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

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Abstract

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 for the period of 1972-2008. We have tried to pinpoint the important determinants of each variable, using the standard econometric techniques. Long run relationship between the variables is specified by using method proposed by Johansen and Juselious (1990).Based on the results of the long-run co-integration parameters short run error correction model is used to estimate the short run relationship between the variables. 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.

Key Words: Public Investment, Private investment, Real Interest Rate, government revenue

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. 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.

2.Review of Empirical Literature

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

Looney and Frederiken (1995) estimated the relationship between public and private investment. The results suggested that certain types of government investment - especially in rural works ‘crowded out’ private investment in non-manufacturing activities. Likewise, the publi infrastructure investment in energy projects provided the greatest inducement to private investment. Side by sideLoony et al (1997) studied the impact of Government investment on private sector in Pakistan over the period 1972 to1995 and concluded 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.

Khan and Sasaki (2001) analyzed the role of public capital in Pakistan s’ economy. 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. According to Naqvi (2002) public investment had a positive impact on private investment, and that economic growth pushes forward both private and public investment. Naqvi (2003) proved 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.

Same relationship is examined by Ghani and Din (2006) and 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 (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. Khan and Sajawal Khan (2007) investigated the determinants of private investment in Pakistan . 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. the keys to establish the conditions for economic stability.while according Ahmed and Qayyum (2007) 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.

3.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.

3.1 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. 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
2001-2008	6.28	5.3	12.78	18.08

Source: Pakistan Economic Survey (various issues).

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 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).

3.2 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.

4 .Data and Variables

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.Model, Methodolog.

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 include 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:

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

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

$$\ln I_{pt} = \gamma_0 + \gamma_1 \ln y_t + \gamma_2 \ln I_{gt} + \gamma_3 \ln Cred_t + \gamma_4 lr_t + \gamma_5 \ln er_t + \gamma_6 Inf_t + \omega_t \quad \text{…..... 5.6}$$

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.

5.2.1 Stationarity

A variable is said to be stationary if it is time independent. 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.

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

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

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 ν_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:

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

$$\Gamma_i = -(I - \Pi_1 - \ldots. - \Pi_i)\nu_t \qquad i=1, 2, 3\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots 5.10$$

where Π □ is a (*p*x *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 (*p*x*r)* matrices α and β such that 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 ($\lambda_{\max}$) 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 ($\lambda_{\max}$) 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:

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

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

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

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.

6.Empirical Results

The empirical work is presented in 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 Johansen and Juselious (1990) method. For estimation of the short run relationship, an Error Correction Model is employed.

6.1 Testing Unit Roots

We examine the order of integration using Augmented Dicky Fuller (ADF) unit root test. All variables, except the 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	0.3973	-5.3540	I(1)
ln I_g	-0.270	-6.2386	I(1)
ln I_p	-2.521	-4.8709	I(1)
ln Cred	-0.3618	-5.1788	I(1)
ln Aid	0.8546	-8.7650	I(1)
ln er	-1.7619	-7.1341	I(1)
Lr	-2.7125	-4.3394	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 above that all the variables are non-stationary at their levels but stationary at their first differences. Next we employ the co-integration test.

6.2 The Co-integration 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.

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 due to Johansen (1988), the number of co-integrating vectors is investigated. Since our data sample consists of thirty-five observations, we follow the degree of freedom adjustment method[1] due to Cheung and Lai (1993) 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 degree of freedom adjusted maximum eigenvalue and trace statistics are reported in Table 6.2 below.

The maximum eigen-values test ($\lambda - \max$) indicates the existence of two co- integrating vectors, while the trace statistics ($\lambda - trace$) indicates the existence of three co-integrating vectors at the 5 % level of significance. However, when we use the adjusted max and the adjusted trace statistics, it is indicated that there are three and two co-integrating vectors respectively included in the model.

Table 6.2

GDP & Co-integrating Factors: Johansen Test

Maximum Eigen-values Test ($\lambda - \max$)				
Null Hypothesis	Alternative Hypothesis	Test Statistics	(T-K/T) Adjusted Max Statistics	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

[1] Cheung and Lai (1993) method is used to scale up the Johansen Critical Value by the factor (T-K/T), where T indicates the number of observations and K stands for the number of variables used in the study.

