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To cite this article: Garikai Makuyana & Nicholas M. Odhiambo (2019) Public and private investment and economic growth in Malawi: an ARDL-bounds testing approach, Economic Research-Ekonomiska Istraživanja, 32:1, 673-689, DOI: [10.1080/1331677X.2019.1578677](https://doi.org/10.1080/1331677X.2019.1578677)

To link to this article: <https://doi.org/10.1080/1331677X.2019.1578677>



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Published online: 16 Apr 2019.



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Public and private investment and economic growth in Malawi: an ARDL-bounds testing approach

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ABSTRACT

This paper examines the relative contribution of public and private investment to economic growth in Malawi from 1970 to 2014 – using the recently developed autoregressive distributed lag model (ARDL) bounds testing procedure. The study also examines the crowding-out or crowding-in effect of public investment on private investment. Unlike most previous studies on this subject which are cross-sectional in nature, this study examines the differential impacts of public and private investment on economic growth focusing on Malawi. The main finding of this study is that while private investment contributes more to economic growth than public investment in Malawi, infrastructural public investment tends to crowd-in private investment.

ARTICLE HISTORY

Received 8 August 2016
Accepted 19 February 2018

KEYWORDS

Malawi; Public Investment;
Private Investment;
Economic Growth; ARDL-
bounds testing approach

1. Introduction

The debate on the relative importance of public and private investment for economic growth is still ongoing. There is, however, a great deal of empirical evidence that has been reported – though with mixed and sometimes conflicting results. The focus of these empirical studies has been to provide answers on two different but related questions. The first is whether public investment stimulates or slows down private investment growth. The second is whether a resource unit allocated to public investment accelerates economic growth more than an equivalent amount allocated to private investment.

Although previous studies that have examined the above mentioned issues are extensive, the majority have focused on developed countries (see, for example, Kalyvitis & Vella, 2015; Pereira, 2001; Tong, Yu, Jensen, Ugarte, & Cho, 2016; Zou, 2006). The scant empirical studies on developing countries are mostly cross-sectional in nature (Candelon, Colletraz, & Hurlin, 2013; Cavallo & Daude, 2011; Erden & Holcombe, 2005). These studies have the limitation that they are unable to make policy recommendations that reflect the individual country's peculiar economic and structural features.

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Against this backdrop, the main objective of this paper is to examine the relative roles of public and private investment in economic growth in Malawi. The paper empirically examines the long-run impact of these two components of investment on economic growth using the recently developed ARDL bounds testing approach.

This paper contributes to the literature on investment and economic growth in various ways. Firstly, this may be the first study of its kind to empirically examine the differential impacts of public and private investment on economic growth in Malawi using time series data from 1970 to 2014. While previous studies have only focused on public investment or its subcomponents (see, Calderón, Moral – Benito, & Servén, 2015; Ramirez & Nazmi, 2003; Roache, 2007; Tong et al., 2016), disentangling investment into public and private components has important policy implications for setting up an economic system that can best grow the economy. Secondly, the study simultaneously examines the long-run and short-run impacts of public investment and its subcomponents (infrastructural and non-infrastructural) on private investment. Lastly, the study utilises the recently developed ARDL bounds testing technique by Pesaran & Shin (1999) and popularised by Pesaran, Shin, & Smith (2001). The ARDL bounds testing approach has recently been credited for its higher estimation power over the traditional techniques (Shrestha & Chowdhury, 2007). Moreover, while previous studies estimated the static models, this study captures the long-run as well as the important short-run dynamics of public and private investment and economic growth.

The rest of the paper is organised as follows: [Section 2](#) highlights the economic policies in Malawi from 1970 to 2014 that have influenced public and private investment and economic growth. This is followed by a brief literature review – both theoretical and empirical in [Section 3](#). [Section 4](#) presents the methodology and empirical analysis, while [Section 5](#) concludes the paper.

2. Investment and economic growth dynamics in Malawi: an overview

Contrary to its predecessor, the new Malawi government adopted a strong market intervention policy after independence in 1965. Accordingly, public investment steadily grew to dominance in economic activities for the period from 1965 to 1980. The infrastructural hypothesis was the guiding principle in setting out the various state owned enterprises. Through state enterprises, the Malawian government aimed to address the infrastructural gap in sectors such as agriculture, health, education, transport and communication, in which the majority had been marginalised during the colonial period (Pryor, 1990). In addition, the motive to indigenise the economy and the absence of strong private capital to fund such infrastructural projects meant that the state expanded ownership of the means of production across all sectors (Kaluwa, Silumbu, Banda, & Chilowa, 1992).

