DETERMINANTS OF PRIVATE INVESTMENT IN GHANA

A THESIS

Presented to the School of Graduate Studies

Addis Ababa University

In partial fulfilment of the requirement for the award of the degree of Master of Science in Economics (Economic Policy Analysis).

By

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May, 1997.

Addis Ababa University

School of Graduate Studies

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Determinants of Private Investment in Ghana

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DEDICATION

This work is dedicated to my parents, brothers and sisters and Anthony Ahiawodzi (ESQ).

ACKNOWLEDGEMENT

I wish to acknowledge all those who helped me in diverse ways to complete this thesis. First, I am grateful to almighty God for the strength and courage to go through all the difficult times.

Second, I am greatly indebted to my advisor, Dr. Gerard Kambou, from the Center for the study of African Economies at the University of oxford but currently lecturing at Addis Ababa University, for his invaluable comments and constructive criticisms, and the African Economic Research Consortium (AERC) for offering me a scholarship.

Next, I wish to express my profound gratitude to Dr. Boo Sjoo, a lecturer at Gotenburg University, for equiping me with the tools of time series econometrics at the Joint Facility for Elective (JFE) in Nairobi, Kenya, and Mr Emmanuel Anyidoho, a consultant at the OAU, for his comments.

Last, I owe so much to my brother, Napoleon Sefordzi, and colleagues: Daniel Opoku, Samuel Mulenga, Gerson Harupara, Alfred Sesay, Raymond Wafula, Innocent Rugambwa and Patrick Ngulumbe for their moral support.

QUOTATION

" THE SAFEST WAY TO DOUBLE YOUR MONEY IS TO FOLD IT OVER ONCE AND PUT IT IN YOUR POCKET "

KIN HUBBARD.

ABSTRACT

Despite efforts made by the government of Ghana to encourage private investment, private investment ratios have remained very low and unstable during and after the ERP. Yet for Ghana to have high and sustained real per capita income growth, investment, particularly private investment, will have to rise above current levels. This thesis employs time series techniques to investigate the determinants of private investment in Ghana. The findings are that, in the long run, credit available to the private sector and real GDP have positive influence on private investment, but real lending rates and public investment negatively influence private investment. In the short run real GDP was not significant, but real per capita income growth rate was found to have a positive impact on private investment. Stationarity tests carried out with the ADF and DF tests reveal that the Private Investment series has a permanent memory.

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CHAPTER ONE

1.1 STATEMENT OF THE PROBLEM.

The growth of an economy's output can be attributed to high investment ratios. Empirical studies have shown that investment plays a very important role in the growth of both developed and underdeveloped economies. As noted by Bleaney (1994), faster growing economies tend to have higher rates of investment than slower growing ones. Although both private and public investment may be necessary for economic growth and development, many researchers have found that private investment plays a much more significant role than public investment. Khan and Reinhart(1990), for example, have shown that private investment contributes much more to economic growth when compared to public investment. The OECD and the East Asian economies have registered relatively high average growth rates of real GDP of about 7-8% from 1960 to 1993, which is about 5 times the growth rate of Sub-Sahara Africa, because of their high rates of private investment[1]. Thus, differences in the rates of private investment are responsible for the disparity in the performance of various economies.

Over the past 10 years, the government of Ghana, through the Economic Recovery Program(ERP) and with the support of the IMF and the World Bank, has been implementing a set of wide ranging

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[1] *See Serven and Solimano(1996).*

policies aimed at reducing macroeconomic imbalances in the economy and laying the foundation for rapid and sustainable economic growth with the private sector as the main engine. There were substantial exchange rate reforms, the financial market was liberalized, government deficits were reduced, taxes were cut and inflation was brought under control. However, the implementation of the ERP did not lead to a sustained increase in private investment. Private investment continued to be low and unstable between 1984 to 1991, and declined by about 50% from 1991 to 1992. The decline continued through 1994. Private investment ratios will have to rise beyond current levels for Ghana to maintain high growth rate of real per capita income. The questions, therefore, arise: why has private investment remained so weak in Ghana and what might stimulate it?. This thesis addresses these questions. It employs time series techniques to investigate the determinants of private investment in Ghana, with a focus on how the latter responds to changes in government policies.

1.2 OBJECTIVES OF THE STUDY

The main objectives of this thesis are to: (1) identify the major determinants of private investment in Ghana; (2) determine how macroeconomic policies affect private investment; and (3) apply time series techniques to the private investment data in Ghana. This is because macroeconomic data, including data on private investment and its determinants, are usually

nonstationary. Application of classical regression procedures to such series is likely to yield *spurious* regression results.

1.3 STATEMENT OF HYPOTHESES

The following hypotheses will be tested:

(1) Private investment in Ghana has a permanent memory, that is the investment data are integrated.

(2) Public expenditure "crowds out" private investment in Ghana.

(3) Credit availability to the private sector increases Private Investment in Ghana.

(4) An increase in the real cost of capital dampens the level of private investment in Ghana.

1.4 SIGNIFICANCE OF THE STUDY.

Stimulating private investment remains a key challenge to policy makers in Ghana. Private investment ratios will have to rise above current levels for Ghana to have high growth rates of real per capita income which are necessary to improve the living standards of the population. Because this study empirically evaluates the impact that government policies can have on the private investment in Ghana, it will enhance the understanding of the determinants of private investment in Ghana, and suggest ways in which government policies may stimulate private investment.

Further, Because it uses new techniques in time series modelling to analyze the determinants of private investment in Ghana, the study will contribute to the empirical literature about the determinants of private investment in developing countries, and Serve as a point of reference to further research on investment in Ghana and developing countries in general.

CHAPTER TWO

2.1 ECONOMIC PERFORMANCE AND TRENDS IN PRIVATE INVESTMENT IN GHANA.

This chapter provides a brief overview of the macroeconomic performance of the Ghanaian economy before and after the ERP in 1983 and examines the trends in private investment.

2.2 THE ECONOMY OF GHANA FROM 1960 TO THE DAWN OF 1983.

At independence in 1957, Ghana had an appreciably high level of real per capita income compared to other Sub-Sahara African countries. Ghana was then considered a mid-income country. The growth of real GDP continued at the rate of about 3% until the mid 1960's, stimulated by high exports of cocoa. Table 1 summarizes the performance of the economy from 1961 to early 1983.

In the 1970's economic performance started to decline as revenue from cocoa exports declined and as world energy prices and interest rates rose sharply. The average growth rate of GDP declined from 4.3% between 1967-1971 to 0.3% between 1972-1977. Real per capita GDP growth rate worsened declining from 2.0% between 1967-1971 to -2.3% between 1972-1977. The situation aggravated in the early 1980's as primary commodity prices collapsed. Internally, economic management weakened substantially

and political instability increased. For the first time in post-

TABLE 1: GHANA:KEY MACROECONOMIC INDICATORS 1961-1983

SOME MACROECONOMIC INDICATORS	PERIOD AVERAGE			
	1961-1966	1967-1971	1972-1977	1978-1983
REAL GDP GROWTH	3.0	4.3	0.3	-1.6
REAL GDP PER CAPITA GROWTH	0.4	2.0	-2.3	-4.6
PRIVATE INVESTMENT/GDP	8.4	8.4	5.5	2.8
PUBLIC INVESTMENT/GDP	8.4	3.9	4.8	2.0
PRIVATE SAVINGS/GDP	7.8	6.3	13.0	8.5
PUBLIC SAVINGS/GDP	2.4	1.8	-2.2	-3.9
FISCAL BALANCE	-6.4	-3.4	-10.0	-6.1
BROAD MONEY (M2) GROWTH	41.6	-4.1	36.9	38.9
M2/GDP	- - -	- - -	24.7	17.6
GROWTH OF PRIVATE SECTOR CREDIT	22.8	22.6	14.1	33.1
GROWTH OF PUBLIC SECTOR CREDIT	- - -	- - -	48.3	54.1
REAL LENDING RATE	-2.9	5.8	-16.8	-28.5
INFLATION RATE	11.8	3.9	41.5	73.0
TERMS OF TRADE(1985=100)	89.9	111.1	142.7	117.8
MERCHANDISE EXPORT (% OF GDP)	19.3	17.1	15.7	5.1
MERCHANDISE IMPORT(% OF GDP)	21.4	15.7	12.6	4.5
GROWTH RATE OF TOTAL EXPORTS	---	---	19.1	70.9
GROWTH RATE OF TOTAL IMPORTS	---	---	29.0	77.0
(CURRENT A/C)/GDP	-5.9	-4.1	0.6	-0.3
EXTERNAL DEBT/GDP			22.4	8.9

Source: Ghanaian Authorities;and IMF staff estimates.

independence history of Ghana the economy recorded a negative average GDP growth rate (-1.6%) from 1978 to 1983.

The macroeconomic policy environment was increasingly characterised by large imbalances. There were large budget deficits, averaging 10 percent of GDP from 1972 to 1977, as revenue declined sharply due to low cocoa production and the smuggling of cocoa out of the Country. Revenue fell from about 20% of GDP in the 1970's to less than 5% in 1982. On the other

hand, government consumption increased significantly each year. During the 1972-1977 period the ratio of public saving to GDP was -2.2%. The ratio fell further to -3.9% between 1978 and 1983. To finance the large budget deficits, the government borrowed from the Central Bank, which led to increased money supply. Within the period of 1970's through 1982, the monetary base expanded by 40% on the average. Inflation rose charply despite price controls. Between 1978 and 1982, the rate of inflation was 123%[2]. The high rate of inflation coupled with price controls discouraged private savings and investment in productive sectors. From 1961 through 1971, the average ratio of private investment to GDP was 8.4%, it was 5.5%, on the average, between 1972-1977, and 2.5% between 1978 and 1983. The official exchange rate which was pegged from 1960 through 1982, became overvalued. By 1982 the overvaluation exceeded 1,000%. This situation led to an acute scarcity of foreign exchange which crippled the industrial and agricultural sectors. The development of a parallel foreign exchange market was, therefore, inevitable, contributing to further macroeconomic instability.

In a nutshell, the economy of Ghana before the ERP was characterised by: large budget deficits, pervasive controls, and overvalued exchange rate which discouraged private savings and investment[3]. By early 1983, the economy had virtual collapsed.

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[2] *See Nowak et al (1996).*

[3] *See Armstrong (1996).*

2.3 GHANA AFTER HER ECONOMIC RECOVERY PROGRAM.

Beginning in 1983, the government of Ghana introduced an economic recovery program to revitalise the economy. The main objectives of the ERP were to: (1) restore production incentives for food, industrial raw materials and export commodities; (2) increase the availability of foreign exchange in the country; (3) increase the availability of essential consumer goods; (4) decrease the rate of inflation; (5) rehabilitate the physical infrastructure; and (6) undertake studies to restructure economic institutions[4].

Essentially, the policies undertaken in the 1983 reform were geared towards encouraging the expansion of private savings and investment in a market-based economy, with the Private sector as the engine of growth. From table 2 below, real GDP growth recovered from -1.6% between 1977-1983 to 3.6% between 1983-1986, the first phase of the ERP, a period considered by most economists as the period of stabilization. This growth rate of real GDP is slightly higher than the 3.0% recorded over the 1969-1966 period but lower than the 4.3% achieved in 1967-1971. During the second phase of the ERP (1987-1992), the period of adjustment, the economy registered some further improvement with real GDP growth rate rising to 4.8%, higher than in any period since

TABLE 2: SUMMARY OF THE PERFORMANCE OF THE GHANAIAN ECONOMY DURING AND AFTER ADJUSTMENT

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[4] *See Sowa, N.K (1993).*

SOME MACROECONOMIC INDICATORS	PERIOD AVERAGE		
	1983-1986	1987-1991	1992-1994
	FIRST PHASE OF ERP	SECOND PHASE OF ERP	POST ERP
REAL GDP GROWTH	3.6	4.8	4.2
REAL GDP PER CAPITA GROWTH	1.0	2.2	1.2
PRIVATE INVESTMENT/GDP	3.8	7.0	4.3
PUBLIC INVESTMENT/GDP	3.7	7.6	10.2
PRIVATE SAVINGS/GDP	5.2	6.7	4.0
PUBLIC SAVINGS/GDP	0.5	5.4	4.0
FISCAL BALANCE	-1.7	0.7	-1.7
BROAD MONEY (M2) GROWTH	55.9	33.9	42.2
M2/GDP	12.5	14.5	17.1
GROWTH OF PRIVATE SECTOR CREDIT	86.3	40.1	44.2
GROWTH OF PUBLIC SECTOR CREDIT	68.9	49.2	36.4
REAL LENDING RATE	-12.2	-3.0	7.8
INFLATION RATE	49.3	30.3	20.0
TERMS OF TRADE(1985=100)	100.1	82.8	58.2
MERCHANDISE EXPORT(% OF GDP)	8.2	15.5	18.1
MERCHANDISE IMPORT(% OF GDP)	8.5	19.1	26.2
GROWTH RATE IN TOTAL EXPORTS	100.4	25.6	55.4
GROWTH RATE IN TOTAL IMPORTS	100.2	37.3	47.2
(CURRENT A/C)/GDP	-1.4	-2.5	-6.5
EXTERNAL DEBT/GDP	29.2	56.7	75.9

Source: Ghanaian Authorities;and IMF staff estimates.

independence. Within the entire period of the ERP, the economy recorded an annual real growth rate of 5% and the real per capita income growth rate was 2%, which is comparable to the 2% of 1967-1971 but higher than in every other periods.