		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.* indicates significance at 5% level.

As evident from the above, both the trace and max statistics confirm the existence of co-integration among real GDP, Public investment, private investment, private sector credit and lending rate. The longrun output function (real GDP) is obtained by normalizing the first co-integrated vector on the growth rate. The results of long run relationship are reported in Table 6.3 below.

Table 6.3

Normalized Coefficients of Co-integrating Vector on Real GDP

Variables	*Coefficients*	*Standard Error*	*t-Value*
ln I_g	- 0.875*	0.154	5.66
ln I_p	0.858*	0.269	-3.181
ln Cred	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 the table 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 is because government is mainly investing in the sectors, which are unproductive and inefficient. This result is line with Ghani and Din (2006). 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 thereby affecting the growth rate positively. The estimated coefficient of lending rate is -0.0423 and insignificant, which reflects that economic growth is not much responsive to lending rate. Anyhow, the negative sign shows that increase in lending rate discourages private investment since it enhances the cost of borrowing.

6.2.2 The long run Public Investment function

The co-integrating relationship between public investment, real GDP, foreign aid, exchange rate, government revenues and inflation rate are estimated using the multivariate co-integration test. Two lags were selected on the basis of Akaike information criterion (AIC). The estimated results are quoted in Table 6.4. The likelihood ratio statistics for ($\lambda - \max$) indicates the existence of four co-integrating vectors where the ($\lambda - trace$) indicates the existence of five co-integrating vectors at 5 % level of significance. By using the test with degree of freedom adjusted, the max statistics indicates non-existence of co-integration while the trace statistics shows that there three 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.

Table 6.4
Public Investment & Co-integrating Factors: Johansen Test

Maximum Eigen-values 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
		Trace Test (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.* indicates significance at 5% level.

The long run public investment function is obtained by normalizing the first co-integration vector on public investment. The results are reported in Table 6.5 below.

Table 6.5
Normalized Coefficients of Co-integrating Vector on Public Investment function

Variables	*Coefficients*	*Standard Error*	*t-Value*
Ln y	4.603 *	0.875	-5.285
Ln Aid	0.195	0.023	-0.961
Ln Gr	-2.127*	0.304	6.993
Ln er	-0.268	0.217	1.232
Inf	-0.106*	0.011	9.456
Constant	25.134	-	-

Note.* indicates significance at 5% level

The above results indicate that the coefficient of real GDP is 4.603 and significant, which implies that 1% increase in real GDP enhances public investment by 4.6 %. It confirms the theoretical relationship of these two variables as implied by accelerator model. The coefficient of foreign aid is 0.195, which shows that foreign aid is important but to a limited extent so far as public investment in Pakistan is concerned. This result hardly supports the findings of Rahman (2008) in the case of SAARC countries and the hypothesis due to Blejer and Khan (1984) that inflow of foreign capital positively affects the investment rate. This is

because the flow of foreign aid has been irregular and too much fluctuating during the period of study. The exchange rate shows negative but insignificant impact on public investment. An increase in exchange rate makes imported goods relatively expensive which is likely to compress investment. On the other hand, the government revenue has (surprisingly) a negative and significant impact. This could be explained by the fact that government revenue is merely used to finance current expenditure of the government and seldom available for development purposes (Rahman 2008). The inflation rate exerts a negative and significant impact on public investment because an increase in inflation leads to increase the nominal interest rate as well as the cost of raw material and machinery/equipment.

6.2.3 The Long Run Private Investment Function

The co-integrating relationship between private investment and real GDP, the ratio of private sector credit to GDP, the lending rate, public investment and inflation rate, based on Johansen co-integration 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).

