

ADDIS ABABA UNIVERSITY
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**THE NEXUSES BETWEEN PUBLIC INVESTMENT, PRIVATE
INVESTMENT, TRADE OPENNES AND ECONOMIC GROWTH IN
ETHIOPIA: CO-INTERATED VAR APPROACH**

By
Alemnesh Tadesse

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**The Nexuses between Public Investment, Private Investment,
Trade Openness and Economic Growth in Ethiopia: Co-
Integrated VAR Approach**

Alemnesh Tadesse

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This is to certify that the thesis prepared by Alemnesh Tadesse, entitled: *The Nexuses between Public investment, Private investment, Trade openness and Economic growth* and submitted in partial fulfillment of the requirements for the Degree of Master of science (International Economics) complies with the regulations of the University and meets the accepted standards with respect to originality and quality.

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Chair of Department or Graduate Program Coordinator

Abstract

The Nexuses between Public investment, Private investment, Trade openness and Economic growth in Ethiopia: Co-integrated VAR approach

Alemnesh Tadesse

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This paper poses and tries to answer one major question: is there a nexus between public investment, private investment, trade openness and economic growth in Ethiopia? The study uses the Co-integrated VAR approach and compared to previous researchers on the topic, this study estimated investment, trade openness and growth nexus together for the period 1970-2009. There are four major findings. First, there is a strong evidence that trade openness, public investment and private investment have complementing effect on long run economic growth of the country. Second, trade openness and economic growth also complements private investment, but trade openness reduces public investment, while economic growth and private investment encourages expansion of public investment. Third, there is evidence of bi directional causality between real GDP, private investment and public investment. Fourth, the impulse response analysis showed that economic growth in Ethiopia exhibits quicker transitory pattern to the long run time path, while public investment and private investment exhibits relatively slower transitory pattern to the long run time path. Overall, the major policy implication of this study is that, given the long run positive impact of trade openness on private investment and economic growth, and as well as the long run positive impact of private investment on public investment and economic growth, it will be natural to think of supplementary reforms.

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Acronyms

ADF	:	Augmented Dickey-Fuller
AIC	:	Akaiki Information Criteria
AR	:	Auto Regressive
AR	:	Auto regression
ARDL	:	Autoregressive-Distributed Lag
BOP	:	Balance Of Payments
CAPRi	:	Collective action and property Rights
DUM	:	A dummy variable for inward looking and outward looking regime
ELG	:	Export-led growth
EU	:	European Union
FPE	:	Final Prediction Error
GDP	:	Gross Domestic Product
GMM	:	Generalized Method of Moment
GNP	:	Gross National Product
HCA	:	Human capital
HQ	:	Hannan-Quinn Information Criteria
IGE	:	Imperial Government of Ethiopia
IMF	:	International Monetary Fund
IRF	:	Impulse Response Functions
IS	:	Import Substitution
JB	:	Jarque-Berra
LAB	:	Active Labour force

LDCs	:	Less Developing Countries
LM	:	Lagrange Multiplier
LOP	:	Law of One Price
NBE	:	National Bank of Ethiopia
NTB	:	Non Tariff Barriers
OLS	:	Ordinary Least Square
OPE	:	Trade openness
PP	:	Phillips-Perron
PPP	:	Purchasing Power Parity
R&D	:	Research and Development
RGDP	:	Real gross domestic product
RIG	:	Real public investment
RIP	:	Real private investment
SDG	:	Share Dealing Group
SFDP	:	Second Five Year Development Plan
SIC	:	Schwarz (Bayesian) Information Criteria
SSA	:	Sub-Saharan Africa countries
TFTA	:	Tripartite Free Trade Area
TGE	:	Transitional Government of Ethiopia
TGE	:	Transitional Government of Ethiopia
U.S	:	United States
UN	:	United Nation
VAR	:	Vector Auto regression

VDC : Variance Decompositions
VECM: Vector Error Correction Model
WB : World Bank
WDR : World Development Report
WTO : World Trade Organization

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CHAPTER 1: INTRODUCTION

1.1 Background to the study

Economic growth is the steady course of action through which the productive and fruitful capacity of an economy is improved in due course to produce increasing levels of national output and income (Todaro and Smith, 2005). Since the early 1970s, the issue of accelerated economic growth has been the main agenda in economic policy formulation for most of the Sub-Saharan Africa countries (SSA) and other developing countries of the world (International Monetary Fund (IMF), 2005). Hence, a number of development economists and government policy makers have paid significant attention to reviewing the experiences of these countries to promote economic growth and improve their living standards.

According to Maqbool, Maaida and Sofia (2010), in the process of investigating the economic performance of a country, one of the key determinants of economic growth is investment. Moreover, most of the countries that grow rapidly invest a considerable fraction of their Gross Domestic Product (GDP). In contrast, countries that develop slowly are those that invest slowly in their economies and remain poor (Solow, 1956).

Recently, economists have developed a common opinion about the constructive effect of sustainable investment on economic growth. Moreover, the sustainability of investment depends on the investment climate (World Bank (WB), 2004). In general, the investment climate refers to the totality of macroeconomic, political, policy, and institutional conditions in a country that, together with structural forces, determines the performance

of private investment and economic growth (WB, 2004a). According to the United Nation (UN, 2005), investment climate can be explained further as access to basic physical infrastructure such as electricity, telephone, water and roads; access to information and advisory services; higher labor productivity; efficient tax administration and tax rates; access to finance; availability and affordability of urban land; business regulations and trade facilitation services, among other elements.

A good investment climate provides opportunities and incentives for investors to invest profitably, create jobs, and expand national output thereby increasing private investment and economic growth (World Bank, 2004). In the 2005 World Development Report (WDR), Bernal *et al.* (2004) note that improvements in the investment climate in developing countries are key to increasing the flow of investments and, consequently, a higher level of economic growth and development. However, in the poorest developing countries, such as Ethiopia, businesses frequently operate in investment climates that undermine their incentive to invest and grow, thus undermining the performance of trade (UN, 2005). In line with this environment, Ethiopian investors complain about poor infrastructure, particularly power shortages; poor transport; poor telecom connectivity of business locations and lack of efficient tax administration (Mima and David, 2012; World Bank, 2004).

According to the World Bank's Ease of Doing Business report (2012), Ethiopia ranked 111th out of 183 countries in 2011, losing ground from its 2010 ranking of 104. In particular, the country lost its rank in the areas of gaining credit, electricity, registering property, and starting businesses.

Regarding public investment, Keynes (1936), believes that there is a need for government intervention to activate and regulate the economy. Therefore, both past and current governments of Ethiopia have made significant capital expenditures aimed at creating the social and economic infrastructures that expand opportunities for better economic growth (Tanzi, 1997).

Similarly, the role of public investment in Ethiopia is one of the central issues with respect to the private investment and economic growth of the country. Actually, both public and private investments across the three regimes were erratic in performance, because each government that came into power started afresh and followed a different political ideology.

For instance, during the socialist regime, the government nationalized all private investment and advocated public investment to achieve sustainable and remarkable trade performance (Wibke et al, 2008). Accordingly, the government also extended excessive credit in all directions in an attempt to promote exports and substitute imports (Tony and Alemayehu, 2001; Alemayehu, 2004). However, the envisaged public sector that engaged itself in socialized sectors faced severe problems, such as inefficiency in production, weak surveillance in management and bank credit defaults. In particular, the public sector was unable to generate foreign currency at an adequate level and instead consumed national savings resources and foreign currency at the expense of the economy in general and of the tradable sector in particular (Harvey and Brownbridge, 1998).

Although the incumbent government took power in 1991 and launched a free-market-oriented economy, the government was concerned with reducing public expenditures to

achieve macroeconomic stability up to the year 2000. However, because the order of the day has changed toward a pro-poor growth policy and state-led development programs from the neo-liberal paradigm, the government has been engaged in extensive public investment in, for example, road construction, telecommunication expansion program, and electrification.

In addition to the aforementioned aspects of the country under consideration, there is no clear consensus on empirical evidence from both developed and developing countries with regard to whether public or private investment has a superior effect on economic growth. Most researchers claim that the contribution of private investment to economic growth is larger than that of public investment. This notion is based on the contention that the marginal productivity of the former is greater than that of the latter (Khan and Reinhart, 1990; Serven and Solimano, 1992), although some studies have shown a possibly larger contribution of public capital to economic growth (Ram, 1996).

According to the IMF (1997) and the UN (2008), another notable determinant of economic growth is foreign trade, which is expected to promote the economic performance of developing countries. Following the failure of command and controlled systems of economic management, there is now an increasing effort to build a market economy in which external competitiveness has prime importance (WTO, 2011; IMF, 2011; Parker, 2004).

As an illustration, international trade has played a crucial role in the historical development of the third world. In the second half of the twentieth century, the tremendous economic performance of the "four tigers," South Korea, Taiwan, Hong

Kong and Singapore, has been largely attributed to the performance of the external sector, where the export sector was given greater emphasis. These countries provided strong political commitment toward export promotion and applied appropriate policies together with efficient institutional mechanisms to help attain higher growth in exports and, hence, growth in the overall economy (Stanley, 2004).

Taking a lesson from the success of these East Asian countries coupled with the failure of the import substitution (IS) strategy once held by many LDCs as the appropriate policy during the 1950s and 1960s, led most LDCs to give consideration to the export promotion trade strategy. Arguably, this strategy can help primarily commodity exporting countries achieve optimal scale and thus enable them to import foreign technology, which is deemed important for the growth process of such countries (Dani, 2001).

Ethiopia, like many other developing countries, has actively pursued an import substitution industrialization strategy during the Imperial and Derge regimes. The underlying notion of the protectionist measure under the former regime was the goal of mobilizing government revenues by imposing taxes, maintaining the BOP at a sustainable level and providing the domestic economy with the necessary protection. Apart from these objectives, during the Derge regime, the objective was also to control and gradually make the private sector extinct and, most importantly, socialize economic activity (Befekadu and Berhanu, 2000).

The import substitution industrialization trade strategy by Ethiopia's past regimes failed to perform well, and industries that were protected through tariff and nontariff mechanisms remained in their infancy and rudimentary stages. However, with the fall of

the Derge regime, the current regime initiated trade reform in which export promotion is the major component of the program. Nevertheless, the country's exports are still categorized as undiversified and highly dependent on primary agricultural products (Debel, 2002).

According to Dan (2010), Ethiopia recently engaged in various trade initiatives, including application of accession to the World Trade Organization and negotiations with the European Union on an Economic Partnership Agreement and with African regional partners toward a Tripartite Free Trade Area (TFTA). The overall objective of all of these trade initiatives is to increase the contribution of foreign trade to the economy. Hence, an empirical investigation to determine the contribution of international trade to economic growth is essential. In general, the main aim of this paper is to empirically analyze the nexus between public investment, private investment and international trade on Ethiopia's economic growth.

1.2 Problem Statement

The issue of whether nexuses exist between private investment, public investment, trade openness and economic growth is a long standing one in macroeconomics and development economics and has attracted renewed attention in recent years. Classical economists argued that an increase in public investment financed by borrowing reduces loanable funds for private investment, increases the interest rate and crowds out private investment. In contrast, Keynesian economists argued that increases in 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,

attract private investment. Thus, the net effect of public investment on private investment depends on the magnitude of the crowding-in or crowding-out.

With regard to the role of private and public investment in economic growth, empirical studies found different results. According to Kustepeli (2005) and El Badawi (2002), the contribution of private investment to economic growth is greater than public investment because the marginal productivity of private investment is higher than that of public investment. In contrast, Ram (1996) showed a relatively larger contribution of public capital to economic growth.

Similarly, public investment in addition to private investment across the three recent regimes of the country under consideration has performed erratically, as each government that came into power started afresh and followed a different political ideology. For instance, during the socialist regime, the government nationalized all private investment and advocated public investment to achieve sustainable economic growth. Ultimately, an average growth rate of 2.3% per annum was registered, which was lower than that of the Imperial regime (4%), which favors private investment in achieving sustainable economic growth.

The incumbent government took power in 1991 and launched a free-market-oriented economy. The government was concerned with reducing public expenditures to achieve macroeconomic stability up to the year 2000. However, because the order of the day changed from the neo-liberal paradigm to a pro-poor growth policy and a state-led development program, the government has been engaged in extensive public investment such as through road construction, a telecommunication expansion program, and

electrification. The current regime has registered average growth rate of 3.6% per year. Thus, this fact demands an examination of the aggregate contribution of public and private investment to economic growth.

Recent years have seen a major controversy over the nature of the relationship between trade openness and economic growth. According to the current orthodox view, trade openness is essential for growth. Countries that liberalize their imports and orient production toward exports are assumed to experience faster growth than those countries that do not, and a faster rate of opening provides greater prospects for development. In recent years, the orthodox view has been challenged by empirical studies showing the lack of a relationship between the degree of trade liberalization and the rate of growth. These studies have raised doubts about the policy prescription of rapid trade liberalization. Empirical evidence that shows the negative consequences of rapid import liberalization on industrial and agriculture sectors in many developing countries is also growing.

In addition to the theoretical confusion, the empirical studies on the nexuses reached different and even conflicting results (Fan and Rao, 2003; Kweka and Morrissey, 1999). Although some studies show that public investment contributes greatly to economic growth and increases the productivity of private investment (Aschauer, 1989 and Kustepeli, 2005), other studies indicated that private investment has higher productivity than public investment and, furthermore, that public investment has a crowding-out effect over private investment (Ghali, 1989; Voss, 2002 and El Badawi, 2002).

In relation to trade, some studies show that trade openness has a positive contribution to economic growth, while other studies maintained the opposite (Dollar, 1992; Sachs and Warner, 1995; Harrison, 1996; Edward, 1992; Edwards, 1998). Most of the empirical literature is based on cross-country growth regressions, which are useful in identifying the factors that most consistently appear as important determinants of the case under consideration. However, cross-country studies only highlight what appears important in general or on average; analytical country studies are needed to understand the process and the most important factors in individual countries (Rodrik, 2003a).

In other words, the value of cross-country studies is that they enable the identification of the factors that help explain cross-country variations in growth performance. Given the plethora of such studies, numerous factors have been identified as potentially important (Durlauf, 2000, 2002; Sala-i-Martin *et al.*, 2003). The situation is compounded by the fact that some variables that were significant in some studies turned out to be insignificant in others (Levine and Renelt, 1992; Sala-i-Martin *et al.*, 2003). Although the possibility of omitted variable bias is always present, such a problem can be addressed by focusing on the importance of a particular variable or set of variables (e.g., private investment, public investment, trade) and availing of the high correlation between many determinants. For our purpose, the limitation of the cross-country approach is that it is not usually informative for a particular country. For example, the assumption of parametric invariance across countries renders it difficult to interpret results for a single country and, therefore, difficult to derive country-specific policy implications (Harrison, 1996; Durlauf, 2002; Hoeffler, 2002). This limitation is important because policies or factors that are appropriate in a particular country might be inappropriate in another country

(Kenny and Williams, 2001). Against this backdrop, this paper employs a *multivariate time series estimation approach* to investigate the nexuses between public investment, private investment, trade openness and economic growth in Ethiopia.

1.3 Objective

The general objective of this study is to investigate the nexuses between public investment, private investment, trade openness and economic growth in Ethiopia. The specific objectives of the study are as follows:

1. To investigate the effects of public investment, private investment and trade openness on economic growth;
2. To examine the effects of private investment, trade openness and economic growth on public investment; and,
3. To examine the effects of public investment, trade openness and economic growth on private investment.

1.4 Hypothesis

Based on the empirical literature on the interaction between economic growth, trade openness, and private and public investment in developing countries, the study proposes the following working hypotheses to hold true in my analysis.

- Public investment has a significant positive effect on economic growth.
- Private investment has a significant positive effect on economic growth.
- Public investment crowds in private investment in Ethiopia.

- Trade openness has a significant positive effect on economic growth, public and private investment.

1.5 Scope and Significance of the Study

The aim of this study is limited to investigating the nexuses between trade openness, public investment and private investment on economic growth in Ethiopia using annual data from 1970 to 2009. The study employs cointegration and vector error correction approaches. Therefore, the result conveys some important messages about the nexuses between trade openness, public investment and private investment on economic growth. Although a number of studies have been conducted on investment growth nexus and trade growth nexus, especially in developing countries, empirical evidence on the nexuses between trade openness, public investment, and private investment on economic growth is limited (Khan and Kumar, 1997). Concerning Ethiopia, the relationship between private investment, public investment and economic growth has been analyzed by Khan and Kumar (1997) in a cross-sectional study among four developing country regions: Africa, Asia, Europe and the Middle East, as well as Latin America. Therefore, isolating the effect of each variable on the economy of Ethiopia is hardly possible. Moreover, investment, trade and growth nexuses are not well documented.

Furthermore, analysis of the relationship among private investment, public investment, international trade and economic growth in Ethiopia is of interest from a policy and academic perspective. Thus, from a policy point of view, identifying the relationship among these variables is of paramount importance to economic growth. The study is also

an important addition to the existing literature on the nexuses between trade openness, public investment, private investment and economic growth.

1.6 Organization of the Study

The remainder of the thesis is organized as follows. Chapter two reviews both the theoretical and empirical studies related to the topic. Chapter three discusses the model specification, data types and sources, and also estimation techniques. Chapter four is devoted to an analysis of trends in international trade, private and public investment and economic growth in Ethiopia. Chapter five presents empirical analysis and findings of the study, and chapter six provides conclusions and policy implications.

CHAPTER 2: REVIEW OF RELATED LITERATURE

2.1 Review of the Theoretical Literature

2.1.1 Classical Theory of Economic Growth

The classical economists Adam Smith, David Ricardo and John Stuart Mill were primarily concerned with the dynamics of the economic growth of a capitalist economy (Dudley, 1988). They argued that population growth and capital accumulation are the necessary conditions of growth (Denis and Paul, 2000). The forces of diminishing returns and technological advancements determine the pace of economic growth. Capital accumulation, which itself is determined by the rate of profits, has two effects: it creates demand for labor and it fosters technological improvements by facilitating the division of labor. The population, which tends to grow rapidly, increases the demand for food. Food production is subject to diminishing returns. Thus, we have two forces working in opposite directions: technological advancements that promote growth and the eventuality of diminishing returns that retard growth. Thus, the long-term trend of the economy depends on the relative strength of these two forces (cited in Mark, 1987).

Classical theorists have postulated production to be written as a function of four variables: land (N), labor (L), capital (K), and technology (T) (cited in Eltis, 2000).

$$Y = f(N, L, K, T) \dots\dots\dots (2.1)$$

2.1.2 Harrod–Domar Growth Model

The Harrod–Domar model is used in development economics literature to explain an economy's growth rate in terms of the level of savings and the productivity of capital. Long before the neoclassical theories, the Harrod–Domar model was the most popular model to contribute to aggregate growth theory (Mansour and Fatimah, 2011).

Easterly (1998) noted that this model was initially used to calculate the required amount of funds needed to bridge the gap between savings and the required level of investment to achieve the desired growth rate. Therefore, the limit on the rate of growth results from factors that constrain the savings rate. The model argues that a steady accumulation of physical capital through savings and investment results in higher levels of economic growth. In other words, savings and, hence, investment are important components for economic growth (Hansen and Tarp, 2000). Nevertheless, an assessment of the model shows that it has a basic limitation resulting from its underlying unrealistic assumption that growth is proportional to capital stock. That is, this assumption implies that any growth target is achieved given the availability of funds for capital accumulation.

2.1.3 Neoclassical Growth Model

Long before neoclassical theories, the Harrod–Domar model was the most popular economic growth model and made the first important contribution to aggregate growth theory. The aggregate growth models were extended in the 1950s and 1960s, with Solow's classic articles playing a leading role. Solow (1956) showed that the rates of savings and population growth, taken exogenously by assuming a standard neoclassical production function with decreasing returns to capital, determine the steady state level of

income per capita, which is exogenous. These exogenous neoclassical growth models were extended in the late 1980s and early 1990s to endogenous growth models (Romer, 1986; Lucas, 1988; Rebelo, 1991).

The conventional neoclassical model is often praised for its simplicity and flexibility in identifying the core determinants of long-term growth (Rodrik, 2003b). The Solow type neoclassical growth model developed in 1956 is one of the most influential models that has shaped much of modern thinking on the process of economic growth and marks the starting point of conventional economic growth theorization (Solow, 1956).

The model shares some assumptions with the classical growth model such as the law of diminishing returns to scale in the short run and the existence of constant returns to scale in the long run. Additional assumptions include exogenously determined technical progress and substitutability between capital and labor (Cypher and Dietz, 2004).

The Solow-type model can be depicted by a simple Cobb–Douglas aggregate production function as:

$$Y = (AL)^{1-\alpha} K^\alpha \dots\dots\dots(2.2)$$

Where $0 < \alpha < 1$, A is technological progress,

L is labor force,

K is capital,

AL is the effective labor force, and

$1-\alpha$ and α are income shares of labor and capital

A represents exogenous technological progress, assumed to be available to all economies at the same rate. According to the model, this exogenous technological progress is

fundamental to a higher level of per capita income because, assuming constant labor, the increased use of input in production through investment, K , has a limit in terms of total income and, hence, per capita income (Cypher and Dietz, 2004).

