Public-Private Investment and Economic Growth in Pakistan: An Empirical Analysis

By

Maryam Bint- E- Ajaz

Registration # 1549-FE/MS/F07

Supervisor

Dr. M. Arshad Khan

Senior Research Economist, PIDE

Co-Supervisor

Dr. Mohammad Yasin.

Associate Professor, IIUI

A dissertation submitted to the department of economics, International Islamic University Islamabad, Pakistan, in fulfillment of the requirement for the degree of Master of Philosophy in Economics

Department of Economics
International Islamic University Islamabad
2009

M. Nil

Economic development - Pakistan

Macroeconomics

Pakistan - Economic conditions

Pakistan - Economic Policy


بسم الله الرحمن الرحيم

Certificate

It is to certify that this thesis submitted by **Ms. Maryam Bint-E-Ajaz**, is accepted in its present form by the Department of Economics, International Islamic University, Islamabad as satisfying the requirement for partial fulfillment for the degree of Master in Philosophy in Economics

Supervisor

Dr. M. Arshad Khan
Senior Research Economist
Pakistan Institute of
Development Economics,
Islamabad.

Co-Supervisor

Dr. Mohammad Yasin
Associate Professor,
School of Economics, IIIE
International Islamic University,
Islamabad.

External Examiner

Dr. Tariq Javed
Associate Professor,
Department of Economics,
Quaid-e-Azam University,
Islamabad.

Internal Examiner

Dr. Abdul Jabbar
Associate Professor,
School of Economics, IIIE
International Islamic University
Islamabad.

DEDICATION

This work is dedicated to my beloved parents whose love, inspiration and guidance have been always working as source of motivation for me in every field of life.

ACKNOWLEDGEMENTS

All praise is to Almighty Allah, Who deserves all praises alone. It is only His blessing, which enabled me to reach this level of knowledge in my field.

I am grateful to most competent, knowledgeable and co-operative Supervisor Dr. M. Arshad Khan for his willingness, considerable time, dedication and supervision. I am also grateful to my co-supervisor Dr.Mohammad Yasin for his meaningful cooperation and encouragement. This study would not have gone through without his motivation.

I have no words to offer my gratitude and humble thanks to my loving parents which are the permanent source of inspiration and cooperation.

I pay my sincere and heartful thanks to my brother and sisters for their loving and helpful attitude. I also offer special thanks to faculty members of IIUI who helped me throughout this study.

The cooperation, encouragement, guidance have been received from my friends particularly Nazima Ellahi, Uzma Nourin, Maria Mukhtar and Huma Anjum whom I solute for so much encouraging and loving behavior.
I be obliged a debt of gratefulness to all who helped me during my research period for their support.

Maryam Bint -e -Ajaz

TABLE OF CONTENTS

CHAPTER 1

Introduction

Investment is an important component of aggregate demand and a leading source of economic growth. Change in investment not only affect aggregate demand but also enhance the productive capacity of an economy. A third important role highlighted in the literature refers to the innovation and modernization of the capital equipment via technological progress. The relationship between investment and economic growth is well documented in the literature. The investment plays an essential and vital role in expanding the productive capacity of the economy and promoting long term economic growth (Jongwanich and Kohpaiboon, 2008). Higher investment rate triggers the fast economic growth. Levine and Renelt (1992) have argued that investment in capital goods is the most robust and vital determinant of economic growth. Gross domestic investment boosts economic growth by increasing physical capital directly and indirectly through technological spillovers (De Long and Summers, 1995). Easterly and Rebelo (1993) have distinguished between the private and public investment and suggested that both are the key determinants of long-run economic growth and mutually inevitable.

1.1 The role of Investment in Growth Process

There has been heated debate in policy making and academic circles regarding the roles of public and private investment in the process of economic growth. These two components of investment can differently affect the growth process. The effect of public investment on economic growth depends on how the increased spending is financed by the

government (Bukhari, 2006). If public and private investments are perfect substitutes, then an increase in public investment would have the same effect on growth as an increase in private investment. Both contribute to the accumulation of physical capital, which increases the productive capacity sustains a higher level of output (Lachler and Aschauer, 1964). Public investment in the infrastructure has to boost up private investment indirectly that in turn increases the marginal productivity of private capital and enhances the growth of GDP (Looney, 1997). In other words, the public investment not only directly effects the economic growth but also indirectly by promoting private investment. It generates positive spillovers by provision of health, education, basic scientific research and physical infrastructure, and may also "crowd in" the private investments. In contrast, the literature also suggests that public investment negatively effects the private investment via the well known "crowding out" phenomenon via attracting the domestic scare sources through bond floating (Erden and Holcomble 2005). These contrasting views about the impact of public investment on private investment are important, however yet unsettled.

Increase in private investment reflects confidence of the private sector on government policies. To achieve a higher rate of economic growth, increase in employment and consequently reduction in poverty, there should be active participation of private investors. In other words, public and private sectors should go side by side and reinforce one another. Persistent increase in private investment is a signal of the efficiency of public investment, if public policy succeeds in providing incentives to investors leading to enhance their profitability and reduce the costs of private investment. A sustained improvement in private investment works as a channel for attracting foreign direct investment (FDI) since it is an indicator of high returns to investment and declining investment risks in the country.

So for as Pakistan is concerned, several studies have been carried out, which concentrate on public and private investment and economic growth. The most important are the studies inter-alia by Khan (1988), Looney and Frederiken (1995), Loony et al (1997), Khan and Sasaki (2001), Naqvi (2003), Ghani and Din (2006), Khan and Khan (2007), Ahmad and Qayyum (2007) and Majeed and Khan (2008). In some studies the relationship between growth and investment is investigated, while others have attempted to examine the determinants of public and private investment.

1.2 Objectives and Rationale of the Study

Given the vital importance of investment in the process of economic growth, this study endeavors to develop an econometric model to examine the relationship between public and private investment and growth. Unlike other studies carried out in Pakistan we would try to examine

- The causal link between the investment (public investment and private) and economic growth in Pakistan,
- The factors effecting public and private investment,
- The inter-relationship between public and private investment.

The present study attempts to follow a comprehensive approach by examining the overall effect of investment on growth, explaining the determinants of public and private investment and evaluating the mutual relationship of the both the components. Thus the rationale is obvious; instead of following a piece meal strategy, it looks more efficient to place all the components in one place and discuss the issue as a whole.

1.3 Organization of the Study

The study is organized as follows. Different theories of investment and the link between investment and growth as well as between public and private investment are discussed in chapter 2. The existing empirical literature on the subject is reviewed in chapter 3. An overview of Pakistan economy regarding investment and growth overtime is presented in chapter 4. The econometric model and estimation methodology are discussed in chapter 5, followed by description of variables and discussion of data in Chapter 6. We present the empirical results and interpretations in chapter 7. The final section (Chapter 8) is reserved for the conclusions and policy implications as usual.

CHAPTER 2

Theories of Investment

The link between Public and Private Investment

Investment plays a crucial role in the economy. It is not only an important component of aggregate demand but the very root of capital formation, in other words it determines the productive capacity of the economy and growth in the long run. Still further, investment not only enhances the volume of capital stock but also modernizes it with the latest technology and innovations. Since capital is one of the most important factors of production, a high rate of investment means that capital stock is growing quickly that leads to higher output. However, because investment is a forward looking activity, it tends to be an unstable component of aggregate demand.

2.1 Capital versus Investment

There is a difference in the notion of investment from economic and business point of view. Investment is the flow of spending at present that adds to the stock of physical capital in future. This is the economist's perception. In contrast, the business views investment as any spending at present (on goods, services, properties etc) that gives a flow of income or profits expected in future. Capital is a stock variable and measured at a point of time whereas investment is a flow variable and measured over a period of time (between two points). Part of the gross investment expenditure may be meant for repairs or in keeping the existing capital stock in tact. The net investment is generally measured as the difference between the capital stock by the end and at the beginning of the period: $I_t = K_t - K_{t-1}$

There is no difference between the flow of investment and stock of capital if all the capital is circulating such that it is completely used up within a period. In other words, capital

built up during the previous period can not be carried over to the next period. In this special case, the theory of capital and the theory of investment are identical. However, in case of fixed capital, there seem to be two decisions that must be dealt with simultaneously regarding the amount of capital and the amount of investment. These decisions are different from each other. One is about the desired level of capital stock by the end of period while other is about the desired rate of investment flow during the period. One decision will surely affect the other, but it is not necessarily the case that one is condensable to the other.

There are effectively two concepts of investment namely the "*Hayekian*" and the "*Keynesian*" concepts. According to Hayekian concept, investment is the adjustment to equilibrium level and thus the optimal amount of investment is effectively a decision on the optimal speed of adjustment. A firm may decide to build a factory (which is the 'capital stock' decision), but its decisions on how fast to build it and how much to spend each period building the factory, are effectively, the 'investment' decisions. Thus, the two decisions are separate and distinct. According to Keynesian concept, the investment decision is behavioral. Investment is simply '*what capitalists do*'. Every period, the workers 'consume' commodities and capitalists 'invest'. The main decision is the therefore investment, since the capital stock just 'follows' from the investment patterns rather than being an important thing by itself that needs to be 'optimally decided' upon ahead of time. Thus, when businesses make investment decisions, they do not have an 'optimal capital stock' in their minds. In fact they are more concerned as to what is the optimal amount of investment for some particular period. For Keynesians, then, the optimal investment is not about 'optimal adjustment' rather it is about the 'optimal behavior'.

2.2 Theories of Investment

The theories of investment generally propose that investment mainly depends on the rate of interest, income level and uncertainty factors. Here we summarize some important theories of investment.

2.2.1 Fisher's Theory of Investment

Irving Fisher introduced the theory of capital and investment in his *Nature of Capital and Income* (1906) and *Rate of Interest* (1907). However, the most famous explanation is given in his *Theory of Interest* (1930). This theory postulates investment decision of the firm as an intertemporal problem. Fisher assumed that all capital in the economy is 'circulating' in nature. No stock of capital remains at the end of the period and all capital is consumed in the production process. Thus there is factually no difference between capital and investment; all capital is in fact investment. Output is thus related to investment: Y=f(I) (Wolfson, 1996).

An additional condition is imposed that investment in any time period yields output in the next period. Interest rate(r) is the cost of investment while investment decision depends on the marginal rate of return or marginal efficiency of investment (MEI). The optimum condition for the firm's investment decision is that MEI = r. There is negative relationship between investment and interest rate because increase in interest rate increases the cost of borrowing and discourages the investment. So investment is mainly related to the interest rate: $I = I(r)$ where $I' = dI/dr < 0$.

At equilibrium, total investment would be equal to total savings and the demand for loan-able funds must equal the supply of loan-able funds. However, this is possible only if the rate of interest is appropriately defined. If the interest rate was such that the demand for loanable funds was not equal to its supply, then investment would not equal to savings

(Diamond, 1994). Thus, in Fisher's 'real theory of loanable funds', the rate of interest that equilibrates supply and demand for loan-able funds will also equilibriate investment and savings (Lutz,2006).

2.2.2 Keynesian Investment Theory

In the General Theory of Employment, Interest and Money (1936), Keynes sets out the Marginal Efficiency of Capital approach to investment. Investment is a flow of spending in a given period. The capital stock, K_t, is the stock of usable capital equipment standing at the beginning of period due to previous investment. Gross investment is then the flow of capital expenditure which adds to the existing size of the capital stock as well as to replace the worn out capital since a fraction of the capital stock depreciates over time due to natural wear and tear. After taking care of this factor, the increase in capital stock by the end of period is given by:

$\Delta K = (I_t$ - depreciation) $= K_{t+1} - K_t \Rightarrow I_t = \Delta K$ + depreciation $= K_{t+1} - K_t + \lambda K_t$, where I_t is gross investment and λ is the rate of depreciation. The Keynesian theory of investment emphasizes the importance of interest rate as the cost of borrowing in investment decisions. However, other factors may also enter into the model, including the expected profitability of an investment project (Minsky, 2008).

According to Keynesian theory, the firms calculate the internal rate of return (IRR) for all investment projects under consideration and choose those projects for which IRR exceeds the market rate of interest. The firms are likely to invest until the marginal efficiency of investment (reflected by IRR) is equal to the rate of interest. Investment spending is both highly unstable and highly correlated across firms. Investment activities are on the peak in periods of boom and very low in periods of recession/depression.

During the upswing of the economic cycle, the business confidence will be high and

will stimulate a strong trend in investment. The opposite will be true in the period of down trend. During boom, the firms will face rising prices of capital goods as the demand rises. This will lower the profitability of investment because the cost of the capital goods relative to the expected future profit will be high. Thus at times of high investment trend, the IRR will fall on all projects. As the investment activities decline, the capital goods prices will fall thereby raising the IRR of all projects. In case of governing investment decisions, Keynes stressed the role of expectations about future demand. Likewise, the business confidence plays important role in investment decisions. Keynes referred to 'animal spirit', a term indicating the role of non-rational business confidence decisions on the MEC and MEI. An increase in business confidence will increase the future evaluation about profit and will increase the volume of investment and vice versa (Leory, 1983).

