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The Impact of Public Investment on Private Investment in Jordan

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ABSTRACT

This study attempts to investigate the causal relationship between government investment and private investment in Jordan over the period 1976-2004. The central question of this study is whether government investment plays a positive effect (complementary hypothesis) or a negative effect (the substitutability hypothesis) on private investment in Jordan.

To achieve it objectives, the study uses the modern technique Vector Error Correction Model (VECM) as its methodology. The study uses the Johansen-Juselius (1990) cointegration analysis of a multivariate system of equations to estimate the long run relationship between government investment and private investment. To determine the order of integration of the variable series, the study employs the Augmented Dickey-Fuller (ADF) unit root test.

The statistical tests reveal that all time series data are nonstationary in their levels and they become stationary after differencing, i.e., they are integrated of order one I (1). The Johansen-Juselius cointegration test shows that the series are cointegrated, and then, the study employs the VECM model. Moreover, the study applies the impulse response functions (IRF) and variance decomposition (VDC) to investigate the effect of government investment shocks on private investment. The empirical findings support the complementarity hypothesis between government investment and private investment, and that, government investment tends to crowd-in private investment in Jordan. Thus, the government investment activities have a positive effect on private investment and the economic growth in Jordan.

Keywords: Government Investment, Private Investment, VAR, Crowding-out, Crowding-in, JEL Classification: C40 C32 E22.

1. INTRODUCTION

The Keynesian revolution contributed to the economic thinking through the orientation of the way economists perceive the influence of government economic activities on private sector (Blinder and Solow, 1973). The effectiveness of fiscal policy instruments divided Economists among themselves. Keynesian advocates stressed the effectiveness of fiscal policy, and hence, its important role in stimulating the economy. On the other hand, classical economists and monetarists believe that government spending or taxation had no effect on the aggregate levels of spending and employment in the economy. Moreover, they argued that the only influence fiscal policy has is the redistribution of resources from the private to the public sector. In full employment context, each dollar of additional government investment can only crowds-out exactly one dollar of private investment; it cannot alter the over-all level of aggregate income (Blinder and Solow, 1973).

Recently, economists began to emphasize the macroeconomic effects of government spending and taxation. It became a common notion that not only would a dollar of additional government investment raise national income by a dollar but also it would have multiplier effects generating perhaps several dollars more. The old view that government investment simply crowded out private investment was banished (Solow, 1973). The investigation of the impact of government investment on private investment has attracted a huge volume of research in recent years. The driving force is the effectiveness of fiscal policy in the economy. That is, whether government investment exerts a positive effect (complementarity hypothesis) or a negative effect (substitutability hypothesis) on private investment.

The substitutability hypothesis gained support based

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on the idea that financing government investment by taxes or debt would compete with the private sector for the use of scarce physical and financial resources; and the increase in government demand for goods and services can only raise the interest rate making capital more expensive for private sector, and hence, reducing private investment. The complementarity hypothesis gained support via the arguments as follows. First, the availability of economic and social infrastructures may create favorable conditions for private investment opportunities. Second, higher public investment (capital) may lead, on one side, to the increment in labor productivity and, on the other, to a reduction in production costs (through the availability of streets, highways, electrical facilities. Finally, government investment, by increasing total demand, may give rise to profit and sales expectations, so encouraging private investment magnitude.

The objective of this paper is to investigate the nature of the relationship between government investment and private investment in Jordan during the period 1976-2004. The paper tests the hypothesis that government investment has a positive impact on private investment in the case of Jordan. In other words, it tries to discuss whether the complementary or the substitutability hypothesis is applicable to Jordan over the study period. It uses techniques such as; different stationarity, cointegration based on Johansen-Juselius maximum likelihood approach, stability test, and VECM. The implementation of the stationarity and cointegration process allows distinguishing between the short run and long run effects of the explanatory variables.

The importance of this paper stems from the fact that Jordan's economy has long been suffering from budget deficit. The considerable and relative size of government investment have become the source of a great concern to economists, policy-makers and the public. Among them is the possibility that government investment will exert an adverse impacts on private investment. This concern is the most important one, because of policy implications for lower growth and living standards in the future (Valintino, 1990).

2. LITERATURE REVIEW

The relationship between government investment and private investment has been a controversial issue among economists and policy makers. Many empirical works investigating such a relationship have concentrated on whether government investment has a positive effect (complementary hypothesis) or a negative effect (the substitutability hypothesis) on private investment as well as on economic growth. In other words, does government investment crowd-out or crowd-in private investment. These studies show that the relationship between government expenditures and private investment is still controversial. Different results have been found for different countries as well as for different times within the same country. Based on these contradictory results, it is improper to generalize on potential relationship between government expenditures and private investment.

Feldstein (1982) investigated the impact of a set of variables on private consumption. His model incorporated the government spending. This variable as indicated by the empirical results has a significant negative impact on private consumption. As stated by Feldstein (1982) "This evidence strongly contradicts the view that variation in government spending induces equal offsetting change in private consumption; the point estimate indicates that only 10 percent of the variation in government spending is offset by changes in personal consumption".

Kormendi (1983) investigated the impact of the government's fiscal policy on private sector consumption-saving behavior. His empirical results revealed that there was a significant negative impact of government spending on private consumption-saving behavior. The coefficient of the variable (GS) was of a magnitude of (-0.22). He further enhanced his work by testing the stability of (GS) by using GLS and First Autocorrelation. He also estimated the impact of GS on private sector by dividing the period into sub-periods and finding that GS still has the negative impact.

Blegar and Khan (1984) estimated a private investment model for 24 developing countries (Latin America and Asia). The estimation results revealed that government investment crowds – in private investment.

Aschauer (1989b) empirically investigated the effect of public capital accumulation on private investment from a neoclassical perspective using the Cob-Douglas production function. From the neoclassical view, the net effect depends upon two fundamental opposing forces. On the one hand, increasing public investment would crowd-out private investment. On the other hand, increasing public investment increases private investment by raising marginal productivity of private capital and hence crowds-in private capital. The author utilized an

econometric model to estimate the impact of government investment on private investment, where private capital depends on the marginal productivity of private capital, government investment and government consumption. He found that government investment has a negative impact on private investment, where the point estimate of the impact of public investment on private investment is very close to unity (0.99).