Assuming that the rates of growth of technological progress (A) and the labor force (L) are constant, and the labor force is fully employed, the Solow growth model states that, for any given level of savings and investment, there will be a steady state level of real per capita income. This concept is a direct corollary of the assumption of diminishing returns to capital (K), i.e., given a constant rate of savings (which by definition equals investment), the return of capital for investors decreases as the stock of capital increases. Ultimately, the total amount of capital also reaches a steady state level at which all savings are needed to compensate for depreciation and population growth. The model asserts that when the total stock of capital reaches a steady state level, the level of per capita income of a country will have reached its maximum.

Accordingly, the Solow model suggests that the difference in per capita income is explained by the difference in the savings rate and population growth, which in turn implies that, all else being equal, a higher rate of savings increases the steady state level of per capita income. In Solow's formulations, countries that do not save or invest a high proportion of their income remain poor. Given this phenomenon, more rapid accumulation of physical capital, as suggested by Solow, is at the heart of many economists' policy recommendations for increasing economic growth in less developed countries.

Foreign trade is another variable that influences private investment and, ultimately, economic growth. According to neoclassical thinking, openness to trade has many advantages, such as efficiency gains that come with specialization and competition from international trade; embodied technological transfer through imported inputs; scale economies arising from expanded markets; and diffusion of ideas through global interaction (Piazolo, 1995; Zhang and Zou, 1995; Harrison, 1996; Frankel and Romer, 1999). In contrast, competition arising from openness to trade may discourage innovation by making investment in research and development less profitable. Underdeveloped domestic industries are exposed to competition from imports, whereas exports are often exposed to very volatile world markets. Although the literature on trade and growth tends to focus on exports, justifications exist for including imports as part of foreign trade; imports represent imported technology, capital, and intermediate goods that can be used for investment.

2.1.4 Endogenous Growth Models

The endogenous growth models developed by Lucas–Romer challenged the old neoclassical model by emphasizing the role of endogenous factors (i.e., human capital stock and R&D activities) as the main engines of economic growth. Whereas early neoclassical models assumed total factor productivity growth (or technical progress) as exogenously given, the newer endogenous growth models attributed this component of growth to the “learning by doing” effect that occurs between physical and human capital, which results in increasing returns to scale in production technology (Lucas, 1988).

The most distinctive difference between neoclassical exogenous and endogenous growth theories is that the former assumes constant returns to scale, whereas the latter generally assumes increasing returns to scale. Making the assumption of increasing returns to scale provides a possible path to long-run sustained growth in endogenous growth theories. These endogenous economic growth theories emphasize that opening investment opportunities under a liberalized market friendly economy results in high economic growth. Moreover, the World Bank gap model, which is offered as an alternative framework for growth, hypothesizes that growth of real output is related to total investment, where investment is considered to be one of the demand factors in determining growth.

The endogenous growth model arose in the mid-1980s from dissatisfaction with the standard neoclassical growth model as a tool to explore long-run growth determinants. The relatively slow progress of many African and South Asian economies has led to a critical examination of the policy recommendation from neoclassical growth theory. The policy recommendation refers to the argument that accumulation of capital is all that a nation needs if it seeks to raise its per capita income and refers to the optimistic belief in the convergence of per capita income of poor and rich nations over time (Barro and Sala-i-Martin, 2004; and Cypher and Dietz, 2004).

In the endogenous growth framework, as noted by Cypher and Dietz (2004), a higher level of investment not only increases per capita income but also serves to achieve sustained rates of growth in future per capita income.

According to Barro and Saia-i-Martin (2004), one way to tackle the problem of per capita growth converging to zero at the steady state because of diminishing returns is to broaden the concept of capital, particularly to include human components, as diminishing returns did not apply to this broader class of capital.

In contrast to the neoclassical model, capital has increasing returns to scale, and technology is not assumed to grow at the same rate for all countries, irrespective of the countries' particular reality but "dependent on the functioning of the particular economy". Furthermore, the model holds that growth "is an endogenous process, coming from within each particular economy, with each having a different production function reflecting different quantities and qualities of its inputs" (Cypher and Dietz, 2004).

The endogenous growth model enables countries to continue to grow quickly for long periods of time, even when they have already achieved relatively high income without an increase in the savings rate. Consequently, the endogenous growth model is able to invalidate the convergence thesis of per capita income between poor and rich countries by disregarding the implicit assumptions of the neoclassical growth model. In other words, the endogenous growth model broke the link between the rate of economic growth and the law of diminishing returns and removed the maximum limit on income per person for any particular rate of savings and investment.

The model indicates that government policies for the rate of capital accumulation could affect this rate for both physical and human capital, as well as the level of research and development expenditures. According to Cypher and Dietz (2004), government policies play a vital role in spurring the long-run rate of growth for an economy.

Endogenous growth theories assign an important role to investment in both the short term and the long term; Levine and Renelt (1992) and Sala-i-Martin (1997) identify investment as a key determinant. High investment ratios do not necessarily lead to rapid economic growth; the quality and productivity of investment, the existence of appropriate policies, and the political and social infrastructure are all determinants of the effectiveness of investment (Hall and Jones, 1999; Fafchamps, 2000; Artadi and Sala-i-Martin, 2003).

2.1.5 Accelerator Theory of Investment

The accelerator model of investment linked investment theory to a simple growth model. As cited in Luintel and Mavrotas (2005), the accelerator model was originated primarily by Clark (1917) with further modifications by Chenery (1952) and Koyack (1954). The accelerator model makes investment a linear proportion of changes in output and explains that, given an incremental capital output ratio, computing the investment requirements associated with a given target for output growth is easy (Fazzari, 1989).

According to this theory, investment is a linear function of changes in output; that is, changes in sales and income cause changes in investment. According to (Berthélemy and Varoudakis, 1997), because the function of investment is to increase capital stock and the function of capital stock is to generate additional output, one way of explaining the level of investment is to review changes in desired levels of output. A key implication of the fixed accelerator model is that investment (changes in capital stock) is driven by changes in aggregate demand (see Blomstrom, Robert, and Mario, 1996; Jorgenson, 1963; Fazzari, 1989).

2.1.6 Complementarities between Public and Private Investment

With regard to the relationship between private and public investment, the general observation is that an increase in public investment leads to competition between private and public sectors for limited domestic savings and, hence, the dominant public sector might crowd out the private sector (Jayaraman, 1996). In contrast, as long as public investment measures are in terms of services such as transportation, communications, and other services used by the public, increases in public investment should contribute to an increase in private investment.

Crowding-in private investment

According to Barro (1991, 1996 and 2003); Artadi and Sala-i-Martin (2003) public and private investment are related, and their relationship can be explained as follows. Private investment is often seen as the engine that drives a country's economy, while public investment provides the necessary infrastructure. The two investment type are tied, as public investment may crowd in (if it provides the infrastructure to support the private sector) or crowd out (by increasing costs of borrowing) private investment. Public investment itself affects growth either directly, via its productivity, or indirectly via its effect on private investment. Public investment in human capital (health and education), law and order, research and development, and social and economic infrastructure leads to creation of positive externalities which in turn improve the productivity of private investment.

When public and private capital are complements of one another, public investment raises the marginal productivity of private capital, which raises the returns to private investment and the amount of private investment. In turn, this crowding-in of private investment increases the economic growth rate. However, although public investment is almost certain to crowd in private investment when starting from a low level, it likely does not do so at all levels. Increases in public investment have a successively smaller positive effect on returns to private investment, whereas the taxes required to finance this public investment have a constant negative effect. Therefore, at some point, it is inevitable that increased public investment will crowd-out private investment (cited in Edward, Paolo and Stephanie, 2006).

In the model of Barro (1990), three stages are distinguished. Initial levels of public investment increase the returns to private investment, which represents the crowding-in phase. After a certain point, the (negative) effects of higher taxes offset the (positive) effects of greater public capital on the returns to private investment, and further increases in public investment lower the private savings rate. Nevertheless, increases in public investment still increase the growth rate because public investment remains highly productive. Therefore, this concept is described as the efficient crowding-out phase. However, after these levels, public investment is less productive and further increases lower both the savings rate and the growth rate, which represents the inefficient crowding-out phase.

2.1.7 Infrastructure Hypothesis

According to Fujita et al., (2001), in “new economic geography” models improvements in the domestic transport and communications infrastructure can have significant effects on growth, for two reasons. First, by lowering transport costs, firms’ profits increase. Second, driving a cumulative process that moves labor and other resources to a small number of core regions and/or cities in which (because of increasing returns) labor productivity levels are higher accelerates a country’s growth rate.

Increased aggregate demand

In Keynesian models of the economy, public investment affects the level of national income through aggregate demand. Such models assume that, because of inflexible wages and/or prices, economies sometimes operate at less than full employment. In such cases, an increase in public investment has an immediate and positive effect on the level of national income (cited in Hausmann et al., 2004).

2.1.8 The Orthodox theory on the trade–growth nexus

According to the current orthodox view, trade openness is essential for growth. The orthodox assumes that poor countries do not sufficiently participate in world trade. Countries that liberalize their imports and orientate production toward exports are assumed to have faster growth than those countries that do not and the faster the rate of opening, the greater the prospects for development (Mehdi, 2006).

According to Martin (2004), this perspective underlies the policy conditionality of rapid or “big-bang” liberalization of the Bretton Woods institutions (IMF, World Bank) under which many developing countries have lowered their applied tariffs on many products.

This perspective also underlies the implicit assumption within the WTO that members should liberalize their imports as much as and as quickly as possible.

In recent years, the orthodox view has been challenged by a number of empirical studies showing that there is a lack of a relationship between the degree of trade liberalization and the rate of growth (Rodrik, 2001; Martin, 2005).

These studies have raised doubts about the policy prescription of rapid trade liberalization. Empirical evidence is also growing on the negative consequences of rapid import liberalization on the industrial and agriculture sectors in many developing countries. An emerging paradigm considers the complexities of the relationship between trade and development and stresses the importance of the context, sequencing, rate and extent of trade liberalization if this process is to contribute to and not detract from development (Martin, 2005; Das, 2003; Das, 2001 and Third World Network, 2001).

The emerging paradigm accepts that there are possible costs and potential benefits of trade liberalization to a particular developing country depending on the conditions in that country and the type of liberalization undertaken. Using this approach makes it crucial that a country's trade policies make the correct choices, with an appropriate blend between liberalization and protection (Thierry and Emilie, 2003).

2.1.9 Export-Led Growth Hypothesis (Export-Led Model of Growth)

The export-led growth (ELG) strategy is an economic development strategy that emphasizes the role of exports and foreign trade on a nation's economic growth and development. Because of the actual and potential benefits from foreign trade accorded to both developing and developed countries alike, a shift toward this strategy has been

witnessed. In addition, development economists, encouraged by the debate on whether exports have a positive effect on economic growth, have given attention to the relationship between exports and economic growth. The discussion that follows addresses the issue of how export growth affects economic growth.

According to Adam Smith, international trade allows a country to reallocate the given resources to provide new, effective demand for output from surplus resources under the assumption that a previously isolated country possesses a surplus productive capacity above the requirements of domestic consumption. Consequently, the domestic surplus productive capacity suitable for the export market generates a costless means of acquiring imports and expanding domestic economic activity (Meier, 1995 and Myint, 1958).

This export-based theory argues that a country's discovery of a primary commodity with a comparative advantage or the increase in demand of such a primary commodity results in expansion of export-based commodities that, in turn, induces higher growth in both aggregate and per capita income.

Meier (1995) noted that exporting primary products reduces both unemployment and underemployment, attracts an inflow of factors of production in the export sector, boosts the rate of investment and savings in the economy, and creates a link with other sectors of the economy. In addition, Jung and Marshall (1985) provided three reasons for why export growth has the effect of increasing real GNP. First, increases in export growth may represent increased demand for national output. Second, relaxing foreign exchange constraints allows for the import of productive intermediate goods used for production.

Third, export growth helps firms exploit economies of scale by enlarging the domestic market and, thus, lowering unit costs.

2.1.10 Wagner's Law

Over one hundred years ago, German economist Adolph Wagner formulated a “law” of expanding state activity in his classic book, *Grundlegung der Politischen Ökonomie* (1863). He asserted that there is a long-run propensity for the scope of government to increase with higher levels of economic development. In other words, as the economy grows, public sector investment expands simultaneously (cited in Amos, 1996). Wagner's contribution to public expenditure theories is particularly significant when we consider that, before Wagner made his observations, the prevailing view was the notion that, as a country grows richer, government activities have a tendency to decline (Henrekson, 1993).

2.1.11 Trade Openness and Public Investment Hypotheses

There are three main set of hypotheses related to trade openness and public investment nexuses; Efficiency hypothesis, Compensation hypothesis and Deindustrialisation hypothesis. According to the efficiency hypothesis globalization imposes a constraint on government expenditure due to efficiency reasons. In fact, government expenditure has to be financed through taxation, raising production costs, and therefore harming firms' competitiveness. For that reason, firms can lobby on governments in order to reduce public intervention, protection and expenditure to reduce costs and then to enhance their competitiveness on the global markets (Garrett, 2001).

Moreover, as capital flows are liberalized, taxes on capital are constrained. An increase in taxation of capital is an incentive to capital outflows, therefore governments who want to finance their expenditure should rely on taxes hitting less mobile production factors, such as labor. However, if taxes on labor income increases, labor costs increase too, affecting negatively firms' competitiveness (Alesina and Perotti, 1997). Therefore, according to the efficiency hypothesis, a negative relationship between trade openness and government spending can be expected.

The compensation hypothesis puts emphasis on the incentives for government interventions in the economy in order to protect national economic agents following globalization. Some authors, like Ruggie (1982), Garrett (1998a) or Rodrik (1997) recognize that there persist political incentives to expand the public economy in response to globalization that may counterbalance the competitiveness pressures consequent on market integration. According to Hecksher-Ohlin models, expanding trade may reduce demand for relatively scarce factors of production and increase demand for plentiful ones, which demands government intervention.

But, according to Rehm (2005), the two forces (the efficiency hypothesis and the compensation hypothesis) can counterbalance each other, in which case empirical results would show no significant associations between trade liberalization and the size of government – the deindustrialisation hypothesis. Iversen and Cusack (2000) argue that there is no direct causal relationship between trade liberalization and public sector size.

2.2 Review of the Empirical Literature

2.2.1 Relationship between Trade Openness and Growth

To date, the available empirical literature on the relationship between trade openness and growth is divided into two categories: cross-sectional studies and time series studies. Within these categories, it is possible to classify further the empirical studies under discussion into early and recent because of the discernible difference in their assertions regarding the link between trade openness and growth (Nabeela *et al.*, 2011). In both the earlier and recent classifications of empirical studies, the disagreements over the analysis of the effects of trade on economic growth focus on the following three issues: the construction of a single appropriate trade openness index, the use of cross-section analysis and the direction of causality (Hamori *et al.*, 2003).

In various studies, one or more of the following economic variables has indexed trade openness. The most widely used are volume of trade as a ratio of GDP and export as a ratio of GDP. Some studies included real exchange rate distortion and variability (Dollar, 1992), and tariff and nontariff barriers as representative of trade openness. Still others such as Sachs and Warner (1995) designed their own openness indices, including nontariff barriers, average tariff rates, black market premiums, whether or not the economy is socialist, and government monopolies on exports.

Dollar (1992) used comparative data for 95 LDCs during the period from 1976–1985, capturing trade openness based on real exchange rate distortion and variability. He used distortions in the real exchange rate to test the hypothesis that purchasing power parity (PPP) holds in the end. The hypothesis holds if exporters/importers are free to exploit

price differences. However, given distortions, exporters/importers cannot exploit price differences and, hence, PPP does not hold. Accordingly, real exchange rate distortion represents the level of trade openness. Dollar's study also showed that trade liberalization, devaluation of the real exchange rate, and maintenance of stable real exchange rates increase growth in many poor countries.

However, Rodriguez and Rodrik (2001) criticized the findings of Dollar (1992) on the grounds that real exchange rate distortion is theoretically appropriate as a measure of trade restrictions when three conditions hold, which obviously is counterfactual. The three conditions are: (i) no export taxes or subsidies are in use, (ii) the LOP holds continuously, and (iii) there are no systematic differences in national price levels attributable to transport costs and other geographic factors. Furthermore, Rodriguez and Rodrik (2001) and Baldwin (2003) noted that distortions in the real exchange rate are not the sole reason why the law of PPP does not hold. They maintained that a variety of other factors might be responsible; in particular, monetary and nominal exchange rate policies have a significant effect on the real exchange rate regardless of trade policies. With respect to variability in the real exchange rate, it is more an indicator of economic instability than trade openness (Rodriguez and Rodrik, 2001).

Sachs and Warner (1995) designed indicators of trade openness (nontariff barriers to trade, average tariff rates, black market premium, whether the economy is socialist, and government monopolies on exports) and used data on 79 countries from the period from 1970–1989 to analyze the relationship between trade and economic growth. Their study found that openness had a significant and positive influence on growth. However, later studies criticized the findings of Sachs and Warner (1995). Rodriguez and Rodrik (2001)

maintained that the black market premium is not a good measure of trade policy because it is also a proxy for many other variables that are unrelated to trade policy.

Furthermore, Pritchett (1996) criticized the other indicators, including nontariff barriers to trade and average tariff rates to proxy trade volume because goods that are less significant for the country may be assigned undue weight, gaps between legal rates and the tariffs actually collected. A study made by Dollar and Kray (2003) showed little correlation between volume of trade and the above indicators (nontariff barriers to trade and average tariff rates).

Harrison (1996) analyzed the link between trade openness and GDP growth for 51 countries for the period from 1960–1988. By using seven different measures to proxy the degree of openness for each country, he attempted to address the controversy of measurement error and cross sectional analysis. He conducted both long-run average cross-sectional analysis and cross-country time series analysis. From the first analysis, he found that only one of the seven indices (black market rate) enters the growth regression with a negative sign, whereas the five-year average data analysis result showed that three of the seven indices have a positive effect on growth. The three variables are tariff and nontariff barriers with a positive sign, black market rate and price distortion index in dollars with a negative sign.

The second analysis (country's time series data analysis) shows that six of the seven indices become statistically significant. He noted three measures that show a strong relationship with GDP, namely black market premium, price level of a country relative to international price, and subjective measure of trade liberalization at the World Bank. The

study concluded that the choice of period of analysis is central to the research outcome and that the relationship between openness and growth is better captured through time series analysis than cross-sectional analysis. Based on time series analysis, Harrison (1996) found that greater openness was associated with positive economic growth. To criticize Harrison (1996), Rodriguez and Rodrik (2000) argued that the black market premium is not a good measure of trade policy because it is also a proxy for many other variables that are unrelated to trade policy.

Pritchett (1996) in his criticism of Harrison cited the potential advantage of trade policies as a proxy for trade openness because the role of trade policy for growth is directly revealed. However, he criticized the use of nontariff barriers to trade and average tariff rates to proxy trade openness given the possibility of assigning unreasonable weight for goods that are less significant for the country, the prevalent gaps between legal rates and the tariffs actually collected. Furthermore, a study by Dollar and Kray (2003) showed little correlation between volume of trade and nontariff barriers to trade and average tariff rates.

Sala-i-Martin (1991) argued that using trade policy measures to proxy openness entails the endogeneity problem because trade policies are likely correlated with factors omitted from the regression (represented by the error term) but that likely affect income (such as free-market domestic policies, stable fiscal and monetary policies), implying correlation between the regressor and the error term.

A study conducted by Edward (1992) analyzed the relationship between trade openness and GDP growth using a cross-country dataset of 30 developing countries during 1970–

1982. Two basic sets of trade policy indicators, as constructed by Leamer (1988), are used in the model. The first set refers to openness and measures of trade policy (tariff and nontariff barriers) that impede imports. The second set measures trade intervention and capture the extent to which trade policy distorted trade. OLS estimation confirmed that the entire first set of openness indicators were positively related to real per capita GDP growth, whereas trade intervention indexes significantly hampered GDP growth. These studies support the hypothesis that countries with a more open trade regime tend to grow faster, and those with a more distorted trade regime tend to grow slower.

A further study by Edwards (1998) used comparative data for 93 countries for the period 1980–1990 and attempted to test the strength of the relationship between trade openness and economic growth. He used the already existing Sachs–Warner indicators of openness (five in number) and four other trade policy indicators, and demonstrated that all proxies of trade openness correlate positively with economic growth.

Rodriguez and Rodrik (2001) criticized Edwards’ (1998) findings by demonstrating that his results depend on the fact that he weights his regression by per capita GDP. They argue that the number of measures that are significant would have dropped to four if he had weighted his regression differently, such as if he had taken the log of per capita GDP. They further maintain that macroeconomic policies affect the exchange rate premium more than trade policy.