2.2.3 The Clark's Accelerator Theory

According to the accelerator theory, investment responds to changing demand conditions, or it depends on the change in output or income (Brown, 1979). When income increases, demand for consumption goods also increases. Under these circumstances, the firms are faced with two choices: either to raise prices in response of excess demand or to meet that demand by raising supply via enhancing investment. The firm may increase their prices under certain favorable conditions. However, in more Keynesian vision, the quantity adjustments generally take place under profit motive and firms are likely to increase their production to meet the excess demand of the market. In this perspective, the firms will enhance their productive capacity by investing in plant and equipment. Thus, investment responds immediately and entirely to changing demand conditions, which may be shown in the following relation: $I_t = K_t - K_{t-1} = \upsilon (Y_t - Y_{t-1})$, where Y_t is aggregate demand, K_t is capital stock and υ is the accelerator coefficient. However, demand shocks are many and not

all permanent. The accelerator argument, which is initially based on the uncertainty of demand movements, sets up the desired change in capital stock in each period. Therefore, changes in demand give incentive to the investment procedure (Knox, 1952).

3.2.4 The Tobin's q-Theory of Investment

The "q" theory of investment was presented in Brainard and Tobin (1968) and James Tobin (1969). This theory emphasizes the link between investment and the stock market and estimates the value of stock market places on a firm's assets relative to the cost of producing those assets. A firm will invest until q = 1, where 'q' is defined as the ratio of market valuation of existing real capital assets and the current replacement cost. When the ratio is high, firms will want to produce more assets and so investment will be rapid.

Whenever 'q' is greater than unity, a firm should add to the stock of physical capital because for each dollar's worth of new machinery the firm can sell stock for 'q' dollars and earn a profit equal to q-1. This implies a flood of investment activities whenever q>1. However, in reality, the adjustment costs make such a flood inefficient and so investment rises reasonably with 'q'. The advantage of 'q' as a measure of incentive to invest lies in the fact that it reflects the expected future profitability of capital as well as the current profitability (Christiano and Fisher: 1995). Thus, Tobin's q-theory of investment stresses that investment decision depends not only on current economic policies, but also on policies expected to prevail in the future.

2.2.5 The Portfolio Theory of Investment

The portfolio theory of investment considers as to how an optimizing investor would behave. The portfolio theory differs from the theory of the firm and the theory of consumer in three aspects. First, it is concerned with investor's returns rather than returns to

manufacturing firms. Second, it is concerned with economic agents who act under uncertainty. Third, with availability of sufficient computer and database resources, this theory can be used to understand the direct practices by large investors. The element of uncertainty cannot be dismissed in the optimizing behavior of investors. An investor who knows future returns with certainty would invest in only one security, which is highly profitable. If there more than one such securities are available, then the investor would be indifferent between two or any combination of these securities. However, uncertainty is always associated with the future rate of return and the investor actually prefers a diversified portfolio, which is the common and reasonable practice to reduce uncertainty.

As the basic principle of portfolio theory, the market value of the stock should equal the present value of future dividends stream, which is discounted at some reasonable rate. If concerned only with the expected value of securities, the investor must also be concerned with the expected value of portfolio. To minimize the expected value of a portfolio, the investor should invest in that security which has maximum expected return.

2.3 The Link between Public and Private Investment

The role of public investment in the process of economic growth has been the subject of research and debate, both in theoretical and empirical literature. Public investment is very important for the long term economic growth. It generates the private spillovers in the economy through the provision of health, education, basic scientific research and physical infrastructure (De Long and Summer, 1991). Most of the public investment projects provide final goods or services that are not directly productive, e.g. investment in mass education and health care system. However, these projects indirectly accelerate the process of growth in the economy since literate and healthy labor is likely to be more productive.

Public expenditure can have an adverse effect on growth by 'crowding out' the efficient and profitable private investment if scarce resources are drawn from private sector. On the other hand public investment, particularly in infrastructure (like improvement of highways, rail and roads, airports, water system, electricity and gas provision etc.) plays complementary role or 'crowding in' for private investment. The theory suggests both the complementary and substitutability relationships between public and private investment. The complementary relationship between public and private investment is of greater importance in the developing world because of the larger role played by the government in these countries towards capital formation. This relationship stands valid if output of public enterprises (like electricity, gas and water projects) constitutes an essential part of private sector investment. In this case, public investment may lead to increase private investment by satisfying the input demand of private sector. Public investment of this type enhances the prospects for private investment by raising the productivity of capital (Khan and Kumar, 1997).

On the other hand, if public enterprises produce goods and services that directly compete with the private sector, then the two types of investments become the substitutes. Moreover the public investment could adversely affect private investment indirectly through the budget constraint. For instance, if public sector investment is financed by increasing taxes, it will adversely affect private investment due to increase in the input prices. Likewise, financing of public sector investment through the debt instruments and inflation can reduce the resources otherwise available to private sector and thus depress private activities (Lachler and Aschauer, 1964). However, there is no a-priori reason to believe that public and private investments are necessarily substitutes or complements. Public investment may stimulate

private out-put by increasing the demand for inputs and other services and may enhance the overall resources available, thereby expanding aggregate output and saving. The net effects of public investment on private sector will depend on the relative strength of both the enforcing and depressing effects.

CHAPTER 3

Review of Empirical Literature

A number of empirical studies are available, which illustrate the relationship between public investment, private investment and economic growth. This chapter presents a brief review of the empirical literature relating to the issue concerned.

3.1 Studies on Developed Countries

Ghali and Al-Mutwa (1999) investigated the relationship between share of fixed investment in GDP and the growth rate of real per capita GDP for the group of seven developed countries (G-7), using time series data from 1960-1990. The vector autoregressive model was used and the causal relationship checked by Granger test. The causality results showed that in Japan and United Kingdom there was two-way causality. In United States and France, the causality was in one direction from fixed investment to growth; while in Canada, Germany and Italy, the causality was from growth to fixed investment. Thus, the relationship between fixed investment and growth varied across the major industrialized countries, i.e. no similar pattern intimated.

Voss (2000) investigated the hypothesis of "crowding out" of private investment due to public investment in Canada and the United States, using the Jorgensen's neo-classical model of investment and the VAR framework. The results showed that there was no evidence of "crowding in" effect; in other words, there was "crowding out" effect. The study found that there was very little difference between the effects of public investment on private investment in US (which is a large open economy) and in Canada (which is relatively small). The accelerator effect for private investment in the US seems

to be more important than that in Canada, and the real interest rate seemed to be more important for private investment in Canada relative to the US. Finally, both countries exhibited a significant negative accelerator effect for public investment.

Paola et-al (2002) analyzed the relationship between investment and growth both for the Euro and Anglo-Saxon countries during the era of nineties. The results indicated that there was structural instability in the beginning of nineties in both group of countries. In the Euro area, the economies grew at the rates only slightly below that recorded in the period from first oil price shock, to the end of nineties and that the growth in investment was very weak, at time even negative. In the Anglo Saxon countries, especially in U.S.A the growth in investment was very strong and economy was in the boom.

Rosik (2006) investigated the effects of public capital on regional economic growth in OECD countries. The study focused on the role of infrastructure and concluded that low investment and trade deficit were the leading causes of the slow growth in developing countries. There was positive relationship between public capital and returns to infrastructure investment when the aggregate data of all economies was used for the purpose. The study suggested that provision of public sector infrastructure should be improved since it will be effective to increase the economic growth.

Pavelescu (2007) investigated the correlation between the gross capital formation and GDP in the countries of European Union for the period 1999-2006. The study found that gross capital formation contributed to sustainable economic growth not only on the demand side but also on the supply side. Distribution of government expenditures played an important role to reveal correlation between capital accumulation and consumption.

These expenditures were made to enhance the infrastructure and development process, which in turn increased fixed investment in the private sector and ensured the economic growth in European Union countries.

Aschauer (1988) investigated the relationship between aggregate productivity, stock and flow of government spending for the United States, using annual data from 1950 to 1985. A generalized Cobb-Douglas form was assumed forthe production technology. The estimated results showed that nonmilitary public stock, which was 67% of total government stock and it was more important in determining the productivity than the to military (33%) expenditures. The author argued that the core infrastructure, which consisted streets, highways, electrical and gas facilities, water system etc, had the most explanatory power in the productivity regression analysis. The average growth of productivity declined overtime because the growth rate of domestic Research and Development had declined.

Aschauer (1989) estimated productivity of public capital in the United States using an aggregate production function. The focus of this study was to investigate whether higher public investment crowds out private investment or otherwise. The study found that public investment had significant effect on output; and net impact of a rise in public expenditure positively affected the private investment.

Delong and Summer (1990) investigated the relationship between equipment investment and economic growth in United States for the period of 1960-85. They concluded that producer's machinery and equipment had a very strong relationship with growth because quality level machinery efficiently enhanced the production level. In

cross section of nations, each percent of GDP invested in equipment raised GDP growth rate by 1/3 percentage points per year. This association showed that the marginal product of equipment was about 30 percent per year. The cross-nation pattern of equipment prices, quantities and growth was consistent, i.e. countries with rapid growth had favorable supply conditions for machinery and equipment. The data pattern was not consistent with the belief that some third factor pushed up both the rate of growth and demand for machinery and equipment.

Chandra and Thompson (2000) examined the relationship between large infrastructure spending (like new inter-state highway construction) and the economic activity in United States, using data over the period 1969 to 1993. The model tested the hypothesis that highways have a different impact across the country and results confirmed its validity. Due to reduction in transportation cost, certain industries flourished while some others shrank. Highways affect the spatial allocation of economic activity within the region and increase the level of economic activity in the areas through which they pass directly. In these areas, earning increased in the manufacturing, retail trade and services industries, but shrank in the farming sector.

Otto (1997) investigated the pattern of public investment in Australia to show whether it satisfied or otherwise the conditions of inter-temporal efficiency. The estimated results showed that resources were used efficiently and there was no evidence of over or under investment in either the public or private sector. There was no excessive return to public investment; rather there was average return to both public and private investment. Private investment goods had become relatively less expensive, while prices

of public investment goods had increased relative to aggregate production. According to the study, a rise in prices of public goods may be due to rising cost, which is because of providing new public capital, for example, construction of new roads may raise the cost of new capital.

Kavanagh (1997) studied the relationship between public capital and private sector productivity in Ireland using an error correction model over the period of 1958 to 1990. The estimated results showed that public capital had no significant influence on private sector output. Hence, the results implied a rejection of the crowding out hypothesis of private investment for Ireland.

Stephan (2002) examined the impact of public capital on private production for the period of 1970 to 1996 for German manufacturing industry using Cobb Douglas Production function. The estimated results showed that there was positive correlation between public capital and output. Changes in public capital translate in changes in manufacturing sector output. This correlation between changes of public capital and output holds both in the long as well as in the short-run.

Marrocu and Paci (2006) investigated the effect of public capital on productivity of Italian regions over the period of 1996-2003 using Cobb Douglas production function. The results indicated that public capital had positive and significant effect on growth and played an important role to enhance growth and development particularly in poorest areas. The physical and intangible infrastructure endowments, being important components of the capital stock, are the key factors for economic growth.

3.2 Studies on Developing Countries

Khan and Reinhart (1990) analyzed the view that private investment is generally more productive and efficient than Public investment for 24 developing countries, using a simple growth model. The result indicated that private and public investments had different effects on long run economic growth. In other words, the marginal productivity of private and public capital was different in developing countries. The study concluded that private investment played much larger role than the public investment in growth process.

Oshikoya (1994) analyzed the macroeconomic determinants of domestic private investment in Africa, using the pooled data for four middle-income countries (Cameroon, Mauritius, Morocco and Tunisia) and three low-income countries (Kenya, Malawi and Tanzania) over the period of 1970-88. The results indicated a two-way causality: that private investment is related positively to growth in real GDP, and an increase in real output enhances private investment. The real exchange rates, domestic inflation rate and changes in terms of trade had different impacts on both group of countries. The real exchange rate had a positive and significant impact on private investment in middle-income countries while the impact was negative, although small and insignificant, in the low-income countries. The inflation rate had a strong negative impact on private investment in the low-income countries. In contrast, the impact of domestic inflation rate on private investment in middle-income countries was positive. In both group of countries, there was adverse effect of term of trade on private investment, while domestic

credit available to private sector was the major determinant of private investment in both groups of countries.

Khan (1996) investigated the relationship between public and private investment and economic growth for 95 developing countries using data over the period of 1970-90. The results suggested that private investment had much larger impact on growth than public investment especially during the 1980's. The study suggested that government should cut off the unproductive investment, which had adverse effect on the growth of the neighboring countries.

Khan and Kumar (1997) analyzed the role of public and private investment in growth process taking a sample of 95 developing countries over the period 1970-90. The results suggested that there were higher returns to private capital, which could increase overtime. There were differences in the impact of private and public investment across all developing countries during the past two decades. Regardless of the region, the impact of public investment was greater in the low-income countries than in the high-income countries; if income differences among countries are taken into account. In low-income countries, the need for public infrastructure was greater to enhance and to boost-up the development process. In contrast, the private sector was comparatively developed in high-income countries that could provide many goods and services otherwise provided by public sector.

