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Effect of Public Investment on Private Investment: In
case of Ethiopia

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Effect of Public Investment on Private Investment: In
case of Ethiopia

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Declaration

I (Temesgen Merga) declare that this thesis titled, “**Effect of Public Investment on Private Investment: In case of Ethiopia**” and the work presented in it are my own. I confirm that:

- This work was done wholly or mainly while in candidature for a Masters Degree at Addis Ababa University.
- Where any part of this thesis has previously been submitted for any qualification at this University or any other institution, this has been clearly stated.
- The source is always given where I have cited from the work of others. With the exception of such quotations, this thesis is entirely my own work.

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Abstract

This study has examined the effect of public investment on private investment in Ethiopia during 1993 to 2018. It also examined their relative contribution to economic growth. The study employed the ARDL bounds testing approach which is initiated by Pesaran & Shin (1999) and later popularized by (Pesaran, et al., 2001). The empirical results reveal that public investment has a crowding-in effect on private investment in the long run which means, public investment stimulates private investment in the long run. In the short run, however, public investment has a crowding-out effect on private investment. The previous year public investment also declines the current period private investment in the short run. On the other case, public investment has no direct impact on economic growth in the long run. Economic growth is positively associated with private investment although it is statistically insignificant in the long run. However, it has no any immediate effect on private investment in the short run. On the other direction, private investment has a significant positive impact on economic growth in the long run while it is negatively related to economic growth in the short run. This suggests that there is a unidirectional effect, which means private investment could affect economic growth while it is not vice versa. In addition, private investment positively contributes to economic growth more than public investment. Real interest rate has a significant negative effect on private investment in the long run while it is positively associated with private investment in the short run. However, real interest rate has no direct significant impact on economic growth in the long run.

Key Words: Private investment, public investment, crowding-in/-out, economic growth

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Acronyms

ADF	Augmented Dickey Fuller
AIC	Akaike Information Criteria
ARDL	Auto-Regressive Distributed Lag
CUSUM	Cumulative Sum of Recursive Residuals
CUSUMSQ	Cumulative Sum of Squares of Recursive Residuals
EFY	Ethiopian Fiscal Year
GDP	Growth Domestic Product
IMF	International Monetary Fund
JB	Jarque-Bera
LM	Lagrange Multiplier
MoF	Ministry of Finance of Ethiopia
NBE	National Bank of Ethiopia
NPDC	National Planning and Development Commission of Ethiopia
OLS	Ordinary Least Squares
PP	Phillips-Perron
SBIC	Schwarz-Bayesian Information Criteria
SSA	Sub-Saharan Africa
VAR	Vector Auto-Regressive
VECM	Vector Error Correction Model
WB	World Bank

1 INTRODUCTION

1.1 Background of the Study

The causal relationship between government sector and private sector investment is a central issue in both macroeconomics and development economics (Aschauer, 1989). In fact, the noteworthy question raised here is what relationship they do have and which investment type more fosters economic growth of certain country. The linkage between public investment and private investment, and their relative contribution to economic growth is a controversial issue from both theoretical and empirical perspectives. There are numerous studies which have been done regarding the effect of public investment on private investment despite the existence of contradicting conclusions. There are two opposite ideas ongoing while the issue of the two components of investment (public and private investment) and economic growth has been taken into consideration. This key issue is the case of crowd in (positive) or crowd out (negative) effect of public investment on private.

On the one hand, the case of substitutability (negative linkage) of the two types of investments can be occurred in different situations. Public sector investment may directly negatively affect private investment through a competition of scarce resources. Public sector will also compete with the private sector for funds in the capital markets, causing the interest rate to rise in order to finance its investment (see, Erden & Holcombe, 2006; Sen & Kaya, 2014). This demand of public sector for funds has indirect negative impact on private sector investment through interest rate. Public enterprises may also produce goods and services which compete directly with the private sector so that the two forms of investment become substitutes (see, Khan & Kumar, 1997; Sen & Kaya, 2014; Makuyana & Odhiambo, 2018).

If public investment is financed by increasing taxes, it may further exacerbate distortions in the economy and increase the costs of inputs, leading to an adverse effect on expected output growth and private investment, which has an indirect adverse effect to private investment (Khan & Kumar, 1997). For this reason, the amount of loanable funds available for private firms reduces, hence, lowering private capital formation, meanwhile, crowded out effect of private by public investment.

Public investment can also crowd out private investment when it is deficit financed which raises the cost of capital above the reach of private enterprises and it is undertaken by inefficient state enterprises that receives state subsidies (Makuyana & Odhiambo, 2018). He also argue the crowding out effect when public sector produces commodities that pose direct competition with the private sector when the latter has a higher and a growing efficiency in their production. In addition, according to Ricardian equivalence theory, indebted government spending must be financed in the future by taxes as more taxes imposed by the government in the future, the less disposable income for the private sector (Arestis, 2011). For these reasons, public investment decreases private capital formation which means crowds out private investment.

On the other hand, there may be complementary relationship between public and private investment. Public investment can create conducive conditions for private investment in terms of infrastructure, which reduces private production costs. Public sector can promote private sector, for instance, by providing infrastructure such as roads, highways, sewer and water systems, and power plants, often resulting in a reduction in costs facing the private sector and raising the productivity of private capital (Erden & Holcombe, 2006). The availability of such core infrastructural goods and services reduces private sector sunk costs and increases total productivity and profitability of private sector.

State owned enterprises of economic activities may also indirectly positively affect private investment through its provision of outputs which is used as inputs for private companies (Khan & Kumar, 1997). In order to enhance sustainable economic growth and improve social wellbeing, the priority should be given to efficient public capital expenditure. Public sector may also initiate private investment through its demand of private sectors output. Necessary increase in public investment should ensure efficiency in attracting private investment and economic growth. Providing public goods and services through investment in technical infrastructure (roads, bridges, ports, and industrial parks) and social infrastructure (hospital, and school) improve investment and business environment thereby enhance sustainable economic growth (Canh & Phong, 2017). Better facilities increase the productivity of private investment and reduce the cost of production of the private sector, which has a positive impact on the profitability of private investment. This would result in a crowding-in effect on private sector investment.

Pertinent to this, there are two opposite empirical evidences regarding to effect of public investment on private investment depending up on countries and/or country groups as well as econometric approaches applied to investigate the linkage. As for the first empirical evidences, many studies in developing countries show evidence that public investment positively affects private investment and as well as economic growth (see, Khan & Reinhart, 1990; Khan & Kumar, 1997; Erden & Holcombe, 2006; Hassan, et al., 2011; Dreger & Reimers, 2015; Ouedraogo, et al., 2019). In addition, other some studies indicate the existence of the positive relationship (crowding in effect) between public and private investment in the long run equilibrium rather than short run (see, Cruz & Teixeira, 1999; Canh & Phong, 2017; Nguyen & Trinh, 2018).

As for the second empirical evidences, which has the opposite result to the first one, there is a case which indicate that public investment negatively affects private investment and/or has little or even no impact on economic growth (see, Dash, 2016; Ghani & Din, 2006). Hence, the empirical results are country and a study time period specific as well as the model used for the study may also affect the empirical results. Hence, study is needed to identify the real effect of public sector investment on private sector investment by choosing appropriate econometric approach and relevant period of time. In this regard, this study aims to identify the real effect of public investment on private investment and their relative contribution to economic growth in Ethiopia during 1993-2018.

1.2 Statement of the Problem

Economic theory indicates that capital fixed formation (investment) takes the largest share of economic growth of a country. Many countries use investment to make sustainable economic growth to rise-up per capita growth so that social wellbeing is improved. However, economic scholars argue that it is not the aggregate level of investment which can highly enhance economic process, but, the efficient investment component one. Thus, the question raised to be answered here is which component of investment is highly enhance economic growth whether public sector investment or private sector investment.

Classical economists argue that an increase in public investment reduces private investment, causing increases in the interest rate through government monetary policy intervention and crowds out private investment. In contrast, Keynesian economists argue that increasing public investment improve infrastructure as a result of stimulating private investment and productivity, because, public investment can reduce the costs of production for firms. And, consequently, this make conducive business environment to attract private sector investment.

Additionally, there is no consensus empirical agreement upon the relationship between public and private investment and growth process even though voluminous empirical studies appeared in accord. But, the policy recommendation depends on country and/or country group cases. Thus, identifying the case of crowd in and crowd out effect is crucial to develop long term development policy and short term economic stabilization. However, in Ethiopia, since 2018 when the Ethiopian Government launched to implement a privatization policy, the impact of government investment on private investment and economic growth has become central issue in policy debates among policy makers and academicians.

Although a few studies have been studied the relationship between public and private investment in Ethiopia, surprisingly, they indicated contradicting results almost for the same study period. Member (2015) studied the relationship between private investment and major determinants of private investment in Ethiopia during the spanning of 1975-2010. He indicated the existence of a crowding out effect of public investment on private investment both in the long run and the short run. Unlike, Ouedraogo, et al. (2019) assessed the effect of public investment on private investment in sub-Saharan Africa and indicated, on average, a crowding in effect of public investment on private investment in the region and particularly, in Ethiopia during 1960-2015.

However, neither of the studies has shown the relative contribution of the investment components to economic growth in the country. There is also limitation that the two studies took inappropriate study period, which these studies didn't consider the break time during 1991¹ year. Meanwhile, the data before and after 1991 years doesn't necessarily reflect the real Ethiopian country's data. Basically, it is good to conduct

¹1991 year is a year in which the Eritrea became independent country or separated from Ethiopia.

study during normal economic situations since majority of econometric models are built assuming normal (stationary) situation, unless it is paid attention to explore the impact of the economic crisis.

In addition, many empirical studies have been indicated a positive (complementary) relationship between public and private investment in developing countries, specially, in the long run. The case of crowding out effect most likely to be appear in the short term when private investors might not fully invest their time and money in sake of convenient business environments or in the countries which has sufficient core public services such as public infrastructures and social services and private sector is strong enough to compete with public sector. As it is notable, but, there is no sufficient public infrastructure and also private sectors investment is at its infant stage in Ethiopia. However, the relationship between public and private investment may also depends on the time series and econometric technique applied to one's country analysis (Naqvi & Tsoukis, 2003).

Against these backdrops, this paper aims to contribute in the reconciliation of the impact of public investment on private investment in Ethiopia. This paper also employs the most famous econometric procedure of ARDL approach which is developed for this purpose and currently applicable in wide ranges. In general, the dynamic relationship between public and private investment accompanied with their relative contribution to economic growth in Ethiopia has not been fully examined. Thus, the paper aims to identify the net effect of public investment on private investment both in short and long run, and their relative contribution to economic growth in Ethiopia during 1993 to 2018.

