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AN EMPIRICAL INVESTIGATION

Garikai Makuyana

Nicholas M. Odhiambo

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Garikai Makuyana
Department of Economics
University of South Africa
P. O. Box 392, UNISA
0003, Pretoria
South Africa
Email: grkmakuyana@gmail.com/
49956876@mylife.unisa.ac.za

Nicholas M. Odhiambo
Department of Economics
University of South Africa
P. O. Box 392, UNISA
0003, Pretoria
South Africa
Email: odhianm@unisa.ac.za /
nmbaya99@yahoo.com

PUBLIC AND PRIVATE INVESTMENT AND ECONOMIC GROWTH IN SOUTH AFRICA: AN EMPIRICAL INVESTIGATION

Garikai Makuyana[1] and Nicholas M. Odhiambo

Abstract

This paper examines the relative impact of public and private investment on economic growth in South Africa during the period from 1970 to 2014. The paper also estimates the crowding effect between the two components of investment in the study country. Applying the recently developed Autoregressive Distributed Lag (ARDL)-bounds testing approach, the study finds that private investment has a positive impact on economic growth both in the long run and short run, while public investment has a negative effect on economic growth in the long run. Further, in the long run, gross public investment is found to crowd out private investment, while its infrastructural component is found to crowd in private investment. The results of the study also reveal that both gross public investment and infrastructural public investment crowd out private investment in the short run. Overall, the study finds private investment to be more important than public investment in the South African economic growth process and that the importance of infrastructural public investment in stimulating private investment in the long run cannot be over-emphasised.

Key Words: South Africa; Public Investment; Private Investment; Economic Growth; Crowding Effect

JEL Classification Codes: E22, O47, P12

[1] Corresponding author: Garikai Makuyana, Department of Economics, University of South Africa (UNISA). Email address: grkmakuyana@gmail.com/49956876@mylife.unisa.ac.za

1. Introduction

While economists and policymakers generally agree that investment is important to the economic growth process, it is still open to debate over which type of investment is more important for driving economic growth and whether the two types of investment crowd in or crowd out each other. Ongoing discussions are mainly centred on the ideal combination of public and private investment that can best grow an economy. An extensive body of empirical studies on the subject has focused on two main issues. The first issue centres on the indirect contribution of public investment to economic growth through its crowding effect on private investment. The second is whether public investment contributes more to economic progress than does the equivalent private investment.

Empirical evidence from previous studies on the above raised concerns is varied and sometimes conflicting. For example, Aschauer (1989) reported that non-military public investment promoted private investment and significantly contributed to USA economic growth. This is in contrast to the empirical findings by Ghali (1998), who reported the crowding out of public investment on private investment in the Tunisian economy. Existing empirical studies on developing countries, including South Africa, are scanty and inconclusive.

Therefore, the main objective of this paper is to empirically examine the relative contribution of public and private investment to economic growth and to estimate the crowding effect of public investment on private investment in South Africa. The paper uses the recently developed ARDL bounds testing approach in exploring the long-run and short-run impact of these two components of investment on economic growth.

The contribution of the paper to the debate on investment and economic growth in South Africa is threefold. Firstly, it divides investment into public and private component and empirically examines their individual contribution to economic growth. Secondly, the paper empirically examines whether public investment and private investment crowd each other in or out. Thirdly, unlike the previous panel analysis based studies, the paper uses the time series approach, which takes into account country-specific effects. The remaining part of the paper is structured as follows: Section 2 briefly discusses the dynamics of investment and economic growth in South Africa from 1970 to 2014. A review of the theoretical and empirical literature follows in Section 3, while the methodology and empirical analysis are presented in Section 4. Lastly, Section 5 concludes the paper.

2. An Overview of Investment and Economic Growth Trends in South Africa

During the apartheid period in South Africa before 1994, the economy was sustained by high public investment in physical infrastructure. Initially, to support an economy based on mining, agriculture, railways and ports, construction became important. Later, a number of state enterprises were formed in order to add value to available natural resources. These included Eskom and Sasol in the energy sector and Iscor in the manufacturing sector (Department of Public Enterprise (DPE), 2012). Cumulatively, this resulted in the creation of a strong state economic management system during the apartheid years.