Khan *et al.* (1995) attempted to investigate the causal relationship between export and economic growth in Pakistan. Their study showed that an increase in exports stimulates economic growth, which is a finding in line with the conventional wisdom. However,

according to Bahmani-Oskooee and Niroomand (1999), using exports as a proxy for openness is flawed because doing so ignores imports.

Sinha and Sinha (2000) conducted a time series analysis using total trade volume as an accurate measure of openness and examined the link between openness and growth for 15 Asian countries for the period 1950 to 1992. They developed a model that specified GDP growth as a function of growth rates of openness (exports plus imports), domestic investment, and population. The coefficient of the growth of openness was found to be significant for only eight of the 15 countries. However, they found support for the proposition that GDP growth rate is positively related to the growth rates of openness and domestic investment, whereas the relationship between GDP growth rate and the growth rate of the population is not conclusive. Still, researchers such as Chandran and Munusamy (2009) calculated trade openness as a ratio of manufacturing imports plus exports to manufacturing output to demonstrate the nexus between openness and growth. Using annual data from 1970 to 2003, their results from the cointegration approach suggested a positive long-term relationship between openness and growth in Malaysia.

Recent studies concluded that the openness of the trade regime has a positive relationship with GDP growth [Ahmed, Yusuf and Anoruo Emmanuel, 2000; Wacziarg, 2001; Yanikkaya, 2003).

Asghar *et al.* (2011) explored the connection among economic growth, openness, income inequality, education, and health in Pakistan by using annual time series data for the period 1974–2009. The study, employing the Johansen and Juselius cointegration test, corroborated the long-run relationship among the variables and VECM to check the

short-run and long-run dynamics. To observe the causality, they used the Toda–Yamamoto causality test. Their result supports a strong positive effect of openness of trade on economic growth in the long run. One major criticism labeled against Asghar *et al.* (2011) is the problem of a missing variable (in this case, investment) that could influence the outcome because this variable is an important factor that affects growth.

Siddique *et al.* (2005), following Sinha's (2000) model, attempted to explore the effect of openness on economic growth for the period from 1972–2002. The model classified GDP growth rate into three components, *i.e.*, investment growth rate, population growth rate and trade growth rate. The study identified a negative relationship between trade openness (exports plus imports) and economic growth, contrary to previous results from empirical research.

Yanikkaya (2003) analyzed cross-sectional data for 120 countries for the period from 1970- 997 to estimate the effect of trade liberalization on per capita income growth employing the generalized method of movement (GMM). He used trade volumes as trade openness measures that include different ratios of trade variables (e.g., exports, imports, exports plus imports and trade with developed countries) with GDP. The results of the GMM estimates showed that openness based on trade volumes was significant and positively related to per capita growth.

Ahmed et al (2000) investigated the long-run relationship between GDP growth and openness for five Southeast Asian countries, the Philippines, Indonesia, Malaysia, Singapore and Thailand, for the period from 1960 to 1997. They used the export plus the import growth rate as a proxy for openness. The Johansen estimation results rejected the

hypothesis that there is no cointegration between economic (GDP) growth and openness, while the hypothesis that the error correction term is significant could not be rejected. These vector error correction estimates showed bi-direction causality.

By analyzing time-series data for each country, Jin (2000) studied the short-run dynamics of trade openness and economic growth in six East Asian economies. Jin (2000) employed a five-variable vector autoregression (VAR) model incorporating GDP, money supply, government spending, foreign price, and openness. Impulse response functions (IRF) and variance decompositions (VDC) are computed to review the effects of trade on growth. The IRFs showed that the short-run output effects of trade are positive but small and insignificant for the five countries. From the VDCs, the forecast error variance of GDP explained by the trade openness innovation is also small and insignificant for the five countries. The study confirmed that the effects of the shocks on government spending and foreign price are more substantial.

In the case of Africa, Rodrik (1998) found that the effect of trade openness is indirect and small. His analysis showed that exports' share of GDP, the Sachs–Warner openness index, import taxes, and the black market premium do not significantly enter the growth equation. Accordingly, his study confirmed that trade policy plays a secondary role in output growth after human capital, physical infrastructure, macroeconomic stability and rule of law. Using the logs of variables in the model, the result of the analysis suggested that the size of the economy and the importance of trade relative to the GDP markedly determine the effects of trade on growth.

With regard to Ethiopia, few attempts have been made to test the relationship between trade and economic growth. Girma (1982) performed country-specific regression analysis for Ethiopia by incorporating GDP as the dependent variable and exports as the only explanatory variable. His results indicated that GDP and exports are highly correlated with a correlation coefficient of 0.962 and that the coefficient of determination (R²) was 0.81. However, his work did not consider the effect of other important variables that could significantly influence economic growth (Debel, 2002).

Debel (2002) used export as a percentage of GDP to proxy the measure of trade openness with the intention to examine the effect of exports on economic growth for the period 1960/61–2000/01. He used a simultaneous equation model and a Granger causality test to examine the indirect effect of exports on economic growth. From the cointegration and error correction models, he learned that exports have a significant and direct effect on economic growth in the short run and the Granger causality test established the direction that runs from exports to growth.

2.2.2 Relationship between Trade Openness and Public Investment

The link through which trade openness affects public expenditure is a point of analysis for most researchers. One way or another, many studies claimed that openness affects public expenditures through the higher specialization that trade offers and interest groups (Cameron, 1978; Swank, 1983; Schmidt, 1983). Still others such as Rodrik (1996, 1998) argue that their link lies in the external risk (shock), whereas others maintain that the link between the two depends on the size of the country under consideration (Alesina and Wacziarg, 1998). Authors such as Saunders and Klau (1985) cite economies of scale in

the provision of public goods and services as the link between trade openness and expenditure. The following review of empirical studies consists of cross-sectional and time series analyses for both developed and developing countries.

Cameron (1978), emphasizing the link between higher specialization and interest group, created pioneering work that established the connection between trade openness and public expenditure. The motivation behind his research is attributable to the unprecedented growth in the public sector in developed economies after the Second World War when the welfare state began to merge. Using a sample of 18 developed capitalist countries for the period from 1960–1975, the main result of his analysis established that public sector expansion was primarily explained by trade openness. Cameron (1978) maintained that a high level of competitiveness and industrial concentration characterize open economies, which in turn generate higher levels of specialization. According to Cameron, this higher level of specialization favors union organizations (interest groups) that lead to an increase in social public incomes. Thus, for Cameron, openness has a positive effect on public expenditures through increased specialization.

Swank (1983) forwarded different explanations for the rise of the welfare state and tested Cameron's argument for 17 developed economies. Swank used Cameron's model with the inclusion of interest group variables and determined that the openness variable remains positive and significant. Swank contended that the increase in public sector expenditure attributable to openness wards off the pressure from international markets. Following Cameron's lead, Swank confirmed the positive connection between openness and public sector spending for the 17 developed economies.

In parallel with Swank, Schmidt (1983) corroborated the finding of Cameron. Schmidt's study on 22 developed countries stretched through three periods: the post war reconstruction (1950–1960), Cameron's data period (1960–1975), and the world economic crisis period (1974–1978). He ascertained that public sector expansion as manifested by taxes and social security contribution as a percentage of GDP rises and falls in the same direction as openness.

A study by Rodrik (1996, 1998) determined that external shock represented a new link through which openness affects public spending. Rodrik (1996) argued that open economies face external shocks and, hence, need larger public sector expenditures to mitigate the destabilizing effects of trade. Rodrik undertook to establish the connection between openness and public sector spending in a cross-country analysis of 103 countries and found a positive relationship between the variables.

Rodrik claimed that the relationship between the variables is not spurious and the result cannot be criticized for choice of data or missing variables because the sample is large, there are many explanatory variables, and a wide range of control variables are included to test the robustness of the link. Furthermore, he asserted that the relationship holds for different periods and different measures of public sector spending.

Alesina and Wacziarg (1998) questioned Rodrik's (1996) external shock as the link between openness and public spending, which led him to establish a positive relationship between them. The challenge is that the link between openness and public sector spending results not from external shock but country size. They argued that access to large markets by small economies does not necessarily ensure benefits from trade if they

do not adopt a free trade policy, and the public sector for such economies is larger if they cannot exploit economies of scale. In their estimation, expansion of public expenditures may not necessarily be to mitigate the destabilizing effect of international markets despite the fact that they obtain some evidence of this notion by incorporating a population variable into the reference specification of Rodrik (1996). Furthermore, the authors indicated the existence of a high level of colinearity between openness and country size that makes a definitive conclusion difficult.

However, Ram (2008) conducted a panel data study of 154 countries for the period 1960–2006 to examine the sensitivity of the relationship between openness, country size and public sector size proposed by Alesina and Wacziarg (1998) by simplifying the reference equation of Alesina and Wacziarg (1998) and Rodrik (1998). He concluded that, once the size of a country is controlled, trade openness exerts a positive and significant effect on public expenditure.

Previous other studies on developed economies by different researchers during different periods show a similar positive relationship between trade openness and public sector spending. Hicks and Swank (1992), using Cameron's (1978) postulates of specialization and interest group, employed panel data from 1960–1982 for 18 developed economies and confirmed the positive relationship between trade openness and public expenditure. The same result was observed in Huber *et al.* (1993) except that the period of analysis runs from 1956–1988.

Recent empirical research reaffirmed the positive link between trade openness and public spending that was already established by early empirical evidence. Some such studies

include Garrett (2001), the UN-World Public Sector Report (2001), Martínez-Mongay (2002), Islam (2004), Garen and Trask (2005), Shelton (2007), Gemmell *et al.* (2008), Ram (2008) and Rivas, Sort and Rodriguez (2010).

Rivas, Sort and Rodriguez (2010) embarked on a study to reveal the empirical link between trade openness and public expenditure in Spain during 1960–2000, a period during which both growth in public expenditures for goods and services and openness increased. By applying the Johansen cointegration test, the time series analysis revealed a positive relationship between public expenditures and openness, along with several protection indicators.

Sanjeev (2010) used data pertaining to 42 sub-Saharan economies to estimate the relationship between trade openness and public spending. These data have been averaged for the period 2000-2005, it is found that, that greater openness tends to drive public sector size bigger. All of the aforementioned empirical studies demonstrated a discernible positive link between openness and public sector expenditures, the causality being unidirectional from openness to public expenditures. However, other studies by Ferris and West (1996), Ferris (2003) and Borcharding *et al.* (2004) demonstrated the opposite (negative) link between the two variables.

Ferris and West (1996) conducted a study in the United States between 1959 and 1986 and found a negative relationship between trade openness and public expenditures. Their study suggested that a negative relationship was observed in the result because integration into international trade involves greater tax competition. According to the researchers, this tax competition hampers a government's capacity to increase taxes, especially capital taxes, thereby restricting the expansion of public sector spending.

However, this result is despite Abizadeh's (2005) finding that confirmed the positive relationship between the two variables for the same country (the United States) for the period 1960–2000.

Similarly, Ferris (2003) and Borcharding *et al.* (2004) established and corroborated the thesis that there is a negative link between trade openness and public spending for 20 OECD countries for the period 1970-1997. Other authors like Iversen and Cusack (2000), Molana *et al.* (2004), Kittel and Winner (2005) and Dreher (2006, 2008) in their respective studies showed that there is no any relation between openness and public sector size in OECD countries.

Molana *et al.* (2004) studied the Spanish economy for the period 1948–1998 and 22 OECD countries to determine the link between trade openness and public expenditures using Johansen's cointegration test. Their findings revealed that no cointegration exists between the two variables and no long-term causality was observed. According to Molana *et al.* (2004), unsuitable measurement of the variables employed in the analysis is responsible for the findings, particularly the measure of openness.

Tanzi (2006) compared 13 of the most open industrial countries with respect to public spending at its highest as a share of GDP and its level in 2002 and he shows that government expenditures are stagnant or declining, although economic openness clearly continues to be high and this finding supports the efficiency hypothesis.

Elisa (2008) investigates the effect of trade openness on public expenditure, using a panel of 20 OECD countries in the period 1980-2003. Trade openness increased competitiveness in the global arena constraints the ability of increasing public

expenditure both because of efficiency reasons and of tax competition (and this supports efficiency hypothesis). And also Stephanie (2008) analyze the relation ship between trade openness and public spending in 44 developing countries from 1981 to 1997 and found that trade openness reduce public spending.

2.2.3 Relationship between Public Investment, Private Investment and

Economic Growth

Various researchers conducted a large number of empirical studies (time series and mostly cross-sectional) and investigated the effect of public investment on economic growth. Studies by Aschauer (1989), Eberts (1986), and Munnell (1990), which inspired further analysis in the area, observed a significantly positive relationship between public investment and economic growth.

Aschauer (1989a), employing a production function framework and fitting the aggregate growth regression for the United States for annual data from the period 1949 to 1985, affirmed that the contribution to growth from public capital is more significant than that from private capital. At the same time, Aschauer (1989b), using pooled data for the Group of Seven industrial countries during 1966–1985, reaffirmed the highly positive and significant contributions of public net investment to growth rate.

Easterly and Rebelo (1993) used cross-country data and observed that public investment in transport and communication has a positive effect on economic growth. Subsequent studies following either the single equation time series analysis of Aschauer (1989a) or the cross-sectional analysis of Easterly and Rebelo (1993) revealed the positive effect of public investment on economic growth.

Munnell (1990) substantiated the findings of Aschauer (1989) and endorsed the high contributions of public capital to growth. Furthermore, both Barro (1989, 1990), within the endogenous growth theory framework, and Khan and Kumar (1997), using cross-national data, demonstrated the positive relationship between public investment and output growth already established by Aschauer (1989).

Nazmi and Ramirez (1997) also investigated the effect of public and private investment spending on economic growth Mexico. Although they found a positive effect from both types of investments on economic growth, their results differ from Aschauer (1989) in that the contribution of private investment is statistically identical to public investment. They argued that expansion in output attributable to public capital spending comes about at the expense of private investment. In other words, they indicated a significant crowding out effect of public investment.

Ram and Ramsey (1989) and Alfredo and Jorge (2012) revisiting the issue, employed both integration and cointegration tests on annual observations in the United States they found a positive effect of public investment on output, labor and private investment in the long run. Along the same lines, Ghali (1999) established a positive causal relationship between public expenditures and economic growth for ten OECD countries using a quarterly dataset covering the period 1970 to 1994.

Other empirical studies such as Pereira (2000, 2001a and 2001b) and Mittnik and Neumann (2001) observed positive effects from public capital spending, particularly infrastructural spending, on private investment, productivity and growth. The findings of

these studies suggested a strong relationship between the variables and that a decrease in public capital spending might severely hamper economic growth.

The above empirical studies faced severe criticism from other researchers both methodologically and with respect to the inferences drawn. Critics argued that the traditional OLS regression analysis is not adequate to establish the flow of causality. Researchers tend to misinterpret the regression of economic growth on public expenditure as evidence of causality from the latter to the former. Nevertheless, the arrival at a significant coefficient does not mean that the result is one directional and in line with the Keynesian view (causality from government expenditure to growth). Instead, the coefficient may equally be compatible with Wagner's law (from growth to spending) and/or a bi-directional causality between the two variables.

Accordingly, Hsieh and Lai (1994) noted that cross section analysis could only identify correlation but not causation between two variables. Ghali (1999) noted that this is the case because correlation provides only "pooled estimates of the effects of government size on economic growth" and fails to disentangle the effects for each country.

Ghali (1999) suggested that the proper way to capture causality is to use the Granger causality test; his findings supported the Keynesian view for all OECD countries, emphasizing size of government in determining economic growth. However, Hsieh and Lai (1994), using the Granger causality test, found no evidence to support the Keynesian view for the G-7 countries and that no apparent evidence of causality exists from government expenditures to economic growth.

In contrast, Wahab (2004), with the intention to unravel the effect of accelerating and decelerating economic growth on government expenditures for OECD, EU and G-7 countries for the period 1950–2000, found evidence of Wagner’s law only for EU countries. However, in general, his findings indicated that for all countries (OECD, EU and G-7), government spending increases less than proportionately with accelerating economic growth and decreases more than proportionately with decelerating economic growth.

Tatom (1991) criticized the findings of Aschauer (1989a) and Munnell (1990) for using an inappropriate method to detrend the data. Tatom (1991) argued that they did not account for the stochastic trend in the data, and the unit root test revealed nonstationarity in the data. He asserted that the correlation between the two variables is spurious because of the presence of nonstationarity. After taking the first difference of the variables to estimate the aggregate U.S. production function, Tatom (1991) observed the positive connection between public capital and economic growth.

Tatom (1991) was also concerned with the direction of causality as ascertained by Aschauer (1989) and Munnell (1990), which was causality from public spending to economic growth. Using a Granger causality test, he found reverse causality, i.e., from economic growth to public spending. His analysis indicated that instead of higher public investment in infrastructure affecting productivity and output, higher output might be incentive for a country to invest in infrastructure.

In addition, Charles and Peterson (1984) emphasized that the reported relationship may not mean causality. MacMillan and Smyth (1994) estimated the VAR models using both

levels and first differences of the variables; they also concluded and indicated negligible effects of public capital on output.

There are conflicting results regarding the nexus between public investment and private investment. In other words, many studies found a significant crowding-in effect. Others found a crowding-out effect and still other studies found inconclusive results. Researchers such as Argimon *et al.* (1995), Cardoso (1993), and Aschauer (1989b) observed that using aggregate rather than disaggregate public investment data, e.g., infrastructural public investment, is the culprit for the ambiguity of the empirical studies.

Mustafa *et al.* (2002) uncovered some evidence of public investment crowding-out private investment but not significantly in the long run. However, they found evidence that the two types of investments supplement each other in the long run even if the recurring macroeconomic instability crushed or even reversed the long-run complementarities.

Munnell (1990) maintained that public investment in infrastructure serves as an important ingredient in the private sector production process, affecting both output and productivity. He asserted that public investment in infrastructure plays an important role in expanding the capital accumulation of a nation and facilitates the economical use of the existing stock.

Glen and Sumlinski (1996) investigated the effect of increases in public investment on real output, real exports and private investment. His findings corroborated the already established fact from previous studies (the positive association between public investment and output) with some variations across regions. In South and Eastern Africa, the strong

effect of public investment came about through a crowding-in effect and a higher capital output ratio. In contrast, the study revealed the weak effect of public investment in West and Central Africa and North Africa attributable to lack of crowding-in and presence of crowding-out in the regions, respectively.

Another study by Ndikumana (2005) investigated the determinant of private investment in South Africa for the period 1970–2001 on both aggregated and disaggregated data on 27 subsectors of manufacturing. The results of the investigation established a strong crowding-in effect of public investment on private investment through public spending expansion and the spurring of domestic demand that produced large gains in private investment.

In a similar study that investigated both the short-run and long-run factors affecting private investment in Botswana, Lesotlho (2006) strengthened the hypothesis that public investment, such as in other developing countries, affects private investment in Botswana. He used the static OLS methodology with cointegration and error correction model procedures, which enabled him to determine simultaneously both the short-term and long-term factors. The study demonstrated that public investment is a significant factor affecting private investment in the short run.

An investigation of the effect of fiscal policy on economic growth in Egypt, Morocco and Tunisia by Mansouri (2008) illustrated that public investment has a positive effect on private capital accumulation and the labor force and a crowding-in effect. However, the result of the analysis for the three countries differed with respect to time range, i.e., public investment positively affects economic growth in Egypt and Tunisia only in the

long run whereas the effect is observed in both time ranges for Morocco. The study accentuated the fact that the means for financing government investment do not put pressure on the availability of financial resources for private investors. Consequently, the study established that “public investment complement instead of crowding-out private capital accumulation”.

Beddies’ (1999) study on the association between investment, capital accumulation, and growth in Gambia for the period 1964–1998 using an aggregate production function demonstrated the large and significant effect of private investment on output. Furthermore, the study found that an increase in public investment enhances output.

Aka (2007) used an autoregressive-distributed lag (ARDL) error correction model to explore the effect of public and private investment on the economic performance of Cote d’Ivoire for the period 1969–2000. He found that the effect of private investment in the short run is greater than that of public investment, whereas the opposite is the case in the long run.

Considering labor, capital, defense expenditure, government human resource expenditure, and government capital expenditure as explanatory variables, Endrias (1996) performed an estimation of parameters at the macro level using a translog production function for the period 1960/61–1990/91. The study revealed that government expenditures on human resources and capital expenditures have a significant effect on economic growth as explained by the elasticity estimates of the translog production function.

Muhammed (2006) explored the direction and the size of private and public investment and their linkage and relative effect on economic growth in Ethiopia employing an error correction model using time series data for the period from 1970/71–2004/05. The study showed the role of both private and public investment in stimulating economic growth, the former in the long run and the latter in the short run. Regarding the relationship between private and public investment, the study confirmed that public investment is found to be injurious to private investment in the short run and insignificant in the long run. In other words, the crowding-out effect of public investment outweighs its crowding-in effect. Mohammed concluded that the role of private investment in stimulating economic growth exceeds that of public investment and the involvement of public investment in areas outside infrastructure “may jeopardize the favorable effects of public sector infrastructural investment on private sector”.

