BOUND COINTEGRATION TEST ON PRIVATE INVESTMENT’S EQUATION: EVIDENCE FROM SAUDI ECONOMY
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Abstract

This paper investigates the long-run equilibrium relationship between the real private and public investment in Saudi Arabia by using ARDL cointegration tests. The finding shows the stable long-run relation between private investment and public investment. The results indicate that the disequilibrium is largely corrected and converges back to the equilibrium in one year and four months, with a speed of adjustment at rate of about 75 per cent a year. This result supports that the Saudi economy is resilient against the shocks.

Key Words: Private Investment, Public Investment, ARDL Cointegration, Saudi Arabia

JEL classification: E22, C22

1. Introduction

Many papers test the effect of public investment on private investment by using an aggregated measure of public investment (public corporate and budget infrastructure investment). In this paper, the effects of total public investment on private investment will be tested in Saudi Arabian economy, where total public investment contains the budget infrastructure investment plus investment of public enterprises. This decomposition is very important to identify the net crowding effects of public investment. Therefore, we assume that there is an adjustment of the equilibrium relationship between public investment and private investment. The government investment policy may motivate private investment, but the investment decision depends upon favorable economic conditions. Based on the demand theory of investment, the hypothesis considered is that the effects of variations in public investment occur in the short and mainly long run (Aschauer 1989; Erenberg 1993; Pereria 2001). To test these effects, the reduced-form private investment function is elaborated assuming a log-linear function. Regarding different order of integration of relevant variables, the appropriate methodology to test the crowding effects and investigate the short and long run relationship is to apply the ARDL cointegration methodology.

This article is organized as follows, in second section the process of investment and economic reform in Saudi Arabia are briefly presented. The third section reviewed the literature and theoretical bases; and the empirical results are presented in fourth section. The fifth section concludes.

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2. Brief of the economic reform in Saudi Arabia

According to governmental plans and strategies in Saudi Arabia, the economic development programs should lead to the expansion of several sectors, notably oil, minerals, agriculture, nutrition and manufacturing industries. The economic strategy adopted is focused on the diversification of the economy sources of income, by having some new income sources from non-oil sectors mainly via the private sector. The government has developed a monitoring system to observe the performance of private sector through the “Supreme Economic Council” (SEC) in 1999 using specific indicators related to the competitiveness in different markets and job opportunities. The government established a “Saudi Arabian General Investment Authority” (SAGIA) in 2000 as a mediator between investors and the government, to organize and support foreign investors (with free capital flows, equal treatment between domestic and foreign investors, the rights to own lands, the abolition of local sponsorship of foreign investors, reducing income taxes on foreign companies and other incentives). Also the Saudi government established different bodies to enhance the private sector participation in the economy.

Since 1989-1990, the available platform of infrastructure in Saudi Arabia could support further economic activities where the private sector would take a major role. The private investment expands the production capacity of the economy and supports long term economic growth. The privatization efforts of government and the role devoted to the private sector have attracted large private investment flows into many sectors. During the period 1989-1998, the share of private investment in GDP tended to increase, while the share of public sector tended to decrease. This tendency exhibits the determination of government to boost the private sector, mainly in non oil activities. Since 1998, the gap between private and public investment becomes more and more reduced, but the share of private investment in GDP remains superior to the share of the public sector (Figure 1 and Table 1).

![Figure 1: Saudi Arabia Private and Public Investment in percent of GDP](image)

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3 These sectors include Telecommunications, Postal Services, Saudi Railway Organization, Saudi Arabian Airlines, Urban Transportation System, Ports Authority, Health Care Sector, Insurance, Energy Sector, Mining Sector and Water & Electricity Sector.
The explanations of this reversion are related to legislative, institutional, cultural and economic factors. Finance, trade and commerce have been traditionally preferred activities by the local investors. The institutional factors via SEC and SAGIA are determinant for the foreign investors, consequently the government focused on initiatives for accelerating local and foreign private investment in many economic and financial activities. To avoid the real exchange rate volatility and their impacts on tradable and non-tradable sectors, the government chooses to have a nominal fixed exchange rate with the US dollar (Saudi Riyal is pegged to US Dollar).

