	23.96	3.30	1052.63
1995	1.65	59.46	32.09	86.88	20.02	4.11	1449.28
1996	1.73	46.56	34.51	85.34	21.20	4.60	1754.39
1997	1.19	27.89	36.78	84.62	24.81	4.20	2272.73
1998	2.24	14.62	38.50	86.19	23.11	4.70	2325.58
1999	3.16	12.41	36.50	85.08	21.00	4.40	3535.14
2000	3.33	25.19	47.00	79.60	24.00	3.70	7047.65
2001	1.68	32.91	43.75	82.10	26.60	4.00	7321.94
2002	0.96	14.82	36.36	80.00	19.70	4.50	8438.82
2003	1.79	26.67	32.75	83.50	22.94	5.20	8852.32
2004	1.57	12.62	28.75	77.30	28.38	5.60	9051.26
2005	1.35	15.12	26.0	76.50	29.00	5.90	9130.82
2006	5.00	10.92	24.25	25.32	30.42	6.40	9236.02
2007	5.72	10.73	23.75	30.05	33.82	5.70	9704.00
2008	12.68	16.52	25.02	31.31	35.94	7.30	12141.00

Source: World Development Indicator and Bank of Ghana

By 2001 the economy appeared to have turned around from its declining state in the 1990s. The major policy drive during this period was the Growth and Poverty Reduction Strategy (GPRS I & II), dubbed an "agenda for growth and prosperity" represented "policies, strategies, programmes and projects to support growth and poverty reduction". It also sought to "enable wealth creation for the benefit of all Ghanaians". The outcome of this strategy was quite impressive. Real GDP growth rate recorded an average of 4.8 per cent from 2000-2008; whereas real per capita GDP growth rate registered an average of 1.8 per cent over the same period. The growth in output over this period was attributed to the remarkable performance in the commanding heights of the economy namely; tourism, cocoa and gold.

The recovery in economic performance since 2001 is attributed to significant improvements in fiscal and monetary discipline. Generally inflation and interest rates have witnessed a downward trend as well as an appreciable stability in the foreign exchange market. From a high of 47% in 2000 the average annual nominal interest rate has declined successively to about 24% by 2007 but a marginal increase to 25 % in 2008. Within the same period the rate of inflation also showed a decline from almost 33% in 2001 to 12.6% in 2004 before rising to 16.52 % in 2008. The average annual cedi-dollar depreciation also realized a fall from 49.8% to 0.9%. However, nominal depreciation that occurred in 2000 moved real exchange rate more than sufficiently to maintain competitiveness. That is, there was a real depreciation. Since the beginning of the decade, the real exchange rate has been slightly overvalued. Many have argued that the use of the exchange rate as a nominal anchor against inflation is wrong since it undermines the competitiveness of Ghana's economy (CEPA, 1998). External debt was generally high for a greater part of the period-an average of 79.16 % for the period 2000-2005 but declining progressively to an average of 28.89 % from 2006-2008. From 2000-2008 the flow of FDI was quite impressive. The average for the period was 4.89 % of GDP with the highest inflow occurring in 2008; maybe, because of the discovery of oil in commercial quantities. Table 1 also demonstrates that the level of capital formation though lowest in the 1980s have gradually increased over the 1990s to record and average of 21.9 % of GDP. The performance was rather higher for the period 2000-2008 where the average stood at 27.87 % of GDP due, possibly because of the launching of the government's "golden age of business" policy.

3. Literature Review

Studies on the traditional models of uncertainty and firm behaviour initially excluded adjustment costs; instead they concentrated on the effect of uncertainty on the optimal output/input level of firms rather than on investment. Such models include Sandmo (1971), Leland (1972), Holthausen (1976) and McKenna (1986). According to these models, a firm can instantly and costlessly adjust its capital stock to its desired levels. Thus the investment decision is basically a fixed decision where the marginal product of capital is equal to the user cost of capital. This result is similar to the net present value (NPV) rule, which presumes that an investment project may be deemed viable and must be accepted if the present value of its expected future cash flows is larger than its investment cost.

The practice where these traditional investment models assumed that firms can instantly and costlessly adjust to their optimal capital stock may not be realistic given that it is usually costly for firms to adjust their capital stock to desired optimal levels. Studies such as Hartman (1972), Pindyck (1982), and Abel (1983), among others have accordingly modelled adjustment cost into investment decisions. Included in the adjustment cost is the role of uncertainty on investment which has received considerable attention in economic theory. On the whole, however, the theoretical predictions are ambiguous; the outcome depends on the underlying assumptions. Some studies predict a positive relationship if the marginal revenue product is convex while others predict a negative one if the marginal revenue product is concave.

The study by Hartman (1972) and Abel (1983) which were among the first to develop the uncertainty-investment nexus within a framework of risk-neutrality, proposed a positive relationship. They argued that an increase in uncertainty raises the incentive to invest as the marginal revenue product of capital is convex in output price within a perfect competitive market. That is, increasing uncertainty of output price has the tendency of causing expected profitability of capital to rise, which may lead to an increase in investment. Given the flexibility in labour relative to capital, firms can adjust labour to price fluctuation thereby causing a change in the labour-capital ratio; leading to a further change in the marginal revenue product of capital change by a greater proportion than the movement in price. Under such conditions, marginal profitability is a convex function of output prices, and Jensen's inequality then implies that higher price uncertainty raises the expected profitability of capital, thereby increasing the desired capital stock and hence investment.