The ERP improved the fiscal balance. The high fiscal deficit of -6.1% of GDP between 1978-1983 declined to -1.7% during the first phase of the ERP and in the second phase of the ERP there was, for the first time in the post independence history of Ghana, a budget surplus amounting to 0.7% of GDP. This helped to reduce the growth of money supply which brought down inflation.

Throughout the ERP the average rate of inflation fell, averaging 49.3% between 1983-1986 and 30.3% between 1987-1991 compared to 73.0% between 1978-1983. The rate of inflation within the first phase of the ERP was higher than all the historical rates except during 1978-1983. This, however, was "corrective inflation" brought about by the removal of subsidies and currency devaluation.

The ERP also improved export. The volume of merchandise export as a percentage of GDP increased from 5.1% between 1978-1983 to 8.2% and 15.5% during the first and second phase of the ERP respectively. Merchandise imports as a percentage of GDP also grew, rising from 4.5% on the average between 1977-1983 to 8.5% and 19.1% on the average during the first and the second phase of the ERP respectively. The high growth of imports, relative to exports, led to the deterioration of the current account balance which declined from -1.4% of GDP between 1983-1986 to -2.5 between 1987-1991.

In summary, the ERP helped restore macroeconomic stability in Ghana. Fiscal deficits declined, inflation was brought down, and export as well as import recovered. However the current account deficit and external debt have been rising. The relative improvement in the economy resulted from the implementation of wide-ranging policy reforms. Because they have implications for private investment, we examine briefly the policy reforms related to the exchange rate, the government budget, and the financial sector.

EXCHANGE RATE POLICY.

After April 1983 the government of Ghana implemented a four-stage exchange rate reform. During the first stage the massive overvaluation of the Cedi was corrected through a sizable discrete exchange rate adjustment. From April 1983 to january 1986, the rate which was pegged at 2.75 cedis per $US, was devalued to 90 cedis per US$. Within the second stage, which started in september 1986, the foreign exchange was floated. The government then introduced a dual exchange rate system for official transactions. Access to the auction was gradually broadened to include all payments and transfers for current international transactions by early 1990. During the third phase, which overlapped with the second stage the parallel market for foreign exchange was absorbed. By 1988 private forex bureaus were in full operation and the exchange rate was free floating. This policy was intended to make forex available to the private sector for the importation of inputs and thereby enhance private investment. The devaluation of the Cedi also increased the real domestic producer price of cocoa and improved cocoa production and export. Between 1983 and 1990 the volume of exports, on the average, increased by 10%, reversing the contraction in the previous two decades. In 1992 the Central Bank abolished sale auctions introduced in 1986 and the management of exchange rates now takes place directly in the interbank markets. The final phase of the exchange rate reform began in early 1990 and by april 27 1990, the bank of Ghana discontinued the retail auction

of foreign exchange and introduced the wholesale auction.

FISCAL POLICY.

The period of the ERP saw a changing role of the government in the management of the economy. The government exercised fiscal discipline, lowering expenditure and increasing revenue. The increase in revenue was achieved by lowering tax rates and broadening the base, and also by strengthening tax collection efforts. In 1991 the corporate tax rate was reduced from 45% to 35%; the capital gain tax was reduced to 5%, except for the capital gain tax on income from publicly traded companies as well as from mergers and acquisitions which stayed unchanged; and withholding tax on dividends was cut from 30% to 15%. These cuts in tax rates improved tax compliance. Government expenditure was reduced to 5% of GDP from over 10%. In addition to cutting consumption levels, the government is implementing a comprehensive expenditure reform program aimed at reducing government involvement in activities that can be carried out by the private sector in a cost effective manner. At the same time public spending is being reoriented towards the sectors and activities that are known to promote long term growth, such as health, education and infrastructural.

MONETARY POLICY.

During the ERP restrictive monetary policies were pursued to curb inflation. The reduction in the budget deficit coupled with the use of some indirect instruments of monetary control, such as open market operations, stabilised the monetary base of the economy. The government of Ghana had substantial external financial support which was used to finance public investment in 1988 and 1989. From 1989 through 1991, domestic credit policy was tightened to offset the growth in foreign assets. The fiscal surplus generated in 1989 was used to repay government's debts to the Bank of Ghana. Repayments were increased in the subsequent years and domestic credit extended by the Bank of Ghana declined. Government no longer has unrestricted access to base money. By the end of 1991, the rate of inflation fell to a single digit. However, except in mid 1991 when Bank deposits and lending rates became positive, monetary policy in Ghana has been less successful in restoring positive real interest rates.

2.4 FINANCIAL INTERMEDIATION

During the ERP the government of Ghana undertook a series of financial sector reforms to improve financial intermediation. These reforms included: the decontrol of the maximum bank lending rate and maximum term deposit rate in 1987; the decontrol of the maximum bank savings rate in 1988; the unification of bank cash reserve requirements on demand and time and saving deposits; the

decontrol of bank charges and fees, and reduction in the required bank cash reserves in 1990; and the increase in the remuneration of the bank cash deposits with the Bank of Ghana to 5% in 1991.

Despite the above reforms, financial intermediation remains very low due to low level of confidence in the banking system, insufficient competition, and weak financial infrastructure. The low confidence in the banking system is the result of currency reversion, the withdrawal of cedi 50 note from circulation, freezing of bank deposits in excess of cedi 50,000 pending investigation for tax liability, restricted bank loans for the financing of trade inventories, and the requirement that cheques must be used for any business transaction exceeding cedi 1,000. Although all the restrictions imposed prior to the ERP have been gradually removed, public confidence in the banking system is still not fully restored. Stringent regulations introduced by the financial sector reforms made the banks more cautious about lending to the private sector until 1991 when credit controls were discarded. The financial institutions have increasingly directed their funds to the acquisition of the high-return earning, low-risk government papers thereby crowding out credit to the private sector. In the light of this constraint, Paul(1990) noted that the major constraint facing the private sector in Ghana is credit availability and allocation. The small scale enterprises still depend on the informal financial sector, which finance about 45% of the private sector demand for credit.

2.5 POST ERP PERFORMANCE

The period after the ERP was characterized by constitutional and political reforms and economic uncertainty. A new constitution was adapted in april 1992 and presidential and parliamentary elections were held in november and december 1992 respectively. In a bid to win political support government increased wages by 80%. This fiscal shock led to high rates of inflation and created macroeconomic uncertainty. This had adverse effect on manufacturing and agricultural output. Although the government budget improved in subsequent years, there is concerned that fiscal discipline has not been fully restored and the private sector's expectation that the government may reverse its policies has not changed.

2.6 TRENDS IN PRIVATE INVESTMENT IN GHANA.

The tables below summarise the recent trends in private investment in Ghana. The data for the analysis is computed from the International Finance Corporation (IFC) Discussion papers, volumes 25 (1995) and 28 (1994), and IMF Occasional Papers numbers 86, (1991); 139, (1996); and 143, (1996).

TABLE 3: SUMMARY OF INVESTMENT STATISTICS

THE GDI, PI AND PUB ARE IN CURRENT PRICES					
Year	PRE-ADJUSTMENT		ADJUSTMENT		POST-ADJUSTMENT
	1972-1977	1978-1983	1983-1986	1987-1991	1992-1994
GDI/GDP	10.3%	4.9%	7.5%	14.7%	14.5%
PI/ GDP	5.5%	2.8%	3.8%	7.0%	4.3%
PUB/GDP	8.8%	2.0%	3.7%	7.6%	10.2%

TABLE 4

INVESTMENT-GDP RATIOS											
Year	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994
GDI/ GDP	6.9%	9.6 %	9.4 %	10.4 %	11.3 %	13.2 %	14.4 %	15.9 %	12.8 %	14.8 %	15.5 %
PI/ GDP	4.4%	4.5 %	2.4 %	2.5 %	3.3 %	5.4 %	7.6%	8.1 %	4.3%	4.9 %	4.4%
PUB/ GDP	2.5%	4.2 %	7.3 %	7.9 %	8.0 %	7.8 %	6.8%	7.7 %	8.5%	9.9 %	11.5 %
PI/ GDI	63.9 %	56.5 %	22.3 %	23.8 %	28.9 %	41.2 %	52.8 %	51.2 %	33.6 %	33.2 %	27.4 %

GDI: gross domestic investment, PI: private investment[5]
PUB: public investment

Prior to adjustment, the share of GDI in GDP (on the average) was 10.3% between 1972 and 1977. Between 1978 and 1983 GDI fell to 4.9% of GDP, a decrease of more than 50%. The study by Hadjimichael et al(1996) found that the low investment rates resulted from the scarcity of foreign exchange. During the period of the ERP, GDI improved due to macroeconomic reforms. From 1983 to 1986, the ratio of GDI to GDP was 7.5%, on the average. This figure increased by nearly 100% to 14.7% from 1987 to 1991.

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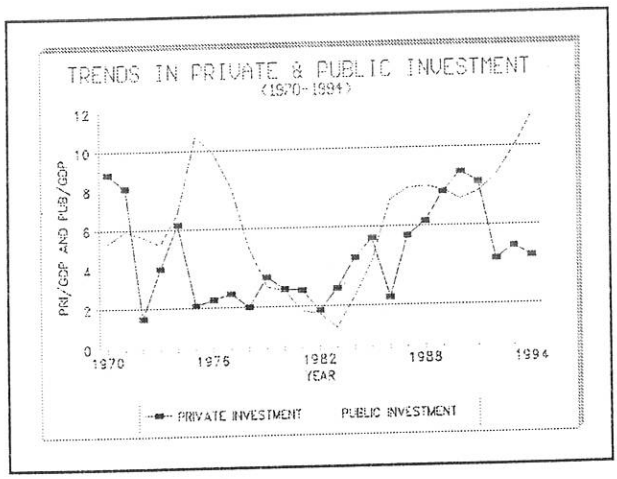
[5] *Private Investment is defined as non-government investment. The difference between Gross Domestic Investment and Private Investment is Public Investment.*

During the adjustment period, GDI as a percentage of GDP was 6.9% in 1984. By 1985 it increased to 9.6% and decreased to 9.4% in 1986. This figure increased by about 10% to 10.4% in 1987. The increasing trend continued until 1992 when GDI declined to 12.8% of GDP from 15.9% in 1991. In 1993 and 1994 the GDI ratio rose to 14.8% and 15.9% respectively. The uneven and relatively weak investment performance within this period could be attributed to persistent macroeconomic policy uncertainty, financial instability and tight government policies that kept public investment as well as private investment low. The figure below illustrates the evolution of private and public investment from 1970 to 1994.



The evolution of GDI hides important differences between private and public investment. Before adjustment, private and public investment as a percentage of GDP were on the average, 5.5% and 2.8% between 1972 and 1977, and 4.8% and 2.0% between 1978 and 1983 respectively. Both private and public investment declined during the latter half of 1970s, reaching a low level of 2% and 1% of GDP, respectively, by 1982. During the period of adjustment, private and public investment represented 3.8% and 3.7% of GDP between 1983 and 1991, and 7% and 7.6% of GDP between 1987 to 1991, respectively. On the average, public investment exceeded

private investment from 1987 to 1991. This may be because during the ERP the Government of Ghana had substantial foreign financing which helped Public investment to recover strongly. By mid-1980s, public investment had surpassed the level achieved in the 1960s and 1970s. This investment was directed towards the rehabilitation of infrastructure in the economy[6]. On the other hand, the recovery of Private investment was modest until the second half of the ERP(1987-1991) when a relatively high and sustained rate was recorded.