The rise in oil prices on international markets, especially in 2007 with around 72 dollars per barrel, led to the expansion of government and public institutions investments inducing an increase of aggregated demand and hence an economic growth. All types of investment indicate that the share of government & oil sector investment increases, whereas the share of non-oil private sector decreases. The private investment is concentrated in construction and machinery & equipment sectors (Table 1). The weight of capital markets is still far lower than that of the banking sector. The ratio of bank credits to GDP is increased in average during the second half of the 2000s, whereas the bank investment in securities is decreased. Comparatively with developed financial markets, the ratio of debt securities to GDP in Saudi Arabia was still very low (Table 2).

### Table 1: Share of Investment by type of Capital Assets (% of GDP)

<table>
<thead>
<tr>
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</tr>
</thead>
<tbody>
<tr>
<td>All types</td>
<td>20.1</td>
<td>17.8</td>
<td>17.0</td>
<td>16.5</td>
<td>17.5</td>
<td>19.9</td>
<td>17.7</td>
</tr>
<tr>
<td>Government &amp; oil sector</td>
<td>4.3</td>
<td>4.8</td>
<td>7.1</td>
<td>6.5</td>
<td>7.7</td>
<td>10.2</td>
<td>9.3</td>
</tr>
<tr>
<td>Non-oil Private sector</td>
<td>15.8</td>
<td>13.0</td>
<td>9.9</td>
<td>10.0</td>
<td>9.7</td>
<td>9.8</td>
<td>8.4</td>
</tr>
</tbody>
</table>

Note: Author’s calculation-Source: Central Department of Statistics & Information, Ministry of Economy & Planning, 2009.

Public corporations are predominant in securities market, whereas the private sector has in average only 1.2% of bank investments in securities. In addition, government bonds largely exceed treasury bills. The access to capital markets for securities and capitalization should be developed to attract more investors in economic activities.

### 3. The model of investment & ARDL cointegration test

#### 3.1 The model of investment

The demand approach evaluates the effects of demand expectation (accelerator’s principle) and takes into account the theory of irreversible investment with uncertainty.
conditions via the user cost of capital (Jorgenson 1971, 1967). The adjustment costs related to investment depend on the degree of economic stability and the credibility of public policies. The assumption of adjustment costs would appear to be most appropriate for modeling private investment (Dixit & Pindyck 1994). They apply the real option theory to explain the investment irreversibility, and exhibit that the reduction of investment is due to the increasing of uncertainty. The empirical analyses use uncertainty concepts in sector level to test the impacts of uncertainty and irreversibility on investment.

These impacts mainly in manufacturing sector indicate the existence of financial constraints for many investors. These impacts could be taken into account in the macro level by adopting the conventional reduced-form investment equation (Leahy et al. 1996). The theoretical behavior of private investment is explained by the following implicit function:

\[
IPR = f(IPR_-, IPU, IBG, Y^*, CRE, rir) \tag{1}
\]

where the variables IPR, IPU, IBG, Y* and CRE design respectively the private investment, investment of public enterprises, government investment, expected demand and credits to private sector. The variable rir represents real interest rate, which is calculated with

\[
rir_t = \ln\left(\frac{1+r_t}{1+\pi_t}\right)
\]

where \( r_t \) and \( \pi_t \) denote respectively nominal interest rate and inflation rate (Neely & Rapach 2008). The global public investment can have either a negative or a positive effect. If the coefficient is negative it shows substitution effect, whereas if it is positive it indicates complementarities effect (Cruz & Teixeira 1999; Khan & Kumar 1997). Notably the government investment in infrastructure can reduce uncertainty by tumbling costs and raising productivity in the private sector. It is expected that the investment of public enterprises could crowd out the private investment, while the infrastructure investment of government would have positive effect on private sector (Ghassan et al. 2009). Although the net effect of total public investment remains ambiguous, so the result depends on which one of the two effects affects more the private investment. Many empirical studies show the evidence of crowding in and crowding out effects of public investments in developing countries (Atukeren 2005; Erden & Holcombe 2006).

The flexible accelerator model suggests that the private investment is affected positively by expected demand i.e. potential GDP. Also, it has been hypothesized that the private investment is positively related to the growth of real GDP. The effect of credits on private investment is expected to be positive. With financial markets being generally reticent, credit policies generally affect private sector investment via the stock of credits available to firms that have access to preferential interest rates. In the other side, if the real interest rate as a proxy of the user cost of capital has a negative effect, this endows with the theory of Jorgenson (1967). However, a very small value of coefficient would endow with the theory of irreversible investment in conditions of macroeconomic uncertainty. The positive coefficient of lagged private investment reflects the irreversibility of investment.