Podrecca and Carmeci (2001) analyzed the causality between investment shares and economic growth, using data for 124 countries with 6 observation per country for the time period of 1960-1990. The estimations showed that there was positive relationship

between growth rates of per capita GDP and investment and that fixed capital formation was the important determinant of economic growth. The causality test showed that there was a two-way causality between growth rates of per capita GDP and investment share of GDP.

Erden and Holcombe (2005) analyzed the impact of public investment on private investment. The study also analyzed the determinants of private investment in both developing and developed economies over the period 1980 to 1997, using the flexible accelerator model. The results showed that there was positive relationship between private investment and public investment and that public investment 'crowded in' private investment in developing countries. However, in case of developed economies, public investment may be competing with private investment and there were signs of negative impact of public investment on private investment. This is because the larger public sector lowers the productivity of private sector. Credit availability was the main constraint for private investment in developing economies. Although, the interest rate was not statistically significant, however the availability of credit showed significant and positive impact on private investment in developing economies. This constraint impact showed that there were significant differences in the capital markets of developed and developing economies.

Chow (1990) analyzed the relationship between capital formation and economic growth for the economy of China over the period of 1952-1985. The study investigated the contribution of five productive sectors in the process of economic growth, including agriculture, industry, construction, transportation and commerce. The main finding was

that technological change was absent in the growth of the Chinese economy for the period under investigation. The study used the Cobb-Douglas production function and found that its coefficients were about 0.60 for aggregate economy, 0.25 for agriculture, 0.68 for industry, 0.52 for construction, 0.47 for transportation and 0.22 for commerce. The rate of return to capital in 1980 was respectively 16 percent for the aggregate economy, and 20 percent, 17 percent, 26 percent, 4 percent and only 2 percent respectively for the sectors concerned. The average annual growth rates of the five sectors are respectively 0.019, 0.113, 0.075, 0.065, and 0.042. The share of capital in the growth rates was 0.05, 0.085 , 0.052, 0.040, and 0.021 respectively for the sectors concerned.

Ding and Knight (2008) analyzed the impact of human and physical capital in the growth rate of China since economic reforms of 1978 (as Chinese economy has shown remarkable growth rate since that time). Two models, the 'Bayesian Model Averaging' and the 'automated General-to- Specific approach' were applied by using annual data for the period 1978-2006, which comprised the panel of 30 provinces. The results showed that there was positive correlation between growth and initial level of income, indicating that there was divergence across the provinces over the entire sample period. Poor provinces did not grow faster as compared to rich but tended to their own steady states. The reasons suggested for this pattern indicated that marginal product of capital was higher because of lower stock of physical and human capital stock and regional policies of the government positively affected the economic growth. The results also indicated that there was conditional convergence among provinces, and both human and physical

capital accumulation played important role to promote economic growth. Investment in research and innovation, which enhanced factor productivity, played an important role in economic growth. On the human capital side, the primary school enrolment had no significance, but secondary school and higher education enrolment rates had positive effects on growth.

Lachler and Aschuer (1998) investigated the claim that a decline in public investment since the 1970s contributed in some way to the decline in Mexico's total factor productivity growth over the time of 1970 to1996. According to view of many economists, the primary reason of a decline in Mexico's growth was the lack of adequate public investment. The study also analyzed the main reasons as to why public investment could have either a positive or a negative impact on overall economic growth. The analysis provided limited support to the claim that the decline in public investment since the 1970s caused decline in Mexico's total factor productivity growth. The main conclusion suggested by earlier studies was that public investment would only have a clear positive impact on growth if it were financed through equal reductions in government consumption expenditures. Mexico hardly had any scope for motivating growth in this manner because its level of current expenditures was already very low. Total public expenditures had declined significantly since the mid-1980s, while most of the decline took place in non-discretionary debt expenditures. Consumption spending also experienced a significant contraction and it was now among the lowest in the world as a share of GDP.

Moshin and Kiliindo (1999) analyzed private investment in Tanzania by estimating a simple model using OLS technique. The results showed that public investment crowded out private investment; however, this depended on the way public investment was introduced. Public investment in the form of infrastructure development positively affected and crowded in, while that in the form of non-infrastructure projects placed negative burden on private investment. The reduction in socioeconomic infrastructure put a constraint on private sector investment. The study suggested that to stimulate and enhance the private sector investment, government should adopt appropriate monetary, fiscal and exchange rate policies for the provision of socioeconomic infrastructure.

Ibrahim (2000) examined the productivity of public and private capital formation in Malaysia using annual data from 1961 to 1995. The study made use of the neoclassical growth model, assuming a generalized Cobb-Douglas production function and adopted error correction Model with ordinary least square estimation technique. The study concluded that there was positive long run relationship between private investment and per capita real income. The Public investment was negatively related to the real income in the long run while positively related in short run. To check the contention that growth in the Malaysian economy was because of increase in exports, the author and re-estimated the growth regression by including the export share in GDP as explanatory variable. This increased the explanatory power of the regression substantially indicating that exports were positively related to economic growth in the long-run. The study identified that public capital was largely unproductive because the government over-

invested in the public enterprises. For policy implications, the study suggested that government may need to reduce its investment so that private investment may flourish.

Guimaraes and Unteroberdoester (2006) investigated the investment trend and its effects on growth in Malaysia. The aggregate data showed that there was over investment in the years leading to Asian crises and the adjustment process was slow. The results also found that corporate profitability was low, which pulled down the private investment. Furthermore, the low market evolution indicator showed that market expectation was of low future profitability, which could contribute to further decline in investment. There were differences in investment behavior of different sectors; for instance, higher sales lead to higher investment in the individual sectors while in other sectors like services, this effect was relatively low.

Badawi (2003) analyzed the impact of macroeconomic policies on private investment in Sudan using data over the period 1969-1998. The study used the autoregressive and error correction techniques to estimate the long and short run coefficients. The results suggested that real output had significant impact on private investment, which provided evidence on the validity of hypothesis that accelerator principle explains private sector investment. The public sector investment was found to have a 'crowding out' impact on private investment over the period of study. The devaluation of the Sudanese currency also discouraged capital expansion in the private sector. Monetary policy in the form of restricting domestic credit appeared to have a significant impact on private investment, indicating that private investment was moving in the same direction as banking sector credit flows, suggesting that a tight monetary

policy may lead to reduction in private capital formation. Increase in real interest rate had negative impact on private investment, indicating that costs of funds did matter for private investors when they make investment decisions.

Patterson (2004) investigated the relationship between investment and growth in Ethiopia using data for 1990 onwards. The results showed that there was positive correlation between investment and growth rate. The financing of investment from exports and capital inflow was the key factor for the promotion of the growth. The environment of political instability also discouraged investment and growth in Ethiopia. Side by side corruption also negatively influenced investment because resource allocation was not just and often used for squabble and illegal activities. The study suggested that country should adopt technology according to local needs, which should increase the skills of labour and take advantage of low cost labour, so that the existing capital could be used efficiently.

Abbas (2004) examined the determinants of private investment in Iran. The study analyzed the long and short run determinants of private investment function, using Johansen's multivariate co integration techniques and short run dynamic model and using annual data for the period 1960-2000. The co-integration tests indicated that there was long run relationship between real non-oil GDP and the rate of inflation. The study adopted an error correction model to analyze the short run dynamics of private investment. The results showed that current growth rate of non-oil GDP was the main determinant of the private investment.

Ismihan (2005) investigated the relationship between macroeconomic instability, public and private capital accumulation and growth in Turkey over the period 1963-1999, using Johansen's multivariate co-integration and impulse-response analysis technique. The government of Turkey did not give attention to stabilization programs over the last twenty-five years, as there was lot of political instability and polarization. The study concluded that the chronic macroeconomic instability of the Turkish economy had seriously affected investment and growth. There was no significant effect of infrastructural public investment on private investment in long run. However, there was some evidence of complementarily between public and private investment. The evidence of 'crowding out' effect of public investment on private investment was also noticed.

Onder et al (2007) studied the impact of public investment on economic growth at regional level in Turkey using panel data of 12 sub regions for the period of 1980-2001. They measured the effect of public stock on regional convergence, using conditional convergence model and GMM system. The results of the two models showed that public capital stock had a positive effect on per capita income; however, when spatial effect was included to the model, the results lost significance. The reason that public capital stock had no strong impact on convergence could be explained by disparities in regional distribution. When population distribution was taken into account, the relatively more developed areas were found to obtain more public investment than the less developed regions. The study suggested that in order to reduce regional disparities, more public investment is required in the relatively less developed regions and it should be directed towards social infrastructure, education, healthcare and public administration.

Ndikumana (2005) studied the factors responsible for boosting investment in South Africa. The study used aggregate industry level data as well as the disaggregate data on 27 sub-sectors of manufacturing sector over the period 1970-2001 by adopting a Hybrid model. The results indicated that domestic borrowing by government had negative impact on investment. Higher investment in public infrastructures like transport, telecommunication and electricity would reduce private cost of production and raise profitability, which would enhance private investment. Thus there was a 'crowding in' effect of public investment on private investment. Furthermore, the study suggested that macroeconomic stability was essential for private investment; particularly the price and exchange rate stability were important conditions for expansion of private investment.

Eng (2005) used the perpetual inventory method to investigate the effect of disaggregate stock of gross fixed capita in Indonesia. The results indicated that Indonesian's non-residential capital stock ratio substantially increased during 1990s. The study found that such investment had substantial effects on Indonesian economy and helped in overcoming the monetary crises during 1990-1997. An increase in private investment raised some concern about the efficiency of public investment.

Bukhari et al (2006) investigated the causal relationship between public investment and economic growth, private investment, as well as public consumption for Korea, Singapore and Taiwan (popularly called "Little Dragons" because they are small countries with unprecedented growth rate) for the period of 1971 to 2001. The analysis suggested that both public and private investment and public consumption had a long-term dynamic impact on economic growth in all the countries. The panel causality

analysis showed no evidence of relationship between the variables. The non-causality hypothesis suggested that the results were completely homogeneous in a small sample of East Asian countries

Bertrand and Mamatzakis (2007) examined the cost saving effects of components of infrastructural capital and their impact on the productivity of Chilean economy over the period 1960-2000. The results showed that infrastructure positively contributed to total factor productivity and its overall impact appeared to reduce the total cost. To capture TFP effects, investment had to be balanced accordance to cost saving over time. The results showed that only the investment in electricity infrastructure managed to capture such cost saving overtime. There was also some significant impact of transport infrastructure; however, telecommunication had totally failed to balance the cost saving systematically over time.

Jongwanich and Kohpaiboon (2008) examined the determinants and trends of private investment in Thailand for the period 1960-2005. The results showed that presence of high degree of uncertainty negatively affected and discouraged private investment. Real exchange rate and public investment positively affected private investment and showed their complementary. The main finding of the study indicated that private investment in Thailand was forced to contract because of Asian financial crises in 1997. The study suggested that in the absence of suitable policy actions, private investment would take a long time to absorb the shocks. Among the short run determinants, credit shortage was the strong constraint on investment recovery during the crisis. In contrast however, private investment was mostly determined by business

opportunities and investment costs in the long run, such as output growth and real exchange rate. Further, the public infrastructure had a long run positive impact on private investment in Thailand.

Ngoc (2008) investigated the role of capital and technological progress in Vietnam's economic growth. The study also investigated the impact of economic reforms since 1986, and rate of returns to capital and labor by estimating a Cobb-Douglas production function, using annual data over the period 1975-2005. The results suggested that investment positively contributed to economic growth, being its major source. There was no technological progress in the country during this period. The study concluded that official data on capital formation might be over-estimated because of low depreciation rate, which would lead to under-estimation of technological progress. That the government tried to build planed Soviet-style, self-sufficient economic system in the country was a major reason for the absence of technological progress. This is because this system was often associated with inefficiency and lack of incentives for firms for adoption or innovation of new technological progress.

Smake (2008) examined the impact of public and private investment on economic growth of Benin by employing VAR model and using data for the period 1965-2005. The results indicated that there was positive relationship between both public and private investments and growth rate in the short as well as the long run, however the public investment had negative impact and crowded out private investment. As credit in Benin tended to be short termed, it had positive short-lived indirect effect on growth because it had positive impact on private sector investment, which enhanced the growth rate of the

economy. The study suggested that fiscal policy should move in the direction such that it should avoid the crowding out effect of public investment.

3.3 Studies on Pakistan

Khan (1988) examined the impact of fiscal and monetary policies on private investment in Pakistan. Private investment in aggregate as well as investment in manufacturing and agriculture sector was estimated. The study concluded that market conditions appear to have a strong influence on private investment in general, while changes in output had minor impact. An important finding revealed that agriculture sector had been operating above the capacity level as against the manufacturing sector that has been operating below the capacity level. Private investment in Pakistan was constrained by the availability of funds. The study suggested that monetary policy could positively affect the investment behavior by proper use of bank credit. Savings, investment and interest rate should be left to find their equilibrium level in a free market environment. So for as fiscal policy is concerned, it is suggested that public investment in the infrastructure plays an important role in enhancing private investment.

Looney and Frederiken (1995) estimated the relationship between public and private investment in Pakistan by using data from 1972 to 1995. The results suggested that certain types of government investment - especially in rural works 'crowded out' private investment in non-manufacturing activities. Likewise, the public infrastructure investment in energy projects provided the greatest inducement to private investment. It is suggested that proper flow of bank credit to the private sector could be an effective tool in inducing private sector investment in the manufacturing sector. Credit rationing, which

is itself a component of financial domination, is obstruction to savings, investment and growth. The interest rate should find its equilibrium in free market environment.