Nevertheless, the growth in these state enterprises was achieved at the expense of retarded growth in private investment during the period. The crowding-out effect of public investment on private investment was effected in two ways: (i) in domestic bank credit allocation, the state commanded a high and growing share necessitated by the need to fund a growing number of state enterprises in infrastructural activities;

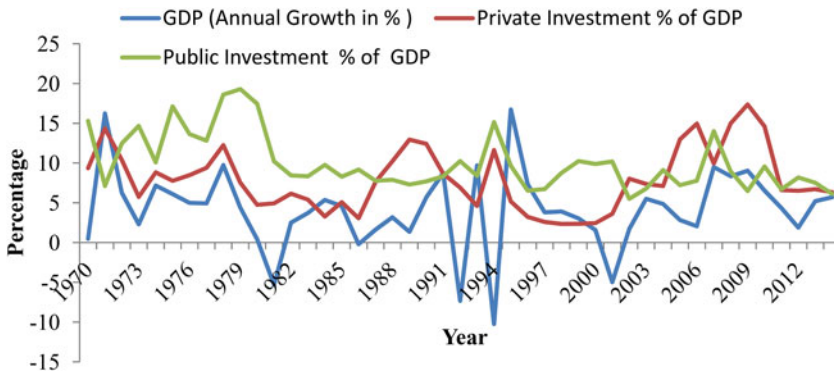


Figure 1. Trends in public and private investment and economic growth in Malawi from 1970 to 2014.

Source: World Bank (2015)

and (ii) the state enacted various acts and regulations that gave business monopoly rights to the state enterprises (Ngóma, 2010). This resulted in private investment having a minority and decreasing investment share from 9.35% of GDP in 1970 to 4.74% of GDP in 1980 (World Bank, 2015).

However, the reversal in public investment economic leadership started in the early 1980s following the second world oil shock of 1978 (Ngóma, 2010). This led to the parastatal crisis during the period, which resulted in negative economic growth rates from 1979 to 1983 (World Bank, 2015). In reaction to this, the Malawian government adopted the first and second phase of privatisation programmes under World Bank and IMF sponsored structural adjustment programmes from 1984 to 2000.

The guiding rationale in the privatisation programmes was to eliminate government participation in commercial economic activities where it was in competition with the private sector, in which the latter had a high and growing marginal productivity. The role of the state was then refocused to portfolios in core infrastructures that stimulated the growth of private business, such as in power generation and transmission, water, health, education and transport (Chirwa, 2000).

Malawi's envisaged market economy received further support through the economic policies that were subsequently adopted from 2004. This included the Malawi Economic Growth Strategy (2004), Malawi Growth and Development Strategy I and II (2006-2016) and Interim Country Strategy Paper (2011-2012). These policies identified two key intervention pillars which were to improve infrastructure and to accelerate private capital growth (Government of Malawi 2006, 2012; African Development Bank, 2011). Figure 1 presents the growth trends of public and private investment and economic growth from 1970 to 2014, in response to the economic policies implemented.

3. Literature review

The debate on the relative importance of public and private investment on economic growth has been centred on the complex and controversial question of whether the components of investment are substitutes or complements (Bom & Ligthart, 2014;

Cavallo & Daude, 2011; Fujii, Hiraga, & Kozuka, 2013). One argument premised on the endogenous growth theory, which is gaining acceptance, is that public investment should be confined to the provision of goods and services in which the private sector cannot produce in optimal amounts because of its non-rivalry in consumption, and because the required investment projects are lumpy and indivisible (Barro, 1990).

However, such public goods and services can be beneficial to the efficient working of the market economy because of their inherent wide positive externalities. For example, the state investment in health, education, water, sewer systems, transport and communication can promote new private capital formation and hence economic growth (Beifert, 2016; Bom & Ligthart, 2014; Wang, 2005). The availability of such core infrastructural goods and services reduces private sector start-up costs and increases total productivity and profitability. On the negative side, public investment can crowd out private investment and slow down economic growth when: (i) it is undertaken by inefficient state enterprises which receive high state subsidies; (ii) it produces goods and services that directly compete with the private sector when it is established that the latter is more efficient in their provision; and (iii) it is debt financed either from internal or external sources (Cavallo & Daude, 2011; Dash, 2016; Fujii et al., 2013).

On the empirical front, a number of studies that examined the contribution of public and private investment to the economy have done so directly by estimating a modified production function or indirectly through the crowding-in or crowding-out effect of public investment on private investment, though with mixed results. However, there is now a general agreement by most economists and policymakers that private investment is more efficient than public investment, based on their marginal contribution to growth. Such a consensus is based on early studies such as by Khan & Reinhart (1989), which reported that private investment has a larger effect on economic growth than does public investment from a cross-sectional sample of 24 developing countries. Although the robustness of such findings can be questioned on the basis of the small sample used, a number of subsequent studies on the subject reported the same evidence. For example, Hague (2013), Phetsavong & Ichihashi (2012), Ponce & Navarro (2016) and Yovo (2017) found strong evidence in support of the private investment-led economic growth process.

In contrast, there are some studies which reported that public investment is more important to economic growth than private investment (see, among others, Bédia, 2007; Belloc & Vertova, 2004; Fournier, 2016). Such findings can, however, be explained in the context of high marginal productivity of public investment brought about by deficits in core infrastructure. For instance, the empirical evidence by Belloc & Vertova (2004) from the selected highly indebted poor countries (HIPCs) is understandable given the infrastructural gap these countries still need to fill.

The contribution of public investment to economic growth through its effect on private investment has also varied across countries and time periods. Two groups of empirical evidence have been reported in the literature: the crowding-out and crowding-in effect of public investment on private investment. Early evidence on the crowding-in effect of public investment was reported by Aschauer (1989). In the

study, Aschauer found that non-military public investment stimulated productivity of private capital and GDP in the USA economy during the 1949 to 1985 period.