Munnell (1990) utilized the Cob-Douglas production function for the U.S.A. data over the period 1949-1985. The OLS estimation results revealed a significant positive relationship between public spending on infrastructure capital and economic growth.

Greane and Villanueva (1991), using a pooled time series, cross-section approach for 23 developing countries (Asia, Sub-Saharan, Africa and Latin America), investigated the relationship between government investment and private investment. The estimation results showed that government investment crowds-in private investment.

Tatom (1991) utilized the Cob-Douglas production function. The OLS estimation results revealed a significant positive relationship between public spending on infrastructure capital and economic growth.

Evans and Karras (1994) estimated the impact of public investment on private investment function employing the traditional technique (OLS). He found no significant impact on private investment.

Smyh (1994), using an economic growth relationship for U.S private business sector, found that inflation has a significant impact on output.

Ghali (1998) employed multivariate cointegration technique to develop a VECM model to investigate the long run effects of public investment on private investment over the period 1963-1993. The study's finding showed that public investment has a negative effect on private investment in both short run and long run.

Menadiemi (1998) investigated the relationship between private investment and government spending in Australia, Britain and U.S over the period 1960-1991 using Quarterly data by using the VECM model, IRF and VDC. His study concluded that interest rate and corporate profit showed a significant effect on private investment.

Rossitor (2000) investigated the relationship between public investment (in equipment structures) and private investment (in equipment and structures) for United States data using structural cointegration approach. He found that the results support the infrastructure hypothesis and that public investment in structures has a weak crowd-in effect on private investment, while the public investment in equipment has a negative effect on private investment in equipment showing the crowding-out effect of public investment.

Nicholas (2000) investigated the impact of public investment on private investment using the co-integration with a break over the 1948-1996 for Greece. He found that public investment has a positive effect on the private investment over the period 1948 -1980. However, the substitutability hypothesis gained support using the co-integration analysis with a break over the period 1981-1996.

Pereira (2001) prepared a study based on impulse response analysis. The empirical results indicated that public investment crowds-in private investment in United states for the period 1956-1997.

Tsung (2001) investigated the relationship between private investment and government private consumption for Taiwan for the period 1968-1994. He employed the Granger-causality test and Markov regime-switching framework. He found a complementary relationship between government spending and private consumption. That is government spending crowds-in private consumption.

Laopodis (2001) investigated the effect of military and non-military public expenditures on gross private investment of four newly industrialized European countries, namely Greece, Ireland, Portugal and Spain over the period 1960-1997. He employed the cointegration and the error-correction analysis. The empirical results were mixed for the countries and the defense spending exerts no effect on private investment.

Mamatzakis (2001) investigated the impact of government investment on private investment for Greece over the period 1950-1994. He employed the cointegration analysis of multivariate system of equations, and applied the impulse response function (IRF) and variance decomposition (VDC). The estimation results showed that public investment has a positive impact on private investment, while the government consumption has a negative effect on private investment.

Badawi (2003) examined the issue of complimentarily and substitutability of public investment and private investment in a neoclassical growth model for Sudan using VAR model for the period 1970-1998. The empirical findings revealed that both investments are

substitutes, that is to say that public investment crowds-out private investment.

Ouattara (2004) investigated the determinants of private investment in Senegal over the period 1970-2000. His methodology utilized the Johansen cointegration analysis and bound test approach. The estimation results indicated that public investment exerted a positive impact on private investment.

Erdal (2004) investigated the impact of disaggregated measures of government expenditures (Government consumption and public investment) on the private investment in Turkey over the period 1968-2000. He utilized the cointegration analysis in order to estimate the long-run relationship between different measures of government spending and private investment. Moreover, the impulse response function and variance decomposition are estimated. The estimated results showed that there is a crowding out effect on private investment.

As for Jordan case, Maghayyerah (1991) studied the determinants of private investment in Jordan over the period 1970-1990 using a simultaneous model. His estimation results revealed that, GDP, and workers' remittances have a positive impact, while interest rate and government investment have a negative impact on private investment. Al-Badry (1998) study, constructed a private Investment function in Jordan, using time series data over the period 1968-1994. The included private investment, government investment, exports, and credit variables were expressed as a ratio of real GDP. His findings showed a negative impact of real interest rate, real exchange rate, and government investment (crowding-out effect). While exports, the growth rate of real GDP and the credit facilitating have a positive impact on the private investment. Moreover, the explanatory variables have a significant impact on private investment in Jordan as shown by the t-ratio.

Halaq and Mrayyan (2000) using OLS method estimated the private investment function in Jordan over the period 1975-1996. The estimation results indicated that real interest rate, government investment, and debt service had a negative impact on private investment. Al-Abdulrazag (2003) estimated the investment function of private construction sector of Jordan over the period 1972-1996 using the OLS method. The estimation results revealed that government spending on construction has a positive impact of investment.

The present study differs from those studies in Jordan's case mentioned above in the methodology and the time span of the data employed.

3. DATA AND METHODOLOGY

The data covers the period of 1976-2004. Data on private investment, gross domestic product, foreign direct investment, and government investment are taken from the Central Bank of Jordan publications. The real GDP was calculated by deflating the nominal GDP by GDP deflator (base 2000) obtained from International financial statistics (IFS) yearbook. The private investment is calculated as the difference between total investment (TI) measured as the gross fixed capital formation and the government investment (GI). The government investment is the difference between government total expenditures (TGE) and government consumption (GC). Therefore, private is calculated according to the following formula (Quraan, 1997: Halaq, 2000; al-badry,1998)

$$PI=TI-GI$$

$$GI=TGE-GC$$

The paper applies an economic strategy, which takes into account the dynamic behaviors of the series and the presences of the feedbacks in their mutual relations. The procedure includes stationarity and cointegration analysis, VECM (Vector Autoregressive Model) estimation, impulse response functions (IRF), variance decomposition (VDC), and stability test. The empirical investigation is applied to model where private investment (PI) depends on government investment (GI), gross domestic product GDP, and foreign direct investment FDI.