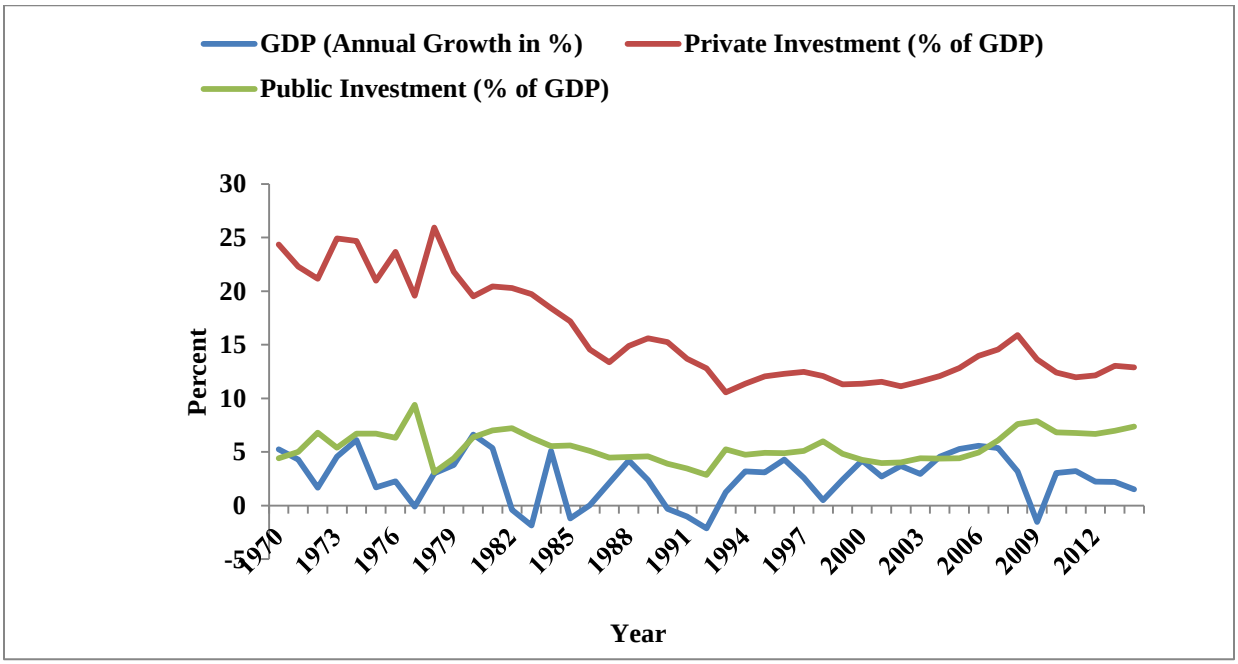
Nevertheless, private investment during the period grew to unprecedented levels, especially in the 1960s and 1970s, taking advantage of the presence of public investment in core infrastructure. Growth in private investment also benefited from growing domestic absorption as

a result of the inward-looking economic policy adopted by the apartheid government. However, a limit to this buoyant growth was reached at the height of the international economic isolation of the regime (Clark, 1994). Partly for this reason, coupled with the growing inefficiency of state enterprises, the government initiated neoclassical economic policies which were centred on privatisation.

In 1994, the new government initiated a privatization programme, as enshrined in the Reconstruction and Development Programme (RDP) in 1994 and the Growth, Employment and Redistribution (GEAR) strategy in 1996. The privatisation programme later focused on the four largest state enterprises – Eskom for energy, Denel for defence, Telkom for communications and Transnet for transport. As a result, private investment grew sharply from its low in 1994 to economic dominance in 2004 (DPE, 2012). To sustain the market economy adopted, state enterprises were once again repositioned to provide the necessary physical infrastructure. This also aimed to absorb labour in the spirit of the creation of a developmental agenda and to address market failure (DPE, 2012).

The economic growth strategies, among others the Accelerated and Shared Growth Initiative for South Africa (ASGISA), the New Growth Path Framework and the National Development Plan 2030, also underscored the need for a concurrent growth in public investment in sectors such as communications, water, energy, transport, health and education (The Presidency, 2006; Republic of South Africa, 2010; National Planning Commission, 2011). This economic philosophy has been credited with the growth in private sector business and high economic growth rate in South Africa. Figure 1 presents a summary of public and private investment and economic growth trends in response to the various economic policies implemented.

Figure 1: Trends in Public and Private Investment and Economic Growth in South Africa (1970 - 2014)



Source: World Bank (2015)

As can be seen in Figure 1, private investment growth maintained economic dominance from 1970 to 2014. The growth in private investment benefited especially from the high infrastructural public investment that was initiated before 1970. The economic growth rates, however, oscillated between -2% and 5% during the 1970 to 2014 period (DPE, 2012; World Bank, 2015).

3. Literature Review

Studies on the relative importance of public and private investment to economic growth have generally been centred on the effect that public investment has on private investment. Theoretically, public investment can stimulate private investment growth when it is confined to the provision of core infrastructure such as water, communications, health, energy, transport and education (Berndt and Hanson, 1992). The justification for public investment in such projects is

that they are typically lumpy, they have widespread positive externalities and they do not compete with the private sector as the private sector cannot undertake such investment to the same degree (Nazmi and Ramirez, 1997). Public investment can also retard private investment growth and slow down economic growth if: (i) it is debt financed, which crowds out the potentially more efficient private sector projects; (ii) it produces goods that pose direct competition with the private sector when is it established that the latter is more productive; and (iii) it is undertaken by state enterprises that are inefficient and are heavily subsidised by the state (Devarajan *et al*., 1996).

Thus, the effect of public investment on private investment and its resultant impact on economic growth is uncertain and can only be empirically determined. Yet economists and policymakers are generally in agreement that private investment is more efficient than public investment in the economic growth process. This consensus rests on the early empirical study by Khan and Reinhart (1989), which reported the superiority of private investment over public investment for a sample of 24 developing countries. Follow up studies also concurred with the findings. For instance, Khan and Kumar (1997) re-examined the relative contribution of public and private investment with an expanded sample of 95 developing countries. Their findings confirmed the earlier results from Khan and Reinhart (1989), who found that while both components of investment are crucial to economic growth, private investment contributes more. Several other studies also reported similar results (see, among others, Odedokun, 1997; Beddies, 1999; Zou, 2006; Phetsavong and Ichihashi, 2012).