In 1984 private investment stood at 4.4% of GDP before increasing to 5.4% in 1985. However, private investment fell sharply in 1986, declining by more than 50% from its 1985 level. This sharp decline occurred at the time when the forex market was deregulated and the country was awarded an adjustment credit by the world bank to rehabilitate the industrial sector. The possible explanation for the weak performance of Private investment may be uncertainty associated with the exchange rate policy change and lack of capital in the private sector to import inputs. 1987 saw a recovery, with private investment rising steadily from 2.5% to 8.1% of GDP in 1991.

In the post-adjustment period of 1992 to 1994, public investment increased to 10.2% of GDP but private investment declined to 4.3%. According to Hadjimichael et al(1996) "in 1992 and 94, private investment slumped in the wake of slippage in the

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6 *See Hadjimichael et al(1996).*

implementation of financial policies". Comparing the overall performance of private and public investment as a percentage of GDP, the former recorded higher rates in 1984, 1985, 1990 and 1991. All the other years the public sector did much better, with differences of 5.2% and 7.1% in 1986 and 1994 respectively. Overall the public investment ratio rose, increasing from 2.5% of GDP in 1984 to 11.5% in 1994, while the private investment ratio remained at 4.4% of GDP as in 1984.

CHAPTER THREE

3.1 LITERATURE REVIEW

3.1.1 THEORETICAL LITERATURE

3.1.2 THEORIES OF INVESTMENT

Investment theories have evolved overtime. This section provides a brief summary of these theories.

(A) THE KEYNESIAN THEORY OF INVESTMENT.

The origin of the more recent theoretical literature on (independent) investment function can be traced to Keynes(1936). According to Keynes the quantity of desired investment is a function of the marginal efficiency of investment(MEI) or the rate of returns on investment and the interest rate, with the latter a function of liquidity preference and the stock of money. Investment is worth undertaken if the present value of the future stream of returns is equal to or greater than the initial cost of capital. Keynes observed that investment spending is highly volatile due to the uncertainty associated with the returns on investment. According to him, this explains the business cycle. The decisions to invest are based on the "animal spirits" of the investors.

(B) THE ACCELERATOR THEORY OF INVESTMENT

The work of Keynes motivated other economists in the 1950's and early 1960's to come up with the accelerator theory of investment. According to this theory, net investment is a linear function of *change* in output. The limitations of this theory are its simplistic assumptions which are: (1) There is a constant ratio of desired capital stock to output, (2) there is sufficient investment to keep desired capital stock to the actual. In spite of the simplistic nature of the accelerator model Sachs and Larrain(1993) stated that " quite surprisingly to many economists, the theory outperforms many other sophisticated theories".

(C) THE NEOCLASSICAL THEORY OF INVESTMENT

Given the limitations of the accelerator theory, Jorgenson(1967) and Hall and Jorgenson(1971) came up with the neoclassical theory of business fixed investment. According to this theory, net investment is proportional to the gap between actual and desired capital stock. This relationship is given by:

$$I_t = K_t - K_{t-1} = \lambda (K^* - K_{t-1}),$$

were I_t : is net investment,

K_t : is existing capital stock at the end of the current period,

K_{t-1}: is capital at the end of the preceding period,

K^* : is desired of capital stock, and

λ : measures the fraction of the gap between the actual and the desired level of capital stock that is closed each period.

The desired capital stock is positively related to the expected level of output(Y), and negatively related to the rental cost of capital(rc). Further, the rental cost of capital depends on real interest rate, expected rate of inflation, and investment tax credit. Also, expected output is affected by current level of output. It, therefore, follows that factors such as changes in GDP, the rental cost of capital, and investment tax credit, that affect the level of desired capital stock subsequently affect private investment behaviour. This theory is criticized on the grounds that it makes the following simplifying assumptions: (1) Perfect competition, (2) Output is exogenously determined, (3) expectations regarding prices, interest rates and output are static.

(D) TOBIN'S Q-THEORY

James Tobin(1969) propounded the *q-theory* of investment. The main concern of his *q-theory* is how to measure the gap between the desired and actual level of capital stock. The q, according to Sachs and Larrain (1993) is defined as "the ratio of the cost of acquiring the firm through the financial market versus the cost of purchasing the firm's capital in the output market". If

$q > 1$, it follows that desired capital stock is greater than the actual level of capital stock which also implies that the market value of the firm exceeds its cost, hence investment will increase, and vice versa for $q < 1$.[7]

(E) DISEQUILIBRIUM MODELS OF INVESTMENT[8]

These models were developed by Malinvaud(1980, 1982) and Sneessens(1987). The models were based on the idea that investment depends on profitability and output demand conditions. According to Malinvaud, investment decisions separate in two stages. The first is the decision relating to the expansion of the level of productive capacity which depends on the level of capacity utilization in an economy, an index of demand conditions. Second is the decision relating to the capital intensity of the additional capacity which is a function of the cost of capital and labour. In the words of Serven and Solimano(1992) " the distinction between both decisions is necessary due to the assumption of putty-clay technology, so that factor proportions are flexible ex-ante and rigid ex-post". Thus, the proportion to which inputs are combined before investment is variable but fixed after that. Sneessens(1987), theorized that net investment is positively related to the gap between actual and long run equilibrium capacity. This gap reflects the

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[7] *See Sacks and Larrain (1993)*

[8] *See Serven and Solimano(1992), vol.7, pp 98-99*

discrepancy between actual and equilibrium rates of capacity utilization (sales constraints), and actual and equilibrium mark up rates (profitability). It is these situations of disequilibra that influence investment behaviours.

The disequilibrium models are based on simplistic assumptions about rational expectation and this has been the basis of criticisms. The counter argument has been that, it is possible for rational expectation and market disequilibrium to coexist. Both the input and the output markets may not clear when rational economic agents anticipate future sales constraints, and price and wage rigidities. Thus the market disequilibrium model and rational expectations can combine to explain the determinants of investment.

(F) INVESTMENT UNDER FINANCIAL CONSTRAINT

A model that improved upon the disequilibrium models of investment by augmenting the sales constraint and profitability with credit constraints was developed by Rama (1987). The model is specific to developing countries where credit is one of the most crucial constraints to investment. Savings ratios are low in under developed countries due to: first, low foreign savings resulting from high stock of foreign debts and, second, low domestic savings due to large budget deficits. In most LDCs interest rates are administered and firms at the micro level face credit rationing. With credit rationing firm's retain earnings

or internal finance and external finance, such as bank credit and bonds, are not perfect substitutes. This is because credit rationing raises the cost of new debt and equity over and above the opportunity cost of retain earnings[9]. With credit rationing firms might not be able to undertake their desired level of investment.

3.1.3 MACROECONOMIC DETERMINANTS OF PRIVATE INVESTMENT.

From a theoretical point of view, many macroeconomic variables influence private investment. Some of these variables are: government fiscal deficits, monetary policy, interest rate policy, credit policy, exchange rate policy, inflation rate, external debt burden, real per capita GDP and financial intermediation.

First, expansionary government spending may "crowd out" private investment if it competes with the private investors in the input, output or financial markets. This is because the public sector has all the power to compete out the private sector in the financial markets of developing economies. According to Chhibber and Dailami(1990) the private sector is also excluded from using resources of non-banking financial institutions, such as insurance companies. Access to these resources are reserved exclusively to public sector companies and often at subsidised

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9 *See Servan and Solimano(1992), pp 99*

rates. This policy can also reduce the credit availability to the private sector. On the other hand if increased public spending is directed towards infrastructural development and other complementary services to the private sector, investment from the private sector may increase.

Second, in the short to medium term, expansionary monetary policy will result in a reduction in the rate of interest and, hence, lower the cost of borrowing. This policy will also make loanable funds available to the private sector by reducing the opportunity cost of retained earnings. The aggregate effect of this policy will be an increase in private investment.

Third, real interest rates can have either positive or negative effect on private investment. According to Mckinnon-Shaw hypothesis, these two variables are positively correlated. This is because higher interest rates induces savings and as a result make funds available for investment. By contrast, higher interest rate increases the cost of capital which will subsequently lead to a decline in investment.

Fourth, in the world of Modigliani-Miller, all investment projects will have adequate finance at a given interest rate. This is not usually the case in both LDCs and industrialised economies. There is credit rationing due to information asymmetry. To ensure equity in distribution, rationing becomes the equilibrium feature of the credit markets. With particular reference to the LDCs, capital markets are segmented and there

are regulatory rules for credit allocation[10]. Low administered interest rates are offered to some firms and other borrowers are relegated to informal credit markets where they may obtain credit but at a much higher interest rate.

Fifth, exchange rate policies are frequently used by governments to correct external imbalances. The objectives of exchange rate devaluations are to reduce expenditure on imports and increase exports. These expenditure switching policies may have conflicting effects on private investment. For example, devaluation reduces the relative price of non-tradables, which results in the diversification of resources towards tradables. Hence, investment in tradables vis-a-vis non-tradables increases. However, a devaluation also increases the burden of foreign debt and thereby reduces the credit worthiness of private businesses that produce both tradables and non-tradables.

Sixth, high domestic inflation rate will have an adverse effect on private investment by enhancing the riskiness of longer-term investment projects, reducing the average maturity of commercial loans and distorting the information conveyed by prices in the economy. Also high inflation rates are a signal of macroeconomic instability. However, "according to Tobin-Mundell effect, higher anticipated inflation leads to a lower real interest rate and causes portfolio adjustment away from real money balances towards real capital. Hence a higher anticipated

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[10] *See Solimano, A.(1989).*

inflation would lead to an increase in real Investment"[11].

Seventh, external debt burden, which is usually proxied by the ratio of external debt to GDP or debt services ratio, can have either positive or negative effects on private investment. If a constant proportion of foreign capital is allocated to investment activities, then the higher the ratio of debt to GDP, the more funds are available for private investment. On the other hand a high ratio of debt to GDP is an indication that a country has a large debt "overhang" which may discourage investment. Clements and Levy (1994) noted that investment decisions are irreversible, and investment is discouraged during periods of macroeconomic uncertainty associated with external imbalances and the financial requirements of debt service.

Eighth, it has been shown by some economists that the level of per capita income has a positive correlation with private investment because wealthier countries or economies devote much more income to investment.

Finally, improvement in financial intermediation can either encourage or slow down savings and investment. Financial liberalization lifts the ceiling on interest rates and allow the rates to be market determined. This may encourage savings and subsequently increase investment if it contributes to an increase in expected profit and capital. On the other hand a rise in

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[11] *This implies that the Fischer effect is not at work. See Nowak et al(1996), P 7.*

interest rate, resulting from financial liberalization, may decrease savings and investment. This is because higher interest rates increase the stream of future income and wealth and this may increase the marginal propensity to consume relative to that of savings. In this case Investment will decline. This means that the substitution and income effects of interest rate changes play an important role in determining the effect of financial intermediation on private investment.

3.2 EMPIRICAL LITERATURE.

(A) AN OVERVIEW

Despite the vital role that private investment plays, the literature in this area is scanty. According to Martin and Wasow (1992)," empirical studies on the determinants of private investment in developing countries have been few and far apart". These studies started just a decade ago.

