The Innovation, Human Development and Economic Growth in Ethiopia

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Acronyms

AfDB	African Development Bank
ADLI	Agriculture-Led-Industrialization
AEO	African Economic Outlook
AIO	African Innovation Outlook
BERD	Business expenditure on research and development
ETB	Ethiopian birr
EG	Economic growth
EPRDF	Ethiopian People`s Revolutionary Democracy Front
FTE	Full Time Equivalent
GDP	Gross domestic product
GERD	Gross expenditure on research and development
GOVERD	Government expenditure on research and development
GRI	Government Research Institution
GTP	Growth and Transformation Plan
HC	Head Count
HD	Human Development
HDI	Human Development Index
HERD	Higher Education Expenditure on Research and Development
HRM	Human Resource Management
ICT	Information Communication Technology
IDS	Industrial Development Strategy
LME	Large and Medium Enterprises
FDI	Foreign Direct Investment
ISCED	International Standard Classification of Education
FDRE	Federal Democratic Republic of Ethiopia
MDG	Millennium Development Goal
MoFED	Ministry of Finance and Economic Development
MOST	Ministry of Science and Technology
NEPAD	New Partnership for Africa’s Development
OECD	Organization for Economic Corporation and Development
PASDEP	Plan for Accelerated and Sustained Development to End Poverty
PNP	Private Non-Profit
PPP	Purchasing Power Parity
R&D	Research and Development

S&T	Science and Technology
SME	Small and Medium Enterprises
SDPRP	Sustainable Development and Poverty Reduction Program
SSA	Sub Saharan African
STIC	Science and Technology Information Center
STI	Science technology and Innovation
STS	Scientific and Technological Services
TVET	Technical and Vocational Education and Training
NESCO	United Nations Educational, Scientific and Cultural Organization
UNCTAD	United Nation Conference on Trade and Development
UNDP	United Nations Development Programme

Abstract

The primary objective of this research is to examine the recent impressive economic growth and to analyze the policy options in Ethiopia with a view to contributing to the ongoing discourse on enhancing sustainable economic development. It identifies the main determinants of Gross Domestic Product (GDP) growth and analyzes the developmental policy that contributed economic growth. It is also emphasizing the role of Investment, Human Capital, and Trade Openness on GDP growth by using time series data that covered from 1981 to 2014. The data analysis was preformed through econometric testing with Augmented Dickey-Fuller Test to check the stability of time series data. Johansen Co-integration Test is employed to check whether GDP has empirically meaningful relationships with other variables. The Vector Error Correction Model and Granger causality test identify long-run equilibrium and short-run causality in GDP growth. The results of this research show that GDP growth has long-run relationship with independent variables and short-run causality with Export, Import, and Employment except Gross Fixed Capital Formation, and Labor productivity growth.

Furthermore, this research is an attempt to measure the relationships among economic growth, innovation and human development in Ethiopia, by comparing with Sub-Saharan Africa and East Asian. Most developing countries in Africa show sustainable economic growth, exceptionally Ethiopia has registered double digit economic growth in the last decade. The growth figure is much higher than the average Sub Saharan African countries. Thus, Ethiopia has been emerging as a key player in Africa. To consider the associated factors in its outstanding growth, we use empirical data analysis and extended theories, using a quantitative approach on the data of macroeconomic and innovation indicators and human development indicators for the period of 1960 to 2015. We use time series and cross country regression with descriptive analysis while employing panel regression and OLS regression model to determine the core engine behind the sustainable double digit economic growth in the last decade. The result of this research reveals that innovation has insignificant relationships with economic growth.

Keywords: Economic Growth, Human Capital, Innovation, VECM, and Income Inequality.

Chapter One

Introduction

1.1 General Background

Ethiopia's political and economic history was passed through conflicts, instability, and civil war (Geda & Degefe, 2002; Geda & Berhanu, 2000; Markakis, 1989). The socio-economics factors brought the multiple regime changes for political and economic reforms. Our focus is on the three periods of historical and economic outlooks. The Imperial period (1889-1973) was the starting point for the implementation of liberal economic policies in Modern Ethiopia (Abyssinia). The second period starts from 1974 to 1991, the Derg Regime period that embraced Marxism-Leninism ideology and followed command economic policies. This period was the lost decades or the dark ages of Ethiopia due to civil unrest. Finally, from 1991 to present, Ethiopian People`s Revolutionary Democracy Front (EPRDF). This period is the renaissance of Ethiopia or the new beginning of Ethiopia.

In 1990s, Ethiopia implemented a new development policy to bring the paradigm shift from preceded policies. Among the notable policy shifts, the government introduced developmental state policy that was emulated from East

Asian countries (Briscoe, 2008). This was supported by Noman and Stiglitz (2008) "resource-poor, landlocked Ethiopia was attempting to emulate East Asia with some success". The late Prime Minister of Ethiopia Meles Zenawi strongly argued in his thesis of "African Development: Dead Ends and New Beginnings", African development needs a paradigm shift from neo-liberal paradigm of development, which is a dead end and incapable of bring a change in Africa. He strongly favored "democratic developmental state" that encourage the role of government intervention in economy and prioritization of rural development (Stiglitz, 2002; Ohno, 2011).

This development model has contributed for economic growth in Ethiopia. The other East Asian countries have shown an enormous growth in the past decades (Cohen & Chiu, 2013; World Bank, 1993; Zenawi, 2006). Likewise, the growth of Ethiopia was also significant in the similar period. However, one cannot conclude that the growth trajectory and the development model of Ethiopia is the replication of East Asian model. This phenomenon entices us to explore the determinants of East Asian economic growth and the characteristics of the growth model with special reference to the economic growth of Ethiopia.

In addition, the export-led industrialization policy of Ethiopia has similar characteristics of other East Asian countries. The classical economic theories supported that the international trade has a significant role in economic growth as it creates competitiveness through specialization. (Jung & Marshall, 1985; Siddiqui, Zehra, Majeed & Butt, 2008). Thus, Ethiopia adopted export led growth strategy to increase competitiveness, and productivity. As a result, Ethiopia's export has increased at the same time diversified to non-traditional export goods (Alemu, 2010). Export values were dominated by primary goods, like coffees, flowers and oilseeds with 90 percent of export shares, still manufacturing sectors are uncompetitive and occupied about 8% of export values in 2016 (The World Factbook, 2017; World Bank, 2017). In general, Ethiopia export to GDP ratio is less than 10 percent in 2016, whereas during the same period East Asian countries have the highest export to GDP ratio such as Singapore (172 percent) and Korea (42 percent). Even the performance of Ethiopia is much lesser than Sub Saharan African countries. Despite implementation of export oriented development strategy, the export sector performance in Ethiopia is very poor.

After 1960s, most of developing countries got their independence and used to have the same level of GDP per capita income. After a few decades, the inequality between countries had gradually widened. Some of the African countries that had the same GDP per capita income with Asian countries, in 1965 GDP per capita income of Ghana was US$263, Sierra Leone was US$151, whereas GDP per capita of China was US$97, India was US$ 121 and Indonesia was US$55 (Bangura, 2014; WDI, 2014). These Asian countries had out performed Africans` in terms of economic growth, human development, and innovation performance. Asian countries had effectively managed to establish stable political systems and macroeconomic policies. Przeworski, Limongi & Giner (1995), and Tiruneh (2006) argued that the economic growth depends on political regime of the country whether authoritarian or democratic. The democratic countries have better policies that protects property rights, and attract foreign direct investment. Thus, they benefit from capital inflow and technology spillover. Contrary to their argument, some authoritarian country like China has been achieving sustainable economic growth, because it had been implementing pro-growth economic policies while holding democracy off agenda (Ali, 2007; Zhuang, 2008). As a result, GDP per capita income of China raised from US$97 in 1965 to US$8123 by 2016 (WDI, 2017). Therefore, pro-poor growth policies play key role to increase a wealth of nations, improve human development and enhance innovation (Barro, 2002; Besley & Cord, 2007; AfDB, 2014; Dorward, Fan, Kydd, Lofgren, Morrison, Poulton & Urey, 2004; Eastwood & Lipton, 2002; IMF, 2014).

Likewise, in 1990s Ethiopia was inspired by IMF and World Bank Structural Adjustment Program. Since then, the political systems and economic policies had started to change radically. The government has introduced pro-poor development policies, which was different than previous regime. The new economic policies emphasized on poverty alleviations rather than militarization policy. The resource allocation policies shifted from militarization strategy to pro-growth strategy to increase infrastructure development (Geda & Berhanu, 2000; Henze, 1989). Moreover, Ethiopia introduced liberal economic policies to encourage private enterprises and to attract foreign direct investment. Accordingly, Ethiopia is becoming the investment destination, it has registered impressive economic growth and it becomes one of the fastest growing economies in Africa.

As a consequence, Ethiopia achieved macroeconomic structural transformation that contributed for sustainable economic growth and improved the living standard of a nation (AEO, 2014). Figure 1-1 indicates, Ethiopia attained double digit economic growth for the last ten years. The GDP growth increased by more than 1000% from US$6.8 Billion in 1994 to US$72.3 Billion in 2016. The economic growth has significant impact on human development and boosted GDP per capita income from US$127 in 1994 to US$706 in 2016 (WDI, 2017).

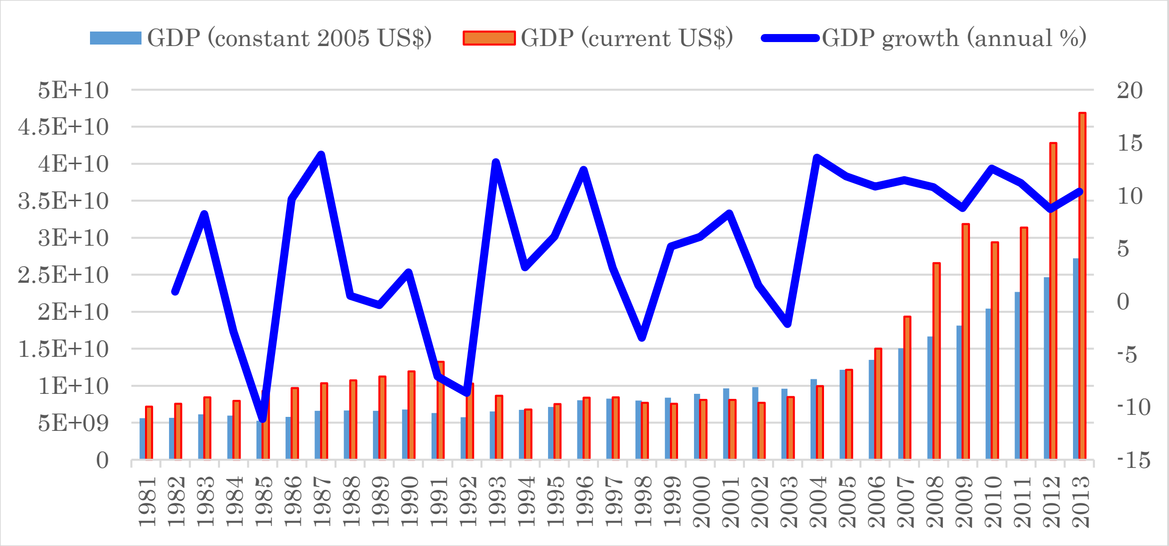


Figure 1-1. The GDP growth trend. (Source: author`s compilation of World Bank Development Indicators (WDI)

Interestingly, the last ten years, Ethiopia has achieved outstanding macroeconomic performance. Therefore, this research employed broad-based analysis to figure out the relationships of innovation, human development and economic growth. While analyzing the correlation of innovation indicators with regarding to macroeconomic indicators, particularly focuses on the correlation between GDP per capita income and economic growth. Because, innovation in general and technology innovation in particular drives economic growth. According to Walter (1972), economic development requires many processes that integrate physical capital, human capital and technology innovations. Hence Science, Technology and Innovation provide a platform to measure the ability of a nation to achieve sustainable economic growth in the long run. Ethiopia has been applying structural transformation policy by leveraging the current rapid economic growth, which heavily depends on agricultural output, it contributed about 37.2% of GPD and observed more than 80% of labor force (WDI, 2017). It is worthwhile to point out that an economy has determined on labor intensive product rather than knowledge based economy. The transformation process from agricultural based economy towards industrialization is inevitable and it requires a technology innovation. This allows transition from a subsistence farming economy to knowledge-based economy. Therefore, innovation has a significant contribution to bring the structural transformation and sustainable economic growth (Fagerberg, Srholec & Knell, 2007; Freeman 1995; Parto, Ciarli & Arora 2006; Metcalfe & Ramlogan 2008). Several empirical evidences show that the countries with effective national innovation system are competitive than others, since innovation is the engine for economic growth (Fagerberg, Srholec & Knell 2007; Freeman 1995; Parto, Ciarli & Arora 2006; Metcalfe & Ramlogan, 2008). According to World Economic Forum, Global competitiveness report (2017) that the innovation ecosystem plays great role to bring a change in society and economy.

1.2 Historical Background of Ethiopia's Development

The historical background of Ethiopia provides the insight of Ethiopian economic progress and the development policies in three different administrative periods. Our focus is mainly on the current period of economic outlooks. According to Geda and Berhanu (2000); Geda and Degefe (2002); Markakis (1989) who described that Ethiopian political history was full of conflict, instability, and civil war. These problems had led to multiple regime change that brought the change in political systems and economic policies.

1.2.1 The Imperial Period (1930-1974)

The Imperial period of Ethiopia traced back to thousands years of history. During these periods Ethiopia had used to be ruled by different kings, they had claimed themselves as the descent of King Solomon of Israel and the Queen of Sheba. The emperor of Ethiopia addressed themselves as "Conquering Lion of the Tribe Judah, Elect of God Emperor of Ethiopia, King of King" (Walter, 1972, p.50). Ethiopia had passed through golden age period and also Ethiopia had one of the oldest civilizations in Africa (Houston & Brooks-Bertram, 2007). Nevertheless, our review starts from the end of 19th century when a modernization of Ethiopia had begun during Menelik II era.

After 1884, the scramble for Africa had started in Berlin conference, Europeans had agreed to divide and to colonize Africa. During this period Menelik II became King of King. Italian had interested on Ethiopia to colonize and extract natural resources. Like their other European counterparts, Italian had tried to impose unfair diplomatic treaty with Ethiopia. According to Pankhurst (1963b) article 17 of the "Wuchale Treaty" had created confusion between Italy and Ethiopia. The interpretation of the treaty had two different versions. The Italian version of this article enforced Ethiopia to execute all kinds of international relations through Italy. Whereas, the Amharic version (Ethiopian language) of the treaty did not violate Ethiopia sovereignty right to contact and deal with foreign powers. Such an aggressive act had never been tolerated by Ethiopian. In 1893, they void the treaty. Thus, Italia declared war and tried to colonize Ethiopia but Italian was bitterly defeated and humiliated at "Adwa War" in 1896 (Habtu, 2005; Pankhurst, 1963b). Ethiopia was the only African country that resisted western aggressions and enjoyed their freedom. This legacy creates the pride among Africans and they had considered Ethiopia as a symbol of freedom.

Since Berlin conference, Europeans aggressively had expanded into Africa to grab natural resources and to exploit cheap labor force. All African countries were the victim of colonization. However, unlike other African nations, Ethiopia was tried to benefit from technological innovations and investment from Europeans while keeping their independence in tact (Habtu, 2005; Pankhurst, 1968). Menelik II had strong ambitions of modernizing the country. He started to open the door to foreign investment and technology transfer. After Ethiopia defeated Italy most European country had indicated interest in Ethiopia and they had signed an agreement to invest in Ethiopia such as, British, France, Russia, Swiss, Greek and USA. (Pankhurst, 1968). Russia was the first country that invested in hospitals, French built Ethio-Djibouti railway that runs from red-sea cost of Djibouti to Addis Ababa, the capital city of Ethiopia. Western companies engaged for telephone and telegraph system expansion. Postal service was started. Furthermore, multidimensional investment had begun. During this period tobacco monopoly and liquor monopoly companies were established and they started to operate their businesses. French engagement increased beyond transportation and invested in flour mills, and soap factory (Garretson, 2000, p. 145-51). Not limited to those physical investments, the first modern bank was established, it was named Bank of Abyssinia. At the same time, Menelik II School was established to provide modern education (Pankhurst, 1968).

Menelik II introduced the first Modern administration system and established ministers of cabinet. After Menelik II passed away, his successor as well as his grandson, Lij Iyasu took over the power and became king of kings. Lij Iyasu followed the legacy of his grandfather. He gave priority to modernize Ethiopia and also Mr. Heagadras Oayla Giyogis was appointed as the first Prime Minister of Ethiopia (Pankhurst, 1968). Iyasu had continued to accomplish railway and other projects that had been started during his grandfather period. In additions, he had started several new projects. Including, hydroelectric power generation project launched with British companies. Banking and printing enterprise were established. Thus, the printing technology helped Iyasu to issue bank note. This had paved the way to attract foreign banks, especially French banks opened branches in Ethiopia along with their railroad projects.

According to Pankhurst (1968), Iyasu had tried to establish good governance by introducing modern municipality management system. In 1908, Ethiopia and France had signed a treaty to ease the regulation of foreign residence. This helped foreign nationality to change their status of residence easily, the treaty had implied for all Europeans. As a consequence, the investment opportunity opened to foreign investors and doing business became easy. The foreign immigrant inflow to Ethiopia increased, especially Armenian and Greek corporation investment to Ethiopia had increased. They had engaged in import export business as well as bakery. Other foreigner enterprises also started to invest and expand their businesses in Ethiopia. Such as German and Austria corporations. During this period the main business activities were dominated by agricultural products, such as coffee, wax and cereals. Furthermore, industrial and service sectors investment had expanded, some of well-known corporations were the German pharmacy and Georgian pharmacy who started to operate in Ethiopia. The modern education system got attention of ruling classes, as a result the first foreign school Alliance Francoise was opened in capital cities of Addis Ababa (Geda & Degefe, 2002).

The modernization had got attention again during The Imperial Regime of HAILE SELASSIE (1930-1974) who was the last Emperor of Ethiopia. He had drafted the first constitution of the country mainly based on French civil code. He gave priority for modern education. At the same time he had continued to invest in the infrastructure development that had been started before. Furthermore, he introduced market based economic policies to encourage investment and also to attract foreign direct investment (FDI). Especially, the Emperor Haile Selassie had developed noble foreign policy that established good relationship with all African countries. As the consequence, Ethiopia had been selected as the head quarter of African Union that was established in capital city of Ethiopia. According to foreign ministry of Ethiopia, Addis Ababa became diplomatic capital of Africa because the third highest numbers of embassies were located, and also third largest diplomatic center after New York and Brussels. Moreover, Addis Ababa became the third largest United Nations duty station after New York and Geneva (UN News Service Section, 2014).

During the last Imperial regime, Ethiopia had implemented western model of economic policies and introduced market oriented economic policy that encouraged private investment and attracted foreign investment. Ethiopia drafted export promotion policy in 1950. This policy provided tax incentive for exporters and attracted FDI. In addition to that, import substitution police introduced in 1960 in order to transfer agricultural based economy to industrial based economy. This policy had contributed for macroeconomic structural transformations. The industrialization policy had worked well, as a result from 1950 to 1974 the industry sectors GDP grew by 7% on average and share of GDP was also increased to 9.4% per annum (Rashid, Assefa & Ayele, 2009). However, the land ownership had been central issue in the country since the state and churches controlled the majority of land (Zewde, 2002).

The land tenure system is the foundation of the Ethiopian society and the fundamental cause of its underdevelopment. Historically, the basis of this system is the result of the allocation of lands to supporters. Through a passage of time, the system has become the foundation of the crown and its supporters. In many traditional societies with authoritarian political structures, the traditional elites who serve under the central ruler hold land as the basis of economic and political power. In such systems, they hold power in society because they are allowed to control the land and use it to facilitate economic advantage, increased social status and authority over others (Cohen, 1973, pp. 380). In 1960, these created tension and upraised among elites under the slogan of "land for the tiller" (Geda & Degefe, 2002). It was one of the main causes for the downfall of the regime (Clapham, 1988). Despite political instability the Imperial region registered fair economic growth with the average growth rate was 3.7% from 1960 to 1974 (Rashid et al., 2009).

1.2.2 The Derg Regime period (1974 to 1991)

The Derg regime period started from 1974 to 1991, this period was the lost decades or the dark age of Ethiopia that left bitter memory among most Ethiopian. The Derg regime was the military junta who came to power by toppling Haile Selassie I, the last emperor of Ethiopia in 1974. It was the last moment for monarchy system in Ethiopian history to be abolished for once and for all. The dreg had changed radically the political system and economic policies. He turned his face 180 degree form market oriented economy toward centrally planned command economy (Rashid et al., 2009). The regime`s main goal was to build a socialist state and strong military by adopting socialist policies from Union of Soviet Socialist Republics (USSR) (Geda & Berhanu, 2000).

The main reason behind the uprising against the Imperial regime was the feudal system that had created income inequality. Particularly, the land policy had impoverished the farmers (Cohen, 1973). The majority of lands were controlled by states, military and churches (Geda & Berhanu, 2000). The farmers had used to work for the feudal landlord that had exploited the peasants (Rashid et al., 2009). The land reform policy of the Derg regime abolished the feudal system and nationalizing urban and rural lands as well as some church properties (Rashid et al., 2009; Berhanu & White, 2000). The pro-poor policy had played vital role through securing property right for citizens. Accordingly, the farmers/tenants got land freely under the slogan of "Land to Tenures" in new land policy (Geda & Berhanu, 2000; Rashid et al., 2009).

According to Zewde (2000) these nationalization policies had headed to monopolization of agricultural market and put quota on farmers. Private enterprises had lost their property as well as they were enforced to limit their capacity of investment in extensive farming. At the same time, the regime established state owned enterprises to control the agricultural output and prices, the nationalization policies extended beyond land. They nationalized private properties such real state buildings and extra house. Not limited to those, they further nationalize all private enterprise companies, manufacturing and financial firm (Geda & Berhanu, 2000).

During this period, there were policies and ideology difference among the regime and between educated elites. Both group used to have common goals to overthrow the Imperial regime but they had differed in policies implementation. There difference created turmoil in the country as well as inside the inner circle of the regime. (Young, 1998) the uprising of university students movement started throughout the country. As a consequence thousands of young generations were killed under “Red Terror” from 1976 to 1979. According to Berhanu & White (2000, pp.92), “the Derg conducted a brutal campaign of killing, detention, and torture. The targets were urban-based opponents, which included groups that formerly supported the regime, young people, and those who have some education." Finally, the Derg had failed to control the uprising. The student movements turned out to a guerrilla warfare for next seventeen years.

The regime’s policy had shifted dramatically from pro-poor policy to militarization. The military expenditure had increased up to 33 percent from13 percent of expenditure during the Imperial period (Geda & Berhanu, 2000). The Derg regime could established strong military in Africa. Thus, they had managed to eliminate most of opposition group except Tigrayan People`s Liberation Front (TPLF) and Ethiopian People`s Liberation Front (EPLF), both groups are the Current coalition ruling group of EPRDF, finally they overthrew the Derg regime and took power after seventeen years civil war (Geda & Berhanu, 2000).

Therefore, Ethiopian economy had been affected due to two decades of instability and civil war. Ethiopia productivity decreased in all sectors, and negative GDP growth registered for several years. Based on Geda & Berhanu (2000) the government policy ignored the economic development and gave high priority to militarization than pro-poor sectors, like education, health and food security. As a result most catastrophic famine erupted and killed about million citizens in 1984 (Rashid et al., 2009; Berhanu & White, 2000). The regime left the darkest history in Ethiopia. In 1988, the gross national product (GDP) grew by 12.86 percent to the highest level while in 1985 it was at the lowest recorded -11.14. Generally, Ethiopian economic growth rate affected due to conflict and civil war.

1.2.3 The EPRDF (Current) Period, the New Beginning of Ethiopia

Since 1991, Ethiopian People`s Revolutionary Democracy Front (EPRDF), the current ruling party of Federal Democratic Republic of Ethiopia (FDRE) controlled the political power. This period is called the Renaissance of Ethiopia or the New Beginning of Ethiopia. EPRDF regime had started to introduce a completely new political system and new economic policies based on free market economy. EPRDF along with others political parties established transitional government and rectified it as an interim constitution that was implemented during the transitional government. Ethiopian constitution was drafted based on federalism (Habtu, 2005; Young, 1998).

The current regime of Ethiopia has implementing different political systems than the previous two regimes. The Transitional Government formed the first ethnic-based federal state (Young, 1998). The ruling party strongly believed that multi-ethnic federalism could bring equality and stability in the country while maintaining the unity in diversity. At the same time, the constitution granted decentralization of power and self-determination (Habtu, 2005). The implementation of federalism had faced challenge at early stage. Some opposition parties and some educated elite groups had boycotted Transitional Government, among the oppositions; the Oromo Liberation Front (OLF) claimed that EPRDF system cannot guarantee the Oromo Ethnic group self-determination right. Whereas, some intellectual group argued that ethnic based federal system could be the cause for conflict among different ethnics group and disintegrate the unity of Ethiopia (Habtu, 2005; Young, 1998). In addition to ideological conflicts, the civil war was erupted during Transitional Government period, EPRDF systematically controlled the conflicts and avoided the civil war within short period before bringing big casualty (Habtu, 2005; Young, 1998). Since then, Ethiopia has been transforming into a new political system. In 1994 Transitional Government held general election and established Federal Democratic Republic of Ethiopia (FDRE). EPRDF political party won the election and elected late Prime Minister Meles Zenawi was the head of the state. The general election are held every five years.

According to Habtu (2005) the late Prime Minister Meles Zenawi was the architect of federalism, he strongly argued the importance of the Article 39, “Rights of Nations, Nationalities and Peoples”. He was not focusing only in political aspect of the right and equality of the nations, but he stressed the importance of economic development. The new beginning of Ethiopia has just been starting to bring stability and structural transformation through economic growth. EPRDF economic policies dedicated to pro-growth policies. They gave priority to eradicate poverty more than anything else. Therefore, based on the strong believe they had, Ethiopia established pro-growth policies that invest heavily, in education, health, agricultural innovation (to ensure food security) and infrastructure development (De Waal, 2013; Evans & Ghelani, 2011).

Ethiopia clearly identified the core problem of a country and prioritized the problems. De Waal (2013) argued that under strong leadership and commitment that implement pro-growth policies, Ethiopia could left out millions of criticizes from poverty and ensured food security. After a few years, Ethiopia managed to increase agricultural productivity and became self-sufficient in food. Accordingly agricultural productivity of Ethiopia has increased by fivefold from 50 million quintals to 250 million quintals within two decades (Ethiopian News, Politics, Video and Opinions, 2014). During EPRDF period, Ethiopia achieved double digit economic growth and the poverty headcount ratio has been declining from 45.5 percent in 1995 to 29.6 percent in 2011. It has been outperforming it neighboring country Kenya, in terms of economic growth and reducing poverty head count ration (World Bank database, 2012; UNDP, 2014).

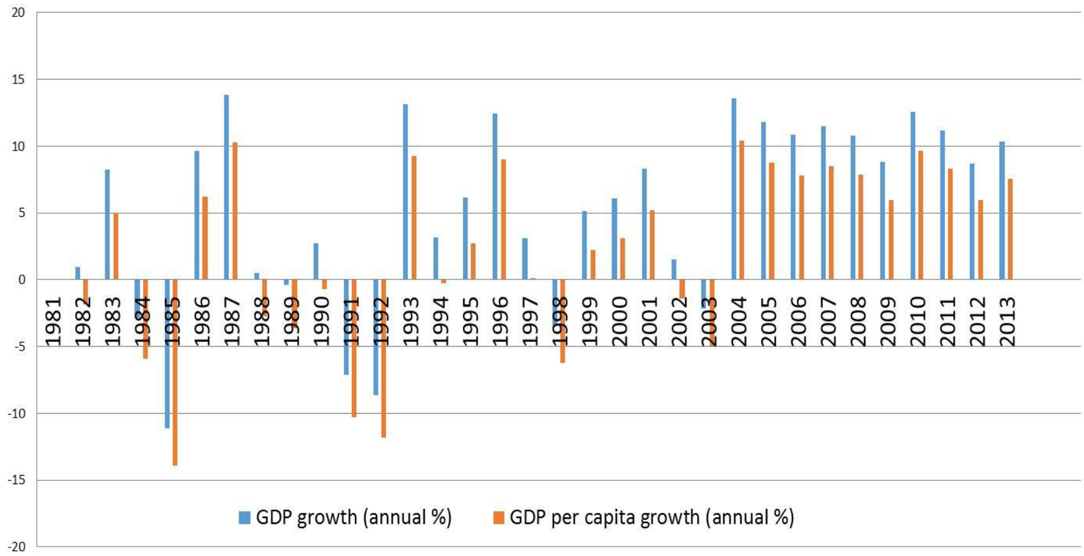


Figure 1-2. The GDP and GDP per capita income growth trend. (Source: author`s compilation of World Bank Development indicator)

1.3 Statement of Research Problem

Over the last 12 years, the Ethiopian economy has been grown with double digit growth rate. The average growth rate surpassed china, and Ethiopia became the fastest growing economy in world. Macroeconomic performance is above average of Sub Saharan African countries. Ethiopia is on transformation period from an agricultural based economy to industrialization. This transformation requires a national innovation system, in order to allow transition from a subsistence farming economy to a knowledge-based economy. However, innovation performance is insignificant and lagged behind other low income countries that is contrary to neoclassical growth theory. This is a fundamental challenge for science, technology, and innovation in developing countries, particularly to Ethiopia.

Despite the fact that Ethiopia has registered sustainable economic growth in the last decade, it is one of the poorest countries that lined-up among the lowest per capita income countries. According to Human Development Report (2015) of United Nations Development Program (UNDP), Ethiopia has been improving in terms of human development index by 44 percent without improving the rank (placed 174th out of 188 countries). Still the least performing country with poor records of human development. So, improving wellbeing is a core challenge to

Ethiopia, without alleviating poverty, the inclusive growth cannot be achieved.

1.4 Objectives of the study

Primary objective of the study is to empirically analyze the factors that affect economic growth and evaluate the significance of national innovation system in economic growth and human development. Furthermore, this research empirically examines the correlation of innovation and economic growth through a comparative analysis of benchmark countries, like East Asia countries' (Japan, South Korea, and China) development policy and macroeconomic achievement. In additions, geographical proximity and macroeconomic similarity take into consideration to employ comparative analyses with Sub Saharan African economic and innovation performance with a view to guiding policymakers on national development. Existing studies on Ethiopian innovation and economic growth largely ignored multidimensional analysis of innovation, economic growth and human development. This study aims to fill the gap of literature and policy specifically focused on the following tasks:

1. This analysis is expected to find the factors that drive the double digit Economic Growth in Ethiopia.

2. To analyze a linkage between innovation, human capital, investment, and economic growth.
3. To investigate the causality connection between macro-indicators in order to propose some policy measures.
4. To find the proper channel through which an innovative policy be proposed in order to enhance the living standard of the people of Ethiopia.

1.5 Research questions and hypothesis

a. Questions

MAIN QUESTION

What is the role of investment, human capital, innovation, and trade openness in economic growth of Ethiopia?

SUB-QUESTIONS

I. What are the fundamental factors behind the economic growth with special reference to Ethiopia?

II. Does economic growth enhance the living standard of the citizens of Ethiopia?

III. Have government policy been effective in improving the welfare of the people in Ethiopia?

IV. Does innovation system in Ethiopia significantly enhance the Economic Growth and Human Development?

b. Hypothesis

I. Innovation, and human capital are the main determinants of the economic growth in Ethiopia**.**

II. The economic growth has positive impact on human capital.

III. The effective government policies towards long run growth can enhance the welfare of the Ethiopian citizen.

IV. Innovation system has positive influence on economic growth and human development in Ethiopia.

1.6 Significance of the study

This study is mainly focused on empirical investigation of the macro-indicators and their inter-connectivity with special emphasis on technology, and innovation system in Ethiopian economic growth. The study is unique in its applicability as well as the practical implication. Finding a right mix of macroeconomics, human capital, and innovation would be a new trend-setting in the existing body of knowledge especially in the context of least developed countries like Ethiopia. The study is not only unique in its nature but may be used to draft a proper strategic plan keeping the view of the findings of this study for the development of Ethiopia.

The methodology that undertakes a comprehensive analysis of the economic growth and its relationship with innovation and human development by employing econometric analysis of Panel regression, OLS regression and Pearson correlation that are hardly to come by in case of Ethiopia. The national policy makers could utilize the findings of this research to evaluate and improve the effectiveness of policies to build competitive nation. The significant value of findings will have great contribution to analyze and provide recommendation to policy makers on the road to guide them in policy making process.

1.7 Scope and Delimitation.

This research is limited in its scope to the Ethiopia's growth determinants only and the empirical analysis of some of the neighboring countries was conducted to introspect the reference point or the measurement scales. Also, a majority of the countries in African continent have significant characteristic differences such as resources, culture, and political powers etc. The inclusion of empirical analysis of other neighboring countries was intentionally left unattended for the future researchers because the existing constraints of this research did not allow the researcher to get more in-depth research. The constraints such as the non-availability of data, time limitation, inaccessibility of on-field data collection facilities etc.

Moreover, it is quite valid that adding other countries in the VECM analysis might increase the significance of this study but it is intentionally left unattended in order to avoid the omitting variable bias in econometric analysis of Vector Error Correction Model that usually observed when we add additional variables in our econometric modelling. Also, I kept the model precise in order to avoid possible problems of Heteroscedasticity and Perfect Multicollinearity.

1.8 The structure of study

This study is consists seven chapters. Chapter One presents the perspectives of Ethiopian macroeconomic background, reviews the political history and socio-economic prospect of Ethiopia, and discusses the problems of study and the significant of study. Chapter Two discusses general economic development theories, empirical and theoretical literature review on economic growth, innovation, and human development. Chapter Three discusses the research methodology and the definition of innovation and human development. Chapter Four investigates the determinants of economic growth. Chapter Five evaluates the prospect of development policy and the adaptability of East Asian growth model in Ethiopia. Chapter Six provides a brief review of the existence empirical study and evaluates the dynamic relationship between economic growth, innovation and human development through comparative analysis of East Asian and African Countries. Chapter seven presents the empirical findings while sets forth its conclusions.

Chapter Two

Empirical and Theoretical Literature Review on Economic growth, Innovation, and Human Development

2.1 The Empirical Review on Economic Growth Theories

Economic Growth has been defined in frameworks since eighteen century. The classical economists have been considering as the first modern economic thought about dynamic economic growth that linked growth theory to income distribution (Salvadori and Panico, 2006). Adam Smith considered as the father of classical economics. Adam Smith in his book "The Wealth of Nations", introduced the concept of labor productivity through division of labor and the importance of accumulation of capital (Osipian, 2009; Thirlwall, 2006; Zhang, 2005). "Smith maintained that the key to the growth of labor productivity is the division of labor, which in turn depends on the extent of the market and thus upon capital accumulation." (Salvadori & Panico, 2006, pp. 7).

The economic growth is a measurable change that increase the economic growth in different periods of time. It is a process that increase the welfare of the nations (Osipian, 2009). According to the World Bank, the economic growth is the increase of national wealth that conventionally quantifiable in the percentage increase in gross domestic product (GDP) or gross national product (GNP). Economic growth enhances its potential for reducing poverty and solving other social problems. Economic development is the process of change that brings economic and social transformation (Thirlwall, 2006). Economic development requires many processes that integrate physical capital, human capital and technological innovations (Walter, 1972). Having clear national innovation system essential to create linkage among different actors and bring sustainable economic development while creating competitive advantage. According to OECD, National innovation systems play vital role to enhance innovation through linking the flow of technology and information among institutions and enterprises. It is the complex relationship that link technological development of different actors, such as universities, government research institutes with enterprises (Leydesdorff, 2009). Most economists argue that there are positive correlations between national innovation system and economic growth (Parto, Ciarli & Arora, 2006; Freeman, 1995).

Another well-known classical economists of eighteen and nineteen centuries who theorized economic growth, such as Thomas Malthus, David Ricardo, and Karl Marx. Malthus focused on problem of population growth and the relationship with agricultural output (Zhang, 2005). He argued that the growth of population multiplies geometrically and agricultural output growth in arithmetical ratios. The population growth eventually surpasses the supply of food (Thirlwall, 2006). Neoclassical theory has been getting popularity in modern age economists. Neoclassical theory clearly defined the factors behind the economic growth are accumulation of capital, labor force and technology. This theory made up of three assumptions of rational preference, maximize utility and maximize profit as well as people act independently. Economic growth was recognized as the accumulation of human and physical capital, and increased productivity arising from technological innovation (Lucas, 1998).

This research mainly focuses on endogenous growth theory and Solow`s growth theory. To some extent, we address Keynesian theory and Neo-Keynesian theory, since those school of thought contrasted with previous classical and neoclassical theory. Their difference laid on the role of government on economy, which only focus on private participation on economic development at the same time discourage the role of government involvement on economic development (Hazlitt, 1965). However, after American Great Depression 1935, John Maynard Keynes came up with Noble idea to solve the economic crises. Keynesian theory exhibits that the country depends only on private sectors monetary decisions led them towards inefficient macroeconomic outputs. Therefore, the role of government interference on the economy is essential for economic development (Stiglitz, 2006). According to Keynes book of general theory of employment, interest and money,

> For my own part I am now somewhat skeptical of the success of a merely monetary policy directed towards influencing the rate of interest. I expect to see the State, which is in a position to calculate the marginal efficiency of capital-goods on long views and on the basis of the general social advantage, taking an ever greater responsibility for directly organizing investment (2016, p.147).