However, some empirical studies reported evidence to the contrary (Crowder and Himarios, 1997; Mallick, 2002; Belloc and Vertova, 2004; Bèdia 2007). For example, Belloc and Vertova

(2004) found that public investment is more important than private investment in the economic growth process of selected highly indebted poor countries (HIPCs). The findings were justified by the physical infrastructural gap between low income countries and developed economies.

The empirical evidence on the crowding effect of private investment also varied across economies. Studies reporting the crowding in effect of public investment on private investment are quite extensive (Munnell, 1990; Cullison, 1993; Odedokun, 1997; Sahoo *at el*., 2010; Erden and Holcombe, 2005). In particular, Odedokun (1997) found infrastructural public investment to have a stimulating effect on private investment growth in developing countries. This was also consistent with the findings by Sahoo *at el*. (2010), who reported that high Chinese economic growth rates were achieved against a backdrop of high public investment in core physical infrastructure, which promoted the growth of private investment.

Yet there are also some economies where public investment has been less beneficial to economic growth as it has had a crowding out effect on private investment (Evans and Karras, 1994; Nazmi and Ramirez, 1997; Odedokun, 1997; Ghali, 1998). In the case of Ghali (1998), public investment retarded economic growth in Tunisia since it was undertaken by the inefficient and state subsidised parastatals in various sectors of the economy.

4. Methodology and Empirical Analysis

4.1. Cointegration-ARDL Bounds Testing Procedure

In this study, the newly proposed ARDL bounds testing procedure introduced by Pesaran and Shin (1999) and later popularised by Pesaran *at el*. (2001) is used to examine the relative contribution of public and private investment on economic growth in South Africa. The approach

has several advantages over the traditional cointegration procedures such as the residual-based approach by Engle and Granger (1987) and the full maximum likelihood approach by Johansen and Juselius (1990). Firstly, the variables of interest are not restricted to being integrated of the same order – a mixture of the order of integration up to a maximum of 1 can be employed. Secondly, unlike the traditional cointegration approaches that are sensitive to sample size, the ARDL procedure can be applied even when dealing with small samples. Thirdly, the ARDL procedure can determine a long-run relationship using a reduced form equation, unlike the traditional cointegration procedures which use a system of equations (Shrestha and Chrowdhury, 2007). Lastly, the ARDL procedure gives valid t-statistics and unbiased long-run estimates (Pesaran and Shin, 1999; Odhiambo, 2008).

4.2. Relative Contribution of Public and Private Investment to Economic Growth

This study uses the empirical model based on Khan and Reinhart (1989), Nazmi and Ramirez (1997), Odedokun (1997) and Phetsvavong and Ichihash (2012), among others, to explore the relative impact of public and private investment on economic growth in South Africa. The ARDL expression of the model (Model 1) in this study is as follows:

Model 1

$$\Delta EGRO_t = \alpha_0 + \sum_{i=1}^{n} \alpha_{1i} \Delta EGRO_{t-i} + \sum_{i=0}^{n} \alpha_{2i} \Delta GI_{t-i} + \sum_{i=0}^{n} \alpha_{3i} \Delta PI_{t-i} + \sum_{i=0}^{n} \alpha_{4i} \Delta LBR_{t-i} + \sum_{i=0}^{n} \alpha_{5i} \Delta CRED_{t-i} + \sum_{i=0}^{n} \alpha_{6i} \Delta TOT_{t-i} + \beta_1 EGRO_{t-1} + \beta_2 GI_{t-1} + \beta_3 PI_{t-1} + \beta_4 LBR_{t-1} + \beta_5 CRED_{t-1} + \beta_6 TOT_{t-1} + \mu_t \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (1)$$

Where EGRO, the dependent variable, is economic progress; GI is public investment; PI is private investment; LBR is labour; CRED is private sector credit; TOT is the terms of trade; α_0 is the intercept; $\alpha_1 - \alpha_6$ and $\beta_1 - \beta_6$ are short-run and long-run elasticities of output with respect to above identified variables; μ_t is the error term; Δ is the difference operator; and *n* is the lag length.

The error correction model based on Model 1 is expressed as follows:

$$\Delta EGRO_t = \alpha_0 + \sum_{i=1}^{n} \alpha_{1i} \Delta EGRO_{t-i} + \sum_{i=0}^{n} \alpha_{2i} \Delta GI_{t-i} + \sum_{i=0}^{n} \alpha_{3i} \Delta PI_{t-i} + \sum_{i=0}^{n} \alpha_{4i} \Delta LBR_{t-i} + \sum_{i=0}^{n} \alpha_{5i} \Delta CRED_{t-i} + \sum_{i=0}^{n} \alpha_{6i} \Delta TOT_{t-i} + \varphi_1 ECM_{t-1} + \mu_t \ldots\ldots\ldots\ldots\ldots (2)$$

Where φ_1 is the coefficient of the *ECM*; ECM_{t-1} is the error correction term lagged by one period; and the other variables are defined as in equation (1).

