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Abstract:

Even though there is a controversy regarding the role of public investment, it is widely believed by policy makers and analysts in developing countries that public investment provides a significant stimulus to private investment and thereby serves as a powerful instrument of stabilization and growth policy. However, the significance of government investment to private sector investment and output depends on the type of public expenditures that complement private investment and output.

The government in Saudi Arabia adopted a mixed economic system in which the private sector operates under free market conditions, while the government owns and controls the natural resources including oil sector, thus assuming an important role in the economy and in influenciing all sectors of the economy.

Given the importance of the government sector in Saudi Arabia, the study attempts to investigate and examine the impact of government investment in infrastructure on private sector investment and output by using annual data covering the period 1964-1998 and utilizing recent developments in econometrics as unit root (stationarity) tests and co-integration and error correction tests.

Empirical results indicate that a long run relationship exists between the variables. Error correction and Granger causality tests results both show that causality runs from government investment in infrastructure to private investment and economic growth. Thus, these results confirm the assertion that government activities in LDC's have positive impact on private sector activities. Further government investment can enhance private sector investment and output. Therefore, for Saudi Arabia to maintain its economic growth, public investment in infrasucture that facilitates economic growth and development is required to put the economy on a higher long run growth path.

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Introduction:

Growth models relate the rate of growth of output to, among other factors, the rate of capital formation which includes both private and public investment spending. Even though there is controversy regarding the role of public investment, it is widely believed by policy makers and analysts in developing countries that public investment provides a significant stimulus to private investment and thereby serves as a powerful instrument of stabilization and growth policy.

The significance of government investment to private investment and output depends on the type of public expenditures that complement private investment and output. However, public sector investment might utilize already scarce physical and financial resources and crowds out private investment and retard economic growth. Thus, overall relationship between government investment and private investment and output depends on the relative strength of the two effects and the overall impact can only be established through empirical analysis.

For Saudi Arabia, the government adopted a mixed economic system in which the private sector operates under free market conditions, while the government owns and controls the natural resources including oil sector, thus assuming an important role in the economy and influencing all sectors of the economy.

Given the importance of the government sector, the aims of the paper are; first, using annual data for Saudi Arabia for the period 1964-1998, with the advances in econometrics methods to investigate and examine the properties of the individual variables and the order of integration of the data using the augmented dickey-Fuller (ADF) test, due to Dickey and Fuller (1979, 1981) and the Phillips-Perron (PP) test, due to Phillips (1987) and Phillips and Perron (1988). Second, given the significant implications that cointegration has for econometric analysis, the model pays particular attention to the problem of obtaining adequate representations of the non-stationary data, thus the hypothesis of long

run relationship between government investment in infrastructure and economic growth and development of the private sector in Saudi Arabia is tested using cointegration methodology pioneered by Engle and Granger, 1987. However, the Multivariate cointegrating system as suggested by Johansen (1988, 1991) and Johansen and Jueslius (1990) is employed in this study. Then the paper examines the dynamics implied by the associated error correction model (ECM).

Investment and Economic Growth: An Overview

Public policies to promote economic growth have always focused on savings and private investment. Therefore, it has been assumed that an increase in the saving rate is the key to a higher rate of growth and a faster rise in standards of living. 'The evidence is that countries with high rates of saving and investment are the ones in which productivity, income, and the standards of living rise most rapidly.' In the words of Khan and Reinhar (1990:19), "Conventional wisdom has it that the way to prosperity, as represented by a sustained higher rate of economic growth, requires stable and conservative macroeconomic policies, liberalization of goods and factor markets, greater flexibility in the financial system, and an enhanced role of the private sector in economic activity."

In recent years, however, there has been an increasing debate on the prospective roles of public and private investment in the growth process. There is general consensus that these two components of investment can have a differential impact on economic growth. B. Friedman (1989:204) has suggested that, "...business investment in plant and equipment is not the only form of investment that can help make a country more productive and therefore more competitive. Government investment in roads, bridges, airports, port facilities, and other kinds of infrastructure also has a direct bearing on how easy or difficult it is, and also how cheap or how costly, for many companies to do business."

Public investment as a proxy for public infrastructure is argued to

have positive direct and indirect effects on private sector output and productivity growth. The direct effect on private sector output growth arises from the availability of public capital to support private sector production; roads, highways, and airports allow the distribution of goods and services throughout national and international markets. The indirect effect evolves from the complementarity between private and public capital in private sector productive activity; an increase in the stock of public capital raises the return to private capital which, in turn, serves to spur the rate of expansion of the private sector capital stock.