Public sectors should response actively to boost economic growth, especially government body should play an active role in controlling monetary policy. To some extent, Keynes strongly advocated the importance of government intervention during recession while private sectors play predominantly role in macroeconomic output and increasing economic growth. This argument supported that developmental state growth model of Ethiopia and East Asian countries.

Furthermore, Harrod-Domar model had developed dynamic extension of Keynes's static equilibrium model. Horrod`s model assumes that capital is the only factor for production functions, but not labor. Contrary to neoclassical theory labor and capital are not substitutable in production functions. This model stressed that economic growth rate is proportional to saving rate (Thirlwall, 2006). Another well know neoclassical economic growth theory based on Robert Solow in 1956 and Tom Swan in 1956 model. Their model was the extension of Harrod-Domar model. In Solow`s growth model, the labor and capital are substitute each other, which is different perspective than the Harrod-Domar model (Zhang, 2005). Endogenous growth theory emphasizes investment in human capital, innovation and knowledge have significant contributors to economic growth. It mainly underlines R&D and innovation activities as determinants of growth. According McCallum (1996), neoclassical mode fail to explain steady-state growth. In additions, Barro (1996) supported the same argument that endogenous growth theory attempts to fill the fundamental missing element of neoclassical model of long–run growth.

The neoclassical growth theory stresses on human capital and technological progress as main factors of economic growth. Human capital is the driving force of economic growth. Education is one of the elements of human capital, which is the engine of growth (Barro, 2002). Economic growth recognized as the accumulation of human and physical capital, and increased productivity arising from technological innovation (Lucas, 1998). This argument has been supported by the World Bank study on the “East Asian Miracle” and public policy in 1993, emphasizes the importance of government policies that stabilize macroeconomic management. East Asian countries had invested on human development to expand broad base education systems of primary and secondary education (World Bank, 1993). Basic education had provided skilled labor for the growing economy, which had been the ingredient for rapid economic growth. In conclusion, basic education had significant contribution to East Asian Miracle rather than higher education. The initial level of education has heterogeneous effects on all countries regardless of the income level of the countries (Krueger & Lindahl, 2001; Durlauf & Johnson, 1995).

Contrary to above findings, Pretchett (2001) examined economic growth rates based on cross-national data and presented that the education has different impact on different countries. Pretchett further provided three reasons, education has negative impact on growth. The first explanation was schooling contributes mainly for private wage increment rather than increasing productivity or intellectual skills. The second explanation was the inadequate innovations create sluggish demand for educated labor, as a result, the rate of return to education decline dramatically. Third explanation was stressed the possibility of raising productivity by means of educated labor, because the demand for more productive and educated labor come from individually benefit rather than contributing to social capita.

However, most literatures and endogenous growth theory had given complementary theoretical support for human capita as the engine of growth (Aghion & Howitt, 1992). Barro (2002) also described human capital as the engine of growth through innovation. Human capital is a driving force of economic growth, and education is one of the elements of human capital, which is the engine of growth. Benhabib and Spiegel (1994) supported this argument, as education is a factor for technological progress to adapt and transfer the new processes. Furthermore, Nelson and Phelps (1966) while emphasizing the relationship between the level of education and growth, argued that a more educated labor force would adopt new technologies faster. Solow growth theory also stress on the importance of physical capital that defined clearly the factors behind economic growth such as accumulation of capital, labor force and technology (Lucas, 1998). Economic growth was recognized as the accumulation of human and physical capital, and increased productivity arising from technological innovation.

2.2 Empirical Review on Human Development

Human development is the way to improve social strata. According to Nobel laureate Amartya Sen described Human development as the transformation of the nations to high level of living standard rather than the size of the advancement of country's economy. Several theoretical and empirical evidences show a positive relationship of economic growth and human development (Hafner & Mayer-Foulkes, 2013; Hanushek, 2013). The cross-country regression findings of Ranis, Stewart & Ramirez (2000) concluded that human development and economic growth have bidirectional significant relationships.

Thus, human development has broad insight beyond the GDP per capita income, it is about improving wellbeing of a nations and increasing opportunities and enlarging freedom of people (UNDP, 2016). Empowering people is not an end but a means to bring social changes and improve welfare of a nations. In addition, economic growth is the way of improving human development index (Osipian, 2009). Theoretical and empirical evidence supported that economic growth has direct impact on human development. The main objective of economic development is to bring a change in the life of the nation by increasing material well-being as well as creating life satisfaction (Thirlwall, 2009). Therefore, economic growth is a means to increase the wealth of the nation and reduce the gap of the income inequality (UNDP, 2016). Economic growth and Economic development have been used interchangeably. According to study of Shearer who underlines the difference between the two terms as follow:

> Economic growth refer to an increase in output goods and services, and economic development to imply a more general development, including personal and social values, a country might be growing economically but flailing to develop (or even maybe retrogressing) because other values were being lost (1961, p.449).

Human Development Index (HDI) is a measurement tool to economic development. The impact of economic growth on human development has measured by several factors. Human capital is one of the determinant of human development, which is the major engine for economic growth (Barro, 2002; Meier & Rauch, 2000; Nelson & Phelps, 1966). Education is a process to build human resource that contributes to better heath and long life. Education and life expectancy have significant relationship in both directions (Ranis et al., 2000). There are three main factors to measure human development. First life expectancy to measure the living status of nations, second education is the means to increase literacy ratio through enhancing enrollment ratio in primary, secondary, and tertiary education; third income level is major indicators to measure the wealthy of a nation based on GDP per capita in terms of Purchasing Power Parity (PPP).

2.3 Conceptual Background of Innovation Review

An innovation is a process that brings changes and creates value for organizations and society. It is a phenomenon that includes technological innovation, process innovation and product innovation. According to Organization for Economic Co-operation and Development (OECD), an innovation has a broad definition that address beyond technological innovation. Mortensen & Bloch (2005) say "an innovation is the implementation of a new or significantly improved product (good or service), or process, a new marketing method, or a new organizational method in business practices, workplace organization or external relations" (p.46). Nelson (1992) argued that an innovation is not necessarily radical improvement, nor new product/ practice to others or universe but it rather new practice to the firms, "the processes by which industries or organization master and get into practice product designs and manufacturing processes that are new to them whether or not they are new to the universe, or even to the nation" (p.3).

At the beginning of 20th century, Joseph Schumpeter has laid well-known theoretical foundation that defined innovation beyond technological prospect. Schumpeter illuminated innovation as central to bring the social change and economic development of a nation (Verspagen, 2005). Similarly, the growing theoretical and empirical evidence argued that innovation is a fundamental tool to accelerate economic growth and human development (Grossman & Helpman, 1993; Kuratko, 2005; Bhattacharya et al., 2017; Szabo, Soltes & Herman, 2013; Suh, 2010). An innovation is the result of a complex set of relationships among different institution in the system, which is a clearly defined process to create interaction among different actors (Parto, Ciarli & Arora, 2006; Freeman, 1995). The national innovation systems are the methods to establish innovation process and also to create diffusions of technology and information among society, institutions and enterprises (Mahajan, 1985, Mintrom, 1997; Negro, Alkemade & Hekkert, 2012; Nelson, 1993; Sundbo & Gallouj, 2000).

The empirical literatures show a positive relationship among national innovation system, economic growth and human development (Easterlin, 1974; UNDP, 2016). Thus, the countries with good national innovation system are competitive than others, since innovation is the engine for growth (Fagerberg, Srholec & Knell 2007; Freeman 1995; Parto, Ciarli & Arora 2006; Metcalfe & Ramlogan, 2008). To review in historical perspective of innovation system, the British had been leading industrial revolution, because they had created space for innovations. Policy makers and church in Britain had considered Newton and Adam Smith as a national hero. Whilst the Italians had acted differently, they charged and arrested Galileo for rising confronted thoughts against the church. As a result, British had increased competitiveness and productivity. In the middle of 19th century, the productivity of the British workers was twice higher than other European countries' workers (Freeman, 2002). National policy plays great role to transform a society and improve wellbeing of a nation (Martin & Johnston, 1999; Bhattacharya, al, pt. 2017; Nelson, 1993). A World Bank study on the East Asian miracle and public policy in 1993 emphasized the importance of government policies that stabilized macroeconomic management, and heavily invested on human capital to expand a broad base education system and to bring social changes.

The study concluded that good government policy is means to assure rapid economic growth.

Accordingly, innovation and industrialization policies of Asian countries have contributed to bring structural transformation from agricultural based economy toward industry based economy. These achievements were driven by government-led development policies that focused on technological innovation and industrialization. Asian countries, however, have different growth pattern and different level of technological capability to catch up the industrialized nations. For instance, Taiwan, and Korea have effective industrialization and innovation policies that contributed to the development of technological capability to local firms a head of Asian countries, except Japan (Amsden, 1989; Amsden and Chu, 2003). Other Asian high-performance economies followed their footsteps and introduced liberal economic policies. Interestingly, China’s growth policy sharply contrasts with the conventional growth model. After open door policy, China`s growth laid on command economy, at the same time, it has embraced globalization in greater extent than any of other countries did in early stage of economic growth (Boltho and Weber, 2009). Malaysia's liberal policies, and then after Thailand and Indonesia followed the same liberal economic policies. Hence, Asian could achieve sustainable economic growth due to trade liberalization, and implementing export-led industrialization (World Bank, 1993). This brought Foreign Direct Investment (FDI) and technology transfer to local firms through outsourcing and subcontracting. Moreover, local firms benefited from spillover of technology, human capital development and acquiring process technology (Lall and Narula 2006).

Empirical studies of Amsden (1992); Amsden and Chu (2003), Briscoe (2008); Stiglitz, (1999); and Zenawi, (2006) claimed that national innovations system and the role of government intervention in industrialization process have great contribution to support local firms and to attract foreign technology through investment, technology acquisition and licensing. However, there is no blueprint to be adapted globally. For instance, Asian countries had different approach of innovation systems. Such as, Korea and Taiwan implemented government-led innovation policies that established the linkage between research institution (R&D centers, and government institutions) and manufacturing sectors. Lall and Narula (2006) argued that whereas Malaysia, Indonesia, Thailand and China's manufacturing sectors are mainly depended on backward linkage for innovation (from suppliers and multinational corporations), and later China introduced new industrial policy that integrate industries with national innovation centers (Rasiah, Kong & Lin, 2010). In Korean and Taiwan local firms engaged in production and exports through acquiring foreign technology and licensing to catch up to multinational corporations; this innovation and industrialization model has lacked in Malaysia but it was replicated in China. Unlike other Asian countries, India's industrialization was driven by software innovation (Parthasarathy, 2010).

Asian countries' development policies and technological catch up strategies attracted the Diasporas. India, Taiwan, and Korea among the countries who effectively benefited from intellectuals who had exposure for high-tech industries and markets in developed countries, particularly in North America. The R&D center of Taiwan and Korea were supported by Diasporas. As a result, the learning curve and technical capability dramatically increased. Indian diaspora also played greater role in terms of changing business model from turnkey contract to R&D services. These Diasporas have created new markets by linking software industry to multinational corporations. (Ministry of Foreign Affairs, 2013) Ethiopia also realized the importance of diaspora to national development, and enacted a proclamation to attract diaspora, however still there are little progress compared to Asian countries.

Since 1960, industrialization of Asia was driven through learning imitation, and technology licensing to innovation (Bolton, 1993; Frost, 1997; Kale & Little, 2007). Japan is a pioneer Asian country that had achieved high growth through learning to industrialization, evolution of R&D and technological capability to innovation. Likewise, Taiwan and Korea (Mowery & Oxley, 1995) had successfully emulated similar catch-up strategy and implemented Science and Technology Policy to boost technology transfer through technology licensing and acquisition of foreign firms. Rasiah, Kong & Lin (2010) argued that Taiwan and Korea established high-tech science parks, R&D laboratories, and packaging and testing centers. Subsequently, they built high capacity of technology absorption and boosted technological capability. Notably, the cases of Sony (Japan) and Samsung (Korea) were widely discussed by scholars. The innovative capabilities of Korean firm Samsung turned-out from follower to competitor (Hobday, 1998; Joo & Lee, 2010). As the result, after 1980 Taiwan and Korea firms shifted labor intensive industry to Southeast Asia and China to focus on high-end value added products development (Ernst, Ganiatsos, & Mytelka, 1998; Mathews & Cho; 2000).

Unlike Taiwan and Korea, the industrialization of China and Malaysia were driven by foreign corporations` FDI (Rasiah et al., 2010). After government of China enacted national science and technology plan to develop Science Park that provided high-tech infrastructure and public R&D laboratories; China successfully linked between research institution, universities and firms (Pingfang & Weimin, 2003; Micic, 2009). This contributes to change labor incentive industry toward value add products. By the same token, Malaysia also introduced national innovation system to support local firms and to catch up in the technology ladder (Sundaram, 2007). The government identified the importance of the sectors and had introduced different economic policies at different times that had attracted multinational corporations (Ali, 1993; Jomo, 2013). To distinguish, the export-led industrialization policy was not only encouraged export-oriented manufacturing industries, but also provided incentives and guarantee to knowledge intensive investment and R&D centers. As the consequence, several multinational corporations had started to operate R&D activities in Malaysia (Jomo, 2013; Lall, 1995). This created technological capability to local firms and built-up human capital and increase productivity.

East Asian countries were a head of India by implementing industrial policy and attracting high-tech industries. The globalization of semiconductor industry bypassed India, while East Asian benefited the most. Heeks (1996) and

Parthasarathy (2010) strongly argued that India liberalized their economic policies later than East Asian countries. As a latecomer, they effectively identified the strength, and weakness in global stage; and they positioning themselves as software-led industrialization than hardware-led industrialization unlike Korea and Taiwan (Lakha, 1990). The Indian computer software revolution that became core engine to bring industrialization. The government of India endorsed two software industries policies to support industry to and create core competence; such as Computer Policy of November 1986 and Computer Software Export, Development and Training of December 1986.The two policies recognized software as an industry and provided incentives to local firms in order to become a key player and the leading software exporter globally (Arora & Gambardella, 2005; Patibandla & Petersen, 2002). To attain software-led industrialization, India invested on human capital by increasing number of graduate software engineers and provided incentive for entrepreneur who returned home with practical experience in the global arena (Chaminade & Vang, 2008). Not limited to these, the government introduced a National e-Government plan to create demand for information technology to drive innovation at the "bottom-of-the-pyramid". This created momentum to the Indian software industry to expand business scope from demand derived deployment of foreign companies as offshore development cent toward addressing local needs (Parthasarathy, 2004). This increased technological capability and also increased their design patents (McManus & Moitra, 2007; Parthasarathy & Aoyama, 2006).

Asian countries technological absorption and innovation capability have been raising in different industrial sectors, from labor intensive industry to capital intensive high-tech industry. Sadio (2010), and Rasiah & Amin (2010) emphasize on industrialization and technology absorption of Thailand and Indonesia, both countries were inspired by the growing dominance of neoliberal development policies that were initiated by IMF and World Bank. They liberalized their economy. Indonesia and Thailand decreed industrialization policies that created favorable environment to attract foreign technology and to support the vertical and horizontal integration of local firm. Moreover, they opened a door to foreign ownership and they created competitive environment in order to boost local production (Syakur, 2009). As a result, they built local firms' technical capability and human capital. The typology of technological capability based on human resource practice, accumulating technical knowledge, process technology, and product technology (Kim, 1997; Rosenberg and Firschtak, 1985).

2.4 Conceptual background of Ethiopian economic growth and Innovation policy review

A recent impressive economic growth of Ethiopia has driven by agricultural productivity and infrastructural investment. The government introduced agricultural-led industrialization and invested on agricultural innovation to enhance productivity, at the same time supported labor intensive industries (Gebreselassie, 2006; Ohno, 2011; Spielman, Davis, Negash & Ayele, 2011; Lemma & Hoffmann, 2005). Certainty, Ethiopia is on transformation from agricultural based economy to industrialization. This transformation requires a national innovation system, in order to allow transition from a subsistence farming economy to knowledge-based economy.

Reviewing the historical prospective of African innovation. For the first time, science and technology institutions were established in 1960s soon after declaring their independence from colonial powers. These institutions were dedicated to support specific and strategic industries. According to United Nations Economic Commission for Africa (UNECA, 2013) report, the Ghana’s government established Research Council in 1959, followed by the National Council for Scientific and Industrial Research of Nigeria. In 1970s, Kenya established the

National Council for Science and Technology. In the middle of 1970, the first Ethiopian Science and Technology commission was established without clear action plan and policy rectification. After two decades in 1993, the first National Science and technology policy was issued. In 1995, under new government of Federal Democratic Republic of Ethiopia, Science and Technology commission became an Agency. Again in 2008, government gave special attention to Science and innovation sectors and upgraded from Agency to STI Ministry. The primary objective of innovation policy is to improve a wellbeing of a nation through sustainable social and economic development (Ethiopian Science and Technology Agency, 2006). The specific objectives are as follow,

> (i)To build national capability to generate and apply scientific knowledge and appropriate new, indigenous and emerging technologies that are useful to the realization of national and global socio-economic development objectives and rational utilization and conservation of resources. (ii) To improve and develop the knowledge, culture and the scientific and technological awareness of the peoples of Ethiopia. (iii) To develop and improve the national productive capacity and competitiveness through efficient application of innovation. (iv) To strengthen S&T cooperation with

developing and developed countries to develop the capacities of national organizations through resource, information and experience sharing (ESTA, 2006, p.4).

Accordingly, Ethiopia innovation policy laid basic foundation to building technologies capability and enhance the efficiency and competitiveness of a nation through innovation. Despite African countries have more than half century history of science and technology establishment they have poor track record and insignificant achievement (UNECA, 2016). The empirical study on African Science, Technology and Innovation also concluded that there are very little progress with regards to innovation and collaboration among triple helix model (Dutta, Lanvin & Wunsch-Vincent, 2012; GCI, 2017). Having acknowledging the ground reality, the executive committee of African Union gathered at Khartoum in 2006 to decide a destiny of African innovation and economic development. They identified the current issue of Africa that has become bottleneck for the growth and development of a continent. These executive committee on Science and Technology came up with a plan to promote innovation in Africa through increasing a ration of Gross Expenditure of R&D fund to one percent of GDP by 2010 (AFRICAN UNION, 2007; UNECA, 2016). Unlike other African countries, Zambia, Kenya, Rwanda and Ethiopia committed to invest more than African Union's targeted budget. Kenya government adapted the most aggressive expenditure plan to increase Gross Expenditure on Research and Development to two percent of GDP, the fund allocated from the annual government budget channel through the National Research Fund. Ethiopia government also adapted similar aggressive target to spend 1.5 percent of GDP on R&D, one percent of the fund allocated from a profit contribution from all service and productivity sectors for an innovation fund (Ethiopian Science and Technology Agency, 2006; UNECA, 2016).

Developing countries have similar challenges regarding to technology innovations. As many of these countries, Ethiopia also has lack of reliable and timely data. These are major issues, to measure the relationships of economic growth and innovations. Therefore, to address those problems, Ethiopia government endorsed Science, Technology and Innovation policy. This policy was strategically drafted to fill technological gap of Science Technology and Innovation. Basically, this policy prioritized on building technological capabilities of a nation through adaptation and utilization of foreign technologies. Therefore, Government singled out target area and focused on the linkage of agriculture innovation to industrial products. The ultimate goal of the policy is to eradicate absolute poverty and to become middle income country by 2025. According to Ohno (2009, June) Ethiopia introduced Agricultural development led industrialization (ADLI) plan in 1990s. This development strategy promotes industrialization through agricultural growth and also creates synergies between industry and agricultural sectors. However, at early stage it has low inertia to bring synergy due to lack of policy that support industrialization process. Therefore, Ethiopian government proclaimed a shift toward market oriented economy, and invited private sectors to engage in industrialization process.

Country like Ethiopia whose predominantly population lives in rural area and its economy depended on agricultural products, at the same time agriculture is major source of foreign currency (Allaro, 2011; Diao, Hazell & Thurlow, 2010; Daviron & Gibbon, 2002; Joosten, 2007; Teshome, 2006, March). Ethiopia, therefore, needs to boost agricultural productivity by increasing innovation and also creating synergy with industry. The notion of ADLI policy is recognition a reality of Ethiopia as agrarian society that requires structural transformation. To implement government policies, first they introduced in 2002/03 to 2005/05, The Sustainable Development and Poverty Reduction Program (SDPRP), second policies were implemented from 2005 to 2010 The Plan for Accelerated and Sustained

Development to End Poverty (PASDEP), and the third policies that have been implementing from 2010 to 2015 are the Growth and Transformation Plan (GTP). The fourth one is the successor of the previous one, which is Growth and Transformation Plan two (GTP II) which has been implementing from 2015 to 2020 (MoFED, 2014, GTP II, 2015).

Similar to East Asian development policies, notably Japan is one of the most successful countries to proclaim government led development policy that became a role model and benchmark to other developing countries. Japan was stepped onto modernization during Meiji era late nineteen century by realizing the impact of imperialism (Norman, 2000; Klein & Ōkawa, 1968; Saxonhouse, 1974). The Meiji restoration was laid development path of modernization under the slogan of “enrich the country and strengthen the military”. Their development policy was centered on learning and absorbing western advance technologies (Goto & Otayiri, 1993; Odagiri & Gotō, 1996; Rosovsky, 1973; Low, 2005; Warner, 1994). Resource poor Japan had no option to survive except to develop their human capital and accelerate industrialization rapidly (Kojima, 1971; Hong, 2011). Following Japanese footsteps, Korean government development policy that was formulated at early stage of development to bring structural transformation from labor intensive industry toward industrialized nations (Kim, 1988; Ho, 1980; Dollar & Sokoloff, 1990; Fagerberg & Godinho, 2004). To mention two of the development policies, such as, "Five-year Economic Development Plans" as well as the three-year rolling plans and yearly economic management plans (Shinohara, Miyohei, Toru & Kim, 1983). Early 1960s, Korean economy was depended on labor intensive industry, and gradually has transferred to capital intensive industry. After implementing effective policies, Korea would able to join industrialized nations (Kim & Nelson, 2000; Amsden, 1992; Nelson, 1993).

Hence, a country`s development and innovation policy are the major determinate factors to bring sustainable economic development and transform a country from primary industry to advanced industry. Still, it is not late to emulate and replicate the same success as Japan and Korea. Likewise, Ethiopia endorsed new policy that encourage innovation of science and technology through universities and research institutions. Endogenous theory supported that human capital is a primary source of innovation. Ethiopia government policy highlight education as main source of innovation. Particularly, education policy gave high attention for natural science study than social sciences. Consequently, the demand for science and technology increased, at the same time to balance demand and supply, public universities admission increased to 70 percent of their students in natural science and technology and only 30 percent of student are in social science field (GPT II, Federal Democratic Republic of Ethiopia National Planning Commission, 2015). This strengthen national capacity of research and development, moreover it boost technological capacity, innovation and increase productivity (Lin, 1991; De Simone, 1968; Edquist, 2010).

The prominent development plan is the second GPT II, which has broad objective than any of policies have every drafted in history Ethiopia. The policy has continuity with previous development polices, and it strengthening technological development and established the linkage between agricultural sector and industry through triple helix model. It provides special emphases for science and technology oriented institutions to create linkage among research institution, universities, technical and vocation education, training centers and industries. These linkages create technological synergy through rapid information diffusion, which contribute to innovation and technology diffusion (Leydesdorff & Etzkowitz, 1998; Leydesdorff, 2009; Varblane, Mets, Võõras & Ukrainski, 2007, May, Etzkowitz & Leydesdorff, 2000). The second GTP II mainly focuses on technology transfer, absorption of foreign technology, and diffusion of innovation across economies.

> creating technological transfer framework that enables the building of national capabilities in technological searching, selection, import, adaptation, and effective utilization, enhance quality infrastructural capacity to support the manufacturing sector to become competitive in the international market in terms of quality and price (GTP II, 2015, p.192).

This is clear indication that Ethiopia is heading towards industrialization by bringing structural transformation from agricultural based economy to industry. Furthermore, GTP II is believed to bring paradigm shift on research and development structures. Historically, Ethiopian innovation, research and development was dominated by government research institution and public universities, however GTP II encourages small and medium enterprises as well as large scale industry to invest on science and technology regardless of industries type (both government and private sectors). Nevertheless, such condition alone may not enough to create effective innovation climate unless policy makers identify clear strategy that builds interaction among business and research institutions in order to commercialize their innovation and spread to social and economic system.

The implementation strategy of GTP II enable technological adaption and utilization of foreign technology by means of FDI and technology transfer. Several empirical studies supported that international trade and investment are one of main factor for foreign technology spillover and diffusion that enhance economic growth (Liu, 2002; Madsen, 2007; Mingyong, Qun, Shuijun & Xin, 2005; Motohashi & Yuan, 2010; Watanabe, Zhu, Griffy-Brown & Asgari, 2001). Accordingly, Ethiopia government policies implementation Strategies categorized mainly into three parts. The first part benchmarking world best practices and emphasizing on technology transfer. At early stage of industrialization in European, Countries like Belgium, Denmark, France, Germany, Italy, and Netherlands had adapted catch-up strategy to Britain (Abramovitz & David, 1996; Fagerberg & Godinho, 2004; Freeman, 1989; Mathews, 2002). Similarly Japanese technology catch-up had benchmarked European countries and United States (Drysdale & Huang, 1997; Goto & Otayiri, 1993; Godo & Hayami, 2002; Hong, 2011; Odagiri & Gotō, 1996; Rosovsky, 1973; Low, 2005; Warner, 1994). High Performing East Asian countries also had emulated management practices and advanced technology from developed countries through importing foreign technology and equipment (Fagerberg & Godinho, 2004; Hobday, 1998; Mathews, 2006; Mazzoleni & Nelson, 2007; Wang, 2007; Wong, 1999, June). The Empirical evidence in the literature supported that benchmarking the best practices strategy has contribution to industrialization, thus, if Ethiopia implement this strategy effectively, it will strengthen innovation system; and create synergy among institutions. The second part of strategic implementation focus on human capital development and effective resource allocation to increase productivity. Especially to increase the productivity of manufacturing sectors by building skilled manpower.

The last part is trying to address triple helix model. This model is one the most vital parts of innovation that create linkage among all actors. It creates synergy among industries and commercial sectors. Moreover, this part has similarity with Japanese and Korea selective industrial policy, which has provided support to strategic industries and companies. They proclaimed several policies that promoted and supported industries selectively (Lawrence & Weinstein, 2001; Zenawi, 2006, Wade, 1988; World Bank, 1993). Japan and Korea implemented selective intervention effectively that had contributed to economic growth. Likewise, Morocco, North African country also has implemented selective industrial policies in 1970s, which had favored private company and industries. Harabi (2008) strongly argued that the selective industrial policy of Morocco has contributed to economic growth. May this policy bring a change in Ethiopia as well?

> Enabling environment will be created to strengthen the capacity of different research institutions by integrating with other research institutions so as to focus on the manufacturing sector (textile, leather, metal and engineering), economic infrastructure development (construction, water and energy) and working sectors on technology capacity building activities. By giving special support for manufacturing industry particularly for those institutions that have a key role for laying the foundation for industry such as METEC and other similar industries, the on-going capacity of designing and fabrication will be strengthened for farther technology transfer (GTP II, 2015, p.194).

Therefore, to achieve its goal, The Government formulated and ratified Science, Technology and Innovation (STI) policy with a clear mission to support a technology capability and to establish national innovation system framework that enables to adapt new technologies through importing foreign technologies. Government of Ethiopia has been highly encouraging R&D by introducing different kinds of policies measurement; such as direct financing R&D sectors by means of subsidies, and providing tax incentives. To benefit from technology spillover and adapt new technology, it requires well established research institution that equipped with high-tech R&D center, and advance laboratories, appropriate policy support, and essay access to finance. Ethiopia has limited resource and also lack these qualities. Similarly, empirical findings presented that Ethiopia lacks integration on innovation ecosystem (Spielman, Byerlee, Alemu & Kelemework, 2010; Abebe, Bijman, Pascucci & Omta, 2013; Weir & Knight, 2000).

Most of development literature emphasize innovation as a fundamental driving force that transform development structure and consider as main factor that drives industrialization, certain literature also highlight on green economic growth contribute to sustainable development. Hence, Ethiopia is pioneer African countries that highly prioritized green innovation for growth and sustainable development. Jeremy (2017) asserted that the ambition and commitment of the Federal Government of Ethiopia to bring economic development and industrialization while implementing, green innovation and Climate Resilient Green Economy Strategy.

Chapter Three

Methodological Approach

This methodology provides a comprehensive analysis with regards to economic growth, innovations and human development in Ethiopia. The first part of methodology focuses on identifying the primary source of economic growth in Ethiopia through employing an application of Vector Error Correction Model (VECM). The second part measures the relationships of macroeconomic indicators, innovation indicators and human development. The analytical methodology is based on panel regression of random effect model (GLS regression) and Ordinary Least Square (OLS) model by using Stata (econometric software) the dataset is based on 63 years from 1960 to 2013 for 258 countries data of World Bank Development Indicator and Ministry of Finance and Economic Development (MoFED). The panel regression analysis has used in Random-effects model of GLS regression and tested by Hausman fixed random test model. Moreover, we check causality effect by employing granger causality test by using OLS equations based on work of Stock, Watson and Green (Torres-Reyna, 2007). The last part employs a prominent methodology to undertake a comprehensive analysis of national innovation system and its relationship with economic growth and human development. In addition, we utilized Pearson correlation methodology to identify the relationships between the indicators.

3.1 An Application of Vector error correction model (VECM).

This part of methodology focuses on identifying the primary source of economic growth in Ethiopia through employing an application of Vector error correction model (VECM). The main objective of the study is to empirically analyze the factors that affect economic growth in past decades by using time series data that covered from 1981 to 2014. The data analysis method was employed with different econometric models. First, we use Augmented Dickey-Fuller (ADF) unit root test to measure the stability of the data. The second approach was Johanson Co-integration test to evaluate the series for integration of data and then we tested Error Correction Model to identify the direction of causality in long-run equilibrium and short-run equilibrium of Vector Error correction model (VECM). Finally, the Granger causality technique has employed to check the casual relationship among vectors. Before applying Co-integration test models, VAR Lag Order Selection Criteria is employed by using sequential modified LR test statistic (each test at 5% level), Final prediction error (FPE), Akaike Information Criterion (AIC), Schwarz

Information Criterion (SIC), and Hannan-Quinn information criterion (HIQ). Lag Order Selection Criteria has employed to determine the right lag length. In addition, we preform Granger causality test by using Wald Statistics as well as we check GDP model whether it has any statistical problem by using the value of R-square and F-statistics (p-value). Then, we preform residual diagnostic test by using Breusch-Pagan-Godfrey Serial Correlation test, Heteroscedasticity test of Breusch-Pagan-Godfrey.

The conceptual framework of GDP and the model that proposed to evaluate the determinants of economic growth of Ethiopia are stated as follow:

$$GDP = \propto + \beta_1 GFCF + \beta_2 EXPT + \beta_3 IMPT + \beta_4 EMPT + \beta_6 LPT + \mu$$

Where, Gross Domestic Product (GDP), Gross Fixed Capital Formation (GFCF), Export (EXPT), Import (IMP), Employment (EMPT) and Labor Productivity Growth (LBP), $\propto$ = intercept and μ = error term, β_i= Coefficients

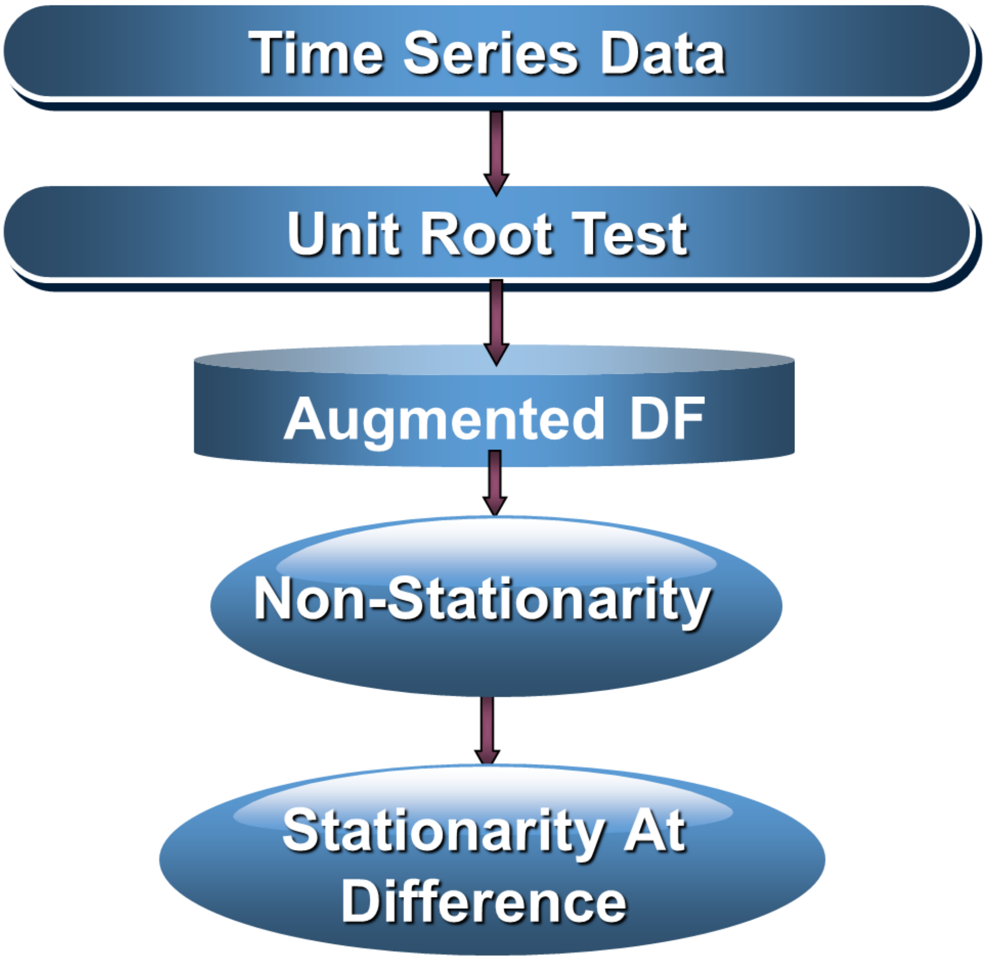
3.1.1 Augmented Dickey-Fuller (ADF) unit root test

Before constructing an econometric model, Augmented Dickey-Fuller test is essential to check unit root test before running Co-integration test in order to track autocorrelation problem. Because macroeconomic time series data have major problem for empirical econometrics that might cause spurious regressions, which create difficulty to measure regression results. The unit root tests are mainly a descriptive tool performed to classify the stability of time series data. Using ADF test exams whether the variable has unit root or not. ADF test determines which variable is integrated of order one or I (1). The null hypothesis assumed that a time series data appear to be non-stationary, which has unit root. The alternative hypothesis assumed that the date is stationery and reject null hypothesis (Dickey and Fuller, 1979). The following equation estimates the Augmented Dickey-Fuller model.

$$\Delta x_{t=}\alpha + \beta t + \pi x_{t-1} + \sum_{i=1}^{k} \gamma_t \, \Delta x_{t-i} + \varepsilon_t$$

According to Fuller (1976), the null hypothesis is that $x_t = x_{t-1} + \varepsilon_t$ where ε_t ~ NID($0, \sigma^2$). The notation NID ($0, \sigma^2$) symbolizes normally and independently distributed with mean zero and variance σ^2 or ε_t the white noise error. The null hypothesis is $H_0 : \pi = 0[x_t \sim I(1)]$ against alternative hypothesis$H_a : \pi < 0[x_t \sim I(0)]$.