Several follow up empirical studies have also admitted the complementary relationship that exists between public and private investment in the economic growth process. The crowding-in relationship reported is mainly through the provision of better core infrastructure, enhancement of cooperation with the private enterprises and the establishment of an ecosystem that stimulates the private entrepreneurship activities (see, among others, Beifert, 2016; Bom & Ligthart, 2014; Branten & Purju, 2015; Calderón et al., 2015; Mitra, Sharma, & Véganzonès-Varoudakis, 2012). In particular, Beifert (2016) argued that government investment in airports can be an economic growth driving force as it can stimulate private enterprise growth. Entrepreneurship activities would flourish in the presence of a good air transport system which permits the easier movement of raw materials and allows better access to the regional and international markets for the finished goods.

In other empirical studies, public investment has been blamed for stunted economic growth rates as in some cases, it crowds out private investment growth (see, Afonso & Aubyn, 2016; Cavallo & Daude, 2011; Dash, 2016; Mallick, 2016). According to Cavallo & Daude (2011) and Mallick (2016), government investment in non-infrastructure projects tends to compete with the private sector particularly in developing countries. Similar evidence have also been reported in Tunisia, in which public investment growth was driven by the inefficient and subsidised state enterprises in agriculture, manufacturing, banking and finance services (Ghali, 1998).

From the foregoing discussion, it can be stated that the impact of public investment on economic growth through its crowding-in or crowding-out effect on private investment remains uncertain and therefore can be determined empirically.

Besides public and private investment, there are other factors that have received attention in contemporary empirical studies as some of the key determinants of economic growth. These include: (i) adoption of modern industrialisation through the use of modern technology (Shatreovich & Strautmane, 2015); (ii) creation of a sustainable start-up ecosystem which supports new innovations (Laužikas, Tindale, Bilota, & Bielousovaitė, 2015); (iii) purposive research and development (R&D) expenditure which stimulates innovation (Rezk, Ibrahim, Tvaronavičienė, Sakr, & Piccinetti, 2015); (iv) exports of goods from the technology driven manufacturing sectors (Travkina & Travonavičienė, 2015); and (v) terms of trade, human capital, institutional quality, foreign direct investment (FDI), credit to the private sector and socio-political stability (Adu, 2013; Mihaela, Kornélia, Gabriela, Kamil, & Adam, 2017; Upreti, 2015). However, due to the non-availability of consistent data on some factors, this study examined the effect of labour, credit to the private sector and terms of trade as other factors that determines economic growth.

4. Methodology and empirical analysis

4.1. Cointegration- ARDL bounds testing procedure

To explore the impact of public and private investment on economic growth in Malawi, the study employs the newly developed ARDL bounds testing procedure that

was initiated by Pesaran & Shin (1999) and popularised by Pesaran et al. (2001). The approach has recently been credited for its advantages over the traditional cointegration techniques such as full maximum likelihood, based on Johansen and Juselius (1990), and the residual based approach (Engle & Granger, 1987). Firstly, while the traditional cointegration techniques are sample size sensitive, the ARDL approach is ideal even with a small sample, which is the case in this study. Secondly, it does not restrict the variables of interest to be integrated of the same order. The ARDL approach to cointegration can be applied when the variables are a mixture of integrated of order zero $I(0)$, one $I(1)$ or partially integrated. Thirdly, the ARDL estimates the long-run relationship using a single reduced form equation, unlike the traditional approach that employs a system of equations (Shrestha & Chowdhury, 2007). Lastly, the ARDL approach provides long-run estimates that are unbiased and gives valid t -statistics (Odhiambo, 2008).

4.2. Relative roles of public and private investment in economic growth

The empirical model adopted to examine the relative contribution of public and private investment to economic growth follows the lead of Bédia (2007), Ponce & Navarro (2016) and Yovo (2017), among others. It is the modified version of the Solow (1956) aggregate production function, which accounts for public and private investment, labour and other control variables. In this study, this is Model 1; and in the ARDL framework, it is expressed as follows:

Model 1

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

Where $EGRO$, the dependent variable, is the annual growth rate of real gross domestic product (a proxy for economic progress); GI is the gross fixed capital formation by the government (a proxy for public investment); PI is the gross fixed capital formation by the private sector (a proxy for private investment); LBR is annual percentage population growth (a proxy for labour); $CRED$ is domestic credit extended to the private sector (a proxy for the financial sector development); TOT is the trade balance that captures the external economy (a proxy for 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, respectively, 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 of the ARDL model (1) is expressed as follows:

$$\begin{aligned} \Delta EGRO_t = & \alpha_0 + \sum_{i=1}^n \alpha_{1i} \Delta EGRO_{t-i} + \sum_{i=0}^n \alpha_{2i} \Delta GI_{t-i} + \sum_{i=0}^n \alpha_{3i} \Delta PI_{t-i} \\ & + \sum_{i=0}^n \alpha_{4i} \Delta LBR_{t-i} + \sum_{i=0}^n \alpha_{5i} \Delta CRED_{t-i} + \sum_{i=0}^n \alpha_{6i} \Delta TOT_{t-i} \\ & + \delta_1 ECM_{t-1} + \mu_t \end{aligned} \quad (2)$$

Where δ_1 is the coefficient of the *ECM*; ECM_{t-1} is the error correction term lagged by one period; and all other variables are defined as in [equation \(1\)](#).