Based on the above arguments, the long run equation of the private investment, in logarithm form, is assumed to be given by:

\[
ipr_t = \beta_0 ± \beta_1ipu_t + \beta_2ibg_t + \beta_3gdp_t + \beta_4cre_t - \beta_5rir_t + u(2)
\]
where $u_t$ represents the error term which is an indicator for macroeconomic instability. All parameters exhibit elasticities and lead to reliable results. The cointegration is tested with unspecified vector. If the Eq. (2) is stable, that is, cointegrated with appropriate adjustment, the crowding-out effect would be checked (Shafik 1992; Ramirez 2000; Ahmed & Miller 2000; Naqvi 2002; Rossiter 2002).

The assumption considered is that the adjustment will be taken in short and long run following different interconnected processes of crowding, accelerator and cost of capital effects. The adjustment mechanisms can be operated through the central bank, the public investment and the preferences of private sector. The public and private capital could be more or less rigid vis-à-vis the discrepancies and the central bank has different preferences regarding deviations from the long run equilibrium.

3.2 ARDL cointegration test

The most commonly used methods for conducting cointegration test include the residual based on Engle-Granger test with single equation (1987), the maximum likelihood based on Johansen-Juselius (1990) and Johansen test with multivariate VAR model (1991, 1995). The existence of any long-run relation among a vector $z_t = (y_t, x_{1t}, x_{2t})$ of logarithmic variables can be tested by the ARDL or bound testing cointegration procedure. This approach uses the following unrestricted error correction model (ECM) (Pesaran-Shin 1999; Pesaran-Shin-Smith 2001):

$$\Delta z_t = c_0 + \Pi z_{t-1} + \sum_{i=1}^{p-1} \Gamma_i \Delta z_{t-i} + \epsilon_t$$

(3) where $c_0$ is the drift, $\Pi$ and $\Gamma$ contain the long-run multipliers and short-run dynamic coefficients, respectively. The vector of errors is assumed to be identically distributed: $\epsilon_t \sim ID(0; \Omega)$ where $\Omega$ is positive definite.

The main advantage of ARDL modeling lies in its flexibility. Firstly, this procedure does not require the unit root test, so the variables included can have different order on integration. Secondly, the model takes sufficient lags to capture the Data Generating Process (DGP) in General-To-Specific (GETS) modeling approach. Thirdly, the ECM, which integrates short-run dynamics and long-run equilibrium, can be derived from ARDL through a simple linear transformation (Banerjee et al. 1993). Assuming that a unique long-run relationship exists between the variables, the conditional Vector Error Correction Model (VECM) becomes as follows:

$$\Delta y_t = c_{01} + \lambda_1 y_{t-1} + \lambda_2 x_{1t-1} + \lambda_3 x_{2t-1} + \sum_{i=1}^{p} \gamma_{1i} \Delta y_{t-i} + \sum_{i=0}^{q_1} \gamma_{2i} \Delta x_{1t-i} + \sum_{i=0}^{q_2} \gamma_{3i} \Delta x_{2t-i} + u_t$$

(4)

with $|\lambda_1| < 1$. This formulation can be interpreted as an ARDL model. The disturbances $u_t$ are supposed uncorrelated. By construction $\Delta x_t$ are non correlated with $u_t$, and due to the unrestricted nature of the lag distribution of Eq. (4), this equation is identified and will be estimated consistently by least square method. To implement the Bounds Testing Procedure, we have three main steps. For convenience these steps are stated with selecting the order of the VAR (using AIC and BIC criteria):

- The first step is to estimate the Eq. (4) in order to test for the existence of long-run
relationship among specified variables. This test is realized by conducting a standard F-test for the joint significance of the lagged variables in levels:

\[ H_0: \lambda_1 = \lambda_2 = \lambda_3 = 0 \quad \text{against} \quad H_1: \lambda_1 \neq \lambda_2 \neq \lambda_3 \neq 0. \]

When a long-run relationship exists between the variables in Eq. (4), the F-test indicates which variable should be normalized. The normalization gives the statistic \( F_y(y/x) \) where \( y \) is the dependant variable. Following Pesaran et al. (2001), the F test has a non-standard distribution; they provide two asymptotic critical values bounds to testing for cointegration when the explanatory variables are different order of integration I(1), I(0). When the cointegration is confirmed i.e. which involves the stationary of the estimated error \( \epsilon_t \);