Table 6.6

Private Investment & Co-integrating Factors: Johansen Test

Maximum Eigen-values Test(λ_{max})				
Null Hypothesis	Alternative Hypothesis	Test Statistics	(T-K/T) Adjusted Trace Statistics	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

		Trace Test (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.* indicates significance at 5% level

The likelihood ratio statistics ($\lambda - \max$) indicates the existence of five co- integrating vectors while ($\lambda - trace$) indicates the existence of four co-integrating vectors at 5 % level of significance. By using the degree of freedom adjusted test statistics, the max-test indicates the existence of four co-integrating vectors and the trace-statistics indicates that of five co-integrating vectors. Thus the estimated 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 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	0.335	0.537	-0.623
ln Cred	-0.567*	0.028	4.946
ln I_g	-1.938*	0.367	5.271
ln er	-0.578*	0.056	10.207
lr	-3.262*	0.766	4.255
Inf	-0.142*	0.028	4.946
Constant	-3.761	-	-

Note.* indicates significance at 5% level

As revealed from the 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 extended mainly to sick units who used the funds to repay their outstanding loans to the banks (Khan and Khan, 2007). The negative and significant values of lending rate and inflation confirm the theoretical relationship between these variables and private investment. The negative impact of lending rate on the level of investment is obvious since an increase in the market rate of interest increases the cost of borrowing. Likewise, an increase in the rate of inflation leads to enhance the prices of raw material, machinery & equipment as well as the wage bill, which discourage private investment. Same is the case with exchange rate since depreciation of domestic currency definitely increases the cost of imported goods. The public investment has negative and significant impact on private investment, which implies the "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 The Short-run Dynamics: The Error Correction Model

After establishing the long-run relationship among the variables concerned, an error correction model is estimated to establish the short run relationship between these variables. The error correction model (ECM) operates through the residuals obtained from the long-run functions of output (real GDP), public investment and private investment already estimated.

6.3.1 The Short-run Growth Function

Equation 5.14 developed is used to investigate the short-run relationship between the GDP and public, private investment, the credit-to-GDP ratio and lending rate. After application of the ECM, the insignificant variables are eliminated following the general to specific methodology. The results show that three regressors are important in establishing the short run relationship with the growth rate of GDP and the remaining two variables, being insignificant, are dropped from the model. The change in private investment lagged by one year (ΔLI_{pt-1}), current public investment (ΔLI_{gt}) and a dummy included for uncertainty (UN_t)[2] are significant variables while other variables like the credit-to-GDP ratio and lending rate are 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*
ΔLI_{pt-1}	0.0808**	0.0463	1.744
ΔLI_{gt}	0.1195*	0.0467	2.553
UN_t	-0.0035**	0.018	1.84
ECM_{t-1}	-0.0058*	0.00085	6.861
R-squared =-0.20	Adjusted R-squared=-0.13		
D.W Test=2.32	F(4,33)=.466		

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

ECM_{t-1} = (Ly_t +0.8745* LI_{gt} -0.86* LI_{pt} -0.1013* $Lcred_t$ +0.0423*lr

[2] A dummy for uncertainty is used in the short-run under the assumption that investment decisions are likely to be affected by recent uncertainty which is created by macro economic uncertainty.

The estimated error correction coefficient (ECM_{t-1})[3] is – 0.0058 has theoretically correct negative sign and significant at 5 % level. 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 positive and significant at 5% level, thereby indicating a strong impact on the growth of GDP. The estimated coefficient of uncertainty is negative which indicates that macroeconomic instability and uncertainty has always depressed economic growth in Pakistan. The estimated model passes different diagnostic tests, such as ARCH test for serial correlation (F-statistics: 0.244, probability: 0.784) and White test for Hetroscedasticity (F-Statistics: 2.21, probability: 0.669). The CUSUM and CUSUM-Square[4] tests of stability also confirm that the estimated model is stable.

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 results show that all variables are insignificant in the short run except changes in public investment lagged by one year (ΔLI_{gt-1}), current inflation rate ($\Delta L\inf$) and lending rate (Δlr). These three variables show significant short-run relationship with public investment. The results are presented on Table 6.9.

[3] 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.

[4] Graphs of CUSUM and CUSUM of Square tests are given in the appendix.