4.3. The effect of public investment on private investment

The contribution that public investment plays to economic growth as estimated in Model 1 can also be examined indirectly through estimating its impact on private investment. This approach addresses the shortfalls inherent in the previous studies that have investigated the relative importance of public and private investment to economic growth. Firstly, estimating a separate private investment equation addresses the potential problem of simultaneous bias since private investment is an endogenous variable. The empirical findings by Bédia (2007) and Khan & Reinhart (1989), among others are susceptible to such bias.

Secondly, while the main objective of the study is to examine the relative effects of public and private investment on economic growth in Malawi, the assessment of the impact of public investment on private investment has important policy implications. If the crowding-out effect occurs when the two components of investment are reported to have an identical impact on growth, the private investment-led economy can be prescribed. However, policy makers may need to draw attention to the possible consequences of cutting back on public investment if the complementary effect is reported.

The approach taken in this study to test the crowding-in or crowding-out effect of public investment follows the lead by Blejer & Khan (1984) and Odedokun (1997). It estimates three separate private investment equations as follows: (i) in the first, gross public investment enters the private investment equation as an explanatory variable, among others; and (ii) in the second and third, public investment is disaggregated into infrastructural and non-infrastructural components where each would enter into separate private investment equations as regressors, among others. The ARDL representations of the private investment equations are specified as follows:

Model 2- Private investment and gross public investment

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

Model 3-Private investment and infrastructural public investment

$$\begin{aligned} \Delta PI_t &= \alpha_0 + \sum_{i=0}^n \alpha_{1i} \Delta INFRA_{t-i} + \sum_{i=0}^n \alpha_{2i} \Delta IFL_{t-i} \\ &+ \sum_{i=0}^n \alpha_{3i} \Delta INTRST_{t-i} + \sum_{i=0}^n \alpha_{4i} \Delta CRED_{t-i} + \sum_{i=0}^n \alpha_{5i} \Delta EXPTS_{t-i} \\ &+ \sum_{i=1}^n \alpha_{6i} \Delta PI_{t-i} + \beta_1 INFRA_{t-1} + \beta_2 IFL_{t-1} + \beta_3 INTRST_{t-1} \\ &+ \beta_4 CRED_{t-1} + \beta_5 EXPTS_{t-1} + \beta_6 PI_{t-1} + \varepsilon_{2t} \end{aligned} \tag{4}$$

Model 4-Private investment and non infrastructural public investment

$$\begin{aligned} \Delta PI_t &= \alpha_0 + \sum_{i=0}^n \alpha_{1i} \Delta NONINFRA_{t-i} + \sum_{i=0}^n \alpha_{2i} \Delta IFL_{t-i} \\ &+ \sum_{i=0}^n \alpha_{3i} \Delta INTRST_{t-i} + \sum_{i=0}^n \alpha_{4i} \Delta CRED_{t-i} + \sum_{i=0}^n \alpha_{5i} \Delta EXPTS_{t-i} \\ &+ \sum_{i=1}^n \alpha_{6i} \Delta PI_{t-i} + \beta_1 NONINFRA_{t-1} + \beta_2 IFL_{t-1} \\ &+ \beta_3 INTRST_{t-1} + \beta_4 CRED_{t-1} + \beta_5 EXPTS_{t-1} + \beta_6 PI_{t-1} + \varepsilon_{3t} \end{aligned} \tag{5}$$

The associated error correction models of the above private investment models are specified as follows:

Based on model (2)

$$\begin{aligned} \Delta PI_t &= \alpha_0 + \sum_{i=0}^n \alpha_{1i} \Delta GI_{t-i} + \sum_{i=0}^n \alpha_{2i} \Delta IFL_{t-i} \\ &+ \sum_{i=0}^n \alpha_{3i} \Delta INTRST_{t-i} + \sum_{i=0}^n \alpha_{4i} \Delta CRED_{t-i} + \sum_{i=0}^n \alpha_{5i} \Delta EXPTS_{t-i} \\ &+ \sum_{i=1}^n \alpha_{6i} \Delta PI_{t-i} + \pi ECM_{t-1} + \varepsilon_{1t} \end{aligned} \tag{6}$$

Based on model (3)

$$\begin{aligned} \Delta PI_t &= \alpha_0 + \sum_{i=0}^n \alpha_{1i} \Delta INFRA_{t-i} + \sum_{i=0}^n \alpha_{2i} \Delta IFL_{t-i} + \sum_{i=0}^n \alpha_{3i} \Delta INTRST_{t-i} \\ &+ \sum_{i=0}^n \alpha_{4i} \Delta CRED_{t-i} + \sum_{i=0}^n \alpha_{5i} \Delta EXPTS_{t-i} + \sum_{i=1}^n \alpha_{6i} \Delta PI_{t-i} \\ &+ \rho ECM_{t-1} + \varepsilon_{2t} \end{aligned} \tag{7}$$

Based on model (4)

$$\begin{aligned} \Delta PI_t &= \alpha_0 + \sum_{i=0}^n \alpha_{1i} \Delta NONINFRA_{t-i} + \sum_{i=0}^n \alpha_{2i} \Delta IFL_{t-i} \\ &+ \sum_{i=0}^n \alpha_{3i} \Delta INTRST_{t-i} + \sum_{i=0}^n \alpha_{4i} \Delta CRED_{t-i} + \sum_{i=0}^n \alpha_{5i} \Delta EXPTS_{t-i} \\ &+ \sum_{i=1}^n \alpha_{6i} \Delta PI_{t-i} + \varphi ECM_{t-1} + \varepsilon_{3t} \end{aligned} \tag{8}$$