For developing countries it is well known that private and public investment are related, although there is some uncertainty about whether, on average, public sector investment raises or lowers private investment. Public investment that is related to the development of infrastructure and the provision of public goods can be complementary to private investment. This type of investment can enhance the possibilities for private investment and raise the productivity of private capital, increase the demand for private output and ancillary services, and augment overall resource availability by expanding aggregate output and saving. (See, Tun Wai and Wong, 1982, Blejer and Khan 1984, Khan, 1988, Looney, 1989, Nazmi and Ramirez, 1997, Odedokun, 1997, Ghali, 1998, and Nourzad, 1998, 2000, among others). Here, the roles of government in developing countries become essential either because the private sector does not have the ability and the strength or lacks the willingness to enter certain activities, or the private sector is willing to enter but sufficient ground has not been prepared for it to enter. Laumas (1962:653) suggests that, ''the creation of such infrastructure in the economy will generate external economies which provide a good milieu within which the private sector can work efficiently.''

Thus, there are several reasons to believe that public investment positively affects economic growth in developing countries. First, the

creation of infrastructure facilities tends to reduce the unit cost of output and create the conditions conducive to private investment. Second, the government might start projects that require high financing beyond the attainment and the ability of the private sector in developing countries, which results in establishing forward or backward industries by the private sector. This enhances private sector investment through reduction in production costs. Third, when resources are not fully employed, an increase in government investment stimulates demand for private investment. These kinds of government investment are complementary to private sector investment.

On the other hand, public sector investment can cause crowding out if it utilizes scarce physical and financial resources that would otherwise be available to the private sector, or if it produces marketable output that competes with private sector, Further, the monopoly power of government in developing countries gives it an advantage over the private sector in competing for the resources. The financing of government investment through taxes, borrowing, or inflation reduces the financial resources available to the private sector. Under these conditions, government investment crowds out private sector investment and therefore discourages private investment and economic growth.

The overall relationship between government investment and private investment depends on the relative strength of the two effects. That is if, on average, government investment is complementary to the private sector investment, then government investment is conducive to private investment, but on the other hand, if government investment is disruptive to the private sector investment, then government investment will tend to crowd out the private sector investment. Thus, the overall impact can only be established through empirical analysis. Depending upon these empirical results, we can draw some policy

implications on how to use fiscal policy to affect private investment and output.

On the empirical side, despite the general acceptance of the economic and social importance of public capital investment, there are an ongoing debate and different perspectives on the need for more infrastructure. Aschauer has made an important contribution to this debate and, with a series of papers (1989a, 1989b, 1989c, 2000) supported his contention that 'core infrastructure' can explain why growth slowed down in the United States in the seventies and eighties. In his studies he examined empirically how important the supply side role of public expenditure is. He used U.S. time series data from 1949-1985 and obtained point estimates of the elasticity of output with respect to public capital of about 0.39. Munnell (1990a, 1990b, 1992), Williams and Daniel (1991), Lynde (1992), Lynde and Richmond (1992, 1993), Neill (1996), de Haan et al (1996), Garcia-Mila and McGuire (1992), Cullison (1993), Devarajan et al. (1996), de Frutos et al (1998). Mullen et al. (1996), Pinnoi (1994), Sturm et al. (1998, 1999), Rioja (1999), and Dussus and Herrea (2000) support the findings by Aschauer. On the other hand Aaron (1990), Tatom (1991a, 1991b, 1993), and Ford and Poret (1991) do not. Tatom (1993:3) indicates that ''infrastructure... includes legal, educational and public health systems; water treatment and distribution systems; garbage and sewage collection, treatment and disposal; public safety systems, such as fire and public protection; communications systems, public utilities and transportation system. The components of infrastructure in these areas largely are not physical capital, nor is the largest physical component of public sector infrastructure, national defense, generally included in the discussion of the infrastructure deficit hypothesis.'' Further, Temple (1999:145) points out that spending on infrastructure, ''appears to raise the social return to ongoing investment.'' however, ''Infrastructure investments may be made in anticipation of fast growth, rather than playing a causal role.''

Some studies have examined the impact of public investment on private investment, private output or both and other studies tested for the efficiency of public investment in relation to private investment. For example, Khan and Reinhart (1990) reported an empirical study on the differential role of private and public investment spending on real gross domestic product (GDP) growth, based on cross section data for 24 countries. They found that the share of private investment in GDP promotes economic growth, while public investment GDP ratio was found with no effect on growth. In a similar study, Ram (1996) enlarged the geographical scope of the data by including up to 53 countries and also extended the period to cover both 1970's and 1980's and estimated cross country regression equations, similar to those of Khan and Reinhart (1990), for subperiods within these two decades as well as a panel of data for these subperiods. However, no definite conclusion emerged from this analysis concerning the relative importance of private and public investment spending on economic growth. According to Ram (1996:1373), "The conclusion is that the parametric structure seems to differ substantially across the 1970's and the 1980's, and public investment is seen to be more productive than private investment in at least as many cases as suggested the opposite." On the other hand, Odedokun (1997) in his study of 48 developing countries for the period 1970-1990 concludes that infrastructual public investment facilitates private investment, especially in the long run and promotes econmic growth and efficiency. He also notes that non infrastructural investment does the reverse. He contends that long run effects of public investment tend to be much more positive than short run ones on growth, efficiency and private investment.