Diagram 3.1 Unit root testing procedure by using Augmented DF



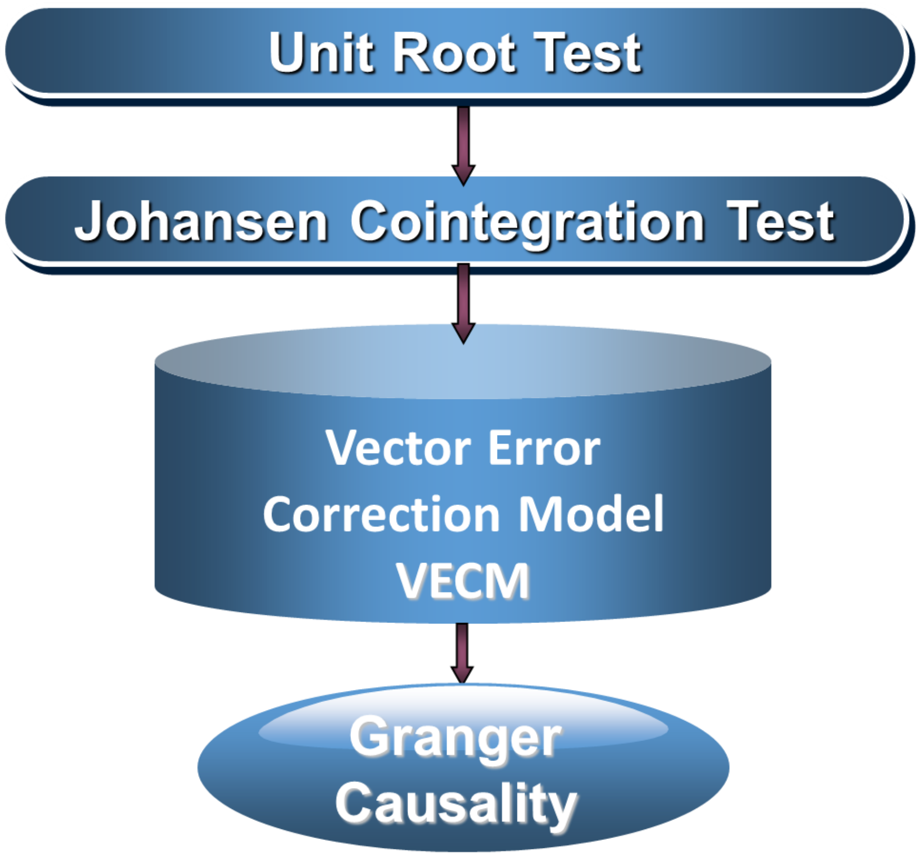
3.1.2 Lag length selection Criteria

Before performing Johansen Co-integration test and Vector correction error mode test, it requires to identify the number of optimal lag length by using VAR Lag Order Selection Criteria. VAR Lag Order Selection Criteria employed by using sequential modified LR test statistic (each test at 5% level), Final prediction error (FPE), Akaike Information Criterion (AIC), Schwarz Information Criterion (SIC), and Hannan-Quinn information criterion (HIQ). It is necessary to determine the right lag length; because endogenous variables are highly sensitive to number of lag length. Thus, the lag selection criteria can select automatically an appropriate number of lag length. The finding indicates that all testing criteria are in favor of using two lag except SIC recommended to use one lag. Therefore, we use lag two as optimal lag length for Johansen Co-integration test and vector error correction model test.

3.1.3 Johansen Co-integration Test

This research further employs testing for Co-integration to evaluate long-run (equilibrium) relationships and short-run adjustment (disequilibrium) between variables. Johansen`s method checks if the GDP modelling has empirically meaningful relationships between vectors. There are several tests of Co-integration. Among these methods, Engle and Granger (1987) formulated one of the first test of Co-integration (or common stochastic trends), since then, the Engle-Granger (EG) has become a widely applied method of cointegration. In addition to EG long-run relationship approach, Johansen (1988, 1991) and Johansen and Juselius (1990) introduced a systems based approach to evaluate the existence of Co-integration among variables. Despite Johansen Co-integration test has weakness of the test on small sample size and sensitive to specification errors, it has theoretical advantage and methodological superiority (Sjö, 2008; Utkulu, 1997). Therefore, this research employed Johansen Maximum Likelihood (ML) method to determine whether a stable long-run relationship (equilibrium) exists between the variables or not? The testing approach assumes that “the system is integrated of order one. If there are signs of I (2) variables, we will transform them to I (1) before setting up the VAR. By using the difference operator $\Delta = 1 - L$, or $L = 1 - \Delta$, the VAR in levels can be transformed to a vector error correction model (VECM)” Sjö, (2008).

Diagram 3.2 Johansen cointegration test procedure



Johansen Maximum likelihood approach identifies the number of cointegrating relationships between GDP and other variables. The Maximum Likelihood (ML) testing model construct based on trace test and Maximum Eigenvalue test. Where the null hypothesis is that the number of cointegrating vectors is *r*, against an alternative of (*r*+1) vector. The empirical model for this test is based on the following Trace statistics and Maximum Eigenvalue equations; as follow

$$\lambda_{Max}(\mathrm{r}, \mathrm{r}+) = -T ln(1 - \lambda_{r+1})$$

$$\lambda_{Trace}(\mathrm{r}) = -T \sum_{i=r+1}^{g} ln(1 - \lambda_{i)}$$

3.1.4 Vector Error Correction Model (VECM)

After evaluating the stability of vector for stationary and unit roots by performing ADF test. The vector should be in levels and first differences. VECM will be employed once the variables integrated in the same order and cointegrated. Then we proceed to check whether a long-run equilibrium exists between variables. Furthermore, Wald statistics preformed to identify the direction of short-run Granger causality. The empirical model of VECM is represented by the following equation

$$\Delta GDP_t = \propto + \lambda Z_{t-n} + \sum \beta_1 \, \Delta \, GDP_{t-n} + \sum \beta_2 \, \Delta \, GFCF_{t-n} + \sum \beta_3 \, \Delta \, \mathrm{EXPT} + \sum \beta_4 \, \Delta \, \mathrm{IMPT} + \sum \beta_5 \, \Delta \, \mathrm{EMPT} + \sum \beta_5 \, \Delta \, \mathrm{LBP} + \mu_t$$

Where, λ is the coefficient of error correction, and Z_{t-n} is error correction term (ECT), which is the lagged residual series of the cointegrating vector. Δ denotes first differences and n is the optimal lag length determined by AIC and SC criteria and μ_t is the white noise term. The coefficient of cointegrated equation indicates the speed of adjustment toward long-run equilibrium, the coefficient must be negative and significant. β denotes the coefficient of short-run equilibrium that measures Granger causality for error correction model (ECM) of dependent variable. Coefficient parameters of error correction term are the speed of adjustment for the short-run imbalances.

3.2 Macroeconomic and Innovation Indicators

This research measures the relationships of national innovation system, economic growth and human development by using the dataset is based on 63 years from 1960 to 2013 for 258 countries data. Different countries have adopted similar development policy frameworks to bring sustainable economic development. However, the degree of development varied across countries. This part of study provides a better understanding of different countries and it could contribute to the development of more effective strategies. Therefore, a cross country analysis is employed to provide greater insight on Ethiopia development. The analytical methodology is based on panel regression of random effect model (GLS regression) and Ordinary Least Square (OLS) model. The panel regression analysis method has be executed in Random-effects model of GLS regression and tested by Hausman fixed random test model. We use time series regression on cross countries comparison, as well as cross regional static (for Sab Saharan African Countries and East Asian Countries). Furthermore, we enhance our analysis by using the panel regression. The panel regression analysis method will be executed in five different periods in order to evaluate the impact of macroeconomic policies and Science Technology and Innovation policies that had implemented at different period of time. Such as, the time frame of starting from 1960 to 2013, from 1960 to 1980, from 1980 to 1990, from 1990 to 1999, and from 2000 to 2014. All the statistical inference will be performed on STATA and E-Views econometric software.

$$Y_i^t = \alpha_i + \sum_{i}^{n} \beta_i X_i + \varepsilon_i$$

Where

Y_{ti} is a dependent variable and i= entities or panels and t=time

α stand for the intercept

$\beta_i X_i$ represent independent variable that will explain the core factors

ε_i Stochastic random disturbance

3.2.1 The specific model of Macroeconomics

The analytical methodology is based on panel regression of random effect model (GLS regression) and Ordinary Least Square (OLS) model. Theses methodology use the following specific model

$$Y_i^t = \alpha_i + \sum_i^n \beta_i X_i + \varepsilon_i$$

$$\mathrm{GRTit} = \alpha + \sum \beta\, 1\mathrm{EDUit} + \beta\, 2.\mathrm{EXPijt} + \beta\, 3\mathrm{INVit} + \sum \beta\, 5.\mathrm{INNOit} + \sum \beta\, 6\mathrm{ICTit} + \sum \beta\, 6\mathrm{Hit} + \varepsilon\ \mathrm{it}$$

Dependent variable

y= GRT ➔ GDP per capita growth (annual %) and GDP growth

Independent variable

1. Education (EDU)
    a. PRI ➔ Primary School enrollment (% gross)
    b. SEC ➔ Secondary School enrollment (% gross)
    c. TER ➔ Tertiary School enrollment (% gross)

d. LTR ➔ Literacy rate

2. Investment

    a. INV ➔ Investment Gross fixed capital formation (% of GDP)

3. Export

    a. EXP ➔ Exports of goods and services (% of GDP)

4. ICT

    a. MOB ➔ Mobile cellular subscriptions (per 100 people)

    b. TEL ➔ Telephone lines (per 100 people)

    c. COM ➔ Mobile & Fix line

5. Innovation (INNO)

    a. JOU ➔ Scientific and technical journal articles

    b. PAT ➔ Patent applications, residents

    c. RAD ➔ Research and development expenditure (% of GDP)

    d. GOVEXP ➔ Government expenditure on higher education (% of GDP)

    e. PRIVEXP ➔Private sector expenditure on R&D (% of GDP)

    f. INVP➔ Innovation policy

6. Health

a. LIFEX➔Life expectancy

b. HZEXP➔Government health expenditure (% of GDP)

7. GDP

a. GDPPC ➔GDP per capita income

b. GDPGRT➔GDP growth rate

NOTE: All independent variable are one year time lagged but GDPPC is ten year time lagged. In addition, the four areas for empirical investigation are: (i) GDP per capita; (ii) educational status; (iii) health status; (iv) innovation indicators.

The four areas for empirical investigation are: (i) GDP per capita; (ii) innovation system; (iii) health status, and (iv) educational status; where are dependent factor variables, respectively denoting GDP per capita income; innovation, health and education. The terms are vectors of independent factor variables. Each equation in the system includes dependent variables from other equations as explanatory variables. Thus, the vectors of independent variables shall include both exogenous and endogenous regressors, for instance, GDP per capita is in the education equation and vice versa; health was in the education equation and vice versa; and so on. The terms are errors. The rest of the other terms are coefficient parameters to be estimated.

3.3 Economic Growth and Innovation Indicators

This section of research methodology analyzes the determinant role of national innovation system on economic growth and human development in Ethiopia. The research employ a prominent methodology to undertake a comprehensive analysis of national innovation system and its relationship with economic growth and human development that has yet to be done before in the case of Ethiopia. Its methodology based on Oslo Manual paradigm and panel regression of random effect model (GLS regression) and Ordinary Least Square (OLS) model. In additions, Pearson coefficient correlation will be used to measure their relationships. The general objective of the methodology is to evaluate whether the result of a data set is statistically significant, like national innovation system to economic growth and human development. Furthermore, this research analyzes empirically to examine the gap of government policy on National Innovation System through a comparative analysis of East Asian countries and African countries economic development experiences with a view to guiding policymakers on national development.

However, national innovation system has great challenge in terms of methodology. European Union and OECD countries have introduced the first innovation survey manual. They jointly developed Oslo manual that provided common methodology (Manual, 2005). The Oslo manual's methodology of innovations have revised several time and extended to developing countries, such as, Latin America and Africa. In addition, World Bank developed comprehensive methodology to address the gap of innovation measurement, described Knowledge Assessment Methodology (KAM). Another a prominent methodology was developed by evolutionary economist Leydesdorff, and he proposed triple helix model to evaluate the relationship of different actors, such as, industries, university and government institutions (Leydesdorff, 2006). Triple helix methodology has been used to measure the interaction among actors. However, this study employed extensively, third edition Oslo manual and use KAM indicators.

Notably, the Community Innovation Survey (CIS) based on the third edition of Oslo manual including annex, and also in some extent include a Frascati Manual that focuses on research and development (R&D) indicators. However, Oslo model has methodological issue to address developing countries innovations system, because, Oslo manual has mainly focused on technological development, such as R&D and patents. These indicators are inappropriate to evaluate innovation system of developing countries (Bogliacino, Perani, Pianta & Supino, 2009). Because it does not include and examine the informal sectors, traditional innovations, and indigenous knowledge.

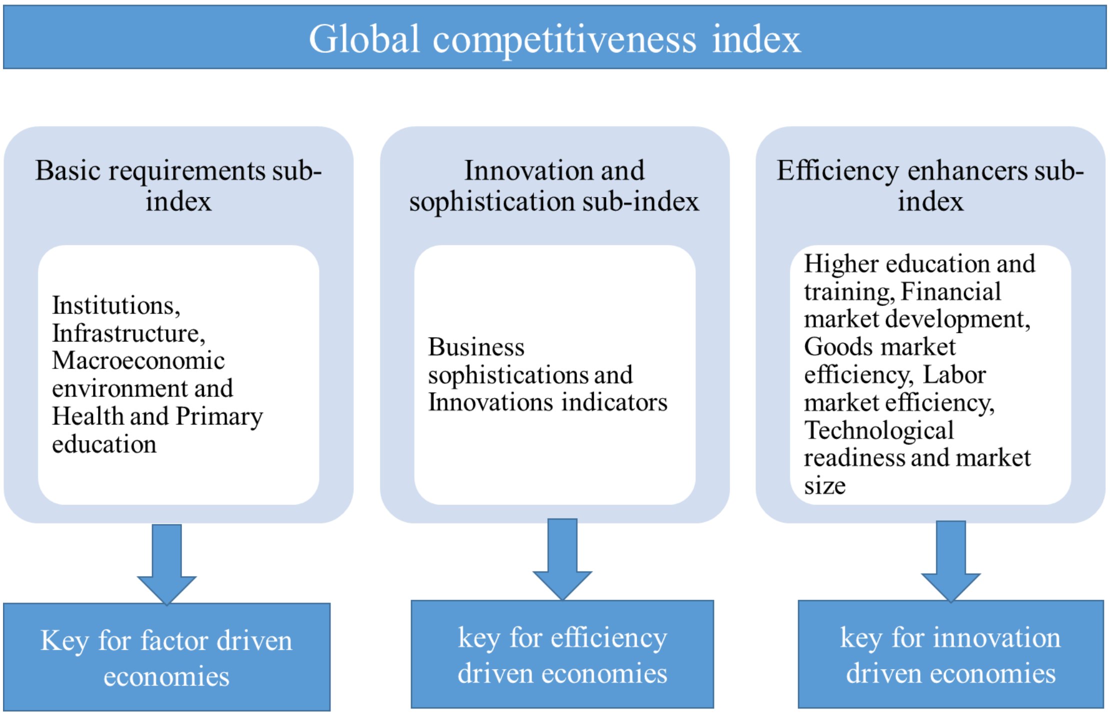
3.3.1 Third edition Oslo manual approach

This approach based on Oslo model Community Innovation Survey. The design of these surveys intended to comply with The New Partnership for Africa's Development (NEPAD) manuals that were modified from Oslo manual standard survey including annex, and Frascati Manual to better fit with the conditions of developing countries, NEPAD manual has developed to address the Africans development issues (Mhula, Jacobs & Hart, 2013). The innovation indicators and measurement of OECD countries are significantly different than science and technology innovation indicators of developing countries. Therefore, according to the study of NEPAD, the role of informal sectors on innovation need to be included. Such as, the informal sectors and indigenous knowledge have been playing significant role in African economy and innovation activities. Since 1960, OECD countries developed different measurement indicators for Science Technology and Innovations (STI) based on five STI indicators. Such as, Research and development (R&D), Innovation; Human resources; Patents; and Technology balance of payments. Moreover OECD developed detail standard manuals for each STI indicators (Manual, 2005)

I. Frascati Manual – focuses on research and development (R&D) indicators;
II. Oslo Manual – focuses on guidelines for developing and identifying innovation indicators and their measurement;
III. Canberra Manual focuses on the human resource indicators necessary to illustrate the development of human resources within a national system of innovation (NSI)
IV. Patent Manual examines the types of indicators required and ways to measure patents and other intellectual property;
V. Technology Balance of Payment (BoP) Manual focuses on the measurement of the transfer of technology at the international level using indicators of income and expenditure related to exchange of technology.

Furthermore, this research broadly use innovation pillar of World Economic Forum Data that extracted from Global Competitiveness Index. The following innovation indicators adopts a broad notion of innovation by OECD. These indicators are grouped into 12 pillars, institutions, infrastructure, macroeconomic environment, health and primary education, higher education and training, goods market efficiency, labor market efficiency, financial market development, technological readiness, market size, business sophistication, and innovation. By using these indicators, this study execute a comparatively analysis of Ethiopia with East Asian countries and African countries. However, all indictors are not key factors that drive innovation, therefore, this study will take some of indicators that has strong driving factors to enhance innovation and economic growth.

Diagram 3-3. GCI pillar. (Source: author`s compilation of GCI)



According to global competitiveness index report, these pillars are classified into the following three sub-indexes based on their characteristics, such as basic requirements (key for factor driven economies), innovation and sophistication (key for efficiency driven economies) as well as efficiency enhancers (key for innovation driven economies). The first sub-index, basic requirements includes the following pillars. Such as institutions, infrastructure, macroeconomic environment and health and primary education. And the second sub-index, innovation and sophistication sub-index includes business sophistications and innovations indicators. The third sub-index is efficiency enhancers that incorporated higher education and training, financial market development, goods market efficiency, labor market efficiency, technological readiness and market size.

The detail research approach focus on the following areas. The main pillar of innovation indicators, which included**,** Capacity for innovation, Company spending on R&D, University-industry collaboration in R&D, Patent applications application per million population. In additions to innovations driven factors of economies, Technological readiness also play key role that included the following indicators. Such as, FDI and technology transfer availability of latest technologies, firm-level technology absorption, internet users' percentage of population, fixed-broadband internet subscriptions per hundred population, and mobile-broadband subscriptions per hundred population.

The above indicators have the following values, which the degree of value varies from 1 to 7 (Not at all < 1 2 3 4 5 6 7 > to a great extent)

Value 1 means you agree completely with the answer on the left-hand side

Value 2 means you largely agree with the left-hand side

Value 3 means you somewhat agree with the left-hand side

Value 4 means your opinion is indifferent between the two answers

Value 5 means you somewhat agree with the right-hand side

Value 6 means you largely agree with the right-hand side

Value 7 means you agree completely with the answer on the right-hand side.

(GCI, 2017, p.82)

The evaluation methodology employed Pearson coefficient correlation between variables by using the following hypothesis as guideline

I. Null hypothesis: There is no correlation between two variable.

II. Alternative Hypothesis: there is correlation between two variables.

III. If p-value or significant value is less than 5 percent reject null hypothesis and accept alternative hypothesis.

IV. If p-value or significant value is more than 5 percent accept null hypothesis and reject alternative hypothesis.

3.3.2 Knowledge Assessment Methodology (KAM) Approach

The methodology employed quantitative assessment of innovation system based knowledge economy benchmarking tool. The Knowledge Assessment Methodology (KAM) was developed by the World Bank Institute's Knowledge for Development (K4D) Program (Methodology, 2012). This comprehensive assessment tools facilitate countries that trying to make the transition from labor intensive economy toward value added knowledge based economy. Furthermore, KAM designed to provide a basic assessment of countries' technological capability and readiness for the knowledge economy. KAM contributes to evaluate their policies and articulate their development goals by identifying specific areas where policymakers may need to improve some sectors (Chen and Dahlman, 2005; Chandra, 2013).

According to World Bank, KAM model provides 80 variables for 128 countries and 9 regions, among variables 14 are widely used as standard variables. KAM`s basic scorecard has four pillars under knowledge economy index, each pillars contain three variables; such as, Economic Incentive and Institutional Regime (EIR), Innovation and Technological Adoption (ITA), Education and Training (ET), and Information and Communications Technologies (ICT) Infrastructure. In additions, KAM included two performance based variables, such as, Growth of GDP and Human Development Index (HDI).

3.4 Pearson Correlation

This research employed Pearson correlation a "partial correlation & bivariate analysis" to evaluate the strengths of association between different variables, which is the most widely accepted and used correlation statistic to measure the degree of the relationship between two variables. To determine the strength of relationships, Pearson methods uses the value of the correlation coefficient varies between +1 and -1. The value strength or the value of the correlation coefficient lies around ± 1, then it is said to be a perfect degree of relationships or strong association between the variables. When the correlation coefficient value goes towards 0, then the association between variables will be weaker. Therefore, to measure the relationships of variable we use the following Pearson`s guideline; (i) when plus (+) sign presents there is positive association ships between the two variables; (ii) when a minus sing (-) reveals a negative association between the two variables.

The following formula is used to calculate the Pearson r correlation:

$$r = \frac{\mathrm{N}\sum \mathrm{xy} - (\sum \mathrm{x})(\sum \mathrm{y})}{\sqrt{[\mathrm{N}\sum \mathrm{x}^2 - \sum(\mathrm{x}^2)][\mathrm{N}\sum \mathrm{y}^2 - \sum(\mathrm{y}^2)]}}$$

Where

r = Pearson r correlation coefficient

N = number of value in each data set

Σ xy = sum of the products of paired scores

Σ x = sum of x scores

Σ y = sum of y scores

Σ x2= sum of squared x scores

Σ y2= sum of squared y scores

3.5 Source of Data

This research utilizes the following main secondary data sources such as, World Bank data (Most of macroeconomic indicators, like economic growth, GDP per capita income, gross capital formation, and education data) Ethiopian Ministry of Finance & Economy (GDP value add of service sectors, industrial sectors and agricultural sectors data and macroeconomic data) Ethiopian Statics Agency (innovation data), UNDP human development index (human development indicators data), International Labor Organization (ILO) (employment data), United Nations Educational, Scientific and Cultural Organization (UNESCO) (data of enrolment rate of education and government expenditure on education), Total Economy Database (TED) (labor productivity growth) and International Monetary Fund (macroeconomic data, specially growth data). Specially, Research and development (R&D) indicators survey data was taken from World Economic Forum (Global Competitive Index Data) and Ethiopian Science and Technology indicators survey data.

3.6 Limitation of methodology

The challenges depicted for this research that most of the previous empirical studies have examined innovation effect in Ethiopia in descriptive method, which limited the availability of theoretical and empirical studies dealing with econometric analysis. The lack of data availability and also the innovation survey data was based on different parameter than macroeconomic data. In additions, due to lack of consistent and complete data, we could not examine the case of Taiwan in detail despite one of high performing countries. Moreover, there might be problem of endogenity cross-equation error correlations, to address the case of endogenity, it requires to employ two-stage least squares (2SLS) and the three-stage least squares (3SLS).

Chapter Four

Source of Economic Growth in Ethiopia: An Application of Vector Error Correction Model (VECM)

4.1 Introduction

Economic growth is a measurable change that expands the output of the country in a given period. It is a process that increases the welfare of the nation (Osipian, 2009). The World Bank stated that Gross Domestic Product (GDP) is one of the macroeconomic indicators that measures the economic growth as an increase of national wealth that conventionally quantifiable in the percentage increase in gross domestic product (GDP) or gross national product (GNP). Economic development is a process of change that brings economic and social transformation (Thirlwall, 2006). Furthermore, economic development requires many processes that integrate physical capital, human capital and technological innovations (Walter, 1972). This paper reviews the source of economic growth that contributed to a current high economic growth. Since 1991, the political and economic policies of Ethiopia had started to change radically and introduced liberal economic policies to encourage private enterprise and to attract foreign direct investment. Accordingly, Ethiopia registered impressive economic growth and become one of the fastest growing economies in Africa.

This research is an attempt to answer what are the determinant factors of economic growth? It also evaluates other associated factors of economic growth. We use empirical data analysis and extended theories, and a quantitative approach on the data of economic growth. The first section of this paper reviews an overview of the GDP growth of Ethiopia. The second section focuses on the empirical analysis of time series data through econometrics models to evaluate the determinate of GDP growth. The data analysis uses Augmented Dickey-Fuller Test (ADF) to check the existence of unit roots and Johansen Co-integration Test to get the cointegration between variables. The third part conducts Granger Causality Test to evaluate the determinate of GDP growth. The last part summarizes the empirical findings of the study and conclusion.

4.2 An over view of Ethiopia`s GDP Growth

The economic growth of Ethiopia has been registering sustainable and vigorous growth for decades. The growth moment was driven by strong domestic demand, investment on infrastructural and economic liberalization. Moreover, the stable macroeconomic policies contributed for structural transformation from agricultural sectors to service sectors, the share of GDP shifted from low productive agriculture sectors to value added service sectors (IMF, 2011; McMill & Harttgen, 2014). Moreover, the government expenditure on infrastructure and human capital have been increasing dramatically, and also introduced economic policies to encourage private sectors expansion. This has attracted world attention as investment destinations. Accordingly, Ethiopia registered impressive economic growth and become one of the fastest growing economies in the world.

Ethiopia introduced market oriented economic policies to encourage private investment and also attracted foreign investment. This liberal economic policies promoted trade openness and provided tax incentive for export sectors and foreign direct investment. In addition, import substitution police introduced to transfer agricultural based economy to industrial based economy. These policies had contributed for macroeconomic structural transformations (Geda & Berhanu, 2000; Rashid et al., 2009; Berhanu & White, 2000). The classical economic theories supported that international trade has significant role in economic growth and create competitiveness through specialization (Jung & Marshall, 1985; Siddiqui, Zehra, Majeed, & Butt, 2008). Thus, Ethiopia implemented export lead growth strategy to increase competitiveness and boost export that catalyzed GDP growth. The share trade increased sharply from 20% of GDP in 1990 to 45% of GDP in 2012.

Investment is the main factor that derives economic growth (Janjili, 2011). Harrod-Domar growth model explained the rate of economic growth proportional to the rate of investment (Zhang, 2005). Saving accelerates investment that contributes to economic growth (Jappelli & Pagano, 1994). Furthermore, Solow's growth model emphasized the importance of physical capital for economic growth (Janjili, 2011). After introducing liberal economic policies, domestic saving has been growing from 9.7 percent of GDP in 1991 to 22.4 percent of GDP in 2014. At the same, Gross Fixed Capital Formation also has been growing proportion to saving from 14.5 percent of GDP in 1991 to 40.3 percent of GDP in 2014.

Several theoretical and empirical evidences show economic growth and human capital have positive relationship (Hafner & Mayer-Foulkes, 2013; Hanushek, 2013). To understand the causal relationship between human capital and economic growth, it needs to develop a two-way approach of study (Hafner & Mayer-Foulkes, 2013; Musai & MEHRARA, 2013; Suri, Boozer, Ranis & Stewart, 2011); therefore, the study employed Granger causality test. Economic growth recognized as the accumulation of human and physical capital, and increased productivity, arising from technological innovation (Lucas, 1998). The endogenous growth theory had given complementary theoretical support (Aghion & Howitt, 1992; Romer, 1990) which described human capital as the engine of growth through innovation (Barro, 2002). Human capital is a driving force of economic growth, which is the engine of growth (Benhabib & Spiegel, 1994). According to Meraj (2013) “Adjustment in labor and capital is required to maintain long-run growth with the help of technological advancement in order to increase productivity”. Solow growth theory also stresses the importance of physical capital that clearly defined the factors behind economic growth such as accumulation of capital, labor force and technology (Lucas, 1998). Economic growth was recognized as the accumulation of human and physical capital. Based on above argument, this paper evaluates the relationship between economic growth and the determinant factors such as Investment (Grow Fixed Capital Formation), trade openness (Export and Import), and Human Capital (Employment, and Labor productivity growth).

4.3 Research approach (Methodology)

The primary objective of the study is to empirically analyze the factors that affect economic growth by using time series data that covered from 1981 to 2014. The data analysis was employed with different econometric models. First, Augmented Dickey-Fuller (ADF) unit root test to measure the stability of the data, followed by Johanson Co-integration test to evaluate the series for integration of data and then Error Correction Model to identify the direction of causality in long-run equilibrium and short-run equilibrium of Vector Error correction model (VECM). Finally, Granger causality technique has employed to check the casual relationship among vectors. Before applying Co-integration test models, VAR Lag Order Selection Criteria is employed by using sequential modified LR test statistic (each test at 5% level) Final prediction error (FPE), Akaike Information Criterion (AIC), Schwarz Information Criterion (SIC), and Hannan-Quinn information criterion (HIQ). Lag Order Selection Criteria has employed to determine the right lag length. In addition, we preform Granger causality test by using Wald Statistics as well as we check GDP model whether it has any statistical problem by using the value of R-square and F-statistics (p-value). Then, we preform residual diagnostics test by using Breusch-Pagan-Godfrey Serial Correlation test, Heteroscedasticity test of Breusch-Pagan-Godfrey.

4.3. 1 Data source

The yearly time series data of Gross Domestic Product, Gross Fixed Capital Formation, Export, Import, Employment and Labor Productivity Growth collected from various sources, it covers from 1981 to 2014. The data obtained from World Bank Development Indicators (WDI), The Ethiopian Ministry of Finance and Economic Development (MOFED), International Labour Organization (ILO), United Nations Educational, Scientific and Cultural Organization (UNESCO) and Total Economy Database (TED).

4.3.2 Empirical findings and discussion

This paper examines the dynamic relations between macroeconomic indicators of economic growth. The conceptual frame work of GDP and the model that proposed to evaluate the determinant of economic growth of Ethiopia are stated as

$$GDP = \propto + \beta_1 GFCF + \beta_2 EXPT + \beta_3 IMPT + \beta_4 EMPT + \beta_6 LPT + \mu$$

Where, Gross Domestic Product (GDP), Gross Fixed Capital Formation (GFCF), Export (EXPT), Import (IMP), Employment (EMPT) and Labor Productivity Growth (LBP), $\propto$ = intercept and μ = error term, β_i= Coefficient

4.3.3 Augmented Dickey-Fuller (ADF) unit root test

Before constructing an econometric model, Augmented Dickey-Fuller test is essential to preform to check unit root test before running Co-integration test in order to track autocorrelation problem. Because macroeconomic time series data have major problem for empirical econometrics that might cause spurious regressions, which create difficulty to measure regression results. The unit root tests are mainly a descriptive tool performed to classify the stability of time series data. Using ADF test exams whether the variable has unit root or not. ADF test determines which variable is integrated of order one or I (1). The findings indicate all variables at level have unit root and became stationery at first difference with trend and intercept. The null hypothesis assumed that a time series data appear to be non-stationary, which has unit root. The alternative hypothesis assumed that the date is stationer and reject null hypothesis (Dickey and Fuller, 1979). The following equation estimates the Augmented Dickey-Fuller model.

$$\Delta x_{t=}\alpha + \beta t + \pi x_{t-1} + \sum_{i=1}^{k} \gamma_t \, \Delta x_{t-i} + \varepsilon_t$$

According to Fuller (1976), the null hypothesis is that $x_t = x_{t-1} + \varepsilon_t$ where ε_t ~ NID($0, \sigma^2$). The notation NID ($0, \sigma^2$) symbolizes normally and independently distributed with mean zero and variance $\sigma^2 \; or \; \varepsilon_t$ the white noise error. The null hypothesis is $H_0 \colon \pi = 0[x_t \sim I(1)]$ against alternative hypothesis

$H_a: \pi < 0[x_t \sim I(0)]$. The below Table 4-1 and Table 4-2 of ADF test result indicates all variables that examined are nonstationary at level, accept the null hypothesis, which indicates all variables have unit root at 1%, 5% and 10% level. However, all variables became stationery at difference and reject null hypothesis at 1% and 5% level.

The below Table 4-1 shows Augmented Dickey-Fuller unit root test results use intercept only at 1% and 5% critical value (MacKinnon (1996) one-sided p-values.)

	Augmented Dickey-Fuller test statistic at only Intercept				
	At Level				
	1% level	5% level	10% level	t-Statistic	p-Value
GDP	- 3.6463	- 2.9540	- 2.6158	4.0853	1.0000
GFCF	- 3.6617	- 2.9604	- 2.6192	4.8681	1.0000
EXPT	- 3.6463	- 2.9540	- 2.6158	4.1475	1.0000
IMPT	- 3.6999	- 2.9763	- 2.6274	4.6303	1.0000
EMPT	- 3.6463	- 2.9540	- 2.6158	10.6042	1.0000
LBP	- 3.6617	- 2.9604	- 2.6192	1.4942	0.9989
	Augmented Dickey-Fuller test statistic at only Intercept				
	At Difference				
	1% level	5% level	10% level	t-Statistic	p-Value
GDP	- 3.6537	- 2.9571	- 2.6174	- 2.9067	0.0557
GFCF	- 3.6793	- 2.9678	- 2.6230	1.8892	0.9997
EXPT	- 3.6537	- 2.9571	- 2.6174	- 2.7779	0.0727
IMPT	- 3.7379	- 2.9919	- 2.6355	3.5246	1.0000
EMPT	- 3.6537	- 2.9571	- 2.6174	- 0.6296	0.8501
LBP	- 3.6702	- 2.9640	- 2.6210	- 1.4591	0.5401

Table 4-1: Augmented Dickey-Fuller unit root test result for Intercept only (MacKinnon (1996) one-sided p-values.)

The below Table 4-2 indicates Augmented Dickey-Fuller unit root test results use intercept and trend at 1% and 5% critical value.

Table 4- 2: Augmented Dickey-Fuller unit root test results for Intercept and Trend.

	Augmented Dickey-Fuller test statistic at Trend and Intercept				
	At Level				
	1% level	5% level	10% level	t-Statistic	p-Value
GDP	- 4.2627	- 3.5530	- 3.2096	1.9272	1.0000
GFCF	- 4.2967	- 3.5684	- 3.2184	3.6375	1.0000
EXPT	- 4.2627	- 3.5530	- 3.2096	0.9809	0.9998
IMPT	- 4.3393	- 3.5875	- 3.2292	4.2330	1.0000
EMPT	- 4.2627	- 3.5530	- 3.2096	4.3403	1.0000
LBP	- 4.3098	- 3.5742	- 3.2217	1.7013	1.0000
	Augmented Dickey-Fuller test statistic at Trend and Intercept				
	At Difference				
	1% level	5% level	10% level	t-Statistic	p-Value
GDP	- 4.2733	- 3.5578	- 3.2124	- 4.0826	0.0157
GFCF	- 4.2733	- 3.5578	- 3.2124	- 5.6178	0.0003
EXPT	- 4.2846	- 3.5629	- 3.2153	- 3.8924	0.0246
IMPT	- 4.3943	- 3.6122	- 3.2431	1.2041	0.9999
EMPT	- 4.2846	- 3.5629	- 3.2153	- 7.4726	0.0000
LBP	- 4.3098	- 3.5742	- 3.2217	- 4.1444	0.0146

4.3.4 Lag length selection Criteria

Before performing Johansen Co-integration test and Vector correction error mode test, it requires to identify the number of optimal lag length by using VAR Lag Order Selection Criteria of Before applying Co-integration test models, VAR Lag Order Selection Criteria employed by using sequential modified LR test statistic (each test at 5% level) Final prediction error (FPE), Akaike Information Criterion (AIC), Schwarz Information Criterion (SIC), and Hannan-Quinn information criterion (HIQ). It is necessary to determine the right lag length; because endogenous variables are highly sensitive to number of lag length. Thus, the lag selection criteria can select automatically an appropriate number of lag length. The finding indicates that all testing criteria are in favor of using two lag except SIC recommended to use one lag. Therefore, we use lag two as optimal lag length for Johansen Co-integration test and vector error correction model test.

4.3.5 Johansen Co-integration Test

This paper employs testing for Co-integration to evaluate long-run (equilibrium) relationships and short-run adjustment (disequilibrium) between variables. Johansen`s method checks if the GDP modelling has empirically meaningful relationships between vector. There are several tests of Co-integration. Among these methods, Engle and Granger (1987) formulated one of the first test of Co-integration (or common stochastic trends), since then, the Engle-Granger (EG) has become a widely applied method of cointegration. In addition to EG long-run relationship approach, Johansen (1988, 1991) and Johansen and Juselius (1990) introduced a systems based approach to evaluate the existence of Co-integration among variables. Despite Johansen Co-integration test has weakness of the test on small sample size and sensitive to specification errors, it has theoretical advantage and methodological superiority (Sjö, 2008; Utkulu, 1997). Therefore, this paper employed Johansen Maximum Likelihood (ML) method to determine whether a stable long-run relationship (equilibrium) exists between the variables or not? The testing approach assumes that “the system is integrated of order one. If there are signs of I (2) variables, we will transform them to I (1) before setting up the VAR. By using the difference operator Δ = 1 − L, or L = 1 − Δ, the VAR in levels can be transformed to a vector error correction model (VECM) ” (Sjö, (2008).

Johansen Maximum likelihood approach identifies the number of cointegrating relationships between GDP and other variables. The Maximum Likelihood (ML) testing model construct based on trace test and Maximum Eigenvalue test. Where the null hypothesis is that the number of cointegrating vectors is r, against an alternative of (r+1) vector. The empirical model for this test is based on the following Trace statistics and Maximum Eigenvalue equations; as follow

$$\lambda_{Max}(\mathrm{r}, \mathrm{r}+) = -Tln(1 - \lambda_{r+1})$$

$$\lambda_{Trace}(\mathrm{r}) = -T \sum_{i=r+1}^{g} ln(1 - \lambda_{i)}$$

The Trace Statistic Test in below Table 4-3 indicates that GDP growth model has three Co-integration equations at 5% level. Therefore, the model has long-run association in GDP model.