The reasons behind choosing the econometric procedure are the following. As well known, the estimation approach based on static equations using the series in their levels may suffer from certain problems. The first problem is the stationarity of the data which intern results in a spurious regression and the estimation results are meaningless. Moreover, if the variables are non-stationary and cointegrated, but the regression does not include the dynamic behavior, the OLS estimation may suffer from the simultaneity bias and residuals could be correlated. Second, regression may impose restrictions on the causality direction among the variables. Hence, the dynamic feedbacks are in the analysis. On the contrary, the dynamic interrelations among the variables are taken into account in a multivariate framework, examining the short run influences as well as the adjustment process over the long time horizon (10 years).

To test the parameter stability, the study implements the methodology based on the cumulative sum (CUSUM) and the cumulative sum squares (CUSUMSQ) tests proposed by Brown *et al.* (1975). The advantage of such a test over the Chow test is that the former test requires the specification of the break points, while the latter test uses the cumulative sum of recursive residuals based on the first n observations and is updated recursively and plotted against break point (Ouattara, 2004). While CUSUMSQ test uses the squared recursive residuals in the same manner as CUSUM test. .

4. THE ECONOMETRIC MODEL

In this section, the paper will deal with the impact of government investment along with other set of economic variables on the private investment. Mainly, the purpose of this section is to construct an economic model to investigate empirically whether the government investment is a substitute or a complementary to private investment. In other words, the question is government investment crowd-out or does it crowd-in private investment?. In general, according to the economic theory, there is a kind of relationship between government investment and private investment; and this relationship is a controversial one. Some of the most recent economic research on this topic supports the negative impact of governmental investment on private investment, while some others support the positive impact; and still some others support the neutrality of governmental investment.

According to the economic theory, private investment is a function of a set of variables based on the acceleration principle. The Neoclassical investment theory argues that private investment is positively related to the real gross domestic product *(Ouattara, 2004)*, since GDP contains some components that have positive relationships with private investment. The increase in income level would lead to a higher level of domestic savings that would influence the private investment.

The impact of real government investment (RG_I) on private investment is a controversial issue. Government investment can positively influence private investment through infrastructures. In Jordan's case, it is expected that government investment has a positive influence on private investment, since most if not all activities demanded by government are executed by private sector. Conversely, government investment may crowd-out private investment if the government financed its additional investment by deficit, which leads to an increase in interest rate, credit rationing, and tax burden. The sign of GI variable would provide information on the crowding effect of government investment; a positive sign means that government spending crowd-in private investment, while the negative sign means that government investment crowds-out private investment.

In the case of developing countries, a modified flexible accelerator model of investment includes the real foreign direct investment (RFDI) flows. The influence of foreign direct investment on private investment depends on the relationship between them. FDI might have a positive (complementary effect) or a negative effect (substitutable effect). This paper utilizes a macro-economic model designed to investigate the quantitative impact of government investment along with a set of variables on private investment. The model consists of a single equation describing the factors and their expected influence on private investment (RP_I) expressed in real terms as follows:

$$RPI = F\left(RGDP,\ RGI,\ RFDI\right)$$

A log Transformation of all variable were undertaken in order to standardize the variables. All variable series are in logarithmic form. This is because the series expressed in logarithmic form have roughly constant variances, while the variances of a level series tend to increase with the sample size. The functional relationship into logarithmic form takes the following form:

$$LRPI = \alpha_0 + \alpha_1 LRGI + \alpha_2 LRGDP + \alpha_3 LRFDI + \varepsilon_t$$

where:

RPI	is the real private investment
RGDP	is the real gross domestic product.
RGI	is the real aggregate government investment
RFDI	is the real foreign direct investment
L	is the natural logarithm
ε_t	Error term

The relationship between government investment and private investment has been the central point of a huge empirical work. The empirical work has been trying to prove the complementary hypothesis or substitutability hypothesis (crowding-out hypothesis or crowding-in hypothesis) using different techniques and different samples. The results of the empirical work are mixed. Several studies used pooled samples that mix regions with different macroeconomic problems and distinct situations. This makes it difficult to generalize the results.

Unit Root Test

The econometric procedure consists of (3) stages which are described in more details as follows: the first step involves determining the order of integration of each of the series used in the analysis by applying the stationarity (or unit root test). The augmented Dickey-fuller (ADF) test (Dickey and Fuller, 1981) is used to test for stationarity. The Perron unit root (PP) test (Perron, 1989) is performed to determine the order of integration of a time series by considering the possibility of structural changes occurring in its behavior (Ribeiro, 2004). This is due to the existence of structural breaks, which result in the ADF test wrongly indicating non-stationarity in what is actually a stationary series.

The prerequisite for cointegration test is to examine the properties of the time series variables. In order to have a reliable regression tests, we first need to make sure our model could not be subjected to "Spurious Regression". The problem of spurious regression arises because time series data usually exhibit non-stationary tendencies, and as a result they could have non-constant mean, variance and autocorrelation as time passes. This could lead to non-consistent regression results with misleading coefficients of determination (R^2) and other statistical test. Therefore, we need to establish stationarity properties of the variables used in our model using Augmented Dickey-Fuller "ADF" (1979, 1981) to determine the degree of integration of variables; how many times should a variable be differenced to attain stationarity. The order of integration (*d*) identified the differencing times to make the series stationary, the series contains (*d*) unit roots, and hence, the integration of the series is of order (*d*). If *d=0,* the series is said to be integrated of degree zero and stationary at level.

The augmented Dickey-Fuller test is based on the estimate of the following regression:

1. ADF (p); without deterministic trend where (p) is the number of Augmentation terms included in ADF test

$$\left(\Delta Y_{t-1}, \qquad , \Delta Y_{t-p}\right)$$

$$\Delta Y_t = \alpha_0 + \alpha_2 Y_{t-1} + \sum_{i=1}^{p} \alpha_i \Delta X_{t-1} + \varepsilon_t$$

2. ADF (p) with deterministic trend

$$\Delta Y_t = \alpha_0 + \alpha_2 Y_{t-1} + \sum_{i=1}^{p} \alpha_i \Delta X_{t-1} + \beta_t + \varepsilon_t$$

P= is the number of lags which should be large enough to ensure the error terms are white noise process and small enough to save degrees of freedom. The number of lags can be determined and will be chosen based on the AIC and SBC selection. The error term is normally distributed. The null and alternative hypothesis can be stated as follows:

$$H_0 : \alpha_2 = 0$$
$$H_1 : \alpha_2 \neq 0$$

If the t-ratio of the estimated coefficient is greater than the critical t-value, the null hypothesis of unit root (nonstationary variable) is rejected indicating the variable is stationary at level and integrated of degree zero denoted by I (0). On the other hand, if the series are found to be nonstationary at level, a transformation of the variable by differencing is needed until we achieve stationarity that is non-autocorrelated residuals.