Khan and Kumar (1997) utilized a large sample of 95 developing countries over the period 1970-1990, with a variety of empirical test undertaken, and found substantial differences in the impact of private and public sector investment on growth, with private investment having a much larger impact than public investment, especially during

the 1980's. They conclude that, ''the evidence suggests a clear need to improve the productivity of public sector investment by identifying much more rigorously the types of investment that have positive net returns and are likely to be complementary to the private sector. At the same time policymakers should be undertaking measures to stimulate private investment.''

Nature of the Saudi Arabian Economy and Investment:

As indicated by various Five Year Development Plans (1970-2000), the economic system in Saudi Arabia is based on the principles of free market economy where a substantial part of the production and distribution of goods and services is left to individuals and groups enjoying freedom in their dealings and transactions. Thus, the government always emphasized that it will uphold the market system and encourage the private sector to play a fundamental role in the accelerated growth and development of the economy. In the meantime it indicated that it would take all necessary measures to make the market system conform to the larger social interest of the country. Moreover, with increased oil prices and revenues the government spent massively on infrastructure over the 1973-1982 period and indicated that its objectives were to increase the participation of the private sector through structural changes in the economy. To achieve this goal it adopted a policy of giving the private sector opportunities to undertake many of the economic tasks and made sure that it would not engage in any activities undertaken by the private sector. Further, it should be emphasized that most of the economic growth witnessed in the country during the last three decades was a result of the government spending from oil revenue. Thus, with reduced oil revenue and increased budget deficit there are concerns and uncertainty about the ability of the government to maintain its level of expenditure and economic polices.

Saudi Arabia is characterized by immense diversity and until at least the period of 1973-1974 oil boom, was fragmented geographically

and economically. In general, because of its relatively small population the country suffers from small market size which denies many local producers the advantages of economies of scale. Historically since producers were dispersed geographically, they suffer from relatively high transportation and communications costs which in turn severely limited the opportunities for domestic trade. All these elements worked to reduce the rate of return on many types of private investment, thereby enhancing the potential for an active role and intervention by the government. (See Mallakh, 1982, Looney, 1989, 1990).

Most attention was given to the private sector investment. The government not only formulated policies designed to encourage private investment, but also participated directly in economic activities. It also indicated that, public investment purpose was to help to break down some of the discountinuties inherent in the early phases of the country's development. Most importantly in this regard, it has to help create an environment in which economies of scale could be obtained in many areas by the private enterprises. To facilitate a strong and more diversified private sector, the government helped to create a positive environment for the private sector and established new institutions to further the interest of this sector.

Oil revenues have facilitated the rapid growth and expanding of the government expenditures. In particular government investment as a percentage of total investment increased from slightly over 7 percent in 1960 to 42.9 percent in 1965, 53.3 percent in 1970, 47.5 in 1975 and 72.6 percent in 1980. Public sector share in investment declined somewhat in 1985 due to oil price declines. Then it increased in 1990 to 57.2 percent mostly because of the gulf crises, to decline in 1992 and after to around 25 percent. This growth in government sector investment has apparently not been at the expense of the private sector with overall private sector investment expanding at slightly under 10.0 percent per annum over the period 1965-1995. The following table shows total gross domestic investment in current prices (TIC) and in constant prices (TIR), private

gross domestic investment in current prices (PIC) and in constant prices (PIR) and government gross domestic investment in current prices (GIC) and in constant prices (GIR) between 1970-1998 in billions of Saudi Riyals (SR), (1984 = 100).

	1965	1970	1975	1980	1985	1990	1995	1998
TIC	1.934	2.369	21.414	94.523	68.012	70.569	78.787	87.762
TIR	8.600	13.672	40.728	100.582	67.511	57.068	86.683	90.790
PIC	0.779	1.120	8.823	27.520	35.237	28.078	53.619	59.73
PIR	5.287	7.246	18.168	30.408	35.068	22.650	61.654	62.347
GIC	0.640	1.249	12.591	67.003	32.775	42.491	25.168	28.032
GIR	3.313	6.426	22.560	70.174	32.443	34.417	25.029	30.253

Sources: Ministry of Planning 'Facts and Figures' different issues.

Although the private sector in Saudi Arabia has developed rapidly during the last three decades it is still dependent on government initiatives. Looney (1990:155) has noted that the private sector in Saudi Arabia is lagging behind, "It appears that the private sector, while in general benefiting indirectly through the impact of oil revenues on overall purchasing power, had considerable difficulties in efficiently absorbing these revenues. This private sector has clearly been demand rather than supply driven." (For more information about the Saudi Arabian economy: El Mallakh, 1982, Al Johany et al. 1986, Looney, 1990, and Krimly, 1999).