1.3 Objective of the Study

This paper mainly proposes to assess whether public investment in Ethiopia has a positive effect on private investment (i.e. public investment stimulates private investment) or not. Specifically, it addresses some key questions:

- To analyze trend of both public and private investment;
- To assess the linkage between public investment and private investment i.e. the case of crowds effect; and
- To assess the relative contribution of public and private investment to economic growth.

1.4 Significance of the Study

The development of investment policy is essential for the economic growth of any country, especially for developing countries like Ethiopia. Investors spend their capitals in sake of profit maximization through lowering their production cost. The government attempts to create conducive environment in attracting and encouraging investors to make sustainable growth and improve social wellbeing. In this regard, government

may attract investors by provision of core infrastructure (roads, ports, and sewerage systems) and social infrastructure (hospitals, and school) and also by appropriate investment policy incentives like tax exemptions, tax holidays and reduction of taxes levied on private sector.

However, the contribution of private investment to the overall economic growth and development in Ethiopia is still at a very low level. Taking this into account, investigating the extent of private investment to output growth is the most important issue to boost the investment itself and economic growth. This study aims also to determine impact of public investment on private investment and to what extents it does so as to shed some light on the most important aspects and issues in relation to which is economy driven investment. Therefore, this paper contributes to the literature on investment and economic growth, that this may be the first study of its kind to empirically examine the effect of public investment on private investment and their differential impact on economic process in Ethiopia both in the short run and the long-run during 1993-2018.

1.5 Scope of the Study

In terms of key objectives, with the available data, the study attempts to look at the trend of the two components of investment, to draw recommendation on the effect of public investment on private investment and identifying their relative effect on growth process Ethiopia during 1993-2018 periods. The analysis is based on data available at the National Planning and Development Commission (NPDC) of Ethiopia and National Bank of Ethiopia (NBE).

1.6 Organization of the Paper

The rest of the paper is organized as follows. In chapter 2 some the relevant theoretical and empirical literature are reviewed. This is followed by the definition of the data used and the methodology employed in the study in chapter 3. Chapter 4 briefly presents and discusses the major findings of the study and talks about the reliability of the model employed in the study. Conclusions and Implications are presented in chapter 5, at the end of the paper.

2 LITERATURE REVIEW

Review of literature is essential to not only understand the issues involved but also in identifying gaps, planning and scrutinising of the experiences of others. And also, it uses to pursue the key questions of the study's objectives and to fill gaps of empirical research. In this regard, this chapter presents the review of theoretical and empirical findings of studies related to the effect of public investment on private investment and their relative contribution to economic growth. However, there are some crucial issues that emerge from many empirical studies regarding the data definition, relative effect of one variable upon the other (may be factors), methodology, and time frame to be taken for the study. So, it needs to put some conceptual framework which is presented at the last section of this chapter to shed some light on selection of variables and to choose time frame for the study.

2.1 Theoretical Review

The production function is one of the key concepts of mainstream neoclassical theories, used to define marginal product and to distinguish allocated efficiency. The focus of Economics is also the study of how to efficiently use to scarce resources so as the output is produced at a higher rate of margin through production function. Cobb–Douglas production function, so, represent the technological relationship between the two economic inputs, particularly physical capital (K) and labor (L), and the amount of output (Y) that can be produced by those inputs. But, the issue may arise here is about the nature of capital formation, which component of capital formation is economic growth driven whether capital formation by government sector (public investment) or capital formation by private sector (private investment). The case is that sustainable growth may not be achieved with inadequate investment policy.

From theoretical perspective, public sector investment which affects economic growth can be reflected by aggregate supply and aggregate demand. Public investment directly impacts on aggregate demand as a government expenditure and aggregate supply as a production function which is capital factor (Canh & Phong, 2017). A rise in public investment, then, can have effects on private investment through substitutable or complementary relationships between them.

As for the first economic view, public investment may negatively affect private investment in a direct way and economic growth in an indirect way by increasing interest rate when latter is more productive than the former. The increase of public investment needs to be financed, which may impose more taxes or impose a higher demand for funds from the government in the capital markets, therefore causing interest rate to rise (Afonso & Aubyn, 2009). Government consumption has no direct effect on private productivity, but lowered saving and growth through the distorting effects from taxation or government expenditure programs (Barro, 1991). This would reduce the saving which is loanable funds available for private investors and decrease the expected rate of return of private capital. There may also be a situation in which public sector compete to private sector in the production of the same good using the

same scarce resources, leading to a crowding-out effect on private sector investment (which is called substitutability relationship).

As for the second view on the other hand, public investment has spillover effect and indirectly impacts to aggregate demand by stimulating private investment and to aggregate supply through attracting private investment (Canh & Phong, 2017). Public investment can create additional favorable conditions for private investment, for instance, by providing relevant infrastructure such as hospitals, roads, highways, and sewage systems. The existence of such infrastructure facilities may increase the productivity of private investment and potentially improve business conditions, which reduces sunk (setup) cost for private investors.

Private investment could also be advocated in favour of public investment, if the public sector is more willing to make higher-risk investments than the private sector, sectors which require large volumes of initial capital and long lead times are considered to be of high risk (Cruz & Teixeira, 1999). He alludes that it would be hard for the private sector to make such investments, not only because of the risk but also because of the limited size of the secondary securities market. There may also be a situation in which state sectors output is used as input for private sector at an affordable price, which encourages private investors to invest more. Government expenditures on education and defense are also more seem public investment, are likely to affect private-sector productivity, which matter for private investment positively (Barro, 1991). This would result a crowding-in effect of public investment on private investment (which is called complementarity relationship).

Mathematically, the equation of crowding-in/-out effect is designed depending on Cobb Douglas production function is designed as follows. If Cobb Douglas production function represents the composition of the two economic inputs (capital stock, K and labor, L) and real level of output (economic growth, Y) with a given labor augmenting technology or knowledge (A) is defined as:

$$Y_t = AK_t^\alpha L_t^{1-\alpha} \quad (1)$$

Where $0 < \alpha < 1$, assuming diminishing returns to scale.

The maximized production function with respect to capital is equivalent to marginal productivity of capital input. Then investment function can be derived following Jorgenson's method as follows:

$$\begin{aligned} \partial Y_t / \partial K_t &= \partial (AK_t^\alpha L_t^{1-\alpha}) / \partial K_t = \alpha AK_t^{\alpha-1} L_t^{1-\alpha} \\ \Rightarrow MPK &= \alpha \frac{A}{K_t} K_t^\alpha L_t^{1-\alpha} = \alpha \frac{A}{K_t} Y_t \\ \Rightarrow K_t &= \alpha \frac{A}{MPK} Y_t = \beta Y_t \end{aligned}$$

(2)

where $\beta = \alpha \frac{A}{MPK}$, $0 < \beta < 1$ shows that capital stock is a certain proportion of real output level and t is a time index.

Then, if we apply difference operator to both sides and subtract the lagged one from the former equation, (2), it becomes:

$$\Delta K_t = \beta \Delta Y_t = I_t \quad (3)$$

This accelerator model assumes that investment would be determined not only by the current change in output, but also by its earlier changes. But there is a change at a time t , the difference between the current and its preceding period actual level. It assume that the economy is not producing at the desired level of output (Y^*). Hence, in each period there is partial adjustment toward its desired level and it becomes to:

$$\Delta Y_t = \lambda(Y_t^* - Y_{t-1}) \rightarrow Y_t = \lambda Y_t^* + (1 - \lambda)Y_{t-1} \quad (4)$$

Where, $0 \leq \lambda \leq 1$ is the adjustment rate to its long run equilibrium. The larger the value of λ the faster will be the adjustment toward to its desired level.

Then, substituting equation (4) into equation (3), we can get:

$$\begin{aligned} \Delta K_t &= \beta(Y_t - Y_{t-1}) = \beta[\lambda Y_t^* + (1 - \lambda)Y_{t-1} - Y_{t-1}] \\ &= \beta\lambda Y_t^* + (1 - \lambda)\Delta Y_{t-1} \rightarrow \Delta K_t = \beta\lambda Y_t^* + (1 - \lambda)\Delta K_{t-1} \\ &\Rightarrow I_t = \beta\lambda Y_t^* + (1 - \lambda)I_{t-1} \end{aligned} \quad (5)$$

And let private investment (PI) is not producing at the desired level and as a result, it also adjusts toward to its desired level capital stock (PK^*) which is given by:

$$PI_t = \lambda(PK_t^* - PK_{t-1}) \quad (6)$$

Additionally, from the theoretical perspective, there are some economic variables which affect the desired level of private investment like output level (Y) in terms of aggregate demand as a government expenditure and aggregate supply as a production function, trend of public capital stock (GK), and real interest rate through saving-investment relationship (R). Thus, let the effect of these variables on private capital formation given by:

$$PK_t^* = \beta_1 Y_t + \beta_2 GK_t + \beta_3 R_t \quad (7)$$

Then, substituting equation (7) into equation (6) and taking the first differences to each economic variables give:

$$PI_t = \lambda[\beta_1 Y_t + \beta_2 GK_t + \beta_3 R_t - PK_{t-1}] = \lambda\beta_1 Y_t + \lambda\beta_2 GK_t + \lambda\beta_3 R_t - \lambda PK_{t-1}$$

$$\begin{aligned} PI_t &= \phi_1(Y_t - Y_{t-1}) + \phi_2(GK_t - GK_{t-1}) + \phi_3(R_t - R_{t-1}) + \phi_4 PI_{t-1} \\ \Rightarrow PI_t &= \phi_1 \Delta Y_t + \phi_2 \Delta GK_t + \phi_3 \Delta R_t + \phi_4 PI_{t-1} \end{aligned}$$

(8)

Where, $\phi_i = \lambda\beta_i$, $i=1, 2, 3$, respectively, and $\phi_4 = (1 - \lambda)$

This equation (8) is called a model of crowding-in/-out effect. It is model that allows checking whether public investment has a crowding-in or crowding-out effect on private investment.