Cointegration Test

The second step of the strategy, after determining the order of integration of each series, is the determination of the number of the linearly independent cointegration vectors by using the maximum likelihood multivariate cointegration test. The long run relationship between the variable series is investigated by the Johansen-Juselius (1990) multivariate cointegration approach. The short–run, on the hand, is analyzed by employing Granger-causality within the vector error correction model (VECM). The system of cointegration vectors can be described as a set of vector autoregression (VAR) of non-stationary time series as follows (Boon, 2000):

$$\Delta X_t = \Pi X_{t-1} \sum_{i=1}^{k-1} \Gamma_i \Delta X_{t-1} + \mu + \Theta t + \varepsilon_t$$

Where

$$\Pi = -\left(I - \sum_{i=1}^{k} \Pi_i\right), \ \Gamma_i = -\left(I - \sum_{j=1}^{i} \Pi_j\right), i = 1,.....,k-1$$

X_t is a vector of ***P*** variables.

μ are the intercepts

t is the deterministic trends

ε is a vector of Gaussian random variables.

The matrix coefficient Π is the long run impact matrix containing information on the stationarity of the variables and the long run relationship amongst them.

The rank of the matrix determines the number of cointegration vectors. If the coefficient matrix is full rank, r=p, (r is the number of cointegration vectors; p is the number of variables) then all variable are stationary

without trend or long-run relationship amongst them. However, if the rank of the matrix is zero, r=0, then there is no cointegration and the variables are non-stationary. The last possible case is where the rank lies between zero and p (0<r<p). In this case, there are (r) linear combinations of variables in X_t that are stationary, and that the variables are cointegrated in the long run with r vectors. The Johansen-Juselius (JJ) approach (1990) to cointegration is a VAR-based test. The main work of JJ is the development of two tests the -trace and the maximum eigenvalue test- to determine the number of cointegrating vectors.

Then the next step is the test for cointegration among the included variables in order to find out, if any, the existence of significant long run relationships when using the Johansen procedure. It is stated that if the variables are I (1) and cointegrated, the vector error correction model (VECM) is proposed. The VECM estimation enables us to study the dynamic relations among the series through the adjustment mechanism. Then we employ the impulse response analysis in order to single out the effects produced by shocks in one variable on all others, and study the dynamic behavior of the series on a ten years horizon.

5. EMPIRICAL RESULTS AND DISCUSSION

Unit Root and Cointegration Tests

To determine the stationarity property of the variable series LPRI, LRGI, LRGDP and LRFDI series, the Augmented Dickey-Fuller (ADF) (Dickey-Fuller, 1979) and Phillip-Perron (PP) (Perron, 1989) unit root tests are applied to the natural logarithms of the series.

Table 1. Augmented Dickey-Fuller Unit Root Test.

	LEVEL		**First difference**	
Variable	ADF	Mac. Val. (5%)	ADF	Mac. Val. (5%)
LRPI	-2.1019 (1)	-2.9750	-4.27139 (1)	-3.7076 *
LRGI	-0.6889 (1)	-2.9750	-4.01871 (1)	-3.7076
LRGDP	-1.73645 (1)	-2.970	-3.36155(2)	-2.850
LRFDI	-0.49973 (1)	-2.9750	-3.86105 (1)	-3.707*

* (**) Significant at 1% (10%) significant level. The number of lags is determined by the AKIAK (AIC) criterion.

Table 2. Results of the Perron Test for Level and First Difference Series.

	LEVEL		**First difference**	
Variable	PP	t (5%)	PP	t (5%)
LRPI	-2.583	-2.9750	-6.48109*	-2.9750
LRGI	-2.5427	-2.9705	-7.14498*	-2.9750
LRGDP	-2.2105	-2.9705	-3.0232	-2.9750
LRFDI	-0.9670	-2.9705	-6.7395*	-2.9750

* Significant at 1% level. The number of lags is determined by the AKIAK (AIC) criterion.

Table (1) presents the results of augmented Dickey-Fuller (ADF) test for the level and the difference series. The number of lags included in the estimation to eliminate the possibility of autocorrelation of residuals. The minimum value of Akaike criteria (AIC) criterion determines the number of lags. The results indicate that the null hypothesis of non-stationarity cannot be rejected for all series in their levels. Applying the ADF test to the series in their first differences indicates that all series became stationary at 5% (cases at 10%) level of significance. The results show that first difference of the series rejects the null hypothesis of non-stationarity and therefore integrated aeries of order one, I (1).

Table (2) shows the results of the Perron test for level and first difference series. The results show that the null hypothesis of a unit root in LRPI process can be rejected at 5% significance. The results obtained from the Perron test confirm those obtained from ADF test.

Co-integration Test

Having determined the order of integration for each variable, the second step is to investigate the cointegration of the data series. The cointegration of the variable series requires the existence of a long-run relationship acts as a constraint on their movement. That is the variables can drift away from each other despite the fact that they are individually non-stationary. The paper employs the Johansen-Juselius (1990) procedure to determine the cointegration rank r and to estimate the adjustment coefficients and cointegration vectors. The cointegration

approach requires the determination of the optimal lag structures by estimating a VAR model to carry out the task. The VAR models are estimated for 1, 2, 3, and 4 lags to select the optimal lag interval that minimizes the SC Criterion. The result of SC Criterion reported in table 3 suggests 3 lags for cointegration models.

Table 3. Schwarz Criterion based on VAR Models.