Methodology:

The potential impact of public investment on private investment and capital formation and output is possible as suggested by Barth and Cordes (1980), to be formulated and analyzed as follows:

$$Y = Af(L, Kp, Kg) \tag{1}$$

$$f1\backslash, ,\backslash, f2 > 0\backslash\ ;\backslash\ f3 \gtrless 0\backslash\ ;\backslash f11\backslash, ,\backslash f22 < 0\backslash\ ;\backslash f12 \lesseqgtr 0\backslash\ ;\backslash f13 \lesseqgtr 0\backslash\ ;\backslash f23 < 0,$$

Where Y is the level of real output, L denotes employment, Kp and Kg are the stock of private and public capital respectively, $f1$ is the marginal productivity of labor, $f2$ is the marginal productivity of private capital, $f3$ is the marginal productivity of public capital, $f11$ is the change in marginal productivity of labor, $f22$ is the change in marginal productivity of private capital, $f12$ is the change in marginal productivity of labor with respect to private capital, $f13$ is the change in marginal productivity of labor with respect to public capital, and $f23$ is the change of marginal productivity of private capital with respect to public capital. Public and private capitals can be substitutes, complements, or independent. By treating public capital as a separate input in the production function, an increase in public investment, other things being equal, will have the following three effects: (1) the case where public capital stock is productive and complements private capital, an increase in public capital stock will increase output directly as any other factor of production ($f3 > 0$). It will indirectly increase private investment and output by raising the marginal productivity of private capital stock ($f23 > 0$). It will also increase output through its positive impact on the marginal productivity of labor, i.e., by increasing the amount of both private and public capital per worker ($f12$ and $f13 > 0$); (2) in the case where public and private capital stock are direct substitutes, an increase in public investment generates a positive direct effect, but a negative indirect effect that could more than offset the positive effect, that is when the following condition holds, $[(f3 + f13) + (f23) - (f12)] < 0$, and (3) in the case where private and public capital stocks are independent, an increase in public investment will generate a direct positive effect on output, but the effect on private investment might be zero, ($f23 = 0$).

Khan and Reinhar (1990), Ram (1996) and Odedokun (1997), in

line with common practice, express equation (1) in growth terms to arrive at expression or equation for real output growth as follows:

$$dY/Y = \alpha 0 + \alpha 1(dKg/Y) + \alpha 2(dKp/Y) + \alpha 3(dL/L) + e \quad (2)$$

Where: $\alpha 0 = dA/A$; $\alpha 1 = A(dY/dKg)$, or the product of A and marginal productivity of public sector capital stock; $\alpha 3 = A(dY/dL)(L/Y)$, or the product of A and the ratio of marginal to average productivity of labor; dK = investment (I); e = error tem, and $\alpha 0$, $\alpha 1$, $\alpha 2$, $\alpha 3$ are parameters of the variables.

Several studies have examined time series variables properties and concluded that most macroeconomic time series data follow random walks (Hall, 1978; Nelson and Plosser, 1982).

Moreover, econometric studies, Granger and Newbold (1974), Phillips (1986), and Ohania (1988), among others, have demonstrated that if time series variables are nonstationary, all regression results with these series will differ from the conventional theory of regression with stationary time series. That is, regression, coefficients with nonstationary time series will be spurious and misleading. To avoid spurious relationships and misleading results and to provide a valid evidence to the relationship between public investment and output, it is important to address the time series properties of the variables, because any empirical analysis from which valid inferences could be drawn must ensure that all series are of the same order of integration in order to avoid the problem of spurious relationships and erroneous conclusions (Ericsson, 1992).

Since this study uses time series data, it is first necessary to transform the variables into stationary processes so that any estimated effects are not attributed to serial correlation. This is accomplished by applying augmented Dickey Fuller (ADF) test for unit roots on each variable (Dickey and Fuller, 1979, 1981). The ADF involves regressing a particular variable on a constant, a time trend, the dependent lagged

variable, and lags of the differenced series. Thus, ADF test for unit root is based on the following regression.

$$\Delta \mathrm{Yt} = \alpha + (\beta - 1)\mathrm{Yt} - 1 + \sum_{\mathrm{t}=1}^{\mathrm{n}} \delta \mathrm{t}\ \Delta \mathrm{Yt} - 1 + \varepsilon \mathrm{t} \qquad (3)$$

Where, Yt is a random variable, Δ is first difference operator, εt is a stationary random error, t is time period and n is the number of lags for the dependent variables which is chosen to ensure that the residuals are white noise. The t statistics of $(\beta - 1)$ is used to test the null hypothesis that this coefficient is equal to zero (I.e. that $\beta = 1$). However, the critical values for this t-statistics does not have the familiar distribution. Thus, several authors have constructed appropriate critical values for the distribution of the t-statistics (i.e. Fuller, 1996; MacKinnon, 1991).

Arbitrariness in choosing lag lengths may affect the reliability of the statistical tests and seriously bias implications of the results, thus to determine the proper lags for each variable, the Akaike's final prediction error criterion (FPE) is used as suggested by Hsiao (1979, 1981).