- **the second step** is to estimate it as the following conditional ARDL \( (p, q_1, q_2) \)

long-run model:

\[
y_t = \epsilon_{01} + \sum_{i=1}^p \lambda_{i1} y_{t-i} + \sum_{i=0}^{q_1} \lambda_{2i} x_{1,t-i} + \sum_{i=0}^{q_2} \lambda_{3i} x_{2,t-i} + \epsilon_t
\]

\((5)\) This conditional ARDL equation involves selecting the orders of \( p \) and \( q \) using AIC criterion. For the annual data, the maximum number of lags is inferior or equal to 2. The error-correction term \( ecm_{t-1} \) is deduced from the previous long-run cointegrating relationship i.e. Eq. (5);

- **the third and final step** is to obtain the short-run dynamic coefficients from the error correction model (ECM) as following:

\[
\Delta y_t = \mu + \sum_{i=1}^p \phi_{1i} \Delta y_{t-i} + \sum_{i=0}^{q_1} \phi_{2i} \Delta x_{1,t-i} + \sum_{i=0}^{q_2} \phi_{3i} \Delta x_{2,t-i} + \nu ecm_{t-1} + \epsilon_t
\]

\((6)\) where \((\phi_1, \phi_2, \phi_3)\) are the short-run dynamic elasticities and \( \nu \) is the speed of adjustment to the long-run equilibrium.

4. **Data and results**

4.1 **Data and unit root test**

All variables listed below are extracted from the annual reports of Saudi Arabia Monetary Agency (SAMA, report 43, 2007), and the annual data are from 1968 to 2006. The National accounts statistics break down the Gross Fixed Capital Formation (GFCF) as a measure of investment into its private (denoted IPR) and public sector (denoted IPU) components (Figure 1) and each component includes local and foreign investment. The public investment contains investment by state-owned enterprises with several organizational forms. The total public investment (consolidated public investment) can be determined by including the investment of the public enterprises (National accounts) and the government investment (Budget Government) i.e. infrastructure and productive investment (denoted IBG).

\[^4\] A lower value of F-statistic assumes that the variable is I(0) and its upper value supposes that the variable is I(1). If the F-statistic is above the upper critical value, then the null hypothesis of no cointegration could be rejected. In revenge, this null hypothesis could be accepted if the F-statistic is below the lower critical value.
The Data of real GDP have been calculated straightforwardly by using implicit deflator of GDP (base 1999), obtained from the Saudi Arabia Monetary Agency (2007). To avoid the influences of inflation, all data comprised the interest rate are taken in real terms in constant 1999 prices with the appropriate deflators and they are not seasonally adjusted.

To test the order of integration of variables, standard tests for unit root such as the Augmented Dickey-Fuller (ADF) and the Phillips-Perron (PP) tests are often used. However, these tests are not generally reliable in small samples, because of their poor size and power properties i.e. they tend to over-reject the null hypothesis when it is true and under-reject it when it is false, respectively (Harris & Sollis 2003). The Dickey-Fuller Generalized Least Square (DF-GLS) de-trending test proposed by Elliott et al. (1996) and the Ng-Perron test following Ng & Perron (2001) have been proposed to address these problems and also the problem of sensitivity of unit root testing to choice of lag. They propose a new information criterion, the modified information criteria (MIC). The distinction between the MIC and the standard information criteria such as the Akaike and the Schwartz Bayesian criteria is that the former takes into account the fact that the bias in the sum of the autoregressive coefficients is highly dependent on the number of lags. Table 1 displays the results of unit root tests for the null hypothesis I(1) and ADF-GLS is the Ng & Perron’s test (2001). The lag order is chosen by employing the data dependent method, denoted by t-sig, to check for possible size distortions for ADF-type tests, proposed by Ng & Perron (1995). We set the maximum lag $k_{max} = 5$. The plot of the variables over time indicates the presence of trend in the variables (mostly in cre).