Table 4-3. Johansen Co-integration Test (Trace Statistic)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	Critical Value 5%	Prob.**
None *	0.855058	174.3795	95.75366	0.0000
At most 1 *	0.824081	116.4369	69.81889	0.0000
At most 2 *	0.638744	64.30502	47.85613	0.0007
At most 3 *	0.522899	33.76001	29.79707	0.0166
At most 4	0.317416	11.55917	15.49471	0.1793
At most 5	0.003430	0.103069	3.841466	0.7482

Trace test indicates 3 cointegrating eqn(s) at the 0.05 level. * denotes rejection of the hypothesis at the 0.05 level. **MacKinnon-Haug-Michelis (1999) p-values

Nevertheless, Max-eigenvalue test result in Table 4-4 indicates Four cointegrating vectors. Therefore, the null hypothesis of no Co-integration has been rejected and the study accepted the alternative hypothesis of existence of Co-integration among time series data. The finding determined that there is long run equilibrium (relationship) between the variables.

Table 4-4. Johansen Co-integration Test (Maximum Eigenvalue Statistic)

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	Critical Value 5%	Prob.**
None *	0.855058	57.94262	40.07757	0.0002
At most 1 *	0.824081	52.13189	33.87687	0.0001
At most 2 *	0.638744	30.54501	27.58434	0.0202
At most 3 *	0.522899	22.20083	21.13162	0.0353
At most 4	0.317416	11.45611	14.26460	0.1328
At most 5	0.003430	0.103069	3.841466	0.7482

Max-eigenvalue test indicates 4 cointegrating eqn(s) at the 0.05 level. * denotes rejection of the hypothesis at the 0.05 level. **MacKinnon-Haug-Michelis (1999) p-values

4.3.6 Vector Error Correction Model (VECM)

After evaluating the stability of vector for stationarity and unit roots by performing ADF test. The vector should be in levels and first differences. VECM will be employed once the variables integrated in the same order and cointegrated. Then we proceed to check whether a long-run equilibrium exists between variables. Furthermore, Wald statistics preformed to identify the direction of short-run Granger causality. The empirical model of VECM is represented by the following equation

$$\Delta GDP_t = \propto + \lambda Z_{t-n} + \sum \beta_1 \,\Delta\, GDP_{t-n} + \sum \beta_2 \,\Delta\, GFCF_{t-n} + \sum \beta_3 \,\Delta\, \mathrm{EXPT} + \sum \beta_4 \,\Delta\, \mathrm{IMPT} + \sum \beta_5 \,\Delta\, \mathrm{EMPT} + \sum \beta_5 \,\Delta\, \mathrm{LBP} + \mu_t$$

Where, λ is the coefficient of error correction, and Z_{t-n} is error correction term (ECT), which is the lagged residual series of the cointegrating vector. Δ denotes first differences and n is the optimal lag length determined by AIC and SC criteria and μ_t is the white noise term. The coefficient of cointegrated equation indicates the speed of adjustment toward long-run equilibrium, the coefficient must be negative and significant. β denotes the coefficient of short-run equilibrium that measures Granger causality for error correction model (ECM) of dependent variable. Coefficient parameters of error correction term are the speed of adjustment for the short-run imbalances. All the variables of vector error correction model are endogenously determined within GDP model and the empirical result indicates the coefficient is negative and significant with p-Value of 3.9 percent. Therefore there are long-run causality from independent variable to GDP. GFCF, EXPT, IMPT, EMPT and LBP have positive impact in GDP growth in long-run. The Wald statistic result shows trade openness, export and import cause GDP growth in short-run, which is in favor of liberalization theory, this results are favorably comparable to those obtained in the literature (Sun and Shan, 1999; Allaro, 2012; Dawit, 2004).

But Gross Fixed Capital Formation and Labor Productivity Growth have no short-run causality with GDP, which is against endogenous theory.

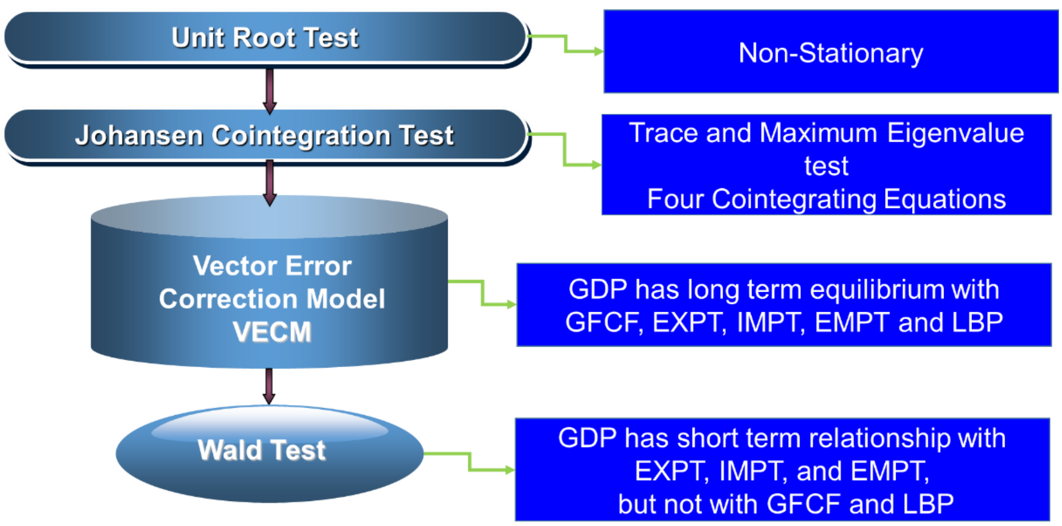
Moreover, this paper evaluate whether the GDP model has statistical problem or not by using the value of R-square and F-statistics (p-value). The finding concluded that there is strong R-square value and statically significant. Finally, we preform residual diagnostics test by using Breusch-Godfrey Serial Correlation test, Heteroscedasticity test of Breusch-Pagan-Godfrey, and Histogram Normality test. The finding indicates that there is no serial correlation and there is no Heteroscedasticity, therefore, we accept the null hypothesis, where as normal distribution test reject the null hypothesis, hence there no normal distribution in the model.

4.4 Conclusion

This study has measured GDP growth of Ethiopia by using Co-integration and Vector Error Correction model. The primary objective of the study is to determine the relationship between GDP growth and gross fixed capital formation, export, import, employment and labor productivity growth. The findings show that the time series data has unit root at level and became stationery at first difference. Moreover, the Co-integration test indicates that the series data is cointegrated in long run. VECM approach found evidence on the causality relationship between GDP and independent variable in long run.

The empirical result reveals that trade openness (export and import), human capital (employment and labor productivity growth) and physical investment (gross fixed capital formation) will cause GDP growth in long-run in Ethiopia. The Granger causality findings surprisingly indicate that gross fixed capital formation does not cause GDP growth in short run, which is theoretically unexpected. In addition, export causes gross fixed capital formation but reverse is statically insignificant.

Diagram 4-1. Summary of findings



Chapter Five

East Asian Economic Growth Model: The Adaptability of the Model in Ethiopia

5.1 Introduction

A majority of East Asian countries have achieved an impressive economic growth in the last four decades. Such economic growth was mainly driven by the state-led industrialization policies (Briscoe, 2008; Stiglitz, 1999; Zenawi, 2006). The World Bank's report on East Asia development in 1993 supported the argument that the economic growth was the result of developmental policies and unique state capacities that did not exist anywhere else. East Asian countries including Japan, the Asian tigers (Taiwan, Republic of Korea, Singapore and Hong Kong) and newly industrialized economies (Malaysia, Indonesia and Thailand) as well as China, these countries used to have similar GDP per capita income with Sub-Sharan African in 1960s, however they have achieved the impressive economic growth and they managed to reduce income inequality. World Bank called them the High Performing Asian Economies (HPAE). This study mainly focuses on four countries' economic growth, such as Japan, Taiwan, Korean and China. At an early stage, East Asian countries have rapidly grown in the quarter of a century. Ethiopia has also been growing on the pattern pf other East Asian countries. This achievement alone is not significant enough to conclude that Ethiopia is replicating their model. That is why, an evaluation of empirical literature on important macroeconomic indicators and social and institutional features is mandatory to get an in-depth knowledge of the topic under consideration.

East Asian growth was led by Japan's highly selective policy, followed by Hong Kong's laissez faire policy, and the developmental state policy of Taiwan and Korea. Unlike neoliberal economic policy, the economic packages of most East Asian governments provide incentive to encourage rapid industrialization through trade protection of infant industries (World Bank, 1993; Zenawi, 2006). Furthermore, East Asians countries adopted export-led policies and gradually opened their markets when their local firms acquired high productivity and skill levels. Interestingly, China's growth was laid by command economy and embraced globalization to a great extent than any other country in its early stage of economic growth (Boltho and Weber, 2009).

According to Cohen and Chiu (2013), East Asian countries included (China, Hong Kong, Taiwan, South Korea, Japan, and ten other ASEAN (Association of South East Asian Nations) have demonstrated impressive economic growth that made East Asia global production center that boost technological capability. The post-war macroeconomic development strategies had created diversity and unique capability in the region. As Hong Kong and Singapore emerged as regional financial center; Japan’s technological capability and innovation became key resource of power to influence the region and the “peaceful rise" of china dominated the international trade.

Briscoe (2008) asserted that Ethiopia, China, and Vietnam had borrowed the developmental state paradigm of East Asia. This argument was supported by Noman and Stiglitz (2008) as they say “resource-poor, and landlocked Ethiopia was attempting to emulate East Asia countries with a limited success.” The late Prime Minister of Ethiopia Meles Zenawi strongly argued in his thesis of “African Development: Dead Ends and New Beginnings”, African development needs a paradigm shift from neo-liberal paradigm of development, which is a dead end incapable of bring a change in Africa. He strongly favors “democratic developmental state” that encourages the role of government intervention in economy and prioritization of rural development (Stiglitz, 2002; Ohno, 2011). He further states “historical practice has shown that the state intervention has been critical in the development process. Economic theory has shown that developing countries are riddled with vicious circles and poverty traps that can only be removed by the state actions. The theory of the developmental state completes the alternative paradigm by showing what type of state can intervene in the economy to accelerate growth while at the same time limiting socially wasteful rent-seeking activities" (Zenawi, 2006, pp .9). It is hard to distinguish his intellectual thoughts and his government policies. It could be said that his argument was the reflection of his administration (Ohno, 2011; Noman and Stiglitz, 2008).

Despite proven track record of East Asian successful growth model, there is no single blueprint of developmental state policies. Different researchers presented different features of development model based on their country-specific studies (Zenawi, 2006; Boltho and Weber, 2009), but arguably, they have commonality that can be adopted based on political power of the country (Noman and Stiglitz, 2008). Kuznets (1988, pp. 12) supports the argument that there are some general reasons that a growth model can't be replicated in other country without taking into account the country-specific differences. This study evaluates whether Ethiopia can replicate East Asian growth model or not, and achieve a rapid growth that can reduce income inequality? Also, we assess whether the government intervention in economy enhance growth? Therefore, we try to identify a few general points that can lead Ethiopia toward similar growth pattern.

The study focuses at the early stages of high growth periods, during that time-span the miracles of East Asia was happened. Therefore, it compares Ethiopia with other East Asian countries having similar successful growth. The time frame for Japan started over the period 1950 to 1975, for Taiwan from 1960 to 1985, for Korea from 1965 to 1990 and for China 1980 to 2005. However, for Ethiopia the time period starts much later from 1994 after the introduction of structural reforms and implementation of liberal economy to 2015. The first parts of this study discusses about the fundamental characteristics of East Asian growth model. The second part summarizes the economic growth of Ethiopia. The third part empirically analyzes the similarity and difference of the growth model and finally discusses the findings. The analytical methodology is based on Ordinary Least Square (OLS) model of panel regression. The panel regression analysis method is executed with Random-effects model of GLS regression, and tested by Hausman fixed-random test model (Greene, 2000; Levine and Renelt, 1992). All the statistical inferences are performed on STATA and E-Views econometric softwares.

$$Y_i^t = \alpha_i + \sum_i^n \beta_i X_i + \varepsilon_i$$

$$Y_{ij} = \alpha + \beta_1 x_{ij} + \beta_2 z_{ij} \dots \beta_n x_{ij}$$

5.2 East Asia development model

The East Asian growth was led by Japan’s highly selective policy, followed by four Tigers, Hong Kong laissez faire policy, and developmental state policy of Taiwan and Korea (Chang, 1999, February). The economists attempted to explain and analyze the ‘miracle’ of East Asia economic growth in different perspectives. They argued that the sustainable growth achieved because of the role of government on effective allocation of resource and accumulations of knowledge through investing on education, health and infrastructures. Simultaneously, they greatly stressed on the role of knowledge accumulation, technology acquisition and productivity growth (World Bank, 1993).

Empirical studies identified the factors behind the East Asian miraculous growth are high rate of investment on physical and human capital, increasing agricultural productivity, and effective macroeconomic management that encouraged savings and government intervention in financial system and industries. Export oriented industrialization policies boosted the competitiveness of local firms. Likewise, the economic packages of most East Asian countries provided government incentive to encourage rapid industrialization through trade protection to infant industries (World bank, 1993; Rao, 2001; Zenawi, 2006).

The growth of East Asian countries has commonality in terms of macroeconomic performance and stability. They achieved impressive economic growth and reduced income inequality.

> The HPAEs have achieved rapid growth through successful attainment of both fundamentalist and mystic objectives. They have performed better than most low- and middle-income countries three critical functions accumulation, allocation, and technological catch-up. They did this with combinations of policies ranging from market-oriented to state led that varied both across economies and over time (World Bank, 1993, p.17).

Kwon and Kang (2011) presented the East Asian economic development model in five different perspectives. They argued that physical capital and natural resource has little contribution to East Asian growth, but human capital and government policies had played great role to bring structural transformation as their policy was based on “the centrality of policy-augmented human capital”. They praised the ability of state policies to identify the right industry and to diversify the composition of an industrial portfolio through introducing import substitution industrial policy (inward oriented) and export-led policy (outward oriented). As a result, the industrial portfolio had greatly diversified from low value added labor intensive industries to high value added capital intensive industries. Remarkably, the states introduced economic differentiation schemes to provide incentives to the industries that performed better and punished uncompetitive industries. At the beginning of growth, East Asian countries had given priority to prosperity rather than democracy. Despite the absence of political freedom, East Asian countries have enjoyed political stability that contributed to East Asian miracle (Fukuyama, 1992; Huntington, 1996).

Boltho and Weber (2009) summarized East Asian development model by stressing the importance of manufacturing sectors and strengthening external competitiveness to achieve rapid economic growth. Among the features of East Asian models, adopting the intervention policy, rewarding local firms and protecting from foreign companies are some of the commonalities of the model. Furthermore, among other characteristics of the models, they had stable macroeconomic policy, they managed to control less than double digit inflation rate, and their budgetary balances were in surplus, and they attained low birth rate. These had contributed to high level of human capital formation and reduced income inequality. Nevertheless, they established competent bureaucratic system with fairly authoritarian governments.

5.2.1 East Asian economic growth Empirical Analysis

The "miracles" of East An economic growth was started by Japanese leadership, and Taiwanese followed Japanese model of development. Sooner, Hong Kong, Korea, and Singapore repeated impressive growth. China also joined growth trajectory after introducing open-door economic policies. For decades, East Asian countries have achieved high growth, which is above average global GDP growth rates (Rao, 2001; World Bank, 1993). Export led industrialization policy has played a vital role in increasing productivity and competitiveness in the global markets. As a result, Japan and China has accumulated the highest foreign exchange reserves, gained by trade surplus. This stimulated both countries to invest in the region, and engage in currency swap agreement. Furthermore, Japan is one of the engines for East Asian economic growth, also Japan is not only investing in the region but also has transferred value added product technology and advanced process technology in the entire world.

According to Cohen & Chiu (2013), and Hong, (2011) East Asian countries to some extent developed autonomy especially Japan and China. Both countries extended their autonomy “power over” beyond their boundaries and influenced the region by means of international trade and financial powers. Asian countries expanded their cooperation of “economic nationalism”, coexists with globalization from trade and investment to financial swap to manage balance of payments, controls exchange rate, and intellectual property rights. Indeed, East Asian countries established regional blocks and exercised autonomy at least to reduce influence of outsiders in terms of trade. Furthermore, geographic proximity and similarity of culture have contributed for establishing regional networks and facilitate technology up scaling through international trade. Accordingly, East Asia became one of the best investment destinations and production power house.

Figure5-1 below compares economic growth of East Asia, and Sab Saharan African countries in different periods of time, starting from 1961 to 2013. The average growth rate of East Asia was 6.12 percent from 1961 to 2013. Since 1960s Japan and four Asian Tiger countries were leading the growth rate until Chinese took leadership position in 1980s. During the same period, Ethiopian growth rate was below the East Asian countries, and Sub Saharan African countries. In 1990s, however, Ethiopia implemented state-led development policies, since then Ethiopia has emerged as the fastest growing economy in Africa (The

Economist, 2012; IMF, 2014; WDI, 2014).

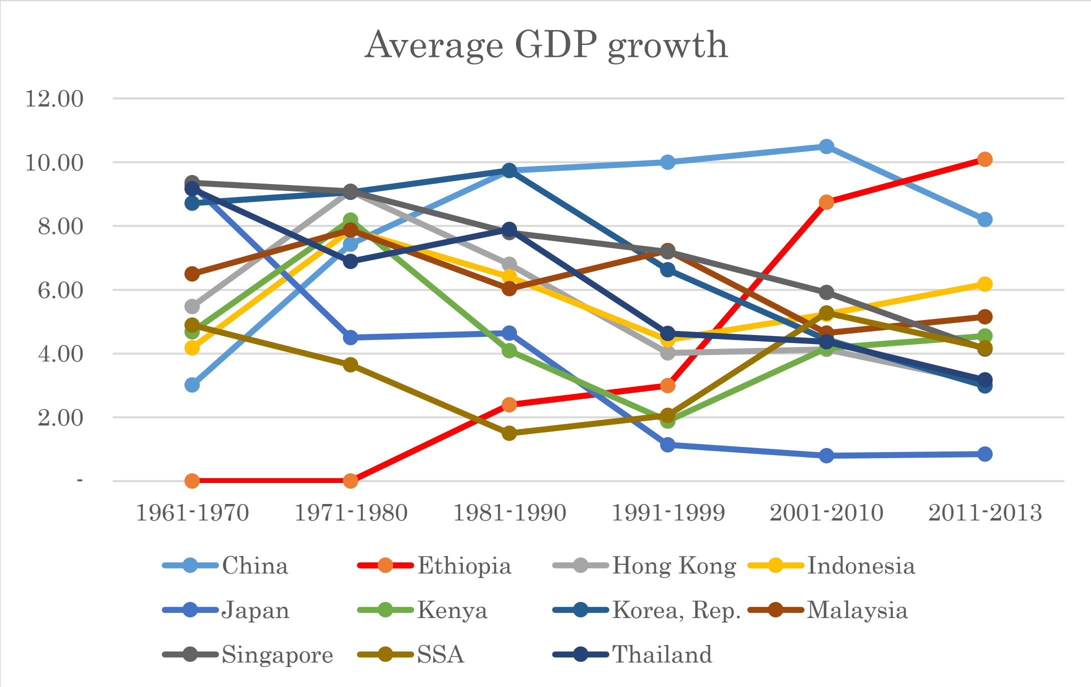


Figure 5-1. Average GDP growth rate. A comparative analysis Ethiopia with East Asian, SSA countries. (Source: author`s compilation of World Bank Development Indicators)

Figure 5-2 below shows that in 2000s Ethiopia surpassed the East Asian countries in terms of GDP growth rate and listed second to China. The growth momentum of Ethiopia has been continuing in 2010s and surpassed even China and became top growing economy above the East Asian countries. IMF forecasted that this growth trajectory will continue for foreseen future.

Rank	Country	Average GDP Growth 2001-2013		Average GDP Growth 2011-2013
1	Ethiopia	9.42	Ethiopia	10.09
2	China	9.35	China	8.21
3	Indonesia	5.71	Indonesia	6.18
4	Singapore	5.03	Malaysia	5.15
5	Malaysia	4.90	Kenya	4.55
6	SSA	4.72	SSA	4.17
7	Kenya	4.36	Singapore	4.14
8	Thailand	3.77	Thailand	3.17
9	Korea, Rep.	3.71	Hong Kong	3.09
10	Hong Kong	3.61	Korea, Rep.	2.98
11	Japan	0.82	Japan	0.84

Figure 5-2. GDP growth ranking. A comparative analysis Ethiopia with East Asian, SSA countries. (Source: author`s compilation of World Bank Development Indicators)

5.2.2 East Asian Gross Domestic Savings

The East Asian growth caused by high domestic saving (Thimann & Dayal-Gulati, 1997). According IMF, East Asian countries' saving rates have been increasing after 1960 while savings rate in Latin America had stayed broadly constant from 1970. But Sab Saharan African countries saving rate had decreased form 1970s positions. Figure 5-3 indicates that most of the East Asian countries have average saving rate between 30 to 40 percent. The saving rate is exceptionally high in Singapore, touched upon 40 to 50 percent for the last four decades, and China appeared as the highest saving country next to Singapore since 1993. The saving rate of Ethiopia is the lowest even below average saving of SSA which is around 20 percent but recently savings have been improving, in other hand, saving rate for

Kenya became deteriorating.

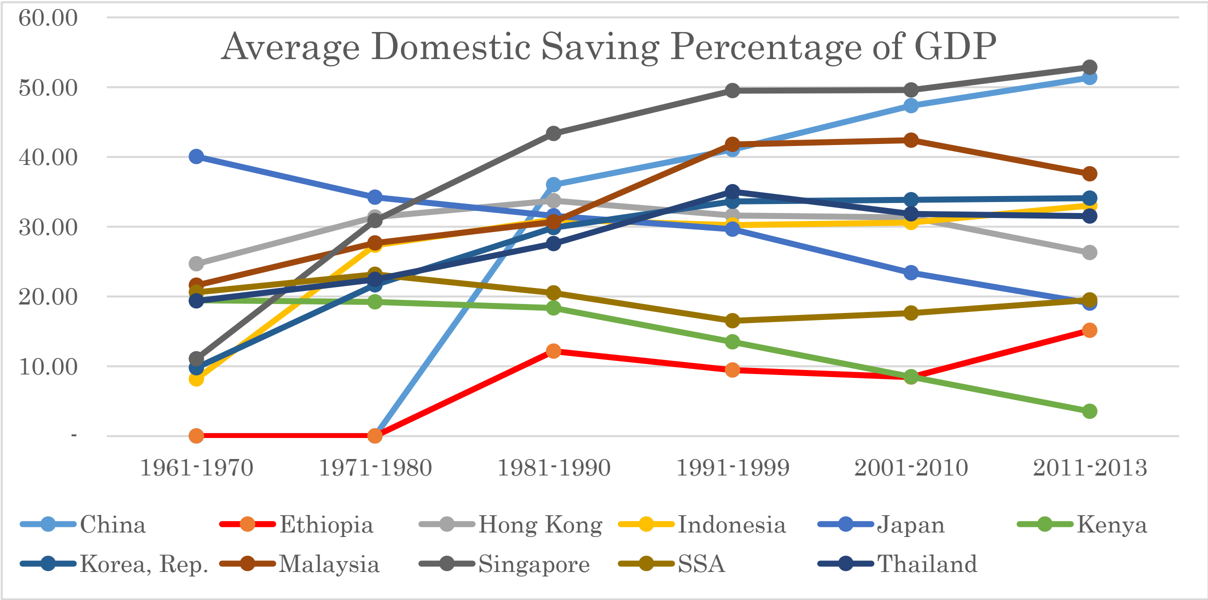


Figure 5-3. Average domestic gross saving. A comparative analysis Ethiopia with East Asian countries. (Source: author`s compilation of World Bank Development Indicators)

5.2.3 East Asian investment

For decades, East Asian countries achieved sustainable economic growth and increased per capita income. This consistent income growth contributed to high rate of saving that driven high rate of investment. Figure 5-4 shows that the average gross capital formation of East Asian countries are about 30% of GDP. Japan in 1960s, Singapore in 1970s and 1980s had a rate of about 40 percent of GDP, China, however, exceptionally has a rate between 40 to 50 percent of capital formation. After 2000, Ethiopia also leveled a rate of capital formation to East Asian countries.

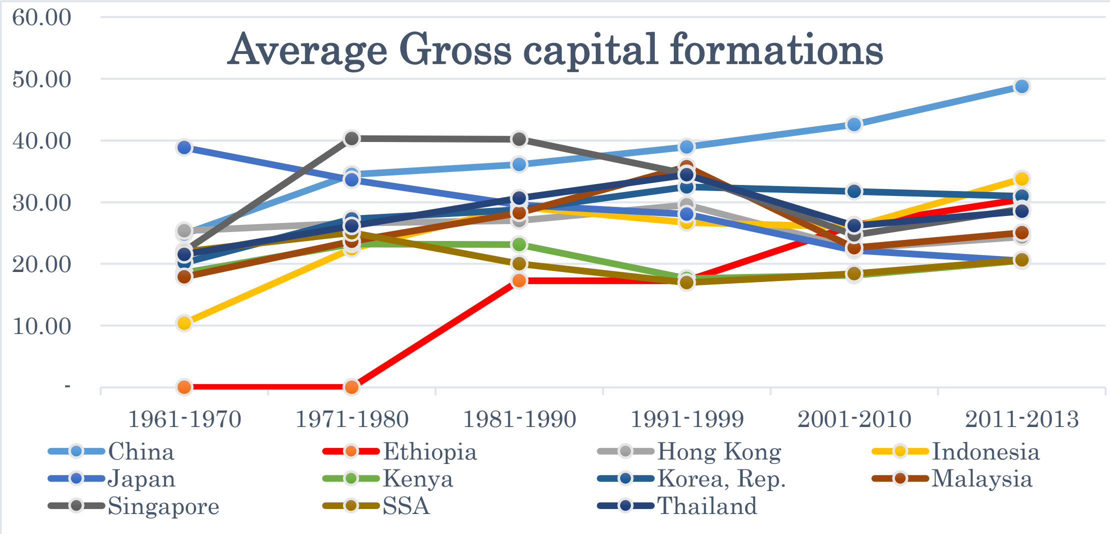


Figure 5-4. Average gross capital formations. A comparative analysis Ethiopia with East Asian countries. (Source: author`s compilation of World Bank Development Indicators)

Furthermore, we analyze and measured the linkage of investment and growth, by employing Incremental Capital Output Ratio (ICOR). The ratio of annual investment as percentage of GDP, which is gross capital formation to annual GDP growth rate (Rao, 2001b). Higher ICOR ratio indicates lower productivity. As Table 5-1 indicates East Asian countries used to have low ICOR in 1960s and 1970s, and high growth rates. After 2000, Ethiopia also has low ICOR just like the East Asian countries had at early stages of development. This indicates Ethiopia's growth is driven by labor intensive industries supported by agricultural-led industrialization policy (Ohno, 2011). Remarkably, Japan has different development structure and having a highest ICOR. Because, Japan invests in high-end capital intensive industries.

Table 5-1. Average ICOR. (Source: author`s compilation of World Bank Development Indicators)

ICOR	1961-1970	1971-1980	1981-1990	1991-2000	2001-2010	2011-2013
China	8.25	4.64	3.71	3.9	4.06	5.94
Ethiopia	NA	NA	7.21	5.76	3.01	3.02
Hong Kong	4.64	2.92	3.97	7.35	5.45	7.89
Indonesia	2.49	2.85	4.56	6.04	4.97	5.47
Japan	4.18	7.48	6.36	24.67	27.9	24.27
Kenya	3.97	2.84	5.66	9.36	4.35	4.51
Korea	2.32	3.02	2.96	4.9	7.15	10.39
Malaysia	2.76	3.01	4.68	4.94	4.87	4.87
Singapore	2.36	4.44	5.16	4.81	4.17	6.99
SSA	4.49	6.87	13.38	8.26	3.5	4.95
Thailand	2.35	3.8	3.88	7.43	6	9

5.2.4 Human Capital

Education is thought to be the most important determinant of the economic growth (Barro, 2002). The first phase of industrialization process starts on borrowed technologies. During this period, primary and secondary education are believed to be more important growth factors than tertiary education. However, in the era of knowledge economy, it is widely considered that the higher education has become a more important growth factor. As Table 5-2 summarizes, most of the East Asian countries, and Kenya have the highest rate of primary school enrolment, but there are significant variation in secondary and tertiary school enrolment. Japan has the highest rate of school enrollment in all stages, but Korea shows impressive improvement in terms of higher education enrolment rate and surpassed Japan. Whereas, Ethiopia has the lowest enrollment rate in all stages except the recent remarkable improvement that has registered in primary educations.

Table 5-2. Education indicators (Source: author`s compilation of World Bank Development Indicators)

School enrollment	**Primary (% gross)**		**Secondary (% gross)**		**Tertiary (% gross)**	
	1975	**2006**	**1975**	**2006**	**1975**	**2006**
China	123	119	48	67	0.48987	19.5188
Ethiopia	19	87	5	29	0.24	2.8
Hong Kong	116	96	46	80	8.88586	32.9846
Indonesia	88	108	21	64	2.61411	17.9113
Japan	99	102	92	101	24.6018	57.1059
Kenya	109	105	22	50	1.04	4.04
Korea, Rep.	104	102	54	97	7.73218	97.5059
Malaysia	91	101	44	68		28.5827
SSA	59	96	15	33	1.60596	6.24346
Thailand	84	97	23	72	3.59415	44.1596

5.2.5 Health

Table 5-3 presents health date for East Asian countries and SSA countries. Health indicators are the most important measurement tools of human development. East Asian countries have improved in all indicators, such as, Life expectancy at birth, mortality rate under-5, and infant mortality rate. In the early period, Ethiopia had the worst record in all indicators, and ranked below the average SSA. In 1960s and

1970s, Kenya used to have better health indicators in SSA, but recently, Ethiopia effectively managed to improve health condition and surpass Kenya in all health indicators.

Table 5-3. Health indictors. (Source: author`s compilation of World Bank Development Indicators)

	Life expectancy at birth		Mortality rate, infant (per 1,000 live births)		Mortality rate, under-5 (per 1,000 live births)	
	1960	**2012**	**1970**	**2012**	**1970**	**2012**
China	43.5	75.2	79	12.1	111	14
Ethiopia	38.4	63	140.1	46.5	237	68.3
Hong Kong	67	83.5	NA	NA	NA	NA
Indonesia	44.8	70.6	112.9	25.8	165.2	31
Japan	67.7	83.1	13.4	2.2	17.5	3
Kenya	46.4	61.1	90.3	48.7	146.4	72.9
Korea, Rep.	53	81.4	40.7	3.3	51.7	3.8
Malaysia	59.5	74.8	43.7	7.3	56.1	8.5
Singapore	65.7	82.1	21.9	2.3	27.3	2.9
SSA	40.2	56.4	140.9	64	241.2	97.9
Thailand	55.2	74.2	71.6	11.4	99.4	13.2

5.2.6 Exports

East Asian countries are known for their export- oriented development model and it became production center, and global investment destination (Hong, 2011; Sarel, 1996). Figure-5-5 illustrates total exports of goods and services, East Asian exports have been growing dramatically. Specially, after 2000, the share of export to GDP is above 30 percent. Singapore is an exceptional country that has been performing the best in Asia as well as in the world whose export share to GDP is about 200 percent. Whereas, Ethiopia had poor export performance and lagged behind East Asian countries. In 2015, Korean exports reached to 42.2 percent of GDP, which is 5 time higher than Ethiopia. The result of Ethiopia is differing to East Asian growth model. Thus, this unexpected poor achievement needs to be given extraordinary attention by policy makers to minimize the trade gap between exports and imports. Unless Ethiopia develops the value chains of international trade to become the export powerhouse and attains trade surplus, it will be hard to catch up and achieve the similar level of development as East Asian countries. To do so, Ethiopia should increase the capability of competitiveness and productivity to compete in the global markets.

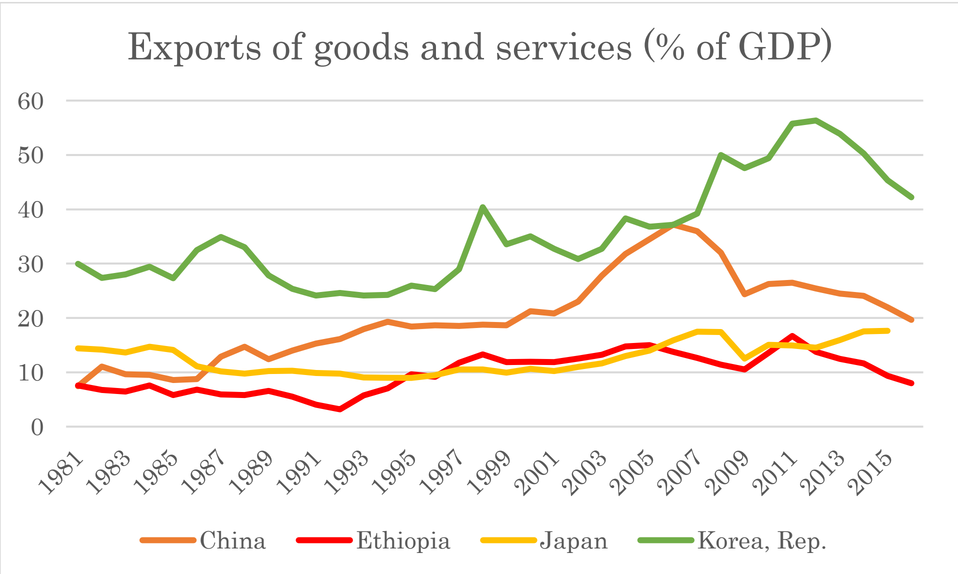


Figure 5-5. Export of goods and service percentage of GDP, comparative analysis

Ethiopia with East Asian countries. (Source: author`s compilation of World Bank Development Indicators)

5.3 Conceptual Background of Ethiopian Development Policy.

Ethiopia has started to follow the footsteps of East Asia growth (Briscoe, 2008; Ohno, 2011; Noman and Stiglitz, 2008; Zenawi, 2006). After introducing Structural Adjustment Program (SAP) in 1993, the government implemented medium term and long term development plans to articulate a development strategy that brought equitable growth to alleviate poverty. Zenawi (2006) argues that the neo-liberal paradigm of development is the major cause to African stagnation that ended up in poverty trap, thus, Africa required fundamental shift in paradigm to end vicious circle and to bring economic development. This argument is supported by Ohno (2011, p.34) "recognizing that predatory states and rent seeking culture have been the major obstacles to African development, the Ethiopian government is determined to build a developmental state. The state that promotes skills, technology and productive investments for all citizens, farmers and firms rather than patronage and personal gains for a few." He, further, summarized a development policy, as Ethiopia has "home-made" unique style and clear development strategy that has never seen in Africa but common in East Asia. Furthermore, Zenawi challenged neo-liberal paradigm and favored government-led development model. He states

> A night watchman state, a state whose intervention in the economy is very limited would be unable to overcome the vicious circles and poverty traps. The neo-liberal paradigms advocacy of such a state in developing countries is thus likely to keep such countries mired in poverty traps (2011, p.7).

Moreover, Ethiopia strongly valued government intervention in economy and criticized the Washington consensus i.e. Ethiopia does not allow “international best practices” to be imposed by the donors (Noman and Stiglitz, 2008; Stiglitz, 2002; Ohno, 2011).

Since, Ethiopia development policy has similarity with East Asian countries. In this study, we evaluate and measure whether Ethiopia can replicate East Asian growth model to achieve high growth and reduce income inequality while implementing government-led growth strategy as other Asian countries did in past. We employed comparative empirical analysis of Ethiopia with East Asian and Sub Saharan Africa (SSA) to determine the causes of growth, based on the indicators such as GDP growth, Gross domestic savings, Gross capital formation, Education, and GDP per capita income. This research mainly focuses on endogenous growth theory and Solow`s growth theory. These growth theory emphasize the role of human capital, labor force, and technology. Lucas (1998) states that the economic growth was recognized as the accumulation of human and physical capital, and increased productivity arising from technological innovation.

Hence, this section focuses on Ethiopia and examines empirically the factors that contributed for growth and reduced income inequality. The indicators are GDP per capita growth rate, GDP, human capital development (Education), investment and export. Human capital is the engine for economic growth (Barro, 2002; Nelson & Phelps, 1966). Economic growth has direct relationship with human development. The significant value of factors' coefficient for human development has positive correlation with GDP growth (Suri, Boozer, Ranis and Stewart, 2011).