However, a problem with the ADF test is that it involves the inclusion of extra differences terms in the testing equation which results in a loss of degrees of freedom and a resultant of reduciton in the power of testing procedure. Alternatively the Phillips-Perron (PP) approach Phillips and Perron (1988) allows for the presence of unknown froms of autocorrelation and conditional heteroscedasticity in the error term. Perron (1988) demonstrates that if a series is stationary about a linear trend but no allowance for this is made in the construction of the unit root test, then the probability of a type II error will be high. Thus, the PP test corrects for serial correlation in equation (3) using a non parametric procedure. This procedure modifies the statistic after estimation in order to take into account the effect that autocorrelated errors will have on the results. Asymptotically, the statistic is corrected by the appropriate amount, and so the same

limiting distribution applies. Perron (1988) suggests estimating the following regression by ordinary least squares:

$$\mathrm{Yt} = \alpha + \lambda(\mathrm{t} - \mathrm{T}/2) + \beta\mathrm{Yt} - 1 + \varepsilon\mathrm{t} \tag{4}$$

Since the ADF test involves transforming the data into first differences which can lead to the loss of important long run information Engle-Granger Cointegration test determines whether the set of variables processes any long run relationship. This test (Engle and Granger, 1987) runs ordinary least squares (OLS) regression of a variable in level forms on the levels of the estimating variables, a constant, and a time trend variable. Using the estimated residuals from this cointegrating regression, the next stage involves running OLS of the differenced residual term and lags oif the differenced residual. The test for cointegration (Engle and Granger, 1987) can be estimated as follows:

$$\mathrm{Yt} = \delta\mathrm{Xt} + \mathrm{ut} \tag{5}$$

then retrieving the residuals of the regression to estimate,

$$\Delta\mathrm{ut} = \mathrm{a} + \mathrm{but} - 1 + \Sigma\mathrm{b1}\ \Delta\mathrm{ut} - 1 + \varepsilon\mathrm{e} \tag{6}$$

the t statistics value is used to test the null hypothesis of no cointegrtation between Y and X.

However, the multivariate cointegration method developed by Johansen (1988, 1991) and Johansen and Jueslius (1990) is preferred to the Engle-Granger (1987) method for several reasons. Engle-Granger procedure depends upon the normalization of the variables and may be sensitive to the choice of dependent and independent variables in the cointegrating equations. Thus, it is possible that the arbitrary choice of one variable as the dependent variable and the other as independent variable may lead to the conclusion that the variables are cointegrated, whereas reversing the choice of dependent and independent variables may indicate no cointegration. Further, because the Engle-Granger procedure relies on a two-step estimator in which the first step is to

generate the residuals from the cointegration regression and the second step is to use the residual generated from step one to test for unit roots, any errors introduced in the first step also affect the second step. On the other hand, Johansen-Jueslius approach provides a very flexible format for investigating the properties of the estimator under various assumptions about the underlying data generating process. Another advantage is that, unlike Engle-Granger approach, the Johansen-Jueslius procedure is capable of determining the number of cointegrating vectors in the relationship.

In the case of more than two variables, Banerjee et al. (1993) and Cuthbertson et al. (1992) have shown that Johansen-Jueslius procedure is preferred, and Phillips (1991) has also indicated that this procedure has optimal properties in terms of symmetry unbiasedness, and efficiency.

Further, Gonzalo (1994) compared the performance of the cointegration tests using a Monte Carlo study and found that Johansen-Jueslius procedure is the most powerful even for the bivariate system. He showed that Johansen-Jueslius approach has consistent estimates even if the errors are non Gausian and the dynamics are not known.

Thus, the Johansen-Jueslius method is used in this study which applies the maximum likelihood procedure to determine the presence of cointegrating vectors in non stationary time series. Furthermore, Johansen and Jueslius provide two different tests, the trace test and the maximum eigenvalue tests, to determine the number of cointegrating vectors. The presence of a significant cointegration vector or vectors indicates a stable relationship between the relevant variables. Johansen (1988) has shown that both tests will have non-standard distribution under the null hypothesis, even in large samples. While Johansen and Jueslius (1990) provided appropriate critical values, Oserwald-Lenum (1992) developed an extended version of these critical values.