Table 6.9
Error Correction Model of Public Investment Function

Variables	*Coefficients*	*Standard error*	**t values**
ΔI_{gt-1}	0.4102*	0.148	2.769
$\Delta L\inf$	-0.0906*	0.035	-2.530
Ler_t	- 0.842*	0.254	-3.302
Constant	-6.385*	1.234	-5.17
ECM_{t-1}	-0.591*	0.115	-5.14
R-squared =0.54	Adjusted R-squared=0.48		
D.W stat =2.59			

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

$$ECM_{t-1} = I_{gt} + 0.818^{*} LG_{rt} + 0.317^{*} Laid_t - 1.841^{*} Ly_t + 0.059^{*} + 1.0395^{*} Ler_t$$

The estimated error correction coefficient is – 0.59, thus having theoretically correct sign and significant at 5 % level. The estimated coefficient of ECM shows that approximately 59% of disequilibrium in the public investment is instantly corrected. The coefficient of lagged government investment is significant and has positive sign, which indicates that changes in previous period's public investment positively affect the short-run changes in current public investment. The changes in inflation rate and exchange rate exert significant and negative impacts on current public investment. The estimated model passes different diagnostic tests, such as ARCH test for serial correlation (F-statistics: 0.163, probability: 0.84) and White test for Hetroscedasticity (F-Statistics: 1.03, probability: 0.44). The CUSUM and CUSUM-Square tests of stability also confirm that the estimated model is stable.

6.3.3 The Short Run estimation of Private Investment function

Equation 5.16 is estimated for the short run relationship between 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 results show that the variables significant in determining changes in private investment include changes in public investment lagged by one year (ΔI_{gt-1}), changes in lending rate lagged by one year (ΔIr_{t-1}) and current inflation rate ($\Delta L\inf$). The remaining variables are insignificant in the short-run. 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*
ΔLI_{gt-1}	0.00015**	7.78 E-05	1.936
Δlr_{t-1}	-0.0438*	0.0179	-2.438
$\Delta L\inf$	-0.0892*	0.0339	-2.630
ECM_{t-1}	-0.0117*	0.0029	-3.952
R Squared = 0.37		Adjusted R squared =0.31	
D-W test.2.421			

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

$$ECM_{t-1} = LI_{Pt} - 0.1520 * Ly_{t-1} + 5.871 * Lcred_t + 0.597 * lr + 1.973 * LI_{gt} + 1.36 * L\inf$$

The estimated error coefficient is – 0.0117, with theoretically correct sign and significant at 5 % level. The coefficient of lagged public investment is positive and significant, indicating a positive effect on current private investment. The coefficients of inflation rate and lending rate are significant. The negative signs confirm the theoretical relationship that these variables negatively affect private investment in the short-run. The estimated model passes different diagnostic tests, such as ARCH test for serial correlation (F-statistics: 0.355, probability: 0.703) and White test for Hetroscedasticity (F-statistics: 2.13, probability:

0.069). The CUSUM and CUSUM-Square tests of stability also confirm that the estimated model is stable.

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 2008. 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.

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7.1 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 2008 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.

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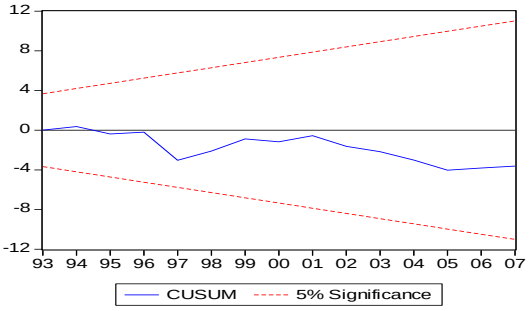
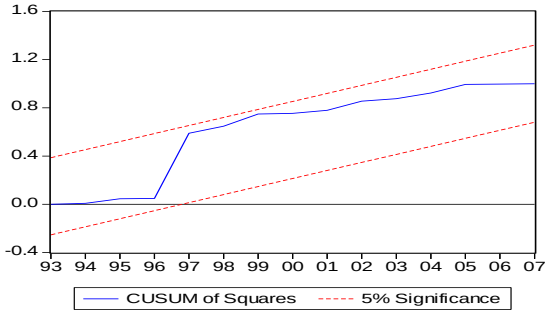
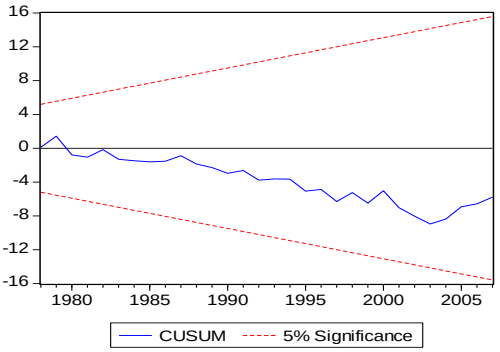
APPENDIX
Graphs of CUSUM and CUSUM- Square Tests of Stability