An important research done to capture the determinants of investment in developing countries was by Greene and Villanueva (1990). The equation they estimated was not derived from an explicitly specified model because of the complications involved in applying standard investment models to private investment behaviour in developing countries. From the 23 countries they studied, they found out that the following factors were significant in their regression analysis:

(a) Real per capita income growth rate

(b) Per capital GDP level

(c) Real interest rate

(d) Public investment rate

(e) Domestic inflation rate

(f) External debt burden

First, Greene and Villanueva found that a higher growth rate would increase private investment activity if the relationship between the level of real output and the desired capital stock is relatively fixed. This result is also supported by Fielding(1994) when he analyzed private investment in Sub-Sahara Africa including Ghana, using a similar regression model. Second, their findings support the hypothesis that the level of Per capita GDP is positively related to private investment. In contrast a study, done on 32 countries over the 1975-1985 period by Ozler and Rodrik (1992), showed that the coefficient of the per capita GDP was not significant in their investment model. Third, Greene and Villanueva found that real deposit interest rate is negatively related to private investment. This finding is also confirmed by Solimano(1989). By contrast Blejer and Khan (1984) and Dailami (1990) found the real deposit interest rate coefficient to have a positive effect on private investment. The positive relationship between real deposit interest rate and private investment is consistent with the Mckinnon-Shaw hypothesis (1973). Fourth, Greene and Villanueva found a positive relationship between public investment and private investment. This finding, which is consistent with the complementarity

hypothesis, is supported by Blejer and Khan(1984), and Serven and Solimano (1991). Others, for example Bellasa (1988), were, however, on the contrary. Fifth, according to the findings of Greene and Villanueva, high inflation rate has a negative effect on private investment. By contrast Fielding (1995), using an error correction model of investment found that the rate of inflation was positively related to private investment in Cameroon. Sixth, they found a negative relationship between the ratio of external debt to GDP and private investment. By contrast, the studies by Fielding (1994) found a positive relationship between the two variables.

Some variables that affect private investment behaviour were not included in the equation estimated by Greene and Villanueva. These are: credit to private sector and exchange rate. The research by Chhibber and Dailami (1990) found that there is a significant positive relationship between the availability of credit to the private sector and private investment. This hypothesis was supported by the regression results of Blejer and Khan (1994). Regarding the exchange rate, a study by Chhibber and Shaffik (1990) has shown that the real exchange rate is negatively related to private investment in the short run. The same result was obtained by Solimano (1990). However, both found that in the medium term the effect of exchange rate devaluation becomes positive so that the positive effect outweighs the short run negative effect.

(B) GHANA

Most of the studies surveyed above have two common features. First, they are based on time-series – cross-sectional data. Second, with the exception of Fielding (1995), their sample of countries excludes Ghana. In what follows below, we review two papers on the determinants of private investment in Ghana.

First, Nowak et al (1995) undertook a specific study on the determinants of private investment in Ghana using annual data from 1976 to 1991. They found out that lagged GDP growth is positively related to private investment; the exchange rate premium had a negative impact before the ERP and positive impact after the ERP; real interest rate is negatively related to private investment; and that export price fluctuations as well as credit availability were not significant.

Second, Goldsbrough et al (1996) conducted a study on the determinants of private investment in Ghana using annual data from 1971 to 1993. They found that: lagged GDP growth and external shocks have positive effect on private investment; financial variables (ie real interest rate and relative prices), public investment, measures of uncertainty (ie inflation rate, parallel market premium, and real effective exchange rate) all had negative effects on private investment. Other factors such as real growth in credit to the private sector, external debt to

GDP and debt service ratio, and sample volatility measures were not significant.

The papers by Nowak et al and Goldsbrough share two similarities with the studies reviewed above. First, with exception of external shocks all the variables they considered in their regression were also considered by the cross-sectional studies. Second, like the studies of Greene and Villanueva (1990) and Fielding(1994), their model was not derived from a formal model of private investment.

The study by Nowak et al, Goldsbrough et al as well as the earlier ones have two important limitations. First, because they follow a time-series – cross-sectional approach they face the problem of heterogeneity bias. Countries within the sample may have different private investment behaviours such that predictions about a country within the sample are likely to be inaccurate. Second, the macroeconomic variables in their regression may not be stationary and therefore the estimation results may be spurious. Like the above studies, this research analyses the effect of government policies on private investment. Unlike them, however, it addresses the problem of *spurious regression results* by employing current econometric techniques such as cointegration, pair-wise cointegration, error correction mechanisms and Granger Causality test to investigate the determinants of private investment behaviour in Ghana.

CHAPTER FOUR

4.1 MODEL SPECIFICATION

The model of private investment used in this thesis is adapted from the "Sectoral Model of Turkish Private Investment" developed by Guncavdi et al(1996). The theoretical macroeconomic model, which is in an error correction setting, is developed from the firm's multiperiod decision problem[12]. We are interested in this model because its theoretical basis is sound and it can be applied to Ghana. The starting point of the model is the long-run equilibrium level of investment equation, which will be expanded to capture all the other possible determinants of private investment behaviour in Ghana. The final model to be estimated will be in a cointegrating setting so as to have a long run component of the variables which obeys equilibrium constraints while allowing for flexible dynamic specification out of equilibrium.

In the long run, when we have steady state equilibrium, the investment equation, as derived by Guncavdi et al(1996) is:

$$I^*_{t+1} = f(\hat{Y}_{t+1}, (C/W)_{t+1}, \delta) \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (1)$$

Where; I^*_t is the optimal level of investment,

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[12] *See Guncavdi et al(1996) for the complete derivation of the model.*

Y_t :GDP,

$(C/W)_t$: Relative user cost of capital; C is interest rate and W wage rates , and

δ : constant rate of depreciation.

Given the optimum level of investment, the problem that the firm faces is to determine how much to invest in the short run to achieve the long run equilibrium level. It is assumed that in the process of moving towards the optimum level of investment, the firm wishes to minimise costs arising from adjustment of the capital stock. Assuming further that the adjustments cost follows a quadratic function, the solution to the firm's cost minimization problem yields the error correction model given by equation (2) below (given that the target level of investment follows a random walk with drift).

$$\Delta I_t = \alpha_0 + \alpha_1 \Delta I^*_t + \alpha_2 (I^*_{t-1} - I_{t-1}) \quad \ldots\ldots\ldots (2)$$

If the functional form of equation (1) is linear it can be written as:

$$I^*_t = \alpha_0 + \alpha_1 \hat{Y}_t + \alpha_2 (C/W)_t + e_t \ldots\ldots\ldots (3)$$

Substituting equation (3) into (2), we obtain an estimatable error correction model given as:

$$\Delta I_t = b_0 + b_1(L)\Delta \hat{Y}_t + b_2(L)\Delta (C/W)_t - b_3 (I^*_{t-1} - I_{t-1}) + u_t, \quad \ldots\ldots (4)$$

where L is lag operator, and $(I^*_{t-1} - I_{t-1})$ is the error correction term which is supposed to "capture the adjustment to prediction errors made by agents". Before estimating the above equations, the authors included public investment and credit to the private sector in order to test whether they affect private investment in Turkey. We follow the strategy of Guncavdi et al but hypothesize that the optimal level of private investment depends on the rate of inflation, public investment, Real exchange rate, external debt burden, price uncertainty and real per capital income growth rate.

The long-run private investment function (equation 1) is therefore augmented with those factors given by Z_t below:

$$Z_t = Z(\pi, I_{g,t}, \text{RER}, \text{CR}, \text{EXT}, \text{RPCIGR}) \ldots . (3)$$

π :the rate of inflation based on the CPI.

$I_{g,t}$:public investment.

RER :Real exchange rate,

CR :Credit to the private sector,

EXT :external debt burden measured by the ratio of external debt to GDP, and

RPCIGR :real per capital income growth.

It follows that we can redefine the optimum level of aggregate private investment as:

$$I^*_t = \alpha_0 + \alpha_1 \hat{Y}_t + \alpha_2 (C/W)_t + \alpha_3 Z_t + e_{1t} \ldots . (6)$$

If the variables at their levels are nonstationary but are cointegrated (ie $e_{1t} \sim 0$, σ^2_e) we cannot apply standard t-statistics because the standard errors of the coefficients of the variables in the model have non-standard distribution. In this case the test of significance is pair-wise cointegration test. On the other hand if the error term has a unit root, the asymptotic properties of the estimated coefficients do not converge to a constant but a random variable which is a function of Weiner Process or Brownian motion.[13]

The error correction representation of equation (6) is:

$$\Delta I_t = \beta_0 + \beta_1 \Delta \hat{Y}_t + \beta_2 \Delta (C/W)_t + \beta_3 \Delta Z_t - \beta_4 [I_t - (\alpha_0 + \alpha_1 \hat{Y}_t + \alpha_2 (C/W)_t + \alpha_3 Z_t)]_{-1} + u_t \quad \ldots\ldots\ldots\ldots (8)$$

The parameter β_4 determines the speed of adjustment to the long run equilibrium. We can then substitute the value of Z_t to get the final model to be estimated. This is as below:

$$\Delta I_t = \beta_0 + \beta_1 \Delta \hat{Y}_t + \beta_2 \Delta (C/W)_t + \beta_3 \Delta I_{g,t} + \beta_{40} \Delta \pi + \beta_{41} \Delta RER + \beta_{42} \Delta CR + \beta_{43} \Delta EXT + \beta_{44} \Delta RPCIGR - \beta_5 \{ I_t - [\alpha_0 + \alpha_1 \hat{Y}_t + \alpha_2 (C/W)_t + \alpha_{30} \pi + \alpha_{31} RER + \alpha_{32} CR + \alpha_{33} EXT + \alpha_{34} RPCIGR +$$

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[13] *These processes are beyond the scope of this work. We, therefore, set the model to generate a white noise error term.*

$\alpha_5 I_{g,t}) \}_{-1} + u_t$ .....(10)

From the model to be estimated the following sings are expected:[14]

$\beta_1 > 0$, $\beta_{42} > 0$, $\beta_{44} > 0$, $\beta_5 > 0$,.

The following cannot be determines a priori; β_2, β_3, β_{40}, β_{41}, β_{43}. If structural breaks are observed in the series the appropriate dummies will be introduced. The model developed here is best suited for the Ghanaian economy because it includes macroeconomic variables that the literature affirms can explain private investment behaviour in a typical developing country such as Ghana.

4.2 METHODOLOGY

4.2.1 INTRODUCTION.

This research involves the use of time series data, the vast majority of which are non-stationary in levels. The regression of non-stationary series on other non-stationary series is most likely to generate a spurious regression result. According to Granger and Newbold(1974) as a rule of thumb, a regression result is spurious if R^2 is greater than Durbin-Watson(DW) statistics.

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[14] *See literature review for reasons.*

Even though it has significant t-statistics and high R^2, the DW statistics will have low values which will converge to zero as the sample size increases. The low DW values positively influence the potential of the test to reject the null hypothesis of no relationship between variables even when this is true. There are two techniques that can be employed to avoid spurious regression results: (1) Cointegrating technique which was advocated by Granger and Newbold, or (2) Transforming data to make it stationary before applying the Classical Regression techniques.

4.3 STATIONARY AND NON-STATIONARY SERIES.

4.3.1 STATIONARITY

A series is stationary when it has a spectrum which is finite but non zero at all frequencies. Such series are said to be integrated of order zero denoted by I(0)[9]. Regression with stationary series does not pose any serious problem in times series econometrics.

4.3.2 NON-STATIONARITY

A series is non-stationary if its moments are not time invariant. One typical class of non-stationary series that is

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[9] *See Granger(1986)*

usually encountered in macroeconomics is integrated series. According to Granger(1986) "a series with no deterministic component and which has a stationary and invertible autoregressive moving average (ARMA) representation after differencing d times but non-stationary after differencing d-1 times is said to be integrated of order d,denoted by $X_t \sim I(d)$".Integrated series have permanent memory and unbounded variance.

4.4 THE TESTS FOR UNIT ROOT

There are several tests that are used to test for unit root but the widely acceptable and reliable are the Dicker-fuller(DF) and the augmented Dicker-Fuller(ADF) tests.

4.4.1 THE DF TEST FOR UNIT ROOT.

This test is formulated as follows:

$$\Delta Y_t = \delta Y_{t-1} + \epsilon_t \quad \ldots\ldots\ldots\ldots\ldots\ldots (1)$$

$$\Delta Y_t = \alpha + \delta Y_{t-1} + \epsilon_t \quad \ldots\ldots\ldots\ldots\ldots\ldots (2)$$

$$\Delta Y_t = \alpha + \beta t + \delta Y_{t-1} + \epsilon_t \quad \ldots\ldots\ldots\ldots\ldots\ldots (3)$$

The first equation is without a constant and a time trend, the second has a constant but no time trend and the third has a constant and time trend. The null hypotheses for all the three equations is the same, and given as: $Ho: t_\delta = 0$ (non-stationarity

or unit root). The critical values of the tests depend on whether a constant term and/or time trend is included in the equation. Since the error term in the above is usually serially correlated, the DF test is sensitive to augmentation.