Other theoretical analyses have suggested a variety of channels through which uncertainty may affect investment behaviour. The real options theory (see; Dixit and Pindyck, 1994) is one of such theories and states that when investment is irreversible, then an increase in uncertainty may cause the firm to postpone investment, even at an unchanged level of expected future profit. Within these models, firms invest if the net present value of the investment project exceeds the value of the option

to postpone. When uncertainty levels are high, the option to wait may become more valuable, making the firm less likely to invest. However, as shown in Abel and Eberly (1999) and Caballero (1991), the impact on the level of the capital stock in the long run is more ambiguous. Firms may decide to invest less in response to positive demand shocks, but they may also be stuck with more capital than they desire following any negative demand shocks. So that whether firms operate with higher or lower capital stocks on the average at higher levels of uncertainty, will depend on which of the effects dominates. Bloom et al. (2001) however, noted that, the more robust prediction of the real options literature is that the impact of demand shocks on investment should be weaker at higher levels of uncertainty. This implies that uncertainty should have an impact on investment dynamics instead of necessarily having an impact on long run capital accumulation.

The theoretical literature leaves open the sign and persistence of the relationship between investment and uncertainty. This ambiguity has incited a large empirical literature on the subject matter. In contrast to the theoretical literature, however, empirical studies on the relationship between uncertainty and fixed investment especially using micro-data are more limited and concentrated on a few developed economies. The paper by Liping et al. (2010) empirically investigates the link between uncertainty and investment among Chinese listed companies. The authors also analyze the effect of government control on the investment-uncertainty nexus. The study finds a negative relation between total firm uncertainty and investment in Chinese listed companies. This result was however found to hold only for privately controlled firms. Among these firms, investment impacted negatively on firm-specific uncertainties, whilst among government-controlled firms investment relates positively to market uncertainty. It is also evident from the study that risk taking preference of government-controlled listed firms is higher among those companies with fewer investment opportunities. The study also finds a non-significant negative relation between investment and uncertainty among financially distressed firms because of risk shifting, which is more prominent among government-controlled listed companies.

Empirical studies that employ macroeconomic data, adopt a non-structural approach, in which various uncertainty proxies are added to other conventional determinants of investment. Despite this limitations, existing evidence suggest a negative relationship between increasing risk and uncertainty and investment. For instance, the study by Edwards (1989) and Pindyck and Salimano (1993) found real exchange instability to have a significantly negative effect on investment in both developed and developing countries.

In the case of developed countries experiences, Federer (1993) found a significant negative long run impact of macroeconomic uncertainty on U.S. equipment investment, while Driver and Moreton (1991) and Price (1995, 1996) found a likewise negative effect on U.K. manufacturing investment. Meanwhile, Goldberg (1993) explores the impact of real exchange rate uncertainty on U.S. industry-level investment and basically finds no effects at the aggregate level, while at the sub-sector level her results vary in sign and significance.

Recent studies attempted to further decompose macroeconomic volatility and assess its impact on the real economy, which underscore the fact that the source of uncertainty matters. This trend of events was predicated on the theoretical study by Baum et al. (2001) that highlighted the possible importance of separating permanent from transitory volatility in assessing the real impact of uncertainty. In this light, the study by Chadha and Sarno (2002) provide evidence of a differential impact of price uncertainty on investment. The study found that short run uncertainties are more damaging to investment than long-run volatility. The authors employed the use of a Kalman filtering technique and maximum likelihood estimation procedure to separate permanent and transitory components of price uncertainty.

Giving the importance of the manufacturing sector in Pakistan's economy, the study by Imtiaz and Qayyum(2009) attempts to explore the role of public expenditures (development and non-development) and macroeconomic uncertainty in the determination of private sector's fixed investment behaviour in large scale manufacturing. The dynamic error correction model of private investment shows that whilst development expenditures tend to augment private investment, non-development expenditures and macroeconomic uncertainty have a negative effect on private investment.

The paper by Bloom et al. (2006) shows that, with (partial) irreversibility, higher uncertainty reduces the impact of demand shocks on investment. Uncertainty increases real option values making firms to be more cautious when making investment decisions. The cautionary effects of uncertainty are large – ranging from the lower quartile to the upper quartile of the uncertainty distribution. The implication is that the responsiveness of firms to any given policy stimulus may be much lower in periods of high uncertainty such as after major shocks like OPEC I and September -11.

Shinada (2008) focused on the effect of uncertainty in productivity growth on Japan's private investment since the 1990s. The study hypothesized that increasing uncertainty in productivity growth, a proxy for technological progress, has an inverse impact on fixed investment. Using a panel data and a Tobin's q-type investment function, the study makes the following findings. The results from the investment model suggest that: i) higher uncertainty in investment growth impacts negatively on investment; ii) this negative effect is however reduced if a firm is a member of an industry with greatly expected demand growth and iii) since the late-1990s, increasing volatility in the shifting of the technological frontier has led to larger negative impact on investment, particularly in the manufacturing industry.