Where PI is the gross fixed capital formation by the private sector (a proxy for private investment); GI is the gross fixed capital formation by the government (a proxy for public investment); INTRST is the annual growth of real interest rate; CRED is domestic credit extended to the private sector (a proxy for the financial sector development); EXPTS is exports (a proxy for the external economy); IFL is the inflation rate; 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; π , ρ and φ are the respective coefficients of the *ECM*; ECM_{t-1} is the error correction term lagged by one period; n is the maximum lag length; and ε 's are the white noise error terms.

The data on infrastructural and non-infrastructural components is generated by decomposing public investment. This is informed by the early work of Blejer & Khan (1984) and later Odedokun (1997), who argued that the infrastructural component of public investment is more related than non-infrastructural to the trend movement of the ratio of the government gross investment to the gross domestic product. The argument was derived from the assumption that most government infrastructural projects have a long gestation period and are related to economic progress. Thus, following Blejer & Khan (1984), infrastructural public investment is obtained as:

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

Where INFRA is the infrastructural public investment as a percentage of GDP; *GI* is the gross fixed capital formation by the government as a percentage of GDP, *g* is the annual growth rate of gross fixed capital formation by the government as a percentage of GDP, GI_0 is the initial value (for example, 1970) of gross fixed capital formation by the government as percentage of GDP; and *e* is the exponent.

Non-infrastructural public investment (NONINFRA) is then generated by subtracting infrastructural public investment from the gross fixed capital formation by the government as a percentage of GDP.

While there are limitations to calculating infrastructural and non-infrastructural public investment using the Blejer & Khan (1984) approach, as Odedokun (1997) also argued, it is the most feasible alternative given the absence of country data as is the case in this study.

Time series data for the other 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

Before conducting the empirical analysis, it is important that all the variables used be subjected to unit root tests. This is important in order to ensure that no variable is integrated of order two or higher.

The Dickey-Fuller Generalised Least Square (ADF-GLS) and Phillips-Perron (PP) unit root test results (see Table 1) show that all the variables are integrated of order 0 or 1. The lag length in ADF-GLS was automatically selected by SIC and the PP truncation lag was selected automatically on the Newey-West bandwidth.

Table 1. Stationarity tests of all variables.

Variable	Stationarity of all variables in levels		Stationarity of all variables in first differences	
	Without trend	With trend	Without trend	With trend
Dickey-Fuller Generalised Least Square (DF-GLS)				
EGRO	-6.084***	-6.245***	-	-
PI	-2.611	-2.671	-6.115***	-6.863***
GI	-0.615	-5.544**	-2.317**	-6.704***
LBR	-2.852	-2.856	-5.337***	-5.343***
CRED	-2.396	-3.123	-5.825***	-6.008***
TOT	-2.153	-2.134	-7.167***	-8.054***
INFL	-2.273	-1.755	-8.797***	-8.883***
INTRST	-2.107	-1.234	-5.594***	-5.724***
EXPTS	-3.088	-3.583	-7.654***	-6.147***
INFRA	-1.809	-1.934	-2.181**	-7.075***
NONINFRA	-1.916	-1.258	-7.274***	-7.045***
Phillips Perron (PP)				
EGRO	-6.309***	-6.234***	-	-
PI	-2.701	-2.667	-7.276***	-7.213***
GI	-1.871	-1.197	-5.197***	-6.581***
LBR	-2.500	-2.481	-5.267***	-5.203***
CRED	-2.262	-2.047	-6.925***	-10.034***
TOT	-6.251***	-7.228***	-	-
INFL	-2.288	-2.664*	-7.450***	-8.174***
INTRST	-1.232	-1.712	-5.573***	-5.623***
EXPTS	-2.826	-3.317	-10.322***	-12.007***
INFRA	-1.904	-1.940	-5.878***	-5.631***
NONINFRA	-1.227	-3.179*	-8.276***	-7.869***

Note:***, ** and * denotes stationarity at 1%, 5% and 10% respectively.

Source: Data generated using Eviews 7.1.

Table 2. Bounds F-test for cointegration.

Dependent Variable	Function	F-Statistic	Cointegration status
EGRO	F(EGRO PI, GI, LBR, CRED, TOT)	6.2792***	Cointegrated
PI	F(PI GI, INFL,INTRST,CRED, EXPTS)	4.8173***	Cointegrated
PI	F(PI INFRA,INFL,INTRST,CRED,EXPTS)	4.8676***	Cointegrated
PI	F(PI NONINFRA,INFL,INTRST,CRED, EXPTS)	3.5439*	Cointegrated
Asymptotic Critical Values			
Pesaran et al. (2001). p.300, Table C1(iii) Case III	1% I(0) I(1)	5% I(0) I(1)	10% 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.

Source: Data generated using Microfit 5.0.