2.2 Empirical Literature

Investigation about the linkage between public investment and private investment and growth process has been needs a series debate among policy makers and academicians. A comprehensive study has been carried out in different countries and groups of countries, and results are quite not the same. Empirical studies have used to various approaches and various time series to investigate the impact of public investment on private investment and in the process of economic growth. In this regard, some studies show positive effects of public investment on private investment often appeared in developing countries or emerging economies (see, Khan & Reinhart, 1990; Khan & Kumar, 1997; Erden & Holcombe, 2006; Hassan et al., 2011; Islam et al., 2018; Ouédraogo et al., 2019). One of the studies which have done very earlier is by Khan & Reinhart (1990) which assessed private investment and economic growth in developing countries. Results of their study argued the existence of indirect complementary relationship between public and private investment. In particular, but, private investment has a larger direct effect on growth than does public investment.

Another famous article, Khan & Kumar (1997), assessed the relationship between public and private investment and the economic growth in 95 developing countries. They employed neoclassical model of cobb-Douglas production function for the period of 1970-1990. Their empirical study argued that there is much more complementarity between private and public investment. They have also analyzed the net effect of public and private on growth in general. Empirical results of their study show that private and public investment has a differential impact on economic growth, with private investment having a much larger impact than public investment.

Another study on the effect of public investment on private investment in developing economies was done by Erden & Holcombe (2006). They applied several pooled OLS specifications of a standard investment model and panel data for the period of

1980 – 1997 of 19 developing countries. This study has a result indicating that public investment has positive effect on private investment both in short and long run. However, the complement effect of public to private investment is much higher in long run than in short run. But, econometric model they used is criticized of inefficient and inconsistent in case of small sample as it is the case for this study.

On the other way, some studies show that there is a competition between public investment and private investment leads to negative relationship between them i.e. the former one crowds-out the latter one (see, Dash, 2016; Ghani & Din, 2006). Dash (2016) analyzed the impact of public investment on private investment in India during 1970-2013 using ARDL procedure. He concluded that public investment negatively affects private investment. His results, in particular, implies that a 1 per cent increase in public investment as a ratio to GDP leads to 0.81 per cent and 0.53 per cent decrease in private investment as a ratio to GDP in the long run and short run, respectively, after controlling for economic conditions.

The impact of public investment on private and economic growth in Pakistan was studied by Ghani & Din (2006) applying VAR approach with period 1973 to 2004. Results of their empirical work indicate that public investment crowds out private investment. They also indicated that growth is largely driven by private investment, and public investment has a negative although it is insignificant impact on output and which may be occurred because of the misallocation of resources towards unproductive capital expenditures.

Other studies are, however, interested in exploring the real effect of disaggregated components of public investment on private investment than the aggregate one. But, not surprisingly, their empirical results are quite not similar (see, Saeed et al., 2006; Hassan et al., 2011; Sen & Kaya, 2014; Xu & Yan, 2014). Following the previous study by Ghani & Din (2006), Saeed et al. (2006) explored the impact of public investment on private investment in Pakistan during spanning period 1973 to 2006 using the same approach as the previous one. But, they have disaggregated public sector capital formation into agriculture and manufacturing sectors. Partially, it confirmed the previous study stating that public investment in manufacturing sector crowds out private investment while increase in public investment crowds in private investment in the agriculture sector. However, reveal insignificant impact of public investment upon private investment for the aggregated level. In this regard, there may be huge public expenditure in manufacturing sector than agriculture sector according so that the former study is to become revealed.

Hassan et al. (2011) explored the relationship between public and private investment by using a panel time series analysis on four sectors of the Malaysian economy (agriculture, industry and trade, transportation and communication, and construction) for the period of 1976–2006. Their study's results show that public investment has positive effect on private investment in all the three sectors except agricultural sector. It suggests that government expenditure encourage more private investment if focus is given towards productive expenditure. In particular, however, public in-

vestment in construction sector has contributed the largest effect on domestic private investment followed by services sector.

A study by Sen & Kaya (2014) searched out crowding in or crowding out effect of government spending on private sector in Turkey during 1975 to 2011. They disaggregated government spending to government current spending, government current transfer spending, government interest spending and government capital spending to see the effects of each component of government spending rather than taking it cumulatively. Their empirical results indicate that government current transfer spending, government current spending, and government interest spending crowds-out private investment, whereas government capital spending crowds-in private investment in Turkey.

Xu & Yan (2014) investigated a study of the relationship between government and private investment in China using structured VAR analysis over the period of 1980 to 2011. Their results indicated that government investment in public goods crowds in private investment significantly, while government investment in private goods mainly through state owned enterprises, crowds out private investment significantly.

On the other hand, many researches argue that there is no evidence to totally conclude the presence of the relationship, rather the relationship is economic term's dependent. There may be positive relationship in the short run and negative in long run or vice versa or has insignificant evidence to conclude (see, Cruz & Teixeira, 1999; Naqvi & Tsoukis, 2003; Dreger & Reimers, 2015; Canh & Phong, 2017; Nguyen & Trinh, 2018; Makuyana & Odhiambo, 2018; Makuyana & Odhiambo, 2019; Ouédraogo et al., 2019). Cruz & Teixeira (1999) assessed the impact of public investment on private investment in Brazil for the period 1947-1990. Their results indicated that private investment is crowded out by public investment in short term, but in the long term there is a positive relationship between them i.e. they complement to each other in the long term.

A study by Naqvi & Tsoukis (2003) explored the relationship evidence between public investment and private investment and growth for 1971-2000. They employed cross sectional VAR approach in six developing Asian countries; Bangladesh, India, Indonesia, Malaysia, Pakistan, and Thailand. They found out that there is not any single robust complementarity or substitutability between public and private investment, but it depends on the time series properties. Not surprisingly, their empirical results show that the crowding in effect for Bangladesh while it is crowding out in Thailand, and also there is no discernible patterns at all in both India and Malaysia. Islam et al. (2018)), then, confirmed that public investment crowds in private investment in Bangladesh over the period 1980-2016. Their results, in addition, show the existence of significant impact of both public and private investment on GDP growth in long run while private investment has impact on growth also in short run but the former is not. Thus, increase in public investment exerts a positive impact on private investment thereby foster economic growth.

The study on linkage between public (state sector) investment on private investment and economic growth in Vietnam was done by Canh & Phong (2017). Their assessment is based on 22 economic industries for the period of 1990-2016. Their findings indicated that public investment has an impact of inverted U-shape on economic growth. Meanwhile, public investment promotes economic growth in most economic industries/sectors in the short and medium term, but, has negative impact on economic growth in the long term. Most similarly, state sector investment (including public investment and state owned enterprise investment for production and business activities) has the same impact as public investment on economic growth in the short and medium term. However, it has no effect on economic growth in the long term. In addition, public investment stimulates domestic private investment in the short and medium term, but crowds out private domestic investment in the long term.

And, Nguyen & Trinh (2018) re-assessed using ARDL approach and the same period (1990-2016) to evaluate the short and long-term effects of public investment on private investment and economic growth for the same country. Their empirical results confirmed that public investment does affect economic growth in an inverted-U shape effect, with positive effects in the short term and negative effects in the long run in Vietnam. The estimated effect of public investment on private investment also shows a similar inverted-U shape in which public investment have crowding-in private investment short-term but crowding-out in the long run.

Dreger & Reimers (2015) assessed an impact of public investment on private investment among 12 countries in Euro area during 1991-2012 using the Cobb-Douglas production function and panel econometric framework. They concerned at the long-term implications of public investment and private investment in the Euro area in capital stocks and gross investment flows with a co-integrated relationship of cumulative investment variables. Results of their study indicated that private investment responds to the effects of public investment on both capital stocks and gross investment flows. Results also assigned that there is a positive relationship between public and private investment. However, public investment seems to be an exogenous variable which means that public investment is a policy variable. Thus, a lack of public investment could lead to restrictions on private investment and GDP growth in the Euro area.

There are also some empirical studies conducted in African countries. The results empirically show the existence of different policy recommendations concerning different countries. According to Makuyana & Odhiambo (2019) in examining public and private investment and economic growth in Malawi by employing ARDL-bounds testing approach, gross public fixed capital formation (investment) has no effect on private investment in the long run, but in the short run it has a crowding-out effect relying on the data during 1970 to 2014. In particular, infrastructural public investment crowds out private investment in the short run, but in the long run it crowds in private investment; and non-infrastructural public investment has no effect on private investment, both in the short run and long run in Malawi.

Makuyana & Odhiambo (2018) applied the same model during the same time period also for Zambia. Unlike Malawi's empirical findings, public investment and its disaggregated components have crowding-out effect on private investment in short run and non-infrastructural investment has a crowding out effect on private investment in long run for Zambia while it has no effect on private investment in Malawi. Nevertheless, the empirical evidences from the study show that private investment contributes more to economic growth than public investment and the long-run contributions of both private and public investment to economic growth can be improved by raising the infrastructural public investment in both Malawi and Zambia.

Another study on the effect of public investment on private investment was asserted by Ouedraogo et al. (2019) for 44 sub-Saharan African countries over the period 1960–2015. Their empirical analysis revealed that on average public investment crowds in private investment in sub-Saharan Africa and, also, the impact differs between countries and is higher in countries with a strong private sector. In particular, they figured out that Ethiopia is one of the countries in which public investment stimulates (crowds in) private investment.

Furthermore, Member (2015) analyzed the relationship between private investment and major determinants of private investment in Ethiopia during the spanning of 1975-2010. Results of his study indicated that public investment has a crowding out effect on private investment both in the long run and in the short run. In the long run, in particular, a unit increase in public investment as share of GDP is accompanied by 0.6 unit decrease in private investment as share of GDP while the effect is much higher estimated at 2.3 unit decline in private investment as share of GDP in the short run. It means the existence of a competition between public investment and private investment for scarce resources is appeared. And his results alluded also a unidirectional relationship of the two implying that public investment is policy variable.

Unlike, there is a recent study which showed a crowding in effect of public on private investment in Ethiopia (in particular) conducted by Ouédraogo et al. (2019) while assessing the case in sub-Saharan Africa countries in general. In addition, empirical findings of many studies in developing countries show that there is the existence of positive association between public and private investment since both of them are not strong enough to compete to each other. Pertinent to this, this study is aims to shed some light on reconciling about the relationship between public and private investment accompanied by output growth in Ethiopia empirically.

2.3 Conceptual Framework

The conceptual approach in understanding the effect of public investment on private investment can be mainly classified into two cases. The first case, the case of crowding-out effect of public investment on private investment which is also called the substitutability relationship between them. It clearly states that an investment taken by public sector could retards investment which is taken by private sector. It is

further argued by classical economists that an increase in public investment reduces private investment, causing increases in the interest rate through government monetary policy intervention. In this way, an increase in real interest rate causes higher cost to private sector so that private investment decline. Not only this, but also private investment declines due to saving-investment relationship which means an increase in real interest rate causes high rate of return on saving and declines investment. Hence, in this regard, private investment and real interest rate is expected to have an inverse relationship.