Cross-country empirical studies that use aggregate data are somehow easy to come by. The study by Hausmann and Gavin (1995) found a negative relation between an index of macroeconomic uncertainty —real GDP and real exchange rate volatility and the aggregate investment/GDP ratio, using a large sample of data from developing countries. In contrast, Bleaney (1996) report that indicators of economic instability (such as variability of the real exchange rate) adversely affect growth performance in developing countries, but not aggregate investment behaviour. This finding was not different from the result obtained by Ramey and Ramey (1995) who also employed aggregate investment data in their study. Aizenman and Marion (1995, 1996) in turn, report a negative cross-country association between various measures of volatility (for example, instability in the terms of trade, inflation and the real exchange rate) and private investment. They further show that these economic instability measures contribute significantly in explaining why private investment perform very well across countries in a reduced-form regression framework. Finally, their study reported that total investment (i.e., private plus public) is not related to instability indicators.

The study by Serven (1998) uses a large panel data set on developing countries to assess the impact of macroeconomic uncertainty on private investment. The study attempted to draw some distinction between sample variability and uncertainty by constructing alternative measures of the volatility in five macroeconomic variables – inflation, growth, the terms of trade, the real exchange rate and the price of capital goods. These constructed measures were then added to an empirical investment equation which was estimated using alternative panel data econometric methods, allowing for simultaneity, country-specific effects and parameter heterogeneity across countries. The results underscored the robustness of the investment-uncertainty link and underscored the negative relation as exiting in other empirical literature

4. Data and Methodology

To explore the empirical association between investment and economic uncertainty, the study uses time-series data set covering the years 1976 to 2008. The major data and their sources are as follows: relative price of capital (source; Penn World data tables); real interest rate (source; Bank of Ghana); private investment % GDP, real exchange rate, terms of trade, inflation rate, real GDP growth, and external debt % GDP, credit flows to private sector/GDP (source; World Development Indicators).

4.1 Measures of Uncertainty

The effect of uncertainty on investment has gained considerable grounds in both analytical and empirical macroeconomic literature. On theoretical grounds, however, uncertainty has been found to affect investment through a number of channels, with some operating in opposing directions. This renders the sign of its overall effect ambiguous, and can only be assessed empirically. An extensive survey of the literature on the investment-uncertainty relationship is provided in the study by Carruth et al. (2000) which seem to suggest a reasonable consensus in the empirical literature that there exist a negative linkage between uncertainty and aggregate investment. This notwithstanding, a few conflicting issues are identifiable within the literature. The most conflicting issue is how to measure uncertainty.

A number of methods have been employed to model the impact of uncertainty on investment. These include simple rolling standard deviations or variance, and time series conditional heteroscedastic methods. Engle (1982) was the first to introduce the ARCH methodology and later extended to incorporate a lagged dependent variable in the conditional variance (GARCH). This method is presumed to capture risk in each period more sensitively than simple rolling standard deviations, which give equal weight to correlated shocks and single large outliers. By and large, ARCH or GARCH measures have been extensively used in measuring macroeconomic variables as proxies for uncertainty (see Huizinga, 1993; Episcopes, 1995and Price, 1995).

In order to assess the association between private investment and measures of economic uncertainty, the study sought to first separate sample variability from uncertainty by computing proxies for uncertainty (following from Serven, 1998). The study uses five key macroeconomic variables, namely; inflation, the relative price of capital goods, the growth of output (measured by real GDP), the real exchange rate and the terms of trade to measure proxies for uncertainty. The first three variables are used to enable us capture the aggregate profitability of capital. Inflation is often taken as a summary measure of the overall macroeconomic stance, and hence the volatility of its unpredictable component can be viewed as an indicator of overall macroeconomic uncertainty (e.g., Eberly, 1993). Also, the relative price of investment goods (measured here by the fixed investment deflator relative to the GDP deflator) is closely associated with the user cost of capital, so that its volatility can be considered as an appropriate measure of the uncertainty on aggregate investment profitability (Seven, 1998). Thirdly, the volatility of output growth is treated in this study as the unpredictability of demand (e.g., Guiso and Parigi, 1998). On the other hand the terms of trade and the real exchange rate capture the relative profitability of investment in the external sector—exportables versus importables, where the terms of trade is limited to the home-market versus foreign-market oriented activities which is captured by the real exchange rate. By and large increased uncertainty in these variables makes price signals less informative about the relative profitability of investment across sectors, thereby likely to hinder investment decisions. For each of these variables, the study will use two different statistical methods, namely; application of the generalized autoregressive conditional heteroscedasticity (GARCH) specification based on Bollerslev (1986) and the recursive regressions model to construct proxies for measuring uncertainty.

Regarding the GARCH model the study will specifically estimate the following univariate GARCH (1, 1) model where (1) is the mean equation and (2) is the conditional variance equation.

$$y_t = \alpha + \alpha_1 t + \beta_1 y_{t-1} + \varepsilon_t \qquad (1)$$

$$\delta_t^2 = \phi + \phi_1 \varepsilon_{t-1}^2 + \phi_2 \delta_{t-1}^2 \qquad (2)$$

where δ_t^2 denotes the variance of ε_t conditional on information up to period *t*.