Estimation using the ARDL bounds testing procedure is based on two stages. The first stage involves testing cointegrating relationships among all variables in the ARDL model through ordinary least squares estimation. The long-run relationship of all the variables is confirmed when lagged levels of variables are statistically significant and this leads to the next stage. The second stage involves estimating the long-run and short-run coefficients of each ARDL model. The short-run dynamics are captured by the first differenced variables in each error correction model. The bounds F-test for cointegration (Table 2) indicate that the variables in the economic growth and private investment equations share a long-run relationship.

Table 3. Estimation of long-run and short-run coefficients.

	Model 1 AIC (3,1, 2, 3, 0, 3)	Model 2 AIC (2,2,0,3,2,0)	Model 3 SBC (1,0,0,3,1,0)	Model 4 AIC (1,0,0,3,2,0)
Panel A: Estimated long-run coefficients (Dependent variables: EGRO for Model 1 and PI for Models 2-4)				
Regressors	Coefficients (t-statistics)			
C	2.522(5.236)***	1.583 (0.404)	2.7778(1.465)	1.436 (0.555)
PI	0.238(2.711)**	–	–	–
GI	0.657(1.497)	0.264 (0.284)	–	–
LBR	–0.378(-2.488)**	–	–	–
INFRA	–	–	0.479 (3.817)**	–
NONINFRA	–	–	–	0.073 (0.568)
INFL	–	–0.207 (-0.830)	–0.058 (-0.382)	0.005 (0.247)
INTRST	–	0.372 (3.61)***	0.804 (2.310)**	0.103 (0.154)
CRED	0.218(2.104)**	0.33(3.08)***	–0.478 (-1.191)	–0.354 (-0.678)
TOT	–0.098(-1.320)	–	–	–
EXPTS	–	–0.377 (-0.388)	0.335 (0.516)	–0.670 (-0.782)
Panel B: Error correction representation for the selected ARDL Model (Dependent variables: DEGRO for Model 1 and DPI for Models 2-4)				
DEGRO(-1)	0.371(1.859)*	–	–	–
DEGRO(-2)	0.3207(2.096)**	–	–	–
DPI	–0.210(-1.356)	–	–	–
DPI(-1)	–	–0.321(-1.726)*	–	–
DGI	–0.376(-1.234)	–0.440 (-1.922)*	–	–
DGI(-1)	–0.605(-1.934)*	–0.517 (-2.05)**	–	–
DLBR	–0.674(-1.799)*	–	–	–
DLBR(-1)	0.376(2.152)**	–	–	–
DLBR(-2)	0.520(1.465)	–	–	–
DINFRA	–	–	–0.61 (-2.96)***	–
DNONINFRA	–	–	–	0.029 (0.549)
DINFL	–	–0.063 (-0.773)	–0.029 (-0.370)	0.002 (0.260)
DINTRST	–	–0.142(-1.406)	–0.0281(-0.340)	–0.221 (-0.181)
DINTRST(-1)	–	–0.378 (-3.553)***	–0.375 (-3.681)***	–0.300 (-2.622)**
DINTRST(-2)	–	–0.160 (-2.071)**	–0.236 (-3.058)***	–0.151 (-1.784)*
DCRED	0.325(2.050)**	0.615 (1.575)	0.918 (2.365)**	0.655 (1.680)
DCRED(-1)	–	–0.542 (-1.689)	–	–0.641(-1.403)
DTOT	0.213(3.209)***	–	–	–
DTOT(-1)	0.315(3.173)***	–	–	–
DTOT(-2)	0.144(1.998)*	–	–	–
DEXPTS	–	–0.114 (-0.395)	0.166 (0.528)	–0.261 (-0.086)
ECM(-1)	–0.993(-4.03)***	–0.302 (-2.130)**	–0.496 (-3.820)***	–0.389 (-2.486)**
R-squared	0.844	0.613	0.753	0.509
F-statistic	8.918	3.893	4.128	3.316
Prob(F-statistic)	0.000	0.001	0.001	0.006
DW statistic	2.130	2.093	1.981	2.293

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

2. Δ = first difference operator.

Source: Data generated using Microfit 5.0.

In estimating the ARDL models, either the AIC or SBC was used in selecting the optimal lag length. The AIC-based ARDL (3, 1, 2, 3, 0, 3) model for the economic growth equation was selected as it is more parsimonious than the SBC-based model. Table 3 Panel A shows the long-run estimates of the selected model and the short-run results are reported in Table 3 Panel B under Model 1.

Table 3 (Panel A-Model 1) indicates that public investment has no significant long-run impact on economic growth. This is contrary to private investment, which has a statistically significant and positive impact on economic growth in Malawi, as expected. The private investment coefficient of 0.23 indicates that a 1% increase in this investment component leads to a 0.23% increase in economic growth in Malawi

in the long term. This could suggest that the privatisation programmes and private investment policies implemented in Malawi were beneficial to its economic progress. These results compare well with the empirical evidence reported by the previous studies on the subject (see, among others, Phetsavong & Ichihashi, 2012; Ponce & Navarro, 2016; Yovo, 2017).

In the long run, the coefficients of labour (LBR) and credit (CRED) are statistically significant. Contrary to expectation, labour is negatively related to economic growth, while as expected, credit positively contributes to economic growth in the long run in Malawi. However, terms of trade (TOT) is found to be statistically insignificant to economic growth.