Loony (1997), investigated the effect of infrastructure on Pakistanis' economic growth. The expansion of public investment in infrastructure provision played an interactive role in the country's development. Public facilities had largely expanded in response to the needs created by private sector investment in manufacturing, rather than strongly initiating private capital formation. It could be more effective if investment funds were allocated efficiently. This phenomenon implied that there was lack of infrastructure in key economic areas. The rate of return to infrastructure investment was high and Pakistan was able to sustain rapid growth rate in general.

Loony et al (1997) studied the impact of Government investment on private sector in Pakistan over the period 1972 to1995. The results suggested that private sector investment depends on the lagged change in GDP, the change in private sector credit, the lagged value of private investment, government expenditure in the infrastructure and other projects. The study found that higher rates of investment took place in the economy when the private sector was properly motivated.

Khan and Sasaki (2001) analyzed the role of public capital in Pakistan s' economy by using time series data from 1964 to 1997 .The study defined the public capital broadly as 'the services from publicly provided facilities'. Beside the total public capital, three different components, namely the agriculture (G1), electricity transport and communication (G2) and financial social, and welfare services (G3) were also used in separate estimations. The results showed that public labor ratio and public capital had

significantly positive effect on output. Public capital productivity contributes largely at the aggregate and sectoral level and so it played an effective role in the production process. Further, the estimated results of investment analysis showed that private capital outputs, public capital ratio and bank credit played important roles in explaining the private sectors investment behavior.

Naqvi (2002) investigated the relationship between economic growth, public investment, and private investment for Pakistan over the period 1964-2000 by using VAR methodology. The results showed that public investment had a positive impact on private investment, and that economic growth pushes forward both private and public investment, as predicted by the accelerator-based models. The impulse response functions showed that it takes about five years for the effects of policy change or a shock (to either private or public investment) to disappear from the system. Further, uncertainty had a much larger impact on private investment than on public investment.

Naqvi (2003) investigated the comparative performance of public and private investment in the economy of Pakistan over the period 1965-2000 using Cobb Douglas production function. The results showed that long run estimates of the elasticities of public and private investment are different under different assumptions made about the evolution of technology. If technology was considered exogenous, the elasticities of private and public capital with respect to output and rate of return were similar to each other. There was large externality to public capital accumulation. When these externalities were taken into account, the public capital was more productive than private

capital. The impulse response analysis showed that an exogenous shock to private capital took double time to disappear from the system as compared to the public investment.

Ghani and Din (2006) explored the relationship between public investment and economic growth for Pakistan economy by using the vector autoregressive approach (VAR). Both the public and private investments were included in the study. The results indicated that public investment had a negative, though insignificant, impact on output. In contrast, there was a positive relationship between private investment and economic growth. Public investment had no favorable impact on private investment; in other words, it 'crowded out' private investment and this result raises some concern about the efficiency of public investment.

Khan and Sajawal Khan (2007) investigated the determinants of private investment in Pakistan for the period 1972-2005. To check the long run and short run changes in investment, the study used ARDL co-integration approach. The results showed that real GDP had positive but insignificant impact on private investment while public investment had negative but insignificant impact on private investment. Thus, the hypothesis that public investment 'crowds out' private investment was valid in case of Pakistan. There was positive but insignificant impact of real interest rate and negative but insignificant impact of FDI and inflation rate on investment. The study concluded that in case of Pakistan most of the traditional factors had very weak or very negligible impact, which supported the view that low quality performance of the institutions was the cause of low investment in Pakistan. The study also showed that inefficient utilization of public sector funds and large budget deficits had negative impacts on private investment. The

study suggested that policy should be focused on the performance of overall institutional framework, improving quality of law and regulations, which are the keys to establish the conditions for economic stability.

Ahmed and Qayyum (2007) investigated the determinants of private fixed investment in Pakistan and the interrelationship between public and private investment. The long run relationship between private investment and its determinants was examined by applying Johansen Maximum Likelihood method (1988), while the short run dynamics of private investment was estimated through an error correction model. The results showed that there was long run relationship between private fixed investment, public consumption and development expenditure and market activities. The relationship between public investment and private investment was positive. The study also found that macroeconomic instability and uncertainty were causing to depress the private sector investment. Thus, macroeconomic stability must be insured to enhance the private sector investment.

3.4 Summary

Summing up the analysis of the existing literature on public investment, private investment and growth relationship, we have mixed evidence about the nature of spillover effects of public and private investments. Most of the studies indicated that private investment is more productive than public investment because of the fact that public investment is not directly productive in most of the cases. Public investment in infrastructure has proved to boost up economic growth by increasing the marginal productivity of private capital. In some cases, public investment played complementary

role and 'crowded in' the private investment but in majority of cases, it had substitution effect and 'crowded out' the private investment. Non-availability of credit and macro economic instability are the main constraints for private investment in developing economies like Pakistan.

CHAPTER 4

Investment and Growth in Pakistan

Pakistan economy has faced many crises since independence in 1947. These crises have hampered the sustainable economic growth. Despite the efforts made by different governments, the persistent fiscal imbalances have adversely affected investment and growth of the economy. The problem of growing external and internal debt and underdeveloped financial markets and banking system, low level of saving and investment rates have added to the problem of slower growth and deterioration of physical infrastructure.

4.1 The Past Experience

During the 1950's decade, the Korean war boosted our exports and foreign exchange earnings that helped maintaining high economic growth. In 1960's, the continuous inflow of foreign aid and assistance also contributed to high and rapid growth. However, this momentum could not continue during 1970's due civil war, oil price shock and nationalization policy. But above all, the political instability after 1970-71 has been the major cause of deterioration in Pakistan. High level of defense spending since then is one of the critical factors, which absorbs a significant fraction of scarce revenues and adversely affects public savings otherwise meant for development purpose. Increase in defense spending and development expenditure cannot be covered by tax revenues alone. So the revenue account has continuously turned into deficit since 1970-71. Prior to that time, there used to be some surplus of around 2 percent of GDP on the revenue account,

which could be appropriated towards development program. The tax revenues in Pakistan could not cope with faster growth in the non-development spending.

Over the past 37 years (since 1970-71), there is variability in the GDP growth and percentage shares of investment. Table 4.1 and the associated Figure illustrate the rate of GDP growth and public/ private investment and the total investment as percent of GDP.

Table 4.1

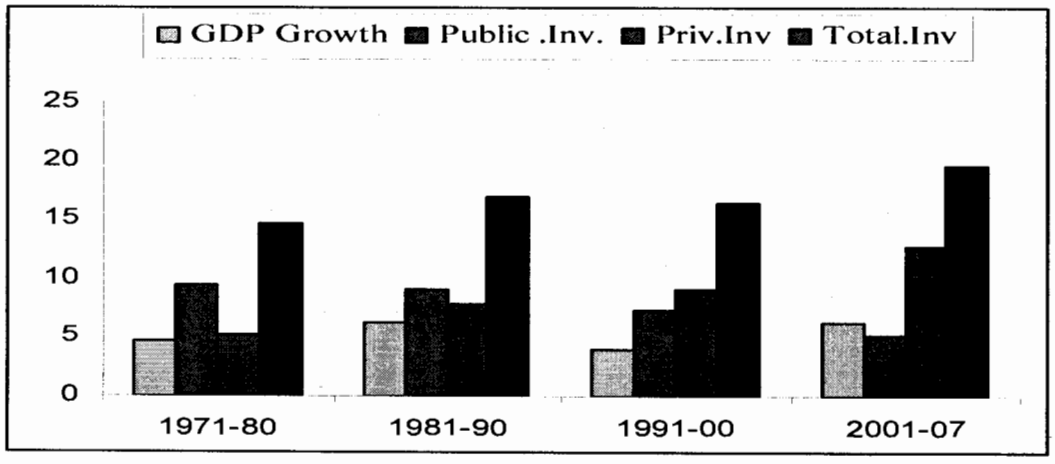
Average GDP growth rate and ratio of Public/ Private Investment to GDP overtime

Time Period	*GDP Growth (%)*	*Public .Inv.* *Ig/GDP*	*Priv.Inv* *Ip/GDP*	*Total.Inv* *Ig+Ip/GDP*
1971-80	4.78	9.44	5.32	14.76
1981-90	6.25	9.17	7.79	16.96
1991-2000	3.99	7.34	9.14	16.48
2001-2007	6.28	5.3	12.78	18.08

Source: Pakistan Economic Survey (various issues).

Figure 4.1

Average GDP growth rate and ratio of Public/ Private Investment to GDP overtime



Because of nationalization policies during the period of 1970's, significant involvement of government in commercial activity and increase in the share of public sector squeezed private investment and adversely affected its growth. At that time, public investment was twice in volume relative to private investment. Domination of state owned/controlled institutions adversely affected the financial sector development in Pakistan. In the decade of 1980's, we notice some revival in private sector activity because of encouragement and incentives provided by the government. However, due to sever political instability during 1990's, the picture of the economy remained gloomy. The growth rate fell from 6.2 percent in 1980's to 3.99 percent in 1990's. There was a slowing down of public investment activity when compared to the trend level especially in the latter part of the decade, while there was some acceleration in the rate of private investment during 1990's relative to the position in the1980's decade. Political instability during the 1990's decade negatively affected the growth rate of the economy. The political leadership rarely emphasized on saving for long term development. The level of domestic savings has been very low, which is indicative of low confidence of masses in the financial structure. The low level of national savings tends to lower the rate of investment and deterioration of infrastructure (Khan and Sasaki, 2001).

4.2 The Present Scenario

With the advent of 21st century, we observe some kind of revival in growth and investment activities. Economic reforms program such as fiscal adjustment, privatization of energy, telecommunication and production, reforms in the banking and trade sectors launched in 2000, played a vital role in the economic recovery of the Pakistan. On the average GDP growth rate increased twice as compared to 1990s decade and total

investment also increased from 16.48% of GDP in 1990s to 18.08% of GDP in the early years of the current decade. Private investment has increased overtime and public investment relatively slowed down. Economy has grown by more than 6.5 percent per year on the average since 2003-04. As a percentage of shares of GDP, investment increased from 15.5 percent in 2001-02 to 20.4 percent in 2007-08, which is a healthy sign. Table 4.2 presents the year-wise percentage of public, private investment, total investment and percentage of GDP from 2000-2001 to 2007-2008 respectively.

Table 4.2

Percentage of GDP growth and public/ private investment and total investment

Time Period	*GDP Growth (%)*	*Public .Inv. Ig/GDP*	*Priv.Inv Ip/GDP*	*Total.Inv Ig+Ip/GDP*
2000-01	2.0	5.7	10.2	15.9
2001-02	3.1	4.2	11.3	15.5
2002-03	4.7	4.0	11.3	15.3
2003-04	7.5	4.0	10.9	14.9
2004-05	9.0	4.3	13.1	17.1
2005-06	5.8	4.7	15.7	20.4
2006-07	6.8	5.7	16.2	21.9
2007-08	5.8	5.4	15.0	20.4

Source: Pakistan Economic Survey (various issues).

The financial sectors reforms after 1990 have shown a positive impact on the degree of interest rate liberalization, moderate reduction in credit subsidies and progress towards the market-based transactions. However, because of high rate of inflation, the interest rate on deposits became negative in real term and discouraged the financial

saving (Hassan, 1997). To finance expenditures, the governments (both democratic and authoritative) have to rely heavily on external and internal borrowing and deficit financing. This practice has resulted into high stakes of debt and high inflation, which has increased debt servicing. The rising interest rate burden along with high defense spending together absorb about two-third of gross revenues. Consequently, nothing is left for the development budget and provision of social services like health and education. The political conditions deteriorated during 2007-08 and the new democratic government that took over in March 2008, has to face a lot of challenges both on the internal and external fronts. The rate of investment has surely slowed down during 2008 and 2009 due to the terrorist activities and shortage of electricity and gas for the industrial sector. The practice of out-wards looking policies on part of the government continues as usual and the prospects of growth and development depend heavily on the availability of foreign aid and assistance. The dream of self-sustaining growth and investment is yet far from turning into reality.

CHAPTER 5

Model, Methodology and Data

The theoretical and empirical literature has proved that there is strong inter-relationship between investment and real output (GDP). There is a two-way causality between the two. Where investment is an important component of aggregate demand that leads to capital formation and growth through multiplier effect, the GDP growth also affects investment as evident from the accelerator models. Investment is divided into two components, the public and private investment. Decisions about private investment are affected by GDP, availability of credit, real interest rate, inflation rate and possibly investment activities in the public sector. Likewise, investment in public sector is mainly determined by the level of GDP, government revenues, foreign aid, inflation rate and exchange rate, but the most important factor is the policies of the government in office.