4.2 Theoretical and empirical Model

To investigate the impact of uncertainty on investment the study employs the neoclassical model of investment behaviour following Jorgenson (1963) which suggests that desired capital stock is determined by output and the user cost of capital. Thus,

$$K_t^* = \beta_1 + \beta_2 Y_t + \beta_3 C_t + \varepsilon_t \qquad (3)$$

where *K** is the desired capital stock, β_1 is a constant, *Y* is the output level, *C* is the user cost of capital and β_2 and β_3 are the coefficients for output and user cost of capital expected to be positive and negative, respectively. By substituting investment for the capital stock, the following static long-run relationship is obtained;

$$I_t^* = \beta_1 + \beta_2 Y_t + \beta_3 C_t + \varepsilon_t \qquad (4)$$

Equation (4) provides our baseline for modelling investment, as developed by Bean (1981) and used in studies such as Darby et al. (1999). The intuition behind equation (4) is that in the long run, determination of investment is based on a simple accelerator model.

The partial adjustment model comprises of a static part which describes how the desired amount is determined as shown in equation (4) and the dynamic partial adjustment process (expressed in equation 5 where $(1-\lambda)$ is the short run adjustment process to long-run equilibrium).

$$I_t - I_{t-1} = (1-\lambda)(I_t^* - I_{t-1}) \qquad (5)$$

By substituting (4) into (5) we obtain the following partial adjustment model

$$I_t = \beta_1(1-\lambda) + \beta_2(1-\lambda)Y_t + \beta_3(1-\lambda)C_t + (1-\lambda)\varepsilon_t + \lambda I_{t-1} \quad (6)$$

By simple rearrangement we obtain the partial adjustment model for investment as

$$I_t = \alpha' + \lambda I_{t-1} + \phi' Y_t + \varphi' C_t + \varepsilon_t' \quad (7)$$

Where $\alpha' = \beta_1(1-\lambda), \phi' = \beta_2(1-\lambda)$, and $\varphi' = \beta_3(1-\lambda)$, are the short-run multipliers and $\varepsilon_t' = (1-\lambda)\varepsilon_t$ is the stochastic disturbance term assumed to be non-autocorrelated. The derived long-run multipliers are given as $\beta_1 = \alpha'/1-\lambda$, $\beta_2 = \phi'/1-\lambda$ and $\beta_3 = \varphi'/1-\lambda$. Based on the model above our empirical investment equation for the study is expressed as relating the real private investment to a set of standard investment determinants, to which we include uncertainty measures as discussed earlier. Hence the model to be estimated is of the form:

$$I_t = f(I_{t-1}, X_t, U_t) + \varepsilon_t \quad (8)$$

where *I* is private fixed investment, X is a set of conventional private investment determinants, U is a set of uncertainty indicators, ε_t is the error term, whereas the subscripts *t = 1, T* refers to the time-series dimension of the data

Broadly, the *X* variables include the current and lagged levels of real GDP, to capture the conventional accelerator effect, and variables measuring the user cost of capital. Included in the latter group of variables are: the relative price of capital goods, measured as the ratio of the investment deflator to the GDP deflator, and the real interest rate. It is expected that both regressors will exert a negative impact on investment. We also add to our model the flow of private credit relative to nominal GDP to capture the overall tightness of credit markets; this variable is expected to have a positive impact on private investment. To these traditional determinants of investment we then add the measures of macroeconomic uncertainty described above. Taken as a whole we expect uncertainty to have a negative impact on investment. Greene (2003) argues that parameters of the partial adjustment model can be estimated consistently and efficiently by ordinary least squares. However, as argued by Phillip-Hansen (1990), the OLS regression suffers from the problems of endogeneity and serial correlation.

4.3 Estimation Techniques

The Fully Modified OLS by Phillip-Hansen (1990), which is a semi-parametric technique, is an instrumental variable estimator with nonstationary regressors and thus, robust in models with nonstationary variables and endogenous regressors. The method is noted to perform well in small samples and provides consistent estimates even when there is no cointegration. One more feature of this approach is that it allows for both stationary and nonstationary variables in the same equation and that does not require for the pre-determination of cointegration rank. In this light Phillips (1995) concludes that the limit theory of the FM-OLS estimates of the stationary components of the regressors are equivalent to that of OLS, while the FM-OLS estimates of the nonstationary components retain their optimality properties (.i.e. they are asymptotically equivalent to the maximum likelihood estimates of cointegrating matrix).

The FM-OLS provides optimal estimates of cointegrating regressions. The approach modifies least squares to account for serial correlation effects and for endogeneity in the regressors that result from the existence of a cointegrating relationship expressed in equation 9.

$$y_t = \mu + \beta' x_t + v_{1t} = \theta' z_t + v_{1t} \quad \text{.....(9)}$$

$$\Delta x_t = v_{2t} \quad \text{.....(10)}$$

Where T=1,.....T, $\theta = (\mu, \beta')'$, $z_t = (1, x_t')$ and y_t and x_t are observed time series with 1 and n dimensions, respectively. It is argued that the OLS estimate of θ is inefficient although consistent. Phillip-Hansen (1990) also concludes that the OLS estimate suffers from endogeneity of the nonstationary regressors and serially correlated error of the regression. Thus, the FM-OLS method modifies y_t to y_t^+ and then corrects the least square estimate $\hat{\theta}$ to get rid of the nuisance parameters completely. In this light the FM-OLS proposes the FM estimator as;

$$\hat{\theta}_{FME} = \left(\sum_{t=1}^{T} z_t z_t' \right)^{-1} \left(\sum_{t=1}^{T} z_t y_t^{+} - T\hat{J}^{+} \right) \quad \text{.....(11)}$$