Shonchoya (2010), focuses on the recent pattern of government expenditure in developing countries using a panel data set for 111 developing countries from 1984 to 2004, this study finds evidence of Wagner’s law which states expansion of public economy is influenced by the greater economic affluence of a nation.

And studies by Chang (2002) examines three emerging countries in Asia (South Korea, Taiwan, and Thailand) as well as three industrialized countries (Japan, the United States, and the United Kingdom) over the period 1951-1996, with the exception of Thailand, again supports the validity of Wagner’s Law.

Chiung (2006), also tests Wagner’s Law for China and Taiwan, using annual time series data covering the period 1979-2002. Empirical results indicate that there exists no long-

run relationship between government expenditures and output in China and Taiwan. Furthermore, Toda and Yamamoto's (1995) Granger non-causality test results also show that Wagner's Law does not hold for China and Taiwan over this same period. The studies of Ansari *et al.* (1997) for three African countries, Ghana, Kenya, and South Africa, also find no evidence supporting Wagner's Law.

CHAPTER 3: MODEL SPECIFICATION, VARIABLE DEFINITION AND ESTIMATION TECHNIQUE

3.1 Model Specification

The empirical frame work of this study is focused on modeling the nexus between private investment, public investment, trade openness and economic growth. A variant of the growth model can be used to evaluate the nexus between private investment, public investment, trade openness and economic growth. However, this paper uses a Solow–Swan aggregate production function that is modified to account for the three types of capital stocks: private and government physical stocks and human capital stock. The production function takes the following form:

$$Y_t = A_t f (K_t^p, K_t^g, Z_t) = A_t (K_t^p)^\alpha (K_t^g)^\beta (Z_t)^\gamma \dots\dots\dots 3.1$$

Where Y is the level of output; A represents technology; K_t^p and K_t^g are the private and public physical capital stocks, respectively; and Z_t is the vector including other factors affecting growth. The standard framework was modified for two main reasons. First, following Barro’s (1990) endogenous growth model, the possibility that private and public capital stocks impact economic growth differently is considered. Most growth models assume that $\alpha = \beta = \eta$ so that $(K_t^p)^\alpha (K_t^g)^\beta$ in Equation(3.1) is replaced by K_t^η where K is the total physical capital stock.

However, Khan and Reinhart (1990) emphasized the disadvantage of equating $\alpha = \beta = \eta$ because this equation tells us little about the independent effects of private and public capital on growth. Because the effects are combined into a single Gross capital formation, it is obviously not possible to ascertain whether an increase in private investment

matched by a decrease in public investment will assist or hinder the rate of growth of output. Decomposing these factors facilitates the evaluation of whether private sector investment and public sector investment have differential impacts on the growth rate.

Second, another strand of endogenous growth models stresses that human capital accumulation, by enhancing labor productivity, can boost growth in the steady state (Lucas, 1988; Romer, 1990; and Becker, Murphy, and Tamura, 1990). By assuming that $\alpha + \beta + \gamma \geq 1$, endogenous growth models can generate sustained growth, even in the absence of exogenously given technological progress and population growth, from forces within the economic system, such as accumulation of physical and human capital stocks and changes in economic policy.

The parameters α , β , and γ in equation (3.1) represent the elasticities of output with respect to private, public and other factors, respectively. Under conditions of perfect competition, equation (3.1) is characterized by constant returns to scale such that $(\alpha + \beta) = 1 - \gamma$. Thus, each individual factor of production faces diminishing returns to scale. Additionally, under conditions of perfect competition, the shares of total capital stock and labor income are given by $(\alpha + \beta)$ and γ . Nevertheless, as assumed in endogenous growth models, when there are positive externalities to the economy stemming from either investment in human capital (Lucas, 1988; and Becker, Murphy, and Tamura, 1990), investment in physical capital (Romer, 1986, 1987, and 1994) or increased openness to international trade (Grossman and Helpman, 1991), $\alpha + \beta + \gamma \geq 1$. Thus, in growth models with externalities, diminishing returns to scale to capital occur more slowly than in models under perfect competition. Grossman and Helpman (1991, p.24)

have noted that in models with externalities, economic growth “can be sustained by continuing accumulation of the inputs that generate the positive externalities”.

Equation (3.1) can be expressed in terms of the growth rate as follows. By taking the total differentials of Equation (3.1), we obtain:

$$dY = Y_K dK + Y_Z dZ + Y_A dA \dots \dots \dots 3.2$$

Dividing Equation (3.2) by Y and manipulating the expression, gives growth function

$$\frac{dY}{Y} = \left(\frac{\partial Y}{\partial K} \cdot \frac{K}{Y} \right) \frac{dK}{K} + \left(\frac{\partial Y}{\partial Z} \cdot \frac{Z}{Y} \right) \frac{dZ}{Z} + \left(\frac{\partial Y}{\partial A} \cdot \frac{A}{Y} \right) \frac{dA}{A} \dots \dots \dots 3.3$$

$$\text{The growth function becomes, } y = \alpha + \alpha k^p + \beta k^g + \gamma z \dots \dots \dots 3.4$$

Where a small letter for a variable denotes its growth rate. Equation (3.4), which represents a long-run economic relationship, can be estimated, provided that data are available for capital stocks. Unfortunately, such data are unavailable in Ethiopia. Nevertheless, Equation (3.4) can be transformed into an estimable form by making some simplifying assumptions regarding physical capital stocks. Consider the following growth equations for the stocks of private and public capital, which are simple transformations of the perpetual inventory accumulation equations:

$$\Delta K^p_t = \frac{I^p_t}{K^p_{t-1}} - \delta_p, \dots \dots \dots 3.5$$

and

$$\Delta K^g_t = \frac{I^g_t}{K^g_{t-1}} - \delta_g, \dots \dots \dots 3.6$$

Where I^p and I^g are private and public investments (both expressed in real terms), respectively; and δ_p and δ_g are the respective rates of depreciation of the private and public capital stocks.

Assuming that

$$K^p = \theta_p Y,$$

and $K^g = \theta_g Y$, where θ_p and θ_g are fixed coefficients, equation(3.4) can be rewritten

$$\text{as } y = \alpha' + \alpha' \left(\frac{I^p_{t-1}}{Y_{t-1}} \right) + \beta' \left(\frac{I^g_{t-1}}{Y_{t-1}} \right) + \gamma z \dots\dots\dots 3.7$$

Where $\alpha' = (\alpha - \alpha\delta_p - \beta\delta_g)$, $\alpha' = \alpha/\theta_p$, and $\beta' = \beta/\theta_g$

The equivalent equation for Equation (3.7) above, which will be used for estimation purposes, can be written in logarithmic form as follows:

$$\text{LRGDP}_t = \beta_1 + \beta_2 \text{LRIP}_t + \beta_3 \text{LRIG}_t + \beta_4 \text{LOPE}_t + \beta_5 \text{LLAB}_t + \beta_6 \text{LHCAt} + \beta_7 \text{DUM} + \varepsilon_t \dots\dots\dots 3.8$$

Where:

RGDP= Real gross domestic product

RIP= Real private investment

RIG= Real public investment

OPE= Trade openness

LAB= Active Labor force

HCA= Human capital

DUM= A dummy variable for inward-looking and outward-looking regimes: for inward-looking regime, a value 1 is required; for an outward-looking regime, a value of zero is required.

ε = stochastic error term

The above model (Equation 3.8) has been conventionally used by many authors to test the relationship between public investment, private investment, trade openness and economic growth. The model specification is based on the assumption that public

investment, private investment and trade are exogenous, and there is no feedback relationship between public investment, private investment, trade and economic growth. However, in reality, public investment, private investment and trade openness may be endogenous to each other. In this case, using Ordinary Least Squares (OLS) will underestimate the respective coefficient. Hence, a simultaneous equation model will be used that takes into account the feedback relationship among public investment, private investment, trade openness and economic growth.

3.2 Variable Definition

The real gross domestic product (RGDP), which is the gross domestic product deflated by GDP deflator, is used as a proxy for economic growth. The real GDP is expected to have a positive impact on private and public investment.

Real private investment (RIP): The theoretical relationship can be readily derived from a flexible-accelerator model with the assumption that there is a fixed relationship between the desired capital stock and the level of real output in the underlying production function (Blejer and Khan, 1984). Greene and Villanueva (1991) assert that countries with higher per capita income could devote more resources to domestic savings, which could be used to finance investment projects. Private investment deflated by the GDP deflator is used as a proxy for real private investment.

Real public investment (RIG): Real public investment is proxied by government public investment deflated by the GDP deflator. At the theoretical level, the impact of government investment is ambiguous. It may have a positive or negative effect on private

investment. According to the infrastructure hypothesis, public investment has a positive impact on private investment and economic growth.

Trade openness (OPE): There are many ways to measure the degree of liberalization, which is also referred to as openness. The most commonly used standard measure of liberalization in the new growth theory literature is the ratio of total trade (export + import) to GDP (Thirwall, 2004). Raju (2011); Alô´cia and Carles (2002) and Markus and Daniel (2012) referred to trade openness as the average of exports and imports expressed as a share of the GDP. This study also uses the same standard to measure the openness of the country.

Active Labor force (LAB) is calculated as the product of the total population and the labor force participation rate. The higher the employment rate, the higher the growth of output. However, because the labor force also includes the unemployed, the contribution of the labor force can be negative. Therefore, the expected sign cannot be predetermined.

Human capital (HCA): Human capital is computed based on primary and secondary school enrollment data. The variable is expected to have a positive impact on private investment, public investment and economic growth.

A dummy variable is used to capture inward-looking and outward-looking regimes in the country: for an inward-oriented government; a value of one is used; for an outward oriented government, a value of zero is used.

3.2.1 Source of Data

The data used in this study were obtained from different sources. Time-series data on GDP, private investment, public investment, exports, and imports were collected from the National Bank of Ethiopia. Human capital data are calculated based on primary and secondary school enrollment data from the Ministry of Education. Active labor force data are calculated as the product of the total population and the participation rate, based on population data collected from the Penn World database.

3.3 Estimation Technique

3.3.1 Stationarity Test

According to Davidson and Mackinnon (1999), Empirical work based on time-series data assumes that the underlying time series is stationary. Before estimating a macroeconomic time-series model of the type considered in this study, it is necessary to identify the time-series properties of the data. Thus, whether the variables in the model are stationary and their orders of integration are evaluated to avoid inappropriate model specification and misleading results.

Stationary implies that the distribution of a process remains unchanged when shifted in time by an arbitrary value. More formally, a stochastic process is said to be weakly stationary if its mean and variance are constant over time and the value of the covariance between the two time periods depends only on the distance or gap between the two time periods and not the actual time at which the covariance is computed (Enders, 1995; and Gujarati, 2003). And according to Gujarati (2003), a time series is strictly stationary if all of the moments of its probability distribution are invariant over time. However, the

normal stochastic process is fully specified by its two moments, the mean and the variance.

The stationarity of each series is verified with the standard Augmented Dickey-Fuller (ADF) and the Phillips-Perron (PP) tests. A time series is said to be integrated of order d , denoted $I(d)$, if it becomes stationary after being differenced a minimum of d times (Dickey and Fuller, 1979, and 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 regression equations.

3.3.1.1 Testing for Unit Roots

The unit root test has become a widely popular approach to test for stationarity. There are several ways of testing for the presence of a unit root: the Dickey-Fuller (DF) test, the Augmented Dickey-Fuller (ADF) test and the Phillips-Peron test. This study employs the ADF and Phillips-Peron tests to determine the existence of a unit root. A commonly applied formal test for the existence of a unit root in data is the Dickey-Fuller (DF) test and its simple extension, the Augmented Dickey Fuller (ADF) tests (Harris, 1995). The augmentation is the addition of lagged values (p) of first differences of the dependent variable as additional regressors that are required to account for the possible occurrence of autocorrelation.

Augmented Dickey-Fuller (ADF) Test

Dickey (1976), and Dickey and Fuller (1979, 1981) developed a method for testing the stationarity of a time series variable by directly testing the null of the unit root (non-stationarity). The original Dickey-Fuller (DF) test is based on a simple autoregressive of order one, AR (1) process with a white-noise disturbance. However, because the DF test regression does not include values of variables beyond one lag, the error terms may be serially correlated; results based on such tests may be biased and are not valid (Davidson and Mackinnon, 1999; Gujarati, 2004; and Kirchgassner and Wolters, 2007). The ADF test avoids this problem because it corrects for serial correlation by adding lagged-difference terms (Greene, 2003).

The general form of the ADF equation in which no intercept term and time trend are included is the following:

$$Y_t = \delta Y_{t-1} + \sum_{i=2}^p \Psi_i \Delta Y_{t-i+1} + \varepsilon_t \dots\dots\dots 3.8$$

For the case where the auto regression includes only intercept is stated as

$$Y_t = a_0 + \delta Y_{t-1} + \sum_{i=2}^p \Psi_i \Delta Y_{t-i+1} + \varepsilon_t \dots\dots\dots 3.9$$

When the auto regression includes the intercept and a trend, the equation is of the following form:

$$Y_t = a_0 + \delta Y_{t-1} + \sum_{i=2}^p \Psi_i \Delta Y_{t-i+1} + a_1 t + \varepsilon_t \dots\dots\dots 3.10$$

Where Y_t is any variable in the model to be tested for stationarity, ε_t is an error term and Δ is the first-difference operator. In the above three equations, the null hypothesis of ADF

is $\delta=0$ against the alternative that $\delta < 0$, where a rejection of this hypothesis indicates that the time series is stationary and it does not contain a unit root (Enders 1995).

After estimating the equations, the appropriate critical values to be used to test for the presence of a unit root are provided by the Dickey-Fuller test, in which the critical values are different for three regressions. After estimating the equations with OLS, the resulting 't' statistics are compared with the respective critical values given in the Dickey-Fuller tables.

However, MacKinnon (1991) has implemented a much larger set of simulations than those tabulated by Dickey and Fuller. In addition, MacKinnon estimates the response surface using the simulation results, permitting the calculation of Dickey-Fuller critical values for any sample size and for any number of right-hand variables. Therefore, in this study, MacKinnon critical values are used for the unit root test. If the t-calculated value is less than the MacKinnon critical value, the null hypothesis of the presence of the unit root will not be rejected.

Phillips-Perron Test

According to Nandwa and Mohan (2007), the other test of stationarity with the same null as ADF is the Phillips-Perron (PP) test, which is argued to be more robust to serial correlation and time-dependent heteroskedasticity and is an improvement over the ADF test with respect to finite sample properties (Deme, 2002).

In contrast to the ADF, the PP test does not add lagged difference terms to account for a potential serial correlation in the error terms; rather, it uses non-parametric statistical methods. This test's statistic follows the same asymptotic distribution as the ADF test

statistic (Gujarati, 2004). However, Kirchgassner and Wolters (2007) argued that both tests have low power if, under the alternative hypothesis, the first-order autocorrelation coefficient is close to one. These researchers noted that if the mean reverting behavior is only weakly pronounced, large sample sizes are necessary to reject the null hypothesis. These authors also argued that with macroeconomic data, such a sample size cannot be materialized, at least as long as only monthly, quarterly or annual data are available.

3.3.2 Econometric Method

3.3.2.1 Vector Autoregressive (VAR) Modeling and Co-Integration Analysis

Recently, 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 the face of non-stationary series with a unit root, first differencing appears to provide the appropriate solutions to ensuring series are weakly stationary. First differencing, however, does possess a major limitation in that it tends to ignore the long run properties of the data.

If two time series y_t and x_t are both integrated of order d (i.e. $I(d)$), then, in general, any linear combination of the two series will also be $I(d)$; that is, the residuals obtained on regressing Y_t on x_t are $I(d)$. If, however, there exists a vector b , such that the disturbance term from the regression ($e_t = y_t - bx_t$) is of a lower order of integration $I(d-b)$, where $b > 0$, then Engle and Granger (1987) define y_t and x_t as cointegrated of order (d,b) .

The procedure used for co-integration testing and estimation of the VAR in this study follows the methodology developed and used by Johansen (1988, 1991), and Johansen

and Juselius (1990). This method is preferred to the single equation based Engel-Granger two step procedure due to the following reasons. The Johansen (1988) procedure allows testing for the presence of more than one cointegration vector. Moreover, it permits to estimate the model without priority restricting the variables as endogenous and exogenous. It is used to determine how each endogenous variable responds over time to a shock in that variable and in every other endogenous variable.

Johansen (1988, 1991) has shown that the test for co-integration can be expressed as a test of reduced rank of a regression coefficient matrix. The coefficient matrix can be estimated consistently using linear regression techniques and the test statistic can be computed from the solution to an eigen value problem. Moreover, linear restrictions on the co-integrating parameters can be tested by computing the shortcomings of the Engle-Granger method likelihood ratio test statistic which follows a χ^2 distribution (Walls, 1993).

The starting point in this procedure is formulation of VAR model in the following form. Considering K-lags of Z_t , a general *p*th-order VAR representing the interrelationships among the *n* variables in the model; as given in Johansen and Juselius (1990) is of the form.

$$Z_t = \Omega + \delta_1 Z_{t-1} + \delta_2 Z_{t-2} + \dots + \delta_p Z_{t-p} + \epsilon_t = \Omega + \sum_{i=1}^p \delta_i Z_{t-i} + \epsilon_t \dots\dots\dots(3.11)$$

Where, Z_t is an $(n \times 1)$ vector containing the *n*-variables (including LRGDP, LIG, LIP, LLAB LHCA and LOPE) δ_i ; is $(n \times n)$ matrix of coefficients; Ω is a vector of deterministic terms like trends and intercepts; and ϵ_t are iid(0, Σ) vector of error terms with Σ representing the contemporaneous covariance matrix.

The Vector Error Correction Model (VECM)

The VECM contains information on both the short-run and long-run properties of the model, with disequilibrium as a process of adjustment to the long run model. Following the Granger representation theorem, if some variables are co-integrated, the vector error correction model (VECM) representation can be written as follows:

$$\Delta Z_t = \psi\Omega + \Pi Z_{t-1} + \theta_1 \Delta Z_{t-1} + \dots + \theta_p \Delta Z_{t-p} + \varepsilon_t = \psi\Omega + \Pi Z_{t-1} - \sum_{i=1}^{p-1} \theta_i \Delta Z_{t-i} + \varepsilon_t \dots 3.12$$

Where, ΔZ_t represents the first differences of the variables; $\theta_1 = -\sum_{i=1}^{p-1} \theta_i$ is (nxn) coefficient matrix in the error correction term (which contains short-run parameters); and $\Pi = \sum_{i=1}^p \alpha_i - I$ is (nxn) matrix of long-run responses, which contains information about the long-run relationships. Further, the error terms are assumed to be Gaussian or well-behaved.

According to Davidson and Mackinnon (1999), the estimation of the VECM requires the determination of the appropriate lag length because the cointegration result may be sensitive to the number of lags included in the VAR. Thus, prior to cointegration testing and estimation of the VECM, we need to determine the appropriate lag length, which is determined using the well-known model selection criteria, the Akaike Information Criteria (AIC), the Final Prediction Error (FPE), the Hannan-Quinn Information Criteria (HQ), and the Schwarz (Bayesian) Information Criteria (SIC).

The next concern is determining the number of distinct linear combinations of the variables (or more technically the number of independent co-integrating vectors). In the Johansen (1988) procedure, determining the rank of (r) of the long run matrix (Π) provides the number of cointegrating vector between the variables.

In general, there are three cases that may occur. The first case is when $r=0$, in which case the short-run dynamics depend only on the lagged changes in the variables and the levels of any of the variables in vector Z have no long run relationship (i.e., there is no co-integration relation; all rows are linearly dependent, and the system is non-stationary). By contrast, if $r=n$, all linear combinations would be stationary. In this case, estimating the level VAR and the VECM with unrestricted OLS will yield identical results (Davidson and Mackinnon, 1999).

In addition to these two extreme cases, one may find the usual intermediate case of $0 < r < n$, implying a co-integration relationship. In this case, the system is non-stationary, but there are r cointegrating relationships that are stationary; Π is said to have reduced rank and contains stationary long-run equilibrium information. However, the rank determination must be supplemented by exogeneity and causality tests to obtain an economically interpretable linear relationship among the variables (Badawi, 2005). To determine the rank of the long-run matrix and hence the number of co-integrating vectors, the two likelihood ratio tests (the trace, λ_{trace}), and the maximal eigenvalue (λ_{maximum}) statistics are used.

These statistics are given by

$$\lambda_{\text{trace}}(r) = -T \sum_{i=r+1}^n \ln(1 - \lambda_i) \dots \dots \dots (3.13)$$

$$\text{and } \lambda_{\text{maximum}}(r, r+1) = -T \ln(1 - \lambda_{r+1}) \dots \dots \dots (3.14)$$

Where r is the number of co-integrating vectors under the null; λ is the estimated characteristic root (eigen values) from the matrix; and T is the number of observation.