The Johansen-Jueslius approach to testing for cointegration considers a p-dimensional vector autoregression (VAR) model:

$$Yt = \Pi 1 Yt - 1 + ... + \Pi k Yt - k + \varepsilon t \qquad t = 1, ..., T \quad (7)$$

This autoregressive model may be written as a conventional error correction model as follows:

$$\Delta Yt = \mu + \Sigma \Gamma t \Delta Yt - 1 + ... + \Pi k Yt + \varepsilon t \quad (8)$$

Where: $\Gamma = 1 + \Pi 1 + ... + \Pi t$

$\Pi = 1 - \Pi 1 - ..... - \Pi k$

The Π matrix contains information about the long run relationships between the variables. Let the rank of the Π matrix be denoted by r. When $0 < r < p$, the Π matrix may be factored into $\alpha\beta$', where α may be interpreted as a p x r matrix of error correction parameters and β as a p x r matrix of cointegrating vectors. the vectors of constants, μ, allow for the possibility of deterministic drift in the data series. According to Granger (1986) and Engle and Granger (1987), assuming that cointegration hods, in the short run, deviations from long run equilibrium will feed back on the changes in the dependent variable in order to force the movement towards the long run equilibrium. If the dependent variable is driven directly by this long run equilibrium error, then it is responding to this feedback, if not, it is responding only to short run shocks to the stochastic environment. Thus, via error correction models, cointegration brings together short and long run information in modeling the data and also allows us to distinguish between short and long run effects and the direction of causality. Maximum likelihood for α, β and Γt are derived in Johansen (1988). To test the hypothesis that there are at most r cointegrting vectors, one calculates the trace statistic (λ trace). The maximum eigenvalues test (λ max) is based on the null hypothesis that the number of cointegrating vectors is r against the alternative r + 1 cointegrating vectors. Johansen and Jueslius (1990) provide critical values for (λ trace) and (λ max) statistics.

Data and Empirical Results:

Time series data for Saudi Arabia are used in this study with annual data for the period 1964-1998. All variables are in real terms. The variables are transformed from nominal to real terms by using the GDP deflator (1984 = 100) and then transformed to log terms.

Even though it has been always suggested that more observations are better, because more observations allow us of better discrimination among hypothesis, however, Hakkio and Rush (1991) suggest that conventional wisdom needs to be taken with care. They point out that, cointegration is a long run concept and, hence requires long span of data, thus there is little gain from increasing observations using higher frequency with the same time span, but there is a gain from using the same frequency data with a longer time span. Further, Shiller and Perron (1985) argue forcibly that, particularly when analyzing the long run characteristics of economic time series, the length of the time series is far more important than the frequency of observations.

Although real Gross National Product (GNP) is a good indicator of the overall level of economic development and activity in any economy, it could in fact be argued that, for Saudi Arabia, this variable does not accurately reflect the level of economic activity within the economy. This is attributed to the country's reduced ability to influence the oil produciton level and the price of oil in international market. Within the extraction and export of oil production being the dominant component of GDP and government revenue to a large part of the economic activity within the country is determined outside its system and has very little control over it. Moreover, as Saudi Arabia is an oil based economy, in which most economic activities are linked to oil, it is generally believed that this basic and important characteristic has a bearing on every aspect of economic activity. While, during the last two decades, the significance of oil in the economy has declined, it remains the dominant sector. Thus, non oil private sector GDP represents income and the data on this and other variables are obtained

from Ministry of Planning ''Facts and Figures'' (different issues) and from Saudi Arabian Monetary Agency (SAMA) annual reports (different issues).

Tables 1-4 show the empirical results of the statistical tests conducted to investigate the relationship between government investment and economic growth in Saudi Arabia. Growth of real non oil private sector GDP(Y) represents growth of the economy. Independent variables used in this study are in real terms and include total investment (TI), private investment (PI), labor (L), non oil government investment (GI), and government expenditure on infrastructure as roads and highways (RH).

Table1: Unit Roots Tests

Variables	ADF		PP	
	Levels	**Differenced**	**Level**	**Differenced**
ln Y	-1.449	-1.596	-1.7169	-5.369*
lnL	0.356	-2.834***	0.610	-4.634*
lnTI	-1.647	-2.628***	-2.245	-3.002**
lnPI	-1.227	-3.546**	-2.613	-3.656*
lnGI	-2.001	-3.730*	-2.482	-3.799*
lnRH	-3.199	-3.619**	-2.621	-5.217*

* Significant at 1%, ** Significant at 5%, and *** Significant at 10%.

Given the time series nature of the data, a first step was to test for unit roots and the common trend of the variables. Table 1 presents the results of the augmented Dicky-Fuller (ADF) and Phillips-Perron (PP) stationarity tests where the results of both ADF and PP tests reveal that the variables are non stationary in their level terms. With first differences these variables become stationary at I(1). Because all variables have been

proven to be non stationary at their level terms and integrated of order I(1) as the results show, but linear combination of the differenced series still I(0), then we can perform the cointegration test with these variables. Results of Johansen-Jueslius cointegration tests appear in table 2 and reveal that the variables are cointegrated which indicate that we can reject the null hypothesis of no-cointegration of the variables at their level terms, thus, these results indicate that a long run relationship exists between these variables. Table 3 shows the results of the error correction tests with the variables and according to Engle and Granger (1987) give the direction of causality and the adjustment of the variables to the long run equilibrium. These results show that causality runs from government investment and investment in infrastructure to economic growth. Thus, these results introduced a channel through which Granger causality has emerged. They also show the speed of adjustment to long run equilibrium and that government investment in infrastructure has significant impact on economic growth. Further, these tests indicate that both TI and GI cause economic growth (Y) in Saudi Arabia. These results are in agreement with Singh and Sahni (1984), Ram (1986a), and Holms and Hutton (1990) who concluded that government expansion has a positive effect on economic growth. These findings also support the bivariate study by Ram (1986b) who tested for 63 developed and less developing countries and found causal relationship between government expenditure and national income.