The second case, the case of crowding-in effect of public investment on private investment which is also called the complementary relationship between them. This case is argued by Keynesian economists that an increasing in public investment improve infrastructure and as a result stimulates private investment and productivity, because, public investment can reduce the costs of production for firms. Furthermore, there is no consensus regarding the linkage although numerous empirical studies appeared in accord. Some studies assured that the linkage is highly the country case (see, Naqvi & Tsoukis, 2003; Ouedraogo et al., 2019).

However, as discussed in empirical literature, more or less the empirical studies show that the case of crowding-out public investment on private investment is most likely to be appeared in developed countries rather than developing ones. The reasons of this case may be because of the existence of sufficient infrastructures which reduces the cost (it might be also set up cost) to private sector so that higher competition between public sector and private sector might be revealed as argued by the scholars. In other words, the case of crowding-in is most likely appears in developing countries. This may be because of insufficient existence of infrastructures and incompetence of private sector. Since private sector in most of the developing countries is at their lower capacity to finance their own business and unable to maintain good business area to themselves, they are dependable on government features. Furthermore, it is an ambiguous to give solid conclusion on the effect of public investment on private investment at all.

In reference to their relative impact on economic growth, most of the studies similarly agree on that private investment contributes direct positive impact to economic growth more than public sector (see, Khan & Reinhart, 1990; Khan & Kumar, 1997; Dreger & Reimers, 2015; Islam et al., 2018). Notwithstanding private investment could contribute more to economic growth than public investment according to these articles, it is accompanied by a complementary relationship between public investment and private investment at least in the long run. In this case, but, the contribution of public investment to economic growth is undeniable which it is seen as an indirect impact through private investment. So, for this study it is expected that private investment has a higher contribution to economic growth than public investment.

3 DATA AND METHODOLOGY

3.1 Introduction

The data employed in this study is found from National Planning and Development Commission (NPDC) of Ethiopia and National Bank of Ethiopia (NBE). As discussed in the theoretical framework, the variables used in this study are private investment, public investment, real rate of economic growth, and real interest rate. In order to estimate, I used information for the following series: GDP at constant basic prices which is at 2003 base year (Y); general government gross fixed capital formation as share GDP as public investment (GI); gross fixed capital formation of the private sector as share of GDP as private investment (PI); the real interest rate calculated as the difference between lending rate and inflation rate (R). The data are taken for the period of 1993 to 2018 upon the restriction of the non-availability of the data beyond the study's starting year. Quality of data and measurement errors are given a priority concerns by taking the data from appropriate organization which actually the government of Ethiopia is officially using to it.

3.2 Estimation Technique

3.2.1 Stationarity Test

The assumption that the variables are stationary is crucial for the properties of standard estimation and testing procedures since econometric models are built on the stationarity property. Before estimating a macroeconomic time-series model, it is necessary to identify the nature of time series data whether it is stationary or non-stationary (trend). It's said stationary if the mean and variance are constant regardless of the actual time taken. Stationary test makes sure that there won't be exists spurious results. Thus, if the employed variables in the model are stationary, then it avoids model misspecification and spurious results.

The stationarity of each series is designed by the standard Augmented Dickey-Fuller (ADF) Dickey & Fuller (1979) and later verified by Dickey & Fuller (1981). The stationarity test results may be sensitive to whether a constant and/or a time trend are/is included in the regression. The appropriateness of including a constant and/or a trend is checked by formally testing whether they are statistically significant in the respective stationarity test for the regression equations.

The hypothesis to be tested is:

Ho: The variable has a unit root

H1: The variable has no a unit root

Under the null hypothesis, each variable of interest (stochastic) has a unit root. The calculated values are compared with the critical values at determined level of significance. If the calculated value is greater than the determined critical values, then we reject the null hypothesis which actually means the variable is stationary. Otherwise,

we do not reject the null hypothesis which leads that there is a unit root implying the variable is non-stationary.

3.2.2 Co-integration Test

Developments in econometrics have allowed the researchers to not only examine the extent to which variables are non-stationary, but also whether they grow together over time and converge to their long-run relationship (Ghani & Din, 2006). Long run linear relationships among variables in the presence of short-run deviations from the long run equilibrium are checked using co-integration test. In case of non-stationary series with a unit root, first differencing of variables provides the appropriate solutions to ensuring the series are weakly stationary.

According to Davidson & Mackinnon (1999), the empirical analysis requires the determination of the appropriate lag length because the estimation result may be sensitive to the number of lags included in the model. Hence, prior to undertaking the co-integration test, it needs to determine the appropriate lag length, which is determined using the model selection criteria by Akaike Information Criteria (AIC), or/and Schwarz (Bayesian) Information Criteria (SBIC). This paper employs the newly developed ARDL bounds testing framework that was initiated by Pesaran & Shin (1999) and later popularised by Pesaran, et al. (2001), which is built for the same purpose.

The approach has recently been credited for its advantages over the traditional co-integration techniques such as full maximum likelihood based approach by Johansen & Juselius (1990) and the residual based approach by Engle & Granger (1987). There are couples of advantage of using ARDL bounds approach over other co-integration tests. Firstly, the ARDL approach is ideal even with a small sample while the traditional co-integration techniques are sample size sensitive, which is the case in this study. Secondly, it does not restrict the variables of interest to be integrated of the same order (Pesaran, et al., 2001). It 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 co-integration approach that employs a system of equations (Makuyana & Odhiambo, 2018). Finally, It doesn't restrict the variables of interest to be all are endogenous i.e. it is applicable to the mixture of endogenous and exogenous variables and it provides long-run estimates that are unbiased.

The ARDL representation of the effect of public investment on private investment model is specified as follows:

$$\Delta PI_t = \alpha_0 + \sum_{i=1}^p \alpha_{1i} \Delta PI_{t-1} + \sum_{i=0}^p \alpha_{2i} \Delta GI_{t-1} + \sum_{i=0}^p \alpha_{3i} \Delta Y_{t-1} + \sum_{i=0}^p \alpha_{4i} \Delta R_{t-1} + \beta_1 PI_{t-1} + \beta_2 GI_{t-1} + \beta_3 Y_{t-1} + \beta_4 R_{t-1} + \epsilon_t$$

(9)

Where, PI , the dependent variable, is the gross fixed capital formation by the private sector (a proxy for private investment); Y is the 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); R is the annual rate of real interest; α_0 is the intercept; $\alpha_1 - \alpha_4$ and $\beta_1 - \beta_4$ are short-run and long-run elasticities, respectively, of private investment with respect to above identified variables; ϵ_t is the white noise residuals; Δ is the difference operator; and p is the lag length.

The null hypothesis to be tested here is:

$H_0 : \beta_1 = \beta_2 = \beta_3 = \beta_4 = 0$, which indicates the non-existence of long run relationship against

$H_1 : \text{not } H_0$ (at least one of the coefficient is different from zero) which indicates the existence of long run relationship.

Similarly, the ARDL representation of the relative contribution of public and private investment to economic growth model is specified as follows:

$$\Delta Y_t = \alpha_0 + \sum_{i=1}^p \alpha_{1i} \Delta Y_{t-i} + \sum_{i=0}^p \alpha_{2i} \Delta PI_{t-i} + \sum_{i=0}^p \alpha_{3i} \Delta GI_{t-i} + \sum_{i=0}^p \alpha_{4i} \Delta R_{t-i} + \beta_1 Y_{t-1} + \beta_2 PI_{t-1} + \beta_3 GI_{t-1} + \beta_4 R_{t-1} + u_t \quad (10)$$

Where, $\alpha_1 - \alpha_4$ and $\beta_1 - \beta_4$ are short-run and long-run elasticities, respectively, of economic growth model with respect to above identified variables; u_t is an white noise residuals; and all other variables are defined as in the above model (9).

The null hypothesis to be tested here is again:

$H_0 : \beta_1 = \beta_2 = \beta_3 = \beta_4 = 0$, which indicates the non-existence of long run relationship against

$H_1 : \text{not } H_0$ (at least one of the coefficient is different from zero) which indicates the existence of long run relationship.

3.2.3 Vector Error Correction Model

Under error correction mechanism, it needs to know the speed of adjustment of short run shocks to its equilibrium dynamics following the existence of co-integrated variables. In the error correction mechanism, the first difference of the dependent variable is regressed on its first lagged difference, the first lagged difference of the explanatory variables and the first lag of residual obtained from the long run model. The error correction model contains information of the speed of adjustment to long run dynamics.

The error correction model of the ARDL bounds procedure for private investment model of equation (9) is expressed as follows:

$$\Delta PI_t = \alpha_0 + \sum_{i=1}^p \alpha_{1i} \Delta PI_{t-1} + \sum_{i=0}^p \alpha_{2i} \Delta GI_{t-1} + \sum_{i=0}^p \alpha_{3i} \Delta Y_{t-1} + \sum_{i=0}^p \alpha_{4i} \Delta R_{t-1} + \phi ECT_{t-1} + \epsilon_t \quad (11)$$

Where, PI , the dependent variable, is the gross fixed capital formation by the private sector (a proxy for private investment); Y 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); R is the annual real rate of interest; α_0 is the intercept; $\alpha_1 - \alpha_4$ are short-run elasticities of private investment model with respect to above identified variables; ϵ_t is the white noise residuals; Δ is the difference operator; ECT_{t-1} is the error correction term lagged by one period; ϕ is the coefficient of the error correction term (ECT); and p is the lag length.

The null hypothesis to be tested here is: $H_0 : \phi = 0$, which indicates the non-convergence to its long run dynamics against the alternative hypothesis of, $H_1 : \phi \neq 0$, existence of long run relationship between the dependent variable and exogenous variables. The coefficient of error correction model is also expected to have negative sign, which indicates the convergence to its long run dynamic equilibrium.

Similarly, the error correction model of the ARDL bounds procedure for economic growth model of equation (10) is also expressed as follows:

$$\Delta Y_t = \alpha_0 + \sum_{i=1}^p \alpha_{1i} \Delta Y_{t-1} + \sum_{i=0}^p \alpha_{2i} \Delta PI_{t-1} + \sum_{i=0}^p \alpha_{3i} \Delta GI_{t-1} + \sum_{i=0}^p \alpha_{4i} \Delta R_{t-1} + \gamma ECT_{t-1} + u_t \quad (12)$$

Where, $\alpha_1 - \alpha_4$ are short-run elasticities of economic growth model with respect to above identified variables; ECT_{t-1} is an error correction term lagged by one period γ is the coefficient of the ECT ; u_t is the white noise residuals; and all other variables defined as in the above model (11).