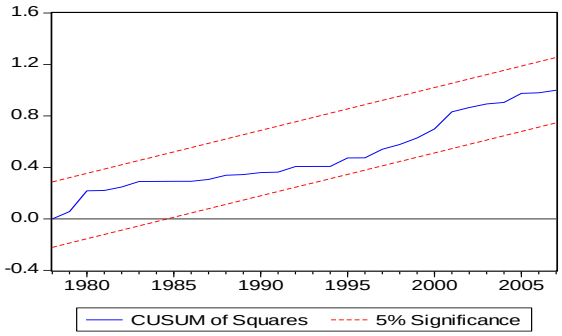
Growth Rate of GDP



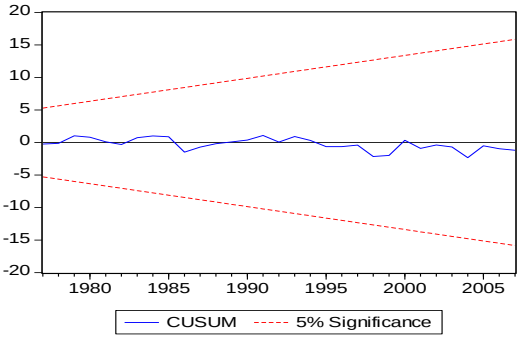


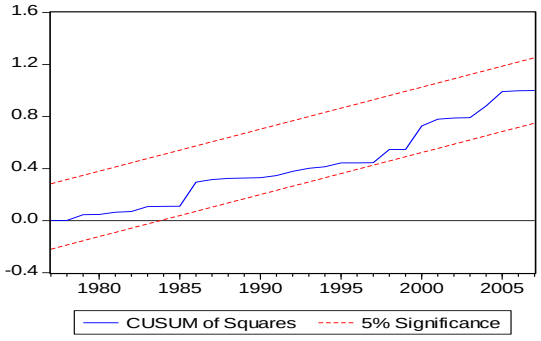
Public Investment Function



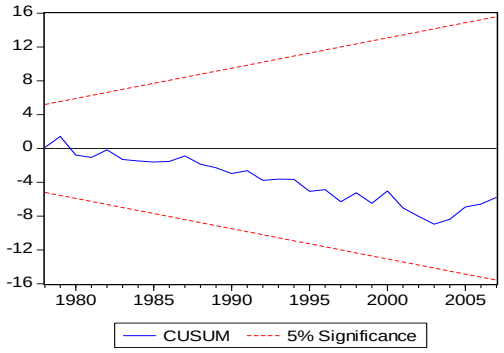


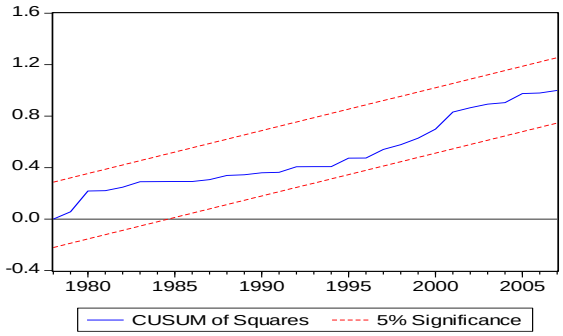
Private Investment Function





Public Investment Function





Private Investment Function