Lag	SC
0	6.617905
1	4.434483
2	4.984701
3	3.712768*
4	4.000254

Table (4) presents the estimation results of Johansen-Juselius multivariate cointegration of the natural logarithm of real private investment equation. The trace test results determine the number of long run relationships and, thus, the cointegration vectors. The trace statistics indicates that the null hypothesis of no cointegration relationship $_{r=0}$ is rejected for all four cases at 1% significance level, but the null hypothesis that exists at most two cointegration vector2 (H_0: r=2) is not. Moreover, this implies that the variables are cointegrated with three cointegration vectors and a long run relationship is present in the underlying data generating process of the time series.

Table 4. Results of Johansen-Juselius Multivariate Cointegration of the Natural Logarithm of RPI Equation.

Hypothesized		Trace	5 Percent	1 Percent
No. of CE(s)	Eigenvalue	Statistic	Critical Value	Critical Value
None **	0.826272	98.95769	47.21	54.46
At most 1 **	0.750985	55.20109	29.68	35.65
At most 2 **	0.556856	20.44507	15.41	20.04
At most 3	0.003935	0.098577	3.76	6.65
*(**) denotes rejection of the hypothesis at the 5%(1%) level				
Trace test indicates 3 cointegrating equation(s) at both 5% and 1% levels				

Table 5. Maximum Eigenvalue Statistics Results.

Hypothesized		Max-Eigen	5 Percent	1 Percent
No. of CE(s)	Eigenvalue	Statistic	Critical Value	Critical Value
None **	0.826272	43.75661	27.07	32.24
At most 1 **	0.750985	34.75602	20.97	25.52
At most 2 **	0.556856	20.34649	14.07	18.63
At most 3	0.003935	0.098577	3.76	6.65
*(**) denotes rejection of the hypothesis at the 5%(1%) level				
Max-eigenvalue test indicates 3 cointegrating equation(s) at both 5% and 1% levels				

Table 6. The Normalized Cointegration Equation.

LRPI	LRGI	LRGDP	LRFDI
1.000000	0.272292	0.199823	0.073427
S.E	(0.91326)	(0.73123)	(0.02348)

Standard errors in parenthesis

Table 7. Variance Decomposition Analysis.

Variance Decomposition of LRPI:					
Period	**S.E.**	**LRPI**	**LRGI**	**LRGDP**	**LRFDI**
1	0.349801	100.0000	0.000000	0.000000	0.000000
2	0.507265	48.10166	37.94336	0.793718	13.16125
3	1.194981	11.35476	85.95014	0.168482	2.526615
4	1.702176	7.550340	89.91947	1.281192	1.249001
5	2.072492	5.104814	91.20132	1.269689	2.424181
6	2.313278	4.097776	91.12660	1.135788	3.639833
7	2.420870	3.782355	90.86572	1.083175	4.268745
8	2.512728	3.585140	90.56661	1.033817	4.814435
9	2.610172	3.326958	90.98748	0.962854	4.722708
10	2.737917	3.028722	91.57952	0.875947	4.515806

Taking the maximum eigenvalue tests, table (5) presents the maximum eigenvalue statistics results. The null hypothesis that there is no cointegration vector (H_0: r= 0) is rejected, but the hypothesis of at most two cointegration vectors (H_0: r = 2) is not rejected. These results provide support to the trace test results of two cointegrating vectors and that there exists a linear combination of I (0) variables that links them in a stable and a long-run relationship.

Table (6) shows the results of the Johansen approach of the long run relationship between variables. The results revealed that government investment as well as real gross domestic product and real foreign investment affect positively the private investment

One possible explanation of the positive impact of GI on PI is that government investment seems to be heavily directed toward construction and infrastructure activities that are carried out by private sector. Therefore, the private sector must expand to carry out government projects by increasing its investment. The way that GI influences positively PI can be through projects that have potential to complement PI particularly, human capital and infrastructure. Human capital improves productivity, whereas, infrastructure facilitates the production and distribution process of goods and services.

As for the FDI, it is considered as a potential future key determinant of private investment for most developing countries including Jordan. However, it must be recognized that FDI could have a mixture impacts on private investment. Therefore, it is the responsibility of the host country to act appropriately to maximize the positive impacts and minimizes the negative effects. For example, government does not only have to monitor the practice of the FDI, but it has to develop their resources to levels capable of exploiting the comparative advantages FDI offers.

Impulse Response Functions

Then, we implement impulse response functions IRF analysis to single out the effects produced by shocks in one variable on all other variables, and study the dynamic behaviors of the series on a ten-years horizon. The deviation from the equilibrium is stationary and any shock to the system generates a time path that eventually returns to a new equilibrium, provided no further shocks occur. The impulse response analysis investigates the interaction between the variables and assesses the adjustment to long run equilibrium. The IRF functions examine the positive and negative responses of private investment to changes in different variables in the model (Mehdi, 1998). To determine the significance of the response to a particular shock, the methodology constructs a one standard deviation confidence interval bands. The response is significant if the confidence interval does not pass through the zero line.

Figure (1) reports the positive response of private investment to one standard deviation shock of government investment over the whole period (see the second column, first row). The positive relationship between government investment and private investment supports the complementary hypothesis -that government investment crowds-in private investment- rather than the substitutability relationship.

Fig. (1) also reports the fluctuating responses of private investment level to one standard deviation shocks in the real gross domestic product LRGDP. The results show that the effect of LRGDP was slightly negative up to the third period, and then it changed to positive up to the eighth period, and negative to the end of the time horizon (see third column, first row). Moreover, another interesting result of the impulse responses function IRF is the positive relationship between private investment and foreign direct investment, due to a positive response of the former variable to a one standard deviation shock of the latter one (see last column, first row). This finding is of interest since it implies a complementary relationship between private investment and FDI, i.e., the latter one crowds-in the former one.