The null hypothesis to be tested here is: $H_0 : \gamma = 0$, which indicates the non-convergence to its long run dynamics against the alternative hypothesis of, $H_1 : \gamma \neq 0$, existence of long run relationship between the dependent variable and exogenous variables. The coefficient of error correction model is also expected to have negative sign, which indicates the convergence to its long run dynamic equilibrium.

3.2.4 Granger Causality Test

The purpose of causality test in multivariate time series analysis is to identify which variable granger causes another variable. It helps to identify the direction of causality so that it is easy to know the policy variable in the econometric model. Here the concept of granger cause is quite different from cause that it stands for if the past history of one variable can affects the future values of another variable. This technique was proposed by Granger (1969) and refined by Sims (1972). Let two variables X and Y ,

X is said to Granger cause Y if lagged values of X predict Y well. In general, a time series X is said to Granger-cause another time series Y if it can be shown that the series X values provide statistically significant information about the future values of series Y ; if not, X does not Granger-cause Y .

According to Granger (1988), the existence of co-integration between X and Y must be evaluated before performing a causality test. If a co-integrating relationship is identified, then causality must exist in at least one direction. There may be bi-directional causality, that is, all of the variables will cause each other. At the other extreme, there may be no causality at all; in this case, the variables are said to be independent.

This causality is tested by regressing each variable on its lagged values and that of other variables and given by:

$$Y_t = \beta_0 + \sum_{j=1}^j \beta_j Y_{t-j} + \sum_{k=1}^k \delta_k X_{t-k} + \epsilon_t \quad (13)$$

The reverse direction approach for the determination of the causal relationship is then:

$$X_t = \alpha_0 + \sum_{j=1}^j \alpha_j X_{t-j} + \sum_{k=1}^k \phi_k Y_{t-k} + u_t \quad (14)$$

In the model specified above, X_t and Y_t are the variables; ϵ and u_t are mutually uncorrelated error terms, t denotes time period; and j and k number of lags. From the proposed model above, there will four cases exist for significance tests:

- If $\delta_k = 0$ and $\phi_k = 0$, there is no relationship between the two variables.
- If $\delta_k = 0$ and $\phi_k \neq 0$, Y_t granger cause X_t (Y_t is weakly exogenous).
- If $\delta_k \neq 0$ and $\phi_k = 0$, X_t granger cause Y_t (X_t is weakly exogenous).
- If $\delta_k \neq 0$ and $\phi_k \neq 0$, there is an inter dependence between the two variables and based on the signs of the coefficients one can decide on the crowding in/out effect.

This will applied on the all variables of interest taking two at a time, to check for causality and its direction among the variables.

3.3 Diagnostic Checking

3.3.1 Residuals Normality Test

The test of normality of the residuals is one of the important post-estimation diagnostic tests in order to check the appropriateness of the model. To test the normality of residuals, Jarque-Bera (JB) test will be used which compares the third and fourth moments of the residuals to those from the normal distribution. Rejection of the null hypothesis at the standard critical values indicates non-normality of the residuals.

3.3.2 Vector Error Autocorrelation Test

The other diagnostic test for evaluating the complete specification and robustness of the results of an econometric model is the test of serial correlation of the residuals. Breusch-Godfrey Lagrange Multiplier (LM) test, which is a multivariate test for residual serial correlation up to some specified lag order is also used to test an autocorrelation between exogenous and error terms. Rejection of the null hypothesis at the standard critical values indicates the existence of serial correlation among the residuals.

3.3.3 Heteroscedacity Test

White noise test will be used to evaluate the heteroskedasticity of the residuals. White noise tests the null hypothesis that the residuals are both homoskedastic and that there is no problem of misspecification. The test of regression will also be performed by regressing each cross-product of the residuals on the cross-products of the regressors and testing the joint significance of the regression to check no autocorrelation between regressors and an error terms.

4 EMPIRICAL ANALYSIS

4.1 Descriptive Statistics

Before estimating the model, it's important to know the properties and the behavior of the study variables. It is useful to take some correction measures so that the variables are certainly applicable for estimation process. The results given in Table 1 below, describe some behavior of the variables. It suggests absence of outliers in the data since the mean values lie between the minimum and the maximum values.

The description of the variables, both private investment (PI) as share of GDP and

Table 1: Summary of all the variables

Variables	N	Mean	sd	min	Max	Skewnes	Kurtosis
PI	26	12.62	3.644	5.717	20.98	.1418	2.697
GI	26	13.31	4.944	6.222	23.03	.7928	2.275
Y	26	7.985	4.645	-4.185	13.53	-1.102	3.460
R	26	1.217	10.18	-24.15	19.85	-.7801	3.806

public investment (GI) as share GDP have close average value as share of GDP but they have quite different minimum and maximum values. Private investment as share of GDP has 5.7 and 21 a minimum and a maximum respectively, whereas, the latter has 6.2 and 23 a minimum and a maximum respectively. The economic has annually grown by 8 percent on average showing a minimum of -4.2 percent and a maximum of 13.5 percent. The real interest rate has an average value of 1.2, a minimum value of -24.2 and a maximum value of 19.8 during the study period.

And also, the description show that private investment, public investment and real economic growth macroeconomic variables are like normal, while the other variable real interest rate has abnormality showing the greater standard deviation than mean value. Real interest rate displays the highest dispersion shown by standard deviation of 10.18, which actually an indication of abnormality of the variable, while the rest of the variables display the lowest level of almost similar standard deviation. This explains why these variables appear in the natural logarithm form to avoid dispersion to some extent and it is easy to explain the variables effect on endogenous one in terms of elasticity in the analysis.

This unrecognized real interest rate is presented following 2008 global financial and economic crisis, when it is registered at -24.2 in 2009. The consequence might be for two reasons: (i) because of the 2008 global financial crisis when almost the global economy depressed, which pushed consumers to spend more their money than keeping save at the bank. This shock could rise inflation up and causes real interest rate fall down; (ii) it may be because of huge consumption expenditure both at the state and the private sectors level stemming higher inflation while the country filled with the

hope of the celebration of the second Ethiopian New Millennium (2000 EFY)². This abnormal result for real interest rate stemmed from the escalation of inflation rate in at that time, which reached 44.4 percent causing the real interest rate to reach down -24.2 percent.

4.2 Trends of Private and Public Investments in Ethiopia

Total investment in Ethiopia is increased sharply during the 1993-2018. Ethiopia's gross domestic investment as share of GDP has markedly improved over years in contrast with the trend observed in of most of Sub-Sahara African (SSA) countries (MoF, 2017/18). It also mentioned that private investment (both domestic and foreign) can boost employment and productivity, transfer technology and could bring foreign exchange so that the reserve will be improved. As a result, the high share of investment compared with the SSA average is due to the creation of an enabling environment, especially for the participation of the private sector along with the public sector aggressive investments in infrastructure and social services according to this report. Nevertheless, Ethiopia's private investment share is yet at its lowest level.

Ethiopia is a country on a fast growth for past two decades. The GDP growth rate was 10.4% per annum during the years 2004- 2018. The most important factors contributed to the economic growth of Ethiopia are agricultural modernization, the development of new export sectors, strong global commodity demand and government led development projects (WB, 2013). The big push of public investment – led development has delivered positive returns but the development of a strong and vibrant private sector is needed to sustain the high growth (WB, 2013), as it is cited in (Feleke, 2013). Therefore, it is not only the total level of investment that matters growth, but also a particular focus on private investment is crucial concern for policy makers. The graph below presents the trends of private investment, public investment and growth process in Ethiopia.

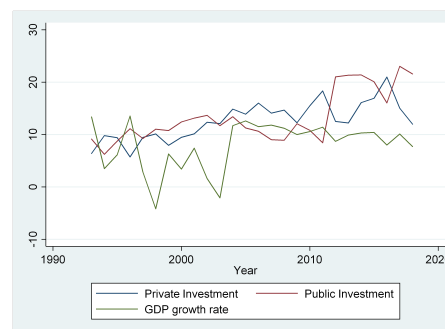


Figure 1: Trends of public investment, private investment and economic growth

²It is known that Ethiopian calendar is lags by 8 years from GC. During the year of the celebration of Ethiopian Millennium, the inflation is stemmed to 25 percent from 15 percent of the previous year. Then, it is escalated to 44 percent in the next year, in 2009.

When investment is disaggregated into its components, as the graph shows, both the public and private investment of Ethiopia have jointly been increased especially following the end of a border conflict against Eritrea, since 2000 until 2016. In particular the public investment escalated from 6.2 percent as share of GDP in 1994 to 23 percent as share of GDP in 2017 but declined to 21.6 percent in 2018. On the other hand, the private investment increased rapidly from 5.7 percent in 1996 to 21 percent in 2016 but surprisingly fallen to 12 percent as share of GDP in 2018. However, on average both the public investment and private investments are almost similar, registering 13.3 percent and 12.6 percent as share of GDP, respectively. As can be observed from the graph above, there is almost positive relationship between public and private investment, which means, private investment seems to follow the evolution of public investment over time.

4.3 Empirical Analysis

All variables included in the analysis are expressed in terms of elasticity by logarithmic transformation. Econometric analysis of time series is highly sensitive to the number of lags included in the analysis. Thus, it needs priority to determine the number of lag length to be included. The number of lags to be included in the stationary test is determined by the given information in the model, at which the generated value of the either the information criterion is minimum.

In the following table, thus, the maximum lag determined in the model is automatically selected depending on Akaike information criterion (AIC), final prediction error (FPE), Hannan-Quinn information criterion (HQIC), and Schwartz-Bayesian information criterion (SBIC) at the minimum value. Therefore, the maximum lag length

Table 2: Selection of maximum lag length

Lag	LL	LR	df	P	FPE	AIC	HQIC	SBIC
0	3.459	0	0	0	.062	.049	.096	.248
1	10.517	14.116	1	0.000	.036	-.502	-.443	-.254
2	10.626	.217	1	0.641	.040	-.421	-.350	-.122983
3	12.976	4.700*	1	0.030	.0345*	-.543*	-.462*	-.196*
4	13.388	.824	1	0.364	.037	-.490	-.396	-.093

for the model is three, which is determined at the lower values of the information criterion, which is automatically shown by asterisk (*). The most important thing to be noticed here is that it doesn't necessarily mean each variable has the lag length of three. But, it shows that the maximum lag length is three and some variables may

have less lag length.