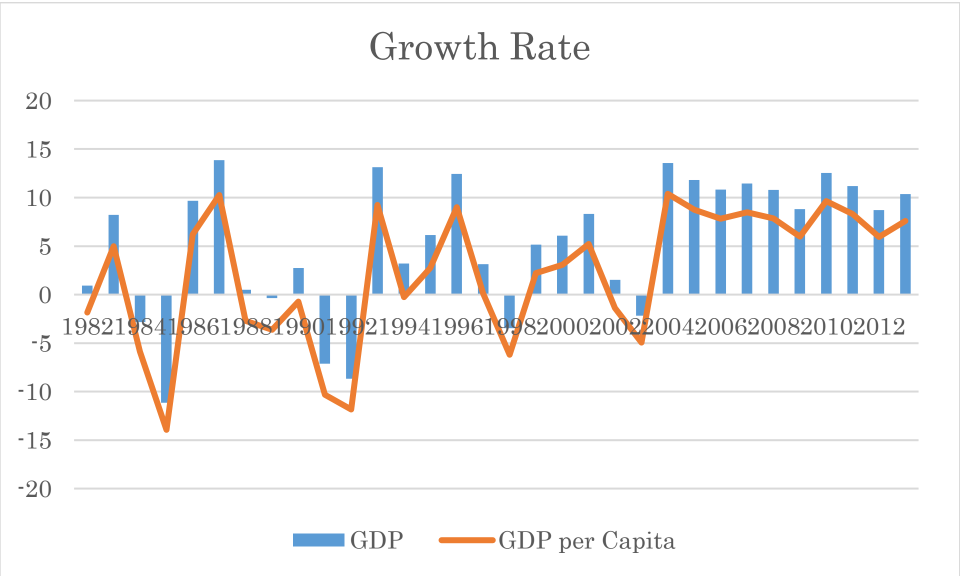


Figure 5-6. The GDP and GDP per capita income growth rate (Source: author`s

compilation of WDI)

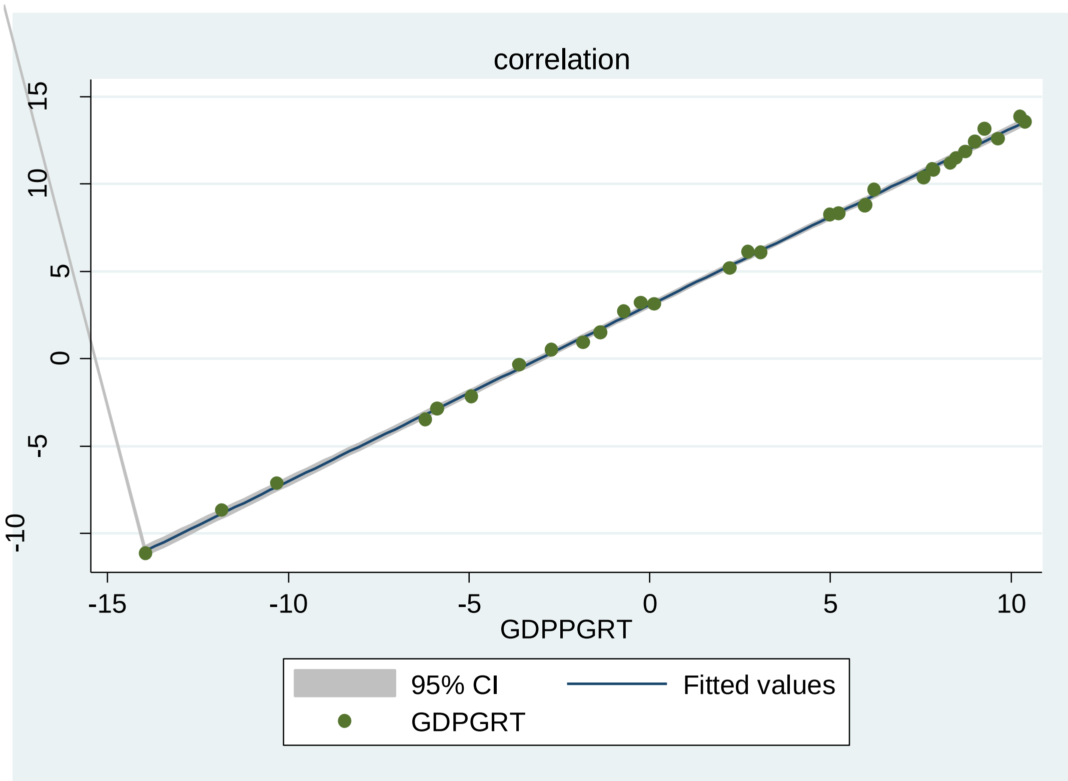


Figure 5-7 Scatter plot of GDP growth and GDP per capita growth rate

Figure 5-6 shows that Ethiopia has registered impressive economic growth and has become one of the fastest growing economies in Africa (IMF, 2014; MoFED, 2014). GDP growth rates were enhanced and GDP per capita income grew as high as East Asian countries' GDP. This high growth of per capita income contributed to decrease income inequality. Table 5-4 shows poverty headcount ratio at $1.25 a day (PPP and % of population) has reduced by half since 1995. Hence, the growth contributed to lift out millions from poverty. This fabulous achievement has leveled Ethiopia with other East Asian countries in terms of growth rates, but more efforts are required to catch up the benchmark countries. The trend of growth allows us to safely conclude that Ethiopia can replicate the East Asian growth model (Noman and Stiglitz, 2008; Ohno, 2011).

Table 5-4. Poverty indicators of Ethiopia (Source: author`s compilation of WDI)

Poverty indicators	**1995**	**2011**	**Change**
Poverty gap at $1.25 a day (PPP) (%)	21.23	8.19	61%
Poverty gap at $2 a day (PPP) (%)	41.19	23.64	43%
Poverty gap at national poverty line (%)	12.9	7.8	40%
Poverty gap at rural poverty line (%)	13.4	8	40%
Poverty gap at urban poverty line (%)	9.9	6.9	30%
Poverty headcount ratio at $1.25 a day (PPP) (% of population)	60.5	30.6	49%
Poverty headcount ratio at $2 a day (PPP) (% of population)	84.5	66	22%
Poverty headcount ratio at national poverty line (% of population)	45.5	29.6	35%
Poverty headcount ratio at rural poverty line (% of rural population)	47.5	30.4	36%
Poverty headcount ratio at urban poverty line (% of urban population)	33.2	25.7	23%

5.3.1 Human Capital

Endogenous growth theory focuses on the importance of human capital. The government of Ethiopia gave priority to human capital development by improving access to education and reforming the education systems (Bishaw & Lasser, 2012; Ministry of education, 2008; Overseas Development Institute, 2011). The ultimate objective of education is to attain development in order to alleviate poverty. A hefty amount is allocated in government’s budget to education sector for infrastructure development. Figure 5-8 below indicates that the total government expenditure on education increased from 8.6 percent in 1980 to 23 percent in 2009. The dramatic shift of expenditures, contributed for equitable expansion of schools throughout the country. Simultaneously, government established training centers and provided capacity building for new teachers and administrators (Ministry of education, 2008; Overseas Development Institute, 2011). The primary education enrolment rate has increased from its bottom line 21.7% to about 90.0% in 2005 (WDI, 2014). Despite such efforts Ethiopia still lagged behind in terms of secondary and higher education. More efforts are needed by the government to fill the gap of higher education to replicate the East Asian Model.

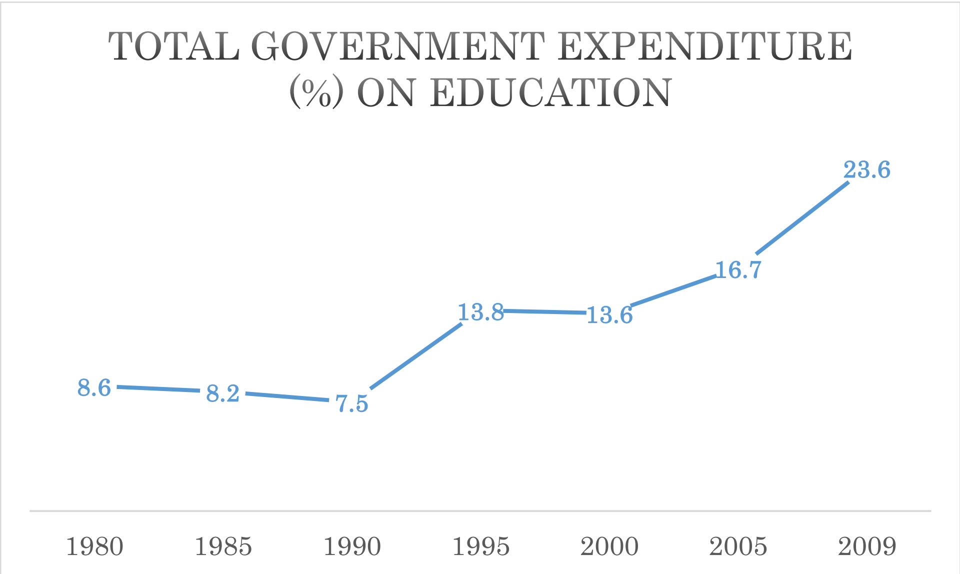


Figure 5-8. The government expenditure on education. (Source: author`s compilation of World Bank Development Indicators)

Table 5-5 shows the results obtained through Ordinary Least Square (OLS) method that indicates the correlation between GDP per capita income and education. The significant value of factors coefficient for education is (2.48) that indicates positive correlations with GDP per capita income.

$$GDPPC_{it} = \alpha + \sum \beta_1 EDU_{ijt} + \varepsilon_{it}$$

Table 5-5: Correlations between GDP per capita and education

GDPPC	Coef.	Std. Err.	t	P>t	[95% Conf.	Interval]
EDU	0.2842858	0.1144072	2.48	0.026	0.0389068	0.5296648
_cons	121.0836	7.667649	15.79	0.000	104.6382	137.5291

Ethiopia should improve human capital (education) with relations to other indicators. East Asian growth and innovation model can be taken as remarkably successful benchmark by improving quality of education and creating linkages with industries. As four Asian Tiger economies, especially Korea and Taiwan successfully achieved the education led growth. These countries had managed to transfer industrial sectors rapidly from labor intensive low-end products to the most advanced and technologically sophisticated products within two decades. This successful achievement was the results of education system that focused and supported on labor market demands (Amsden, 1992; Amsden and Chu, 2003, Briscoe, 2008; Nelson, 1992; Stiglitz, 1999; Zenawi, 2006). However, the prominence of East Asian success model alone is not sufficient enough to bring the wave of technological revolution by simply focusing on education that does not address or does not have linkage with commercial sectors. Therefore, Ethiopia would rather broaden the prospective education related to innovation frameworks. The notable experience of Argentina's case delivered valuable lesson to Ethiopian current education and innovation system. Nelson (1992) noted that the availability of an educated human power is not enough to bring innovation and increase productivity. Policy makers should provide economic incentives to create synergy between education institutions and labor markets that produce skilled working force to compete effectively with their competitors.

5.3.2 Trend of Investment

After, liberalizing investment policy and implementing market oriented economic development strategy, Ethiopia opened to a wide range of private investors and attracted both domestic and foreign investments. Among a notable reforms, the newly adopted investment policy allows foreign firms to invest in all areas of investment sectors except those reserved for domestic investors with Ethiopian nationality and for government. For example, Telecommunication sectors (reserved only for government), and financial and transportation sectors. Investment is the main factors that drives economic growth (Janjili, 2011; Rao, 2001b). Capital investment is one of the primary engines of economic growth.

Furthermore, neoclassical growth model emphasized the importance of physical capital and technological progress for economic growth (Janjili, 2011). The effectiveness depend on other determinant factors that are compulsory elements in the growth process. Physical and human capital are one of the most notable factors for economic growth. The Ethiopian government, therefore, encourage saving through raising awareness and implemeting new policy that encourages private and governement employees to have social pensions (MoFED, 2014). Theoretical and empirical literature reviews supports that saving and investment have causal relationships but the causality direction has mixed result (Lee & McKibbin, 2006; Hundie, 2014). Ethiopian saving culture has changed and gross domestic saving as a percentage of GDP has increased from about 11 percent in 2000 to 20 percent in 2016. Simultaneously, the saving rate creates momentum for raising the domestic investment. Furthermore, Ethiopian government expanded access to finance in order to encourage investment especially for micro and small scale industries. Figure 5-9 below indicates, a graph of gross domestic capital formations (percentage of GDP) increased to 40 percent in 2016 from 23 percent in 2000.

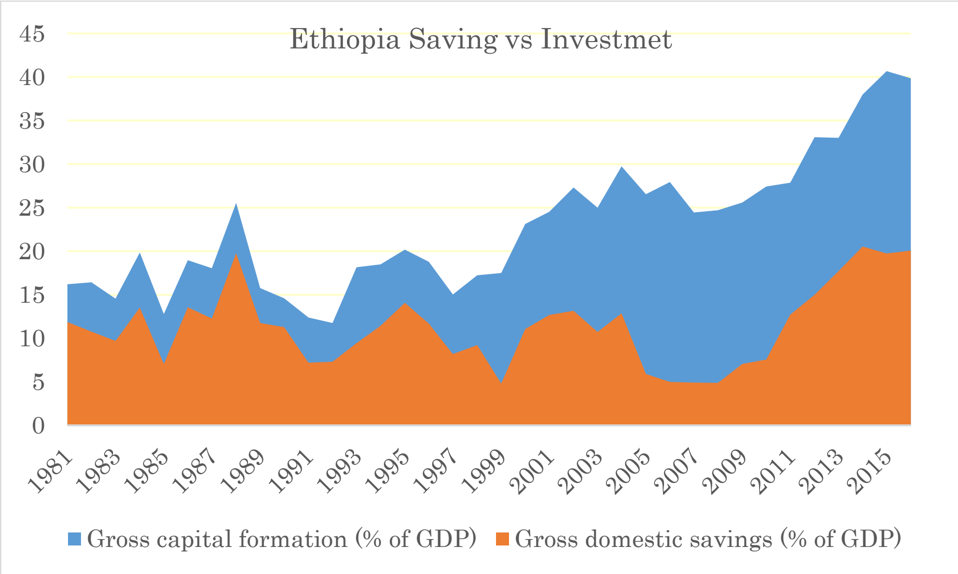


Figure 5-9. The trend of investment and saving. (Source: author`s compilation of MoFED and World Bank Development Indicators)

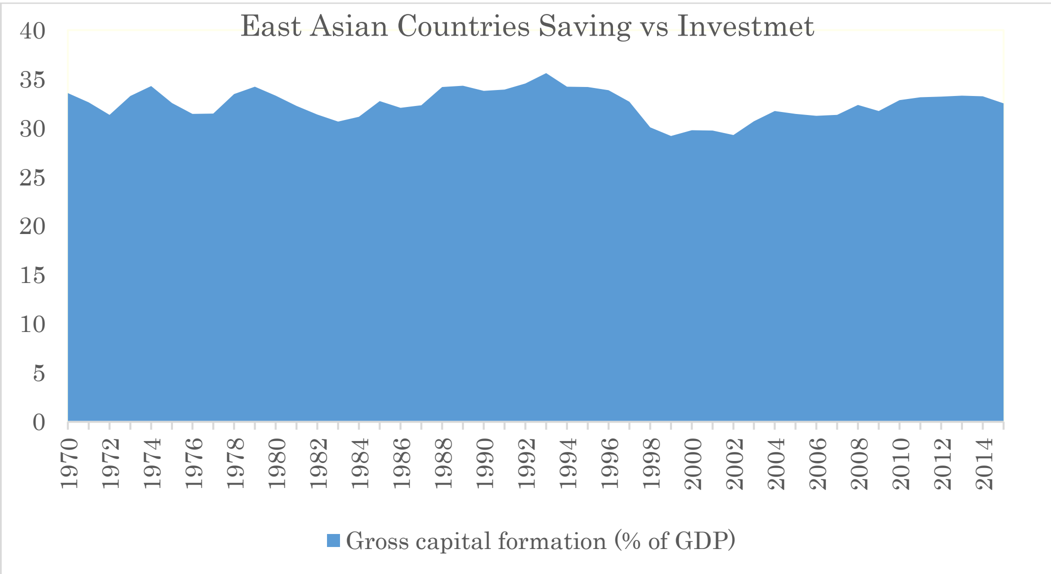


Figure 5-10. The trend of East Asian countries investment and saving. (Source: author`s compilation of MoFED and World Bank Development Indicators)

Despite having an increasing capital formation there is a weak rate of domestic saving in Ethiopia. This result highly contradicts with East Asian growth model. Figure 5-10 illustrates that the East Asian countries have almost same rate of gross capital formation in percentage of GDP and gross domestic saving in percentage of GDP. That means they have high domestic saving ratios (Rao, 2001b; Maddison, 2006; Thimann & Dayal-Gulati, 1997; World Bank, 1993). Although, after Ethiopia claiming East Asian growth model, the gap of domestic saving and investment has widen with an alarming rate. This requires a serious policy adjustment to turn around the current trend without decreasing the ratio of gross capital formations since private saving has adverse effect on investment.

Saving behavior has thought to be influenced by government policy. The following factors have to be addressed by policy makers. First of all, fiscal policy that increases public saving through tax reform and taking austerity measure on certain public expenditures by increasing quality of services and productivity. Secondly, macroeconomic stability has great contribution to increase broad-based savings and investments while controlling high inflation (especially artificial inflation), interest rate, and creating consumer confidence on economy. “The simplest way to let the interest rate or yield on capital influence the volume of savings is to make the fraction of income saved depend on the real return to owners of capital" (Solow, 1956, pp.88). Third, improving social security system through enforcing all relevant sectors to adopt pension system that has significant effect on private saving. Last but not least, financial market development is a backbone for economic establishment of a nation, hence Ethiopian financial market have to provide world class services that equipped with the state of art technology in order to create easy access to users, and to encourage savings. Furthermore, the government needs to promote domestic savings by improving household's income through controlling the inflation and interest rate. The household's income should be higher than the growth rate of inflation and interest rate.

In addition to empirical analysis, we employed OLS regressions to examine the linkage between economic growth and investment. Table 5-6 indicates the OLS regression analysis of GDP per capita growth rate indicates the significant value of factors coefficient for investment is (2.66).

$$GRT_{it} = \alpha + \beta_1 INV_{ijt} + \varepsilon_{it}$$

Table 5-6: Correlations between GDP per capita growth rate and Investment

GRT	Coef.	Std. Err.	t	P>t	[95% Conf.	Interval]
INV	0.5260966	0.1981029	2.66	0.013	0.1215164	0.9306768
_cons	-8.813521	4.291095	-2.05	0.049	-17.57711	0.0499372

5.3.3 International Trade

Globalization and trade openness accelerate international trade and regional integrations. Export-led growth theory favored East Asian growth model (Hong, 2011; World Bank 1993). Since 1991, Ethiopia completely shifted from command economic policies to liberal economic policies that promote trade openness (Geda & Berhanu, 2000; Rashid, Assefa & Ayele, 2009). The classical economic theories supported that international trade has significant role in economic growth, it creates competitiveness through specialization, and also exports have a positive contribution to economic growth (Jung and Marshall, 1985; Siddiqui, Zehra, Majeed, and Butt, 2008). Ethiopia implemented export-led growth strategy to increase competitiveness and boost export that catalyzed GDP growth (Ohno, 2011). Government provides incentives and promotes export sectors, such as, agricultural and minerals sectors. Hence, Ethiopia has diversified export items from coffee to sesame, leather goods, flowers, and minerals. Export industries have enjoyed considerable success (Noman and Stiglitz, 2008). In 1991, Exports was 2.3

percent of GDP that has sharply increased to 17 percent in 2011. However, this growth was not sustainable in the long run just like the East Asian countries. Despite double digit economic growth, the performance of exports has been declining by half and reached below 10 percent of GDP in 2015. A recent progress is against government target, and it contradicts export oriented growth model that was adopted from the East Asian countries. Therefore, Ethiopian exports sector needs to bring paradigm shift from price competitiveness to quality competitiveness by increasing value added goods and service as well as enhancing productivity.

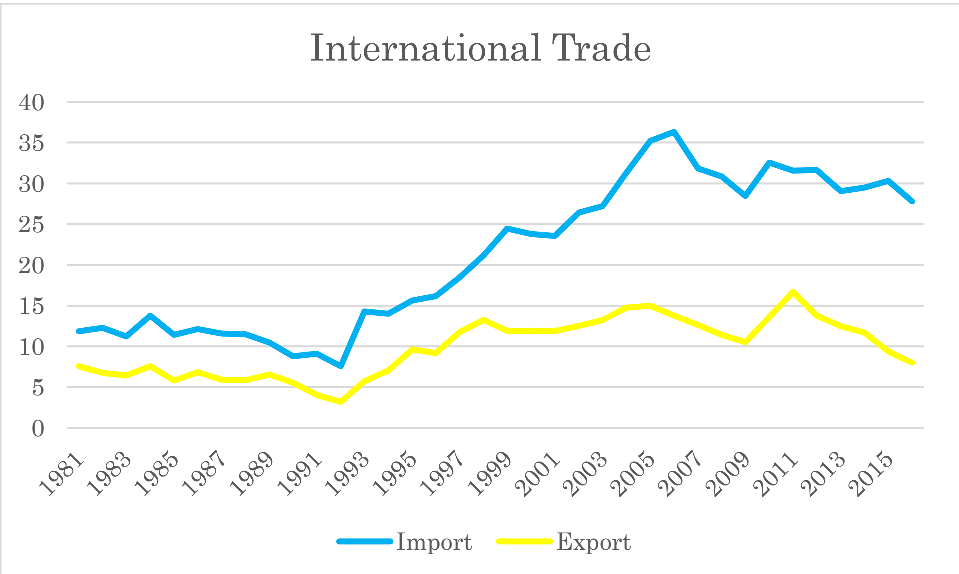


Figure 5-11. Exports of goods and services (% of GDP). (Source: author`s compilation of MoFED and World Bank Development Indicators)

Figure 5-11 above indicates that since 1991 exports and imports have been increased with similar growth rate, however after 2000, the growth rate of imports has accelerated while exports' growth has raised steadily. Local manufactures were unable to compete with import and produce enough to satisfy a growing domestic demand. As a result, the gap between imports and exports have been widened gradually. Even though, it is too early to conclude that the performance of Ethiopia regarding international trade and industrialization strategy has failed to replicate East Asian growth model, it can be said it unambiguously contrast to East Asia development model. Hence, Ethiopia has to give equal attention to import substitution policy with export-led industrialization policy. The East Asian countries effectively utilized import substitution to accumulate an industrial technological know-how and competence, at the same time, they easily managed to access local market. "Starting with the low-skilled, labor intensive manufacturers, these countries gradually moved on to manufacture more technologically complex products for exports using competencies and skills acquired in the ISI phase. Typically, protectionist industrial policy featured strongly in the East-Asian experiences (Ogujiuba, Nwogwugwu & Dike, 2011, pp.8). This requires economic policy that advocates domestic production by providing incentives to local manufacturers, and support on human capital development to increase a capacity of local manufacturing sectors, and to expand import substitution industries.

Table 5-7 below indicates that the OLS regression analysis of GDP per capita growth rates are significant value of factors coefficients. For Exports its value (3.09), which is strongly correlated with GDP per capita growth rate. The Economic growth was driven by export lead growth strategy.

$$GDPPGRT_{it} == \alpha + \sum \beta_1 EXP_{ijt} + \varepsilon_{it}$$

Table 5-7: Correlations between GDP per capita growth rate and export

GDPPGRT	Coeff.	Std. Err.	T	P>t	[95% Conf.	Interval]
EXP	0.909417	0.2939065	3.09	0.004	0.3083108	1.510523
_cons	-7.078691	3.137771	-2.26	0.032	-13.49615	-0.661228

The econometrics analysis confirms a significant correlation between export and macroeconomic indicators that favored international trade theory and growth theory. The empirical finding on import and export performance failed to meet the government target, also it contradicts export-led growth strategy that was emulated from East Asia countries. Therefore, Ethiopian industrialization policy needs to bring paradigm shift from labor intensive and price competitive primary goods to knowledge based and quality oriented industry by creating conducive environment to entrepreneurs. Accordingly, import and export sectors have to focuse on competitiveness and increased output through improving value added goods and services. Moreover, international trade indicators, particularly, export related indicators need to be improved in order to be competitive in global stages.

The following indicators have strong relationship with productivity improvement, such as cost to export per container, Time to export, and Time to export documentary compliance. In all of these indicators, Ethiopia has performing very badly and Singapore has performing the best among East Asian countries in terms of cost to export per container an time to export. In Singapore, per container export cost is cheaper than China roughly by half, and also it takes less time to export goods and services (3.5 time less than China). This gives Singapore a competitive advantage and makes Singapore an export power house. As a result, Singapore is the most competitive country in the world. Nowadays, Singapore is the only East Asian countries that has the highest export to GDP (percentage of export to GDP is above 200 percent). Korea is also performing better, especially time to export documentary compliance only takes an hour, while it take two hour in Singapore and Japan, in China it takes 21 hours. The Ethiopian case is the most unproductive, time to clear the same document take 91 hours, which literally means 91 times higher than Korea. In addition, Cost to export is 5 times higher than Singapore, almost 3 times higher than Japan and China. These international trade indicators exposed Ethiopian position in regard of global competitiveness, and also provides unambiguous answers for export-led growth hypothesis. Therefore, Ethiopia should learn from East Asia thoroughly to turn around and solve the issues of international trade. Undoubtedly, policy makers will be able to improve these indicators to increase efficiency and productivity by creating transparent system in all level of government institutions. Simplifying procedures eliminate unnecessary steps, corruption, performs parallel processing, and utilize information technology system. Primarily, the most crucial part is creating awareness for each level of public services in order to change their attitude toward efficiency and productivity. This will gives comparative advantage and also increase efficiency and productivity.

Table 5-8: Export competiveness indicators of Ethiopia and East Asian countries

	China	**Ethiopia**	**Japan**	**Korea**	**Singapore**
Cost to export (US$ per container)	823	2380	829.3	670	460
Time to export (days)	21	44	11	8	6
Time to export, documentary compliance (hours)	21	91	2	1	2

5.3.3 Population growth

The literature on East Asian economic growth argued that controlling fertility rate is among one of the characteristics of growth model. Bloom & Williamson (1998) and Mason & Kinugasa (2008) argued that low fertility rates and economic development have strong correlations. The neoclassical growth model also supports that at early stages of economic growth, population has a moderate influence on GDP per capita income, while it has insignificant effect during the steady-state growth (Solow, 1956). Figure 5-12 indicates that the fertility rate of East Asian countries had started to decline since 1960. Japan has registered the lowest growth rate (0.57 percent). However, Ethiopian population has been growing by average 2.7 percent per annum. Ethiopia has implemented strong family planning program similar to East Asia countries, but it is not as effective as East Asian countries to reduce fertility rate. This should not be a primary concern to increase income inequality, the main issue for Ethiopia is to bring inclusive growth through job creation.

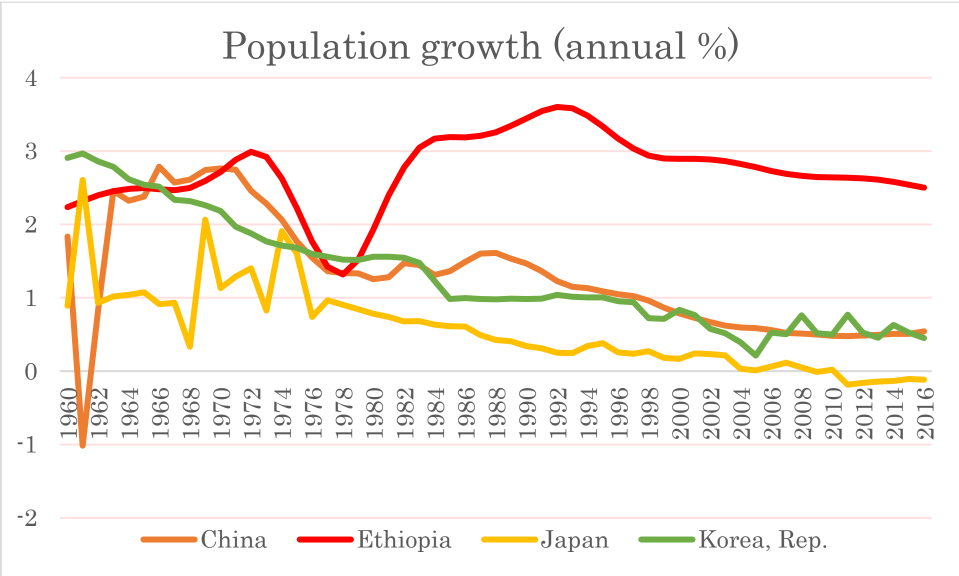


Figure 5-12. The trend of Ethiopia East Asian countries Population growth. (Source: author`s compilation of MoFED and World Bank Development Indicators)

5.4 Conclusion

East Asian countries achieved high economic growth and reduced income inequality. The growth had started by Japanese leadership and followed by four tigers and newly industrialized countries. The East Asian miracles growth were driven by high rate of investment on physical and human capital, effective macroeconomic management and government intervention in financial system and industries. In additions, export-led industrialization policies enhanced the competitiveness of local firms. Likewise, the economic packages of most East Asian countries` provided government incentive to encourage rapid industrialization through trade protection to infant industries. Accordingly, East

Asian demonstrated impressive economic growth and became production powerhouse. These factors boosted technological capability of the region.

Ethiopia also has adopted similar development policies with East Asian countries by implementing state-led development policies, since then Ethiopia has been emerging as the fastest growing economy in Africa. The empirical findings indicate, Ethiopia has achieved high economic growth and reduced income inequality alike East Asian countries. This marvelous achievement leveled Ethiopia with East Asian countries in terms of growth rate and other development indicators. The growth trend can give confidence to conclude that Ethiopia can replicate East Asian growth model. However, it needs to be done more to catch up to East Asia countries. It needs to invest on human capital, particularly, the education policy should be improved to enhance the enrolment rate of secondary education and tertiary educations. Likewise, controlling fertility rate through education is equally important. In addition, domestic saving rate and the export sector failed behind East Asian. This needs to be given serious attention to encourage saving and to boost export through creating competitive environment to minimize the trade gap between export and import. Unless Ethiopia becomes export center and attains trade surplus, it will be challenging to catch up and achieve the same level of development as East Asian countries. To do so, Ethiopia should increase the ability of competitiveness and productivity to compete in global markets.

Chapter Six

The Relationship of Economic Growth, Innovation and Human Development in Ethiopia

This chapter is divided into three main parts. Part one analyzes macroeconomic policies of Ethiopia and evaluate the recent macroeconomic development and performance. Specially it focuses on government development strategy and evaluates the achievement of macroeconomics indicators, such as economic growth, investment and export. Part two presents the characteristics of innovation and the relationship with economic growth and human development. Explicitly, highlighting on innovation indicators, by employing a comparative analysis of Ethiopia with East Asian countries as well as Sub Saharan African countries. In addition, it focuses on the following pillar of innovation indicators such as, Capacity for innovation, FDI and technology transfer, Business Sophistications, Company spending on R&D, University-industry collaboration in R&D, ICT use, and Patent applications per million population. Part three evaluates the impact of economic growth on human development, basically it takes into consideration human develop index, like education, poverty, and mortality rate, while presenting comparative analysis with African and East Asian countries. Exceptionally, focuses on Ethiopia and Kenya, because they have more in common than any other neighboring countries. Their commonalities are not limited to geographical features and proximity, both countries' majority of population live in highland area and surrounded by tropical lowland and desert, and also they are dependent on livestock and agricultural products. These two countries' export heavily depended on commodity products, particularly coffee and horticulture. And also they passed through similar economic policy and political systems.

6.1 Macroeconomic policies of Ethiopia

A section of this chapter examines empirically the current growth trend, the impact of government policy on macroeconomic development, and evaluates the structural transformation in the economy. The study of macroeconomic policy mainly focuses on current ruling regime of Federal Democratic Republic of Ethiopia (FDRE). During the last fifteen years, Ethiopia has implemented different kinds of macroeconomic policies and achieved impressive growth that could bring the structural transformation (MoFED, 2014; World Bank, 2014; IMF, 2014). After long civil war, the current government had started to build the nation under federalism principle. Those policies had contributed for nation building and brought the stability in the country. Simultaneously, government has invested on human capital development particularly, emphasized on strengthening of the internal capacity building for civil servants and has expanded infrastructural development.

The ultimate objective of Ethiopian government is to eliminate poverty by bringing the structural transformation to the economy in order to achieve sustainable economic growth. Therefore, Ethiopia has implemented different macroeconomic policies at different periods. First policy they introduced in 2002 to 2005, The Sustainable Development and Poverty Reduction Program (SDPRP), second policy was implemented from 2005 to 2010. The Plan for Accelerated and Sustained Development to End Poverty (PASDEP), and the third policy implemented from 2010 to 2015, was the Growth and Transformation Plan (GTP) that highly prioritize to achieve Millennium Development Goals (MDGs). The fourth development plan is the second Growth and Transformation Plan (GTP II). This latest policy was drafted based on the experience of the first Growth and Transformation Plan, which took into consideration the lesson of the pervious development plans, challenges and success experiences. All of the above development polices except the GTP II (it is the ongoing plan) had implemented effectively, and had positive outcomes. Similarly, they identified bottlenecks and core issues to be improved in future. After implementing these policies, Ethiopia has achieved sustainable GDP growth and has improved human development (African Economic Outlook, 2017; MoFED, 2014).

The First comprehensive development strategy and macroeconomic policy introduced in 2002 to 2005, which was The Sustainable Development and Poverty Reduction Program (SDPRP). This policy created a momentum for current sustainable economic growth. According to Federal Democratic Republic of Ethiopia Minister of Finance and Economic Development (MoFED). The fundamental development objectives of the Federal Democratic Republic of Ethiopia (FDRE) set out in the SDPRP were to build a free-market economic system in the country, which enables the economy to develop rapidly, to end dependence on food aid, and to allow poor people to benefit from economic growth. The development strategy was built on four pillars: a) Agricultural Development-led Industrialization (ADLI); b) Reforms of the Justice System and the Civil Service; c) Decentralization and empowerment; and d) Capacity building in public and private sectors (2006).

The development policy indicates that, the government of Ethiopia made strong commitment to implement the development polices in order to alleviate poverty, and to achieve Millennium Development Goal (MDG) by 2015 to reduce poverty by half from current poverty level. Ethiopian government, the World Bank, the IMF and other stakeholders started to work closely to bring macroeconomic stability to achieve Millennium Development Goals through sustainable economic growth i.e. above 5.7 percent growth rate. The overall performance of the sustainable development and poverty reduction program had significant results except 2002-03 (negative 3.3 percent GDP growth) because of prolong drought that happened in the country. During this period, the agricultural sectors were heavily affected and the production had sharply declined. Despite industrial output increased by 3 percent of GDP, agricultural production growth was negative 11.4 percent. Particularly, the crop production declined by 25 percent that occupied 60 percent of total agricultural output. During this period, Ethiopia was not only affected by drought but also seriously affected by the collapse of global coffee price (IMF, 2004; MoFED, 2006). Since 86 percent of Ethiopian export depended on agricultural output wherein coffee had the majority share of export (Ruben, Pender & Kuyvenhoven, 2007).

Ethiopian economy recovered rapidly and registered positive growth. The real GDP growth was 11.9 percent in 2003-04 and 10.6 percent in 2004-05 (MoFED, 2006; AfDB, 2014). Along with favorable raining season, all macroeconomic indicators and social sectors had contributed to economic growth. During Sustainable Development and Poverty Reduction Program (SDPRP) implementation period, the average economic growth was 6.4 percent (MoFED, 2006). The agricultural production recovered quickly in 2003-04 as production increased by 17.3 percent; at the same time industrial sectors' output growth was 10 percent of GDP. The positive trend of growth had continued in 2004-05, the agricultural production and industrial output increased by 13.4 percent and 8.1 percent of GDP respectively. The overall economic growth was boosted up by strong private consumption expenditure that increased by three fold from 8.2 percent in 2002 to 23.1 percent in 2005. Simultaneously, the growth of domestic investment also increased by three fold to 15.5 percent in 2004 from 4.5 percent in 2002 (AEO, 2014; MoFED, 2006).

The Ethiopian government policies played an important role through investing on pro-poor development sectors. Government capital expenditure had increased and defense expenditure was decreased. The government gave priority for five sectors, such as education sector, agriculture and food security, health, road and water and sanitation. These five sectors' expenditure increased from 43% to

57%, which education and agriculture and food security occupied major shares of total government expenditures.

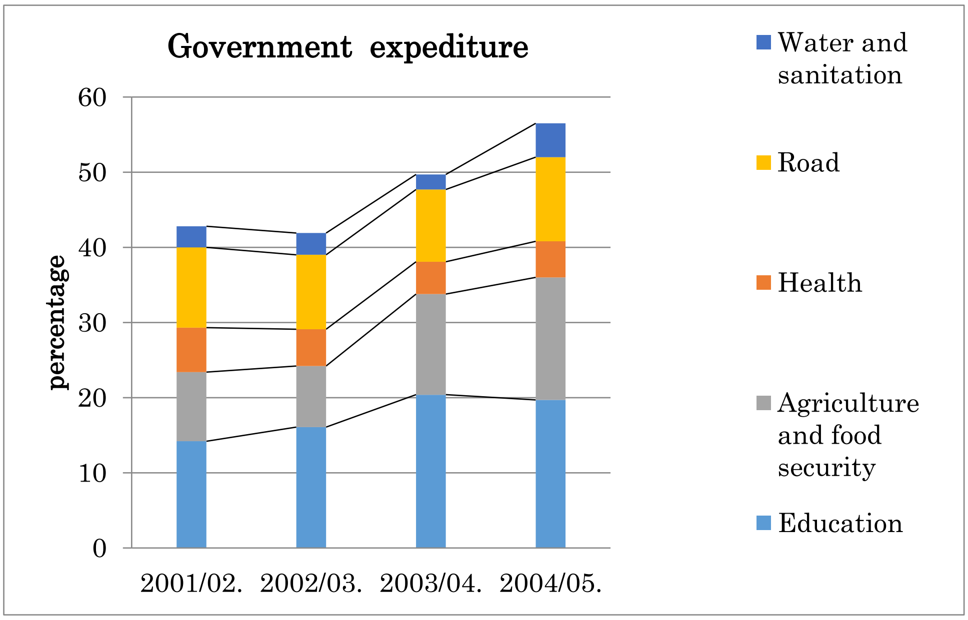


Figure 6-1. Government expenditure by sectors. (Source: author`s compilation of MoFED and World Bank Development Indicators)

The second development phase was the Plan for Accelerated and Sustained Development to End Poverty (PASDEP). This plan was introduced for five year development strategic plan and macroeconomic policies for the period 2005-2010. This plan was drafted based on the experience of three years' Sustainable Development and Poverty Reduction Program (SDPRP). According to MoFED (2006), the PASDEP had eight Pillars. The plan had focused particularly on agriculture productivity, industrial expansion, increase private sectors development, and urban development as well as to accelerate the efforts to achieve the Millennium Development Goals. These pillar's strategies were:

1. Building all-inclusive implementation capacity;
2. A massive push to accelerate growth;
3. Creating the balance between economic development and population growth;
4. Unleashing the potentials of Ethiopian women;
5. Strengthening the infrastructure backbone of the country;
6. Strengthening human resource development;
7. Managing risk and volatility; and,
8. Creating employment opportunities.