4.3. The Crowding Effect of Public Investment on Private Investment

While the impact of public and private investment on economic growth can be estimated as in Model 1, it is also important to determine the public investment's indirect contribution to economic growth through its effect on private investment. Firstly, estimating the crowding effect of public investment on private investment addresses the potential simultaneous bias in estimation since private investment is an endogenous variable. Previous studies such as Bedia (2007) are prone to such bias. Secondly, estimates of the crowding effect of public investment have important policy implications. For instance, if the two components of investment have an

identical contribution to economic growth when the crowding out relationship between them is determined, a market economy can be prescribed.

In estimating the crowding effect of public investment, this study follows the approach of Blejer and Khan (1984) and later Odedokun (1997). Three separate private investment models are estimated where gross public investment, infrastructural public investment and non-infrastructural public investment would each enter separately as independent variables, one at a time. The private investment models in the ARDL are expressed as follows:

Model 2: Private Investment and Gross Public Investment

$$\begin{aligned}\Delta PI_t = \alpha_0 &+ \sum_{i=0}^{n} \alpha_{1i} \Delta GI_{t-i} + \sum_{i=0}^{n} \alpha_{2i} \Delta INFL_{t-i} + \sum_{i=0}^{n} \alpha_{3i} \Delta EGRO_{t-i} \\ &+ \sum_{i=0}^{n} \alpha_{4i} \Delta CRED_{t-i} + \sum_{i=0}^{n} \alpha_{5i} \Delta TOT_{t-i} + \sum_{i=1}^{n} \alpha_{6i} \Delta PI_{t-i} + \beta_1 GI_{t-1} \\ &+ \beta_2 INFL_{t-1} + \beta_3 EGRO_{t-1} + \beta_4 CRED_{t-1} + \beta_5 TOT_{t-1} + \beta_6 PI_{t-1} \\ &+ \varepsilon_{1t} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots. (3)\end{aligned}$$

Model 3: Private Investment and Infrastructural Public Investment

$$\begin{aligned}\Delta PI_t = \alpha_0 &+ \sum_{i=0}^{n} \alpha_{1i} \Delta INFRA_{t-i} + \sum_{i=0}^{n} \alpha_{2i} \Delta INFL_{t-i} \\ &+ \sum_{i=0}^{n} \alpha_{3i} \Delta EGRO_{t-i} + \sum_{i=0}^{n} \alpha_{4i} \Delta CRED_{t-i} + \sum_{i=0}^{n} \alpha_{5i} \Delta TOT_{t-i} \\ &+ \sum_{i=1}^{n} \alpha_{6i} \Delta PI_{t-i} + \beta_1 INFRA_{t-1} + \beta_2 INFL_{t-1} + \beta_3 EGRO_{t-1} \\ &+ \beta_4 CRED_{t-1} + \beta_5 TOT_{t-1} + \beta_6 PI_{t-1} + \varepsilon_{2t} \ldots\ldots\ldots\ldots\ldots. (4)\end{aligned}$$

Model 4: Private Investment and Non-Infrastructural Public Investment

$$\Delta PI_t = \alpha_0 + \sum_{i=0}^{n} \alpha_{1i} \Delta NONINFRA_{t-i} + \sum_{i=0}^{n} \alpha_{2i} \Delta INFL_{t-i} + \sum_{i=0}^{n} \alpha_{3i} \Delta EGRO_{t-i} + \sum_{i=0}^{n} \alpha_{4i} \Delta CRED_{t-i} + \sum_{i=0}^{n} \alpha_{5i} \Delta TOT_{t-i} + \sum_{i=1}^{n} \alpha_{6i} \Delta PI_{t-i} + \beta_1 NONINFRA_{t-1} + \beta_2 INFL_{t-1} + \beta_3 EGRO_{t-1} + \beta_4 CRED_{t-1} + \beta_5 TOT_{t-1} + \beta_6 PI_{t-1} + \varepsilon_{3t} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (5)$$

Where PI is private investment; GI is public investment; INFL is the inflation rate; EGRO is economic progress; CRED is private sector credit; TOT is the terms of trade; INFRA and NONINFRA are infrastructural and non-infrastructural public investment, respectively; α_0 is the constant; Δ is the difference operator; $\alpha_1 - \alpha_6$ are the short-run slope coefficients; $\beta_1 - \beta_6$ are the long-run slope coefficients; *n* is the maximum lag length; and $\varepsilon's$ are the white noise error terms.

The error correction model representations of the private investment models are expressed as follows:

Based on Model 2

$$\Delta PI_t = \alpha_0 + \sum_{i=0}^{n} \alpha_{1i} \Delta GI_{t-i} + \sum_{i=0}^{n} \alpha_{2i} \Delta INFL_{t-i} + \sum_{i=0}^{n} \alpha_{3i} \Delta EGRO_{t-i} + \sum_{i=0}^{n} \alpha_{4i} \Delta CRED_{t-i} + \sum_{i-0}^{n} \alpha_{5i} \Delta TOT_{t-i} + \sum_{i=1}^{n} \alpha_{6i} \Delta PI_{t-i} + \pi ECM_{t-1} + \varepsilon_{1t} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (6)$$