The trace method tests current (actual) values of the fundamentals.

3.3.2.2 Granger Causality Test

The purpose of causality test in multivariate time series analysis is to identify which variable causes (precedes) another variable. This technique was proposed by Granger (1969) and refined by Sims (1972). Given two variables X and Y , X is said to Granger-cause Y if lagged values of X predict Y well. If lagged values of X predict Y and, at the same time, lagged values of Y predict X , then there is a bi-directional causality between X and Y . 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 (Vebeek, 2003).

According to Granger (1988), the existence of cointegration between X and Y must be evaluated before performing a causality test. If a cointegrating relationship is identified, then causality must exist in at least one direction. Causality can be unidirectional, that is, it can run only from X to Y ; in this study, for instance, the cointegration may be from private investment to public investment, or it may be from public investment to private investment. As suggested in the literature, there may be bi-directional causality, that is, all of the variables will cause each other. In the two-variable case, X and Y , the notation will be $(X \Leftrightarrow Y)$. When causality runs from one variable to the other and, in turn, runs from that other variable to the other, then feedback effects are said to exist. If the innovation to Y and innovation to X are correlated, then it is said that there is direct causality. At the other extreme, there may be no causality at all; in this case, the variables are said to be independent.

3.3.2.3 Diagnostic Checks

Residual Vector Normality Test

The test of normality of the residuals is one of the important post-estimation diagnostic tests in empirical studies. This study uses the multivariate extension of the Jarque-Bera (*JB*) test for residual normality, which compares the third and fourth moments of the residuals to those from the normal distribution (*EViews 5.1 user's guide*). This test is a joint asymptotic test in which the statistic is calculated from the skewness and kurtosis of the residuals as follows.

$$JB = \frac{T}{6} \left[S^2 + \frac{(\beta_3 - 3)^2}{4} \right] \dots\dots\dots 3.15$$

Where T is the number of observation; S is the coefficient of skewness, β_3 is a measure of kurtosis; and the test statistic is χ^2 distributed. The joint test is based on the null hypothesis that the residuals are normally distributed (i.e., $S = 0$ and $\beta_3 = 3$). Rejection of the null hypothesis at the standard critical values indicates non-normality of the residuals.

Error Vector 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. This study uses the Breusch-Godfrey Lagrange Multiplier (LM) test, which is a multivariate test for residual serial correlation up to some specified lag order. The test statistic for the chosen lag order (L) is computed by performing an auxiliary regression of the residuals (ϵ_t) on the original variables and the lagged residuals (ϵ_{t-L}).

$$LM = (T-q) R^2_{\epsilon^A} \dots\dots\dots (3.16)$$

Where q is the degrees of freedom and $R^2_{\hat{e}}$ is the coefficient of determination obtained from the auxiliary regression, and the LM test statistic is χ^2 distributed. The LM tests the null hypothesis of no serial correlation against an alternative of auto correlated residuals.

Heteroskedacity Test

The last diagnostic test considered in this study is the test of heteroskedasticity. White's test is used to evaluate the heteroskedasticity of the residuals. White's test tests the null hypothesis that the residuals are both homoskedastic and that there is no problem of misspecification. The test regression is performed by regressing each cross-product of the residuals on the cross-products of the regressors and testing the joint significance of the regression.

3.3.2.4 Impulse Response Functions and Variance Decomposition

3.3.2.4.1 Impulse Response Functions

Impulse response analysis is used to investigate the interrelationships between the variables and assess adjustments to long-run equilibrium. Because the deviations from the equilibrium are stationary, any shock to the system generates a time path that eventually returns to a new equilibrium, provided no further shocks occur. Figure 3 shows the impulse response function (IRF). The time period of the IRF function extends over ten years. The impulse response function traces over time the effects on a variable of an exogenous shock to another variable. The persistence of a shock illustrates how rapidly the system returns to equilibrium. The response is measured in terms of the standard deviation.

Impulse-response functions provide information for analyzing the dynamic behavior of a variable due to a random shock or innovation in other variables. The impulse response traces the cross effect on current and future values of the endogenous variables of one standard deviation shock to the variables. The impulse response functions show the sign, magnitude, and persistence of real and nominal shocks to the dependent variable. A shock to a variable in a VAR not only directly affects that variable but is also transmitted to all other endogenous variables in the system through the dynamic structure of the VAR. Basically, the impulse response traces how one variable, such as private investment, responds overtime to a shock in another variable (real GDP, trade openness or public investment in the country) and compares this response to shocks from other variables. Impulse response only traces out the time path of the effects of shocks of other variables contained in the VAR model on a specific variable. In other words, this approach is designed to determine how each variable responds over time to an earlier shock in that variable and to shocks in other variables (Shin et al., 2006).

3.3.2.4.2 Variance Decomposition

Decomposing the forecast-error variance also yields additional information concerning how the RGDP and trade openness, private and public investment are linked. This approach measures the proportion of forecast-error variance in a variable that is explained by innovations themselves and the other variables. In other words, variance decompositions illustrate the portion (or relative importance) of variance in the prediction for each variable in the system that is attributable to its own innovations and to shocks to other variables in the system.

Enders in Shan *et al.* (2006) proposed that the forecast-error variance decomposition permits inferences to be drawn concerning the proportion of the movements in a particular time-series due to its own earlier shocks vis-a-vis shocks arising from other variables in a VAR model. The technique breaks down the variance of the forecast error for each variance following a shock to a particular variable, and in this way, it identifies which variables are strongly affected and those that are not.

CHAPTER 4: ECONOMIC POLICY AND PERFORMANCE OF PRIVATE INVESTMENT, PUBLIC INVESTMENT, TRADE OPENNESS AND ECONOMIC GROWTH IN ETHIOPIA

4.1 Economic Policy and Trends of Public and Private Investment

4.1.1 Imperial Regime (1955/56-1973/74)

A low level of infrastructure development along with negligible participation of the private sector characterized the imperial regime in the early 1950s. In 1956, for the first time, the country introduced a five-year development plan, extending from 1957 to 1962, and revised several economic policies. The economic policies were guided by the goal of increasing the level of income and savings to expand investment expenditures (Second Five Year Development Plan-SFDP, 1962).

The development plan targeted the bulk of public investment in the productive sector and laid the foundation for the basic infrastructure development that began to occur. Among others, a network of roads, the generation of electric power and the development of Ethiopian Air Lines were in motion, offering a favorable environment for the success of the five-year plan.

During the five-year development plan, legislation was introduced in 1950 as a notice (notice No. 10, 1950) with the objective of encouraging private investment growth, particularly the absorption of private foreign capital (Imperial Government of Ethiopia, 1950, cited in Mohammed, 2006).

Furthermore, to attract local and foreign investors, a series of proclamations were enacted by the imperial regime. These statements include the 1954 new investment proclamation, an improvement over the 1950s notice that differs greatly in terms of conceptual framework and coverage. The new proclamation was meant to attract domestic and foreign investors to participate both in the agricultural and industrial sector. In 1963, the government consolidated both the notice and legislation as the investment decree that culminated in the 1966 investment proclamation (Imperial Government of Ethiopia, proclamation No. 242/1966). Among others, the investment proclamation established tariff protection for infant industries and the exemption of import and export duties on selected capital and manufacturing goods.

During the imperial regime, the monetary sector was designed in such a way to support and ease the mobilization of funds for investment. In this regard, there were attempts to expand the capital market that were aimed at improving and facilitating resources for investment. An example of such an endeavor is the establishment of the Share Dealing Group (SDG), which facilitated the buying and selling of shares of various companies (Shiferaw, 1995).

Because of the continued effort to encourage the participation of both domestic and foreign investments, the rate of private investment participation averaged approximately 8% of real GDP, while public investment accounted for 1% (Muhammed, 2006). The private sector was expected to play a significant role, until the Derg regime reversed the policy, as the figure below shows. In the last period of the regime, 1970/71-1973/74, private investment as a share of RGDP was 14.07% while that of public investment as a share of RGDP was 4.05%.

4.1.2 Derge Regime (1974/75 - 1990/91)

A command economic system in which the state played a considerable role in all aspects of economic activity was characteristic of the period 1974–1991. Throughout its ruling period, with the exception of the late 1980s, the military government (Derge) followed socialist policy, emphasizing the expansion of medium- and large-scale manufacturing owned by the state. In other words, the economy was guided by central planning, and economic policies were devised in such a way that the public sector was favored at the cost of the private sector (Berhanu, 2001).

The Derge regime froze the private sector by issuing nationalization proclamations at various periods. Soon after the revolution, the military government came to power and nationalized all private large- and medium-scale manufacturing enterprises owned by nationals and foreigners (MEDaC, 1999). With proclamation No. 26/1975, the government nationalized a large number of domestic and foreign producers, distributors, and service-providing establishments (Berhanu, 2001).

Furthermore, the government, through another proclamation (Proclamation No. 76/1975), allowed only the operation of individual businesses; if businesses wished to organize themselves, their membership was limited to five persons. To increase the freezing effect further, the government set the maximum ceiling for private-sector investment to Birr 500,000.00; it also prohibited the issuance of licenses to investors for more than one line of business, and investors could not possess other jobs. The government levied progressive taxes on the income and profit of individual business that completely discouraged the participation of the private sector.

However, the government made policy changes in the 1980s after an unsuccessful attempt to lead the country in a socialist direction. In light of this new perspective, the government raised the level of the capital ceiling and exempted the import duty on vital goods. The government is also issued a proclamation (proclamation No.235/1983) inviting the participation of foreign investors in joint ventures with the objective of bringing technology and technical skills in to the country.

The government also invoked the Ten-Year Perspective Plan from 1984/85 to 1993/94, which recognized the role of savings in improving the economy, although the government also relied on the public sector at this time. In addition, by decree, the government allowed domestic private investment participation (special decree No. 11 of 1989) in the form of joint-venture agreements, although the state retained the majority of the share.

In contrast to the preceding four decades of the Imperial period, private investment during the military government followed a poor trend. During the early period of the military government, from 1974 to 1979, private investment as a share of real GDP fell to 7.81%, whereas public investment as a share of real GDP was approximately 3.9%. From 1974 to 1990, private investment as a share of real GDP averaged 6.5 percent. The low rate of private-sector development in the period of the Derge was a result of the restrictive policies pursued by the state.

However, due to policy reforms, private investment as a share of real GDP improved. These policy reforms helped boost the share of private investment (11.1% of real GDP) in the later periods of the military government, particularly in 1988, which may be

considered the peak of investment during the military period. In the last days of its political dominance, the Derge pursued a mixed economic development approach. Most of the restrictions imposed on both domestic and foreign investments were removed by Proclamation No. 17/1990. This last proclamation offered various privileges and incentives, namely, that both domestic and foreign investors were exempted from income tax and custom duty; leased land was also given to those engaged in agricultural endeavors.

4.1.3 Post-Derge Period (Mid-1991-to today)

Since 1991, the country has witnessed a transition of the economic system from a socialist, planned economic system to a more market-oriented economic system, particularly in terms of macroeconomic policy. Unlike the military government, which made itself a crucial player in the economy, the Transitional Government of Ethiopia (TGE) attempted to reduce its role in the economy and promoted the active participation of the private sector through various economic reforms (Ethiopian Investment Commission, 2008).

At the center of the new economic policy lay the notion of market liberalization guidelines geared toward creating a favorable environment for both domestic and foreign private investment. The reform measures included a public enterprise reform program (meant to improve efficiency, productivity, and competitiveness), price decontrol, and the removal of subsidies and preferential treatment (on the supply of credit, labor and foreign exchange) to public enterprises (MEDaC, 1999).

The TGE introduced a private investment policy, the first in the country's history, under investment proclamation No. 15/1992. The stipulation made by the private investment policy includes, among others, entry and ownership requirements, investment incentives, labor laws, immigration rules, settlement of disputes, guarantees and protection. The proclamation was introduced to support, expand, and coordinate investment in the country. The objectives of the proclamation were to expand the domestic market, increase employment opportunities, strengthen private-sector investment, and encourage the use of domestic raw materials and the absorption of foreign production know-how.

The proclamation enabled the private sector to invest in most sectors, except in those areas reserved for the government such as defense industries, the production and supply of electricity, telecommunication and postal services, large-scale air and marine transport services and the import of petroleum and weaponry for the government.

Furthermore, the government reserved investments in the following areas for itself or in partnership with private investors. These additional areas of investment include investment in large-scale engineering and metallic industries, capital-intensive and technology-intensive investment, large-scale mining and energy production, large-scale pharmaceutical and fertilizer production and industries that supply strategic raw materials for chemical industries.

To overcome the shortcomings of the first proclamation, the government enacted a second investment proclamation in June 1996 (Investment Proclamation No. 37/1996). The second investment proclamation guaranteed incentives for private investors who invest in priority sectors with an investment capital of less than Birr 250,000. This

proclamation also lowered the capital requirements of foreign investors to USD 100,000 or its equivalent, provided that they reinvest profits or dividends drawn from the existing investment; service sectors, such as tourism, health and education, enjoyed duty-free exemptions as a result of the second investment proclamation.

Between the two proclamations (1991/92-1995/96), the share of private investment averaged 5.8% of real GDP, and public investment averaged 7.3% of real GDP. In particular, the former reached 7.5% of real GDP in 1993. To redefine domestic investors to include foreign nationals who were Ethiopian by birth and to allow investors to invest jointly with the government in defense industries and telecommunication services, the second proclamation (proclamation No. 37/1996) was amended in June 1998 by proclamation No. 116/1998. The proclamation also enabled the Federal Investment Board to grant, after securing approval from the Council of Ministers, additional incentives other than what is provided under the Investment Incentive Regulations.

Investment areas included under the additional incentive package include education, health, defense, telecommunication, and industry. The government also legislated two proclamations (proclamation No 280/2002 and its reenactment proclamation No. 373/2003) that provided more opportunity for private-sector participation and permitted the improvement of transparency and efficiency in service delivery. Because of the revised investment proclamation in 1996 and subsequent amendments, private-sector participation has increased. The share of private investment to real GDP reached an average of 13.96% for the period 1996/97-2009/10.

In general, except for the two-year-period of war with Eritrea, investment has continued to increase after the reforms in 1991/92 and subsequent proclamations. However, the increase in investment has been modest (See Figure 4.2). In 2000/01, total investment equaled 16% of GDP, 2 percentage points higher than in the two preceding years of conflict; both private and public investment have recovered, with the former exceeding prewar levels.

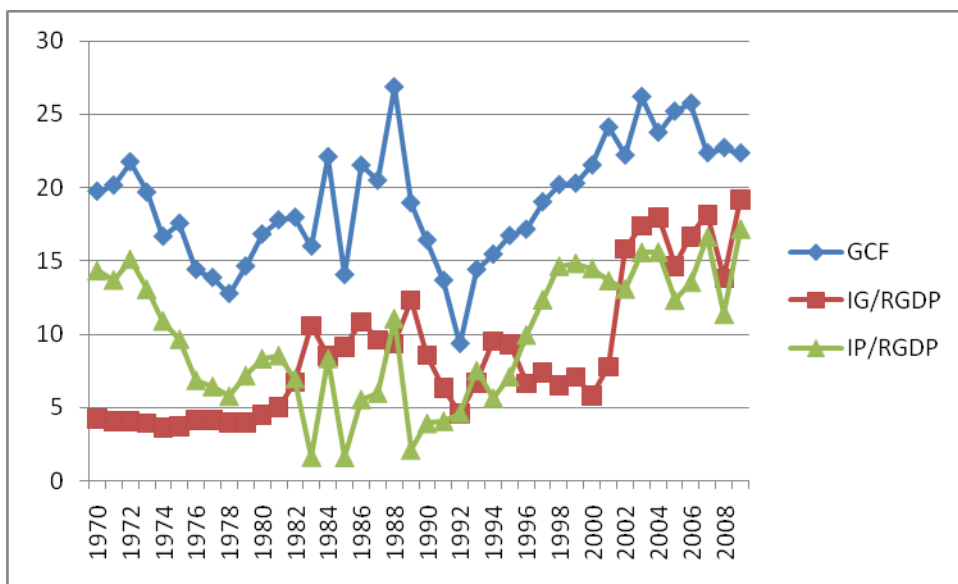


Figure 4.1: Public and Private Investment Trend

Three important conclusions emerge from Figure 4.2. Primarily, the pre-reform period exhibited a declining trend in gross capital formation, indicating the worsening state of the economy in the last period of the Derge regime. This downward trend, however, did not improve in the early periods of the TGE until 1992, primarily due to the violent political change. The second conclusion is the rising importance of private investment during the post-Derg period, which was brought about by the liberalization policies pursued by the incumbent with the support of the WB and IMF stabilization policy. The

third conclusion is the expansion of public investment from 2001 onward due to the shift in paradigm from a neoliberal paradigm to a pro-poor growth policy and state-led development program.

4.2 Economic Policy and Trends of Economic Growth

4.2.1. The Imperial Regime (1955/56-1973/74)

During the Imperial era, economic and population growth increased at a rate of 4.2% and 2.1% per year, respectively, while the growth in per capita income was 1.8. Over the ten-year period of the imperial regime, from 1962/63 to 1973/74, the average growth rate of the GDP registered by the country was 3.7%. Nonetheless, this figure is comparatively lower than the one envisaged in both the First and Second “Five-Year Development Plan”, which were 4.3% and 6%, respectively (see First Five-Year Development Plan, 1956; Second Five-Year Development Plan, 1962). Over these periods, the service sector accounted for 46% of the growth in the real GDP, exceeding that of the agricultural sector.

4.2.2. The Derge Regime (1974/75-1990/91)

The inappropriate economic policy and mismanagement, together with prolonged internal and external social and political unrest (such as the war with Somalia and drought) and high population growth are at least partially responsible for the poor performance of the economy and the erratic nature of growth (whenever it occurs) over this time period. The period can best be illustrative of acute economic failure. For example, real GDP exhibited growth of 2.7% on average (which is almost 27% lower than the growth in real GDP during the Imperial era), while the population grew at 2.5% per year. The rate of growth

of population over the real GDP dropped the per capita real GDP below zero to 0.19, reflecting deterioration in the standard of living compared to the previous regime. Disaggregation of the periods would yield greater insight into the dismal economic performance, as well as the irregular nature of growth. This irregularity of growth is strongly connected to the growth of agriculture, which, in turn, is vulnerable to the vagaries of nature. The more favorable the weather, the greater the growth of agriculture and consequently the greater the growth of the economy (Alemayehu, 2001). For instance, the average growth rate over the period 1974/75–77/78 was 3.9%, while per capita growth was 1.5%.

The economy, on average, has increased to 4% growth over the period 1978/79 to 1982/83, a period characterized by relative stability and good weather conditions, while the per capita growth for the same period was 1.3 percent. Other periods ensued, including periods of severe drought (1983/84 and 1984/85) that decelerated growth by 6.9 percent and 8.7 percent, respectively. However, the growth rate increased, showing remarkable recovery from the previous years, and reached 7.8 percent during 1985/86 and 1987/88, only to fall to 1.3% during the next two years (1988 to 1989). The collapse of manufacturing (-8.3%) and construction (-14.7%) that was responsible for the sharp drop in the industry's added value to -8.3% chiefly accounted for the decline in GDP for the year 1982/83.

4.2.3. Post-1991 Period

The post-1991 period witnessed the economy's revival and increasing impetus to reverse the poor performance trend of the economy that characterized the previous regime. Under

the auspices of the Bretton Woods Institutions (IMF and WB), the new regime embraced structural adjustment policies, and the country witnessed a shift in the economic system, allowing more room for the private sector to play a significant role in the economy.

As a result, overall economic performance has shown relative improvement in spite of fluctuations (due to recurrent drought, population pressure, war, and land degradation) over the period, and the country experienced broad-based growth across sectors. From 1991/92 to 2009/10, the economy and per capita income have registered an average annual growth of 4.9 and 2.04 percent, respectively. The growth in real GDP would have been expected to be higher if the country did not face frequent droughts and Eritrean aggression in 1998, the year of negative growth.

Between 1997/98 and 1998/99, real GDP decreased by 0.1 percent, primarily due to the severe drought and conflict with Eritrea, which affected agricultural production, thereby significantly lowering the share of agriculture in the GDP. However, real GDP has recovered since 1998/99 and registered a 4.95 percent increase over the preceding year.

The following table depicts the average growth of real GDP and the real per capita GDP over the three regimes.

Table 1: Growth Rate

Period	% Growth Rate	
	Real GDP	Real Per Capita GDP
Imperial (1962/63 - 1973/74)	3.7	1.3
Derge (1974/75 - 1990/91)	2.9	.03
Post Derge (1991/92 - 2009/10)	4.9	2.04

In general, Ethiopia's average growth rate of real GDP, population and real per capita GDP over the period 1970/71 to 2009/10 was 3.97, 2.77 and 1.25 percent, respectively.

The growth performance after the reforms has also been moderate and volatile, mainly due to the early periods of instability and continuous drought because the agricultural sector is highly dependent on the vagaries of nature.