Table 3A: Unit root tests with constant and trend

<table>
<thead>
<tr>
<th></th>
<th>ipr</th>
<th>ipu</th>
<th>ibg</th>
<th>gdp</th>
<th>cre</th>
<th>rir</th>
</tr>
</thead>
<tbody>
<tr>
<td>ADF</td>
<td>-1.526</td>
<td>-1.458</td>
<td>-1.547</td>
<td>-2.266</td>
<td>-1.558</td>
<td>-2.002</td>
</tr>
<tr>
<td>GLS</td>
<td>-2.887</td>
<td>-2.194</td>
<td>-2.908</td>
<td>-6.796</td>
<td>-4.026</td>
<td>-6.568</td>
</tr>
</tbody>
</table>

Table 3B: Unit root tests with only constant

<table>
<thead>
<tr>
<th></th>
<th>Δipr</th>
<th>Δipu</th>
<th>Δibg</th>
<th>Δgdp</th>
<th>Δcre</th>
<th>Δrir</th>
</tr>
</thead>
<tbody>
<tr>
<td>ADF</td>
<td>-4.249*</td>
<td>-1.780*</td>
<td>-2.211*</td>
<td>-2.065*</td>
<td>-4.209**</td>
<td>-3.113**</td>
</tr>
</tbody>
</table>

Note: ipr, ipu, ibg, gdp, cre and rir denote in logarithm real private investment, investment of public enterprises, State budget investment, gross disposable product, credits to private sector and real interest rate, respectively.

5 T-sig selects the lag order $k$ via top-down testing. More accurately, the equation with the maximum lag (here, the max lag is 5) is estimated. We use the lag length if the absolute t-statistic of the parameters of the maximum lag is larger than 1.65 i.e. significant. If the t-statistic in the maximum lag is smaller than 1.65 i.e. not significant, we estimate the equation with the lag = $k_{max} - 1$. That is, when the absolute t-statistic of the parameter of the lag = $k_{max} - q$ is significant at a conventional level, we employ the lag length.

6 In all Tables of results †, *, ** indicate significance at the 10, 5 and 1 percent, respectively. The AIC has better theoretical and empirical properties. In the ADF-GLS test: one-sided (lower-tail) test of the null
The results indicate that the computed t-statistics are superior than the critical values i.e. the null hypothesis can’t be rejected. Since neither level of variables are significant at a 1%, the results from Table 3A show that these variables have a unit root process. The two tests on the first difference of the variables show that the null hypothesis can be rejected mainly for $\Delta ipr$, $\Delta cre$ and $\Delta rir$ variables. The ADF-GLS test confirms that the variables are I(1), but the modified Phillips-Perron test shows mix I(1) and I(0) variables. These unit root results have significant implications for the cointegration analysis type.

4.2 Cointegration tests
The existence of the long-run equilibrium relationship, between private and public investment, is tested. If this equilibrium relationship holds, it would imply that economic policies can influence fluctuations in private investment and the flows of credits to private sector. The Saudi economy is characterized by oil revenues as major resources of national income and its dependence on the international oil market. Therefore the economic and financial authorities have strategic policies to boost the private sector.

Table 3C illustrates the results of cointegration tests. The equation of private investment and the visualizing data do support constant and trend components. Hence, each cointegration test includes constant and trend as deterministic components. For the estimation of $e_i$ (from Eq. 4), the lag order is chosen by AIC and t-sig.

| Table 3C: Cointegration tests (dependent variable: ipr)\(^7\) |
|-----------------|-----------------|-----------------|-----------------|
|                 | EG              | PR=EG\(^{GLS}\) |
| AIC             | t-sig           | AIC             | t-sig           |
| $\rho$          | -0.0758         | -0.0708         | -0.5043\(^*\)  | -0.6769\(^*\)  |
| $\tau_\rho$     | (-1.513)        | (-1.515)        | (-3.015)        | (-3.123)        |

Note: EG and PR denote Engle & Granger’s (1987) and Perron & Rodriguez’s (2001) methods assume a linear adjustment.

From two first columns of Table 3C, the null hypothesis of no cointegration using the ADF cointegration test cannot be rejected. Thus, there is no evidence of cointegration at the 5% or 1% significance level according to the conventional Engle & Granger (1987) ADF test. Also, we employ the Perron & Rodriguez (2001) cointegration tests with good size and power. The null hypothesis of no cointegration is hypothesis that the variable is non-stationary: at 1, 5 and 10 percent asymptotic critical values equal -3.46, -2.91 and -2.59, respectively when the model includes a constant and trend ; and equal -2.58, -1.98 and -1.62, respectively when the model includes only a constant (Rapach & Weber, 2004). For the Modified Phillips-Perron test: one-sided (lower-tail) test of the null hypothesis that the variable is non-stationary; at 1, 5 and 10 percent asymptotic critical values equal -19.95, -17.30 and -11.16, respectively when the model includes a constant and trend; and equal -13.80, -8.10 and -5.70, respectively when the model includes only a constant (Ng & Perron 2001).\(^7\)