Based on Model 3

$$\Delta PI_t = \alpha_0 + \sum_{i=0}^{n} \alpha_{1i}\Delta INFRA_{t-i} + \sum_{i=0}^{n} \alpha_{2i}\Delta INFL_{t-i} + \sum_{i=0}^{n} \alpha_{3i}\Delta EGRO_{t-i} + \sum_{i=0}^{n} \alpha_{4i}\Delta CRED_{t-i} + \sum_{i-0}^{n} \alpha_{5i}\Delta TOT_{t-i} + \sum_{i=1}^{n} \alpha_{6i}\Delta PI_{t-i} + \rho ECM_{t-1} + \varepsilon_{2t} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (7)$$

Based on Model 4

$$\Delta PI_t = \alpha_0 + \sum_{i=0}^{n} \alpha_{1i}\Delta NONINFRA_{t-i} + \sum_{i=0}^{n} \alpha_{2i}\Delta INFL_{t-i} + \sum_{i=0}^{n} \alpha_{3i}\Delta EGRO_{t-i} + \sum_{i=0}^{n} \alpha_{4i}\Delta CRED_{t-i} + \sum_{i=0}^{n} \alpha_{5i}\Delta TOT_{t-i} + \sum_{i=1}^{n} \alpha_{6i}\Delta PI_{t-i} + \varphi ECM_{t-1} + \varepsilon_{3t} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (8)$$

Where PI is private investment; GI is public investment; INFL is the inflation rate; EGRO is economic progress; CRED is private sector credit; TOT is the terms of trade; INFRA and NONINFRA are infrastructural and non-infrastructural public investment respectively; α_0 is the constant; Δ is the difference operator; $\alpha_1 - \alpha_6$ are the short-run slope coefficients; n is the maximum lag length; $\varepsilon's$ are the white noise error terms; π, ρ and φ are the respective coefficients of the *ECM*; and ECM_{t-1} is the error correction term lagged by one period.

Following the lead of Blejer and Khan (1984) and later Odedokun (1997), this study generates the data on infrastructural and non-infrastructural public investment from gross public investment. According to Blejer and Khan (1984), the main assumption underlying this approach

is that infrastructural public investment is more associated than its non-infrastructural counterpart with the long term growth in the ratio of gross public investment to gross domestic product. This emanates from the argument that infrastructural projects undertaken by the government generally have a long completion period and are related to economic growth. Thus, following Blejer and Khan (1984), infrastructural public investment is generated by the following expression:

$$INFRA = GI_0 e^{gt}$$

Where *INFRA* is the infrastructural public investment; *GI* is the gross public investment; g is the annual growth rate of gross public investment, GI_0 is the initial value of gross public investment; and *e* is the exponent.

Data on non-infrastructural public investment (NONINFRA) is then given by the difference between gross public investment and infrastructural public investment.

While the weaknesses that may arise from using the Blejer and Khan (1984) procedure to generate data on the two components of public investment are acknowledged, the technique has been credited as the most practical option when there is no country data (see Odedokun, 1997).

The annual time series data for all the variables used in this study is sourced from the World Bank Development Indicators 2015 and the IMF's International Financial Statistics 2015.

4.4. Empirical Analysis

While the ARDL bounds testing procedure does not require unit root pretesting of the variables, such tests are still necessary to determine whether the approach is applicable. Accordingly, this study conducts the Augmented Dickey-Fuller Generalised Least Squares (ADF-GLS) and the Phillips-Perron (PP) unit root testing procedures. The lag length was automatically selected by the SIC for the ADF-GLS unit root test and for the PP test, the PP truncation lag was also automatically selected on the Newey-West bandwidth. Table 1 presents the ADF-GLS and the PP unit root tests.

Table 1: Stationarity Tests of All Variables

Dickey-Fuller Generalised Least Square (DF-GLS)				
Variable	**Stationarity of all Variables in Levels**		**Stationarity of all Variables in First Differences**	
	Without Trend	With Trend	Without Trend	With Trend
EGRO	-4.583***	-4.868***	-	-
PI	-0.620	-1.621	-7.128***	-7.882***
GI	-3.325	-3.436	-8.426***	-8.800***
LBR	-2.659	-2.868	-3.774***	-4.913***
CRED	-0.772	-2.248	-5.962***	-5.984***
TOT	-1.580	-1.896	-6.075***	-6.091***
INFL	-2.012	-2.603	-5.598***	-6.149***
INFRA	-3.107***	-3.973***	-	-
NONINFRA	-1.066	-2.234	-9.673***	-6.592***
Phillips Perron (PP)				
Variable	**Stationarity of all Variables in Levels**		**Stationarity of all Variables in First Differences**	
	Without Trend	With Trend	Without Trend	With Trend

EGR0	-4.982***	-4.930***	-	-
PI	-1.649	-1.889	-8.361***	-8.595***
GI	-3.442	-3.403	-11.657***	-12.686***
LBR	-2.250	-2.445	-5.664***	-5.594***
CRED	-1.058	-2.434	-5.892***	-5.817***
TOT	-1.670	-1.790	-6.117***	-6.218***
INFL	-2.513	-3.486	-7.937***	-10.413***
INFRA	-3.263	-3.210	-8.421***	-9.407***
NONINFRA	-6.040***	-6.078***	-	-

Note: *** denotes stationary at 1%

As illustrated in Table 1, all the variables are either integrated of order 0 or 1, so the ARDL procedure is applicable. This sets the stage for testing the existence of a cointegrating relationship between the variables in the economic growth and private investment models. For this purpose, the study employs the bounds F-test, with the results reported in Table 2.