4.3.1 Unit Root Tests

Following the lag length determination of the model, before conducting the empirical analysis, it is important that all the variables used be subjected to stationary either at the level or at the first difference in order to undertake further analysis. Estimation of the model using time series data techniques without testing for stationarity may leads to spurious regression which leads to false conclusion. This is important in order to ensure that no variable is integrated of order two or higher so as ascertaining ARDL bounds procedures. The study employs the Augmented Dickey-Fuller (ADF) and the Phillips Perron (PP) unit root testing techniques. The lag length in ADF is automatically selected by Akaike information criterion (AIC) and Phillips-Perron (PP) truncation lag is selected automatically by the Newey-West bandwidth.

Table 3: Stationarity tests of all variables at levels and at first differences
Stationarity of all variables at levels Variables at first differences

Using ADF				
Variables	Without trend	With trend	Without trend	With trend
LnPI	-2.763	-3.680**	-6.352***	-6.282***
LnGI	-1.730	-3.012	-6.860***	-6.662***
LnY	-1.067	-2.743	-6.266**	* -6.454***
nLR	-4.142***	-4.280**	-7.335***	-7.168***
Using PP				
LnPI	-2.719*	-3.642**	-9.541***	-13.568***
LnGI	-1.520	-3.012	-7.402***	-7.152***
LnY	-4.020***	-4.687***	-18.502***	-17.862***
LnR	-4.142***	-4.282**	-12.996***	-12.580***

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

Source: Compiled by the author

The results of ADF and Phillips-Perron (PP) unit root test show that LnPI and LnGI are non-stationary at level since their respective absolute test statistic are lower than 5% critical value. Logarithm of real interest rate (LnR) is stationary with both tests since the p-value is less than 0.05. However, the test contradicts on LnY. The logarithm of rate of GDP growth (LnY) is stationary at level when Phillips-Perron

(PP) is employed to test the existence of unit root while the ADF shows that it is non-stationary at level. Since there are non-stationary series in the data, then it needs to apply first differencing to ascertain whether the ARDL bounds model is applicable or not. It is done by checking the unit roots of variables after differencing to which are non-stationary at level.

Here, the results of the unit root test at first difference of the variables show that all variables become stationary after first differencing regardless of the inclusion of trend and constant term. This shows that all the variables are integrated of order zero, $I(0)$ and order 1, $I(1)$. Now, it possible to apply ARDL bounds test since the variables are either of integrated of order zero, $I(0)$ or integrated of order one, $I(1)$.

4.3.2 ARDL Bounds Test

Under ARDL bounds procedure, the study tests the null hypothesis of no long run relationship (there is no co-integration) exist against the alternative hypothesis of the existence of long run relationship in the model. The ARDL bounds test results indicate that, in general, there is a co-integration among the variables given in the models since F statistic is higher than the given upper critical bounds values as it is given in the table below.

Table 4: ARDL bounds test for co-integration of both models

Dependent variable	Function	F Statistic	Co-integration Status
LnPI	$F(\text{LnPI} - \text{LnGI}, \text{LnY}, \text{LnR})$	11.23148***	Co-integrated
LnY	$F(\text{LnY} - \text{LnPI}, \text{LnGI}, \text{LnR})$	6.1798***	Co-integrated
<i>Asymptotic critical values</i>			
Pesaran et al. (2001)	1% bounds	5% bounds	10% bounds
	$I(0), I(1)$	$I(0), I(1)$	$I(0), I(1)$
	4.29, 5.61	3.23, 4.35	2.72, 3.77

Note: 1) ***, ** and * denotes stationarity at 1% , 5% and 10% respectively. 2) AIC (1, 3, 0, 1) → Respective lag length of each variable.

Source: Compiled by the author.

The results of the bounds tests confirm the existence of a level relationship among the variables for both models since their respective F-statistic is above the upper bound at all levels of significance. This leads to the rejection of the null hypothesis of no co-integration (no long run relationship) exist in favor of the alternative of the variables share the long run relationship. The bounds F-test for co-integration so, indicate that the variables share a long-run relationship. The long-run relationship of all the variables is confirmed when lagged levels of variables are statistically significant (see the full output of the results from Appendix, part C).

One of the most important advantages of employing ARDL bounds test, unlike the other traditional co-integration tests, is that it indicates the integration of each exoge-

nous variable with the endogenous variable. In this regard, there is integration (a long run relationship) between private investment and public investment at current period and at its first lag period since their p-values is less than 5% level of significance. In the same way, there is a long run relationship between private investment and the first lagged values of real interest rate since their respective p-values are less than a given level of significance. However, the results show no integration (nonexistence of long run relationship) between private investment and real output growth rate as the p-values of current and lagged values of output growth rate are higher than a given level of significance.

As mentioned earlier, another advantage of using ARDL bounds test for co-integration over the traditional co-integration tests is that it doesn't restrict all the variables to have the same level of lag length. In this regard, each variable in the model has different lag length implying logarithms of both private investment and real interest rate have a lag length of 1 while the log of public investment has a maximum lag length of 3 and log of output growth rate has no any lag length. The next stage involves estimating the long run and short-run coefficients of each ARDL model.

4.3.3 Vector Error Correction Model (VECM)

Since the variables are co-integrated, a VECM is set up for estimating the long run and short run coefficients of the ARDL model. In the error correction model, the first difference of endogenous variable is regressed on a one period lag of the co-integrating equation using maximum likelihood estimation method. The short-run dynamics are captured by the first differenced variables while the long run is captured by level variables in the error correction model. The error correction results presented are in Table 5 below. Column A shows that the error correction term (ECT) coefficient of the given equation is statistically significant and have negative signs, as expected. The error correction term lagged by one period (ECT(-1)) confirms the co-integration relationship among variables at 1% level of significance. The coefficient of the ECT(-1) of -0.59 indicates a rate of adjustment to the equilibrium at 59 percent per annum in the next period in case of a shock to private investment in the current period. This implies that convergence is achieved in the long-run i.e. the series cannot drift to far apart from the equilibrium.

Table 5 column B presents the long-run results of the model while the short-run results are presented in the same table under column C. The results show that public investment has statistically significant positive effect on private investment in the long run while it negatively affects private investment in the short run. It means, public investment has a crowding in effect on private investment in the long run in Ethiopia. In line with this, a one percent increase in public investment stimulates private investment by 0.57 percent in the long run. Thus, it implies the existence of complementarity between public investment and private investment in the long run which actually called crowding-in effect.

The short-run results show that public investment has significant negative impact

Table 5: Error correction for private investment model (model 1)

Variables	ECT	Long Run	Short Run
LnGI		0.565*** _(0.176)	
LnY		0.0171 _(0.0714)	
LnR		-0.292*** _(0.0864)	
D.LnGI			-0.808*** _(0.213)
LD.LnGI			-0.658** _(0.242)
L2D.LnGI			0.246 _(0.157)
D.LnR			0.130*** _(0.0420)
L.LnPI	-0.590*** _(0.192)		
Constant			1.207*** _(0.376)
Observations	23	23	23
R ²	0.837	0.837	0.837

*Note: 1) ***, ** and* denotes statistical significance at 1% , 5% and 10% level, respectively; 2) Standard errors in parentheses; 3) D. is first difference operator; 4) L. is lag operator.*

Source: Compiled by the author.

on private investment. Numerically, one percent increase in public investment is associated with 0.81 percent decline in private investment in the short run. Not only current, but also previous one period lagged public investment undertaken is negatively associated with current period private investment with statistically significant coefficient. However, two periods lagged public investment is positively related to private investment but statistically insignificant in the short run. This is shown by the statistical significance of the coefficients of the lags of public investment. This suggests that the private sector is waiting for good business environment to be created by the public sector, which reduces production costs to private sector. This confirms the study done by Ouedraogo, et al. (2019) while it is thoroughly counter to Member (2015) in case of Ethiopia. The estimate from the above ARDL bounds technique also confirms most of the empirical results found in the literature (see, Cruz & Teixeira, 1999; Makuyana & Odhiambo, 2019; Ouedraogo, et al., 2019).

The results of the other variables indicate that real interest rate is positively associated with private investment in the short run, but in the long run it has negative effect. In line with this, one percent increase in real interest rate is associated with 0.13 percent rises in private investment in the short run. Contrary to that, a one percent increases in real interest rate causes a statistically significant 0.29 percent decline in private investment in the long run in Ethiopia. Hence, this rise in real interest rate is not lasting incentive to private investment, because private agents prefer saving to investing more in the long run.

Economic growth rate has a positive effect on private investment, but statistically insignificant in the long run while it is a negative effect in the short run regardless of the econometric model. Pertinent to this, it is impossible to give solid conclusion regarding this variable. However, it can be said that growth process in Ethiopia has no direct effect on economic growth, which in itself is an important result. Furthermore, this supports the theory of accelerator investment hypothesis which says that an increase in output may hasn't (even can has negative) impact on investment in the short run, but, has positive impact in the long run. It says an output has a reciprocal relationship with investment.

Error Correction for Output growth model (model 2)

Here is the other error correction model for output growth model. The error correction term (ECT (-1)) of model 2 is also statistically significant with expected sign at a given level of significance, as it is seen in the Table 6 below. This confirms the long run relationship among the variables. The coefficient of the ECT (-1) of -0.011 indicates a slow rate of adjustment to the equilibrium in case there is a shock to economic growth in the previous period. Meanwhile, economic growth quite slowly adjusts by 1.1 percent per annum to its long run equilibrium in case a shock is revealed in the previous period of output growth. This implies that convergence to its equilibrium is achieved in the long-term at very slow rate.

The results indicate that private investment has statistically significant effect on

Table 6: Error correction for economic growth model (model 2)

Variables	ECT	Long run	Short run
LnPI		1.459** _(0.589)	
LnGI		-0.469 _(0.475)	
LnR		0.0371 _(0.172)	
L.LnPI	-0.011*** _(0.213)		
D.LnPI			-1.864** _(0.810)
LD.LnPI			-1.607** _(0.615)
Constant			0.101** _(1.585)
Observations	23	23	23
R ²	0.628	0.628	0.628

Note: 1) ***, ** and * denotes statistical significance at 1% , 5% and 10% level, respectively; 2) Standard errors in parentheses; 3) D. is first difference operator; 4) L. is lag operator.