During PASDEP period, the average real GDP growth was surpassed the set out goal. There were two cases of scenario for all sectors. Such as, the low case scenario and the high case scenario. The two scenarios' targets were achieved in all sectors except industrial output especially the service sector gained the highest growth as twice high of base case scenario. In spite of 8.4 percent growth in agricultural sector, the GPD share declined to 41.6 percent in 2010 from above 45 percent in 2005. Consequently, there was the structural transformation from agricultural sectors to service sectors, the share of GDP shifted from low productive agriculture sectors to value added service sectors (IMF, 2011; McMill & Harttgen, 2014).

Figure 6-2 below shows the Average Growth Targets from 2005 to 2010, based on two alternative growth scenarios of high scenario and base line scenario. Also it shows the average Real GDP growth during the same period by economic sectors.

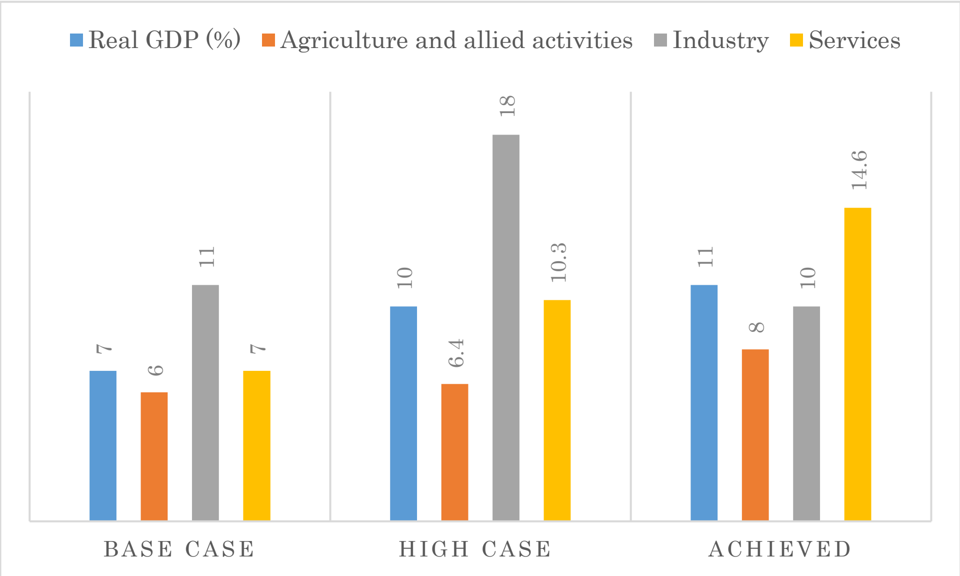


Figure 6-2. PASDEP`s targets and achievement form 2005-2010. (Source: author`s compilation of MoFED)

The major achievement of PASDEP had boosted productivity in all sectors. Agricultural productivity had increased. Particularly, the crop productions per hectares increased by 40.5 percent from 12.1 quintals per hectare in 2005 to 17 quintals per hectare in 2010. At the same time, the cultivated land coverage also increased from 9.8 million hectares to 11.2 million hectares. The overall production of crops increased by 60.4 percent from 119.1 million quintals to 191 million quintals within five years period. To achieve PASDEP goal, government of Ethiopia invested on human capital through training agricultural extension staffs and established training center. Moreover, government enterprises invested on research and development to improve seeds quality and they provided the seeds to farmers along with chemical fertilizers. During five year of PASDEP, Ethiopia achieved impressive economic growth and succeeded significant improvement in both physical and human capital development (Mekonnen, Gerber, & Matz, 2016, September; MoFED, 2010).

The third development strategy and macroeconomic policies had implemented from 2010 to 2015, which was the Growth and Transformation Plan (GTP). The fundamental strategy of GTP had been designed based on the past two consecutive experience of development plan, such as Sustainable Development and Poverty Reduction Program (SDPRP), the Plan for Accelerated and Sustained Development to End Poverty (PASDEP) and the MDGs and the National Vision (IMF, 2011; MoFED, 2010). According to Ethiopian government,

> The major objectives of the plan are (1) maintain at least an average real GDP growth rate of 11.2 percent per annum and attain MDGs, (2) expand and ensure the qualities of education and health services and achieve MDGs

> in the social sector, (3) establish suitable conditions for sustainable nation building through the creation of a stable democratic and developmental state; and (4) ensure the sustainability of growth by realizing all the above objectives within a stable macroeconomic framework (MoFED, 2010, p.7).

To realize the GTP, Ethiopian government drafted inclusive development strategy that incorporated the following seven pillars:

1. Sustaining faster and equitable economic growth.
2. Maintaining agriculture as a major source of economic growth.
3. Creating favorable conditions for the industry to play key role in the economy.
4. Enhancing expansion and quality of infrastructure development.
5. Enhancing expansion and quality of social development.
6. Building capacity and deepen good governance.
7. Promoting women and youth empowerment and equitable benefit.

GTPI development strategies were some of the ambitious plans that Ethiopia had ever been implemented to eradicate poverty by means of achieving sustainable and high economic growth. During three years implementation of GTP from 2010 to 2013, Ethiopia registered (on average) 10 percent economic growth below GTP target 11.2 percent growth, still higher than MDG`s which requires 7 percent growth. All economic indicators had shown an comprehensive growth. Unlike the previous SDPRP and PASDEP period, industrial sectors growth was the most promising and surpassed the growth rate of service sectors. The industry sector led the growth by average 17 percent, followed by service sector 11 percent growth, and 7 percent growth for agriculture in three years period. According to the Central Statistical Agency (CSA), agricultural land productivity of the major crops has increased. Smallholder farmers' average productivity of major crops increased to 21.5 quintal per hectare in 2015 from 15.7 quintal per hectare in 2010. During five years, agricultural output had increased by 73 percent.

According to World Bank's study (2014), agricultural and manufacturing productivity had shown improvement. Agricultural sector value added per worker has raised by 66 percent from 1999 to 2013, while manufacturing industry value added per worker had also raised by 55 percent in 2013. The productivity growth in both agriculture and manufacturing accelerated after structural adjustment on macroeconomic policy. Figure 6-3 below indicates the growth trend of three sectors. During GTP period, the share of agriculture declined to 42.9 percent in 2012 from 45.6 percent in 2010. During the same period, the share of industrial production increased from 10.6 to 12.4 percent. Simultaneously, the share of service sector has also increased slightly from 44.5 percent to 45.2 percent.

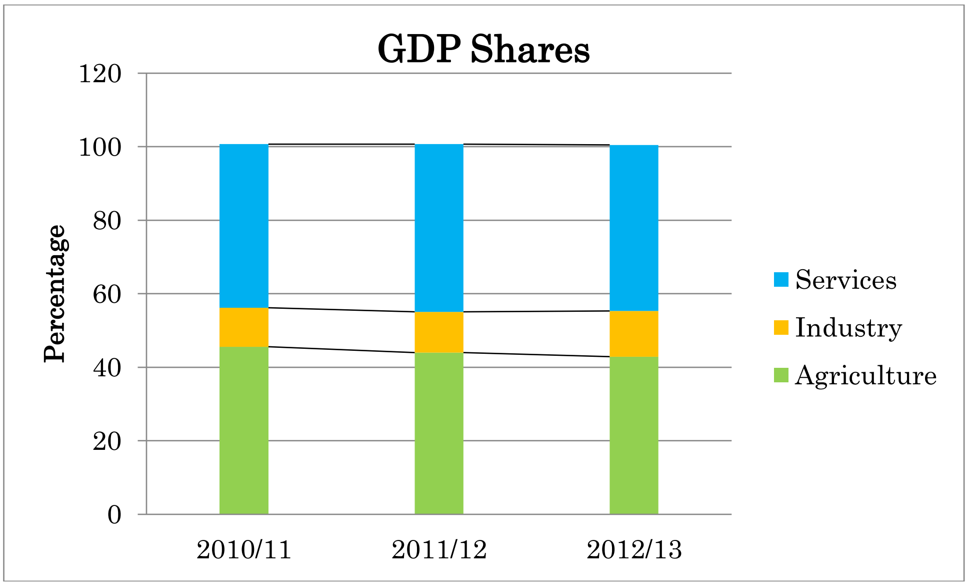


Figure 6-3. Comparative trend of GDP Share for Ethiopia. (Source: author`s compilation of MoFEDand World Bank Development Indicators)

During GTPI, the structural transformation implemented to transfer low value added industry towards high value added goods and services. This result has brought a structural shift particularly in services and industry sectors that have grown above GDP growth rate, while agricultural share to GDP has decreased. Figure 6-4 below shows that the growth rate of industry was the highest (18.5 percent in 2012). The average industrial sector growth rate during GTPI was 16.8 percent followed by service sector average growth rate that was 11 percent higher than growth rate. The agricultural growth rate was also 7 percent. The overall achievement of macroeconomic strategy was measured by growth indicators and the stability of macroeconomic policies. It indicates that Ethiopian macroeconomic development policies are on the right track to achieve Millennium Development Goal. The sustainable economic growth and structural transformation in order to bring paradigm shift is properly implemented by increased investment on value added sectors.

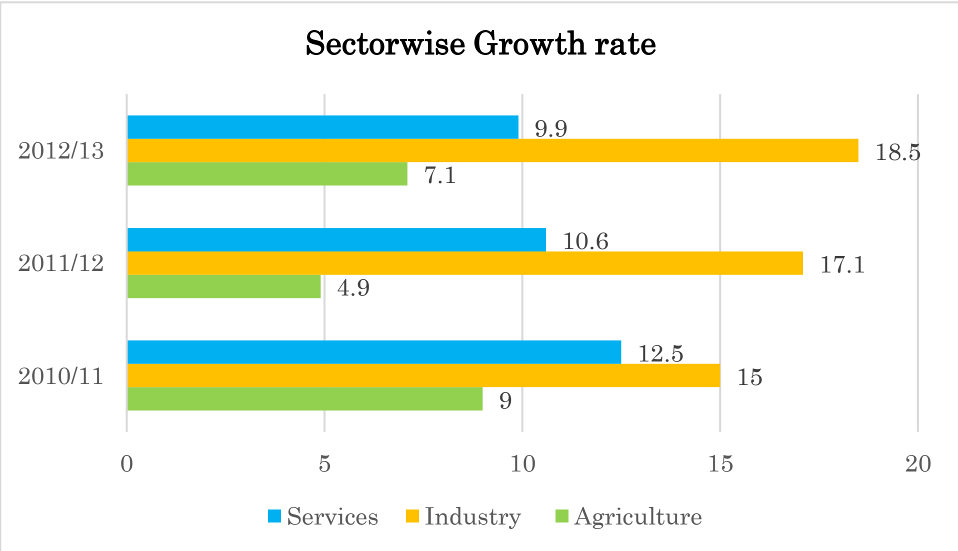


Figure 6-4. GDP growth rate by sectors. (Source: author`s compilation of MoFED and World Bank Development Indicators)

Finally, the ongoing development plan is the second Growth and Transformation Plan (GTP II) that has been implementing for2015 to 2020. This one was articulated based on the first Growth and Transformation Plan (GTPI). The implementation of GTPI has left significant lessons that contributed to formulate the second GTP. After carefully evaluating the significant success and failure factors, the strategic development plan of GTP II was drafted through focusing on strategic sectors that have a substantial contribution to economic growth and structural transformation. It sets out aggressive goal to achieve 11 percent average real GDP growth rate during the implementation period while establishing stable macroeconomic environment. The main objective of GTPII is to bring structural transformation in the economy in order to accelerate the achievement of vision 2025 that targets to eliminate absolute poverty, and to join lower middle income countries.

In the latest development strategy, Agricultural-led industrialization has reminded as the prominent growth strategy. Still agriculture sector play vital role to drive the economy through sectorial linkage with industry. GTP II target to increase agricultural output to 550 million quintals by 2020, which is five time higher than 2010 output level (GTP II, 2015). The achievement of this goal is expected to push up the basic goal of 8% growth up to 11%. The major distinctive characteristics of GTP II, focuses on light manufacturing industries by setting aggressive targets to become manufacturing hub in Africa. Moreover, GTP II gave extraordinary emphasis to expand export sectors and develop export oriented manufacturing industry. At the same time, GTP II focuses on efficiency and productivity to build competitive advantage to manufacturing sectors through implementing Kaizen method (the Japanese philosophy of continues improvement), which was introduced by Japan International Cooperation Agency (JICA) during GTPI (Desta, 2011; Ohno-I, Ohno-K, Uesu, Ishiwata, Hosono, Kikuchi & Uenda, 2009). Another main area is building human capital and expanding innovation sectors as well as developing climate resilient green economy.

After highlighting the development polices of the country, this research summarizes the statistical results of Ethiopia. We employed Ordinary Least Square (OLS) regression by using econometrics Stata Software to examine GDP growth rate with export, import, investment and GDP per capita income growth. Unexpectedly the result of time series regression shows all factors predictors are weakly correlated except export. The significant value of factors coefficient for education is (0.12) and Investment (-1.87) are unexpected findings but GDP per capita (-1.75) and Export (2.66) are as expected

$$Y_i^t = \alpha_i + \sum_i^n \beta_i X_i + \varepsilon_i$$

$$GRT_{it} == \alpha + \sum \beta_1 EDU_{ijt} + \beta_2.EXP_{ijt} + \beta_3 INV_{ijt} + \sum \beta_6 ICT_{ijt} + \sum \beta_6 CONSGDP_{ijt+} \varepsilon_{it}$$

Table 6-1: OLS regression for Ethiopia

GRT	Coef.	Std. Err.	t	P>t	[95% Conf.	Interval]
L1.EDU	0.070323	0.585087	0.12	0.915	-2.4471	2.58775
L1.EXP	12.47283	4.697477	2.6	0.117	-7.73879	32.68444
L1.INV	-7.46383	3.989037	-1.87	0.202	-24.6273	9.69961
L1.	-6.0021	3.436079	-1.75	0.223	-20.7864	8.782156
L10.GDPPC	0.090464	0.330675	0.27	0.81	-1.33232	1.513243
L1.COM	17.0904	11.80602	1.45	0.285	-33.7068	67.8876
_cons	533.0558	290.4695	1.84	0.208	-716.733	1782.845

6.2 Background of Ethiopian Economic Growth

Ethiopia economy has experienced broad-based growth and emerged as the fastest growing economy in Africa within the few decades. However, Economic history of Ethiopia had mixed records. The average real GDP growth during the Imperial regime (1930-1974) was 3.5 percent while the average growth during the Derg regime (1974 to 1991) declined to 1.7 percent (Geda, 2001). The current government of Ethiopia has changed development landscape by registering impressive economic growth (double digit growth) and improved welfare of the nation. Ethiopia becomes one of the best performing economies in East Africa (African Economic Outlook, 2017; IMF, 2014; MoFED, 2014; WDI, 2014).

Furthermore, Ethiopian government has implementing “Vision 2025” strategy plan, in order to continue the growth momentum by attracting foreign direct investment inflow and making the country a manufacturing powerhouse in a continent through establishing special industrial park (GTP II, 2015). According to African economic outlook (2017)'s report, and Ernst & Young Attractiveness Program Africa (2017), Ethiopia has been the most attractive investment destination for light manufacturing and services sectors. The government of Ethiopia has promoted the development of industrial parks in different parts of a country that are focused on light manufacturing industries (Oqubay, 2015). Such as, textiles, agro-processing, leather, and pharmaceuticals industry to make the country a light manufacturing hub in east Africa (Ernst & Young, 2017; AEO, 2017). This attracts FDI and technology transfer as well as it will be a major driving force to increase employment to lift out millions from poverty. Figure 6-5 below indicates, at the beginning of 1990s, Ethiopian economy recoded negative GDP growth as real GDP declined by 32 percent due to intensive civil war. However, the economic growth had recovered very fast and registered double digit growth.

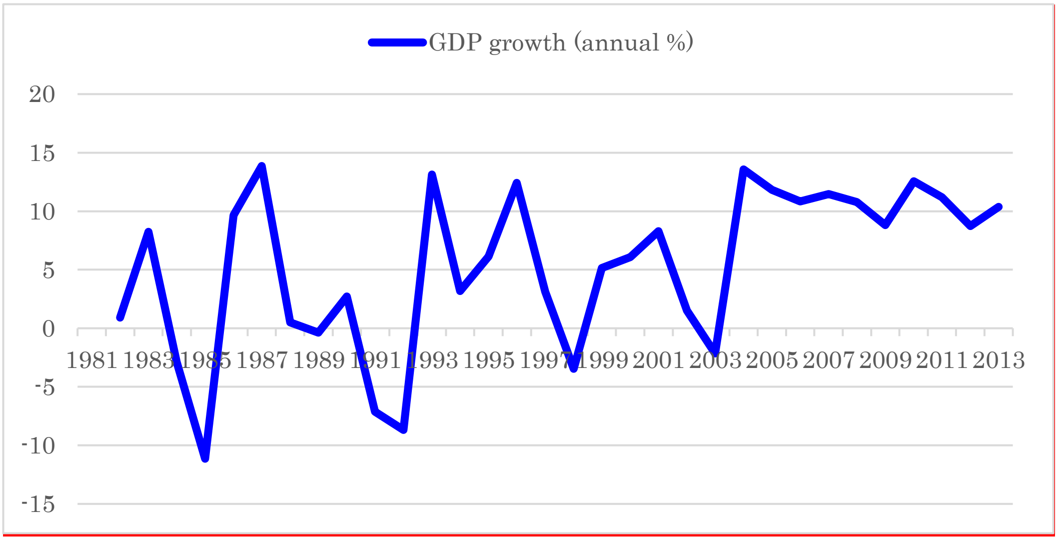


Figure 6-5. The GDP growth rate (Source: author`s compilation of WDI)

6.3 Investment

This section presents the trend of gross capital formation and the relationships with GDP per capita income in Ethiopia. Investment has broad definitions, which refers to all kind of economic activities or the process of utilizing resources to produce goods and services in the economy (Wehinger, 2011). It is the key factor that determine economic growth (Janjili, 2011). Harrod-Domar growth model explained the rate of economic growth is proportional to the rate of investment (Zhang, 2005). Saving accelerates the investment that contributes to economic growth (Jappelli & Pagano, 1994). Solow's growth model emphasized the importance of physical capital for economic growth (Janjili, 2011). The Ethiopian government therefore encouraged savings through raising awareness and implemeting new policy that encourage private and governement employees to have social insurance (MoFED, 2014).

According to Asian Development Bank study, investment in physical and human resources are essential for economic growth. It says “if national saving has a substantial effect on the level of investment, the obvious conclusion is that saving drives growth and that appropriate policies for growth are those that promote saving (Jha, Terada-Hagiwara & Prasad, 2009, p.11)”. Due to macroeconomic improvement and financial policy reform, Ethiopian saving culture has changed as gross domestic saving as percentage of GDP increased dramatically from 4.8 percent in 1999 to 20 percent in 2016. The policy change created a momentum for raising the domestic invest. Furthermore, Ethiopia government has expanded banking services (state owned banks) in all corners of the country to provide easy access to finance. This has encouraged saving and facilitated investment. Figure 6-6 below indicates a gross domestic capital formations (percentage of GDP) increased to 39.6 percent in 2016 from 17.5 percent in 1999, which is the best performance in history of Ethiopia that double investment the ratio to GDP.

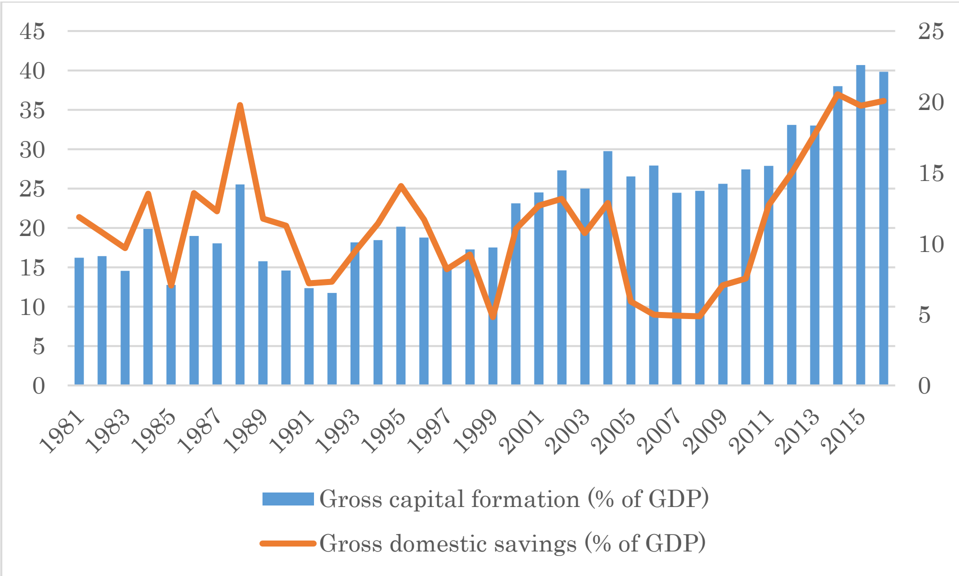


Figure 6-6. The trend of investment and saving in Ethiopia. (Source: author`s compilation of MoFED and World Bank Development Indicators)

Figure 6-7 below reveals that OLS regression examined the linkage between GDP per capita growth and investment. Unexpectedly, we found weak correlation with R-square value. The OLS regression analysis of GDP per capita growth rate significant value of factor coefficient for investment is (2.66).

$$GDPPGRT_{it} = \alpha + \beta_1 INV_{ijt} + \varepsilon_{it}$$

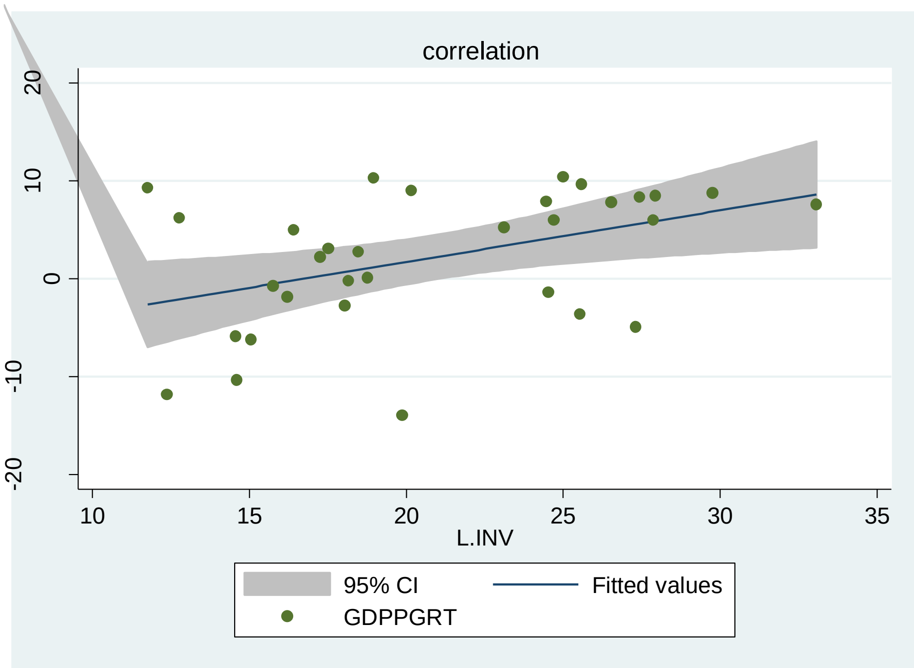


Figure 6-7. Scatter plot of GDP per capita growth rate and gross capital formation (Investment).

6.4 Exports

Ethiopia has been promoting export since 1960 by enacting different kind of policies to increase export and diversify products. The primary goods are major export products, notably, coffee is a principal agricultural products that dominates export earning with more than 50 percent share (Wolde, 2007). After 1992, Ethiopia accepted IMF and the World Bank Structural Adjustment Programs (SAPs) to bring macroeconomic policy for stability and structural transformation. Since then, Ethiopia has completely shifted from command economy to liberal economic policy that promotes trade openness (Geda & Berhanu, 2000; Rashid et al., 2009; Berhanu & White, 2000). In the middle of 1990s, Ethiopia has endorsed several policies to bring export sector structural adjustment. These policy reforms have contributed to bring export diversification in terms of products and destinations, and also increased export performance (Alemu, 2010).

The classical economic theory supported that international trade has significant role in economic growth, and creates competitiveness through specialization while exports has a positive correlation with economic growth (Jung & Marshall 1985; Siddiqui, Zehra, Majeed & Butt, 2008). Ethiopia adopted export led growth strategy to increase competitiveness, and productivity. As a result, Ethiopia is diversifying export from primary goods (coffee, sesame, khat and horticulture products) to other commodities like livestock and manufacturing goods. Coffee has still the highest share (27% by value) followed by oilseeds (17%), edible vegetables including khat (17%), gold (13%), flowers (7%), live animals (7%), raw leather products (3%), and meat products (3%). Still manufacturing sector is uncompetitive and represented less than 8% of total exports in 2016 (The World Factbook, 2017; World Bank, 2017).

Figure 6-8 below shows that in 1980s, export figures had steady growth with little decline, but since 1991, after implementation of structural adjustment, Export has increased sharply and until 2011 and it reached 17 percent of GDP. This growth was not sustainable for long and immediately descending downward. Despite double digit economic growth, the performance of export has been declining by half, and it reached to 8 percent of GDP in 2015. Moreover, the comparative empirical analysis indicates, Ethiopia has been performing below Kenya, South African and Sub Saharan African countries' average. Ethiopian average export performance for the last three decades was about 10 percent of GDP, which accounts only one third of Sab Saharan African countries export (31 percent to GDP). Despite Kenya export performance has been decreasing recently, Kenya average export to GDP ratio was 24 percent for three decades that is more than twice of Ethiopian performance. Both Kenyan and Ethiopian export performance has been declining since 2012 because their export sectors are heavily depended on agricultural commodities. During these period, global commodity prices have been decreased. Eventually, the export revenue has been affected (FAO Food Commodity Index, 2017, IMF Primary Commodity Prices, 2017).

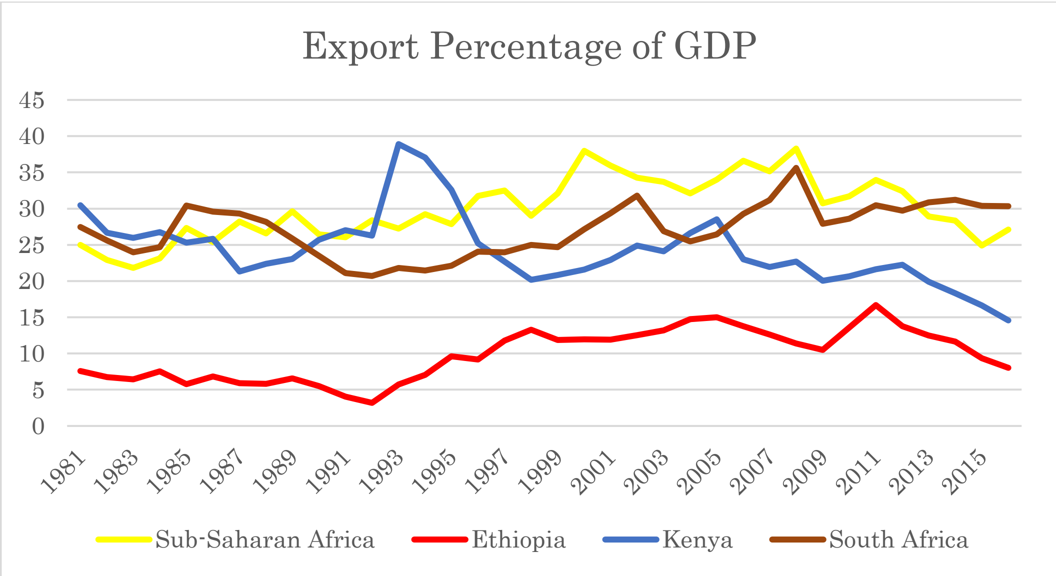


Figure 6-8. Export. (Source: author`s compilation of MoFED and World Bank Development Indicators)

In fact, the general performance of Ethiopian export was poor and the share to GDP was declined. However, the transport sector's export performance is exceptional. It appears as the best performing industry in Ethiopia, and one of the most competitive industries in the world. According to World Bank's definition

> Transport covers all transport services (sea, air, land, internal waterway, and space) performed by residents of one economy for those of another and involving the carriage of passengers, movement of goods (freight), rental of carriers with crew, and related support and auxiliary services (World Development Indicators, 2009, pp.231).

Ethiopian transport sector is one of the best performing industry in Africa. Table 6-2 below indicates that, Ethiopian transport services' share as a percentage of commercial service exports occupies 68 percent, which is the highest share in Africa, and twice higher than average Sub-Saharan African countries. Rwanda and Uganda are the least competitive countries in Africa with 2 percent and 9 percent shares respectively. The credit of outstanding achievement goes to Ethiopian Airlines. It is the largest and the most profitable in Africa with 20 percent growth rate, wihch positioned Ethiopia Airlines five time higher than global industrial average growth rate (Ethiopia Airlines, 2016). Despite the fact that Airline has owned 100 percent by government of Ethiopia, it is the most successful enterprise and its success is driven by efficiency and productively. The achievement of Ethiopian Airline provides high insight for export industry. All sectors should emulate and follow the footsteps of Ethiopian Airline to increase their competiveness in the global markets.

Table 6-2 Transport services (% of commercial service exports)

	Ethiopia	Kenya	Rwanda	South Africa	Uganda
Transport services (% of commercial service exports)	68	54	2	18	9

The Economic growth Ethiopia was driven by export led growth strategy. Moreover, export led policy has significant contribution for human development that has strong correlation with education and life expectancy. The OLS regression finding indicates the significant value of factor coefficient for Export is (3.09), which is strongly correlated with GDP per capita growth rate The Table A-1 and table A-2 in the Appendix A show the OLS regression result of Export and human development indicators.

$$GDPPGRT_{it} == \alpha + \sum \beta_1 EXP_{ijt} + \varepsilon_{it}$$

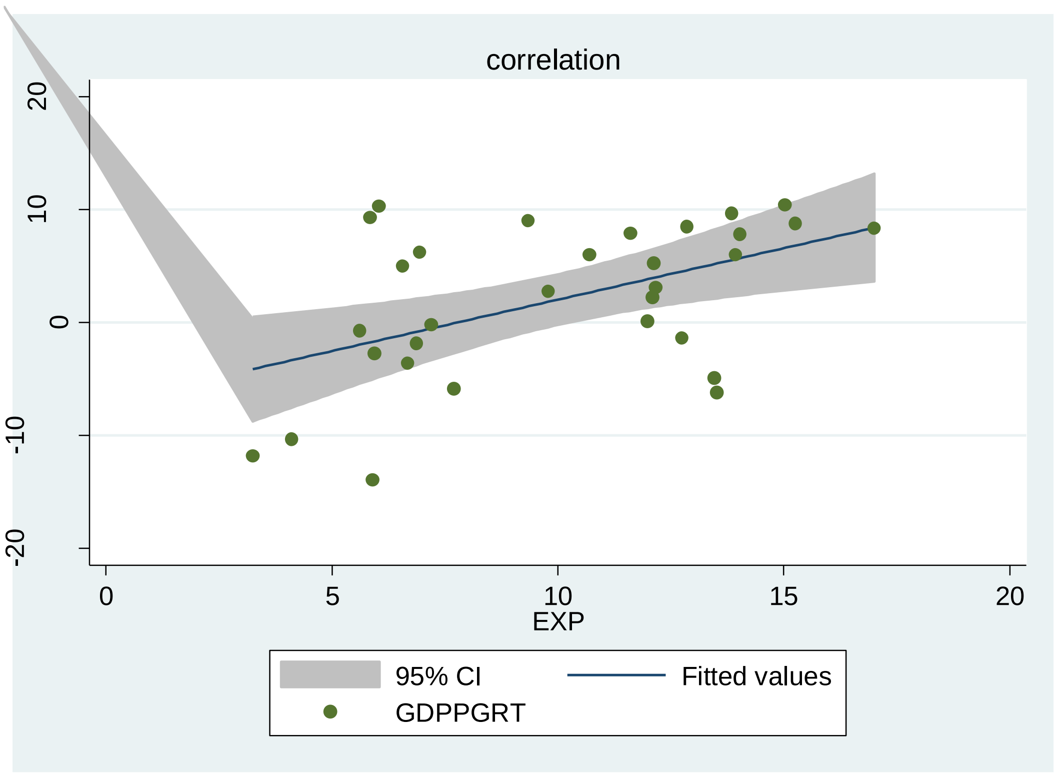


Figure 6-9. Scatter plot of GDP per capita growth rate and export

The econometrics analysis indicates that export has a significant correlation with macroeconomic indicators, which favored growth theory. The last three years export performance has been failed below government target and it contradicts East Asian export oriented growth model that was emulated by Ethiopia. Therefore, Ethiopian export sector should bring paradigm shift from primary goods to value added goods quality competitiveness by increasing value added goods and service as well as enhancing productivity. The export related indicators needs to be improved in order to be competitive in international market. These indicators have positive relationship with productivity improvement, such as Cost to Export per container, Time to Export, and Time to Export Documentary Compliance. Policy makers will be able to improve these indicators and increase productivity by taking up the following insight, recommendation. It contributes to strengthen competitive advantage and also increase efficiency and productivity.

Cost to Export per container and Export cost per container for Sab Saharan African countries is higher than South Asian countries. Particularly, landlocked countries, like Ethiopia, Rwanda, and Uganda are suffering from higher export cost, which is above average SSA countries. The logistic cost has direct relationship with destination distance, this cost has great impact on cost competitiveness in international markets. This cost can be reduced by establishing advance logistic system and expanding infrastructural investment through investing environment friendly railway infrastructure rather than fossil based transportation, accordingly they can reduce logistic cost and save foreign currency.

Time to Export and Time to Export Documentary Compliance refers a necessary time to accomplish all procedures required to export goods and services. Currently, globalization has reduced the entry barriers and has created interaction and integration among companies and governments. Due to globalization and technology advancement, the world becomes a global village, the way we communicate, commute and involve in business transaction are changing to great extent. Ethiopia is the least competitive African country that requires longer time to comply with all procedural requirements. This has influence on competiveness. South Africa has the most comparative advantage with less time to export (only 16 days), which is one third of Ethiopia. Ghana is also more competitive than Ethiopia with 19 day, and Kenya & Rwanda requires 26 days.

The competitiveness has a direct relationships with efficiency and productivity of the economy. Therefore, Ethiopia should take serious measures to improve documentation system and procedures by creating transparent system, simplifying procedures, eliminating unnecessary steps, performing parallel processing, and utilizing information technology system. Above all, the most crucial part is creating awareness to all level of public services to change their attitude towards efficiency and productivity. It requires continuous improvement "Kaizen" to reduce delay time to increase efficiency. Moreover, providing broad-based, effective and measurable training to all relevant bodies and stakeholders is compulsory to provide performance based incentives to high performing public servants in addition to salary increment, simultaneously encourage and award competitive private sectors.