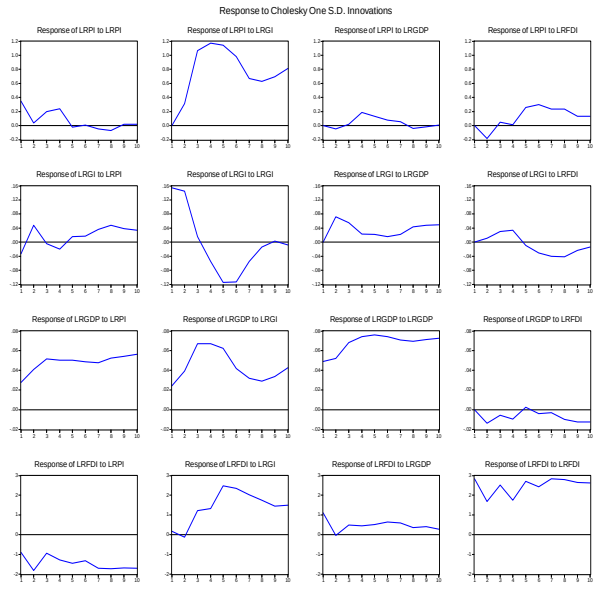

Fig. 1. Response to one standard deviation.

Variance Decomposition Coefficients (VDC)

VDC Indicates the importance of certain variable but fail to give information about the direction of the response of the variable to certain shocks. That is, one cannot deduce any information about the complementarity or substitutability of private investment and government investment from VDC coefficients.

Table (7) presents the variance decomposition (VDC) estimations. The results support the conclusion derived from the IRF results earlier, where there is a positive relationship between private investment and shocks to real government investment, real GDP and real foreign direct investment. The variance decomposition explains how much of uncertainty concerning the prediction of private investment level can be explained by the uncertainty surrounding the other variables (Mamatzakis, 2001). Moreover, over the ten years, 91.57% of the forecast error variance of real private investment is explained by the disturbances of government investment, while, while 0.875% is explained by real gross domestic product (LRGDP) and 4.515% % is explained by real foreign direct investment (LRFDI).

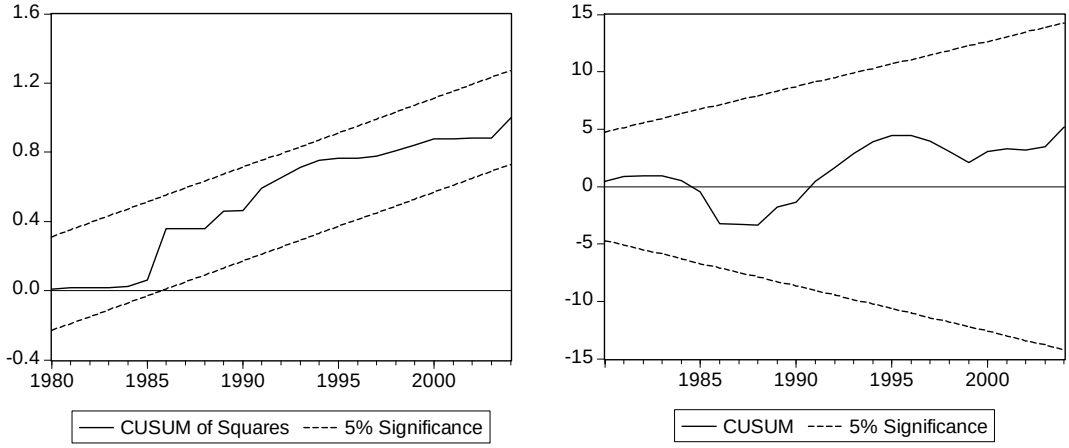

Fig. 2. Plot of the cumulative sum of recursive residuals.

Testing the Parameter Stability

Graham (1993) suggested that the model (equation) is sensitive to the sample size. Based on this proposition, it is important that we investigate the stability of the long-run relationship between variable series for the entire period. In other words, we have to test for the parameter stability. The decision about the parameter stability relies on the position of the plot relative to the 5% critical bound. If the plot of the CUSUM or CUSUMSQ lies with the 5% critical bound, then the null hypothesis that the coefficients are stable cannot be rejected, but if the plot crosses either one of the parallel lines, then the null hypothesis of parameter stability is rejected. The results of stability test, using CUSUM and CUSUSMSQ methods are presented in the following figure 2. Fig.2 shows that both CUSUM and CUSUMSQ plots lie within the 5 percent critical bound, which provides evidence that the parameters are stable over the study period , that is there are no structural changes.

6. CONCLUSION

Aggregate, annual, time series data for Jordan over the period 1976-2004 were used to analyze the relationship between government investment and private investment. Since most of time series data are nonstationary in their first levels, the study applied the ADF and the PP tests to verify the stationarity properties of the series. The ADF results showed that all series are stationary in their first differences. The cointegration test provides that the series are cointegrated, and hence, a long run relationship is present between series exists. Since the series turned out to be integrate of order one I(1), and cointegrated, the VECM procedure is used to examine the responses of private investment to government investment shocks.

The empirical results provide no support for the crowding-out hypothesis. Indeed, the results show that there is a complementarity between real government investment and real private investment. The estimated results of impulse response function, (IRF), and variance decomposition (VDC) show that real private investment show significant responses to a one standard deviation shock of real government investment as well as to real GDP and real FDI during most of the ten years period. The results provide support to the Keynesian notion of

expansionary public investment of Jordan.

In terms of economic policy implications, the results support the notion that government investment stimulate private investment, and hence, economic growth. The study suggests that fiscal policy in general and the increase government investment in specific may indeed contribute to the development of Jordan economy. Moreover, the Jordan government should pay attention to encourage the corporation between private sector and public sector.

Moreover, it is recommended that government should speed the process of privatization to eliminate any probability of substitute projects for private investment. The return derived from the privatization of the projects can then be directed to projects that are complementary to private investment.

Attracting FDI can be achieved by government through developing resource bases that can facilitate shifting up the level of technological complexity. Moreover, export activities; build human capital and macroeconomic capacity.

There are two modifications, which could be pursued following the present work. First, the study recommends future research on the disaggregated government expenditure into different categories. Second, this research does not corporate all variables that are expected to influence the private investment in Jordan, therefore. Both are left research in the future.