5.1 The Model

The link between private, public investment and economic growth is examined by the researchers like Ibrahim (2000). The relationship may be expressed as under in somewhat modified form:

$$Y_t = f\ (I_{pt}\ ,\ I_{gt}\ ,\ Cred_t\ ,\ lr_t\ ) \qquad \text{.....5.1}$$

Where Y = real GDP, Ig = public investment, Ip = private investment, lr =lending rate, Cred = ratio of private sector credit to GDP. Theoretically both types of investments are positively related to the GDP but empirically it depends on the efficiency and productivity of investment. Private sector credit and lending rate is also included in the function as it affects the private investment directly and also the growth rate of GDP

indirectly since the availability of easy credit provides incentives to private investors, which increases the growth rate of GDP. Similarly, an increase in the real interest rate increases the cost of borrowing and thus discourages new investment and growth of GDP.

Public investment is mainly determined by foreign aid and government revenue. It also depends on GDP. We expect positive coefficients of these three variables. Exchange rate and inflation rate also influence the public investment negatively. Following Rahman (2008), we specify following public investment function as under:

$$I_{gt} = f\ (Y_t\ ,\ Aid_t\ ,\ er_t\ ,\ Gr_t\ ,\ Inf_t) \qquad \text{.....5.2}$$

Where the symbols stand for: Aid = foreign aid, er= exchange rate, Gr = Government Revenue, Inf= inflation rate.

GDP plays an important role in determining private investment. The investment decisions are affected by domestic credit available to private sector, lending rate and inflation, while public investment may also included as explanatory variable to capture the "crowding out" or "crowding in" effect on private investment. Following Khan and Khan (2007), we specify the private investment function as follows:

$$I_{pt} = f\ (Y_t\ ,\ Cred_t\ ,\ I_{gt}\ ,lr_t\ ,\ er_t\ ,\ Inf_t) \qquad \text{.....5.3}$$

The above three functions can be written in a testable form as:

$$\ln Y_t = \alpha_0 + \alpha_1 \ln I_{pt} + \alpha_2 \ln I_{gt} + \alpha_3 \ln Cred_t + \alpha_4\ lr_t + u_t \text{.....5.4}$$

$$\ln I_{gt} = \beta_0 + \beta_1 \ln y_t + \beta_2 \ln Aid_t + \beta_3 \ln Gr_t + \beta_4 \ln er_t + \beta_5\ Inf_t + v_t \text{.....5.5}$$

$$\ln I_{pt} = \gamma_0 + \gamma_1 \ln y_t + \gamma_2 \ln I_{gt} + \gamma_3 \ln Cred_t + \gamma_4\ lr_t + \gamma_5 \ln er_t + \gamma_6\ Inf_t + \omega_t$$

..... 5.6

The terms u, v and w are the stochastic/ error terms as usual.

5.2 Econometric Methodology

The above model will be estimated in three steps. First, using the Augmented Dickey Fuller (ADF) unit root tests and assuming individual time series as non-stationary, we examine the time series properties of the data. Second, conditional to the results of the unit root test, we check co-integration between the variables specified in each equation using the method proposed by Johansen (1988) and Johansen and Juselius (1990). Third, based on the results of the long-run co-integration parameters, we will estimate the short-run error-correction models of each equation.

In order to determine the nature of long-run relationship among time series variables, we employ co-integration method to investigate how a change in one variable brings about changes in other variables. Since many macroeconomic time series are trended (they change overtime) and in most cases non-stationary, so conducting co-integration analysis (stationarity and causality tests) for each time series is necessary. The standard OLS results may be spurious and lead to wrong conclusion if non-stationary variable are used.

5.21 Stationarity

A variable is said to be stationary if it is time independent. A time series is said to be stationary when it has three properties:

i. $E(y_t)$ = constant for all t.

ii. $Var(y_t)$ = constant for all t.

iii. $Cov(y_t, y_{t+k})$ = constant for all t while $k \neq 0$

In other words, a series is said to be stationary if its mean variance and covariance remain constant and do not vary systematically over time. To test the presence of unit

root, we apply Augmented Dickey-Fuller (ADF) test (Dickey an Fuller 1997). The test suggests the following regression equation.

$$\Delta X_t = \beta_1 + \beta_2 t + \phi X_{t-1} + \alpha_i \sum_{i=1}^{n} \Delta X_{t-1} + e_t \quad \text{.....5.7}$$

In the above equation, X_t is the time series that has to be tested for unit roots, t is the time trend and e_t is the error term or white noise. The null hypothesis to be tested is ϕ=0, which means that the given time series is non-stationary. After estimating the coefficient of x_{t-1}, its standard error is used to compute the τ - statistic, which is then compared with the DF or Mackinnon critical value. If the estimated tau (τ) value is greater than DF tabulated critical value, the hypothesis H_0: ϕ=0 is rejected in favor of the alternative hypothesis that the given time series is stationary.

5.2.2 Co integration Analysis

The concept of co-integration was first introduced by Granger (1981). If the variables of interest share a common stochastic trend, they are considered co-integrated in the long run (Christensen, Nielsen, 2003). The main feature of macroeconomic modeling is to specify and estimate the inter-temporal connection between different variables. Such modeling is required to capture both the short run effects as well as the long run dynamics.

Engle and Granger (1987) formalized the concept of Co-integration to check the existence of long run relationship between the variable. Although the Engle and Granger (EG) test is very simple and easy to implement, however it suffers from some shortcomings as well. This test has no theoretical base and does not say anything as to which of the variables can be used as regressor and why. One can either regress Y_t on X_t

or vice versa. A second problem arises when more than two variables are used in the regression and there may be more than one co-integrating relationships. It does not give the number of co-integrating vectors and direction of normalization. Therefore, an alternative to EG approach is the Johansen approach, which is appropriate for multiple equations. We discuss briefly the Johansen co-integration procedure.

Lets we have an endogenous variable of kth order, which can be written in a vector error correction model (VECM) as follows:

$$Y_t = \pi_0 + \pi_1 Y_{t-1} + \pi_2 Y_{t-2} + \ldots\ldots\ldots + \pi_k Y_{t-k} + v_t \quad \ldots\ldots\ldots\ldots\ldots 5.8$$

Where Y_t is a (px1) random time series vector (the variables with order of integration of at most one are denoted by 1 (1), Π represents the vector of constant term and v_t is the vector of error term which is I (0) and distributed with (0, σ^2). Defining Δ=1-L, where L is the lag operator, the dynamics of the error correction model (ECM) is deduced as follows:

$$\Delta Y_t = \pi_0 + \sum_{i=1}^{k-1} \Gamma_i \Delta Y_{t-1} + \Pi Y_{t-k} + v_t \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots 5.9$$

$$\Gamma_i = -(I - \Pi_1 - \ldots. - \Pi_i) v_t \qquad \text{i=1, 2, 3} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots 5.10$$

where Π is a (px p) matrix of parameters, the rank of which contains information about long-run relationships among the variables in the model. If Π has full rank p, all elements in Y_t are stationary. If the rank of Π is zero, the model reduces to VAR in the first-differences. When 0< *rank*< p , there exist co-integrating relationships equal to the rank. In this case there exist (pxr) matrices α and β such that α will include the coefficients showing the speed of adjustment to equilibrium while $\Pi = \alpha\beta$. will be the

long-run matrix of coefficients. If the individual series is I (1), then the first differences of the series are stationary. If there is co-integration relationship between I (1) series, then the linear combination of these variable is I (0), so that the $\Pi_i Y_t$ term is stationary.

To test whether there exists co-integration between the variable or otherwise, two test statistics are used, which determine the rank of co-integration space. One is the likelihood ratio test based on the maximum Eigen value (λ_{max}) of the stochastic matrix and the second test is the value of the likelihood ratio test based on the trace of the stochastic matrix (λ_{trace}). The likelihood ratio test statistics developed by Johansen are given below:

$$LR\ \lambda_{trace} = -T \sum_{t=r+1}^{n} \ln (1 - \hat{\lambda_1}) \qquad \text{..... 5.11}$$

Where λ_{t+1}, λ_{t+2},....., λ_n are the n-r smallest eigen-values and T stands for number of observations.

$$LR\ \lambda_{\max} = -T \ln (1 - \hat{\lambda}_{t+1}) \qquad \text{..... 5.12}$$

The first statistics (λ_{max}) tests the null hypothesis that there are less than or equal to "r" co- integrating vectors against the general alternative where "r" is the number of co-integrating relations. The second statistics (λ_{trace}) tests the hypothesis that there are "n" numbers of co-integrating vectors against the alternative of r+1.

5.2.3 Short run Analysis of the variables

The short run dynamics are examined using the error correction mechanism (ECM), which explains changes in the dependent variable in terms of changes in the explanatory variables as well as deviations from the long run relationships between the

variables and its determinants. The ECM is important for many reasons. It is a convenient model, which is formulated in term of first differences. It measures the correction from disequilibrium of the previous period. ECM eliminates trend from the variables and resolves the problem of spurious regression. This model follows the general to specific approach in econometric modeling, which best fits the given data sets. By definition of co-integration disequilibrium, the error term is stationary. Two variables are co-integrated implies that there is some adjustment process which prevents the error into the long-run relationship. Thus the concepts of co-integration and the error correction mechanism (ECM) are closely related.

We formulate the error correction models for the real GDP, public investment and private investment respectively as follows:

$$\Delta \ln y_t = \beta_0 + \beta_i \Delta \ln y_{t-1} + \sum_{i=o}^{k} \delta_i \Delta \ln I_{pt-i} + \sum_{i=0}^{k} \phi_i \Delta \ln I_{gt-i} + \sum_{i=0}^{k} \gamma_i \Delta lr_{t-i} + \sum_{i=0}^{k} \mu_i \Delta \ln cred_{t-1} + \gamma ECM_{t-1} + \varepsilon_t \quad \text{.....5.14}$$

$$\Delta \ln I_{gt} = \theta_0 + \rho_1 \Delta \ln I_{gt-1} + \sum_{i=0}^{k} \sigma_i \ln \Delta y_{t-1} + \sum_{i=0}^{k} \sigma_i \Delta \ln G_{rt-i} + \sum_{i=0}^{k} \phi i \Delta \ln Aid_{t-i} + \sum_{i=0}^{k} \Omega_i \Delta \ln er_{t-i} + \sum_{i=0}^{k} \theta_i \Delta \inf_{t-i} + \sigma ECM_{t-1} + \mu_t \quad \text{.....5.15}$$

$$\Delta \ln I_{pt} = \gamma_0 + \alpha_1 \ln \Delta I_{Pt-1} + \sum_{i=0}^{k} \psi_i \Delta \ln y_{t-i} + \sum_{i=0}^{k} \eta_i \Delta \ln cred_{t-i} + \sum_{i=0}^{k} \omega_i \Delta lr_{t-i} + \sum_{i=0}^{k} \rho_i \Delta \ln I_{gt-i} + \sum_{i=0}^{k} \kappa_i \Delta \ln er_{t-i} + \sum_{i=0}^{k} \chi_i \Delta \inf_{t-i} + \delta ECM_{t-1} + \eta_t \quad \text{.....5.16}$$

Where Δ is the difference operator and ECM_{t-1} is an error correction term. The expected signs of the parameters γ, σ and δ should be negative, which will measure the speed of adjustment towards long run equilibrium

5.3 Data and Variables

The availability of adequate and reliable data is utmost necessary for empirical analysis since the use of inappropriate data leads to incorrect conclusions. It is therefore essential to check the data for consistency and reliability before carrying out empirical analysis. We have used the annual time series data on different variables over the period 1972-2007. The dataset is compiled from different sources. Most of the data is retrieved from the International Financial Statistic (IFS) Yearbook published by International Monetary Fund (IMF). The data on some variables is collected from various issues of Pakistan Economic Survey compiled by the Federal Bureau of Statistics, Government of Pakistan and from the Annual Reports of the State Bank of Pakistan. All the data is expressed in million rupees except the Credit-to-GDP ratio, inflation rate, exchange rate and lending rate.

5.3.1 Variables Description

The important variables used in this study include the GDP, Public and Private Investment, Government Revenues, Foreign Aid, the ratio of Credit to GDP, the Lending rate (market rate of interest), Exchange rate and the rate of Inflation. A brief description of these variables is presented below.

(a) Gross Domestic Product (GDP)

GDP is the sum total of gross value added by all resident economic agents in the economy at current market prices during the accounting period. We have used GDP in real terms, when deflated by the Consumers Price Index (CPI), and derived the data from the Yearbook of International Financial Statistics (IFS), after due comparison with other sources like the Pakistan economic Survey.

(b) Public investment

The total public investment encompasses investment in physical infrastructure made by central government, local governments and public corporations. This is investment in key welfare areas such as health, education and training, roads and railways etc. All the data on public investment is taken at current prices and deflated by CPI because the data in the early seventies was not available at constant factor cost. The data are taken from Pakistan Economic survey.

(c) Private Investment

Private investment leads to capital accumulation by the private investors. The data on private investment is taken at current prices and deflated with CPI to render it in real terms like that of the public investment and other variables. The data are derived from various issues of Pakistan Economic Survey.

(d) Government Revenue

Governments acquire the resources to finance their expenditures from a number of different sources. The most important of these sources is taxation. However, there are other non-tax sources and the governments also raise funds through sale of certain goods and services. The data on government revenues are retrieved from various issues of Pakistan Economic Survey, the annual reports of the Sate Bank and the Yearbooks of the International Financial Statistics (IFS).