Table 6-3 Export competiveness of Ethiopia with average Sub Saharan African

	Ethiopia	Kenya	Rwanda	South Africa	Uganda
Cost to export (US$ per container)	2,380	2,255	3,245	1,830	2,800
Time to export (days)	44	26	26	16	28
Time to export, documentary compliance (hours)	91	19	42	68	64

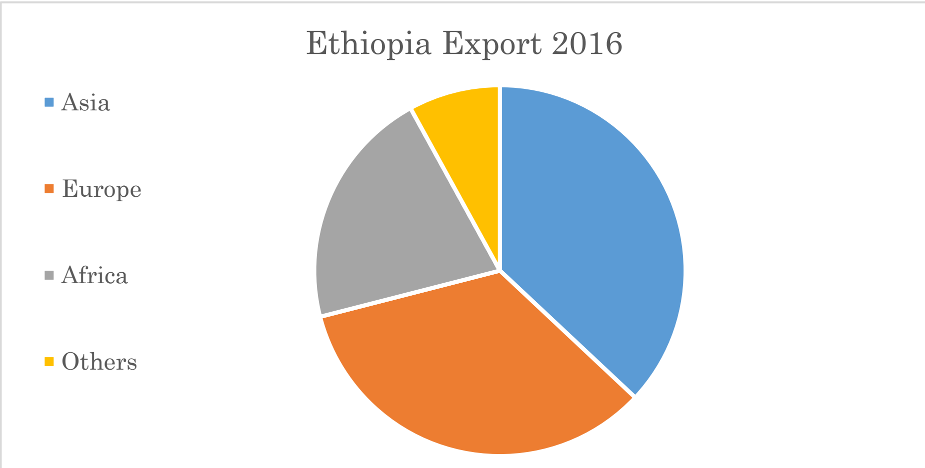
In addition to expand international trade competiveness, regional economic integration is an important factor to increase exports and to expand intra-regional trade transactions as well as investment. According to African

Development Bank, and African development Fund (2015)'s report on East African regional integration strategy, since 1960 regional integration has been started in Africa to promote peace and stability, harmonizing and coordinating the market integration, investment on infrastructure, attract FDI and industrial development. The Common Market for Eastern and Southern Africa (COMESA) accord is among notable economic cooperation in Africa to reduce poverty through enhancing economic growth. Despite the fact that they set ambitious goals to accelerate market integration, they have poor track record and also they are far from achieving their target (Hartzenberg, (2011).

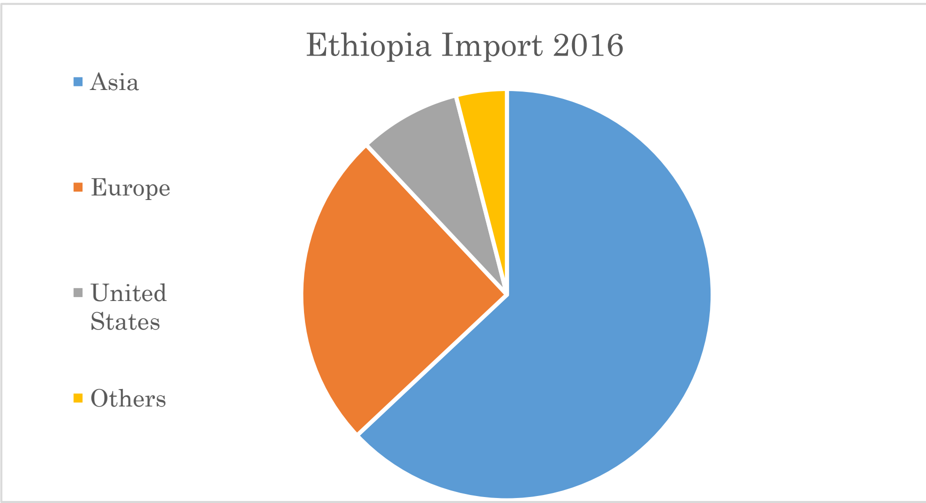
The Pie-Chart 6-1 and 6-2 illustrate that the intra-regional trade between Ethiopia and Africa is at the lowest level compared to exports and imports outside the continent. As Pie Chart 6-1 presents, Ethiopian export to Africa is only one-fifth of international trade value in 2016 (21 percent), the rest goes to international trade transaction that was made outside the continent. However, Ethiopia has achieved strong export figure with neighboring country of Somalia that accounts for 58 percent of intra-regional trade in Africa. Interestingly there is one way trade between Ethiopia and Somalia. Literally, it is against the principles of bilateral trade. Ethiopian imports from Somalia is almost insignificant or nothing. Ethiopian major export destinations are Asia with 37 percent and Europe with 34 percent of total export shares.

The intra-regional trade regarding to import is poorer than exports, the Pie Chart 6-2 shows that the intra-regional trade has less than 4 percent of imports which is insignificant share, whereas Asia and Europe accounted for 63 percent and 25 percent respectively. The potential intraregional markets in Africa is huge, the neighboring country of Kenya has performing better than Ethiopia in terms of interregional trade. Kenya becomes regional hub for international trade and major player to expand and strengthen regional trade blocs such as the COMESA and East African Community (EAC). As a result, Kenyan export is highly diversified . Unlike Ethiopia, 45.6 percent of Kenyan exports value goes to Africa, followed by Europe 25.4 percent and the remaining value were delivered to Asia and North America 19.8 percent and 7.6 percent respectively. Moreover, East African are top export destination for Kenyan goods and services with total export value of 24.2 percent. The lion's share is accounted by Uganda 10.7 percent, Tanzania 7.7 percent, and Zambia 5.8 percent in 2015.Therefore, Ethiopia should learn and emulate the best practices from Kenya to increase intra-regional trade in Africa. Ethiopia should develop risk mitigation strategy through diversifying export destinations, eliminating tariff barriers, improving customs procedures and reducing administrative requirements. It should adapt internationally accepted documentations as well as expand ICT systems. Moreover, expanding intraregional linkage by developing physical infrastructure (road and railway) among East African countries.

Pie Chart 6-1. Ethiopia Export Destinations



Pie Chart 6-2. Ethiopa import



6.5 Comparative analysis of Ethiopia Science, Technology and innovation with East Asian and African Countries.

This part focuses on innovation indicators with regarding to macroeconomic indicators, particularly analyzing the correlation between GDP per capita income and economic growth. In addition, analyzes innovation indicators regarding with macroeconomic performance. Because, innovation and technology are a backbone of future economic growth and human development. According to Walter (1972), economic development requires many processes that integrate physical capital, human capital and technology innovations. Science, Technology and Innovation provide a platform to measure the ability of a nation to achieve sustainable economic growth in the long run. Ethiopia has been applying structural transformation policy by leveraging the current rapid economic growth, which is heavily depended on agricultural output.

Ethiopian economy depended on agricultural output, which contributed about 37.2% of GDP and observe more than 80% of labor force (WDI, 2017). This points out, that the country`s economy has determined on labor intensive products rather than knowledge-based economy. The transformation process from agricultural based economy towards industrialization is inevitable and requires technological innovation. This allows transition from subsistence farming economy to a knowledge-based economy. Therefore, innovation has significant contribution to bring the structural transformation and sustainable economic growth (Fagerberg, Srholec & Knell 2007; Freeman, 1995; Parto, Ciarli & Arora 2006; Metcalfe & Ramlogan, 2008). Several empirical evidences show that the countries with effective national innovation system are competitive than others, since innovation is the engine for economic growth (Fagerberg, Srholec & Knell, 2007; Freeman, 1995; Parto, Ciarli & Arora, 2006; Metcalfe & Ramlogan, 2008). According to World Economic Forum, Global competitiveness report (2017), Innovation ecosystem plays a great role to bring a change in society and economy. It further says that

> the capacity of a country to be innovative has to be thought of as an ecosystem that not only produces scientific knowledge but also enables all industries, including in the service sector, and society at large to be more flexible, interconnected, and open to new ideas and business models. This way of understanding innovation focuses on a country's ability to bring new products and services to market, and it attributes equal importance to non-technical and technical inventions and rewards individuals who are open-minded and embrace new ways to perform tasks (GCI, 2016, pp.54).

Interestingly, an innovation is not only about investing on research and development, bring up scientific findings and increasing patent applications, but it is more about creating innovation ecosystem that promotes entrepreneurships and provides space to creativity, and facilitates collaboration among all relevant institutions.

This part of research analysis is based on empirical data and extended theory of national innovation system, economic growth and human development through the comparative analysis of Science, Technology and Innovation practices of East Asian Countries, such as Japan, Korea, Singapore and Taiwan. Furthermore, this research broadly uses innovation pillars of World Economic Forum Data that extracted from Global Competitiveness Index. These indicators are grouped into 12 pillars, such as, Institutions, which includes twenty one indicators, Innovation has seven indicators, Infrastructure has nine indicators, Macroeconomic Environment has five indicators, Technological Readiness has seven indicators, Health and Primary Education is not included in analysis and will be considered in human development analysis section at the end of this chapter, Higher Education and Training have eight indications, Goods Market Efficiency have sixteen indicators, none of these factors are considered in this part of analysis except intensity of local competition, Labor Market Efficiency has ten indicators, Financial Market Development, Market Size, and Business Sophistication have eight, four, and nine pillars respectively. However, all indictors are not key factors that drive innovation, therefore, this study will take some of indicators that has strong driving factors to enhance innovation and economic growth.

According to global competitiveness index report, these pillars are classified into the following three sub-indices based on their characteristics, such as basic requirements (key for factor driven economies), innovation and sophistication (key for efficiency driven economies) as well as efficiency enhancers (key for innovation driven economies). The first sub-index, basic requirements includes the following pillars. Such as institutions, infrastructure, macroeconomic environment and health and primary education. And the second sub-index, innovation and sophistication sub-index includes business sophistications and innovations indicators. The third sub-index is efficiency enhancement that incorporated higher education and training, financial market development, goods market efficiency, labor market efficiency, technological readiness and market size.

The detail research approach focuses on the following areas. The main pillar of innovation indicators, which included**,** Capacity for innovation, Quality of scientific research institutions, Company spending on R&D, University-industry collaboration in R&D, Gov't procurement of advanced technology products, Patent applications per million population. In addition to innovations driven factors of economies, Technological readiness also play a key role that included the following indicators. Such as, FDI and technology transfer and availability of latest technologies, firm-level technology absorption, internet users' percentage of population, fixed-broadband internet subscriptions per hundred population, and mobile-broadband subscriptions per hundred population.

6.5.1 Comparative Analysis of Innovation Indicators of Ethiopia with East Asian Countries

Ethiopian development policy emulates East Asian countries' development model that has been replicating with a similar growth trajectory. Thus, it is appropriate to take East Asian countries as a benchmark to employ comparative analysis with Ethiopia by using innovation and R&D indicators. The below analysis is based on Global Competitive index data, UNESCO Innovation indicators data, and Ethiopian Science and technology innovation survey data. The innovation indicators have been derived from the survey data. It was articulated by Likert scale, which has a scores value from 1–7 scale, 1 is the least desirable outcome and 7 is the most desirable outcome.

Based on the below indicators, this study uses a comparative analysis of Ethiopia with East Asian countries. Particularly focused on the following pillar of innovation indicators**. S**uch as, Capacity for innovation, Quality of scientific research institutions, Company spending on R&D, University-industry collaboration in R&D, and Patent applications per million population.

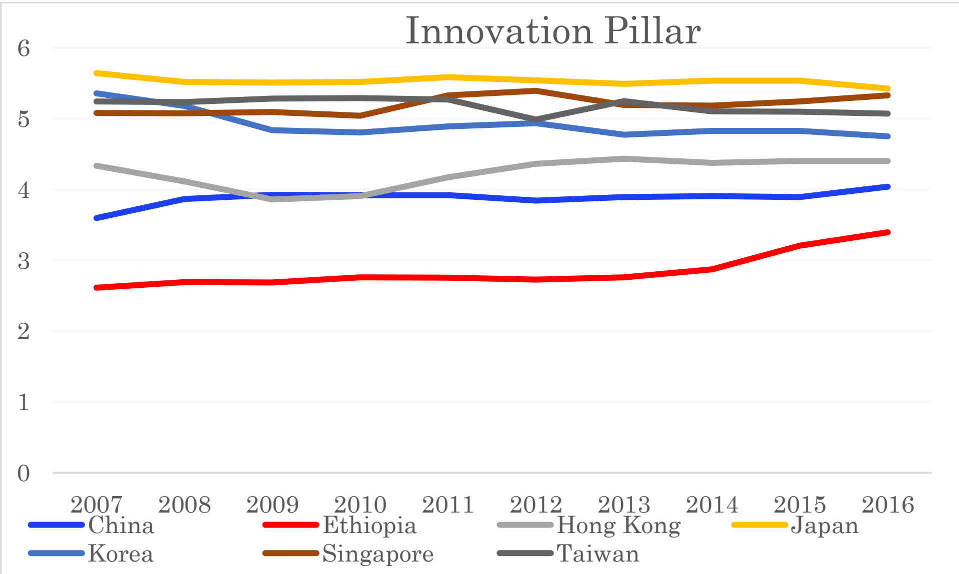


Figure 6-10. Innovation indicator pillar (Source: author`s compilation of WEF, GCI)

East Asian countries have relatively similar records of innovation performance, except Hong Kong and China. Figure 6-10 above provides a comparative analysis of innovation indicators of Ethiopia with high preforming economies of East Asian countries including China (Fogel, 2004; World Bank, 1993). Japan leads its neighboring countries in overall scale of innovation indicators, followed by Singapore, Taiwan and Korean respectively. Singapore has been improving in performance in all innovation indicators and had surpassed Taiwan and Korea. China innovation performance score was two third of Japan in 2007, however, China has been improving and has minimized the gap with high preforming economy, a gap reduced to one fourth of Japan in 2016. Whereas, Ethiopia was preformed half of Taiwan in 2007, which scored 2.69. This figure gradually improved since 2014 by 25 percent and had shown upward rising trend. Those East Asian Countries also lagged in global stage and lined up behind the best performing countries, such as Switzerland, Israel, Finland, the United States, Germany and Sweden.

The following time series graphs provide the detailed innovation indicators evaluation based on a conceptual analysis of a triple helix model. This part provides a deep comparative insight to highlight the position of Ethiopia with respect to East

Asian countries. The following innovation indicators are playing very important role to bring synergy among different actors and also to boost innovation capability and enhance technology diffusions among institutions. Such indicators are University and Industry Collaboration in R&D, Company Spending on R&D, and FDI and Technology Transfer.

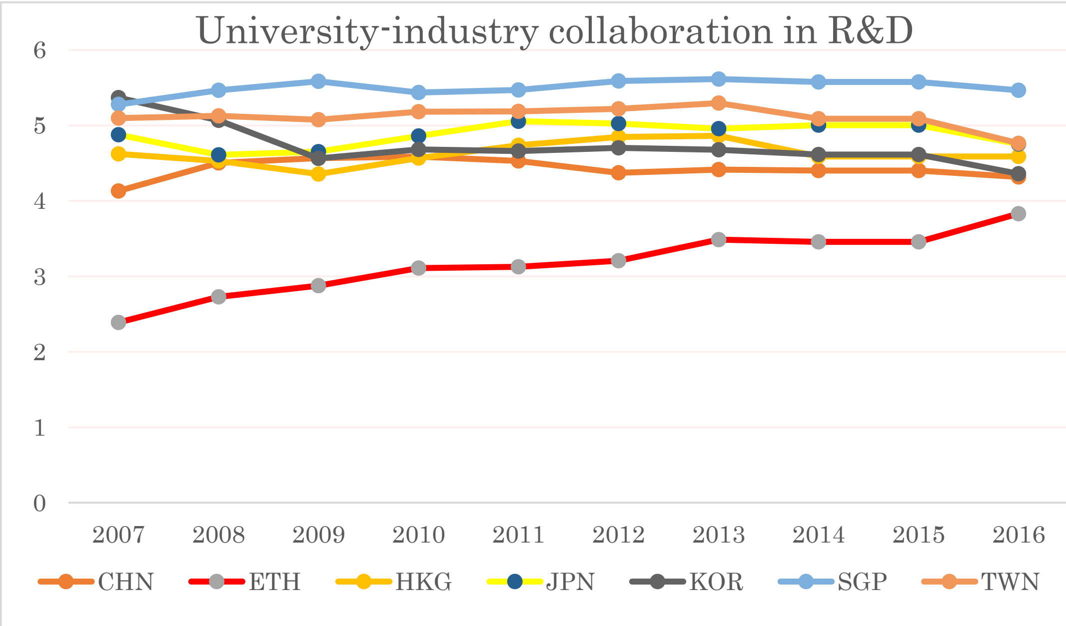


Figure 6-11. University and Industry collaboration on R&D (Source: author`s compilation of WEF, GCI)

The technology diffusion theory supports that the linkage of university and industry contribute for technology innovation. Figure 6-11 above indicates that East Asian countries have uneven distribution of performance score values. Singapore has been leading in terms of University and Industry Collaboration on R&D. For the last ten years, Taiwan has shown stable performance except declining in 2016 without losing the second position. Japan was displaced even further behind Taiwan and very close with Hong Kong performance score value of 4.76 and 4.58 respectively. South Korea lagged far behind the best performing countries and dropped from 2007's position, which scores value was the highest and ranked at the top spot for East Asian countries by 5.36. However, in 2016 this record declined to 4.3 and listed below Taiwan, Japan and Hong Kong. On the other hand, China's collaboration between universities with industry has increased and levelled with South Korea in 2016. Ethiopia used to have big gap compared to average score of East Asian by 3 point scale. Surprising, Ethiopia has improved dramatically the linkage among different actors by 65 percent.

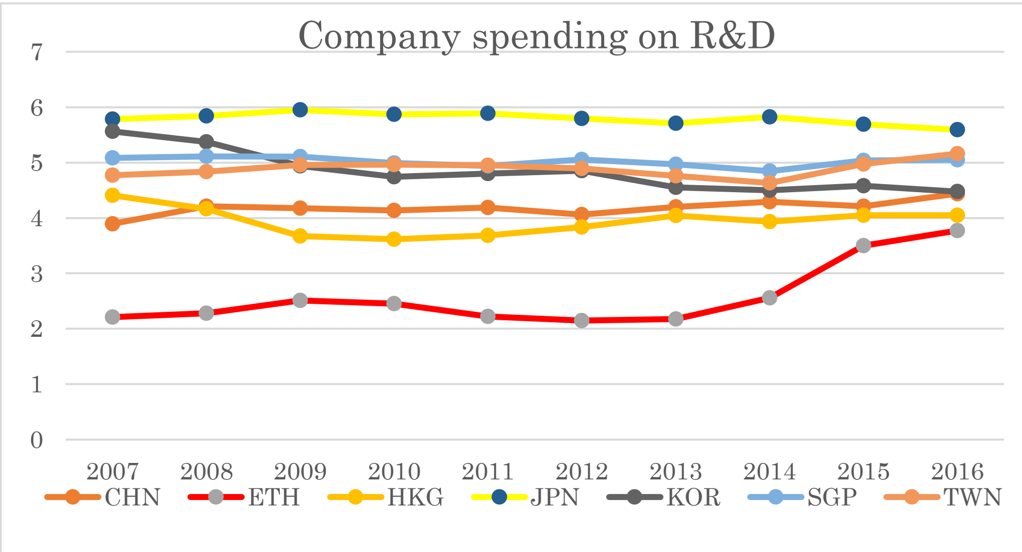


Figure 6-12. Company spending on R&D (Source: author`s compilation of WEF, GCI)

Firm level research and development is not a requirement to company but it is a means to be innovative and create corporate value in order to survive in fierce competition. Therefore, corporate spending on R&D enhances competitive position through innovation. Figure 6-12 provides an insight to understand the performance of different countries at firm level. Furthermore, it is an indicator for competiveness of a country. Japanese company invested on R&D more than any other East Asian countries that led by high margin. The expenditure score value of Japanese company not only has a leadership position in Asia but also top player in global R&D expenditures. Japan lined up next to top three countries, such as Switzerland, the United States of America and Israel. As a result, Japanese companies are highly competitive in global stage. Korea is the only country, which decline a score value from 2007 level by 24 percent in 2016, whose score value was 5.56 and 4.47. While Taiwan is ascending to second place from fourth place in 2007 to second place in 2016, Taiwan and Korean Switched off their position in ten years. Astonishingly, China's corporate expenditure on R&D is higher than Honk Kong with slight improvement in ten years period. Ethiopia have significant gap compared to East Asia countries in terms of expenditures, despite the last two years performance improvement, it lags behind.

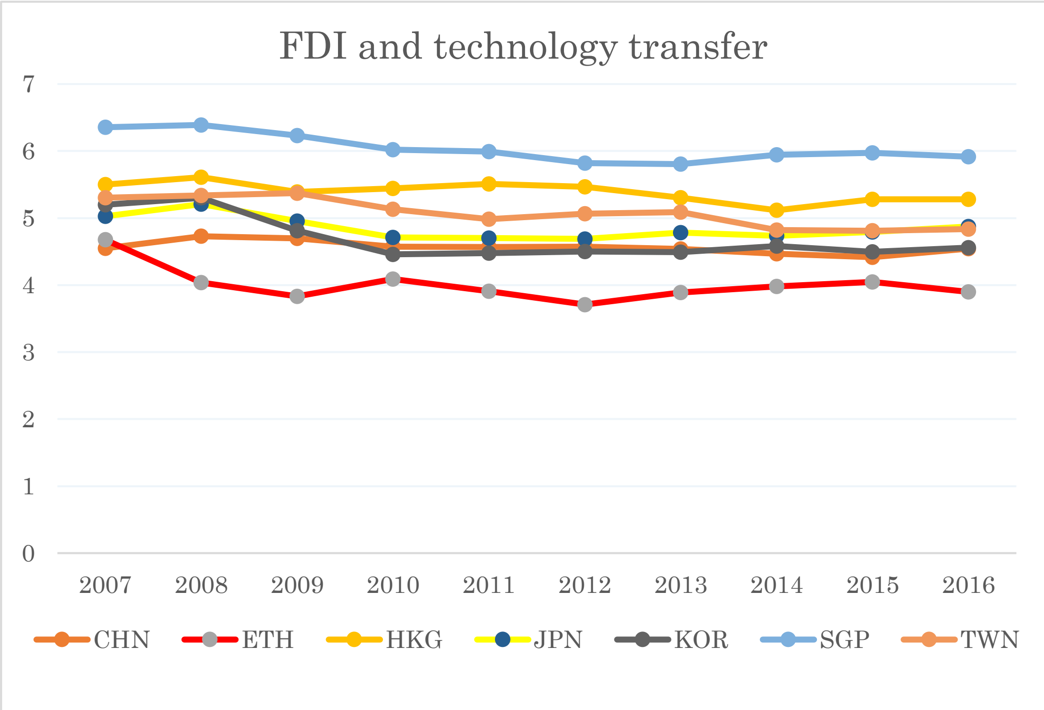


Figure 6-13. FDI and technology transfer (Source: author`s compilation of WEF, GCI)

Globalization facilitates trade openness, and accelerates technology dissemination. Literature on international trade supported that FDI is one the ultimate source of technology dissemination. Multinational corporations' investment and expansion to other countries not only bring capital inflow but also technology transfer. Among East Asian countries, Singapore has benefited the most from FDI and technology transfer. Japan is one of the main source of FDI and technology transmission in Asia. The outward Japan FDI has exceeded $100 billion for the last five year. Whereas the inward FDI is only one tenth of outward FDI (JETRO Global Trade and Investment Report, 2016). According to UNCTAD

World Investment Report (2017), in spite of the most attractive destination for Multinational Corporations, Japan's performance in terms of attracting FDI has been very weak. Figure 6-13 above supported the same argument that Japan benefited less from FDI and technology transfer than Singapore, Hong Kong and Taiwan. In case of Ethiopia, the FDI and technology transfer score value has preforming well (better than other indicators) and has indicated a few gap between East Asian Countries.

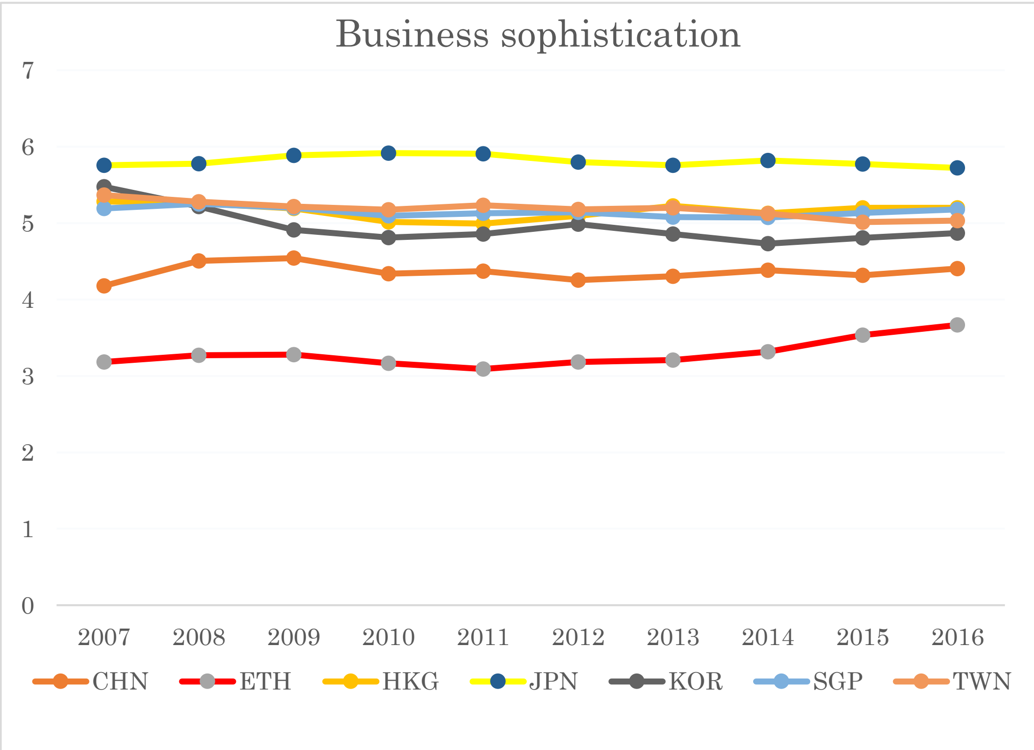


Figure 6-14. Business Sophistications (Source: author`s compilation of WEF, GCI)

Developed countries have established advanced and sophisticated system to conduct business at highly efficient way of producing goods and services. Business sophistication increases productivity of national output. These countries with higher scores are more competitive and they deliver high quality of goods and services. Figure 6-14 above indicates that Japan has the most sophisticated system and well developed business networks. China is lagged behind Japan by 1.3 score value but preforms better than Ethiopia by 0.8 score value. Taiwan, Singapore and Korea are preforming with similar level.

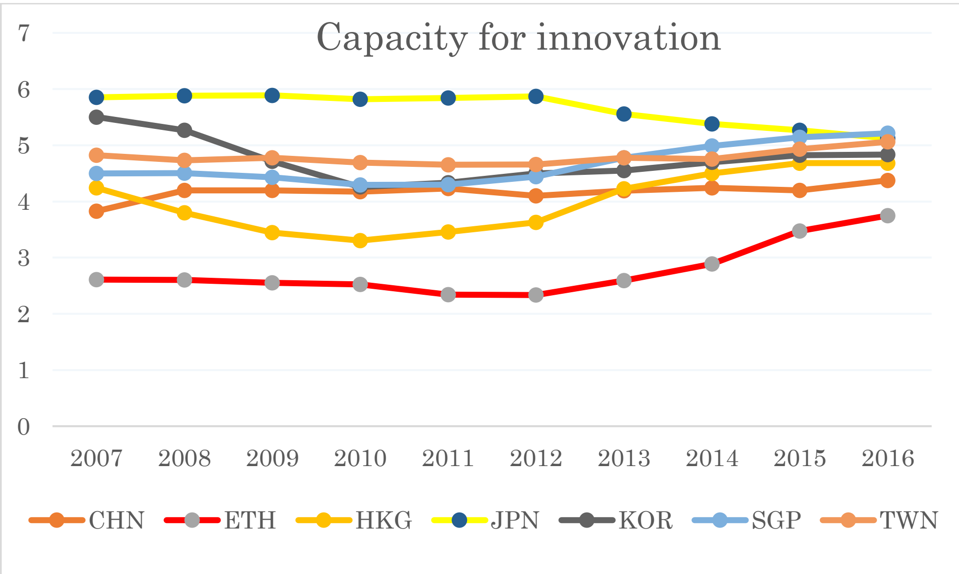


Figure 6-15. Capacity for innovation (Source: author`s compilation of WEF, GCI)

The competitiveness of a nation is determined by a capacity of firm's innovation. Historically, Japan has been preforming above average of East Asian countries in terms of innovation capacity. As a result, Japan had crowned the leadership position for decades and Japanese firms have dominated in global markets. However, as Figure 6-15 illustrates, recently the gap among East Asian countries have been minimized. On the other hand, the score value of South Korea is used to be more than twice of Ethiopia in 2007 The last four years, Ethiopia has improved innovation capacity performance and has managed to increase a score value to 3.7 in 2016. The gap with South Korea is reduced by half.

The recent improvement of Ethiopia is due to a paradigm shift of policy that was proclaimed to encourage all level of industry to increase capital expenditure on R&D. Also, science and technology innovation increase national gross expenditure on R&D to 1.5 percent of GDP (GTP II, 2015). In spite of Ethiopia claiming East Asian development model, Ethiopia significantly lags behind high performance countries in all aspect of innovation indicators. Hence, Ethiopia should improve in all innovation indicators in order to replicate East Asian growth model, and to bring successful structural transformation.

6.5.2 Comparative Analysis of Innovation Indicators of Ethiopia with Sub Saharan African Countries

This part of research provide comprehensive evaluation of Sub Saharan Africa countries and to some extend it included North African countries like Egypt, and Morocco. The selection methodology is based on different perspectives that consider macroeconomic indicators, population size and geographical proximity. Macroeconomics indicators mainly included the achievement of recent economic growth (the top preforming countries in terms of economic growth are Rwanda, Uganda, Kenya, and Ethiopia), and size of gross domestic product's output in terms of the United State Dollar value. It also evaluates the country with a same characteristics with regard to development policies such as Rwanda and Ethiopia. In addition, comparing Ethiopia with the highest GDP per capita income country. Such as Egypt, South Africa, Nigeria, and Morocco. GDP has taken into consideration to select the countries with the largest GDP share in Africa. Such as, Nigeria, South Africa, Egypt, Angola, Ethiopia and Kenya. Angola is excluding from comparative analysis due to the lack of data. The other selection criteria is geographical proximity that is close to each other, most of the countries are located in East Africa. Those countries have been preforming much better than other African countries in most macroeconomic indicators for the last ten years. Lastly, a country's selection criteria includes the countries with similar population size with Ethiopia (Nigeria, and Egypt). This method of cross country comparison is a tools to understand national capacity and to measure international competitiveness.

In 1960s, Sub Saharan Africa countries' productivity was much better than South Asian Countries. According to the Competitiveness Africa Report (2017), South Asia's innovation and productivity have improved remarkably and it has surpassed the Sub Saharan African in 1980s. Innovation capacity and productivity have some correlation. Figure 6-16 below comparatively analyzes innovation pillar of African Countries by taking into consideration macroeconomics indicators in different parts of Africa.

The below analysis is based on the following pillar of innovation indicators**. S**uch as, Capacity for innovation, Quality of scientific research institutions, Company spending on R&D, University-industry collaboration in R&D, Gov't procurement of advanced technology products, patent applications application per million population and . ICT user

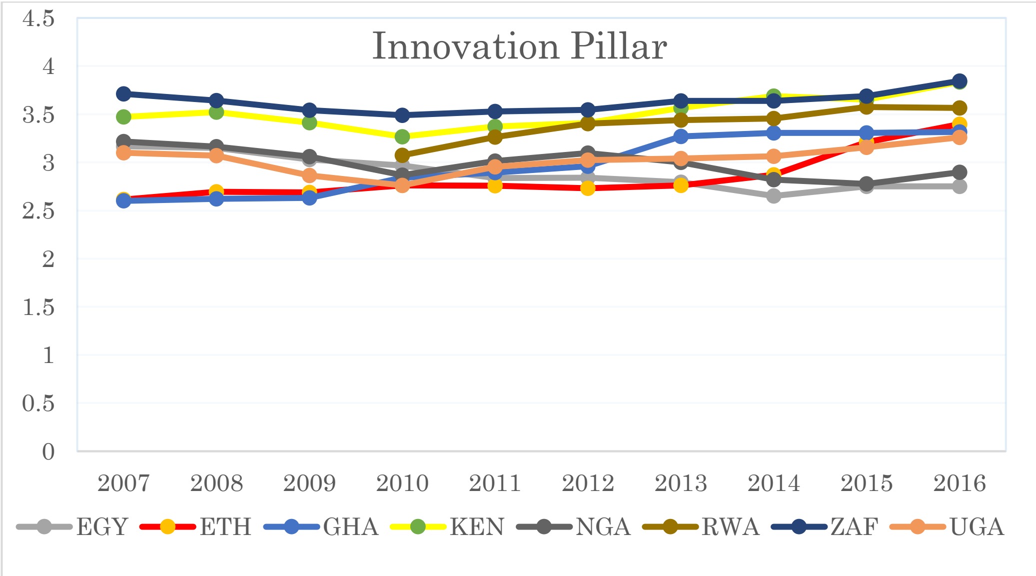


Figure 6-16. Innovation pillar (Source: author`s compilation of WEF, GCI)

Figurer 6-16 indicates that South Africa is the most competitive African country that has performed very well. Kenya has followed South Africa very closely until 2013 with score value of 3.5 and 3.6 respectively. However, Kenya had taken over South Africa in 2014. The remarkable performance improvement comes from Ghana and Ethiopia. Both countries' performance score values had increased by 30 percent for the last ten years. Ghana`s innovation performance score surpassed Egypt, Nigeria and Uganda in 2013. Whereas, Ethiopia performed with slow pace and surpassed Ghana in 2016 by a slight margin. These countries with the largest GDP share in Africa have been preforming poorly as well as they have declining in a score of innovation pillar by about 13 percent by 2016 (Nigeria and Egypt). Rwanda performs much better than Ethiopia throughout the years.

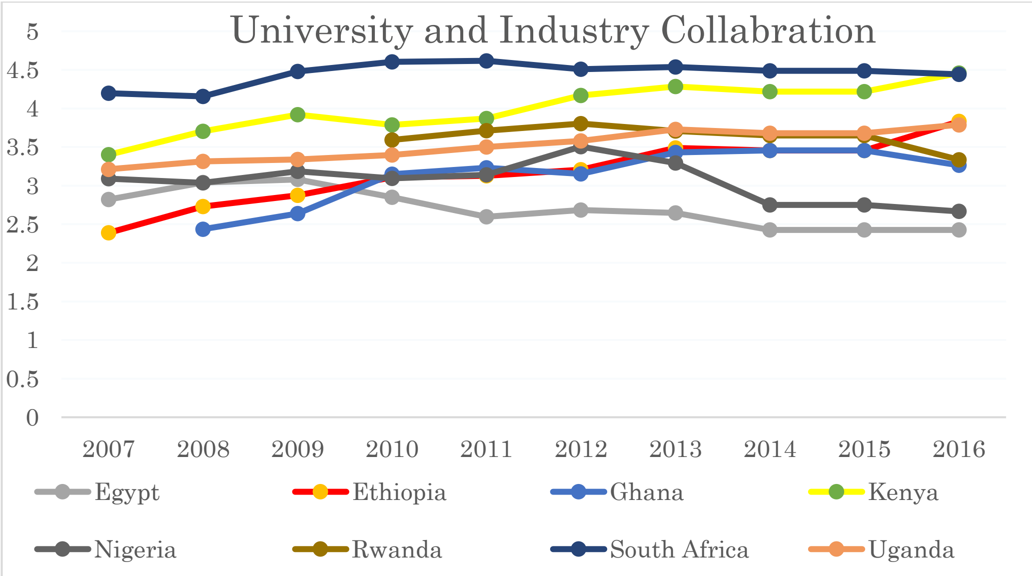


Figure 6-17. University and Industry collaboration on R&D (Source: author`s compilation of WEF, GCI)

Triple helix model measures innovation performance by the interaction between university, industry and government. Triple Helix theoretical and empirical research extensively discussed the collaboration among research institutions (Etzkowitz & Leydesdorff, 1995). Figure 6-17 presented that South Africa has well established collaboration between industry and university, and also they have been preforming better than any of these African countries. Kenya has increased collaboration among institutions, and minimized a gap with South Africa. In 2016, Kenyan performance score became the level of best performing country. Egypt and Nigeria have the worst performance scores, which are about half of South Africa and Kenya. Interestingly, Ethiopia emerged as one of the best preforming countries and managed to catch up Uganda and Rwanda in 2015. Ethiopia outperformed Ghana, Nigeria and Egypt and reduced the gap with South Africa and Kenya. Ethiopia performance has been increasing for last ten years and also create synergy between university and industry. The empirical evidence supported that university and industry collaboration in Ethiopia contribute to increase agricultural productivity (Ezezew, 2014).