Table 2: Bounds F-test for Co-integration

Dependent Variable	**Function**		**F-Statistic**	**Cointegration Status**
EGRO	F(EGRO|PI, GI, LBR, CRED, TOT,)		4.92***	Cointegrated
PI	F(PI|GI, INFL, EGRO, CRED, TOT)		3.86**	Cointegrated
PI	F(PI|INFRA, INFL, EGRO, CRED, TOT)		3.84**	Cointegrated
PI	F(PI|NONINFRA, INFL, EGRO, CRED, TOT)		4.18**	Cointegrated
Asymptotic Critical Values				
Pesaran et	1%	5%	10%	

al. (2001). P.300, Table CI(iii) CaseIII	I(0)	I(1)	I(0)	I(1)	I(0)	I(1)
	3.41	4.68	2.62	3.79	2.26	3.35

Note: ***and** denotes statistical significance at 1% and 10% level, respectively.

The outcome of the bounds F-test indicates that all the variables in the economic growth and private investment models share a long-run relationship. Following the established cointegration relationship, the long-run and short-run coefficients of the variables in the economic growth and private investment models can now be estimated. Estimating models were chosen based on either the AIC or SBC, guided by the principle of model parsimony. Thus the SBC(2,0,1,0,0,0) based ARDL for Model 1 and the SBC(1,1,0,1,0,2) based ARDL for model 4 were selected, while the AIC(1,1,0,1,1,2) based ARDL for model 2 and the AIC(2,1,0,1,1,2) base ARDL for model 3 were selected. Table 3 gives the long-run and short-run coefficient estimates of the selected models.

Table 3: Estimation of Long-Run and Short-Run Coefficients

	Model 1 SBC (2,0,1,0,0,0,)	**Model 2 AIC (1,1,0,1,1,2)**	**Model 3 AIC (2,1,0,1,1,2)**	**Model 4 SBC (1,1,0,1,0,2)**
Panel A: Estimated long-run coefficients (Dependent variables: EGRO for Model 1 and PI for Models 2-4)				
Regressors	**Coefficients (t-statistics)**			
C	3.011 (3.968)***	4.884 (7.191)***	7.181 (4.080)***	4.659 (6.788)***
PI	0.147 (1.948)*	-	-	-
GI	-0.453 (-3.847)***	-0.331 (-1.737)*	-	-

INFRA	-	-	0.708(1.737)*	-
NONINFRA	-	-	-	-0.047 (-1.489)
LBR	-0.143 (-3.829)***	-	-	-
INFL	-	-0.017 (-0.146)	-0.139 (-0.982)	-0.124 (-0.847)
EGRO	-	0.220 (2.156)**	0.124 (1.303)	0.193 (1.769)*
CRED	-0.014 (-0.790)	-0.019 (-3.391)***	-0.038 (-2.218)**	-0.022 (-3.416)***
TOT	-0.141 (-1.218)	-0.464 (-3.216)***	-0.747 (-2.529)**	-0.380 (-2.644)**
Panel B: Estimated long-run coefficients (Dependent variables: DEGRO for Model 1 and DPI for Models 2-4)				
DPI	0.180(1.907)*	-	-	-
DPI(-1)	-	-	-0.254 (-1.383)	-
DGI	0.126(1.082)	-0.218 (-6.862)***	-	-
DINFRA	-	-	-0.019 (-0.210)	-
DNONINFRA	-	-	-	-0.032 (-7.038)***
DINFL	-	-0.004 (-0.148)	-0.049 (-1.152)	-0.026 (-0.982)
DEGRO	-	-0.014 (-0.731)	-0.008 (-0.301)	-0.012 (-0.649)
DEGRO(-1)	0.287 (2.631)**	-	-	-
DLBR	-0.175 (-3.718)***	-	-	-
DCRED	-0.017 (-0.794)	-0.0003 (-0.083)	-0.006 (-1.172)	-0.005 (-2.243)**
DTOT	-0.172 (-1.171)	-0.025 (-0.695)	-0.067 (-1.002)	0.070 (2.517)**
DTOT(-1)	-	0.106 (3.502***	-	-
ECM(-1)	-0.972 (-6.404)***	-0.256 (-2.975)***	-0.355 (-2.407)**	-0.211 (-2.675)**
R-squared	0.804	0.798	0.609	0.815
F-statistic	16.402	17.547	4.846	20.087

Prob(F-statistic)	0.000	0.000	0.000	0.000
DW statistic	2.008	2.024	2.125	1.883

Notes: 1. ***, ** and * denote statistical significance at the 1%, 5% and 10% levels, respectively.

2. Δ=first difference operator.

The long-run results in Table 3 (Panel A - Model 1) show that the coefficient of private investment (PI) is positive, as expected, and statistically significant at 10%. However, the coefficient of public investment (GI) is negative and statistically significant at 1%. This could suggest that the economic policies implemented in South Africa to buttress private investment-led economic growth have been beneficial to economic progress. The empirical results compare favourably with reports from previous studies on the subject such as Khan and Reinhart (1989), Khan and Kumar (1997) and Odedokun (1997), among others.