4.3 Economic Policy and Trends of Foreign Trade

4.3.1 Pre-1991/92

Both the imperial and military government pursued inward-looking development strategies that entailed import substitution as the center of trade policy. However, a comparison of the two regimes reveals that the imperial period's inward-looking strategy is much more loose than that of the military régime. Both periods were characterized by prolonged overvaluation of domestic currency, high tariff rates, extensive foreign exchange control, non-tariff barriers and heavy taxation on exports. Despite the fact that both regimes pursued an import substitution strategy and exports were considered secondary, the regimes made efforts to promote and diversify the country's exports, as shown in the three different five-year development plans of the Imperial Government of Ethiopia (IGE) and in the Derge's Ten Year Perspective Plan.

During the last years of the imperial regime (1970 to 1973), exports as a share of GDP averaged approximately 8.6 percent, while imports as a share of GDP averaged 8.8 percent. By contrast, the exports and imports as a share of GDP during the Derg regime (1974 to 1990) averaged approximately 11 and 12.7 percent, respectively. The value of goods and services exported and imported increased at an average annual rate of 11.2 and

3.3 percent, respectively, for the period 1970 to 1973 and 7.1 and 8.7 percent, respectively, for the period 1974 to 1990.

4.3.2 Post-1991 (EPDRF Regime)

Ethiopia abandoned the socialist economic system by the end of 1991, and after 1992/93, the Transitional Government of Ethiopia (TGE) adopted a policy of trade liberalization and devised new foreign trade policies. The reforms in trade regime and deregulation were motivated by the belief that free markets facilitate the improvement and expansion of exports, enhance the efficiency and competitiveness of the domestic economy, and result in strong and sustainable growth. To achieve these objectives, such steps as exchange-rate liberalization, simplified licensing and exchange retention procedures, and modified tariff structures, among others, have been taken by the government.

As a result of the above reforms, average exports as a share of GDP between 1991/92-2009/10 reached 11.1, while that of imports reached 23.4 percent. The average values of exports and imports for the same period were 24.2 and 26.9 percent, respectively, which is mainly the result of the outward-looking policy pursued by the current government.

In general, the assessment of the trend in external trade over the three regimes indicates that there is a shift in policy perspectives from an inward-looking trade policy to an outward-oriented policy.

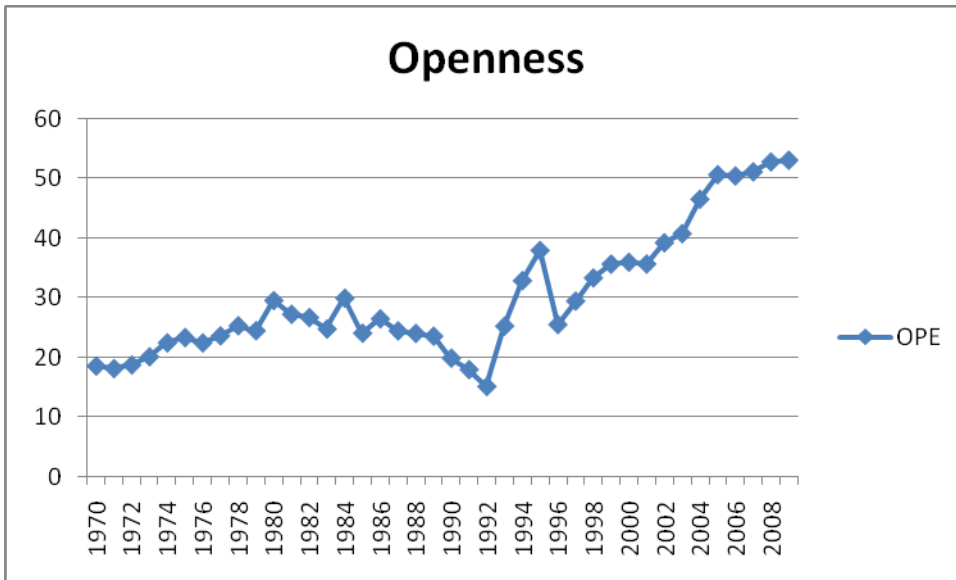


Figure 4.2. Trade Openness Trend

Figure 4.2 shows that trade openness remained stable over the majority of the pre-reform period (1970 to 1979), mainly due to restrictive trade policy. From the period 1984 to 1991, trade openness continually fell, which can be attributed to recurrent drought and civil war. However, after the reform period (1991/92), trade openness has increased with the exception of the period during 1998, which saw a reduction due to the Ethio-Eritrean conflict. The sharp increase in openness is due to the policy reform following the stabilization policy of the WB and IMF, as well as the liberalization of the trade regime.

CHAPTER 5: EMPIRICAL ANALYSIS AND FINDINGS

5.1 Time Series Properties of the Data

One of the pre-estimation diagnostic tests in empirical analysis is a test of multicollinearity. When the explanatory variables are very highly correlated (they are “multicollinear”) then data cannot tell, with the desired precision, if the movements in the dependent variable was due to movements in one or the other explanatory variables. This means that the point estimates might fluctuate wildly over subsamples and it is often the case that individual coefficients are insignificant even though the overall fit may be high and the joint significance of the coefficients is also high. However, the estimators can still be consistent and asymptotically normally distributed (Greene, 2003).

There are several classical tests for diagnosing collinearity problems to augment the results from the simple pair-wise correlation matrix, but this study focuses on only one the variance inflation factor (VIF) - perhaps the simplest and most commonly used test. Even though, the VIF test by itself is not free from limitations, as a rule of thumb the VIF must be less than 5. Using the VIF and its reciprocal- the Tolerance, it is found that VIF is less than 5 which shows absence of multicollinearity (see appendix 1).

5.1.1 Unit Root Tests

The unit root test is a common practice in macro-level data analysis to accommodate non-stationarity. If this behavior of macro-variables is left uncorrected, it would lead to the problem of spurious regression when there is a need to model relationships among variables. As explained in the methodology, formal testing for stationarity and the order of integration of each variable are primarily undertaken using different methods (mostly

ADF and Phillips-Perron). The tests with the ADF and PP methods are performed with different trend assumptions (only intercept, both linear trend and intercept, and no intercept and no trend). Performing the tests under all three alternatives will identify whether only the intercept or both the trend and intercept are significant.

The results from the stationarity test equations under the ADF (Table 2) demonstrate that only an intercept must be included in all variables (LRGDP, LIG, LIP, LOPE and LHCA) in testing for stationarity, while LLAB is tested without the trend and intercept. A linear trend is found to be insignificant in all of the test equations. The results show that all of the variables included in the model are integrated of order 1, *i.e.*, I (1).

Table 2: Augmented Dickey-Fuller Stationarity Test Result

Variable	Test Statistic Under Different Assumptions			Order of Integration
	Intercept	Trend and Intercept	No Trend No Intercept	
LRGDP	0.990922	-1.876345	1.958591	I(1)
D(LRGDP)	-5.856855*	-6.414400	-5.381591	
LIG	-0.956601	-3.499921	0.753969	I(1)
D(LIG)	-7.187298*	-7.079198	-7.011171	
LIP	-0.286331	-1.927719	0.645633	I(1)
D(LIP)	-10.50597*	-10.88810	-10.54546	
LLAB	2.095381	-0.050909	2.654316	I(1)
D(LLAB)	-2.158269	-3.077277	-2.743208*	
LOPE	-1.634963	-2.517938	0.653958	I(1)
D(LOPPC)	-5.489594*	-5.399805	-6.228879	
LHCA	-0.239835	-2.372014	2.270381	I(1)
D(LHCA)	-7.900541*	-7.939363	-6.905033	

*Note: D shows the variable is differenced once. Note: MacKinnon (1996) one-sided critical values for rejection of a unit root are used here. * shows significance at 1%.*

The Phillips-Perron test (see appendix 2) gives a result that is consistent with and supports the results of the ADF. Therefore, both the ADF and PP results are consistent with each other and demonstrate that all variables included in the model are integrated of order 1, *i.e.*, I (1).

5.2 Econometric Analysis

5.2.1 Results for Cointegration Test and Vector Error Correction Model

5.2.1.1 Co-Integration Test Result

Lag Order Selection for Endogenous Variables

The Johansen co-integration test results could be highly sensitive to the number of lags included for the endogenous variables in the estimation of the VAR, which necessitates the determination of an optimal lag order prior to the test of co-integration. The optimal lag order is determined with the sequential modified Likelihood Ratio test statistics [LR], the Final Prediction Error [FPE], the Akaike Information Criterion [AIC], the Schwarz Information Criterion [SIC], and the Hannan-Quinn Information Criterion [HQ]). As shown in Table 3, LR, FPE, SIC, and HQ suggest an optimal lag of one, all at a 5% level of significance.

Table 3: Optimal Lag Order Selection Criteria

Lag	Log-likelihood	LR	FPE	AIC	SC	HQ
0	10.92169	NA	4.27e-08	0.058287	0.580747	0.242478
1	181.3053	267.0879*	3.12e-11*	-7.205694	-5.115855*	-6.468928*
2	216.5631	43.83402	3.95e-11	-7.165575	-3.508356	-5.876234
3	266.0220	45.44868	3.26e-11	-7.893081*	-2.668482	-6.051165

Lag Exclusion Test

A number of the lags (of some endogenous variables) that are chosen as optimal may have insignificant contributions to movements in real GDP, individually as well as jointly. Therefore, whether the first lags (chosen as optimal) of all variables are individually and jointly important and should be included in the testing for co-integration and estimation of the VECM should be evaluated. This approach was taken with the Wald form of the lag-exclusion test (which is asymptotically chi-square distributed). Table 4 shows that the first lags of all of the endogenous variables are significant both individually and jointly. This suggests that the use of the first lags of the variables in the model is valid.

Table 4: VAR Wald Lag-Exclusion Test

Lag	Equation						Joint
	LRGDP	LIG	LIP	LOPPC	LHCA	LLAB	
1	14.75449	3.424979	8.912672	4.419416	13.15394	22.03299	110.1549
	[0.022255]	[0.053923]	[0.078549]	[0.020112]	[0.040656]	[0.001194]	[0.000001]
DF	6	6	6	6	6	6	36

Granger Causality/Block Exogeneity Test

In addition to the lag-exclusion test, the Granger causality test was performed to examine the presence of bidirectional causality as described by Granger. Table 5 shows the existence of bidirectional causality among real GDP, private investment and public investment. Real GDP Granger-causes real public investment, real private investment and trade openness, and real public investment Granger-causes real GDP and real private

investment. By contrast, real private investment Granger-causes real GDP and real Public investment. Trade openness Granger-causes real GDP, real public investment and real private investment. Finally, labor force and human capital Granger-causes real GDP, real public investment, real private investment and trade openness, but human capital is Granger-caused by labor force only.

Table 5: Results of the Granger Causality/Block Exogeneity Wald Tests.

Equation	LRGDP	LIG	LIP	LOPPC	LHCA	LLAB
Excluded						
LRGDPP		2.03828 (0.06200)	22.3706 (0.00034)	5.56799 (0.02383)	2.60357 (0.11536)	2.04630 (0.16120)
LIG	0.10923 (0.04294)		7.40535 (0.00996)	0.45507 (0.50425)	1.18892 (0.28279)	1.28821 (0.26388)
LIP	0.37216 (0.04566)	2.79454 (0.05326)		2.07323 (0.15854)	0.16712 (0.68510)	1.38758 (0.24654)
LOPPC	4.64828 (0.03784)	4.18643 (0.04811)	2.39560 (0.03042)		0.00884 (0.92563)	0.69428 (0.41021)
LHCA	18.7636 (0.00011)	13.0996 (0.00090)	10.2373 (0.00287)	10.0556 (0.31000)		1.29192 (0.26320)
LLAB	8.57537 (0.00588)	9.04946 (0.00477)	7.81207 (0.00827)	4.39389 (0.04316)	8.84614 (0.00522)	

NB: The numbers in parenthesis show the P-values for the corresponding Chi-square statistics

This finding implies that the lagged values of the variables have significant roles in explaining the current and future values of some other variables, and this effect occurs in both directions in some of the cases (among real GDP, private investment and public investment). Thus, due to the implied dynamic interaction among the variables, it may not be legitimate to consider economic growth (real GDP) in Ethiopia as purely endogenous and the other variables as exogenous. This in turn confirms the legitimacy of using the VAR model and the Johansen Procedure, as opposed to the single-equation approach of Engel and Granger.

The Johansen Co-integration Test Result

The ADF and Philips-Perron stationarity test results demonstrate that all of the variables are stationary at first difference, and this result can be further strengthened by the Johansen Co-integration test. Thus, the presence and the number of such co-integrating relationships are evaluated with the trace and the maximum eigenvalue. It may also be possible to use the Engle-Granger two-step procedure to test for cointegration. However, the Engle-Granger method tests the presence of only one co-integrating relationship and does not reveal whether there may be other such relationships.

The results from the Johansen method of co-integration rank test may also be sensitive to the deterministic trend assumption (in addition to the number of lags of the endogenous variables) in the underlying VAR structure. Because the results may vary with the alternatives, a decision must be made as to which one to choose for the purpose of further analysis. Following the rough guide provided by EViews (*EViews 5.1 User's Guide, page 739*), case 2 is chosen as appropriate for this case because none of the series appear to exhibit a linear trend; case 2 assumes an intercept (no trend) in the co-integration

equation. It should also be noted that such pre-tests and justifications would increase the credibility of the results. The VECM is estimated based on the number of cointegration rank obtained from case 2.

Table 6: Unrestricted Co-integration Rank Test

Test	Null Hypothesis	Alternative Hypothesis	Eigenvalue	Cointegration test statistics	Critical value(5%)
Trace statistic	$H_0: r \leq 0$	$H_A: r > 0$	0.688632	143.1434*	103.8473
	$H_0 : r \leq 1$	$H_A: r > 1$	0.609273	98.80578*	76.97277
	$H_0 : r \leq 2$	$H_A: r > 2$	0.545322	63.09544*	54.07904
	$H_0 : r \leq 3$	$H_A: r > 3$	0.375728	33.14514	35.19275
	$H_0 : r \leq 4$	$H_A: r > 4$	0.310517	15.24071	20.26184
	$H_0: r \leq 5$	$H_A: r > 5$	0.028834	1.111801	9.164546
Maximal Eigenvalue	$H_0 : r = 0$	$H_A: r = 1$	0.688632	44.33765*	40.95680
	$H_0 : r = 1$	$H_A: r = 2$	0.609273	35.71034*	34.80587
	$H_0 : r = 2$	$H_A: r = 3$	0.545322	29.95031*	28.58808
	$H_0 : r = 3$	$H_A: r = 4$	0.375728	17.90443	22.29962
	$H_0 : r = 4$	$H_A: r = 5$	0.310517	14.12891	15.89210
	$H_0 : r = 5$	$H_A: r = 6$	0.028834	1.111801	9.164546

Note: * denotes rejection of null hypothesis at 5 percent level.

Both the trace and the maximal Eigen value tests identified three co-integrating relationships at the 5% level of significance (see Table 6). This is evidence of the significant long-run relationship among economic growth, trade openness, real public investment and real private investment. These results also legitimize the use of the VAR

and the Johansen method instead of the single-equation-based Engle-Granger two-step procedure.

Model Stability Test

The stability of the VAR model and the results of the post-estimation diagnostics could affect the validity and robustness of the results of the impulse response functions and other diagnostics and thus should be tested prior to further analysis. The companion matrix showing the roots of the characteristic polynomial and the corresponding modulus is presented in Appendix 3. Appendix 3 shows that all of the moduli for the characteristic roots are less than unity. This result can also be visualized from the graph of the inverse roots of the AR characteristic polynomial (Figure 5.1). The figure shows that all of the moduli lie inside the unit circle. Therefore, the results suggest that the VAR model satisfies the stability condition.

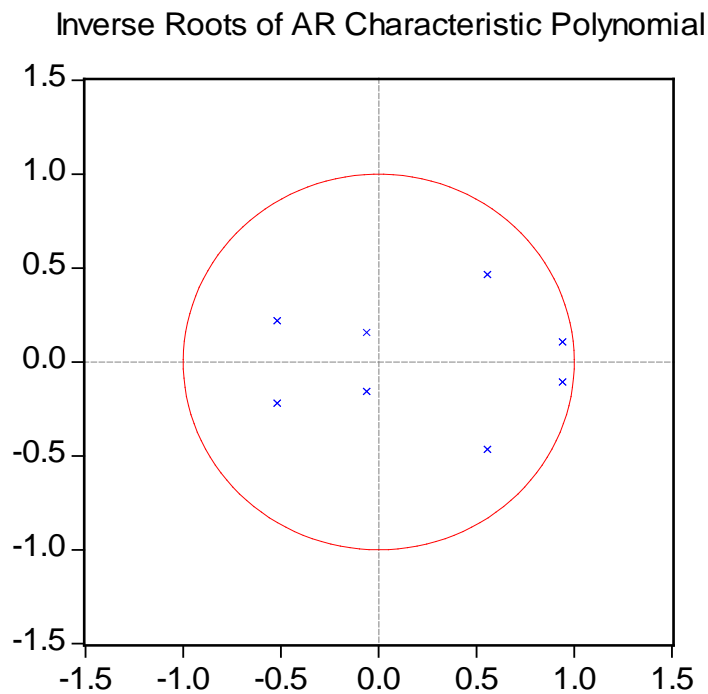


Figure 5.1: Inverse roots of the AR

5.2.1.2. Vector Error Correction Model (VECM)

After the vector autoregressive model is estimated, an optimal lag of one is chosen based on the information criteria results, and the VECM is estimated by making use of these and the results of the Johansen co-integration test. The VECM consists of two parts: the matrix of long-run co-integrating coefficients (used to derive the long-run co-integrating relationship), and the short-run coefficients (for the short-run analysis).

Long-run Relationship

As explained previously, there are three co-integrating relationships based on the Johansen cointegration test. This study aimed to examine the following: the impact of public investment, private investment and trade openness on economic growth; the impact of private investment, trade openness and economic growth on public investment; and the impact of public investment, trade openness and economic growth on private investment. The three equations are solved through ad-hoc normalization. And the Johansen test was used to confirm the appropriateness of the three selected equations, which confirmed the validity of selecting the above-listed equations by providing more weight for them.

Table 7: The Estimated Long-Run Model for LRGDP

Variable	LRIG	LRIP	LOPE	LLAB	LHCA	C
Coefficient	0.095374	0.157145	0.31323	-0.575643	0.051784	153.231804
	(-3.75696)	(-4.81544)	(-5.60043)	(-1.01821)	(3.75064)	(-2.67)

Note: values in parentheses are t-Statistics

The results, after eliminating the insignificant variable of labor force, yield the following.

$$\text{LRGDP}_t = -153.231804 - 0.157145\text{LRIP}_t - 0.095374\text{LRIG}_t - 0.31323\text{LOPE}_t + 0.051784\text{LHCA}_t + 0.575643\text{LLAB} = 0 \dots \dots 5.1$$

This equation is the long-run equation for economic growth that relates real economic growth to trade openness, real public and private investment and upon which the long-run analysis is based. This result shows that in the long run, economic growth in Ethiopia can be explained by private investment, public investment, trade openness and human capital.

The long-run impact of real public investment on economic growth is found to be positive, which means that a 10-percentage-point increase in real public investment will raise the real GDP by 0.95 percentage points in the long run. This finding is in line with the theoretical prediction of the endogenous growth model which states that fiscal policy (including public investment policy) can determine the national level of output. And particularly the model indicates that public investment policies on the rate of capital accumulation could affect the rate of accumulation of both physical and human capital along with the level of research and development expenditures which can directly reduce economic growth of the country.

Furthermore, this finding is consistent with studies by (Aschauer, 1989a; Eberts, 1986; Munnell, 1990; Tatom, 1991) in which a significant positive relationship between public investment and economic growth was observed. Similarly, more recent studies of the effects of public investment on growth have included (Nazima and Kiani, 2011; Mansouri, 2008; Muhammed, 2006; Milbourne et al., 2003; Aschauer, 2000; Pereira, 2000, 2001a and 2001b; Mittnik and Neumann, 2001) and have revealed that public investment

has a positive and statistically significant impact on economic growth. This finding is not unique to the Ethiopian case as suggested by Muhammed (2006), who argues that public investment has an important positive impact on the country's economic growth.

With respect to private investment, real private investment has positive and significant impact on real GDP in Ethiopia, both in the short run and in the long run. The result here suggests that a 10-percentage-point increase in real private investment in the long run raises real GDP by 1.5 percentage points in the long run. This result is sound and consistent with the theoretical prediction of the classical growth model and the endogenous growth model, as well as the World Bank gap model.