Source: Compiled by the author.

economic growth. In line with this, it is positively related to economic growth in the long run while it has significant negative impact in the short run in Ethiopia. In the long-run, the coefficient of private investment is 1.46 which means a one percent increase in private investment leads to a 1.46 percent increase in economic growth in the long run. In the short run, however, a one percent increases in the current period of private investment causes a 1.86 percent decline in the economic growth and a one percent increase in previous year private investment causes a 1.61 percent slows down in the economic growth. This suggests that private investment couldn't automatically exerts positive impact growth process, which implies that it takes time to private investment to adjust itself and to contribute positive impact to economic growth. It compares well with the conclusion of the model 1 which private sector might not effectively working and waits for good business environment prior to its investment in the short run.

On the other hand, public investment has negative impact on the economic growth in the long run though it is statistically insignificant. Hence, as the estimated coefficient is not significantly different from zero at the 5% significance, one cannot make too much conclusion of the sign of this coefficient. Although the estimated result measures the direct effect of public investment which is insignificant at a given significance, it may has indirect impact on growth process through private investment. In this regard, public investment might has an indirect positive impact on economic growth through private investment since it exerts direct positive impact on private investment in the long run. For example, if private and public investments are complementary, it encourages private investment through infrastructure expenditure (Khan & Reinhart, 1990). Then, private investment exerts positive impact on growth process. However, the dynamics of public investment has no any immediate effect on economic growth in the short run.

These result of the effects of both investment components on output growth compare well with the empirical evidence reported by Feleke (2013). Many famous scholars also say that private investment has a much larger impact than public investment in the developing countries (see, Khan & Reinhart, 1990; Barro, 1991; Khan & Kumar, 1997). This might also be due to government's large expenditure in non-capital which aimed at the present consumption rather than long run capital formation, which leads to imposition of higher taxation and/or competes with private sector for scarce resources to finance its expenditure. Moreover, the results depend on the econometric model used (see, Naqvi & Tsoukis, 2003; Ouedraogo, et al., 2019).

The other variable, real interest rate is positively related to economic growth although it is statistically insignificant in the long run while it has no any immediate effect in the short run. This implies that real interest rate has no direct impact on economic growth. It suggests that an increase in real interest rate encourages individuals to save money more, then, it contributes indirectly to economic growth through real investment. However, it takes time to the deposited money to be converted to real investment.

4.3.4 Granger Causality Test

Since co-integration is existed, it needs to test the direction of causality by granger method following the existence of co-integration among the variables. According to Granger (1988), if a co-integrating relationship is identified, then, causality must exist in at least one direction. It helps to identify the direction of causality so that it is easy to know the policy variable in the econometric model. The table below presents the pairwise causality test among the variables of interest. The results show that

Table 7: Pairwise granger causality test results

Null Hypothesis:	Obs	F-Statistic	Prob.
LGI does not Granger Cause LPI	23	3.37117	0.0447**
LPI does not Granger Cause LGI		0.19232	0.9001
LY does not Granger Cause LPI	23	0.07591	0.9721
LPI does not Granger Cause LY		4.86924	0.0136**

*Note: 1) ***, ** and* denotes statistical significance at 1% , 5% and 10% level, respectively; 2) Computed at lags of 3.*

Source: Compiled by the author.

there is uni-directional causality between the displayed variables. The null hypothesis of public investment does not granger causes private investment is rejected at 5% level of significance. This indicates the evidence that previous values of public investment have an impact on current and future values of private investment since it is statistically significant. Then, it is called public investment granger causes private investment. However, there is no evidence that private investment can granger causes public investment since a test is statistically insignificant. So, it doesn't show that private investment granger causes public investment. This implies that public investment is weakly exogenous to private investment, which means public investment leads private investment, but not vice versa.

For the second variable of interest, there is evidence to reject the null hypothesis of private investment does not granger causes economic growth at 5% level of significance. This means, previous values of private investment have an impact on current and future values of economic growth since the test is statistically significant. Thus, private investment granger causes economic growth. But, there is no evidence that economic growth granger causes private investment since the test result is insignificant. As a result, economic growth is not weakly exogenous to private investment which implies that growth doesn't granger causes private investment.

In general, therefore, public investment seems to be an exogenous variable which means that public investment is policy variable. It suggests that a lack of public

investment could lead to direct restrictions on private investment and indirect restrictions on economic growth through private investment. Thus, an increase in proper public investment policy exerts positive impact on private investment thereby foster economic growth.

4.4 Diagnostic Checking

To check on the reliability of the results on economic growth and private investment models, diagnostic test were carried out. Here the econometric test is checking the above models specification, non-existence of autocorrelation, normality of the model and homoscedasticity of error terms. It is undertaken to guarantee the results are not spurious and to witness the robustness of the model and the results are reported in Table 8 below. The results show that the model stability is correctly specified. Durbin-

Table 8: Diagnostic tests for ARDL models

Testing methods	ts result for model 1	ts result for model 2	Critical Values
D-Watson test	2.02	1.83	0.89
Breusch-Godfrey test	0.56	0.26	0.05
Normality test	0.44	0.12	0.05
Heteroskedasticity	0.40	0.40	0.05

*Note: ***, ** and* denotes statistical significance at 1% , 5% and 10% level, respectively.*

Source: Compiled by the author.

Watson test indicates that there is no multicollinearity among the variables since test statistic is higher than R-squared despite the test is used as a rule of thumb. Breusch-Godfrey Lagrange multiplier test is used to test the autocorrelation. The result leads to the rejection of null hypothesis of there is serial correlation among variables and error term due to the probability test is significantly much higher than a given level of significance. Hence, there is no autocorrelation problem in the econometric model applied.

In the same way, white noise test is applied by Jarque-bera (JB) test in favor of normality of error terms which implies that error terms have zero mean and constant variance over time as well as indicates homoscedasticity. In line with this, as it is shown in the Table 8, there is statistically significant normal distribution of error terms since statistic probabilities are much higher than a given level of significance. Thus, it indicates that the estimates are both consistent and efficient as well as the robustness of the model used.

At the end, the stability of residuals is tested in order to see further stability of the models. As expected, the stationary test of the residuals show that residuals are stationary at level which implies the model is stable. Both models of private investment and economic growth models again passed the stability tests as given by the cumulative sum of recursive residuals (CUSUM) and the cumulative sum of squares of recursive residuals (CUSUMSQ) plots. All residuals CUSUM and CUSUMSQ lies in between the given level of significance (see, figures 2 and 3 in Appendix, part A and B, respectively for model 1 and model 2).

5 CONCLUSIONS AND RECOMMENDATIONS

5.1 Conclusions

This study has empirically examined the effect of public investment on private investment and their relative contribution to economic growth in Ethiopia for the period of 1993 to 2018. The study employed the ARDL bounds testing approach which is popularized by Pesaran, et al. (2001)). Although the issue of crowding-out/-in has been studied extensively, there is still no consensus for the effects of government investment on private investment. Therefore, it is difficult to make a policy suggestion from either theoretical or empirical perspective, but it seems highly country's empirical case.

The empirical results of this study reveal that public investment stimulates private investment in the long run, which implies their complementarity. It means there is a crowding-in effect of public investment on private investment in the long run. However, it is a crowding-out in the short run. In the short run, not only the current period of public investment, but also an increasing of previous year public investment retards private investment. On the other hand, public investment is negatively associated with economic growth although it is statistically insignificant in the long run, but it has no any immediate effect in the short run. As the estimated coefficient measures the direct effect of public investment is insignificant at a given significance, it may exerts positive impact on growth process through private investment in the long run.

The other variable, real interest rate has negative effect on private investment in the long run while it is positively associated with private investment in the short run. In the short run, rising real interest rate might encourages lenders to save sufficient money so that private sectors can easily get funds to invest more. Unfortunately, this risen cost of funds retards the ability of private sector to be sustained with the cost, which actually declines private investment in the long run. On the other model, real interest rate has insignificant positive on economic growth in the long run while it has no any immediate effect. This implies that real interest rate has no direct impact on economic growth, but it has indirect negative impact on output growth through private investment in the long run.

Economic growth is positively related to private investment although it is statistically insignificant in the long run. However, it has no any immediate effect on private investment in the short run. On the other direction, private investment has a significant positive impact on economic growth in the long run while it is negatively related to economic growth in the short run. This confirmed that there is a uni-directional effect, which is private investment could affect economic growth while it is not vice versa. It implies that private investment led-economic growth. Based on these results, it can be concluded that private investment contributes to economic growth more than public investment in Ethiopia. However, the contribution to economic growth of public investment can be enhanced by focusing on growing the public investment policy which more stimulates private investment.

5.2 Policy Recommendations

Private investment is reported to be more important than public investment in the growth process. There is also a complementary relationship between the two components of investment in the long run. Thus, it is prudent for policy makers not to cut back on efficient component of public investment, but, raising the infrastructural public investment to a level that promotes private investment in the long run thereby it indirectly foster economic process. Then, private sectors invest more resources in those profitable business environments.

Government should have to pay attention in formulating policies in the provision of more financial resources for the private sectors, so that it is important to stimulate private sectors investment directly and boost output growth indirectly through private investment activity.

This study may have limitations as do many empirical studies although it is done to ensure the results are robust and reliable to my best knowledge. This may be due to the non-availability of data on some economic variables, which may the econometric models has been under specified. The other limitation may be the shortness of time frame although the econometric model applied here gets credit of appropriateness for the case. Therefore, it would be interesting to find out if the empirical results on the crowding-in/-out effect would change fundamentally in future studies on the availability of some variables like infrastructural and non-infrastructural public investments in Ethiopia.