Where $y_t^{+} = y_t - \hat{\lambda}_{ox}\hat{\lambda}_{xx}^{-1}\Delta x_t$ is the correction term for endogeneity, $\hat{\lambda}_{ox}$, $\hat{\lambda}_{xx}$ are the kernel estimates of the long-run convariances, $\hat{J}^{+} = \hat{\Delta}_{ox} - \hat{\lambda}_{ox}\hat{\lambda}_{xx}^{-1}\hat{\Delta}_{xx}$ is the correction term for serial correlation, $\hat{\Delta}_{ox}$, $\hat{\Delta}_{xx}$ are the kernel estimates of the one-sided long-run covariances. The serial correlation correction term is employed to deal with the effects of covariances in the shocks v_{2t} that drive the nonstationary regressors x_t and any serial covariance between the equation error v_{1t} and the past history of v_{2t}. This is vital since shocks from the past persist in x_t (i.e. as a result of unit roots in x_t) and set in motion the presence of one-sided long-run covariances that lug their effects in an OLS regression. These covariances are removed non-parametrically by means of the kernel estimate $\hat{J}^{+}$. Hence we estimate our partial adjustment investment model using the Fully Modified OLS regression technique, which is robust to small sample size, corrects for both problems of serial correlation in errors and endogeneity in regressors and produces consistent and efficient parameters.

5. Empirical Results and Discussion

Economic variables often suggest the existence of a level relationship among nonstationary time series. Cointegration techniques can be used to model these long-run relations if the variables are I(1). Thus, pre-testing for unit roots is often the first stage for cointegration analysis. The DF-GLS and PP unit root tests are used in this study to investigate the unit root properties of the time series variables (table 2).

Table 2. Unit Root Test of Variables

Variable	DF-GLS STATISTIC		PHILLIP-PERRON STATISTIC	
	Constant	Constant & trend	Constant	Constant & trend
Lned	-0.904436	-1.50081	-3.043159**	-1.579835
Dlned	-4.294049*	-6.38601*		-10.22987*
Lner	-0.534359	-1.8593	-1.29347	-0.375310
Dlner	-3.124716*	-3.505336*	-3.20416**	-3.39862***
Lnif	-3.15352*	-5.316673*	-3.20297**	-5.147143*
Dlnif				
Lntt	-1.58744	-2.74896	-1.28004	-1.651038
Dlntt	-8.37266*	-9.603212*	-4.64935*	-6.404517*
Lnpi	-1.83866	-1.927117	-2.00741	-2.137823
Dlnpi	-3.43839*	-3.9669**	-4.56221*	-6.59929*
Lny	0.350858	-1.084528	-0.842596	-0.972980
Dlny	-2.92263***	-3.59016**	-3.72414*	-7.075087*
Lnir	0.600915	-1.845100	-2.038816	-1.845100
Dlnir	-4.99725*	-5.57708*	-5.32542*	-5.577079*
Cdf	-1.174218	-1.96179	1.375188	-0.8638
Dcdf	-1.600609	-2.169257	-2.667126**	-3.59575**
Rir	-2.10229	-0.962653	1.832302	0.561744
Drir	-6.171957*	-6.852774*	-2.906503***	-3.377841***

*, **, *** represent 1%, 5%, and 10% significance levels

These unit tests are known to have significant greater power than the Augmented Dickey Fuller test. For each specific test statistic we estimate two models; model with constant but no trend and model with constant and trend. The DF-GLS statistic shows that for both models all the time series variables are nonstationary in their levels except inflation which is stationary in levels. By taking the first difference of the nonstationary series the DF-GLS statistic reveals that all the series with the exception of credit flows to the private sector are stationary in their first difference. The result of the Phillip-Perron test statistic shows that for the model with constant but not trend, all variables with the exception of inflation and external debt, are nonstationary in levels. However, the result for

their first difference reveals evidence of stationary series. The Phillip-Perron test statistic for the model with constant and trend also reveals that with the exception of inflation all the other variables are nonstationary in their levels but stationary after their first difference.

5.1 Private Investment and Macroeconomic Uncertainty

We investigate the extent of volatility in inflation rate, real exchange rate, terms of trade, relative price of capital, and GDP growth rate. Measure of volatility, as provided by GARCH (1, 1), shows that the variables exhibit high volatility clustering over the sample period and are statistically significant with the exception of inflation volatility (see table 3).

Table 3. GARCH (1, 1) estimates

Variable	Inflation rate	GDP growth	Terms of trade	Exchange rate	Price of capital
Conditional variance[2]	0.971186	0.9143	0.9244	0.966	1.00
Prob(f-stats)	0.1667	0.000	0.000	0.000	0.00

Source: Authors' computation

Next we examine the correlation between private investment performance and the unpredictable components of the five economic variables. We employ the Spearman rank correlation to minimize any potential outliers. One major revealing result from the Spearman rank correlation is that private investment is negatively correlated with all the five uncertainty indicator variables. Inflation rate, relative price of capital, and GDP growth has the highest correlation with private investment (see table 4).