4.4.2 THE ADF TEST.

This test augments the DF test with some lag structures. It is stated as follows;

$$\Delta Y_t = \delta Y_{t-1} + \Sigma\gamma_i \Delta Y_{t-1} + \epsilon_t \quad \ldots\ldots\ldots\ldots\ldots\ldots (1a)$$

$$\Delta Y_t = \alpha + \delta Y_{t-1} + \Sigma\gamma_i \Delta Y_{t-1} + \epsilon_t \quad \ldots\ldots\ldots\ldots\ldots\ldots (2a)$$

$$\Delta Y_t = \alpha + \beta t + \delta Y_{t-1} + \Sigma\gamma_i \Delta Y_{t-1} + \epsilon_t \quad \ldots\ldots\ldots\ldots\ldots\ldots (3a)$$

The null hypotheses of the test is the same as that of the DF test because both tests have the same asymptotic properties. One typical problem of the ADF test is that the lag structure is not known.

4.4.3 TEST FOR UNIT ROOT IN THE PRESENCE OF STRUCTURAL BREAKS

The cumulative sum of recursive residual(CUSUM) and the cumulative sum of residual square(CUSUMQ) will be used to detect structural breaks if the regression does not contain lagged dependent variables. Otherwise the Chow test will be used. Structural breaks can influence the intercept and/or the trend

coefficient of the regression at the time of the break.[10] The ADF equation is as below:

$$\Delta Y_t = \alpha + \beta t + \theta DU_t + \lambda DT_t + dD(TB)_t + \delta Y_{t-1} + \Sigma \gamma_i \Delta Y_{t-1} + \epsilon_t$$

Where TB is the time of the break, and

DT, DU, D(TB) are dummies;

DT_t = t if t > TB and zero otherwise,

DU_t = 1 if t > TB and zero otherwise,

D(TB) = 1 if t = TB+1 and zero otherwise.

Note: Ho : $\delta = 1$ (unit root) and ,

Ha : $\delta < 1$ (stationarity)

4.4.4 OTHER TESTS FOR UNIT ROOT

(a) SARGAN-BHARGAVA DURBIN-WATSON (SBDW) TEST

This test is based on the standard **DW** statistics. Unlike the **DW** test it is applied to the individual series on levels. The hypotheses are stated as follows:

Ho: **I(0)**, for **DW** not significantly different from 2; and

Ha: **I(1)**, for **DW** greater than 2.

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[10] *See Perron(1994)*

(b) SCHMIDT AND PHILLIPS LM (LMSP) TEST

This test assumes a data generating process given by, $Y_t = \alpha + \beta t + X_t$, and $X_t = \Pi X_{t-1} + U_t$, where U_t is a white noise process. The test is based on the following hypotheses:

Ho : $\Pi = 1$ (nonstationarity), and

Ha : $\Pi < 1$ (no unit root).

The limitation of this test is that it is relatively unknown.

(c) KWIAKOWSKY, PHILLIPS, SCHMIDT AND SHIN (KPSS) TEST

This test assumes a data generating process of:

$Y_t = bt + V_t + \epsilon_t$, where $V_t = V_{t-1} + e_t$, $\epsilon_t \sim NID(0, \sigma^2\epsilon)$ and et $\sim NID(0, \sigma^2_e)$. The hypotheses are:

Ho: $\sigma^2_e = 0$, (Y_t is stationary), and

Ha: $\sigma^2_e > 0$, (Y_t is nonstationary).

The advantage of this test is that it is good for testing fractional integrations. Its limitation is that although it is an extension of Z test discussed below, it leads to new critical values.

(d) PARK'S G-TEST [G(P,q) TEST]

This test is based on the observation that for non stationary series the estimated residuals are inappropriate and that the unrelated variables are statistically insignificant. The test therefore estimates:

1. $Y_t = \alpha + \beta t + \epsilon_{1t}$
2. $Y_t = \alpha + \beta_1 t + \beta_2 t^2 + \epsilon 2_t$

where t^2 is *overflows* variable. The G statistics is then calculated as: $G(1,2) = (RSS1 - RSS2)/S^2(k)$, where: RSS1 and RSS2 are the residual sum of squares from equation one and two respectively. This test is also relatively unknown.

(e) PHILLPS AND PERRON'S Z TEST

This test adjusts the t statistics in the DF model so that the t follows the DF table. The test has an advantage over the ADF if problems of normality, heteroscedasticity, and autocorrelation exist in the series. On the other hand it is not advisable to use this test if negative moving average components are suspected in the error term.

4.5 THEORY AND TEST FOR COINTEGRATION

Since the variables in our model are likely to be integrated of order greater than zero we shall employ the test of cointegration. Series are said to be cointegrated if there exist some long-run equilibrium relationship between them. The deviation of the cointegrating variable from its long run relationship due to random shocks produces a stationary process even though the series have infinite variance.

4.5.1 TEST FOR COINTEGRATION

This test examines whether some linear combination of the non-stationary series in the regression produces a white noise process or not. Although there are many tests that can be used, we shall concentrate on the Engle-Granger(EG) two- step procedure and the Johansen's multivariate Vector Autoregressive (VAR) approach.

(A) THE ENGLE-GRANGER TWO STEP PROCEDURE

This test requires performing a unit root test on the residuals from the regression on levels. It is a two-step procedure because: (1) we have to save residuals from the OLS applied to the series on levels, and (2) perform a unit root test

on the estimated residuals. The null hypothesis for this test is that the estimated error term has a unit root and the alternative is that the variables are cointegrated. According to Maddala(1991) the way the null and the alternative hypotheses are formulated and the significant levels are such that the test is biased towards accepting no cointegration. The absence of cointegration may result from: (1) omission of some important variables, (2) some problems with the data, (3) the combination of (1) and (2). The limitation of the EG 2-step procedure is that it is limited to bivariate analysis.

(B) JOHANSEN TEST FOR COINTEGRATION

This test is an error correction representation of the standard vector autoregressive(VAR) model in the form:

$$X_t = A_1X_{t-1} + \ldots + A_kX_{t-k} + \mu + \theta D_t + \epsilon_t$$

Where X_t is a row vector of macroeconomic variables, μ is a vector of constants, D is a vector of seasonal dummies and $\epsilon_t \sim (0, \sigma^2)$.

An error correction representation of the above is;

$$\Delta X_t = \Gamma_1\Delta Xt\text{-}1 + \ldots + \Gamma_{k-1}\Delta Xt\text{-}k + \Pi X_{t-k} + \mu + \theta D_t + \epsilon_t$$

This implies that:

$\Delta X_t = \Pi X_{t-i} + \Sigma \Gamma_i \Delta X_{t-i} + \epsilon_t$, Where:

$\Gamma_i = -(I - \Pi_i - \ldots - \Pi_{k-1})$ $i = 1, \ldots k$

$\Pi_i = -(I - \Pi_i - \ldots - \Pi_k)$

Where I is an identity matrix.

This test will be used to determine whether the Π matrix contains the long run information. Given that the dimension of the matrix X is N, the following 3 cases are possible: (1) rank(π)= N, this implies that the series are stationary; (2) rank(π) =0, this means that we have non-stationary series that are not cointegrated; and (3) 0< rank(π)< N, this implies that there are some distinct cointegrating vectors in the series. The number of the distinct cointegrating vectors is determined by the rank of the matrix. If the third scenario occurs then we have: $\pi = \alpha' \beta$ such that, $\pi X_t = \alpha' \beta X_{t-1}$, Where βX_t is the vector of cointegrating relations and α' is the matrix of adjustment coefficients measuring the strength by which each cointegrating vector affects an element of ΔX_t. The likelihood test statistics, $-2\ln Q = -T \sum \ln(1-\lambda_i)$, is used to determine the number of the cointegrating vectors, where T is the total number of observations, and λ_i are the estimated eigenvalues from π matrix corresponding to its rank.

4.6 THE ERROR CORRECTION MODELS.

In a bid to avoid spurious regression results, some researchers run their regression on the differences of non-stationary series. This is not advisable because all the information about the long run relationship between the variables at their levels is lost. The best solution is to use an error correction mechanisms which can help to capture both the long run and the short run relationship between the variables. According to the Granger representation theorem,"if a set of variables are cointegrated then there exists a valid error correction representation of the data"[11]. The ECM can either be constructed from the cointegrating equation or one can impose long run homogeneity directly and construct the ECM directly without estimating the parameters. These two scenarios yield the same result. According to Stock, and Engle and Granger, the two approaches produce consistent parameter estimates. Also, since the conventional asymptotic properties of the t-distribution are valid it can be used to test the significance of the parameter estimates of the ECM. One problem that can be encountered in estimating the ECM is the choice of the appropriate lag structure of the variables in the model. If different combinations of the lag structures produce white noise residuals then the test for rival models will be used to select the best. One very good test that can be used for this is the Shwartz Criteria(SC).

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[11] See Granger (1986)

4.7 GRANGER NON-CAUSALITY TEST.

Another very important issue to be considered in this research is the test of causality propounded by Granger. According to him if some variables are cointegrated then there exist some causality at least in one direction. This test will examine whether there is any line of causality between some of the variables considered in the model. In a bivariate case, this test which assumes an autoregressive distributed lag form is as follows:

$$Y_t = \Sigma\alpha_i Y_{t-i} + \Sigma\beta_i X_{t-i} + \epsilon_t \ldots\ldots\ldots\ldots\ldots\ldots (1)$$

$$X_t = \Sigma\alpha_i X_{t-i} + \Sigma\beta_i Y_{t-i} + \epsilon_t \ldots\ldots\ldots\ldots\ldots\ldots (2)$$

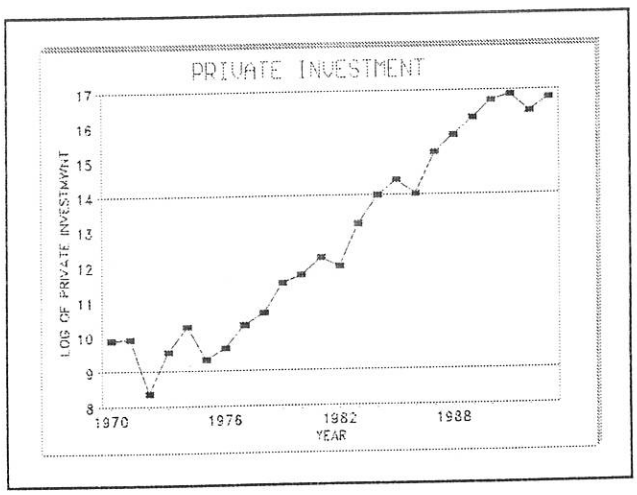
Equation (1) implies that Y_t is explained by its lagged values and the lagged values of X_t (ie X_t Granger causes Y_t). Similarly equation (2) states that Y_t Granger causes X_t. The error terms in the two equations are white noise processes. Note that equation (1) is independent of equation (2), thus rejecting one of the equations does not imply accepting the other. In the above specification the F-statistics is used to test the null hypothesis of no Granger causality.

CHAPTER FIVE

5.1 ANALYSES OF RESULTS

5.2 DATA DESCRIPTION AND SOURCES.

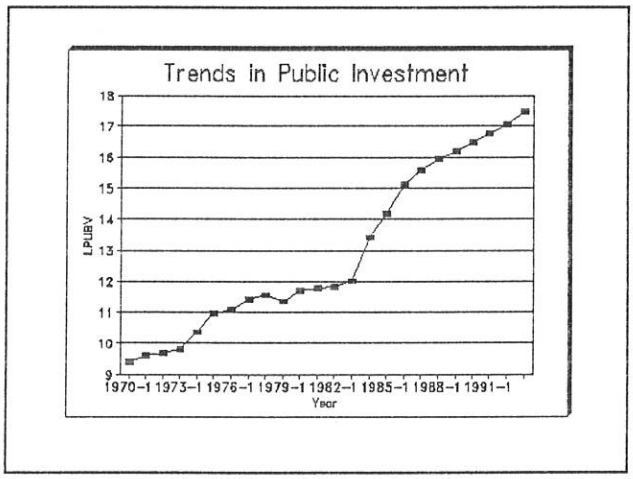
This research, which is specifically on Ghana, covers a 25-year period from 1970 to 1994. Annual data is collected on the following variables: Private Investment, GDP, Public Investment, Real exchange rate, credit to the private sector, External Debt, lending Rate, CPI and GDP per capita. In what follows below we discuss each of the variables.