Furthermore, this finding is consistent with studies by Miguel and Nader (2003) and Festus (2006). With respect to Ethiopia, Alemayehu and Befekadu (2005) have explored the role of investment as one of the long-run determinants of Ethiopia's growth rate. With regard to the relative contribution of public investment and private investment to economic growth, this paper found that private investment is a greater contributor than public investment to the country's economic growth; a 10% increase in private investment leads to an approximately 1.5% increase in output, while a similar increase in government investment leads to a 0.95% increase. This is consistent with studies by Khan and Reinhart (1990) and Khan and Kumar (1997), who found that for developing countries, although public investment contributes to the productive performance of the economies, private investment has a greater influence on economic growth.

The long-run impact of trade openness on economic growth is found to be positive and statistically significant, which means that a 10-percentage-point increase in trade

openness raises economic growth (real GDP) by 3.1 percentage points in the long-run. This finding indicates that international integration is a beneficial strategy for growth in the long term, which is in line with what is predicted by Orthodox trade growth theory. According to the current Orthodox view, the positive contribution of trade openness to growth stemmed from the notion that liberalization increases specialization and the division of labor, thus improving productivity and export capability, as well as economic performance.

According to the World Bank (1993), the economies of countries with greater relative trade openness outperformed those of less-opened countries. In addition, studies by Lloyd and MacLaren (2000) and Jonsson and Subramanian (2001) on Asian countries support a similar opinion that the rapid growth of Asian countries was largely caused by openness. Furthermore, in studies of the trade-growth nexus, Lipsey (2000); Pahlavani *et al.* (2005); Yue Yaoxing (2010) and Gilles, Valérie and Charalambos(2009) have concluded that trade openness promote economic growth in the long run.

The estimate of the human capital variable bears a positive sign. This finding confirms the predictions of the endogenous growth theory on the importance of human capital for economic growth. Also, this finding is consistent with studies by Babatunde and Adefabi (2005), Leoning (2004), Young (1995) and Barro and Salai-Martin (1995), who found that the human capital variable has a significant positive impact on economic growth.

Table 8: Estimated Long-Run Model for LRIP (Private investment)

Variable	LRIG	LRGDP	LOPE	LLAB	LHCA	C
Coefficient	-0.003072 (0.72104)	3.063564 (-9.08558)	2.819274 (5.66337)	-1.663141 (-1.01821)	0.329532 (2.15981)	97.510036 (-2.67)

Note: values in parentheses are t-Statistics.

$$\text{LRIP}_t = -97.510036 + 0.003072\text{LRIG}_t - 3.063564\text{LRGDP}_t - 2.819274\text{LOPE}_t - 0.329532\text{LHCA}_t + 1.663141\text{LLAB} = 0. \dots 5.2$$

The result indicates that real GDP, human capital and trade openness exert significant long-run effects on the level of real private investment.

The long-run impact of real public investment on private investment is found to be inconclusive (negative but not statistically significant) over the period 1970–2009.

In part, this is because public investment is taken in aggregate form which merges the effect of public investment in different sectors, and makes impossible to identify which sectors are crowding out and which are crowding in. And this obscures the underlying relationship between public and private investment.

The long-run impact of economic growth (real GDP) on private investment is found to be positive and statistically significant, which means that a 1-percentage-point increase in real economic growth (real GDP) increases private investment by 3.06 percentage points in the long run. This model states that economic growth (real GDP) affects private investment positively in Ethiopia. Theoretically, the result can be supported by accelerator model which assumes that investment as a linear proportion of changes in output.

This study also confirms the findings of Greene and Velnueva (1991), Jayaraman (1996) and Blejer and Khan (1984), which asserted that countries with higher real income can devote more resources to finance investment projects. The recent empirical findings of Patrick, L (2006), Outtarra (2005), Bazoumana (2004), Ibrahim (2000), Asante (2000),

and Akpalu (2002) demonstrated that private investment responded positively to changes in real output.

The long-run impact of trade openness on private investment is found to be positive and statistically significant, which means that a 10-percentage-point increase in trade openness increases private investment by 2.8 percentage points in the long run.

This finding is in line with the sound theoretical argument that by enhancing the efficiency of investments (either through the capacity to more fully employ an investment or by enriching the competitiveness of the market place), restraints on the potential capacity of an economy are relaxed. By encouraging the transfer of ideas, opportunities for investment are created where they were once unavailable. By fostering competition in the market for inputs (both in acquiring low-cost or more appropriate inputs from a broader market and by permitting international competition for the most efficient or most appropriate form of domestic governance structures), investments are freed to realize their greatest potential. This result is consistent with studies by Aysan et al. (2006) in which it was found that trade openness and human development affects private investment positively.

Table 9: Estimated Long-Run Model for LRIG (real Public investment)

Variable	LRIP	LRGDP	LOPE	LLAB	LHCA	C
Coefficient	1.871018	2.722201	-1.262580	-1.663141	0.028572	35.56770
	[2.15062]	[-4.62193]	[6.64288]	[-1.01821]	[1.15981]	[-3.88]

Not: values in parenthesis are t-Statistic

The results, after eliminating the insignificant variable, labour force and human capital look the following.

$$\text{LRIG}_t - 35.56770 - 1.871018\text{LIP}_t - 2.722201\text{LRGDP}_t + 1.262580\text{LOPE}_t + 0.028572\text{LHCA} + 1.663141\text{LLAB} = 0 \dots \dots 5.3$$

The long-run impact of trade openness on public investment is found to be negative and statistically significant, which means that a 1-percentage-point increase in trade openness decreases public investment by 1.26 percentage points in the long run. This finding is in line with efficiency hypothesis and according to the efficiency hypothesis openness imposes a constraint on government expenditure, which means, those government expenditure financed through taxation may raise production costs, and therefore harming firms' competitiveness. For that reason, firms in the long run can lobby on governments in order to reduce public intervention and its expenditure covered through tax in order to reduce their costs and then to enhance their competitiveness on the global markets.

This finding is consistent with studies by Ferris and West (1996) in which a negative relationship is found between trade openness and public expenditures in the United States between 1959 and 1986. Similarly, Ferris (2003) and Borchering *et al.* (2004) observe a negative relationship between trade openness and total public expenditures.

The public investment equation results reveal that the long-run impact of private investment on public investment is found to be positive and statistically significant, which means that a 10-percentage-point increase in private investment increases public investment by 1.87 percentage points in the long run. This finding is in line with sound theoretical argument: booming private investment goes hand-in-hand with vibrant public investment. Theoretically, one can argue that increased private investment generates tax

revenue with which the government can undertake its investment programs, thereby giving rise to a positive relationship between private and public investment.

The long-run impact of real GDP on public investment is found to be positive and statistically significant, which means that a 1-percentage-point increase in real GDP increases public investment by 2.7 percentage points in the long run.

This result is in line with Wagner's Law, which emphasizes economic growth as the fundamental determinant of public-sector growth. This finding is consistent with studies by Satish and Rahul (2010); Wahab (2004); Bird (1971); Nagarajan and Spears (1990); Murthy (1993); and Hondroyiannis and Papapetrou (1995), in which government expenditures was found to grow simultaneously with economic growth.

Short run Relationship

Table 10 shows the results of the D (LRGDP) equation in the error-correction model, from which the short-run impact of trade openness, real private and real public investment on economic growth (real GDP) can be analyzed. The coefficients of the one-period lagged differences in the table can be interpreted as the short-run parameters representing the short-run impact of trade openness, private and public investment on economic growth (real GDP). The result shows that trade openness, public investment and private investment have significant impacts on real income (real GDP). In addition, such variables as labor force and human capital are found to have no significant role in the short run.

The short-run coefficient of trade openness indicates a negative significant causal effect on growth from changes in openness, suggesting that openness can be painful for an

economy and invoke a call for protectionism. However, the long-run effect is positive and significant, indicating that in the long-run, changes in openness cause greater GDP growth. These short-term and long-run results demonstrate that free trade and protectionism should not be considered two contradictory aspects in the international trade literature. Rather, foreign competition seems to have a negative short-term effect on growth; import-competing firms are disadvantaged and seek protection against openness. However, in the long run, free-trade policies prove beneficial to productivity and growth, consistent with recent literature that suggests that openness promotes long-run economic growth through various channels, such as technological progress, increases in key markets and increasing competition. This result is consistent with studies by Thomas and Margarete (2005), in which trade openness was found to have a negative and significant impact on economic growth in the short run.

The short-run impact of public investment on economic growth is found to be negative and statistically significant, which means that a 10-percentage-point increase in public investment decreases economic growth by 0.3 percentage points in the short run; the negative sign of public investment is indicative of a “crowding out” effect on growth in the short run. This result may be observed because public spending has a long gestation period; we look for the impact after a long period but consume resources in the interim that can be used for private resources.

Table 10: Short-Run Coefficients when dependent variable is D (LRGDP)

Error Correction	Dependent Variable: D(LRGDP)	
	Coefficient	t-value
Coint.Eq1	-0.655241	[-4.39626]
D(LRIG(-1))	-0.035806	[-2.36021]
D(LRIP(-1))	0.000229	[-3.00621]
D(LOPE(-1))	-0.352629	[-2.04053]
D(LLAB(-1))	0.665472	[0.33692]
D(LHCA(-1))	0.098719	[1.24679]
DUM	-0.137649	[-3.13919]

The coefficient of the error correction term for the output equation possesses the expected negative sign, indicating that it is error-correcting. This guarantees that although the actual real GDP may temporarily deviate from its long-run equilibrium value, it would gradually converge to its equilibrium. The error correction term of -0.655241 shows that 65.53 percent of the deviation of the actual real GDP from its equilibrium value is eliminated every year; hence, full adjustment would require a period of less than two years.

In estimating the error-correction model, a dummy for inward-looking economic systems (dum) is introduced to capture the effect of inward-looking behavior. The negative and significant coefficient of dummy for inward-looking (dum) indicates that the prolonged inward-looking behavior by both the imperial and Derg regimes has negatively affected the growth of the economy.

Table 11: Short Run Coefficients when dependent variable is D(LRIP)

Error Correction	Dependent Variable D (LRIP)	
	Coefficient	t-value
Coint.Eq1	-0.213678	[-5.99626]
D(LRIG(-1))	-0.217572	[-2.36021]
D(LRGDP(-1))	1.164600	[2.28192]
D(LOPE(-1))	- 0.767264	[4.06110]
D(LLAB(-1))	0.50552	[1.18829]
D(LHCA(-1))	0.279126	[1.41928]
DUM	-0.072088	[-0.36729]

The excessive exposure of private investors to foreign competition through increased trade liberalization seemed to have had an adverse effect on short-term private investment. Thus, a percentage increase in the ratio of trade to GDP (i.e., openness) will reduce short-run private investment by 0.76 percent. This result further implies the existence of infant industries in the short-run that demand protection or intervention from the government.

There is also evidence to support the theory of a short-run "crowding-out" effect of public investment (an increase of 1% reduces private investment by 0.22%). Public investment can crowd out private investment through different channels. First, government investment can crowd out private investment through increased borrowing. For example, if public-sector investments are financed by borrowing, this leads to an increase in the market interest rate and thus raises the cost of capital for the private sector, crowding out the private sector. In the case of tax financing of public-sector investment, the tax may

distort the resource allocation decisions of private investors in the economy by changing relative prices.

Second, public investment can exert a negative influence on private investment. If both the private and public sectors compete for a limited amount of resources in the economy, the costs of financing private investment increase, while the availability of credit to the private sector declines, this could crowd out investment in the private sector. Furthermore, investments undertaken by highly subsidized state economic enterprises are often financed through the printing press, external debts and deficit spending. Finally, public investment may substitute for private investment when they both produce goods and services that are in direct competition in a marketplace, particularly if public production is subsidized by the government. This suggests that there is a kind of competition for resources between the public and the private sectors, at least in the short run.

The coefficient of the ECM model for the private investment equation possesses the expected negative sign, indicating that it is error-correcting. In other words, any deviation from the long-run equilibrium is corrected back to equilibrium, although at a slow pace of approximately 21% (see Table 11) in each subsequent period. The relatively low speed of adjustment may be attributed to structural rigidities common in developing countries that slow down the adjustment process.

The coefficient of the ECM model for the public investment equation possesses the expected negative sign, indicating that it is error-correcting. The coefficient is 0.298 (see appendix 4), suggesting a slow adjustment process in government investment. Nearly 30

percent of the disequilibria from the shock of the previous period return to the long-run equilibrium in the current year.

5.2.1.3. Post-Estimation Diagnostics

In the study, different post-estimation diagnostic tests were performed to guarantee that the residuals from the model are Gaussian that the assumptions are not violated and the estimation results and inferences are trustworthy. The diagnostic test results could also be used as indicators of the validity of employing impulse-response functions and variance-decomposition analyses.

Residual Vector Serial Correlation LM Test

Table 12 shows that there is no evidence that reveals the presence of autocorrelation at the first through the third lags. The large p-values imply that the chi-squared statistics at all lags are not large enough to help reject the null of no autocorrelation at any of the usual critical values. Thus, the study could not find any evidence of autocorrelation problem in the residuals.

Residual Vector Normality Test

Normality is checked mainly by using the Jarque-Bera test. The result (in table 12) shows that the residual vector of the model is found to be jointly normal only at the 10% level. However, since normality is an asymptotic or large sample property, it may be expected that the residual normality could asymptotically be improved if the sample size could be increased. Unfortunately, the sample size could not be increased because of investment data. This may suggest that there could be small sample size problem in the data that has probably reduced the power of this test.

Residual Vector Heteroskedasticity Test

Only the levels and square terms (and no cross terms) of the residuals are included in performing this test, owing to the small sample in the data. The result in table 12 suggests that there is no enough evidence to help reject the null of no heteroskedasticity. Therefore, the residuals of the model are found to be homoskedastic. This, together with the results of the other pre and post estimation diagnostic tests, suggests the validity and robustness of the estimated results.

Table 12: Diagnostic Test Results

Test	Statistic		P-value
	lags	Chi-sq	
Residual Vector Serial Correlation LM	1	31.10	0.7005
	2	33.12	0.6063
	3	50.06	0.5098
	Joint	44.99	0.08
Residual Vector Normality (Jarque-Bera)	Joint	44.99	0.08
Residual Vector Heteroskedasticity		296.7158	0.4447

5.2.1.4 Impulse Response

Impulse response functions could tell us how the real GDP at any point in time may respond to a one standard deviation innovation (impulse) generated from any of the variables earlier times and how that effect may be multiplied (lasts for long or is transitory). But it should be noted that the impulse response results based on cholesky's impulse response analyses are sensitive to the ordering of the variables and the lag length (see for example Lutkepohl, 1990). Thus to account of this problem, the results in this study are based on the generalized impulse response functions (GIRFs) based on the works of Pesaran and shin (1998).

The results indicate that there is negative relation between trade openness and real GDP in the short run. As seen from the fourth column, first row of Appendix 5, it is obvious that the effect of one standard deviation shock of trade openness on real GDP is negative in the short run over the whole period. Hence this tells us that in Ethiopia, trade openness have distortionary impact in the short run. This result is quite realistic in the case of developing countries where there are large number infant industries which are incapable of competing with well developed industries of developed countries in the short run.

Similarly there is negative relation between public investment and real GDP in the short run. As seen from the fifth column, first row of Appendix 5, it is obvious that the effect of one standard deviation shock of public investment on real GDP is negative in the short run. The reason might be institutions in developing countries where Ethiopia is one, are weak that lengthens gestation period of public investment beyond tolerable limit. Generally, the exogenous shocks in Real GDP in Ethiopia exhibit relatively quicker transitory pattern in converging to the long run time path. So Economic growth in the country behaves in a transitory manner with the effects from the shock in each particular variable being dampened through time.

Impulse Response Functions (IRF) is also computed for private investment and public investment. The results indicate that the short run fluctuations in real private investment is attributable significantly to shocks to itself, real GDP and trade openness. The result from appendix 5 indicates that positive shocks to GDP will have significant and direct impact on real private investment. While private investment responds negatively to shocks in trade openness, but it tends to have positive shocks on private investment in the

long run. Generally, the exogenous shocks in private investment in Ethiopia exhibit transitory pattern in converging to the long run time path.

The results indicate that the short run fluctuation in real public investment is attributable significantly to shocks to itself and trade openness. The result from appendix 4 indicates that public investment responds negatively to shocks in trade openness. And the impact of other variables, RGDP, private investment and human capital, seems insignificant. Generally, the exogenous shocks in public investment in Ethiopia exhibit slower transitory pattern in converging to the long run time path.

5.2.1.5 Variance Decomposition

Table 13 presents variance decomposition (VDC) estimations. Mamatzakis (2001) states that the variance decomposition analysis indicates how much of the uncertainty surrounding the predictions of real GDP can be explained by the uncertainty surrounding the other variables. The full decomposition of the variation in real GDP is presented in appendix 6 for the first 40 periods along side with the Monte Carlo standard errors. The result reveals that all the variation in real GDP is explained by the lagged value of the variable itself in the first period. But in the second period, human capital also explains about 10% of the variation in. And the variation in human capital was strong until period four and after this period its contribution starts to decline and on the other hand, the variation in private and public investment take relatively significant shares after fourth period in explaining the variation in real GDP in the short run (see appendix 6). The results further showed that a huge variation in real GDP in the data is explained by the lagged values of the variable itself (61%). In summary, over forty years, 8%, 7% and 6.2% of the forecast error variance of real GDP is explained by disturbances in trade

openness, human capital and labour force while 8.8% and 9.57% by public investment and private investment.

Table 13: Variance Decomposition Analysis

Variance Decomposition of LRGDP							
PERIOD	S.E	LRGDP	LHCA	LLAB	LOPE	LRIP	LRIG
1	0.116036	100.0000	0.000000	0.000000	0.000000	0.000000	0.000000
5	0.266829	61.79963	8.100313	7.774254	8.104948	7.184199	7.036658
10	0.378607	61.55258	7.034271	7.141883	7.622479	8.219638	8.429152
15	0.463552	61.33374	6.667799	7.003763	7.542795	8.515326	8.936579
20	0.535163	61.21619	6.488600	6.935889	7.504163	8.663389	9.191766
25	0.598264	61.14612	6.380651	6.895083	7.480955	8.752186	9.345006
30	0.655317	61.09933	6.308703	6.867874	7.465479	8.811413	9.447204
35	0.707786	61.06590	6.257294	6.848433	7.454422	8.853728	9.520222
40	0.756625	61.04083	6.218731	6.833850	7.446128	8.885470	9.574995

Variance Decompositions (VDC) is also computed for private investment and public investment (See Appendix 7 and 8). From the VDCs, the forecast error variance of private investment explained by the RGDP, trade openness and public investment innovation is significant. And further the study confirmed that effects of the shocks of real GDP and trade openness are more substantial. And in relation to public investment, the forecast error variance of public investment explained by the RGDP, trade openness and private investment innovation is significant. And further the study confirmed that effects of the shocks of real GDP and trade openness are more substantial.

CHAPTER 6: CONCLUSIONS AND POLICY

IMPLICATIONS

6.1 Conclusions

This study examined whether there is nexuses between public investment, private investment, trade openness and economic growth in Ethiopia during the period 1970-2009. Co-integration and Vector Error Correction approaches have been applied for the identification of nexuses between public investment, private investment, trade openness and economic growth both in the short run and in the long run. The study also employs innovation accounting to analyze the response of the real economic growth, real public and private investment and examine the relative importance of the shocks. Based on the findings of the study both from the descriptive and econometric results, the following conclusions are derived.

The major contribution of this study is that, unlike other researchers who consider trade - growth nexus and investment-growth nexus separately, this study looks the nexuses between trade openness, investment and growth together using Co-integration and Vector Error Correction approaches. And further this study found evidence on the nexuses between public investment, private investment, trade openness and economic growth in the long run.

Trade openness, public and private investments have significant long run impact on economic growth of the country. Public investment affects economic growth differently both in the short run and in the long run. In the short run the impact of public investment is crowding out economic growth but in the long run it has complementarity effect. Such

short run result may be due to the fact that public spending has long gestation period and the productive outcome of public investment is only visible in the long run and thus, in between consume resources that can be used by private resources.

Similarly, trade openness has different impact on economic growth and private investment both in the short run and in the long run. In the short run the impact of trade openness on economic growth as well as on private investment is negative but in the long run it has a positive impact. Such short run result may be due to the collapse of infant industries following trade openness, which is the result of tough competition from well organized foreign firms. Whereas, the reason for the long run positive impact might be trade openness promotes long run economic growth through various channels, such as technological progress, increasing key markets and rising competition. Overall, in view of the long run and short run trade-off between gain and loss from trade openness, increasing trade openness is a useful channel to boost private sector development and economic growth.

Given the long run and short run positive impact of private investment on economic growth and on public investment, expanding private sector has beneficial effect. And economic growth has positive long run and short run impact on public and private investment.

Furthermore, apart from the variation in real GDP itself, the impulse response analysis reveals that much of the fluctuation in economic growth in the country is explained by shocks in private investment, public investment and trade openness. The impulse response analysis shows as economic growth in Ethiopia exhibits a relatively quicker

transitory pattern to the long run time path. Similarly, the variance decomposition suggested that the variation in economic growth in the data is explained by the variation in trade openness, private investment and public investment.