In the EG’s test: one-sided (lower-tail) test of the null hypothesis that the variables are not cointegrated; at the 1, 5 and 10 percent levels asymptotic critical values equal -4.02, -3.40 and -3.09, respectively (Rapach & Weber 2004). In the PR’s test: one-sided (lower-tail) test of the null hypothesis that the variables are not cointegrated; at the 1, 5 and 10 percent levels asymptotic critical values equal -3.33, -2.76 and -2.47, respectively (Perron & Rodriguez 2001).\(^7\)
rejected at 5 percent level. From the standard cointegration test, there is no evidence of a plausible cointegrating relationship between the private and the public investment. The contrast between the results in Table 3C suggests that the rejections using EG test entail a Type II error. To investigate empirically the cointegration between endogenous variables which are integrated of order one, the standard Johansen approach is implemented. In the ARDL’s approach the variables can be I(1) or I(0).

The bound cointegration test is based on F-statistic, the distribution of this test statistic under the null hypothesis depends on the order of integration of variables in Eq. (4) and on the choice of the lag order $p$. If all variables are I(0), the asymptotic critical value at 1% is 3.41. If all variables are I(1), the critical value is 4.68. For cases in which some series are I(0) and others are I(1), the critical value falls in the interval [3.41; 4.68] (Pesaran et al. 2001, Table CI.iii). As tabulated in Table 4, the Bounds test cointegration approach reject clearly, at 1% significance level, the null hypothesis of no cointegration particularly for the private investment equation. This result implies long-run cointegration relationships amongst the variables when the regressions are normalized on $ipr$ and $gdp$ variables.

<table>
<thead>
<tr>
<th>Table 4: Bounds cointegration tests from Eq. (4)</th>
</tr>
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<tbody>
<tr>
<td>$F$ (.X)</td>
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</table>

Note: The asymptotic critical value bounds are Min $F=3.41$ & Max $F=4.68$ and Min $F=2.62$ & Max $F=3.79$ at 1% and 5%, respectively (Table C1.iii: unrestricted intercept and no trend, Pesaran et al. 2001). When the regression contains I(0) and I(1) series, the critical value at 5% falls in the interval [2.62, 3.79]. For the $gdp$ equation, the value of $F$ falls within the 0.05 bounds, then the test result is inconclusive; the same result is reached for $p=3$.

The results of diagnostic test show that the models have no serial correlation and no heteroskedasticity, except for $rir$ model. The ARDL model appears to be robust against specification form, except for $rir$ model. All models accept the null hypothesis of a normality distribution, except the main model $ipr$ which has light leptokurtic distribution (Kurtosis=4.3). This can be attributed to a relative jump component in the error term, which reflects news, events or information released by government policy or the strategies of private firms (Table 5). The existence of a long-run cointegration relationship allows to estimate the Eq. (5) using the ARDL(1,0,0,1,2,1) specification. The results are reported in Table 6.

<table>
<thead>
<tr>
<th>Table 5: Diagnostic Tests for Bounds cointegration tests (Eq. 4)</th>
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<tbody>
<tr>
<td><strong>LM</strong></td>
</tr>
<tr>
<td><strong>WH</strong></td>
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<tr>
<td><strong>JB</strong></td>
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<tr>
<td><strong>FF</strong></td>
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</tbody>
</table>
Note: Parentheses show the P-Value of tests. The diagnostic tests for ARDL model concern the following tests: Lagrange Multiplier (LM) for the null hypothesis \(H_0\) of no residual serial correlation, White Heteroscedasticity (WH) for \(H_0\) of no residual heteroskedasticity, Jarque-Bera (JB) for \(H_0\) of residual normality and Ramsey’s RESET (FF) for \(H_0\) of no stable specification or no Functional Form misspecification. In the LM test, the lag length is 2 according to AIC for all variables except for \(ipu\), lag=3.