PRIVATE INVESTMENT: It is the sum of all non-governmental investment. In Ghana the private sector invests in agriculture, industry, wholesale and retail trade, the financial sector, transport and communications, and education.

Due to the fact that published data on the private sector hardly exists in Ghana, we obtained data on private investment from IFC discussion papers and IMF occasional papers. The private investment series are in current prices.

PUBLIC INVESTMENT: This is computed as the difference between gross domestic investment and private investment. In Ghana the public sector invests in various forms of economic activities. Since the beginning of the ERP in 1983 considerable attention has been given to the rehabilitation of infrastructure. The plot of this series with the log of public investment on the vertical axis, shows that there has been a sustained increase in Public investment after the ERP. There is therefore need to introduce slope dummy to capture the change in the slope of the series[11].



REAL GROSS DOMESTIC PRODUCT (RDGP): Is the sum of the value added in agriculture, industry, and services. The GDP is valued at 1987 prices. Data on this variable was collected from World Tables, various years.

REAL PER CAPITA GDP: The ratio of RGDP to the size of population,

[11] *The dummy variable (D1) is defined as: D1=D*LPUBV, where D=1 for all years after the ERP and zero otherwise.*

was collected from various issues of World tables.

CONSUMER PRICE INDEX: This reflects the prices of goods and services used for private final consumption of households. The series are taken from World tables. For consistency, we chose the CPI with the base year of 1987.

LENDING RATE: This is the rate at which the commercial banks lend to the private sector. It is fixed according to the short-term and the long-term financial needs of the private sector. Data on this variable is collected from various issues of Bank of Ghana annual reports and line 60p of International Finance Statistics (IFS) year books.

EXTERNAL DEBT: It is the amount disbursed and outstanding, expressed in U.S dollar converted at the official rate. It is collected from World tables. This series and the GDP at market prices from above are used to compute the external debt to GDP ratio (EXT) variable.

COST OF CAPITAL: The real lending rate is used as a proxy for this variable. It is computed as $[((1+r)/(1+\pi)-1))*100)]$, where r is lending rate and π is the rate of inflation. There are other measures of cost of capital, such as: The relative price of capital goods measured by the ratio of investment deflator to GDP deflator; and Relative input prices measured by the ratio of the price of capital to the price of labour, but data constraints limited us to the use of real lending rate.

5.3 TIME SERIES CHARACTERISTICS OF DATA[13]

The time series characteristics of all the variables are considered. The results of the Dicker-Fuller(**DF**) and the augmented Dicker-Fuller(**ADF**) are given in tables below.

TABLE 1 UNIT ROOT TESTS FOR VARIABLES

VARIABLE	LEVELS				1ST DIFFERENCE			
	WITHOUT TREND		WITH TREND		WITHOUT TREND		WITH TREND	
	DF	ADF(1)	DF	ADF(1)	DF	ADF(1)	DF	ADF(1
LPRIV	-.056 (-2.997)	.0620 (-3.004)	-3.587 (-3.622)	-4.315 (-3.633)	-5.475 (-3.004)	-6.425 (-3.011)	-5.454 (-3.63)	-5.999 (-3.64)
LCR	1.072 (-2.991)	1.061 (-2.997)	-1.932 (-3.612)	-3.182 (-3.622)	-3.826 (-2.997)	-3.359 (-3.004)	-4.365 (-3.62)	-3.757 (-3.63)
C	-1.163 (-2.991)	-2.843 (-2.997)	-1.338 (-3.612)	-1.626 (-3.622)	-5.396 (-2.997)	-6.521 (-3.004)	-6.160 (-3.62)	-14.00 (-3.63)
LRPCIGR	-3.973 (-2.997)	-3.273 (-3.004)	-4.424 (-3.622)	-3.723 (-3.633)				
LRGDP	.813 (-2.991)	.594 (-2.997)	-.622 (-3.612)	-.975 (-3.622)	-3.891 (-3.003)	-3.073 (-3.012)	-4.416 (-3.63)	-3.593 (-3.64)
D1	-.407 (-2.997)	-.516 -3.004)	-1.953 (-3.622)	-2.076 (-3.633)	-4.279 (-3.004)	-3.008 (-3.002)	-4.199 (-3.63)	-3.932 (-3.64)

[13] Although there are several methods for testing for unit root - such as, SBDW, LMSP, KPSS and G(p,q) tests - discussed in the chapter on methodology, the most cost effective and popular are the DF and the ADF tests used in this analysis.

LRER	-1.507 (- 2.990)	-2.261 (- 2.997)	-.9807 (- 3.612)	-1.922 (- 3.622)	-2.443 (- 2.997)	-2.585 (- 3.004)	-2.808 (- 3.622)	-3.034 (- 3.633)
LINF	-0.790 (-2.99)	-1.330 (- 2.997)	-0.693 (- 3.611)	-0.524 (- 3.622)	-4.316 (- 2.997)	-2.048 (- 3.004)	-4.496 (- 3.622)	-2.248 (- 3.63)
LEXT	-0.874 (- 2.991)	-0.875 (- 2.997)	-3.769 (- 3.612)	-2.602 (- 3.622)	-6.354 (- 3.004)	-4.311 (- 3.012)	-6.194 (- 3.633)	-4.204 (- 3.65)

95% critical values from MFIT386 are in bracket

NOTE: LPRIV, is log of private investment; LCR, is the log of credit to the private sector; C, is the user cost of capital; LRGDP, is the log of Real GDP; D1, is a slope dummy associated with LPUBV; LINF, is the log of consumer price index; LEXT, is the log of the ratio of external debt to GDP; LRPCIGR, is log of real per capita income growth rate and LRER, is the log of real exchange rate.

Table 1b: TEST OF UNIT ROOT OF LPUBV[14]

ORDINARY LEAST SQUARES ESTIMATION

Dependent variable is DLPUBV

Regressor	Coefficient	Standard Error	T-Ratio[Prob]
K	-1.3149	1.7226	-.76337[.456]
DT	-.076114	.041496	-1.8343[.084]
DU	.43165	.36137	1.1945[.249]
DTB	.78857	.29529	2.6705[.016]
T	-.051649	.041844	-1.2343[.234]
LPUBV	.17534	.18439	.95093[.355]

LPUBV, is log of Public Investment

TABLE 2: SUMMARY OF THE ORDER OF INTEGRATION OF VARIABLES.

LPRIV	LPUBV	C	LRPCIGR	LRGDP	D1	LCR
I(1)	1(1)	I(1)	I(0)	I(1)	I(1)	(1)

LRER	LINF	LEXT
I(2)	I(1) OR I(2)	I(1)

[14] The test indicates non stationarity because the coefficients of LPUBV, T, and DT are insignificant.

From table 1, the results of the **DF test, with and without trend,** shows that **LPRIV** is nonstationary in level while the **ADF** test without trend show stationarity but the **ADF** with trend rejected nonstationarity at 5% level of significance[15]. Since the result is mixed we proceeded to observe the plot and the first difference of the series. Both the **DF** and the **ADF** tests, with and without trend, from the first difference, accepted stationarity. We therefore conclude that the private investment series is integrated of order one.

Second, both the **DF** and the **ADF** tests, with and without trend, accepts the hypothesis of nonstationarity of **LCR** at 5% level of significance. However, the two tests shows that the first difference of the variable is stationary. Thus the **LCR** series is **I(1)**.

Third, both the **DF** and **ADF** tests, with and without trend, reject the hypothesis of stationarity of the cost of capital(C) in level but accept stationarity in first difference. Hence, **C** is **I(1)**.

Fourth, the results from both the **DF** and the **ADF** tests, with trend and without trend, indicate that **LRPCIGR** is stationary in level. This means that the **LRPCIGR** is an **I(0)** series.

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15 *The ADF test for all the variables includes one difference term which may be sufficient to produce a white noise process.*

Fifth, the **DF** and the **ADF** tests with and without trend, accept the null hypothesis that **LRGDP** is nonstationary in levels. After the first difference, the **DF** test with and without trend, and the **ADF** test without trend accept stationarity. However the **ADF** test with trend rejects stationarity with a critical value which is approximately equal to the computed statistic. We therefore have no substantial evidence to reject the hypothesis that the first difference of the series is stationary. Thus **LRGDP** is **I(1)**.

Sixth, both the **DF** and **ADF** tests shows that **LRER** is non stationary both in level and first difference. However, the second difference is stationary, which means that the **LRER** series is an **1(2)** series.

Seventh, both the **DF** and the **ADF** tests, with and without trend, show that **LINF** is nonstationary in level. After the first differencing the **DF** test, with and without trend, shows stationarity but the **ADF** test is in contrast. After second differencing the two tests accepts stationarity. We therefore conclude that the variable is **I(1)** or **I(2)**.

Eight, except for the **DF test** with trend, the results show that **LEXT** is nonstationary in level. The first difference as per the **DF** and **ADF** tests is stationary. Hence the **LEXT** series is **I(1)**.

Finally, the result of the unit root test in the presence

of structural break reported in table 1b indicates that **LPUBV** is non stationary in levels. However the first difference was stationary which implies that the series is I(1).

In conclusion, the **DF** and the **ADF** tests coupled with the plot of the series shows that all the variables, except the log of real per capita income growth rate (**LRPCIGR**), are non-stationary in levels at 5% significant level[16]. However, only the first difference of **LRGDP, LPRIV, LPUBV, LCR, LEXT** and the slope dummy **(D1)** for the **LPUBV** are stationary, that is they are **I(1)**[17]. **LINF** is between **I(1)** and **I(2)**. And **LRER** is a typical **I(2)** series. The structural change in the public investment series called for the use of the **DF** and the **ADF** test in the presence of structural break[18]. The test shows that the public investment series is an I(1) series.

5.4 TEST FOR COINTEGRATION.

After testing for unit root, the test for cointegration was employed to determine which variables explain the long-run behaviour of private investment in Ghana. The tests used here are the Engle-Granger Two Step procedure and the Johansen

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14 LRPCIGR is I(0) because for small values the first difference of the logarithm of a variable is equivalent to the rate of growth of the variable.

17 *While the first difference of a series stabilises its first moment, a power transformation may have to be done to transform its variance. Hence we logged some of the variables.*

18 *Refer to the chapter on methodology.*

multivariate test. The former involves the performance of unit root test on saved residuals from the cointegrating regression. Cointegration is accepted because the linear combination of the series in the long-run equation produces a white noise process. The long run equation is given by[19]:

$$LPRIV = -48.5 - 0.5LPUBV + 0.9\ LCR - 0.3C + 4.5LRGDP + 0.08D1$$
$$(-2.515)\ (-2.197)\ \ (2.900)\ \ (-5.07)\ \ (2.915)\ (2.297)$$

F-statistic =237.93; R^2 =99%; R-bar-squared =98% and DW =1.9337

The **E** in table (3) below is the residual from the long-run equation. Both the **DF** and the **ADF** tests, with and without trend, indicate stationarity at 5% level of significance. The ADF test includes one lag term which was sufficient to produce a white noise process in the test. That the residual is stationary is confirmed by the DW statistics above, the coefficient of the lagged residual in the autoregressive process is not significant.

TABLE 3: UNIT ROOT TESTS FOR VARIABLE E[20]

STATISTIC	WITHOUT TREND	WITH TREND
DF	-4.7171(-2.9970)	-4.6193(-3.6219)
ADF(1)	-5.8041(-3.0039)	-6.5124(-3.6331)

95% critical values in brackets.

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19 The t-stats are in parentheses.

20 *The modelling of the unit root test on the residual follows the same procedure as that of the unit variate analysis described in the methodology.*

Due to the limitations associated with the use of the Engle-Granger Two Step procedure, we went further to confirm that the result was not spurious by using Johansen's multivariate test. By setting the lag length to one, the result showed that there is one cointegrating vector. This result therefore confirms cointegration. The results of the Johansen multivariate tests are in tables 4 and 5 below.