(e) Credit-to-GDP ratio

The credit-to-GDP ratio is an indicator of the availability of credit facilities to investors in the economy. The data on credit extended to the private sector during the periods concerned are derived from various issues of the annual reports of State Bank of

Pakistan. The ratio is compiled readily by dividing the credit through the GDP at current prices of the periods concerned and there is no need of deflating the ratio.

(f) Foreign Aid

Foreign aid is the economic and financial assistance provided by one nation or international agency to the country concerned, which may be provided to achieve certain socioeconomic objectives or on humanitarian grounds in the event of natural calamities. The role of foreign aid has always been very important in the economic development of Pakistan. The data on foreign aid are derived from a number of sources, particularly from the annual reports of the State Bank of Pakistan.

(g) Inflation

Inflation is a persistent increase in the general price level (of goods and services) overtime. It is measured by the consumer price index (CPI), the wholesale price index (WPI) and the GDP deflator. The CPI reflects the annual percentage change in the cost to the average consumer in acquiring a given basket of commodities that may be fixed or variable at specific intervals. We have used the CPI version of inflation rate since the data is available for the period concerned from the International Financial Statistics (IFS).

(h) Exchange Rate

The rate at which one currency can be exchanged for another, or the number of units of domestic currecy available against one unit of the foreign currency, is called the exchange rate. The data on Exchange rate is retrieved from the Yearbooks of International Financial Statistics (IFS).

(i) Lending Rate

The lending rate is the market rate of interest charged by the commercial banks from the borrowers as percent of the principal amount per annum. The data on lending rate are collected from annual reports of State Bank of Pakistan.

The descriptive statistics of the variables is given in the below in Table 5.1.

Table 5.1
Descriptive Statistics of the Variables

Variables	Mean	Median	Standard Deviation	Minimum	Maximum
Y_t	10.08019	10.19242	0.49919	9.21124	10.96083
I_{gt}	0.00288	0.00125	0.00345	0.00017	0.01128
I_{pt}	0.00233	0.00224	0.00160	0.00074	0.00839
$Cred_t$	0.18432	0.18802	0.03852	0.13064	0.27867
Aid_t	0.04111	0.04097	0.01307	0.01317	0.07128
Inf_t	9.57703	7.75402	7.08208	1.82822	34.27684
Gr_t	$2.97*10^5$	$1.52*10^5$	$3.49*10^5$	$7.05*10^3$	$1.39*10^6$
lr_t	11.51667	10.96000	1.93885	7.28000	15.64000
er	29.30836	21.66000	19.61776	9.90000	60.98100

CHAPTER 6

Empirical Results

The empirical work is preceded by three steps. In first step the order of integration of each variable included in the model is determined. On the basis of these results, we test for co integration using Johansson and Juselious (1990) method. For estimation of the short run relationship, an error correction mechanism is employed.

6.1. Testing Unit Roots.

We examine the order of integration using Augmented Dicky Fuller (ADF) unit root test. All variables, except lending rate and inflation are in log form. Table 6.1 reports the results.

Table 6.1

Results for Augmented Dickey-Fuller Test of Unit Roots

(Hypothesis: There is unit root existing.)

Variables	*ADF at Level*	*ADF at First difference.*	*I( )(decision)*
$\ln y_t$	0.3973	-5.3540	I(1)
$\ln Ig_t$	-0.270	-6.2386	I(1)
$\ln Ip_t$	-2.521	-4.8709	I(1)
$\ln cred_t$	-0.3618	-5.1788	I(1)
lr	-2.7125	-4.3394	I(1)
$\log Aid_t$	0.8546	-8.7650	I(1)
$\log er_t$	-1.7619	-7.1341	I(1)
inf	-2.2405	-5.5965	I(1)

Note: ADF test is based on the Mackinnon (1991) critical values.

It can be seen from the Table that all the variables are non-stationary at their levels but stationary at their first difference. This result motivates us to employ Johansen (1989) cointegration test.

6.2 .The Long run Estimates: Cointegration Analysis.

The long-run co relationship between the variable is obtained by using multivariate co-integration method advanced by Johansen (1989), Johansen and Juselius (1990).The model includes unrestricted constant and no trend.

6.2.1. The Long run growth function.

Major objective of this study is to investigate the relationship between investment (both public and private) and growth for Pakistan over the period of 1972 to 2007. To examine the co integration between real GDP and its determinants we use Multivariate co integration test. Two lags were selected on the basis of Akaike information criterion (AIC). By applying the two stage likelihood ratio tests which is based on the maximal eigenvalue and trace statistics of the stochastic matrix of the Johansen (1988) procedure, the number of co integrating vectors is investigated. Since our data sample consists of thirty-five observations. We follow Cheung and Lai (1993) degree of freedom adjustment method[1] for trace and max statistics. We use sample correction test statistics to correct for the finite sample test bias. The results from the Johansen co-integration test based on the eigenvalue and the trace statistics and degree of freedom adjusted maximum eigenvalue and trace statistics are reported in Table 6.2.

[1] Cheung and Lai(1993) method is used to scaling up the Johansen Critical value by the factor(T-K/T).T indicate the number of observation and k stands for number of variables used in the study.

Johansen Tests for Co integration.

Table 6.2.

Maximum Eigenvalues Test ($\lambda - \max$)				
Null Hypothesis	Alternative Hypothesis	Test Statistics	(T-K/T) Adjusted Max Statistic	5% critical Value
r=0	r=1	46.649*	39.17*	33.87
r=1	r=2	26.988	22.66	27.584
r=2	r=3	23.011*	19.39	21.136
r=3	r=4	8.881	7.46	14.264
r=4	r=5	2.419	2.0	3.8416
	Trace Test	($\lambda - trace$)		
r=0	r≥1	107.95*	90.67*	69.818
r=1	r≥2	61.301*	51.49*	47.856
r=2	r≥3	34.312*	29.85*	29.797
r=3	r≥4	11.300	9.492	15.494
r=4	r≥5	2.419	2.03	3.8414

Note.1* indicates significance at 5% level.

The maximum Eigenvalues Test ($\lambda - \max$) indicates the existence of two co integrating vectors, while trace statistitics ($\lambda - trace$) indicates the existence of three co integrating vectors at the 5 % level of significance. By using adjusted max test statistics it is indicated that there is one co-integrating vector included in the model and two vectors by using adjusted trace statistics.

Both trace and max statistics confirms the existence of co-integration among real GDP, Public investment, private investment, private sector credit and lending rate. The longrun output function (real GDP) function is obtained by normalizing the first co integrated vector on the growth rate. The result of long run relationship is reported in Table 6.3.

Table 6.3.

Normalized Coefficients of Co integrating Vector on real GDP.

Variables	*Coefficients*	*Standard Error*	*t-Value*
$\ln Ig_t$	-0.875*	0.154	5.66
$\ln Ip_t$	0.858*	0.269	-3.181
$\ln cred_t$	0.1013	0.445	-0.227
lr	-0.0423	0.0432	0.980
Constant.	-10.644	_	_

Note.* indicates significance at 5% level

It is evident from Table 6.3 that the estimated coefficient of public investment is negative (-0.875) and significant. It indicates that in long run public investment exerts negative impact on the growth rate of GDP. This result is line with Ghani and Din (2006). This indicates that government is mainly investing in the sectors which are unproductive and inefficient. On the other hand, the coefficient of private investment is positive (0.858) and significant, indicating that private investment positively affects the GDP in long run and enhances the growth rate. This result confirms the findings of Khan and Sasaki (2002) and Ghani and Din (2006). The estimated coefficient of private sector credit relative to GDP is 0.10 which is insignificant however, it confirms the theoretical relationship that disbursement of credit to private sector will enhance the private investment which positively affects growth rate .The Estimated coefficient of lending rate is -0.0423 and insignificant which reflects the non-responsiveness of economic growth to lending rate. Negative sign shows that increase in lending rate enhances cost of borrowing rate and compresses the private investment. There will be the reduction in the future profit which discourages the private investor to invest more, which indirectly results in decline of the economic growth.

6.2.2. The long run public investment Function.

The co integrating relationship between public investment, real GDP, foreign aid, exchange rate, government revenue and inflation rate are estimated using Multivariate co integration test. Two lags were selected on the basis of Akaike information criterion (AIC). Estimated results are quoted in Table 6.4.

Johansen Tests for Cointegration
Table 6.4.

Maximum Eigenvalues Test (λ_{max})				
Null Hypothesis	Alternative Hypothesis	Test Statistics	(T-K/T) Adjusted Trace Statistic	5% critical Value.
r=0	r=1	66.893*	55.454*	40.077
r=1	r=2	52.223*	43.292*	33.876
r=2	r=3	33.995*	28.181*	27.584
r=3	r=4	18.673	15.479	21.131
r=4	r=5	15.674*	12.971	14.264
r=5	r=6	7.525*	6.238*	3.841
	TraceTest.	(λ_{trace})		
r=0	r≥1	194.96*	161.62*	95.75
r=1	r≥2	128.06*	106.17*	69.818
r=2	r≥3	75.842*	62.87*	47.856
r=3	r≥4	41.846*	34.69*	29.797
r=4	r≥5	23.173*	19.21*	15.494
r=5	r≥6	7.525*	6.24*	3.841

Note.1* indicates significance at 5% level.

The likelihood ratio (LR) statistics for ($\lambda - \max$) indicates the existence of five co integrating vectors and ($\lambda - trace$) indicates the existence of six co integrating vectors at 5 % level of significance. By using test with degree of freedom adjusted, max statistics indicates existence of four co-integration vectors while trace statistics concluded that there six co-integrating relationships in the model. The model includes unrestricted intercept but no trend.Two lags were selected on the basis of Akaike information criterion

(AIC).Thus the existence of co-integration and long run relationship is confirmed on the basis of trace test. The long run public investment function is obtained by normalizing the first cointegration vector on public investment. The results are reported in Table 6.5.

Table 6.5.
Normalized Coefficients of Co integrating Vector on public investment function.

Variables	*Coefficients*	*Standard Error*	*t-Value*
$\ln y_t$	4.603*	0.875	-5.285
$\ln Aid_t$	0.195	0.0.23	-0.961
$\ln er_t$	-0.268	0.217	1.232
$\ln G_{rt}$	-2.127*	0.304	6.993
inf	-0.106*	0.011	9.456
Constant	25.134	-	-

Note.* indicates significance at 5% level

These results indicates that the coefficient of real GDP ($\ln y_t$) is 4.603 and significant which implies that 1% increase in real GDP exerts 4.6 % increase in public investment. It confirms the theoretical relationship of these two variables, i.e increase in real GDP enhances investment as stated by accelerator model. The coefficient of foreign aid is 0.195 which shows that foreign aid enhances the public investment. This result confirms the findings of Rahman (2008) in the case of SAARC countries and also supports the hypothesis of Blejer and Khan (1984) that inflow of foreign capital positively affects the investment rate. The exchange rate reveals negative and insignificant impact on public investment because an increase in exchange rate (depreciation of home currency) makes imported goods (machinery and raw material) relatively expensive which compress the investment incentive. On the other hand Government revenue surprisingly has negative and significant impact. This could be explained in that of the government revenue is used

to finance budget merely the current expenditure of the government (Rahman, 2008). The inflation rate exerts negative and significant impact on public investment because an increase in inflation rate leads to increase the nominal interest rate which. An increase the real interest rate increases the cost of borrowing and discourages new investment by increase cost of capital (Hyder and Ahmad, 2002).

6.2.3. Long Run Private Investment Function.

The co-integrating relationship between private investment, real GDP, private sector credit to GDP ratio, lending rate, public investment, inflation rate and exchange rate, based on Johansen cointegration test is presented below in Table 6.6.The model includes unrestricted intercept and no trend. Two lags were selected on the basis of Akaike information criterion (AIC).

Johansen Tests for Cointegration.
Table 6.6.

Maximum Eigenvalues Test(λ_{max})				
Null Hypothesis	Alternative Hypothesis	Test Statistics	(T-K/T) Adjusted Trace Statistic	5% critical Value
r=0	r=1	79.994*	62.995*	46.231
r=1	r=2	69.880*	54.995*	40.077
r=2	r=3	34.805*	27.391	33.876
r=3	r=4	31.395*	21.708	27.584
r=4	r=5	21.151*	16.630	21.131
r=5	r=6	9.992	11.225	14.264
r=6	r=7	9.078*	3.022	3.841
	TraceTest	(λ_{trace}).		
r=0	r≥1	256.297*	201.705*	125.615
r=1	r≥2	176.302*	138.74*	95.753
r=2	r≥3	106.422*	83.754*	69.818
r=3	r≥4	71.617*	56.362*	47.856
r=4	r≥5	40.222*	31.654*	29.797
r=5	r≥6	19.070*	12.193	15.494
r=6	r≥7	9.078*	3.022	3.841

Note.1* indicates significance at 5% level

The likelihood ratio (LR) statistics for ($\lambda - \max$) indicates the existence of six co integrating and ($\lambda - trace$) indicates the existence of seven co-integrating vectors at 5 % level of significance. By using adjusted max test statistics, the results indicate the existence of two co-integrating vector and adjusted trace statistics indicates the five co-integrating vectors.