Table 6: ARDL long-run estimation of \(LIPR\) (Eq. 5)

<table>
<thead>
<tr>
<th></th>
<th>(ipu)</th>
<th>ibg</th>
<th>gdp</th>
<th>cre</th>
<th>rir</th>
<th>d74</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coefficient</td>
<td>-17.385</td>
<td>-0.913</td>
<td>0.421</td>
<td>2.773</td>
<td>-0.241</td>
<td>-1.999</td>
</tr>
<tr>
<td>Std. Error</td>
<td>1.83</td>
<td>0.09</td>
<td>0.06</td>
<td>0.23</td>
<td>0.06</td>
<td>0.30</td>
</tr>
<tr>
<td>Prob.</td>
<td>0.0004</td>
<td>0.0005</td>
<td>0.01</td>
<td>0.0000</td>
<td>0.13</td>
<td>0.009</td>
</tr>
</tbody>
</table>

Note: The shift in the trend occurring at 1974⁸ accounts for the existence of structural break. This is an impulse dummy variable which is introduced in the model to avoid a broken linear trend in the level of private investment. Not knowing other structural break point, the CUSUM tests can be used to test for parameter stability. The null hypothesis that all coefficients are stable can be accepted because the CUSUM and CUSUMSQ stays within the 5 percent critical bound (Figure 3).

The findings indicate that investment of public enterprises affects negatively and significantly the private investment, whereas the infrastructure investment of government improves the efforts of private investment. Thus, the net result shows that the total public investment crowds out the private investment in the Saudi economy. The crowding-out effect seems to be verified in the Saudi economy. So the increase of investment in public sector reduces the opportunities of investment in the private sector, even if there is no constraint in capital markets. While it seems that the government expenditure on infrastructure encourages private investment demand. These results invalidate the findings of Looney (1992, 1995), which indicates that there is no crowding effect between government and private investment. The studies of Looney are based on data over the period 1960-1992 where the share of private sector in total investment was relatively limited. From 1992, the private investors appear to be more sensitive to long run and potential economic conditions in all markets. The government measures constitute the major causes to boost and promote the initiatives in private sector.

The long-run net elasticity of crowding-out is nearly to \(-0.492\) (Table 6). Also the private investment is affected positively and significantly by the real income, as the theory of accelerator predicts. It seems that the crowding out effect is moderated by the facts that government spending expands the market for private sector products through the multiplier-accelerator mechanism, and hence stimulates the private investment.

Furthermore, the credits to private sector have a negative coefficient but no significant at 5% level. Initially the loans policy of banks must play a determinant role to support the efforts of private investment. It does not appear in the long-run that credit flows are an obstacle to the private investment projects. Also it does not represent clearly a positive role in financial accelerating investment (Bernanke et al.

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⁸ The year 1974 is marked by unexpected growth of oil revenues (more than 13 times comparatively to the year 1971). This impulse modified the entire system of the Saudi economy and permitted to the non-oil sectors a greater participation in economic growth.
But the real interest rate of bank seems to be a barrier and strong constraint to the private sector projects. The capital markets still play a limited role in being an alternative source of funds for the private sector. In fact, the investment in private securities in 2006 represented only 11.3% of the investment in Government securities, this rate fallen down to 10.4% in 2008. Accordingly, the crowding out effect is expected to be more accentuated due to the volatility of oil prices and the huge public investment program in infrastructure and public enterprises (Table 1).

These observations reflect the limited role of the banking sector, and require the development of financial markets to allowing more liquidity for investors through the new and appropriated financial instruments, especially in line with Islamic rules. Such financial policy permits to avoid severe financial crises by reducing moral hazard.

Table 7: ARDL(1,0,0,1,2,1) Error Correction Model of \( LIPR \) (Eq. 6)

<table>
<thead>
<tr>
<th>Coefficient</th>
<th>1</th>
<th>dipr(-1)</th>
<th>dipu</th>
<th>dibg</th>
<th>dgdpt(-1)</th>
<th>dcre(-2)</th>
<th>drir(-1)</th>
<th>d74</th>
<th>ecm(-1)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coefficient</td>
<td>0.029</td>
<td>0.247</td>
<td>-0.347</td>
<td>0.138</td>
<td>1.187</td>
<td>-0.232</td>
<td>-1.029</td>
<td>0.743</td>
<td>-0.744</td>
</tr>
<tr>
<td>Std. Error</td>
<td>0.02</td>
<td>0.11</td>
<td>0.09</td>
<td>0.07</td>
<td>0.39</td>
<td>0.13</td>
<td>0.42</td>
<td>0.12</td>
<td>0.23</td>
</tr>
<tr>
<td>Prob.</td>
<td>0.26</td>
<td>0.04</td>
<td>0.0007</td>
<td>0.05</td>
<td>0.005</td>
<td>0.07</td>
<td>0.02</td>
<td>0.000</td>
<td>0.003 (^9)</td>
</tr>
</tbody>
</table>