These results also reaffirm the findings of the studies by Dhumale (2000), Crihfield and Panggabean (1995), Holtz-Eakin and Schwartz (1995), Kamada et al (1998), Lau and Sin (1997), Thangavelu and Owyong (2000), Pereira (2000), Hurlin (2001), Albala-Bertrand and Mamatzakis (2001) who found that infrastructure contributes to economic growth and Ahsan et al, (1992) who conducted tests with both bivatiate and trivariate models and found bidirectional causality between government expenditure and economic growth in France and Italy.

Table2: Johansen-Jueslius Cointegration Test

Eigen Values	λ max	λ trace	5% for λ max	5% for λ trace	Hypothesis
	lnY = f(lnL, lnTI)				
0.429	18.47	37.09	20.97	34.55	$r \leq 0$**
0.331	13.25	18.62	14.07	18.17	$r \leq 1$**
0.150	5.375	5.373	3.74	3.74	$r \leq 2$**
	lnY = f(lnL, lnPI, lnGI)				
0.611	31.12	65.945	29.97	54.64	$r \leq 0$*
0.353	14.34	34.833	20.97	34.55	$r \leq 1$**
0.318	12.60	20.478	14.07	18.17	$r \leq 2$**
0.212	7.874	7.874	3.74	3.74	$r \leq 3$*
	lnY = f(lnL, lnPi, lnRH)				
0.567	23.47	65.827	29.97	53.12	$r \leq 0$*
0.450	22.01	42.361	20.97	34.91	$r \leq 1$*
0.334	11.39	20.357	14.07	19.96	$r \leq 2$**
0.274	8.97	8.965	9.24	9.24	$r \leq 3$***

* Significant at 1%, ** Significant at 5% and *** Significant at 10%.

Since cointegration clarifies the 'spurious regression' or 'nonsense correlation' problem associated with trending time series data (Ericsson, 1992; Phillips, 1986; Ohanian, 1988), an OLS regression based on the differenced variables was conducted. Table 4 shows the results of regressing the differenced log of economic growth (Y) as a dependent variable on the differences of the log of other variables. The

coefficient of government investment (GI) has the expected sign and significant at 5 percent, however, government investment on infrastructure (RH) has the right sign but only significant at 15 percent. These results show that while an increase in total investment by 1 percent will increase economic growth by 0.231 percent the increase in private investment and government investment by 1 percent will increase economic growth only by 0.121 and 0.16 percent respectively. However, an increase in infrastructure investment by 1 percent will increase economic growth by about 0.032 percent.

Table3: Error Correction Results

$\Delta \ln Yt = 0.092 + 0.411\ \Delta \ln Yt-1 - 0.267\ \Delta \ln Yt-2 - 0.124\ \Delta \ln Lt-1 + 0.258\ \Delta \ln Lt-2 + 0.003\ \Delta \ln TIt-1$

(2.95)* (1.63)*** (-1.24) (-0.393) (0.82) (2.631)*

-0.0005 Δln TIt-2 -0.003 Trend -0.008ECt-1

(-0.501) (-2.594)* (-2.465)*

R = 0.759, F = 13.189*, log Likelihood = 75.68, AIC = -4.168, SC = -3.755

$\Delta \ln Yt = 0.034 + 0.490\Delta \ln Yt-1 - 0.0012\ \Delta \ln Yt-2 + 0.283\ \Delta \ln Lt-1 + 0.164\ \Delta \ln Lt-2 + 0.035\ \Delta \ln PIt-1$

(1.44) (1.749)*** (-0.006) (0.706) (0.450) (-0.738)

$+0.070\Delta \ln PIt-2 + 0.005\Delta \ln GIt-1 - 0.011\Delta \ln GIt-2$ -0.002trend -0.069ECt-1

(1.148) (0.148) (-0.381) (-1.842)*** (-2.113)**

R = 0.706, F-8.425*, Log likelihood = 73.944, AIC = -3.43, SC = -3.43.

$\Delta \ln Yt = 0.807\ \Delta \ln Yt-1 - 0.089\ \Delta \ln Yt-2 - 0.347\ \Delta \ln Lt-1 - 0.204\ \Delta \ln Lt-2 - 0.0111\ \Delta \ln PIt-1 - 0.041\ \Delta \ln PIt-2$

(2.854)* (-0.302) (-0.712) (-0.562) (-0.231) (-0.854)

$0.234\Delta \ln RHt-1 + 0.082\Delta \ln RHt-2$ -0.0023ECt-1

(0.881) (0.275) (-1.236)

R = 0.752, F-9.586*, Log likelihood = 60.994, AIC = -3.851, SC = -3.419

* Significant at 1%, ** Significant at 5%, *** Significant at 10%.