TABLE 4
JOHANSEN MAXIMUM LIKELIHOOD PROCEDURE (TRENDED CASE, WITH TREND IN DGP)
COINTEGRATION LR TEST BASED ON MAXIMAL EIGENVALUE OF THE STOCHASTIC MATRIX

Maximum lag in VAR = 1.
List of variables included in the cointegrating vector:
LPRIV LPUBV LCR C D1 LRGDP
List of eigenvalues in descending order:
.88478 .73017 .51276 .36425 .29402 .039353

Null	Alternative	Statistic	95% Critical Value	90% Critical Value
r = 0	r = 1	49.7007	39.3720	36.7620
r<= 1	r = 2	30.1296	33.4610	30.9000
r<= 2	r = 3	6.5371	27.0670	24.7340
r<= 3	r = 4	10.4179	20.9670	18.5980
r<= 4	r = 5	8.0078	14.0690	12.0710
r<= 5	r = 6	.92341	3.7620	2.6870

TABLE 5
JOHANSEN MAXIMUM LIKELIHOOD PROCEDURE (TRENDED CASE, WITH TREND IN DGP)
COINTEGRATION LR TEST BASED ON TRACE OF THE STOCHASTIC MATRIX

Maximum lag in VAR = 1.
List of variables included in the cointegrating vector:
LPRIV LPUBV LCR C D1 LRGDP
List of eigenvalues in descending order:
.88478 .73017 .51276 .36425 .29402 .039353

Null	Alternative	Statistic	95% Critical Value	90% Critical Value
r = 0	r>= 1	115.7165	94.1550	89.483
r<= 1	r>= 2	66.0158	68.5240	64.843
r<= 2	r>= 3	35.8862	47.2100	43.949
r<= 3	r>= 4	19.3491	29.6800	26.785
r<= 4	r>= 5	8.9312	15.4100	13.325
r<= 5	r = 6	.92341	3.7620	2.687

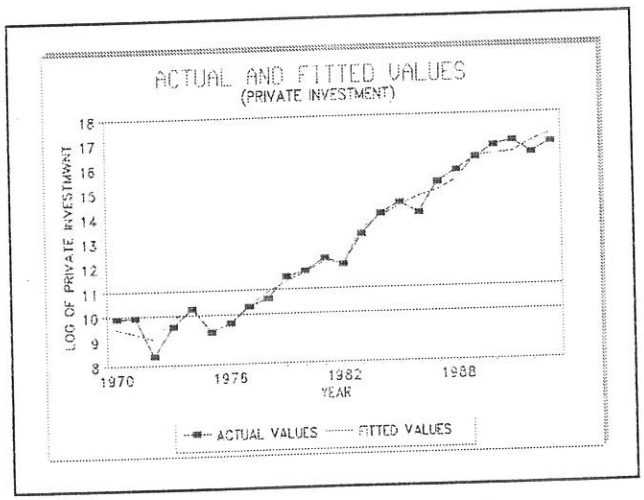
Use the above table to determine r (the number of cointegrating vectors)

From the tables 4 and 5, the hypothesis of the presence of no cointegrating vector is rejected in favour of one, from both

the test of significance of the maximum eigen values, which is specific with the alternative hypothesis, and the trace test[21].

5.5 THE TEST FOR GOODNESS OF FIT OF THE LONG-RUN MODEL.

Finally, the F statistic and the coefficients of determination are used to test for the overall significance of the long run model. The F statistic of 237.93 indicate that the line is a good fit at 1% level of significance. This follows that all the variables in the cointegrating equation explains the long run level of private investment in Ghana within the period covered by this research. Also the R-squared and the R-bar-squared show that about 99 and 98% of the private investment series can be explained by the regressors. The figure shows the plot of the fitted and the actual values of the private investment.



[21] *Note that if non-stationary series are cointegrated the standard distribution of the coefficient in the cointegrating regression are not standard normal. Also the presence of multicollinearity, which is necessary for cointegration, inflates the standard errors of the estimated coefficients of the regressors. Hence the standard t test cannot be relied upon.*

5.6 THE SHORT-RUN DYNAMIC MODEL OF PRIVATE INVESTMENT.

The results of the estimation of the short-run dynamic model are given in table 6 below.

$I(1)$

TABLE 6: THE ERROR CORRECTION MODEL.

Dependent variable is DLPRIV

Regressor	Coefficient		T-Ratio[Prob]
DLPUBV	-.65810		-2.2925[.036]
DC	-.16000		-1.7989[.091]
DLCR	.83055		2.1342[.049]
DD1	.070605		1.9173[.073]
LRPCIGR	21.3390		3.1104[.007]
E1	-1.2423		-4.5061[.000]
CONSTANT	.24179		1.5713[.136]
R-Squared	.78673	F-statistic F(6, 16)	9.8373[.000]
R-Bar-Squared	.70676	DW-statistic	1.9193

MODEL TESTS:
AR (1-2), F =(0.94); ARCH 1, F =(0.92); NORMALITY, CHI-SQUARE = (2.79); FORECAST ERROR, CHI-SQUARE =(0.54) RESET, F =(2.054).

D before a series indicates the difference of the series

We experimented with various specifications of the short run model, and applied standard t and F tests to test for the significance of the variables in the regression. The regression that yielded the best result is summarized in table (6).

The negative and significant lagged residual from the cointegrating regression is the Error Correction Term. It determines the speed of adjustment to the Long-run equilibrium level of private investment in Ghana. The coefficient of 1.2 indicates that any error committed in the short-run will be corrected in one year and ten weeks. The t-Statistic indicates

that all the variables in table (6) are significant at 10% levels of significance. The F-Statistics shows that the regression line is a good fit at 1% level of significance. Both the R-Squared and R-Bar-Squared indicates that about 79% and 71% of the variability in private investment is explained by the independent variables respectively. The DW-Statistic of 1.92 implies that there is no serious problem of serial correlation. Standard diagnostic tests were also carried out and the results are summarised in the next section.

5.6.1 DIAGNOSTIC TESTS (MODEL TESTS)

The **AR** test confirms the absence of serial or residual Correlation, the test of normality indicates that there are no outliers in the data, and finally, the **ARCH** test rejected the presence of heteroscedasticity. This is so because by introducing logs to the variables we reduce the scale of measurement and therefore track down the incidence of heteroscedasticity. The presence of **ARCH** effect may lead to over parameterization of an ARMA process.

To test for structural break the **CUSUM** and **CUSUMQ** test was used. This test is in graphical form. The critical values of the test are given by the lines indicating the critical boundaries of the test. The test shows that there is no structural break in the model.

5.6.2 THE RELATIVE IMPORTANCE OF THE VARIABLES IN THE DYNAMIC MODEL.

The partial R^2 reported in table 7 below are used to investigate the relative strength of each variable in the short run model. First, from table per capita income growth rate, LRPCIGR, has the strongest predictive power with a partial R^2 of 0.3771. This supports the hypothesis that the growth of real per capita income has a strong influence on private investment. The second important variable is public investment, **DLPUBV,** with partial R^2 of 0.2475 implying that the magnitude as well as the composition of the public sector investment is a very important determinant of private investment in the short run. Credit availability, **DLCR,** is the third important determinant of private investment in Ghana in the short run. Private investment depends on the amount of credit available to the private sector. The partial R^2 for the DLCR is 0.2214. The least important determinant of private investment in Ghana in the short run is the cost of capital, **DC,** it has a partial R^2 of 0.1683. This suggests that the private investors are not very much concerned about the cost of capital. In our model the **DC** is proxied by the real interest rate variable which has been kept negative for a long time in Ghana. In relative terms private investment in the short run responds more to real per capita income growth rate, credit availability, and public investment.

TABLE 7: RELATIVE IMPORTANCE OF VARIABLES IN THE SHORT RUN MODEL.

VARIABLES	LRPCIGR	DLPUBV	DLCR	DC
PARTIAL R^2	0.3771	0.2475	0.2214	0.1683

5.7 TEST OF HYPOTHESES.

In this section we discuss, in turn,the main hypotheses of this research. We report and analyze the result of each test.

HYPOTHESIS (1): PRIVATE INVESTMENT IN GHANA HAS A PERMANENT MEMORY.

The first hypothesis is that private investment in Ghana has a permanent memory. This hypothesis is accepted if the order of integration of the private investment series is greater than zero. Since the Dicker-Fuller (**DF**) and augmented Dicker-Fuller (**ADF**) tests reject the hypothesis of no unit root in favour of non-stationarity, it follows that the null hypothesis cannot be rejected. Thus the value of private investment at any point in time contains the sum of past shocks. A further investigation based on the plot of the Partial Autocorrelation Function(**PACF**) and Autocorrelation Function(**ACF**) shown in tables 8 and 9 below

reveals that the private investment series is a random walk process. From the graph, not even the first lags of the two functions are significant at 5% significance. A random walk series has no long-run trend values from which the series may depart and eventually return. Any series of shock(s) will send the whole series to a wholly different path for the rest of time[22]. Thus, the results of the test suggest that private investment in Ghana is very sensitive to policy action that may influence it. The findings that private investment series is a random walk process implies that the first difference of the series can only be modelled by an ARMA(0,0) process. Hence neither the lag of the series nor residuals from its univariate analysis were included in the short run dynamic model.

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22 *A random walk series is a typical AR(1) process whose value at a point in time is equal to its immediate past values and a deviation by a random walk.*

TABLE 8: AUTOCORRELATIONS: LPRIV TRANSFORMATIONS: DIFFERENCE (1)
AUTO- STAND.

```
Lag  Corr.   Err. -1  -.75  -.5 -.25   0   .25  .5   .75   1   Box-Ljung  Prob.
                  Ûßßßßßßßßßßßßßßßßßßßßßßßßßßßßßßßßßßßßßßßß¢
  1  -.196   .196                .   ****ö       .                1.008   .315
  2  -.249   .191                .  *****ö       .                2.706   .258
  3   .168   .187                .      ö***     .                3.514   .319
  4   .143   .182                .      ö***     .                4.132   .388
  5  -.116   .177                .    **ö        .                4.561   .472
  6   .150   .172                .      ö***     .                5.320   .504
  7  -.072   .167                .     *ö        .                5.503   .599
  8  -.124   .162                .    **ö        .                6.097   .636
  9  -.177   .156                .  ****ö        .                7.381   .598
 10   .273   .150                .      ö*****   .               10.671   .384
 11  -.016   .144                .       *       .               10.683   .470
 12  -.238   .138                .*****ö         .               13.647   .324
 13  -.123   .132                .   **ö         .               14.523   .338
 14   .188   .125                .      ö****    .               16.788   .268
 15  -.174   .118                .  ***ö         .               18.959   .216
 16  -.016   .110                .     *         .               18.980   .270
Plot Symbols:       Autocorrelations *     Two Standard Error Limits .
Total cases:  24     Computable first lags after differencing:  22
Hi-Res Chart  # 3:Acf for lpriv
```

TABLE 9: PARTIAL AUTOCORRELATIONS: LPRIV TRANSFORMATIONS: DIFFERENCE (1) PR-AUT- STAND.

Lag	Corr.	Err.	-1 -.75 -.5 -.25 0 .25 .5 .75 1
1	-.196	.209	****ö
2	-.299	.209	******ö
3	.052	.209	ö*
4	.140	.209	ö***
5	.011	.209	*
6	.209	.209	ö****
7	-.063	.209	*ö
8	-.112	.209	**ö
9	-.363	.209	*******ö
10	.083	.209	ö**
11	.048	.209	ö*
12	-.059	.209	*ö
13	-.183	.209	****ö
14	-.015	.209	*
15	-.168	.209	***ö
16	-.104	.209	**ö

Plot Symbols: Autocorrelations * Two Standard Error Limits .
Total cases: 24 Computable first lags after differencing: 22
Hi-Res Chart # 4:Pacf for lpriv

HYPOTHESIS (2): PUBLIC INVESTMENT "CROWDS OUT" PRIVATE INVESTMENT IN GHANA.

One major contribution of this research is that it has been able to identify the short run and the long run relationships between these two variables. From the long-run regression, Private and Public investment are negatively related. The elasticity coefficient of -0.5 indicates a significant crowding out. In the short run, the relationship remains negative and the crowding out of private investment is stronger, although not complete, with the elasticity of -0.7. The crowding out effect in the long run is weaker because investment also depends on output and as output grows the crowding out effect is reduced. In a nutshell, the hypothesis that public investment crowds out

private investment both in the long run and in the short run cannot be rejected. We could not disaggregate public investment into infrastructural and non-infratructural expenditure but our findings, based on the aggregate public investment data, suggests that the substitution effect between private and public investment overrides the complementary effect in Ghana. Our finding that there is a negative relationship between public and private investment is consistent with the empirical results of Goldsbrough et al (1996).