Regarding, private investment, the result of impulse response function indicates that the short run fluctuations in real private investment is attributable significantly to shocks to itself, real GDP and trade openness. And with regard to the short run fluctuation in real public investment, the fluctuation is attributable significantly to shocks to itself and trade openness.

Variance Decompositions (VDC) is also computed for private investment and public investment. From the VDCs, the forecast error variance of private investment explained by the economic growth (RGDP), trade openness and public investment innovation is significant. Furthermore, the study confirmed that effects of the shocks on Real GDP and trade openness are more substantial.

In relation to public investment, the forecast error variance of public investment explained by the RGDP, trade openness and private investment innovation is significant. The study further confirmed that effects of the shocks on Real GDP and trade openness are more substantial on public investment. After examining the nexuses between public investment, private investment, trade openness and economic growth in Ethiopia the following policy implications are forwarded.

6.2 Policy Implications

Given the significant long run positive impact of trade openness on private investment and economic growth, as well as the long run positive impact of private investment on

public investment and economic growth, it is logical to consider supplementary reforms. Major policy stances that could emanate from this work include the following.

First and foremost, to realize the long term potential of trade openness, the government of Ethiopia should take supplementary reforms tailored to the specific requirements of the country. The supplementary reforms should include 1) having an adequate level of physical infrastructure; human capital, particularly trade specialist or experts that can advice or provide technical support for the government and private investors in order to get benefit from trade openness; 2) improving enterprise capacity to overcome supply-side constraints in producing for export; and also the existence of export opportunities or adequate market access for their products, which is a long time taking and difficult process. In the absence of some or all of these prerequisites, trade openness may not result in the projected benefits and may instead produce adverse results. It is thus critical to decide on the appropriate timing of trade openness in relation to the presence or absence of these prerequisites. A more realistic and responsible approach would enable the country to first establish these conditions and integrate trade openness into its overall national development strategy when and where appropriate, rather than pressuring the economy and the country.

Secondly, to realize the long run positive effect of real private investment the government of Ethiopia should take supplementary reforms that will improve the country's poor investment climate, which this study reviewed it under chapter one (for example : poor infrastructure, particularly, Power shortage; poor transport; poor telecom connectivity of business locations and lack of efficient tax administration). Thus the study calls for the government intervention in improving investment climate in a way that

promotes private sector development, in supportive of entrepreneurial endeavor and with a bias towards expansion of business activities. In particular, the government has roles to play at different levels of the economy to encourage the private sector and to attain sustainable development. These include supply of efficient infrastructure facilities such as electricity, telephone, water and road; improving the tax administration system for example minimizing the random imposition of taxes and increasing access to information and advisory services. In the absence of some or all of these prerequisites, private investment expansion which is a means for accumulation of physical capital and increment of national output may not result at the projected level.

Thirdly, the long run positive effect of real public investment on growth and loss of sufficient statistical evidence of crowding out effect on private investment calls the responsible authority, first to identify which sectors of public investment are crowding in and which sectors are crowding out private investment, before expansion of state participation. The guiding principle for public investment should be complimentary rather than compete with private investment.

At the aggregate level, this study examined whether there are nexuses between public investment, private investment, trade openness and economic growth in Ethiopia during the period 1970-2009. This is done only at aggregate level and, thus, the impacts of disaggregated public investment on private investment using ARDL CO-Integration are open to research.

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Appendices

Appendix 1: Variance Inflation Factor for the Test of Multicollinearity

Variable	VIF	Tolerance
LRGDP	2.04	0.490196
LRIG	2.16	0.462962
LRIP	1.89	0.305810
LOPE	1.17	0.854700
LHCA	3.43	0.291545
LLAB	3.67	0.272479
<i>Mean VIF</i>	2.678	

Appendix 2: Phillips-Perron Stationarity Test Result

Variable	Test Statistic Under Different Assumptions			Order of integration
	Intercept	Trend and Intercept	NoTrend, No intercept	
LRGDP	1.305775	-1.833428	1.958591	I(1)
D(LRGDP)	-5.856855*	-6.470996	-5.361777	
LIG	-0.783738	-3.499921	1.069090	I(1)
D(LIG)	-7.343966*	-7.252025	-7.011171	
LIP	-0.923744	-2.508980	0.522031	I(1)
D(LIP)	-10.40200*	-13.12390	-10.27815	
LLAB	1.586943	-0.532756	15.75554	I(1)
D(LLAB)	-4.217055*	-4.677277	-0.701118	
LOPPC	-1.525474	-2.539625	2.334546	I(1)
D(LOPPC)	-10.86072*	-10.43396	-6.571126	
LHCA	-0.067444	-2.286835	2.960109	I(1)
D(LHCA)	-7.946858*	-8.216599	-6.858279	

*Note: D shows the variable is differenced once. Note: MacKinnon (1996) one-sided critical values for rejection of a unit root used here. * shows significance at 1%*

Appendix 3: Roots of Polynomial Characteristics

Roots of Characteristic Polynomial
 Endogenous variables: LRGDP LRIG LRIP LOPE LLAB
 LHCA
 Exogenous variables: DUM C
 Lag specification: 1 1

Root	Modulus
0.993859	0.993859
0.874222	0.874222
0.644006 - 0.103696i	0.652301
0.644006 + 0.103696i	0.652301
-0.373318	0.373318
0.148686	0.148686

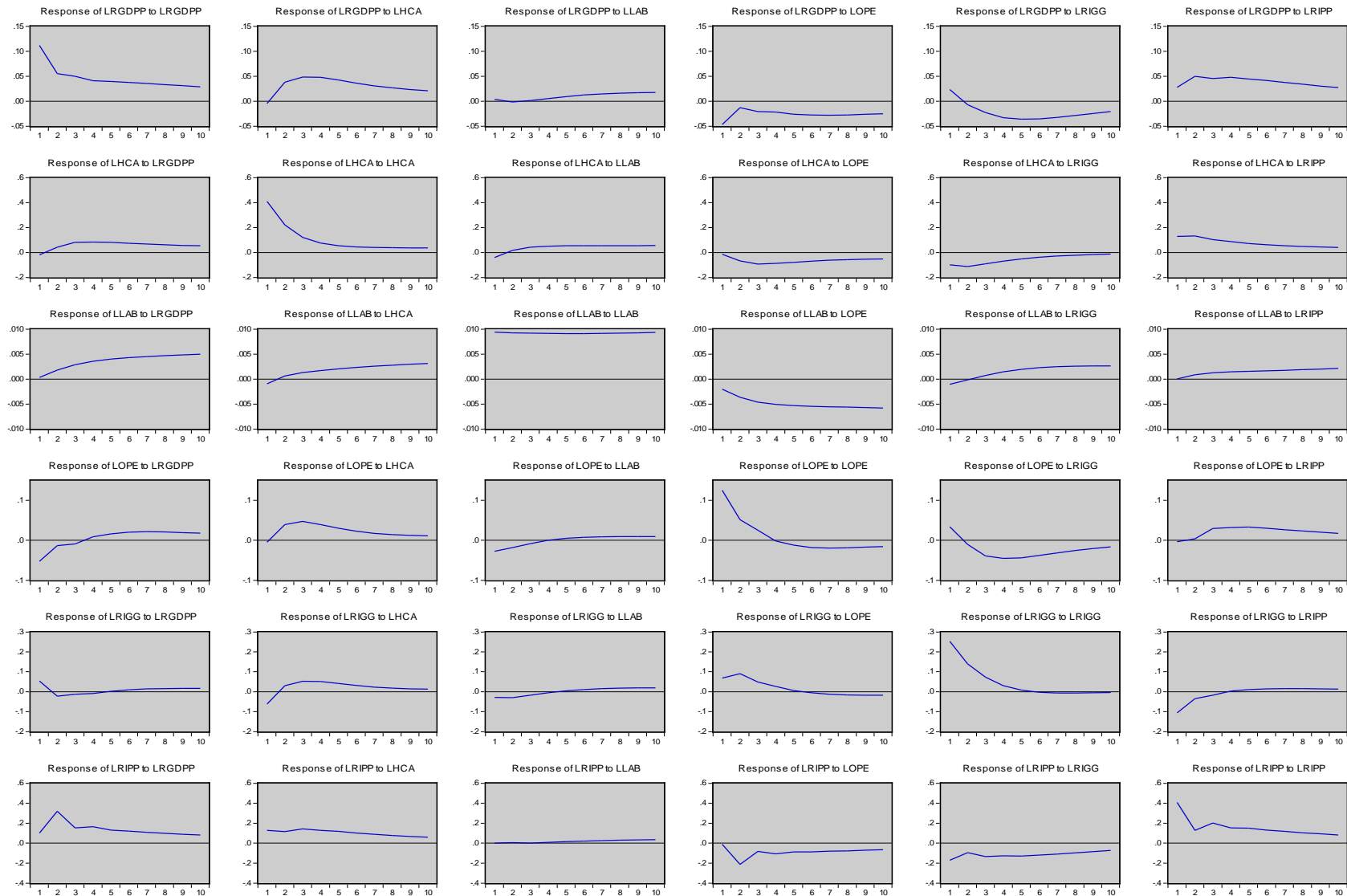
No root lies outside the unit circle.
 VAR satisfies the stability condition.

Appendix 4: Short Run Coefficients when dependent variable is D (LRIG)

Error Correction	Dependent Variable D (LRIG)	
	Coefficient	t-value
CoInt.Eq1	-0.2978	[-4.39626]
D(LRIP(-1))	0.040258	[0.44960]
D(LRGDP(-1))	1.038224	[2.09402]
D(LOPE(-1))	-0.049982	[-0.12474]
D(LLAB(-1))	-1.010204	[-0.22035]
D(LHCA(-1))	0.220627	[2.11703]
DUM	0.042088	[-0.36729]

Appendix 5: Impulse Response function

Response to Generalized One S.D. Innovations



Appendix 6: Variance Decomposition Functions (LRGDP)

Period	S.E.	LRGDP	LRIP	LRIG	LOPE	LLAB	LHCA
1	0.116036	100.0000	0.000000	0.000000	0.000000	0.000000	0.000000
2	0.173898	81.31477	5.617045	1.879137	0.522233	0.276008	10.39081
3	0.208876	71.80675	5.966259	4.792887	4.310904	3.289353	9.833847
4	0.238815	63.74104	6.620104	6.351869	7.297455	6.815135	9.174396
5	0.266829	61.79963	7.184199	7.036658	8.104948	7.774254	8.100313
6	0.292855	61.59633	7.633874	7.421160	7.961234	7.634158	7.753241
7	0.316971	61.86753	7.854709	7.747503	7.743590	7.350240	7.436425
8	0.338832	61.76601	8.009237	8.031891	7.658387	7.222606	7.311869
9	0.359289	61.67267	8.119535	8.257268	7.636319	7.171984	7.142223
10	0.378607	61.55258	8.219638	8.429152	7.622479	7.141883	7.034271
11	0.397063	61.50164	8.299674	8.566446	7.601591	7.105350	6.925301
12	0.414685	61.44652	8.368284	8.681127	7.581972	7.072715	6.849382
13	0.431597	61.40802	8.424383	8.779263	7.565982	7.044934	6.777419
14	0.447856	61.36600	8.473345	8.863585	7.553587	7.022979	6.720505
15	0.463552	61.33374	8.515326	8.936579	7.542795	7.003763	6.667799
16	0.478730	61.30331	8.552476	9.000334	7.533244	6.986980	6.623655
17	0.493445	61.27836	8.585024	9.056607	7.524642	6.971877	6.583487
18	0.507732	61.25507	8.614089	9.106651	7.517047	6.958552	6.548590
19	0.521628	61.23485	8.640003	9.151448	7.510253	6.946598	6.516852
20	0.535163	61.21619	8.663389	9.191766	7.504163	6.935889	6.488600
21	0.548365	61.19960	8.684515	9.228246	7.498637	6.926169	6.462830
22	0.561256	61.18435	8.703746	9.261411	7.493616	6.917345	6.439532
23	0.573857	61.17053	8.721291	9.291697	7.489027	6.909276	6.418175
24	0.586188	61.15779	8.737385	9.319461	7.484824	6.901886	6.398650
25	0.598264	61.14612	8.752186	9.345006	7.480955	6.895083	6.380651
26	0.610102	61.13531	8.765853	9.368587	7.477385	6.888806	6.364057
27	0.621714	61.12532	8.778507	9.390424	7.474078	6.882991	6.348677
28	0.633113	61.11604	8.790259	9.410701	7.471007	6.877593	6.334404
29	0.644311	61.10740	8.801200	9.429582	7.468148	6.872566	6.321109
30	0.655317	61.09933	8.811413	9.447204	7.465479	6.867874	6.308703
31	0.666142	61.09178	8.820967	9.463691	7.462983	6.863484	6.297095
32	0.676793	61.08470	8.829924	9.479148	7.460642	6.859369	6.286213
33	0.687279	61.07806	8.838339	9.493668	7.458443	6.855503	6.275989
34	0.697608	61.07180	8.846260	9.507335	7.456374	6.851864	6.266367
35	0.707786	61.06590	8.853728	9.520222	7.454422	6.848433	6.257294
36	0.717820	61.06033	8.860781	9.532393	7.452579	6.845193	6.248725
37	0.727715	61.05506	8.867453	9.543907	7.450835	6.842127	6.240619
38	0.737477	61.05007	8.873775	9.554814	7.449184	6.839223	6.232939
39	0.747113	61.04533	8.879772	9.565163	7.447617	6.836468	6.225653
40	0.756625	61.04083	8.885470	9.574995	7.446128	6.833850	6.218731

Appendix 7: Variance Decomposition Functions (private investment)

Period	S.E.	LRIP	LRGDP	LOPE	LRIG	LHCA	LLAB
1	0.460755	98.29020	1.709798	0.000000	0.000000	0.000000	0.000000
2	0.566034	66.95367	26.70878	2.233532	2.945457	0.843533	0.315030
3	0.677900	70.56319	21.69780	3.549425	3.262255	0.720831	0.206498
4	0.778044	65.39336	25.21844	4.967964	3.541869	0.706261	0.172100
5	0.866443	64.64696	25.18807	5.384976	3.767048	0.802319	0.210631
6	0.944151	61.51340	27.46138	5.749732	3.860422	1.090078	0.324987
7	1.015039	60.52687	27.92387	5.914618	3.902077	1.308742	0.423821
8	1.081416	59.17124	28.83773	6.116014	3.916379	1.472446	0.486190
9	1.144182	58.60066	29.12698	6.242502	3.934104	1.569721	0.526038
10	1.203733	57.88015	29.59826	6.362294	3.949015	1.652769	0.557513
11	1.260438	57.44455	29.84591	6.444773	3.963270	1.717529	0.583977
12	1.314677	56.98163	30.14106	6.521250	3.973924	1.775518	0.606614
13	1.366765	56.65350	30.33418	6.581223	3.983248	1.822378	0.625477
14	1.416946	56.33519	30.53302	6.635897	3.990913	1.863419	0.641561
15	1.465413	56.08373	30.68377	6.681201	3.997808	1.898092	0.655402
16	1.512326	55.84865	30.82915	6.721981	4.003721	1.928931	0.667562
17	1.557826	55.65097	30.94881	6.757116	4.009003	1.955832	0.678270
18	1.602034	55.46939	31.06043	6.788826	4.013636	1.979919	0.687794
19	1.645054	55.31096	31.15676	6.816859	4.017809	2.001316	0.696293
20	1.686978	55.16604	31.24557	6.842271	4.021542	2.020635	0.703941
21	1.727886	55.03658	31.32447	6.865114	4.024932	2.038050	0.710851
22	1.767846	54.91797	31.39704	6.885950	4.028002	2.053906	0.717133
23	1.806924	54.81038	31.46269	6.904908	4.030809	2.068352	0.722863
24	1.845173	54.71140	31.52320	6.922311	4.033377	2.081601	0.728113
25	1.882646	54.62065	31.57861	6.938292	4.035741	2.093775	0.732940
26	1.919388	54.53675	31.62988	6.953050	4.037920	2.105012	0.737394
27	1.955439	54.45921	31.67723	6.966700	4.039938	2.115409	0.741517
28	1.990837	54.38716	31.72125	6.979376	4.041810	2.125061	0.745343
29	2.025617	54.32016	31.76217	6.991169	4.043553	2.134043	0.748904
30	2.059810	54.25762	31.80038	7.002174	4.045179	2.142424	0.752226
31	2.093444	54.19915	31.83609	7.012465	4.046700	2.150261	0.755333
32	2.126547	54.14434	31.86958	7.022110	4.048125	2.157607	0.758245
33	2.159142	54.09287	31.90101	7.031167	4.049464	2.164505	0.760980
34	2.191252	54.04444	31.93060	7.039690	4.050723	2.170995	0.763553
35	2.222899	53.99879	31.95848	7.047724	4.051910	2.177113	0.765978
36	2.254101	53.95569	31.98481	7.055309	4.053031	2.182890	0.768268
37	2.284877	53.91493	32.00971	7.062483	4.054091	2.188354	0.770434
38	2.315244	53.87632	32.03330	7.069277	4.055095	2.193528	0.772486
39	2.345218	53.83970	32.05567	7.075722	4.056048	2.198436	0.774431
40	2.374813	53.80491	32.07692	7.081844	4.056952	2.203098	0.776280

Appendix 8: Variance Decomposition Functions (public investment)

Period	S.E.	LRIG	LRGDP	LRIP	LOPE	LHCA	LLAB
1	0.009501	67.77410	0.000000	30.57417	0.000000	1.651731	0.000000
2	0.015206	71.81712	5.997149	16.87622	2.349512	2.941292	0.018706
3	0.021001	75.04373	6.365209	11.24047	5.128638	1.879421	0.342539
4	0.027220	76.20371	6.368995	8.268828	7.372341	1.301372	0.484757
5	0.032801	76.49615	6.531649	7.232766	8.206311	0.990471	0.542655
6	0.037506	76.73528	6.852391	6.519479	8.455361	0.865105	0.572383
7	0.041505	76.83730	7.088783	6.093924	8.544135	0.829372	0.606485
8	0.045111	76.98157	7.246336	5.728486	8.626743	0.781292	0.635569
9	0.048450	77.07709	7.344975	5.472876	8.706639	0.740013	0.658404
10	0.051589	77.16679	7.425260	5.256627	8.774204	0.702488	0.674636
11	0.054546	77.22859	7.491502	5.090721	8.826175	0.675358	0.687650
12	0.057351	77.28515	7.548815	4.947107	8.868232	0.652332	0.698364
13	0.060022	77.32960	7.596051	4.829498	8.903602	0.633628	0.707623
14	0.062580	77.36987	7.636475	4.726899	8.934292	0.616983	0.715477
15	0.065038	77.40327	7.671028	4.639741	8.960816	0.602864	0.722278
16	0.067407	77.43321	7.701420	4.562863	8.983945	0.590390	0.728173
17	0.069694	77.45900	7.728086	4.495757	9.004222	0.579554	0.733378
18	0.071910	77.48222	7.751804	4.435897	9.022220	0.569872	0.737986
19	0.074058	77.50274	7.772923	4.382673	9.038284	0.561270	0.742108
20	0.076147	77.52131	7.791920	4.334725	9.052727	0.553511	0.745806
21	0.078179	77.53799	7.809060	4.291509	9.065765	0.546523	0.749148
22	0.080160	77.55319	7.824631	4.252226	9.077602	0.540169	0.752180
23	0.082093	77.56701	7.838819	4.216447	9.088391	0.534383	0.754945
24	0.083982	77.57969	7.851813	4.183669	9.098270	0.529081	0.757476
25	0.085829	77.59132	7.863750	4.153565	9.107347	0.524213	0.759802
26	0.087638	77.60206	7.874759	4.125797	9.115717	0.519722	0.761947
27	0.089409	77.61198	7.884940	4.100119	9.123459	0.515569	0.763931
28	0.091146	77.62119	7.894386	4.076293	9.130641	0.511715	0.765771
29	0.092851	77.62976	7.903172	4.054133	9.137321	0.508132	0.767483
30	0.094525	77.63775	7.911366	4.033466	9.143552	0.504789	0.769079
31	0.096170	77.64522	7.919025	4.014148	9.149375	0.501665	0.770572
32	0.097787	77.65221	7.926201	3.996049	9.154831	0.498737	0.771970
33	0.099378	77.65878	7.932937	3.979059	9.159953	0.495990	0.773282
34	0.100944	77.66496	7.939273	3.963079	9.164771	0.493405	0.774516
35	0.102486	77.67078	7.945243	3.948021	9.169310	0.490970	0.775680
36	0.104005	77.67627	7.950878	3.933807	9.173595	0.488671	0.776778
37	0.105502	77.68147	7.956206	3.920369	9.177646	0.486498	0.777816
38	0.106978	77.68638	7.961251	3.907645	9.181482	0.484440	0.778798
39	0.108435	77.69105	7.966035	3.895578	9.185120	0.482488	0.779731
40	0.109871	77.69548	7.970578	3.884121	9.188574	0.480635	0.780616