A look at the short-run economic growth dynamics in Table 3 (Panel B) reveals that private investment has no immediate effect on economic growth, while public investment retards the growth process in Malawi. The coefficient of one period lagged public investment of -0.60, which is statistically significant at 10%, implies that a 1% increase in previous year public investment slows down economic growth by 0.60% in the short run. The coefficients of DEGRO (-1), DEGRO (-2), DLBR, DLBR (-1), DCRED, DTOT (-2) are statistically significant at either 10% or 5%, while the coefficient of DTOT and DTOT (-2) are significant at 1%. The coefficient of DLBR (-2) is not statistically significant. The error correction term (ECM (-1)) is statistically significant at 1% with the expected sign and this confirms the cointegration relationship among variables. The coefficient of the ECM (-1) of -0.99 indicates a quick rate of adjustment to the equilibrium at 99% per annum whenever there is a shock to economic growth in the previous period.

The results of the private investment models are shown in Table 3, which reports the crowding-in or crowding-out effect of: (i) gross public investment (Model 2); (ii) infrastructural public investment (Model 3); and (iii) non-infrastructural public investment (Model 4). The AIC-based ARDL (2, 2, 0, 3, 2, 0) and ARDL (1, 0, 0, 3, 2, 2, 0) models for Model 2 and Model 4, respectively were selected because they are more parsimonious than the SBC-based models, while the same criterion was used in selecting the SBC-based ARDL (1, 0, 0, 3, 1, 0) model for Model 3. Table 3 Panel A presents the long-run results of the selected models, while the short-run results are presented in Table 3 Panel A.

The results reported in Table 3 show that while gross public investment has no effect on private investment in the long run, in the short run it has a crowding-out effect. This is shown by the statistically significant negative coefficient of gross public investment in Model 2. The results from Model 3 show that infrastructural public investment crowds out private investment in the short run but in the long run it crowds in private investment growth. However, non-infrastructural public investment has no effect on private investment both in the short run and long run as reported in Model 4.

The results from the other variables indicate that interest rate is positively associated with private investment in Malawi in the long run, but in the short run it has negative effect. Credit positively affects private investment in the short run and long run. The short-run results also show that the previous year private investment undertaking, as unexpected, is negatively related with its current value. The coefficients of

Table 4. Diagnostic tests for the ECM based ARDL models.

LM Test Statistic	Results [Probability]			
	Model 1	Model 3	Model 4	Model 5
Serial correlation: CHSQ(1)	0.570 [0.450]	0.317 [0.574]	0.753 [0.386]	2.166 [0.141]
Functional form: CHSQ(1)	0.103 [0.749]	0.586 [0.444]	0.074 [0.786]	0.040 [0.841]
Normality: CHSQ (2)	0.898 [0.638]	0.351 [0.839]	0.502 [0.778]	0.273 [0.873]
Heteroscedasticity: CHSQ(1)	2.292 [0.130]	0.336 [0.562]	0.087 [0.768]	0.169 [0.681]

Source: Data generated using Microfit 5.0.

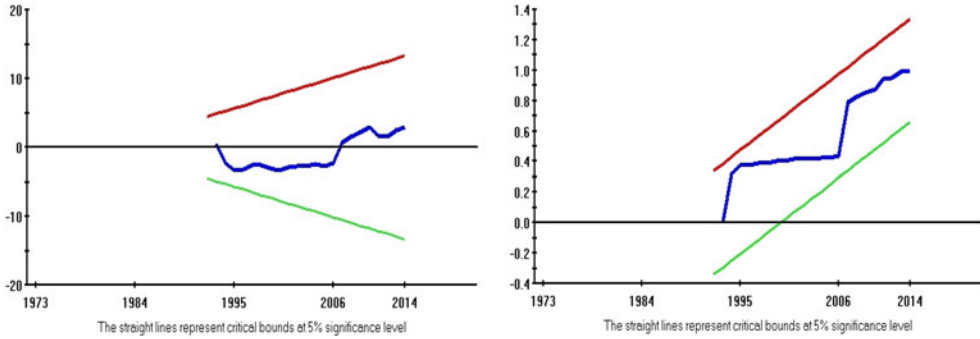


Figure 2. Model 1- cumulative sum of recursive residuals and cumulative sum of squares of recursive residuals plots.

Source: Generated using Microfit 5.0

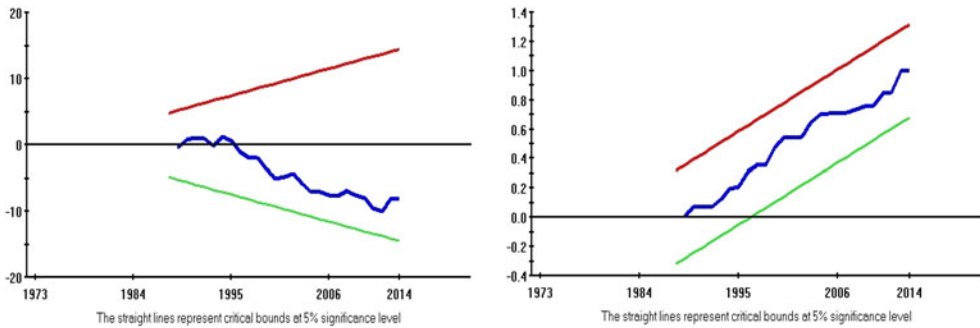


Figure 3. Model 2- cumulative sum of recursive residuals and cumulative sum of squares of recursive residuals plots.