Note of Table 7: Adjusted \( R^2 = 0.793 \), Standard Error of Regression=0.103, Log Likelihood=35.76, \( F \text{ (SC)}_1=0.667[0.42], F \text{ (WH)}=1.097[0.41], \chi^2_N (2) = 0.960 \) \([0.62], F \text{ (FF)}_2=0.723[0.49]; F \text{ (SC)}_1, F \text{ (WH)} \) and \( F \text{ (FF)}_2 \) denote Fisher Statistics to test for no residual serial correlation, no residual heteroskedasticity and no functional form misspecification respectively. \( \chi^2_N (2) \) denotes Chi-square Statistic for residual normality; all with p-values given in [.].

The results indicate the absence of any instability of the coefficients of ECM, there is strong evidence in favor of parameter constancy over the sample period. Figure 3 evidently exhibits that recursive estimation of the conditional ECM and the associated cumulative sum and cumulative sum of squares plots lie within the 5 per cent critical bound.

Figure 2: Plot of CUSUM & CUSUMSQ of Recursive Residuals from Eq. (6)

\(^9\) The equilibrium correction coefficient is highly large and seems to be significant, but the t-ratio reported does not have the standard t-distribution (Pesaran et al. 2001, theorem 3.2).
The coefficient of error correction term is highly significant and indicates that the disequilibrium, due to a shock, is widely corrected and converges back to the equilibrium in one year and four months with a high speed of adjustment at rate of about 75% a year. The deviation from the equilibrium would be corrected either by private investment or by public investment processes. As for the long term, the net result shows that the public investment crowds out private investment in the short-run, which the net elasticity of crowding-out is slightly higher than 0.209. The short-run accelerator plays also an important role in getting investors for productive projects, and its elasticity's value is close to 1.19.

Furthermore, the inertia factor shows very slow evolution of private investment so the self-adjustment in efforts of investment attains only nearly a quarter. In the short-term the real interest rate of bank is a hard negative constraint to the private investment. Also, the credits to private sector have a negative and significant coefficient at 7% level. Thus, in the short-run a raise in this variable will not increase the private investment as the theory predicts. One explanation is that the institution environment surrounding of its private sector is characterised by a lack of strong business. It seems that the private sector prefers habitual projects and does not storm new various projects especially in perspective to elaborate some substitution of imports. Also, there is widespread agreement that the banking system seems to be in contradiction with the Islamic jurisprudence of finance and banking which is based on risk-return, thus eliminating the system of finance investment by debt (Chapra 2007).

5. Conclusions
This paper founds evidence that private investment, public investment, GDP, credits to private sector and real interest rate are bound together in the long run. The net result of crowd effects shows that the investment of public enterprises crowds out the private investment in short and long-run. The real interest rate of bank seems to be a strong constraint to the private sector projects. The finding indicates that the disequilibrium due to a shock is completely corrected and converges back to the equilibrium in one year and four months with a high speed of adjustment at rate of about 75 per cent a year. This result corroborates that the Saudi economy as an oil-exporter country is strength against the shocks and mostly negative ones.

The main policy conclusions that may be inferred from these results are: firstly the infrastructure financed by government budget is a useful channel to boost private sector in Saudi Arabia. Secondly, the real interest rate discourages largely the private investments efforts in short and long term. Thirdly, given the negative effects of external shocks, the private sector must be assisted to sustain and expand its contribution to the economic growth. The credit channel and infrastructure finance could be extended by taking into account the Islamic finance products to boost the private investment projects. The private investor would have a predominant role in the economy. Extensions of this work could be considered by testing the weak exogeneity of the bound cointegration equation, this test would improve the statistic quality of

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10 The PLS system (Profit-and-Loss Sharing, PLS) in Islamic finance should, in its ideal form, help raise substantially the share of equity in businesses and of PLS i.e. risk-sharing in projects and ventures through the *mudarabah* and *musharakah* modes of financing. The PLS modes are to avoid debt-financing and use partnership and equity-financing, similar to venture capitalism system.
short and long run parameters.

References


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