Table 4. Spearman rank correlation between private investment and selected uncertainty measure

Volatility measure	Real exchange rate	Inflation rate	Terms of trade	Relative price of capital	GDP Growth
Conditional variance from GARCH (1, 1)	-0.351938 (-2.05940) [0.0482]	-0.915773 (-12.4868) [0.000]	-0.596096 (-4.06638) [0.0003]	-0.5922005 (-13.0430) [0.000]	-0.894693 (-10.9708) [0.000]
Recursive estimate 5-period standard deviation of AR(1) forecast errors	-0.745313 (-5.700133) [0.000]	-0.649587 (-4.43958) [0.0001]	-0.442665 (-2.585173) [0.0162]	-0.871782 (-9.24673) [0.000]	-0.432188 (-2.443754) [0.0216]

Source: Authors' Compilation

( ) and [ ] denotes standard errors and p-values

The similarity in sign of the correlation between private investment and the volatility of the unpredictable component of each of the five variables under consideration raises the question; to what extent does the unpredictable components of each of the five variables contain common information. The result reveals that the volatilities of the different variables by both measures are all positively correlated and statistically significant. The result further shows that inflation volatility is highly correlated with the relative price of capital and GDP growth uncertainties. Also real exchange rate is highly correlated with terms of trade and price of capital uncertainties (See Table 5 and 6).

5.2 Cointegration Test

The Phillip-Hansen cointegration approach is used to investigate the existence or otherwise of long-run equilibrium relationship among the time series. The ADF test of the FM-OLS as shown in table 7 indicates rejection of the null hypothesis of no cointegration. Thus, there exist a long-run equilibrium relation between private fixed investment, standard determinants of investment, and macroeconomic uncertainty.

[2] Sum of the ARCH and GARCH effects

Table 5. Full-sample rank correlation among the measures of uncertainties of various economic variables
GARCH (1, 1) Conditional Variances

Variables	Terms of trade	Relative price of capital	GDP growth	Inflation rate	Real exchange rate
Terms of trade	1.000000				

Relative price of capital	0.560850	1.000000			
	(3.710401)	-----			
	[0.0008]	-----			
GDP Growth	0.483871	0.861070	1.000000		
	(3.028398)	(9.275140)	-----		
	[0.0050]	[0.0000]	-----		
Inflation rate	0.545088	0.964076	0.850806	1.000000	
	(3.561123)	(19.87934)	(8.868208)	-----	
	[0.0013]	[0.0000]	[0.0000]	-----	
Real exchange rate	0.528592	0.431085	0.226540	0.468842	1.000000
	(3.410652)	(2.616780)	(1.273928)	(2.907283)	-----
	[0.0019]	[0.0138]	[0.2125]	[0.0068]	-----

Figures in ( ) and [ ] denotes standard errors and p-values, respectively. Source: Authors' computation

Table 6. Full-sample rank correlation among the measures of uncertainties of various economic variables
Recursive estimate of 5-period standard deviation of AR(1) forecast errors

Variables	Terms of trade	Relative price of capital	GDP growth	Inflation rate	Real Exchange rate
Terms of trade	1.000000				

Relative price of capital	0.732348	1.000000			
	(5.484051)	-----			
	[0.0000]	-----			
GDP growth	0.032293	0.338259	1.000000		
	(0.164750)	(1.832832)	-----		
	[0.8704]	[0.0783]	-----		
Inflation rate	0.504105	0.625616	0.465791	1.000000	
	(2.976280)	(4.089090)	(2.684022)	-----	
	[0.0062]	[0.0004]	[0.0125]	-----	
Real exchange rate	0.742748	0.853311	0.081554	0.531472	1.000000
	(5.656282)	(8.344915)	(0.417238)	(3.199228)	-----
	[0.0000]	[0.0000]	[0.6799]	[0.0036]	-----

Figures in ( ) and [ ] denotes standard errors and p-values, respectively. Source: Authors' computation

5.3 Short-run and long-run determinants of private investment

The Fully-Modified OLS is used to estimate the partial adjustment investment model. This approach as earlier discussed solves the problems of serial correlation and endogeneity. Two different models were run; the investment model with summary statistic of macroeconomic uncertainty; and the investment model with the five variable uncertainty indicators. The result for these models is as shown in Table 7. The coefficient of the lagged private investment is positive and statistically significant at the 1% significance level. The high coefficient value shows a large degree of persistence, an indication of an important inertia. Abel and Eberly (1994) argued that when the cost of adjustment is asymmetric there exist regimes of reaction within which the investor cannot invest if the marginal value of capital increases. As a result within the zone of inertia investment becomes independent of the value of capital but dependent on the previous level of investment. Ndiwulu and Manzongani (2008) and Serven (1998) all found evidence of important inertia. The existence of an important inertia is an indication of low adjustment to long-run equilibrium. In other words private investment is very sticky. Specifically for every initial short term deviation from long-run equilibrium identified, it is estimated that 10.81% of the initial error will be corrected in the first year.