The other variables show that LBR negatively affects economic growth, which is unexpected, while CRED and TOT have no effect on economic progress in the long run.

The short–run dynamics of Model 1 are shown in Table 3 Panel B. These results show that the coefficient of private investment is positive and statistically significant at 10%. However, the coefficient of public investment is statistically insignificant, implying that public investment has no immediate effect on economic growth. The other variable that positively affects economic growth in the short run is DEGRO (-1), while DLBR retards growth. The coefficient of the ECM (-1) is negative as expected and is statistically significant at 1%. A coefficient of -0.972 indicates a quick adjustment to economic growth equilibrium of about one year and one month when there is a disequilibrium.

Overall, results from Model 1 show that in South Africa, private investment has a positive impact on economic growth, irrespective of whether the analysis is done in the long run or in the short run. However, public investment was found to have a negative impact on economic growth only in the long run. In the short run, public investment has no effect. The results from Model 1 imply that private investment contributes more to economic progress in South Africa than public investment.

Empirical results of Model 2, as shown in Table 3, Panels A and B indicate that the coefficient of gross public investment (GI) is negative and statistically significant both in the long run and short run. This suggests the crowding out effect of gross public investment on private investment growth in South Africa under the review period.

The results of Model 3, in Panel A, show that the coefficient of infrastructural public investment (INFRA) is positive and statistically significant in the long run, as expected. In the short run, as shown in Panel B, the coefficient of infrastructural public investment has no statistically significant effect on private investment growth. Furthermore, estimates from Model 4 reveal that the coefficient of non-infrastructural public investment (NONINFRA) also has no statistically significant effect on private investment in the long run; but in the short run, its coefficient is negative and statistically significant.

The other variables that affect private investment shown in Table 3 Panel A are EGRO, CRED, and TOT. EGRO is positive as expected while CRED and TOT negatively influence private investment, which is unexpected. The variables that affect private investment in the short run are DCRED, which has a negative effect and DTOT and DTOT (-1), which positively influence

private investment. The coefficients of the ECM (-1) terms are negative as expected and are all statistically significant at 1%. This confirms the existence of the long-run relationship between the variables in the private investment models, as well as quick adjustment to equilibrium should there be a shock.

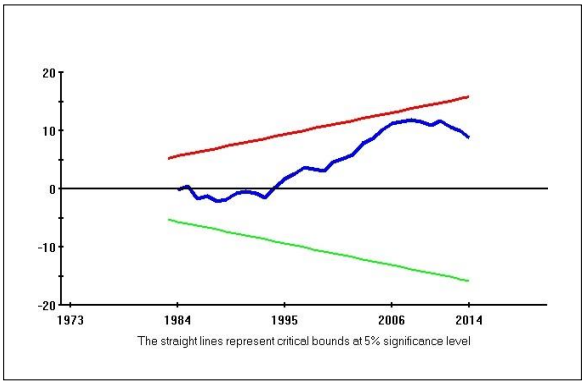
Based on the empirical results from the private investment models, gross public investment crowds out private investment growth in the long run, while infrastructural public investment crowds in private investment growth in the long run in South Africa. However in the short run, gross public investment and non-infrastructural public investment crowd out private investment growth. The results imply that although the contribution of public investment to economic growth has been negative, public investment in infrastructure is important to economic growth as it stimulates private investment growth. To sustain high economic growth rates in the long run, policymakers need to focus on boosting public investment in infrastructure in South Africa.

The results of the cumulative sum of recursive residuals (CUSUM) and the cumulative sum of squares of recursive residuals (CUSUMQ) plotted in Figure 2 also confirm the stability of both the economic growth and private investment models.

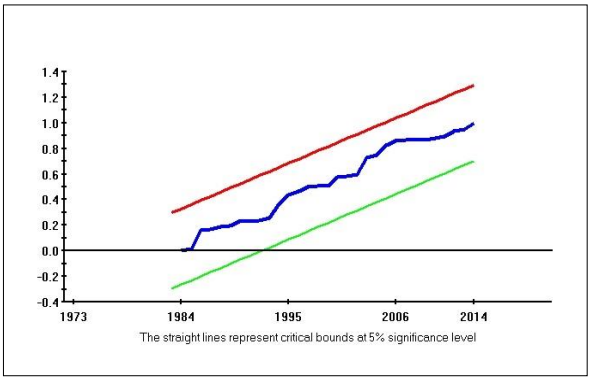
Figure 2: Plot of CUSUM and CUSUMQ for the Economic Growth and Private Investment Models