These results confirm the existence of long-run relationship among the variables concerned. The long-run private investment function is obtained by normalizing the estimated co integrated vector on the private investment function. The results of estimated private investment function are reported in Table 6.7.

Table 6.7.
Normalized Coefficients of Co integrating Vector on private investment function

Variables	*Coefficients*	*Standard Error*	*t-Value*
$\ln y_t$	0.335	0.537	-0.623
$\ln cred_t$	-0.567*	0.028	4.946
$\ln er$	-0.578*	0.056	10.207
lr	-3.262*	0.766	4.255
inf	-0.142*	0.028	4.946
$\ln I_{gt}$	-1.938*	0.367	5.271
Constant	-3.761	-	-

Note.* indicates significance at 5% level

As revealed from above, the coefficient of real GDP is positive but statistically insignificant showing weak accelerator. This finding is consistent with Blejer and Khan (1984), Naqvi (2002), Ahmed and Qayyum (2007) and Khan and Khan (2007). Surprisingly the coefficient of private sector credit to GDP ratio has negative and

significant impact on private investment. This may be explained by the factual position that credit was given to sick units who used it to repay due their outstanding loans to the banks (Khan and Khan, 2007). Negative and significant impact of exchange rate, lending rate, and inflation rate confirm the theoretical relationship between these variables and private investment showing that increase in these variables compress the private investment. The public investment has negative and significant impact which implies "crowding out" effect. The results is consistent with findings of Ghani and Din (2006), Khan and Sasaki (2001), Khan and Khan (2007) and Majeed and Khan (2008).

6.3. Short-run Dynamics of Variables: The Error Correction Model.

After estimating the long run relationship an error correction model is estimated to establish the short run relationship between the variables. The term error correction (ECM) consists of residual obtained from the long run output (real GDP), public investment and private investment functions

6.3.1. Short run Growth Function.

Equation 5.14 is estimated to investigate the short run relationship between the GDP and public, private investment, private sector credit and lending rate. After estimating this model insignificant variables are eliminated following the general to specific methodology. The results show that two regressors are important in establishing the short run relationship with growth rate of GDP.All other insignificant variables are dropped from the model. The change in private investment lagged by one year ($\Delta \ln I_{pt-1}$), current

public investment ($\Delta \ln I_{gt}$) are significant variables while other all variables proved to be insignificant. The results are given below in Table 6.8.

Table 6.8.

Error Correction Model of real (GDP).

Variables	*Coefficient*	*Std. Error*	*t-Statistic*
$\Delta \ln I_{pt-1}$	0.0808**	0.0463	1.744
$\Delta \ln I_{gt}$	0.1195*	0.0467	2.553
ECM_{t-1}	0.-0058*	0.00085	6.861
R-squared =0.20	Adjusted R-squared=0.13		
D.W Test=2.32			

$ECM_{t-1} = \log y_t + 0.8745 * \log I_{gt} - 0.86 * \log I_{Pt} - 0.101 * \log cred_t + 0.042 * 1r$

Note *shows significant at 5% level and ** shows significant at 10% level.

The estimated error correction coefficient (ECM_{t-1})[2] is – 0.0058 and it is significant at 5 % level with theoretically correct negative sign. Likewise the coefficient of lagged private investment is 0.080 and significant at 5 % level, which indicates that private investment positively affects the growth rate of GDP.The coefficient of public investment is negative and significant which public investment has "crowding out" effect on growth . The estimated model passes different diagnostic tests, such as ARCH test for serial correlation (F stat is 0.244, probability is 0.784).and White test for Hetroscedasticity (F Stats is 2.21, probability is 0.669). The stability of specified model is checked using the cumulative sum (CUSUM) and the cumulative sum of squares (CUSUMSQ) of the

[2] The term error correction (ECM) consists of residual obtained from the long run output (real GDP), public investment and private investment functions. The estimated error correction coefficient is obtained by resetting the normalizing coefficients obtained from long run growth function.

recursive residuals test for structural stability[3] The CUSUM and CUSUM of Square tests of stability also confirm that estimated model is stable because neither of the two test statistics exceeds the bounds of 5 percent level of significance

6.3.2. Short run Public Investment Function.

Equation 5.15 is estimated for the short run relationship between the public investment and its determinants like real GDP, foreign aid, exchange rate, government revenue and inflation rate. The estimated result show that all variables are insignificant in the short run except current inflation rate ($\Delta \inf$) and current exchange rate ($\ln er_t$).These three variables show significant short- run relationship with public investment. The results are presented on Table 6.9.

Table 6.9.
Error Correction Model of Public Investment Function.

Variables	*Coefficients*	*Standard error*	*t values*
$\Delta \inf$	-0.0069*	0.003	-2.035
$\ln er_t$	-0.523**	0.299	1.750
Constant	2.557*	0.752	-3.401
ECM_{t-1}	-0.099*	0.029	-3.335

R-squared =0.36 Adjusted R-squared=0.29
D.W stat =2.20

$ECM_{t-1} = \log I_{gt} + 2.127 * \log G_{rt} - 0.195 * \log aid_t - 4.603 * \log y_t + 0.106 * \inf + 0.268 * \log er_t$

Note.*shows significant at 5% level and ** shows significant at 10% level

The estimated error correction coefficient is – 0.099 and significant at 5 % level, which is theoretically correct sign. The estimated coefficient of ECM shows that approximately 9.9 % of disequilibrium in the public investment is instantly corrected. The changes in current inflation rate and exchange rate exert significant and negative effects on current

[3] Graphs of CUSUM and CUSUM of Square tests are given in end of this chapter.

public investment in the short- run. The estimated model passes different diagnostic tests, such as ARCH test for serial correlation (F stat is 0.163, probability is 0.84) and White test for Hetroscedasticity (F Stats is 1.03, probability is 0.44) .The CUSUM and CUSUM of Square tests of stability also confirm that estimated model is stable.

6.3.3. The Short Run estimation of private Investment function.

Equation 5.16 is estimated for the short run relation ship between the private investment, real GDP, ratio of private sector credit to GDP, lending rate, public investment and inflation rate

After estimating the model the insignificant variables are eliminated. The estimated results show that these variables are significant in determining changes in private investment these included change in public investment lagged by one year ($\Delta \ln I_{gt-1}$), change in current exchange rate ($\Delta \ln er$) and current inflation rate ($\Delta \inf$).The results are presented below in Table 6.10.

Table 6.10.
Error Correction Model of Private Investment Function.

variables	*Coefficients*	*Standard error*	*t values*
$\Delta \ln I_{gt-1}$	0.3756*	0.142	2.639
$\Delta \ln er$	-0.541**	0.292	1.852
$\Delta \inf$	-0.0064*	0.002	-2.261
ECM_{t-1}	-0.0261*	0.0059	-4.380

R Squared = 0.39 Adjusted R squared =0.33
D-W test.2.41

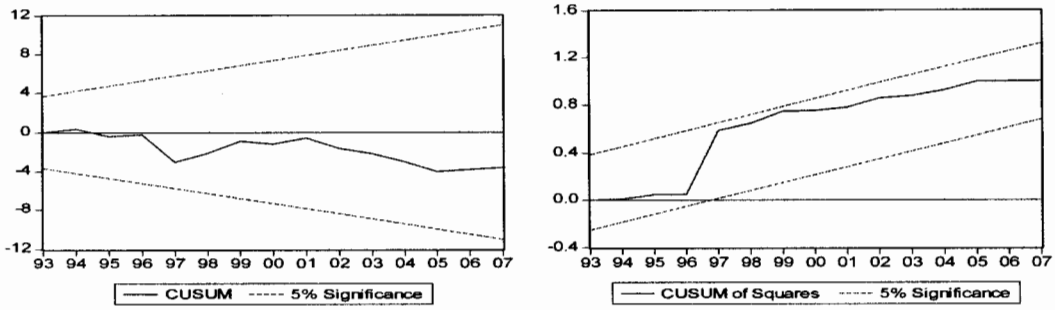
$$ECM_{t-1} = \log I_{Pt} - 0.335 * \log y_{t-1} + 3.26 * \log cred_t + 0.578 * lr + 1.938 * \log I_{gt} + 0.142 * \inf + 0.566 * \log er$$

Note:*shows significant at 5% level and ** shows significant at 10% level.

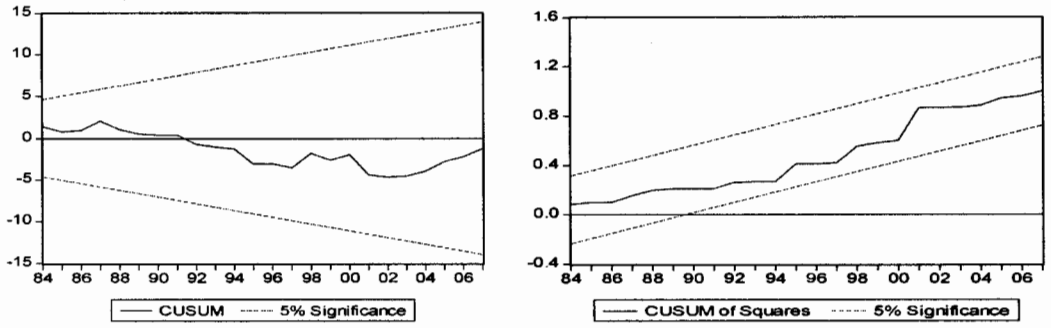
The estimated error coefficient is – 0.0261 and it is significant at 5 % level, with theoretically correct sign. The coefficient of lagged public investment is positive and significant, indicating a positive effect on current private investment. The coefficients of exchange rate and inflation rate are significant and have negative sign which confirm the theoretical relationship that these variables negatively affect private investment. The estimated model passes different diagnostic tests, such as ARCH test for serial correlation (F stat is 0.332, probability is 0.719) and White test for Hetroscedasticity (F Stats is 2.13, probability is 0.069) .The CUSUM and CUSUM of Square tests of stability also confirm that estimated model is stable.

Graphs of CUSUM and CUSUM of square test of stability.

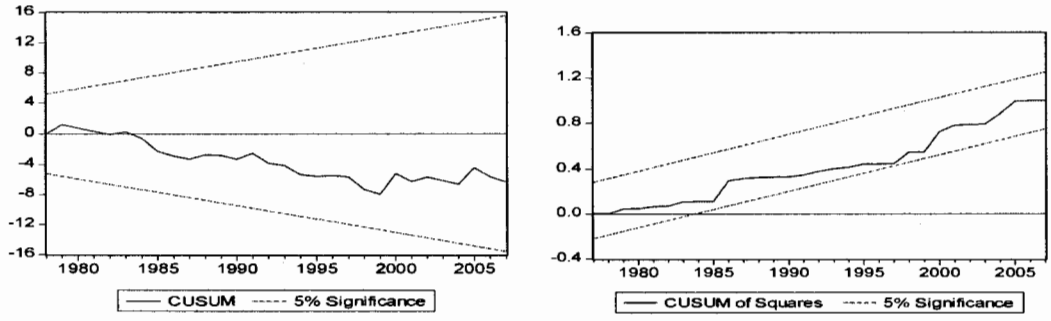
Growth Rate of GDP.



Public Investment Function.



Private Investment Function.



CHAPTER 7

Conclusions and Policy Implications

This study analyzes the role of public and private investment in the process of growth for the economy of Pakistan over the period 1972 to 2007. The behavior of public and private sectors and the factors determining investment is investigated. The issue whether public investment plays the role of substitute or complement for private investment in the context of Pakistan is also investigated. Thus we have followed a three-pronged strategy to explore the nexus between investment and growth. Further, the model is tested for the long as well as the short run using the co-integration technique and the error correction method. We have applied all the relevant tests for consistency of the data used in the analysis.

7.1 Summary of Results

The main findings of the study are summarized below.

1. The estimated function for GDP shows that private investment has a positive and significant impact on GDP growth in the long-run while the impact of public investment is negative. This contrasting result may be explained by the fact that government is mainly investing in the sectors, which are not directly productive (like the expenditure on defense and maintenance of law and order). This result is also supported by other researchers. The impact of credit availability is positive and that of lending rate negative as expected.

The short-run estimated relationships show that the current level of public investment and the change in private investment lagged by one year are the important determinants of the GDP growth while other variables like the credit-to-GDP ratio and the lending rate are not that much important.

2. The estimated public investment function reveals that increase in real GDP has strong and positive impact while foreign aid has positive and insignificant impact on public investment in the long- run. On the other hand, increase in exchange rate and inflation rate have negative impacts as expected. Surprisingly enough, the government revenues show a negative relationship with the growth of public investment. A plausible explanation of this result may be given in that the government revenues can hardly finance the current recurring expenditure and nothing is left for the development purposes.

   The error correction model for short-run analysis that current inflation rate and current exchange rate are significant for the growth of public investment. The results show that all other variables are insignificant in the short-run.

3. The estimated function for private investment depicts some interesting results. The effect of real GDP is positive, although insignificant. The credit-to-GDP ratio, which is an indicator of the availability of credit to private investors, has a negative effect on the growth of private investment. Although, this goes against the common wisdom, however the fact that the loans offered by the banking system are seldom used for real investment, in other words, often used in property business or elsewhere. Further the credit was extended mainly to sick units in the private sector who used the funds to repay their outstanding loans rather than to

rebuild and improve their productive capacity. Another important result is the impact of public investment, which is negative and implies the crowding out phenomenon for the private investment. The negative and significant values of lending rate and inflation confirm the theoretical relationship between these variables and private investment in the long-run.