The growth in GDP and lagged GDP growth enhances and deteriorates private investment, respectively. However, the coefficients are both not statistically significant. Thus, we did not find significant accelerator effect. Real interest rate is found to deteriorate private investment and it is statistically significant at the 1% significance level. Specifically a 1% increase in real interest rate reduces private investment by 19.7% annually. This result implies that real interest rate is treated as a key component of the user cost of capital thereby affecting private investment negatively. This contrast frimpong and Marbuah (2010) result.

Credit flow to the private sector is found to have a positive effect on private investment but it is not statistically significant. Frimpong and Marbuah (2010) also found a similar result for Ghana in the long-run. We explain the positive insignificant nature of credit flows to the private sector as a result of the rationing nature of credit in the country. This result is also confirmed in Serven (1998).

The external debt to GDP ratio and the relative price of capital coefficients are found to be negative. Thus, both external debt burden and user cost of capital deteriorate private investment in Ghana. However, these coefficients are not statistically significant.

Next we proceed to examine the effect of macroeconomic uncertainty on private investment. Specifically we examine the impact of volatility in inflation, real exchange rate, relative price of capital, terms of trade, and GDP growth on private investment. The result shows that real exchange rate volatility negatively affects private investment. However, this is found not to be statistically significant. Terms of trade uncertainty value is high in absolute terms, negative, and statistically significant. Thus terms of trade volatility in Ghana makes price signals less informative about the relative profitability of investment between export and import sectors, thereby hampering investment in these sectors.

The coefficient of relative price of capital uncertainty is negative, statistically significant at 10% significance level, and higher in absolute terms. This implies that in Ghana, the higher the volatility in the user cost of capital, the less likely it is to predict aggregate investment profitability which thus hampers firms/investors decision to invest. This confirms the result by Serven (1998).

The coefficient for GDP growth uncertainty is negative, statistically significant at the 1% significance level, and very large in absolute terms. This suggests that, in Ghana, the more volatile GDP growth becomes, the less likely an investor can predict demand growth. The unpredictability of demand in the economy due to high volatility in GDP growth increases volatility in aggregate investment profitability hence hampering firms' decision to invest during period of high GDP growth volatility.

The coefficient for inflation uncertainty is negative and statistically significant at the 5% significance level. Given that inflation is often used as summary measure of overall macroeconomic stance, the volatility of its unpredictable component can be equated to overall macroeconomic uncertainty. This implies that in Ghana, the more unstable or volatile the overall macroeconomic becomes, the more reluctant investors/firms become with regard to their investment decision. Not only does this deteriorate their profit levels but also increases the risk involved in doing business. This result confirms the result by Ndiwulu and Manzongani (2008). We further conduct a joint significance test on the coefficients of the five uncertainty indicators using the Wald test of parameter restriction.

The result, as shown in the bottom part of table 7, shows rejection of the null hypothesis. Thus, macroeconomic uncertainties have a general significant negative effect on private fixed investment in the short-run.

The long-run impact of income growth on real private investment is found to be positive and estimated to increase investment by 3.24% for every 1% increase in income on the average in the long-run. Interest rate impact in the long-run is estimated to be -1.8241. This implies that for every 1% increase in real interest rate, real private investment is expected to reduce by 182.4% in the long-run. The long-term effects of external debt and price of capital on real private investment are estimated to be -0.62 and -2.64, respectively. This implies that 1% increases in external debt and price of capital will decrease real private investment by 0.62% and 2.64%, respectively. Credit flows to the private sector is estimated to increase real private investment by 6.98% for every 1% increase in the long-run. The investment-uncertainty link in the long-run still reveals a negative association with private investment with the relative effect been more pronounced in the long-run which is not consistent with the findings of Chadha and Sarno (2002).

It is important to state that these uncertainty indicator variables are not uncorrelated. Inflation volatility typically reflects in the relative price of capital. Also in economies where investment has a significant import content like Ghana, real exchange rate volatility and terms of trade volatility should reflect in the relative price of capital. Thus, these variables do in fact have a good deal of common information. As a result we run another model where the first principal components of the conditional variances of the five variables are used as a summary measure of overall macroeconomic uncertainty (see model II in Table 7).

The result as shown in model II reveals that the lag of private investment and real interest rate has a significant positive and negative impact on private investment, respectively. Specifically an increase in real interest rate of 1% will reduce private investment by 21.1%. Compared with model I estimate there is no clear significant difference in the real interest rate effect on private investment. However, the lag private investment effect shows vast difference between the models. Specifically the lag investment effect of model II reveals that there is low degree of persistence, which implies higher short-run adjustment to long-run equilibrium. The remaining standard determinants of private investment though theoretically carried their a priori predictions, are not statistically significant. The long-term real interest rate effect shows a relatively higher effect reducing real private investment by 30% for every 1% increase. Lastly the coefficient for the summary statistic of the overall macroeconomic uncertainty is negative, statistically significant, and lower in absolute terms both in the short-run and long-run. This result is in line with Serven (1998)[3].