We further performed a pair-wise cointegration test between Public and private investment. The hypothesis of cointegration was rejected based on the Engle-Granger Two Step Procedure. It was, therefore, not cost effective to investigate causality from any direction since the acceptance of the hypothesis of **no line of causality** was obvious. The absence of Granger Causality implies that although public investment crowds out private investment, we cannot predict the future of the latter with the current values of the former. This finding is consistent with hypothesis 1 above that private investment has a stochastic trend.

HYPOTHESIS (3):THE AVAILABILITY OF CREDIT TO THE PRIVATE SECTOR INCREASES PRIVATE INVESTMENT IN GHANA.

One main constraint facing the private sector is lack of credit. We confirmed this by testing the third hypothesis. In both the long-run equation and the dynamic model we failed to reject this hypothesis. The coefficient of elasticity in the long-run and the short run equation are 0.9 and 0.8 respectively.

A test for pair-wise cointegration revealed that the two series are cointegrated. Based on this idea we investigated the direction of causality. The Granger-Non-Causality tests, which are reported in tables 10 and 11, and 12 and 13 below, reveals the existence of a line of causality running from private investment to credit with an instantaneous feedback.

TABLE 10: ORDINARY LEAST SQUARES ESTIMATION

Dependent variable is	DLCR	
Regressor	Coefficient	T-Ratio[Prob]
DLCR1	.19104	.90340[.377]
K	.23672	2.6942[.014]
F-statistic F(1, 21)	.81614[.377]	
Residual Sum of Squares	1.7764	

TABLE 11: ORDINARY LEAST SQUARES ESTIMATION

Dependent variable is	DLCR	
Regressor	Coefficient	T-Ratio[Prob]
DLCR1	.13560	.68271[.503]
DLPRIV1	.17658	2.0608[.053]
K	.20056	2.3982[.026]
F-statistic F(2, 20)	2.5947[.100]	
Residual Sum of Squares	1.4652	

The computed F-Stats from above two tables is 4.25.

TABLE 12: ORDINARY LEAST SQUARES ESTIMATION

Dependent variable is	DLPRIV	
Regressor	Coefficient	T-Ratio[Prob]
DLPRIV1	.26725	.90646[.377]
DLCR1	-.41968	-.95106[.355]
DLCR	1.3411	2.5031[.023]
E2(-1)	-1.1064	-2.7567[.013]
K	-.027472	-.11361[.911]
F-statistic F(4, 17)	r.8858[.054]	
Residual Sum of Squares	6.0055	

TABLE 13: ORDINARY LEAST SQUARES ESTIMATION

Dependent variable is	DLPRIV	
Regressor	Coefficient	T-Ratio[Prob]
DLPRIV1	.25750	.76831[.452]
DLCR1	-.26132	-.52632[.605]
E2(-1)	-.70758	-1.6895[.108]
K	.31629	1.3978[.179]
F-statistic F(3, 18)	1.3611[.286]	
Residual Sum of Squares	8.2188	

The computed F-Stats from the ensuing two tables is 6.26.

The computed **F-statistic** of **4.25** from tables 9 and 10, and **6.26** from tables 11 and 12 based on the **CHOW** test indicate causality. The acceptance of the hypothesis that there is a line of Causality running from private investment to credit conforms to the fact that many private investors in Ghana are credit rationed. In a situation where financial sectors have limited

resources, credit rationing could be an equilibrium solution. Since granting credit to private investors involves some risk, financial institutions may rely on some observable characteristics of the borrowers. A typical example of these characteristics is the size of the firm which is a positive function of the level of investment[23]. As noted by Chhibber and Dailami(1990) " In a regime of rationed credit smaller firms get hurt more than the larger ones". In Ghana, financial institutions, avoid granting loans as start up capital to private investors. Due to the fact that levels of private investment are important determinant of credit it is not surprising that credit to the private sector is invested immediately, hence the instantaneous feedback from the credit to private investment. The positive relationship between these two variables is consistent with the findings of Blejer and Khan (1984) and Chhibber and Dailami (1990). However Goldsbrough et al (1996) found this variable to be insignificant in Ghana. The fact that numerous studies have emphasised the lack of credit as one of the most crucial constraint facing the private sector in developing countries makes the finding of Goldsbrough et al that credit is not a significant variable in the model of private investment in Ghana questionable.

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23 *See Sachs and Larrain (1993), p 140*

HYPOTHESIS (4):AN INCREASE IN THE REAL USER COST OF CAPITAL DAMPENS PRIVATE INVESTMENT IN GHANA.

The final hypothesis is that the real user cost of capital has a negative impact on private investment. Since we have established that the private sector is constrained by credit availability, it is important to test whether this situation makes the private investors insensitive to the price they pay for credit in Ghana. From the cointegration equation these variables are negatively related. The associated long-run coefficient is -0.3. In the short-run, this variable was significant at 10% level with the coefficient of -0.16. Thus private investors are not insensitive to increase in the cost of capital. Rising borrowing costs will cause private investment to fall. Our findings that private investment and the cost of capital are negatively related conform to the work of Solimano(1989), Greene and Villanueva (1990) and Goldsbrough (1996), but are in contrast with that of Blejer and Khan (1984) Dailami (1990) and the Mckinnon-Shaw hypothesis (1973).

CHAPTER SIX

6.1 SUMMARY, POLICY IMPLICATIONS AND CONCLUSION.

6.1.1 SUMMARY

This study employed time series techniques to investigate the determinants of private investment in Ghana. The findings are that in the long run, private investment depends on the real GDP, real lending rate, public investment and the availability of credit. First, RGDP is positively related to private investment implying that the investment function should be modelled along the line suggested by the accelerator theory of investment. In the long run, sustained growth in real output will stimulate private investment in Ghana. Second, public investment is negatively related to private investment which signifies that the latter crowds out the former. Because we could not disaggregate public investment into infrastructural and non infrastructural investment we could not test the complementarity of public and private investment hypothesis. However, the hypothesis of pair wise cointegration between the two variables was rejected, indicating no line of causality between the two series which, in turn, means that we can neither predict the future values of private investment based on current levels of public investment nor the reverse. Third, credit availability to the private sector is positively related to private investment. The Granger-Non-

Causality test reveals that credit to the private sector is invested instantly, confirming the fact that a major constraint facing the Private sector in Ghana is lack of credit. Credit allocation in Ghana favours the Public Sector. In a bid to minimize the risk of default financial institutions ration credit to the private sector according to previous levels of investment. Finally, the real lending rate is negatively related to private investment. This means that although the private sector faces credit constraint it is also concerned about the cost of credit since this influences returns on investment.

In the short run, public investment, credit availability to the private sector and real lending rate have similar effects on private investment but RGDP is not significant. However RPCIGR, was positively related to private investment. This is consistent with theory because in the short run firms in Ghana operate far below full capacity hence increasing aggregate demand does not necessitate expansion of capital stock. In the short run, Private Investors are rather attracted by real per capita income growth, **LRPCIGR**, which is a proxy of the size of the domestic market. The ranking of the variables according to their relative strength indicates that in the short run, RPCIGR is first followed by Public investment, credit availability to the private sector, and real lending rate.

The real exchange rate and the rate of inflation were used as proxies, in both the long and the short run models, to test

for the impact of macroeconomic instability on private investment. These variables were neither cointegrating with the other series in the long run equation nor significant in the dynamic model. This seem to suggest that although Ghana's macroeconomic environment is characterised by imbalances, such as high rates of inflation due to monetary and fiscal shocks, private investment has not been deterred. The high rate of inflation may rather positively influence private investment by reducing the real lending rate.

We also used the stock of external debt expressed as a ratio to GDP to proxy for macroeconomic uncertainty. This series was not significant in both the long run and the short run models. Debt overhang indicates a possibility for future policy changes. This creates uncertainty in the investment environment and subsequently reduces the response of domestic investment to economic and financial incentives. That this variable is not significant in both the long run and the short run models seems to indicate that private investment in Ghana is not significantly influenced by macroeconomic uncertainty.

Finally, employing DF and the ADF tests for unit root, we found that private investment in Ghana has a permanent memory. A further test based on the plot of ACF and PACF revealed that the series is a random walk process. Any shock to private investment will not only throw it to an unknown path but will remain in memory of the series forever. In a nutshell, private

investors in Ghana react to policy reversals.

6.1.2 POLICY IMPLICATIONS

The fact that private investment in Ghana is a random walk process means that implementing appropriate investment policies will make private investment thrive and subsequently lead to economic growth and development. It is important that government refrain from policy reversals since this can permanently discourage private investment. While government can easily reverse its policies, private investors cannot reverse fixed investment hence government policies must be stable and predictable if they are to stimulate private investment.

Although the economy of Ghana has been, for a long period, characterized by macroeconomic instability, with high rates of inflation and overvalued real exchange rates, our findings suggest that Private investment has not been very responsive to it. However, this does not, in any way, indicate that private investment will be insensitive to any degree of instability. Indeed, the nature of the private investment series indicates inappropriate government policies will cause investment to deviate permanently from its long run equilibrium path. Thus, government should strive to reduce uncertainty in the economy by maintaining low and stable inflation rates, a stable and competitive exchange rate, and bringing debt to GDP ratios down.

From our finding that the accelerator principle works in Ghana we recommend that, in both the long and short run, government policy should be geared towards encouraging the growth of real output so that aggregate private investment can be stimulated. This will require not only maintaining macroeconomic stability but also implementing the necessary policy reforms that will stimulate the productive capacity of the economy.

Since public expenditure crowds out private investment in the credit market, it is important that the public sector reduces its deficits and its unproductive expenditures. That is, public investment in Ghana may have to concentrate on infrastructural development and on improving or enhancing the social delivery system. This type of investment may help stimulate private investment.

The serious nature of credit constraint facing private investors in Ghana is a reflection of weak financial intermediation and inadequate credit policies. It is therefore necessary that some policies be undertaken to improve financial intermediation. The liberalization of the financial sector in Ghana is necessary to provide a conducive platform for fair competition between the private and public sector. In order to improve financial intermediation, public confidence in the banking system will have to be restored and the inefficient state-owned banks and Non Bank Financial Institutions (NBFI)

should be privatized. By so doing the public may be encouraged to use the banking system in large numbers. The existing large stock of savings will then be mobilised from both the rural and the urban centres of the economy and made available for investment.

That real lending rates are negatively related to private investment implies that contractionary monetary policy may discourage private investment. This is because the policy may reduce the rate of inflation rapidly and with unaltered or less than proportionate reduction in nominal lending rate, as suggested by the Mudell-tobin effect, real lending rate will increase and lead to a decline in private investment.

6.3 CONCLUSION

This thesis has several limitations. Most importantly the data on the private sector in Ghana is extremely scarce, and the statistical system is very weak. The deficiencies associated with the data may therefore have biased predictions of our model. Furthermore, because it uses aggregate data the thesis does not consider sectoral investment. Despite these limitations this study has made some contribution to the existing literature on private investment in Ghana. First, unlike other studies it employed time series techniques to investigate the determinants of private investment in Ghana. This method guarded against

obtaining spurious regression results and also enabled the modelling of the long run and the dynamic behaviour of private Investment in Ghana. Second, this research identified the long run and the short run impacts of public sector borrowing on private investment. Third, it was found that Private investors face credit constraint both in the long and short run. Since credit is rationed, the size of previous levels of investment is used by the financial institutions to gauge the capacity of firms to repay their loans. Furthermore, the study has shown that private investment behaves according to the accelerator principle. Changes in output measured either by real GDP or real income growth rate are important determinants of private investment both in the short and long run. Finally, the ECM enabled us to determine the speed of adjustment to the long run equilibrium.

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DECLARATION

I, the undersigned, declare that this thesis is my original work and has not been presented for a degree in any other university. All sources of materials used for this thesis has been fully acknowledged.

Name AKPALU WISDOM

signature

Date MAY, 1997

Place A.A.U