The short run model for private investment shows that changes in public investment lagged by one year, changes in exchange rate and current inflation rate are significant variables in determining the growth of private investment.

7.2 Conclusions & Policy Implications

As stated above, this study has attempted to evaluate the inter-relationship among the three macro-variables, namely public and private investment and GDP growth both in the long and short run with reference to Pakistan economy. We have tried to pinpoint the important determinants of each variable, using the standard econometric techniques. As expected, the GDP growth has a strong positive relationship with public and private investment and there is a two-way causality between GDP and investment. The public investment is affected by the level of GDP, inflation and exchange rates. Likewise, private investment is affected by inflation and exchange rates, the lending rate, besides the level of GDP. The general negative theoretical relationship between public and private investment is confirmed in the context of Pakistan economy, i.e. public investment exerts a "crowding-out" effect on private investment at large. This is because public investment has primarily been financed in the past through internal and external

borrowing. The government revenues collected through taxation has little contribution in promoting public investment.

In view of the main findings of this exercise, it is suggested that public policies be framed and designed such that the public investment plays a complementary role for the private investment rather than being depressant. In other words, the "crowding effect" of public sector activities for private investment ought to be as small as possible. This negative impact was probably in notice of the 'past' military-led government, which had taken some steps to reduce the rate of return on national saving certificates and national bond during 2007-08 so that easy credit could be made available to the private sector. However, these measures seem to be insufficient since the public sector corporations and autonomous bodies like Railway and WAPDA still depend on borrowing from the open market by offering a high rate of interest.

The policy makers ought to undertake effective measures to stimulate private investment by improving the financial markets. At present, most of the investment in private sector flows to business in property and real estates rather than to real investment, which leads to capital formation and economic prosperity. This point needs special consideration of the policy makers since merely provision of easy credit to the private sector might not motivate real investment. Likewise, the problem of energy shortage needs immediate resolution failing which the current recession may lead to deep depression and further complications.

The social tranquility and macroeconomic stability is a pre-condition for economic development and growth. Of course, public investment is utmost necessary for

providing the infrastructure and other facilities to the private sector; however, ensuring the socio-political stability by improving the law and order situation and diffusing the prevailing uncertainty is far more important to boost up private investment. Presently, Pakistan is passing through a very difficult phase of its history as the country is trapped in terrorist activities through its length and breadth. Under the prevailing circumstances, even the domestic investors are hesitant in undertaking any enterprise in the positive direction, let aside inviting foreign investment.

Although we have applied the model to the past long-run data from 1970 to 2007 and derived the results, the macroeconomic conditions may further deteriorate so far as the growth of GDP and investment is concerned. The reasons are obvious, the present socio-political scenario is hardly conducive to private investment and the global economic recession is further exerting a negative impact on our economy. The internal situation is grave and needs immediate measures to get rid of it as soon as possible. Every Pakistani is anxious about the prevailing instability and future prospects of the solidarity of the homeland. If by the grace of Allah Almighty and serious plus compassionate efforts of the government and general public, the country overcomes the challenges and hardships to which it is faced, there are fair chances that our economy will start marching on the path of sustainable development and growth. We ask His Mercy and Favor for the poor masses of this sacred land.

Refrences

Abbas, Q (2000). "The role of Human Capital in Economic Growth: A comparative study of Pakistan and India" *The Pakistan Development Review*29:4.pp 451-473.

Ahmad,Imtiaz and Qayyum Abdul(2007) "Do public expenditure and macroeconomic uncertainity matter to private investment?Evidence from Pakistan"The Pakistan Development Review,Vol46.No2 pp 145-161.

Aschuar, David. A (1989a). "Is public Expenditures Productive"? *Journal of Monetary Economics,* pp.177-200.

Aschuar, David. A (1989b). "Does Public Capital Crowd out Private Capital"? *Journal of Monetary Economics,* 24: pp177-188.

Badawi,A.(2003)"Private capital formation and macroeconomic policies in Sudan: application of a simple co integrated vector autoregressive model" Department of Economics University of Khartoum.

Bertrand, J.M.A and Mamatzakis (2007) "The impact of disaggregated infrastructure capital productivity growth of Chilean Economy" The Manchester School. 2 pp 258-273.

Bukhari,S.A.A.S,Ali,L and Sadaqat (2006*)* " Public investment and economic growth in the three little dragons. Evidence from heterogeneous dynamic panel data".Applied Economics Research Centre, University of Karachi,Pakistan.

Carmeci,G and Podrecca,E(2001) "Fixed investment and economic growth:new results on causality."*Applied Economics*,2001,33,pp177-182.

Cellini, R. (1997). "Growth Empirics: Evidence from a Panel of Annual Data," *Applied Economics Letters*. 4 pp.247-51.

Chandra and Thompson (2000) "Does public infrastructure affect economic activity? Evidence from the rural interstate highway system" *Regional Science and Urban Economics.* 30. pp 457-490.

Chow,G.C(1990) " Capital formation and economic growth in China"Econometric Research Programe,Research Memorandum No. 356p 258-273.

Christiano,J.F and Fisher Jonas(1995) "Tobin's q and Asset Return:Implication for Business cycle Analysis.NBER working paper No 5292.

Diamond,R.WIrving "Fisher's debt deflation, theory of current depression"*Review of Social Economy.*

Delong, J.B and Summers, L.H (1995) Equipment Investment and Economic.*Harvard University and NBER*,pp 1-50.

Erden,L and H,R(2005) "The effect of public investment on private investment in Developing economies"*Public Finance Review*,l33:5,pp 575-602.

Eng, P. V. (2005). "Capital Formation and Economic growth in Indonesia".Sano-Shoin Hitotsubashi University Kunitachi Press, Tokyo.

Fisher,W.H and Turnovsky,S.J.(1998) "Public Investment, Congestion, and private Capital Accumulation" The Economic Journal, 108 ,pp 399-413.

Ghali,K.H and Mutawa,A.A(1999). "The intertemporal causal dynamics between fixed capital formation and economic growth in the group of seven countries". International Economic Journal.13:2.pp31-37.

Ghani, E and Musleh-Ud Din. (2006). "The Impact of Public Investment on Economic Growth in Pakistan". *The Pakistan Development Review* 45: 1 pp. 87–98.

Guimaraes,R and Unteroberdoerster,O(2006) What's Driving Private Investment in Malaysia? Aggregate Trends and Firm-Level Evidence. International Monetary Fund Working paper Asia and Pacific Department.

Ibrahim, M.H. (2000). "Public and private Capital formation and Economic growth in Malaysia."*IIUM journal of Economics and Management* 8:1pp21-40.

Ismihan, M,Ozcan,K.M,Tansel,A (2005) "The role of macroeconomic instability in public and private capital accumulation and growth: Applied Economics, 37,239-251.

Javed,T and Janjua,M.Y.Y Fixed Investment in Pakistan s' Agriculture sector :The role of exegnious shock"Journal of Economic Cooperation among Islamic countries, 19 : 3,pp95-12

Jongwanich,J and Kohpaiboon,A (2008) "Private investment:Trends and determinants in Thiland."World Development 36: 10,pp1709-172.

Kavanagh,C."Public capital and private sector productivity in Ireland," 1958-1990 Journal of Economic Studies,. 24 :. 1/2, 1997, pp. 72-94.

Khan,M.S. and C. M. Rheinhardt (1990) "Private Investment and Economic Growth in Developing Countries"World Development,18.:1.pp.19-27,1990.Printed in Great Britain.

Knox,A.D"An acceleration principal and theory of investment:Economia,19:75 pp269.297.

Khan, M.S. and M.S. Kumar (1997): "Public and Private Investment and the Growth. Process in Developing Countries."*Oxford Bulletin of Economics and Statistics* 59 pp69-88.

Khan,M.T.and Sasaki Komei (2001). "Roles of Public Capital in Pakistan's Economy:Productivity, Investment and growth analysis." *Rural Urban Development Studies* 13:pp143-161.

Knight and Ding,S (2008) "Why China grown so fast? The role of physical and human capital formation"Departmet of Economics.University of Oxford.

Khan.Sajawal and Khan Arshad(2007) "What determines private investmet?The case of Pakistan"PIDE working papers 2007:36.

Leory,S.F(1983) "Keynes's theory of investment " *Leroy History of political economy* 15:pp 397-442.

Looney, R. E. (1997). "Infrastructure and Private Sector Investment in Pakistan." *Journal of Asian Economics* 8:3pp.393-420.

Looney, R.E and Frederic, Peter C. (1997) "Government Investment and Follow-on Private Sector Investment in Pakistan". *Journal of Economic Development.*22:1 pp. 91-100.

Majeed,T.M and Khan.S(2008) "The determinants of Private Investment and the relationship between Public and Private Investment in Pakistan."Nust Journal of Business and Economics.1:1 pp.41-48.

Mallick,S.K(2001) "Dynamics of macroeconomic adjustment with growth:Some simulation results"International Economic Journal.15:1,pp115-139.

Marrocu,E and Paci Raffaell (2006) "The effects of public capital on the productivity of the Italian regions"working paper Centro Ricerche Economiche Nord Sud No.13. Economic Modeling 19 PP. 641-664.

Murthy,V.N.R and Nath,R(2003) "Investment in informational technology capital and income inequality in the United StatesAn empirical analysis"Paper presented at Annual Meeting of Southwestren Society of Economics,Houston,Texas on March 6,2003.

Muscatelli,V.A (1992) "Demand and supply factors in the determination of nie . exports:Asimultaneous error correction Model."*The Economic Journal*,102 pp 1467-1477.

Naqvi (2003) "Is public capital more productive than private capital? Macroeconomic

Evidence from Pakistan,1965-2000".Working paper in Economics and Finance No 03/03,School of finance and Business University of Durhan.

Ndikumana, L (2005) "Can Macroeconomic Policy stimulate Private Investment in South Africa? New Insights from Aggregate and Manufacturing Sector-Level Evidence.Pollitical Economy Research Institute, University of Massach husetts Amherts.

Ngoc, P.M (2008) ".The roles of capital and technological progress in Vietnam s'economic growth" *Journal of Economic Studies* 35:2.pp 200-219.

Onder, A.Z, Karadag, M and Deliktas, E(2007) "The effects of public capital on regional convergence in Turkey" Department of Economics Ege University. Working paper No: 07/01.

Oshikoya.T.W (1994) Macroeconomic determinants of domestic private investment in Africa: An empirical analysis.*Economic Development and Cultural change*, 42, :3,pp573-596.

Otto,G.D and Voss(1997) "Is public capital provision efficient?" *Journal of Monetary Economics42* pp *47-66.*

Pakistan, Government of (Various Issues) *Economic Surveys*. Islamabad: Ministry of Finance.

Parkerm,D and Zhang,Y.F(2005) "Private investment in infrastructure in Asia:The impact of regulation"The Singapore Economic Review,.50,Special Issue(2005) pp369-391 .

Patterson, S(2004),Economic growth and investment Nexus in Ethiopia .Truman State University. Division of Social Sciences.

Pavelescu, F.M (2007) Economic growth during early 2000 s' in EU members and candidates. states"Institue of National Economy.

Phillips,P C. B. and Hansen ,Brucee(1990). "Statistical Inference in Instrumental Variables Regression with I(1) Processes " Review of Economic Studies 57.pp 99-125.

Poderecaa,E and Carmeci,G(2001) "Fixed investment and economic growth: new results on causality" *Applied Economics*, 33.pp 177-182.

Rahman,M.M(2008)"Macro-economic and trade link models of Saarc countries: an investigation for regional trade expansion"Journal of Asia Pacific Economy.13:1,pp 50-62.

Roberto,M.S(2005) " An Estimation of Residential Water Demand Using Co-Integration and Error Correction Techniques" MPRA Paper . 615,pp1-44.

Rebelo, S. (1991) Long-Run Policy Analysis and Long-Run Growth. *Journal of Political Economy* 94:5, 56–62.

Samake,I(2008) " Investment and Growth Dynamics: An empirical assessment applied to Benin"IMF Working Paper WP/08/120.

Shahbaz etal(2008) " Does Foreign Remittances Reduce Government Spending? Longand Short Run Phenomenon." International Research Journal of Finance and Economics ISSN 1450-2887 Issue 14 (2008).

Sinha.D and Sinha.T(2000) "An agreegate import demand function for Greece"AEJ,.28: 2.pp196-209.

Stephan,A. (2002) "Assessing the Contribution of Public Capital to Private Production Evidence from the German Manufacturing Sectr"Discussion Paper German Institute for Economic Research.

Valadkhani,A(2004)"What determinants private investment in Iran?" International Journal of Social Economics.l31:5/6 pp 457-468.

Voss,M.G(2000) "Public and private investment in the United States and Canada"Economic Research Department Reserve Bank of Australia,Sydeny.

Wolfson,M.H"Irving Fisher's debt-deflation theory: Its relevance to current conditions."Cambridge Journal of Economics 20:3 315-333.