Table 7. Fully Modified Phillips-Hansen Estimates
Parzen weights, truncation lag= 3 , Trended Case

Partial adjustment model
Dependent variable is LNPI
31 observations used for estimation from 1978 to 2008

Regressor	Model I	Derived LE*	Model II	Derived LE*
Intercept	**1.5864**	**14.6821**	**-3.2485**	**-4.5865**
	(2.2330)		(2.1948)	
	[.487]		[.153]	
Lagged private investment[a]	**.89195**		**.29173**	
	(.11816)		(.0882)	
	[.000]		[.003]	
Real GDP[a]	**.35012**	**3.24035**	**.30615**	**0.43225**
	(.71257)		(.6905)	
	[.629]		[.662]	
Lagged real GDP[a]	**-.26684**		**1.3507**	**1.9070**

[3] Estimate of the absolute value of the autocorrelation parameter is restricted to one which is an indication that the estimated partial adjustment investment model is stable.

	(.79229)		(.7988)	
	[.740]		[.105]	
Real interest rate	**-.19709**	**-1.8241**	**-.21255**	**-0.300**
	(.03970)		(.0309)	
	[.000]		[.000]	
Credit flow to priv.sector/**GDP**	**.7539E-3**	**0.06977**	**.015814**	**0.0223**
	(.00805)		(.0104)	
	[.926]		[.142]	
External debt % Total debt[a]	**-.067007**	**-0.62015**	**-.13030**	**-0.1840**
	(.082116)		(.1019)	
	[.425]		[.214]	
Relative price of capital[a]	**-.028515**	**-2.6391**	**-.12025**	**-0.1698**
	(.079795)		(.09927)	
	[.725]		[.239]	
Uncertainty[c]	**……**		**-.40259**	**-0.5684**
			(.12939)	
			[.005]	
Real exchange rate uncertainty[b]	**-.14141**	**-1.3087**		
	(.09624)			
	[.159]			
Price of capital uncertainty [b]	**-10.1642**	**-94.0694**		
	(5.4373)			
	[.078]			
GDP growth uncertainty [b]	**-72.1853**	**-668.0731**		
	(23.8819)			
	[.007]			
Terms of trade uncertainty [b]	**-11.3110**	**-104.6830**		
	(6.1479)			
	[.082]			
Inflation uncertainty[b]	**-.87790**	**-8.1249**		
	(.4552)			
	[.070]			

ADF test of FM-OLS Residuals test statistic = -7.0940 95% critical value for ADF = -2.9665
Wald test of joint restriction on the coefficient of the five macroeconomic uncertainty variables
CHSQ(5)= 20.8731[.001]

Notes: figures in ( ) and [ ] represent standard errors and p-values, respectively.

a. Expressed in logs
b. First principal components of the conditional variances of real exchange rate, relative price of capital, GDP growth rate, terms of trade, and inflation, each obtained from a univariate GARCH(1,1) model.
c. Measured by the conditional variances from the GARCH(1,1) estimates.

*directly derived long-run estimates

Source: Authors' computation

6. Conclusions and Policy Recommendations

In this study we have explored empirically the investment-uncertainty link controlling for some standard investment determinants. Using the standard GARCH (1, 1) and a Recursive estimate of a 5-period standard deviation of AR (1) forecast errors we have constructed uncertainty indicators for five macroeconomic variables - real GDP growth, relative price of capital, and inflation (related to the macroeconomic environment and profitability of capital); and real exchange rate and terms of trade (related to the relative profitability of different economic sectors).

The result of the conditional variance (i.e. sum of ARCH and GARCH effects) for all five uncertainty indicator variables shows high degree of volatility. The Spearman Rank correlation between the two constructed uncertainty measures and private investment reveals a significant negative association between private investment and the five uncertainty indicator variables. Also the

Spearman Rank correlation among the five indicator variables for both constructed uncertainty measures reveals a significant positive association among the five uncertainty indicator variables.

Controlling for some standard investment determinants the paper further investigated the impact of five macroeconomic uncertainty indicators on private investment using the fully modified OLS. The regression result reveals that private investment displays important inertia and slow adjustment to long-run equilibrium. Real GDP and credit flow to the private sector both have an insignificant direct effect on private investment. While external debt and relative price of capital both affect private investment negatively, their effects are insignificant. Real interest rate however, is found to have a significant negative effect on private investment.

On the whole the investment-uncertainty link reveals a significant negative effect of all five macroeconomic uncertainty indicator variables on private investment with the exception of real exchange rate volatility. The values for price of capital uncertainty, real GDP growth uncertainty, and terms of trade uncertainty are large in absolute terms in the long-run relative to the short-run. Lastly, the summary measure of macroeconomic uncertainty which encompasses the first principal components of the conditional variances of the five variables shows a consistent indirect effect on private investment both in the short-run and long-run, though lower in absolute terms.

The significant negative uncertainty effects on private investment behaviour suggest that government give it the needed policy interventions. Accordingly, we recommend that, the government take measures that will encourage fixed investment not only by uniform support for all firms, such as changing depreciation rules in tax reforms, but also encouraging market competition through deregulation of market entry and support for research and development. At the same time firms should be encouraged to enhance their capabilities of risk management in various projects and the business environment through proper risk evaluation and management systems to mitigate the negative impact of increasing uncertainty. Finally we call on the government to ensure the overall harmony and stability of the country both economically and politically.

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