Appendix (1)
Data used in the statistical analysis.

year	GDP	CPI	DEFL	TGE	GC	GI	GFCF	PI	FDI
1976	567.3	23.6	30.192	262.5	190.1	72.4	193.4	121	6.9
1977	690.4	27	33.93	337.9	187.2	150.7	277.9	127.2	9.1
1978	795.4	28.9	34.09	361.5	234.4	127.1	263.1	136	18.6
1979	982.5	33	34.86	515.6	337.1	178.5	310.1	131.6	8.2
1980	1164.8	36.6	37.16	563.2	340.2	223	433	210	11.7
1981	1448.7	39.5	39.45	647.1	456.4	190.7	666.8	476.1	46.9
1982	1649.9	42.4	41.98	693.6	477.9	215.7	650.8	435.1	33
1983	1786.6	44.5	46.49	705.3	473.4	231.9	589.8	357.9	13.7
1984	1909.7	46.2	47.65	720.8	534.6	186.2	571.2	385	29.9
1985	1970.6	47.6	50.53	805.79	531.7	274.09	414.9	140.8	9.6
1986	2240.5	47.6	54.46	981.3	566.5	414.8	444.3	29.5	10.5
1987	2286.7	47.5	54.32	965.9	586.7	379.2	515.6	136.4	13.5
1988	2349.6	50.7	5545	1054	604.3	449.7	532.56	82.86	9.6
1989	2425.4	63.7	63.6	1102.3	618.8	483.5	563.22	79.72	1
1990	2760.9	74	72.6	1120.1	663.9	456.2	850.16	393.96	45.8
1991	2958	80.1	76.56	1234.3	742	492.3	738.5	246.2	0.2
1992	3610.5	83.3	81.71	1372.5	790.6	581.9	1208.72	626.82	47.1
1993	3884.3	86	83.56	1411.6	857.9	553.7	1422.73	869.03	40.5
1994	4358.3	89.1	87.62	1587.8	985.6	602.2	1450.9	848.7	21.4
1995	4714.6	91.2	91.62	1693.9	1111.3	582.6	1554.15	971.55	37.6
1996	4912.2	97.7	93.5	1789.6	1204.1	585.5	1499.8	914.3	79.2
1997	5137.5	100	94.66	1952	1312.5	639.5	1321.9	682.4	176
1998	5609.8	103.1	100.3	2087.7	1367	720.7	1226.3	505.6	217.6
1999	5778.1	103.7	100.28	2039.5	1386.7	652.8	1245.3	592.5	230.6
2000	5998.6	104.4	100	2187.1	1421.6	765.5	1338	572.5	120.79
2001	6363.8	106.3	101.13	2316.3	1458.4	857.9	1343	485.1	136.64
2002	6794	108.2	102.77	2296.7	1541.6	755.1	1372.4	617.3	74.45
2003	7228.7	110.7	106.78	2809.8	1670.8	1139	1506.5	367.5	436.11
2004	8081.3	105	108	3180.5	1723.1	1457.4	2214.9	757.5	650.86

Source: GFCF, GDP, CPI, TGE, GC are drawn from Central Bank of Jordan publications, Monthly Statistical Bulletin, different issues; Yearly Statistical Series (1964-2003).
FDI; (1973-1999) Al-Nusor, Maan (2000), (2001-2004) CBJ.
DEFL was drawn from IFS, statistical yearbook.
GI and PI were calculated by the author.

GFCF: Gross Fixed Capital Formation
GDP: Gross Domestic Product
CPI: Consumer private Index (base 2000=100)
TGE: Total Government expenditures
GC: Government Consumption
PI: Private Investment
GI: Government Investment
FDI Foreign Direct Investment

REFERENCES

Abdulrazag, B. 2003. Determinants of Investment in Private Construction Sector in Jordan: An Empirical Study (1972-1996), *Damascus University Journal,* Vol.(19) No. (1).

Al-Badry, Sabah S. M. 1998. Private Investment and Factors Affecting it in Jordan, *Economic Horizons*, Vol.74. (Arabic).

Al-Nusor, Maan. 2000. Foreign Aid and Economic Growth in Jordan, unpublished paper, Ministry of Planning, Jordan.

Al-Zabdi, Nader. 2007. The Impact of Trade Liberalization on Jordan's Exports, Unpublished Thesis, Mutah University, Jordan.

Apergis, Nicholas. 2000. Public and Private Investments in Greece: Complementary or Substitute Goods? *Bulletin of Economic Research*, 52 (3): 225-234.

Aschaur, D. A. 1989a. Public Investment and Productivity Growth in Group of Seven, *Perspectives*, Vol. 13, 17-25.

Aschaur, D. A. 1989b. Does Public Capital Crowd Out Private Capital, *Journal of Monetary Economics*, 171-188.

Badawi, Ahmad. 2003. Private Capital Formation and Public Investment in Sudan: Testing the Substitutability and Complementarity Hypotheses in Growth Framework, *Journal of International Development*, 15, 783-799.

Beljar, M. and M. Khan. 1984. Government Policy and Private Investment in Developing Countries, *IMF Staff Papers*, 31 (2): 379-403.

Belloc, Marianna and Pietro Vertova. 2004. How Does Public Investment Affect Economic Growth in HIPC: An Empirical Assessment, *Quadeni*, No. 416.

Blinder, A.S. and Robert M. Solow. 1979. Does Fiscal Policy Matter? *Journal of Public Economics*, Vol. 2: 319-337.

Boon, T.H. 2000. Savings, Investment and Capital Flows: An Empirical Study of the ASEAN Economies, *Working Paper, 3.2000*, University of Putra, Malaysia.

Brown, R. L., Durbin, J. and Evans, J. M. 1975. Techniques for Testing the Consistency of Regression Relations over Time, *Journal of the Royal Statistical Society*, 37, 149-192.

Buiter, W. H. 1977. Crowding out and the Effectiveness of Fiscal Policy, *Journal of Public Economics*, Vol. 7, 309-328.

Dickey, D. and Fuller, W. 1979. Distribution of the Estimators for Autoregressive Time Series with a Unit Root, *Journal of the American Statistical Association*, Vol. (74), 427-431.

Dickey, D. and W.A. Fuller. 1981. Likelihood Ratio Statistics for Autoregressive Time Series with Unit Root, *Econometrica*, Vol.49, No.4, Evanston, Illinois, The Econometric Society.