These results are in agreement with the findings of Carlino (1993), Kim et al. (1999), Mahmood (1999), Duggal et al. (1999), Rioja (1999) and Nourzad (1998, 2000) that government investment in infrastructure, especially in roads and highways, is a major determinant of productivity and enhances the overall production efficiency. Thus, these results suggest that government investment has positive impact on private sector non oil GDP and suggest that devoting additional resources to infrastructure investment can payoff in term of increased private investment and private sector GDP.

Table 4: OLS Results (Dependent Variable ΔY)

Ind. Var	1	2	3
C	0.032	0.032	0.052
	(1.72)**	(1.642)	(1.854)***
ΔlnL	0.320	0.316	-0.055
	(0.76)	(0.714)	(-0.090)
ln(TI/Y)	0.231		
	(5.10)*	———	———
ln(PI/Y)		0.121	0.1033
	———	(2.286)**	(1.370)
ln(GI/Y)		0.16	
	———	(3.620)*	———
ln(RH/Y)			0.0318
	———	———	(1.476
R	0.421	0.377	0.141
F	13.01*	7.50*	2.533**
Log like	61.74	61.035	46.287
AIC	-3.46	-3.355	-2.728
SC	-3.32	-3.176	-2.533

* Significcant at 1%, ** Significant at 5% and *** Significant at 10%. In tables 3 and 4 R = adjusted R squared, F = F statistics, AIC = Akaike Information Criteria, SC = Schwarz Criteria.

Conclusion and Policy Implications:

This study has conducted a series of unit root, cointegration, and regression analysis to ascertain the impact and the relationship between government investment and the growth of real non oil private sector GDP in Saudi Arabia. Final prediction error (FPE) method was employed to determine the optimal lag length of the explanatory variables. Empirical results show the presence of cointegration between the variables which suggest that a long run relationship between government investment (GI) and government investment in infrastructure (RH) on one hand and non oil private sector GDP on the other exists and that these two variables exert positive impact on private sector economic growth. The findings of the study furnish supportive evidence that the government has played an important role in the economic development in Saudi Arabia.

The rapid increase in oil prices and revenue especially after 1973, enabled the government to spend massively on infrastructure, however, the drop in oil prices and revenue forced the government to run a deficit for a long period of time. Thus, this situation could have an adverse effect on the growth of the economy since it is possible that during budget constraint, spending on public investment could be canceled or postponed. That is capital budget could be hit disproportionately since it is easier to cut back public capital spending without much resistance. Further, the long term consequence of reducing government investment spending are not felt in the short run (Sturm and de Haan, 1998; Sturm et al 1999; de Haan et al 1996).

Even though the government maintained high level of expenditure, increase in budget deficit in Saudi Arabia forced policy makers to choose among priorities. According to Krimly (1999) various social sectors were less vulnerable to cuts than infrastructure projects and administration which were subject to canceling and postponement. This indicates that government spending on investment will be reduced during periods with increased pressure to reduce budget deficit. This

implies that government budget deficit and its impact on government investment might reduce the rate of capital formation which implies in turn slower rate of growth and productivity of the private sector.

In addition, public sector investment can cause crowding out of the private sector if it uses scarce physical and financial resources which would otherwise be utilized by the private sector. Moreover, the use of taxes and deb-as being used lately in Saudi Arabia and other measures to finance public sector investment reduces the resources available to the private sector. However, the private sector can benefit from public investment via the development of infrastructure. Such improvements are not realized by a mere increase in investment outlay, but rather through the quality of the investment. Expanded restructuring of public sector expenditure may, therefore, be required to achieve an efficient public sector. Efficiency in resources use and allocation in the public sector is important as the level of expenditure. When public investment is used to promote efficiency, it may have a crowding-in effect. Thus, it is important for the policymakers to pay attention not just to the level of government investment but also to its composition. Cuts in government expenditures should fall only on those expenditures that are not related to the development of infrastructure. There should be an awareness of the consequences and the adverse effects of the government policies on the long run growth of the economy.

Further, these statistical results support the assertion that government activities enhance future growth of real income and that public policy has permanent effects on real output. Thus, for Saudi Arabia to maintain its economic growth, public investment in infrastructure that facilitates this growth is required to put the economy on higher long term growth path. In this respect, the development of economic institutions including financial and capital markets is crucial for economic development. Developed financial and capital markets can mobilize savings and channel them to productive use.

Finally, since economic growth and development are the main objectives of the government investment, issues for growth policy should emphasize on investment in infrastructure through technology and human resources. In short, there should be an effort to maintain adequate levels of investment in social and economic infrastructure. It is also important to pay attention to the composition not just to the level of government expenditure and investment.

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