References

- [1] Afonso, Antonio and Aubyn, Miguel (2009). *Macroeconomic rates of Return of Public and Private Investment: Crowding-in and Crowdingout Effects*. The Manchester School, 21-39.
- [2] Arestis, Philip (2011). *The ‘Crowding-Out’ of Private Expenditure by Fiscal Actions: An Empirical Investigation*. 34, 36-50.
- [3] Aschauer, David (1989). *Does Public Capital Crowd Out Private Capital?*. Journal of Monetary Economics, 24, 171-188.
- [4] Barro, Robert (1991). *Economic Growth in a Cross Section of Countries*. The Quarterly Journal of Economics, 106(2), 407-443.
- [5] Canh, Nguyen and Phong, Nguyen (2017). *Linkage between Public (State Sector) Investment, Private Investment and Economic Growth: Evidence from Vietnam*. International Research Journal of Finance and Economics, 164.
- [6] Cruz, Bruno de Oliveira and Teixeira, Joalio (1999). *The impact of public investment on private investment in Brazil, 1947-1990*. Institute of Applied Economic Research (IPEA), 75-84.
- [7] Davidson, Russell and Mackinnon, James (1999). *The size distortion of Bootstrap tests*. Econometric Theory.
- [8] Dash, Pradyumna (2016). *The Impact of Public Investment on Private Investment: Evidence from India*. The Journal for Decision Makers, 41, 288–307.
- [9] Dreger, Christian and Reimers, Hans-Eggert (2015). *The Impact of Public Investment on Private Investment in the Euro Area*. Vierteljahrshefte zur Wirtschaftsforschung, 84, 183-193.
- [10] Dickey and Fuller (1979). *Distribution of the Estimators for Autoregressive Time Series with a Unit Root*. Journal of American Statistics Association, 74(366), 427-31.
- [11] Dickey and Fuller (1981). *Likelihood ratio test statistics for autoregressive time series with a unit root*. Econometrica, 49, 1057-1072.
- [12] Erden, Lutfi and Holcombe, Randal (2006). *The Linkage Between Public and Private Investment: a Co-integration Analysis of a Panel of Developing Countries*. Eastern Economic Journal, 32, 476-492.
- [13] Feleke, Eyobe (2013). *The Role of Private Investment to the Economic Growth of Ethiopia*. Addis Ababa University, Addis Ababa, Ethiopia.
- [14] Ghani, Ejaz and Din, Musleh-ud (2006). *The Impact of Public Investment on Economic growth in pakistan*. The Pakistan Development Review, 45, 87–98.

- [15] Hassan, Sallahuddin; Othman, Zalila and Karim, Mohd Zaini (2011). *Private and Public Investment in Malaysia: A Panel Time Series Analysis*. International Journal of Economics and Financial Issues, 1, 199-210.
- [16] Islam, Monirul; Hossain, Asif and Tareque, Mohammad (2018). *Impact of Public and Private Investment on GDP Growth in Bangladesh: Crowding-in or out?*. Global Journal of HUMAN-SOCIAL SCIENCE: Economics, 18.
- [17] Khan and Kumar (1997). *Public and Private and the Growth Process in Developing Countries*. Oxford Bulletin of Economics and Statistics, 59, 0305-9049.
- [18] Khan, Mohsin and Reinhart, Karmen (1990). *Private Investment and Economic Growth in Developing Countries*. World Development, 18(1), 19-27.
- [19] Makuyan, Garikai and Odhiambo, Nicholas (2018). *Public and Private Investment and Economic Growth in Zambia: A Dynamic Approach*. International Economics, 71, 503-526.
- [20] Makuyana, Garikai and Odhiambo, Nicholas (2019). *Public and private investment and economic growth in Malawi: an ARDL-bounds testing approach*. Economic Research, 32, 673-689.
- [21] Member, Kurabachew (2015). *Public and Private Investment Analysis in Ethiopia*. Research Journal of Economics and Business Studies, 04, 26-38.
- [22] Ministry of Finance (2017/18). *Overview of Fiscal Policy and Recent Fiscal Development in Ethiopia*. Addis Ababa, Ethiopia.
- [23] Naqvi, Naveed and Tsoukis, Christopher (2003). *Does Public Investment Crowd Out Private Investment? Evidence On Investment And Growth In Asia, 1971-2000*. European Research Studies, 6, 58-72.
- [24] Nguyen, Canh Thi and Trinh, Lua Thi (2018). *The impacts of public investment on private investment and economic growth: Evidence from Vietnam*. Journal of Asian Business and Economic Studies, 25, 15-32.
- [25] Ouedraogo, Rasmane; Sawadogo, Hamidou and Sawadogo, Relwende (2019). *Impact of Public Investment on Private Investment in Sub-Saharan Africa: Crowding in or Crowding out?*. African Development Review, 31, 318-334.
- [26] Pesaran, Hashem and Shin, Yongcheol (1999). *An Autoregressive Distributed Lag Modelling Approach to Cointegration Analysis*. University of Cambridge Press, Cambridge.
- [27] Pesaran, Hashem; Shin, Yongcheol and Smith, Richard (2001). *Bounds Testing Approaches to the Analysis of Level Relations*. Journal of Applied Econometrics, 16, 289-326.
- [28] Sen, Huseyin and Kaya, Ayse (2014). *Crowding-Out or Crowding-In? Analyzing the Effects of Government Spending on Private Investment in Turkey*. PANOECONOMICUS, 6, 631-651.

- [29] World Bank (2013). *Investment climate survey in Ethiopia*. The World Bank's Doing Bussines
- [30] Xu, Xiaoming and Yan, Yanyang (2014). *Does government investment crowd out private investment in China?*. Journal of Economic Policy Reform, 17, 1-12.

A Appendix

The graphs of cumulative recursive residuals for private investment model (model 1)

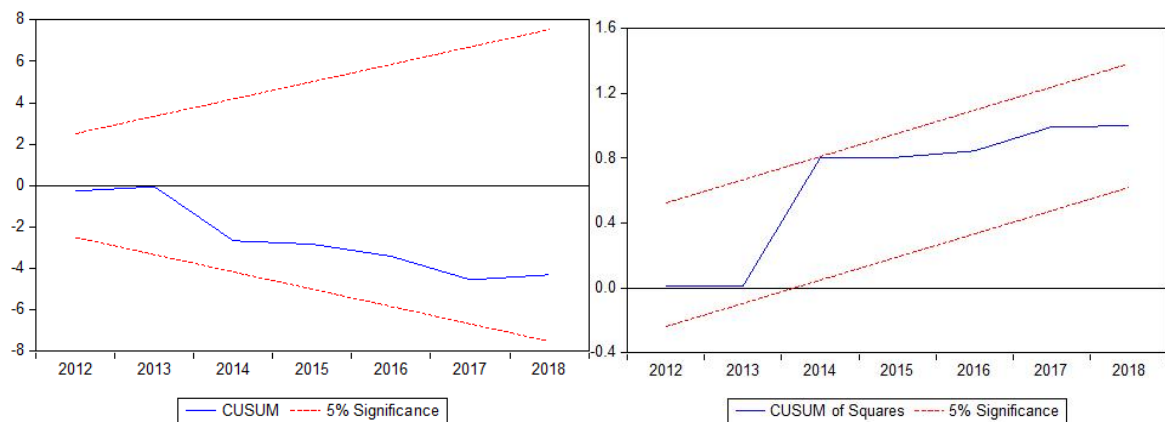


Figure 2: Cumulative sum of recursive residuals and cumulative sum of squares of recursive residuals plots of model 1

Source: Generated by the author using Eviews 9.

B Appendix

The graphs of cumulative recursive residuals for economic growth model (model 2)

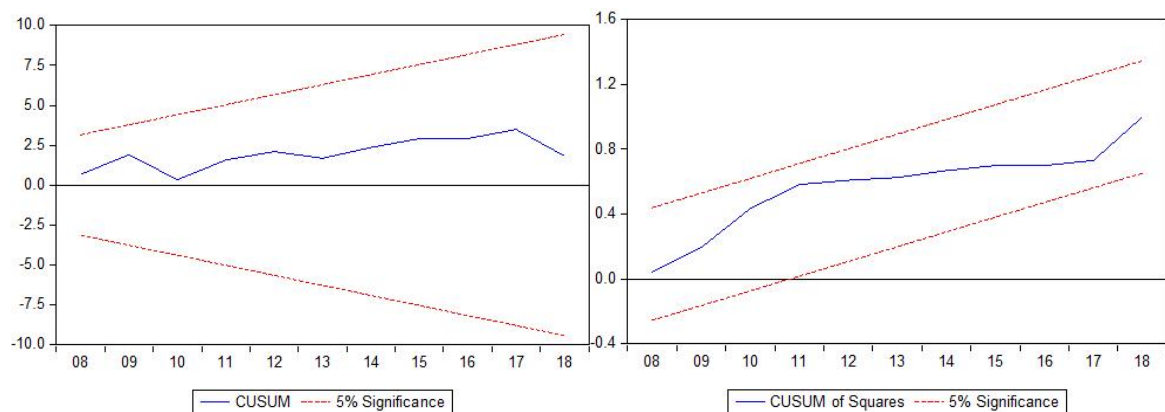


Figure 3: Cumulative sum of recursive residuals and cumulative sum of squares of recursive residuals plots of model 2

Source: Generated by the author using Eviews 9.

C Appendix

The full output of ARDL bounds co-integration test results for private investment model

ARDL Bounds Test

Null Hypothesis: No long-run relationships exist

Test Statistic	Value	k		
F-statistic	11.23148	3		
Critical Value Bounds				
Significance	l0 Bound	l1 Bound		
10%	2.72	3.77		
5%	3.23	4.35		
2.5%	3.69	4.89		
1%	4.29	5.61		
Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LGI)	-0.399418	0.138674	-2.880264	0.0236
D(LGI(-1))	-0.868095	0.181025	-4.795455	0.0020
D(LY)	0.031358	0.040374	0.776686	0.4628
D(LY(-1))	0.079793	0.074412	1.072319	0.3191
D(LY(-2))	0.076417	0.053730	1.422226	0.1980
D(LY(-3))	0.045287	0.035282	1.283599	0.2401
D(LR)	-0.022860	0.042637	-0.536167	0.6085
D(LR(-1))	0.130727	0.051919	2.517918	0.0399
D(LR(-2))	0.086600	0.043825	1.976035	0.0887
D(LR(-3))	0.077359	0.033346	2.319853	0.0534
C	2.138178	0.473474	4.515937	0.0027
LGI(-1)	0.343004	0.128389	2.671593	0.0319
LY(-1)	-0.001478	0.110762	-0.013341	0.9897
LR(-1)	-0.274834	0.090447	-3.038622	0.0189
LPI(-1)	-0.823554	0.130074	-6.331429	0.0004
R-squared	0.933198	Mean dependent var		0.033625
Adjusted R-squared	0.799595	S.D. dependent var		0.218387
S.E. of regression	0.097764	Akaike info criterion		-1.594007
Sum squared resid	0.066905	Schwarz criterion		-0.850115
Log likelihood	32.53408	Hannan-Quinn criter.		-1.418769
F-statistic	6.984837	Durbin-Watson stat		1.330593
Prob(F-statistic)	0.007588			