Erenburg, S. and Wohar, M. 1995. Public and Private Investment: Are There Any Causal Linkages? *Journal of Macroeconomics*, 17 (1): 1-30.

Erdal Karagol. 2004. A Disaggregated Analysis of Government Expenditures and Private Investment in Turkey, *Journal of Economic Coorporation*, 25 (2): 131-144.

Evans, P. and Karras, G. 1994. Is Government Capital Productive? Evidence from a Panel of Seven Countries, *Journal of Macroeconomics*, Vol. 16, 271-279.

Ghali, K.H. 1998. Public Investment and Private Capital Formation in a Vector Error-Correction Model of Growth, *Applied Economics*, 30, 837-844.

Greene, J. and Villanueva, D. 1991. Private Investment in Developing Countries: An Empirical Analysis, *IMF Staff Papers*, 38 (1): 33-58.

Halaq, Said and Nader Mrayyan. 2003. Private Investment and Its Impact on Economic Growth in Jordan: An Empirical Study (1975-1996), *Dirasat: Administrative Sciences*, University of Jordan, Vol. 27 (2).

Johansen, S. and Juselius, K. 1990. Maximum Likelihood Estimation and Inference on Cointegration with Application to the Demand for Money, *Oxford Bulletin of Economics and Statistics*, Vol. 52, 169-210.

Kormendi, R.C. 1983. Government Debt, Government Spending and Private Sector Behavior), *American Economic Review*, 73 (5): 995-1010.

Laopodis, N. T. 2001. Effects of Government Spending on Private Investment, *Applied Economics*, 33, 1563-1577.

Maghayerah, Aktham. 1991. Private Investment and Economic Growth in Jordan, Unpublished Thesis, Yarmouk University, Irbid-Jordan.

Monadiemi, M. S. and Hyeonseung, Huh. 1998. Private and Government Investment: A Study of Three OECD Countries, *International Economic Journa*l, 12 (2): 93-104.

Mamatzakis, E.C. 2001. Public Spending and Private Investment, Evidence from Greece, *International Economic Journal*, 15 (4): 33-46.

Munnell, A. H. 1990. Does Public Infrastructure Affect Regional Economic Performance? *New England Economic Review*, 11-32.

Ouattara, Bazoumana. 2004. Modeling the Long Run Determinants of Private Investment in Senegal, *CREDIT*, University of Nottingham.

Pereira, A. M. 2001. On the Effect of Public Investment on Private Investment, What Crowds in What. *Public Finance Review*, 29 (1): 461-472.

Perron, P. 1989. The Great Crash, the Oil Price Shock and the Unit Root Hypothesis, *Econometrica*, Vol.57, No.6, Evanston, Illinois, The Econometric Society.

Quraan, Anwar. 1997. Private and public Investment and Economic Growth in Jordan: An Empirical Analysis, *Abhath Al-Yarmouk* (Hum. and Soc. Sci), Vol.13, No.3.

Ribeiro, M.B. and Joanilio, R.T. 2001. An Econometric Analysis of Private-Sector Investment in Brazil, *CEPAL Review*, 74.

Rossiter, R. 2002. Structural Cointegration Analysis of Private and Public Investment, *International Journal of Business and Economics*, 1(1): 59-67.

Shone, R. 1984. *Issues in Macroeconomics*, Martin Robertson and Company Ltd.

Smyh, D. J. 1994. Inflation and Growth, *Journal of Macroeconomics*, Vol. 16, 261-70.

Stung-wu, Ho. 2001. Analyzing the Crowding-out Problems of Taiwan, *Journal of Economic Development*, Vol. (26), No. 1.

Tatom, J.A. 1991. Public Capital and Private Sector Performance: *Federal Reserve Bank of St. Louis Economic Review*, 3-15.

Vitaliano, Donald. and Mazeya, Y. 1990. The Effect of Servicing the Public Debt on Capital Formulation, *Public Finance, Quarterly*, Vol. 18 (3): 339-359.

تأثير الاستثمار العام في الاستثمار الخاص في الأردن

بشير العبدالرزاق*

ملخص

هذه الدراسة محاولة للبحث في العلاقة السببية بين الاستثمار الحكومي والاستثمار الخاص في الأردن في الفترة 1976-2004. يتمحور سؤال الدراسة حول ما إذا كان الاستثمار الحكومي ذا تأثير إيجابي (مكملا) أم ذا تأثير سلبي (بديلا) في الاستثمار الخاص في الأردن. وقد اعتمدت منهجية الدراسة على استخدام الأساليب الحديثة، مثل تصحيح متجه الخطأ لتحقيق أهدافها. استخدمت الدراسة تحليل جوهانسن-جولياس (1990) المتعدد لتقدير العلاقة على المدى الطويل بين الاستثمار الحكومي والاستثمار الخاص. ولتحديد درجة التكامل للمتغيرات، تم استخدام طريقة ديكي- فولر المعدلة لاختبار جذر الوحدة. أشارت نتائج الاختبارات الإحصائية إلى أن السلاسل الزمنية جميعها كانت غير مستقرة عند المستوى، لكنها أصبحت كذلك عند الفرق الأول، أي انها متكاملة من الدرجة الأولى. اظهر اختبار جوهانسن-جولياس للتكامل المشترك أن المتغيرات متكاملة، وهذا يدل على وجود علاقة توازنية بينها في المدى الطويل، وبناء على هذه النتيجة فإن الدراسة استخدمت نموذج متجه تصحيح الخطأ. وقد استخدمت الدراسة دالة الاستجابة الفورية، وتحليل مكونات التباين لبيان أثر الاستثمار الحكومي في الاستثمار الخاص. جاءت نتائج التحليل مؤيدة لنظرية العلاقة التكاملية بين الاستثمار الحكومي والاستثمار الخاص، أي أن الاستثمار الحكومي يحفز الاستثمار الخاص في الأردن، وهذا بطريقة غير مباشرة يؤدي إلى النمو الاقتصادي في الأردن.

الكلمات الدالة: الاستثمار الحكومي، الاستثمار الخاص، نموذج VAR، تأثير المزاحمة.

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