Source: Generated using Microfit 5.0

the ECM (-1) terms for all the models are found to be negative, as expected and statistically significant.

Based on the results from private investment models for Malawi, gross public investment and infrastructural public investment were found to crowd out private investment in the short run. However, infrastructural public investment crowded in private investment in the long run. For policy makers to enhance the contribution of public investment to long-run economic growth, they need to draw particular attention to growing the infrastructural public investment component. This is despite the short-run crowding out effect findings of both gross and infrastructural public investment which may only suggest displacement of the private sector projects in resource allocation in Malawi.

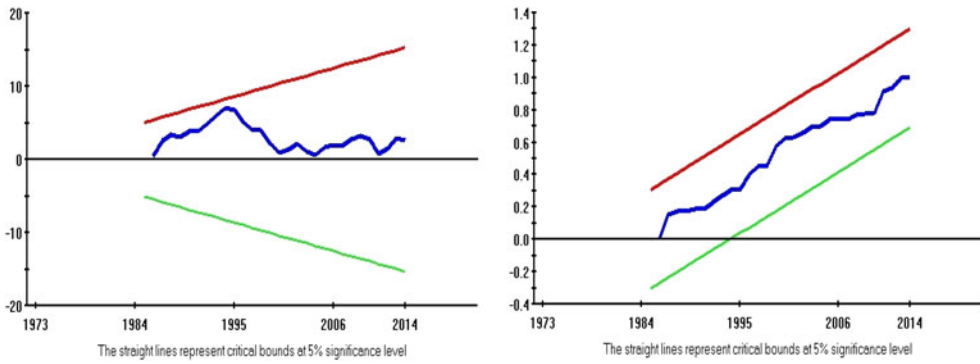


Figure 4. Model 3- cumulative sum of recursive residuals and cumulative sum of squares of recursive residuals plots.

Source: Generated using Microfit 5.0

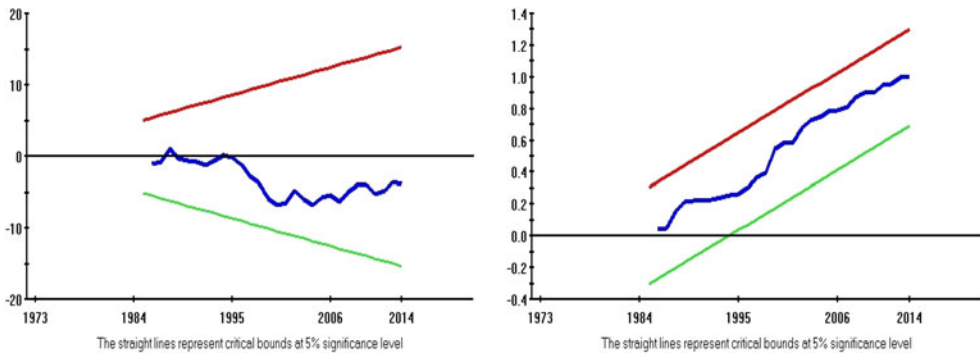


Figure 5. Model 4- cumulative sum of recursive residuals and cumulative sum of squares of recursive residuals plots.

Source: Generated using Microfit 5.0

The results displayed for economic growth and private investment models pass all the diagnostic tests on serial correlation, functional form, normality and heteroscedasticity (see Table 4). Again, all the models (economic growth and private investment) passed the stability tests as given by the cumulative sum of recursive residuals (CUSUM) and the cumulative sum of squares of recursive residuals (CUSUMQ) plots (see Figures 2–5).

5. Conclusion

This study has empirically examined the relative impact of public and private investment on economic growth in Malawi for the period from 1970 to 2014 using the recently developed ARDL bounds testing approach. In order to examine the crowding-in or crowding-out effect of public investment on private investment, the study has also estimated three private investment equations separately – where gross public investment, infrastructural public investment and non-infrastructural investment enter separately in each equation. The empirical results of this study reveal that: (i) in the short run, public investment negatively affects economic growth, while private investment has no effect on economic growth effect; (ii) in the long run, private

investment has a positive impact on economic growth, while public investment has no growth effect; (iii) gross public investment has no effect on private investment in the long run, but in the short run it has a crowding-out effect; (iv) infrastructural public investment crowds out private investment in the short run, but in the long run it crowds in private investment; and (v) non-infrastructural public investment has no effect on private investment, both in the short run and long run. Based on these results, it can be concluded that private investment stimulates economic growth in Malawi more than public investment. However, the contribution to economic growth of public investment in Malawi can be enhanced by focusing on growing the infrastructural public investment component.

While extra effort has been made to ensure that the empirical results are robust and reliable, this research may have certain limitations as do many empirical studies. First, due to the non-availability of data on some factors, the economic growth and private investment models may have been under specified. As data becomes available on other factors such as the rate of modern industrialisation, exports competitiveness and structure, institutional quality and socio-political stability, it would be interesting to find out if the empirical results would change fundamentally in future studies after including these variables. Second, due to the non-availability of data points on infrastructural and non-infrastructural public investment, this study used the Blejer & Khan (1984) methodology to generate the data. It is also important for future studies on the subject to find out if the empirical results on the crowding-in or crowding-out effect of public investment would change significantly when data points become available in Malawi on the variables.

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