Model 1

Plot of Cumulative Sum of Recursive Residual

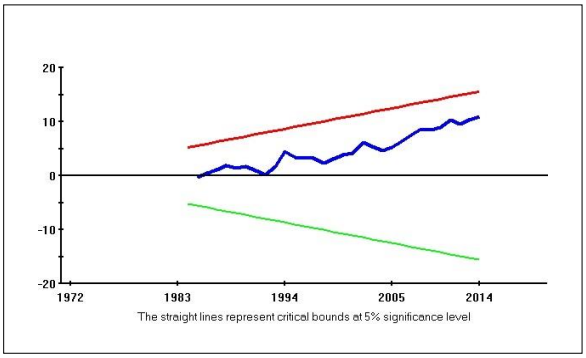


Plot of Cumulative Sum of Squares of Recursive Residuals

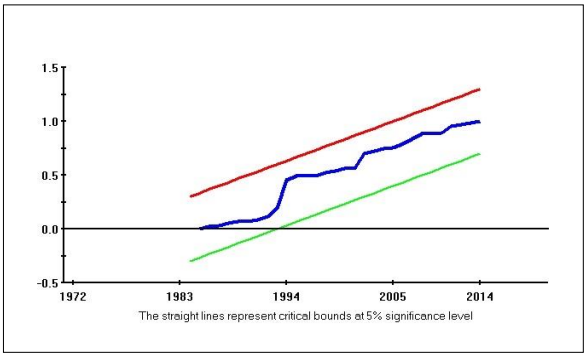


Model 2

Plot of Cumulative Sum of Recursive Residual

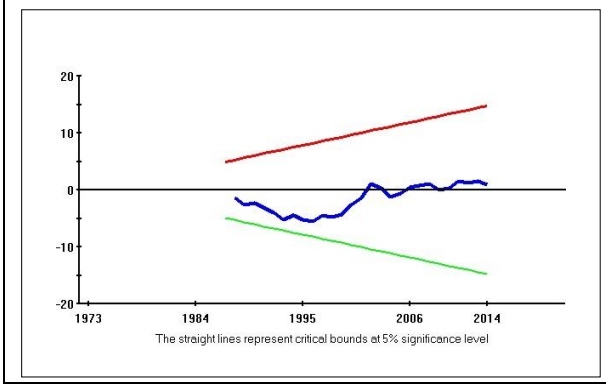


Plot of Cumulative Sum of Squares of Recursive Residuals

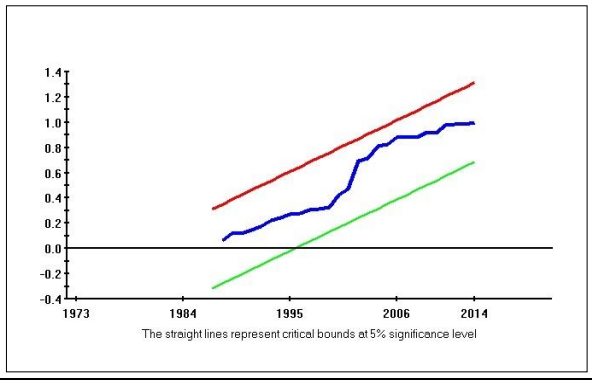


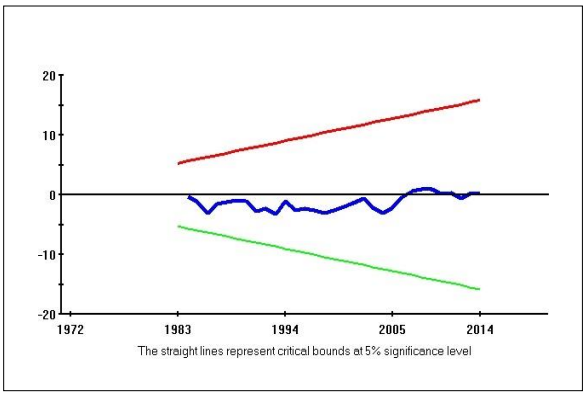
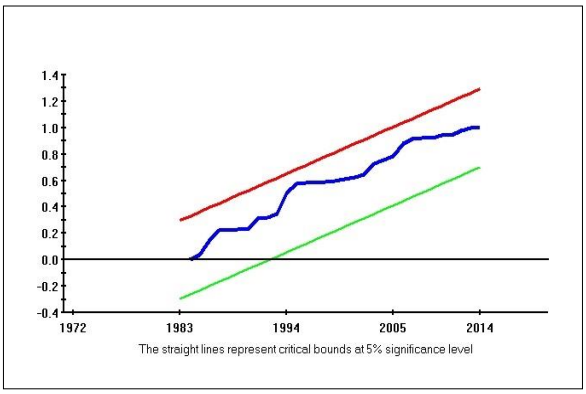
Model 3

Plot of Cumulative Sum of Recursive Residual



Plot of Cumulative Sum of Squares of Recursive Residuals



Model 4	
Plot of Cumulative Sum of Recursive Residual	Plot of Cumulative Sum of Squares of Recursive Residuals
	

5. Conclusion

The main objective of this study is to empirically examine the relative contribution of public and private investment to economic growth in South Africa from 1970 to 2014. The study attempts to answer two related questions: (i) does public investment spur economic growth more than private investment; and (ii) does public investment crowd in or crowd out private investment? To address the above questions, the study estimates economic growth and private investment models using the recently developed ARDL-bounds testing approach. The empirical results show that private investment positively affects economic growth both in the long run and short run. While public investment has a negative effect on growth in the long run, in the short run it has no significant economic growth influence. The results further reveal that in the long run, gross public investment crowds out private investment, while infrastructural public investment crowds in private investment growth. Additionally, both gross public investment and non-infrastructural public investment are found to stifle private investment growth in the short run. Based on these

findings, it can be concluded that private investment has a higher contribution to economic growth in South African than public investment. However, the indirect contribution to economic growth of infrastructural public investment through private investment promotion cannot be overstated.

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