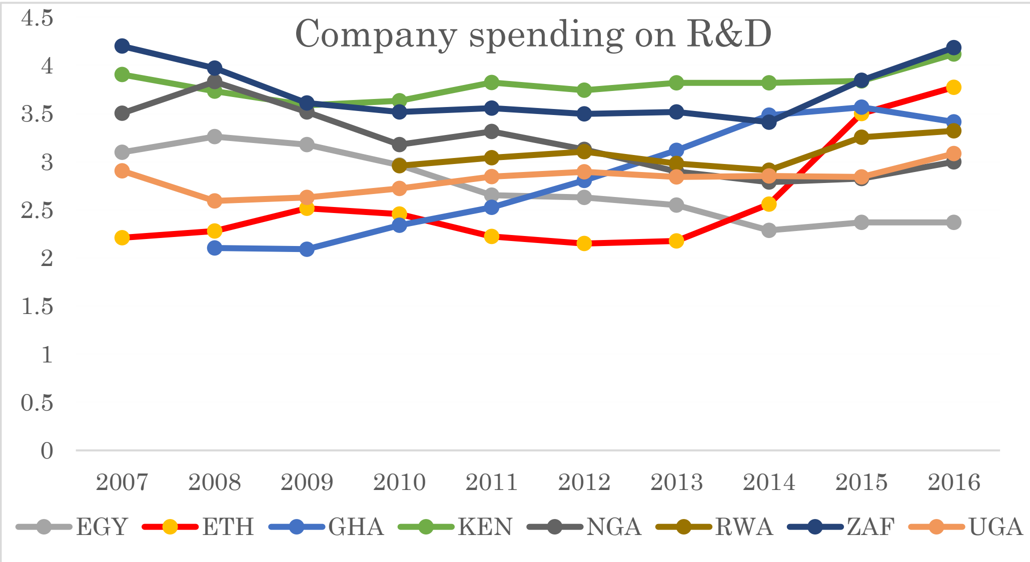


Figure 6-18. Company spending on R&D (Source: author`s compilation of WEF, GCI)

Spending on research and development is an ultimate source of productive that leads to success of an enterprise. Technologically advanced company spends the most in R&D in order to be competitive and create value through innovation. Exogenous growth theory and literature strongly argued that spending on R&D and innovation have significant relationship (Morbey, 1988). Figure 6-18 indicates, Kenya and South African companies have been spending the most in Africa for the last ten years. They spent almost twice of Ethiopia in 2007. Among the above selected countries Ethiopia and Ghana had performed very poorly and they had score the lowest value until 2010. Afterward both countries have intensely increased their performance. Ethiopia improved by 42 percent and Ghana improved by 37 percent within ten years. The two country had the most improvement rate and the score value exceeded Uganda and Rwanda while achieving their highest value of 3.8 for Ethiopia and 3.3 for Ghana. Company spending on R&D (Ethiopia) is above average of Sub Saharan Africa by 17 percent. On contrary, Egypt and Nigeria had been declining their companies spending on R&D and they had the worst performance rate. In addition, Uganda and Rwanda's performance have been improved slightly by 16 percent and 11 percent respectively.

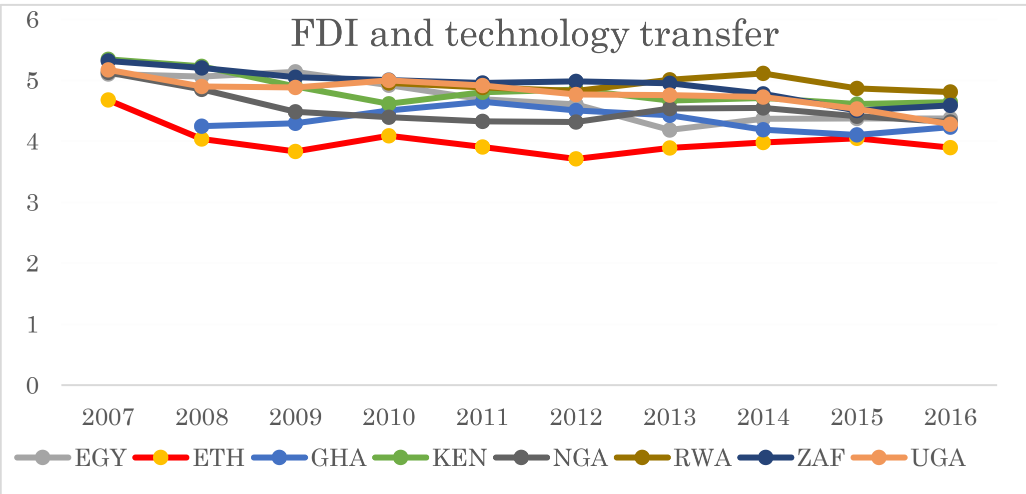


Figure 6-19. FDI and technology transfer (Source: author`s compilation of WEF, GCI)

The study of Chryssochoidis, Millar and Clegg (1997) argued that FDI has different characteristics. Among the notable FDI characteristics, multinational corporations invest to gain access to cheaper factor of production (they bring their own innovative technology), and they invest to benefit from technical capability of host nations. FDI is a major source of technology. African countries economy mainly dependent on labor intensive products that do not require advance technology. Most of Multinational Corporations invest in Africa either in extractive industry or labor intensive industry to access natural resources. Those countries` economies have traditionally relied heavily on mineral resources, exports, or agricultural based economy. Due to the fact that resource based economy (mineral resource endowment) creates momentum in FDI inflow rather than knowledge driven economy. As a result African countries have benefited the least from advance technology transfer. Figure 6-19 presents the score value of FDI and technology transfers in selected African countries. The graph shows that there are minimum difference among these countries` score value except for Ethiopia. The performance of Rwanda is slightly better than Kenya and South Africa. However, the gap between Ethiopia and Rwanda is significant with marginal gap of 19 percent in 2016.

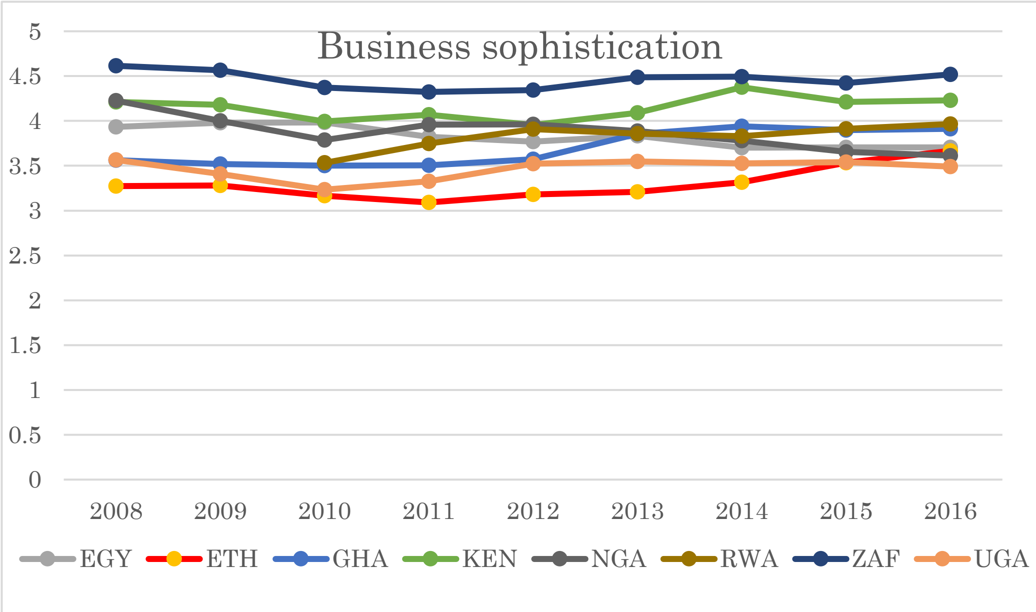


Figure 6-20. Business Sophistication (Source: author`s compilation of WEF, GCI)

Business sophistication is a tools to measure competitiveness of a firms. The most productive and innovative country has a highest score. Japan, Singapore, Korea and Taiwan are among best performing countries. Whereas, Sub Saharan African countries competitiveness performance are slightly below South Asian countries average scores. Figure 6-20 indicates that South Africa performs the most and followed by Kenya. The competiveness of Ethiopia is below average Sub Saharan African countries and also perform the least among selected countries until 2015. Afterward it shows a slight improvement of score value and surpassed Uganda as well as equalized with Nigeria and Egypt.

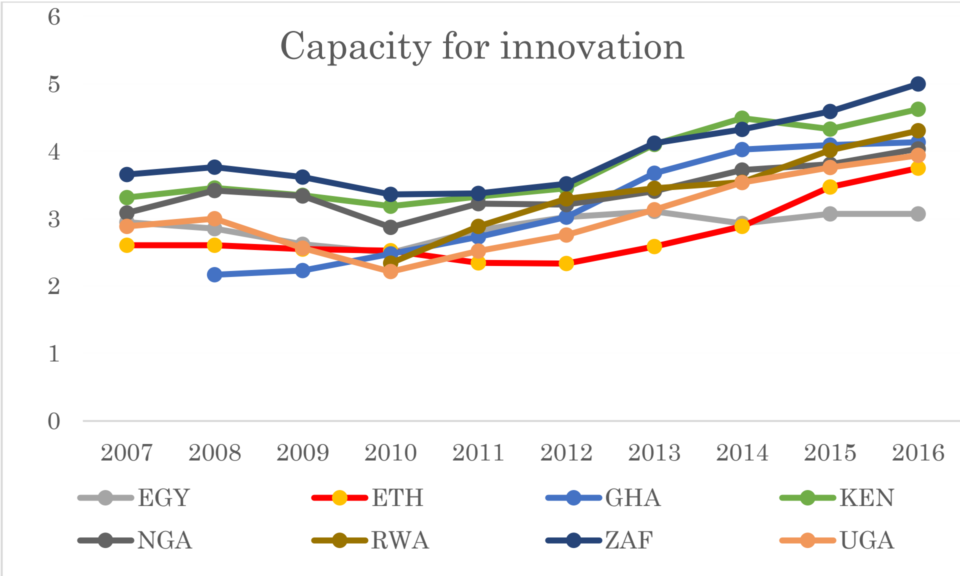


Figure 6-21. Capacity of innovation (Source: author`s compilation of WEF, GCI)

Resource based theory argued that capacity of innovation is a determinant tool to achieve sustainable growth, build competitive advantage and strength strategic value in order to outperform others (Madhani, 2010). Exogenous growth theory argued that a firm with innovative capability has a potential to adapt external technology and develop core competency. East Asian countries are the most innovative nations, especially Japan, Taiwan and Korean firms are effectively managed to integrate their absorption capacity into innovation ecosystems. Whereas Sub Saharan African Countries' average performance score value is less than South Asian Countries. Figure 6-21 indicates that South Africa and Kenya are the best performing Sub Saharan African countries. For the last ten years, South

Africa improved by 27 percent and Kenya improved by 21.4 percent. Despite Ethiopian improvement rate is the highest among all countries with average improvement rata of 31 percent, still Ethiopia score value is the lowest of all countries. Surprisingly Ethiopia had appeared only above Egypt, which surpassed in 2015. At the same time. Rwanda, Nigeria and Uganda have shown average improvement of 26 percent.

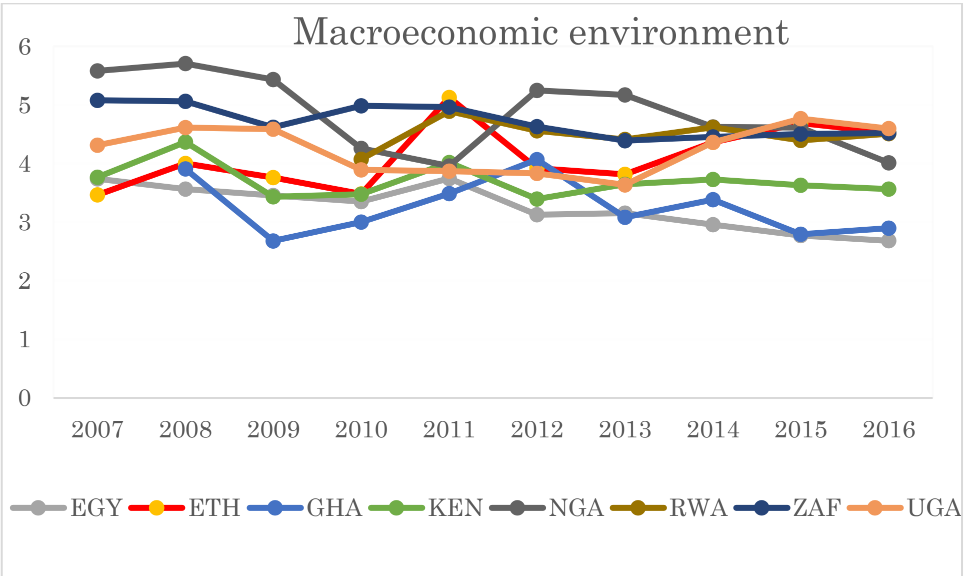


Figure 6-22. Macroeconomic environment (Source: author`s compilation of WEF, GCI)

The Sub Saharan African countries have emerged from instability and economic stagnation that had dragged them back for decades (IMF, 2014; Africa Economic Outlook, 2017). Recently they have appeared as one of the fastest growing economies in the world with the average GDP growth rate of 5 percent.

Particularly, East African countries have shown astonishing macroeconomic performance above average growth rate of Sub Saharan Africa (AFDB, 2015; IMF, 2014). This remarkable achievement leveled East Africa with South Asian countries' performance. Figure 6-22 indicates that Nigeria ranked at the top in terms of performance, followed by South Africa (in 2007). Unlike the previous innovation indicators, Nigeria's competitive performance in macroeconomic environment has shown astonishing result with the highest score above the two leading countries in other indicators (South Africa and Kenya). At the same time, Nigeria and Ethiopia used to have huge gap, which was 38 percent marginal score difference in 2007. However, Ethiopia has been improving the most of all African countries in terms of macroeconomics environment and also Ethiopia had taken over Uganda, Rwanda and South Africa in 2016. Moreover, Ethiopia surpassed Egypt, Kenya, Ghana and Nigeria with marginal gap of 41 percent, 22 percent, 36 percent and 11 percent respectively. Other selected countries have shown positive progress in macroeconomic environment except Kenya's steady growth and Egypt declining slightly as compared to 2007.

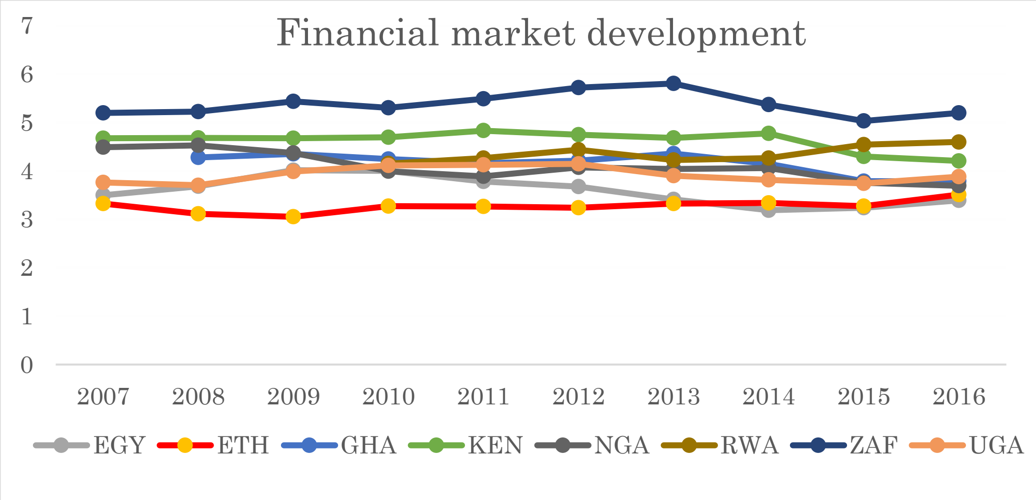


Figure 6-23. Financial market development (Source: author`s compilation of WEF, GCI)

The International Monetary Fund (IMF) and the World Bank (WB) strongly advocate financial market development and they encouraged developing countries to liberalize their financial markets by imposition of Structural Adjustment Programs (Weber, Davis & Lounsbury, 2009). Endogenous growth theory insisted the importance of financial markets and its contribution to economic growth. Most developed countries have advanced financial markets, and they established well developed financial platform that mobilize huge amount of capital to inject into the economic system. Likewise, developing countries have been trying to implement similar financial markets, conferring to the prescription of IMF and World Bank, but they ended up with little success or failed into financial traps. This situation was argued by prominent economist Joseph Stiglitz, he presented his thought on financial markets and development in different paradigm, specifically by singled out capital markets and financial institutions, the successful experience of developed countries` capital markets and financial institutions are not replicable or do not work perfectly in developing countries. He says

> thus, I will argue that the LDCs should not set their sights on imitating the capital markets of the most developed countries, but rather should adapt themselves to the reality that capital markets will most likely, if not necessarily, work poorly within their country (Stiglitz, 1989, p.56).

Figure 6-23 indicates that, South Africa has the most advanced financial market in Africa, followed by Kenya with 20 percent gap in 2007. During the same period, Ethiopia had a very wide gap with South African by 33 percent. Most African countries have shown horizontal growth or there is no improvement on their financial market development. Among the listed African Countries only Rwanda has improved competitiveness score by 10 percent, which is the highest in Sub Saharan Africa. On contrary, Egypt declined by 4 percent, and widen the gap with South Africa and leveled with Ethiopia in 2016. Kenya, Uganda, and Ghana have higher performance score than Ethiopia. Therefore, Ethiopian financial market competitive performance is one of the lowest in Africa. South Africa and Kenya have the most liberal and well developed financial markets in African countries, whereas Ethiopian financial market is still under developed despite strong pressure from IMF and World Bank to liberalize and open financial market to foreign companies, Ethiopia is unwilling to accept IMF and World Bank prescription and adopted different paradigm of development strategy without liberalizing financial market. Regardless of worst performance of Ethiopia in financial market development, macroeconomic development is the best not only in Africa but also in the world. It contradicts the establishment of neoliberalism theory that strongly advocates financial liberalization. It is indeed true, well developed and liberal financial market attracts better capital inflow than the current Ethiopia financial market or ecosystem. Therefore, the relationships of Ethiopia financial market and macroeconomic environment findings are needed further investigation in future research.

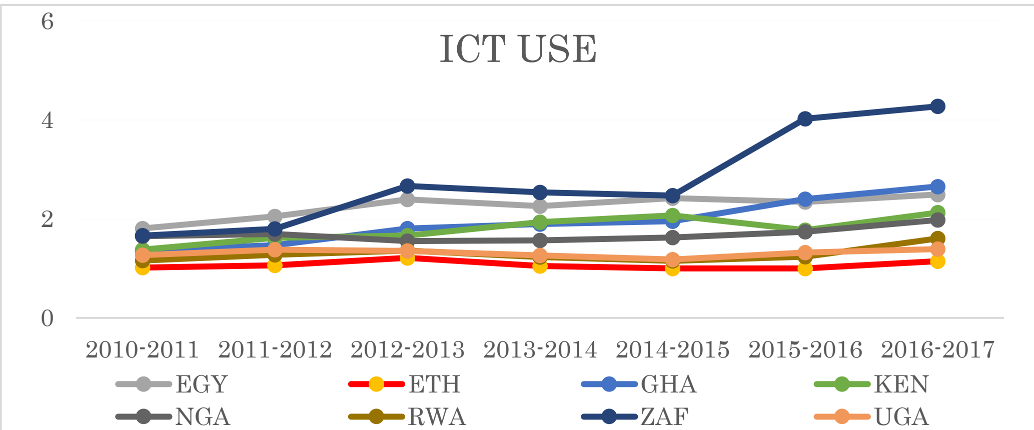


Figure 6-24. ICT USE (Source: author`s compilation of WEF, GCI)

OCED study on Information and Communications Technology (ICT) transmission to business concluded that ICT is a fundamental input to increase productivity and enhance economic growth. Moreover, ICT gears for technological spread as one of the main factors that contributes in economic development. The degree of importance of technology transmission by means of ICT has been acknowledged by international policy-makers and different institutions to bring economic growth. (Cette, Mairesse & Kocoglu, 2005; Lechman, 2014; Vergara & Grazzi, 2008).

Developed countries have realized the importance of information technology ahead of developing nations for decades. They had started to invest in information technology infrastructure as well as on human capital development. Empirical evidence indicates that developed countries' productivity and competitiveness have been increased since the policy makers and private sectors had given priority to expand ICT. Later on, most developing countries have realized the importance of ICT but they failed to achieve it. Because, ICT transmission requires not only human capital but necessitates huge amount of financial capital investment, which in reality is beyond their fiscal budge. Together with ICT expansion, developing countries oblige to invest on Electricity (both investments are capital intensive). Therefore, underdeveloped countries lagged behind advanced nations.

Figure 6-23 above shows that Sub Saharan African Countries' ICT usage is very low in 2010, but South Africa and Nigeria's performance is slightly above average score. However, South Africa has registered exceptional performance and widen a gap with other African countries by 216 percent with Nigeria and the highest gap is with Ethiopia by 372 percent. South Africa is the only African countries that joined developed nations club in terms of ICT performance. The competitiveness score increased dramatically from 2010 level by 257 percent with score value of 4.27. This achievement is much better than Eurasia (3.65), Latin America and the Caribbean (3.40), Sub-Saharan Africa (1.84), South Asia (1.73) and Middle East and North Africa (3.78). The performance of South Africa is also similar to East Asia and Pacific (4.31), and less than Europe and North America (5.61). On the other hand, Ethiopia's performance is worst and below average score. All the above targeted countries' performance is better than Ethiopia, particularly, Ghana, Kenya, and Rwanda with score value of 95 percent, 54 percent and 38 percent respectively. This does not mean African countries are in a competitive position, still they are far behind advanced nations. Therefore, the contribution of policy makers are important to create momentum in facilitating and expanding ICT sectors, which has strong relationship with economic development.

Case of Ethiopia is contradicting from the current miracles economic growth. This comparative analysis result proved that Ethiopia is far behind even Sub Saharan African countries in terms of knowledge based competitiveness. Despite a recent increasing number of mobile user in the country and expanding an investment on communication infrastructures, still Ethiopia is the most uncompetitive nation on earth. To change the current situation, and to emerge as knowledge driven economy, it requires a paradigm shift to acknowledge the ground reality and to revise Science and Technology policy. Policy makers also need to bring paradigm shift on a current firm stance/policy that block or limit the involvement of private sectors from participating or investing in ICT infrastructure. Having said that Ethiopia should liberalize ICT sectors and create favorable environment that encourage entrepreneur and attract technology based FDI. Furthermore, African countries, particularly Ethiopia, have to invest heavily on technology infrastructure and have to invest on human capital to increase skilled manpower that improve the capacity of innovation. Therefore, policy makers have to promote modern education through universities and training institutions. These institution should play great role to produce a competitive citizen that has an absorption capacity to adapt new technology.

Table 6-4 and Table 6-5 employed Pearson correlation between Kenya and Ethiopia to evaluate the relationship between ICT, Innovation and GDP per capita income. The Pearson correlation coefficient indicates different outcomes for Ethiopia and Kenya as they differed in global competitive score value. The coefficient factors for Kenya, ICT shows strong relationship with innovation and GDP per capita income with significant p-value less than one percent (reject null hypothesis and accept alternative one). The case for Ethiopia, it is undesirable coefficient value for both innovation and GDP per capita income with insignificant p-value of 93 percent and 85 percent respectively (Accept null hypotheses and reject alternative one).

Table 6-4 Pearson Correlation for Kenya

Correlations

		KEYGDPPC	KEYICT	KEYINNO
KEYGDPPC	Pearson Correlation	1	.884**	.800**
	Sig. (2-tailed)		.008	.005
	N	10	7	10
KEYICT	Pearson Correlation	.884**	1	.933**
	Sig. (2-tailed)	.008		.002
	N	7	7	7
KEYINNO	Pearson Correlation	.800**	.933**	1
	Sig. (2-tailed)	.005	.002	
	N	10	7	10

**. Correlation is significant at the 0.01 level (2-tailed).

Table 6-5 Pearson Correlation for Ethiopia

Correlations

		INNV	GDPP	ETHICT
INNV	Pearson Correlation	1	.886**	.040
	Sig. (2-tailed)		.001	.932
	N	10	10	7
GDPP	Pearson Correlation	.886**	1	.084
	Sig. (2-tailed)	.001		.858
	N	10	10	7
ETHICT	Pearson Correlation	.040	.084	1
	Sig. (2-tailed)	.932	.858	
	N	7	7	7

**. Correlation is significant at the 0.01 level (2-tailed).

To sum up the above findings, in all measurements Kenya's ICT performance is much better than Ethiopia. ICT in Kenya has exceptional contribution to bring inclusive economic development. For last ten years ICT growth rate is 8.4 percent, which is twice higher than average economic growth of Kenya. It plays a great role by revolutionizing financial sectors, which become a model for Africa and other developing countries. Notably, M-Pesa mobile phone based payment system that has been utilized by grass rote level citizens. Kenya's ICT contribution is not limited to finance and communication, but has equal contribution in agriculture and health sectors. Ethiopia is far behind Kenya to utilize ICT and to bring inclusive growth. Hence, Ethiopia should benchmark Kenya as best practice in terms of ICT, this requires more liberal ICT policy and strategy than the current one.

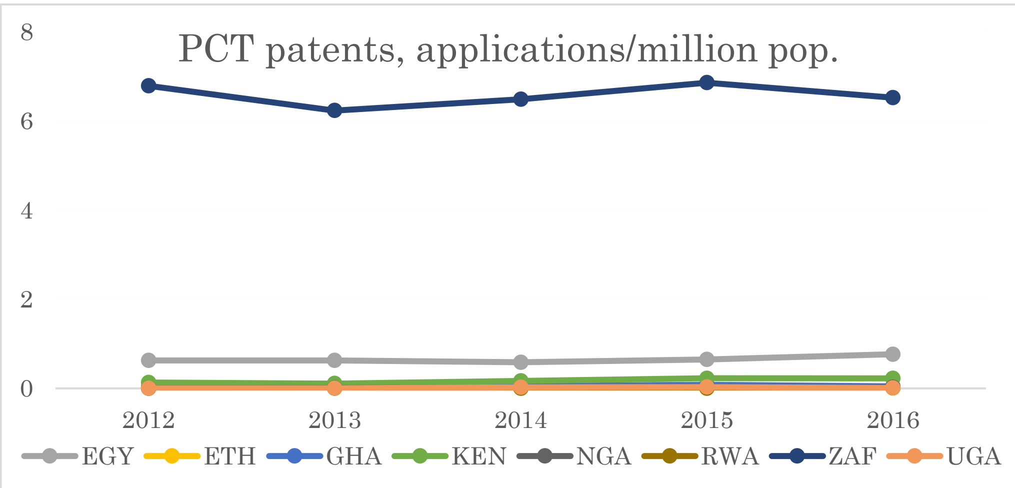


Figure 6-25. Patent applications per million population (Source: author`s compilation of WEF, GCI)

Patent application is one of the determinants of innovation capacity which creates the aptitude of private firms to commercialize new products. Innovation theory argued that those countries with higher number of patent are more competitive than others. Research and patent activity consider as a benchmark to measure innovation capacity. Research and development increases the accumulation of knowledge produced, that leads to innovation and increase the country's capacity of creativity, interaction, and collaboration between private sectors, research institutions, and universities (OECD, 1997).

Figure 6-25 indicates the number of patent applicants per million population. The number of patents indicate that Sub Saharan African countries have been suffering from lack of innovation. The only country in Africa that has the most patent application is South Africa, which has the highest number 6.8 per million population. Ethiopia is one of the country that has the least number of application along with Rwanda.

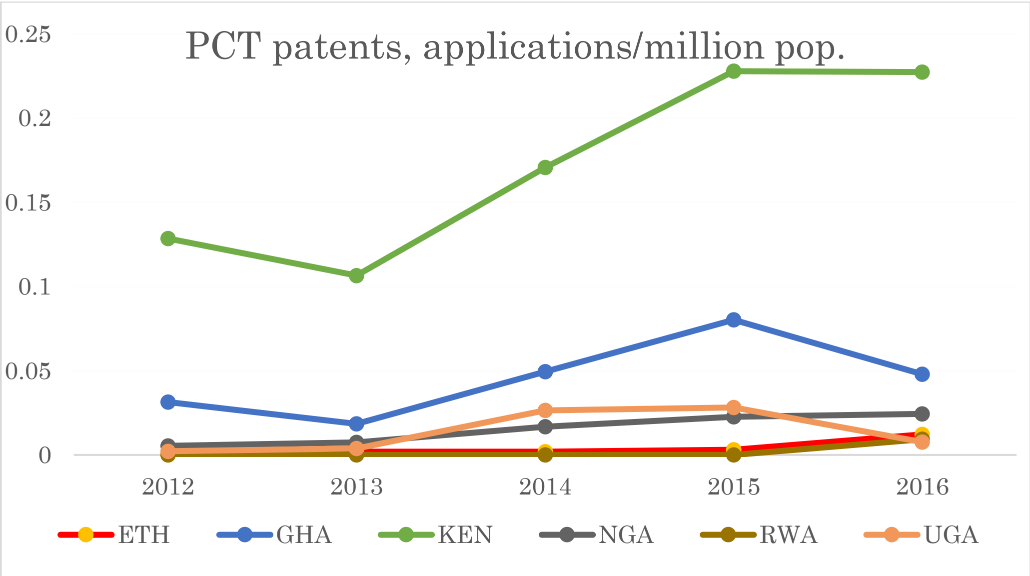


Figure 6-26. Patent application per million population (excluding South Africa and Egypt) (Source: author`s compilation of WEF, GCI)

The performance for Kenya is much higher than Ethiopia with 0.23 patent application per million in 2016, but Ethiopian average patent application is 0.0038 from 2012 to 2016, the highest patent application to Ethiopia (0.012) in 2016. This figure is less than Kenya by more than 2000 percent during the same period, this is extremely ordinary outcome for Ethiopia. In spite of having largest GDP in Africa, Nigeria lagged behind Kenya with a high margin. The total sum of patent application from 2010 to 2016 is 0.0765 per million population, whereas Kenya applied 0.227 in 2016, this figure is 300 times higher than Nigeria. Among selected countries, Ghana is better than Ethiopia, Nigeria, Rwanda and Uganda.

Innovation performance is insignificant in Ethiopia and lagged behind low income countries. A basic challenge for science, technology and innovation in developing countries is lack of transparent policy and sufficient financial support for research and development. Policy makers' initiation plays a vital role to address major socioeconomic challenges and to improve innovation performance, and to strengthen human capital by providing incentive to research institution and private sectors. In existing knowledge based economy, Government of Ethiopia should evaluate the current practice on innovation to find out the root cause of problem that hinder the progress towards advance level of innovation. Furthermore, the effort of policy makers by themselves are not enough to solve a core problem, it requires all stakeholders participation to get ride off a bottleneck. Therefore, policy makers are main drivers to create innovation ecosystem. Notably, by capitalizing the benefit of information and communication technologies, and by developing global value chain through trade openness and attract foreign direct investment. Unless and otherwise, government of Ethiopia acts quickly and gives high priority for innovation, it may be hard to eradicate poverty in Ethiopia. The current miraculous growth may not be sustainable in the long term without establishing innovation ecosystem.

The findings of a competitiveness performance considerably vary between African countries. For instance, Kenya and South Africa have shown outstanding performance in all innovation indicators, especially South African and Kenya. Ethiopia is the least performing nation among the selected countries in all indicators in 2000s. Nevertheless, Ethiopia has been improved since 2010 and has outperformed some of the African countries, like Egypt and Nigeria When it comes to macroeconomic environment performance, none of African countries had shown strong competitive performance as much as Ethiopia achieved.

6.5.3 The Relationship of Innovation and Macroeconomic indicators: in case of Ethiopia performance

The pervious chapter of this research identified the determinants of economic growth in Ethiopia. Also, we evaluate the relationship of economic growth and human development by using macrocosmic indicators. This analysis focuses on different perspectives of macroeconomic indicators. The main objective is to evaluate the role of innovation in economic growth in Ethiopia. Since innovation is one of the major driving forces behind the economic growth. Neoclassical growth theory emphasizes the importance of knowledge accumulation and technological progress as the only way to achieve long-run growth. Theoretical and empirical evidence supported that innovation and economic growth have positive correlations (Cameron, 1996; Rosenberg, 2004; Aghion, David & Foray, 2009; Ulku, 2004). Innovation is an essential device that is required at all stages of development. Specifically, Ethiopian innovation is at an early stage of development, which is on transition from agricultural based economy towards industrialization. Therefore, technological innovation and dissemination are important for economic growth to increase welfare of the nation (Philibert, 2003; Santacreu, Comin & Gertler, 2009). Different type of innovation play a role at various stages, but in case of Ethiopia, incremental innovation is the ultimate preference since the country is heading to light industry, by which the country has been implementing agricultural led industrialization policy.

The review of historical perspective of innovation system showed that Ethiopian innovation system had introduced a bit later than some African countries. In the middle of 1970, the first Ethiopian Science and Technology commission was established without clear action plan and policy rectification. The current Government of Ethiopia proclaimed Science, Technology and Innovation policy after two decades with the objectives of creating a technology framework. The fundamental objective of the policy to build national capabilities of science and technology through technological learning, and adaptation of foreign technology. Moreover, strengthening a capacity of technology utilization through absorption of capacity, adaption and technology transmission.

The executive committee of African Union gathered at Khartoum in 2006 to decide the destiny of African economic development. They realized that the current issue of Africa, which become bottleneck for the growth and development of a continent. These executive committee on Science and Technology came up with a plan to promote innovation in Africa through increasing a ration of Gross Expenditure of R&D fund to one percent of GDP by 2010 (AFRICAN UNION, 2007; UNECA, 2016). Unlike other African countries, Zambia, Kenya, Rwanda and Ethiopia were committed to invest more than the targeted Africa Union budget. Kenya government adapted the most aggressive expenditure plan to increase Gross Expenditure on Research and Development up to two percent of GDP, the fund allocated from the annual government budget, channeled through the National Research Fund. Ethiopian government also adapted similar aggressive target to spend 1.5 percent of GDP on R&D, one percent of the fund allocated from the profit contribution from all service and productivity sectors (Ethiopian Science and Technology Agency, 2006; UNECA, 2016). This strategy has believed to bring a change and created a momentum in innovation sectors. The below analysis evaluates the effectiveness of policy implementation with regard to innovation and economic growth. Macroeconomic indicators and innovation indicators are taken in to consideration as major factors to run correlations.

This research attempts to evaluate in detail the correlation of economic growth and innovation. In addition, it takes into consideration the following factors, such as, innovation and sophistication (key for efficiency driven economies), basic requirements (key for factor driven economies), as well as efficiency enhancers (key for innovation driven economies). Basic requirements includes the following pillars, such as, institutions, infrastructure, macroeconomic environment and health and primary education. And Innovation and sophistication sub-index includes business sophistications and innovations indicators. The third sub-index is efficiency enhancers that incorporated higher education and training, financial market development, goods market efficiency, labor market efficiency, technological readiness, and market size.

In addition to a global competitiveness survey data, this study included Ethiopian Science and technology survey data that was collected in 2013 by the Ministry of Science and Technology, which is responsible for Science and

Technology Information Center (STIC). Data collection methodology was employed based on Franscati manual, that was built on OECD`s Oslo manual. Basically, the survey was collected information on experimental research and applied research, in addition to that it provides human capital data, which is the supply of R&D personnel within a country. Explicitly, the primary indicators of the survey include: capital expenditure on research and development, such as the gross domestic expenditure on R&D (GERD), R&D expenditure by source of funds and sector of performance. Moreover, it includes the availability of human capital, such as R&D personnel by background qualification and gender, R&D by research type, and R&D personnel full time equivalent (FTE).

According to Ethiopian Ministry of Science and Technology, the OECD`s Frascati Manual, the survey included the following basic sectors, which divided into three categories, such as, business enterprise sector; which included private sector and state owned enterprise (SOE), covering large enterprises with large registered capital (more than 1.5million birr) and also those have more than ten employees. The second one is the government institutions that includes all level of government sectors with a capacity of R&D as well as government research institutions, moreover it includes higher education sector that includes all public and government higher education institutions. The third one is the private nonprofit sector, which was covering non-governmental and other organizations formally registered as not-for-profit organizations.

This part of the chapter will take a look on capital expenditure on research and development, which comprises gross domestic expenditure on R&D, and R&D expenditure by source of funds with regards to performance from 2007 to 2013. Moreover, it evaluates three stage of correlation among scientific and technical journal articles, patent application per million populations, and gross expenditure on R&D by employing Pearson correlation under the following hypothesis based on the following guidelines; (I) Null hypothesis: There is no correlation between two variable; (II) Alternative Hypothesis: there is correlation between two variables; (III) If p-value or significant value is less than 5 percent reject null hypothesis and accept alternative hypothesis; (IV) If p-value or significant value is more than 5 percent accept null hypothesis and reject alternative hypothesis.

1. Scientific and technical journal articles have positive correlation with gross domestic expenditure on R&D.
2. Scientific and technical journal articles have positive correlation with patent application.

3. Gross domestic expenditure on R&D has positive correlation with patent application.
4. Gross domestic expenditure on R&D has positive correlation with Innovation.
5. Gross domestic expenditure on R&D has positive correlation with GDP growth.
6. Gross domestic expenditure on R&D has positive correlation with GDP per capita income.
7. Scientific and technical journal articles has positive correlation with innovation and economic growth.

Empirical study strongly supported that the country that spend the most on R&D has highest number of Scientific and technical journal articles. Figure 6-27 below indicates that gross domestic expenditure on R&D of Ethiopia has been increasing. In 2013, the R&D expenditure increased by 700 percent from 2007 level. At the same time, number of scientific and technical journal articles publication also has raised sharply by 245 percent in 2013 compared to number of publication in 2007.

7.3.1 Research and Development

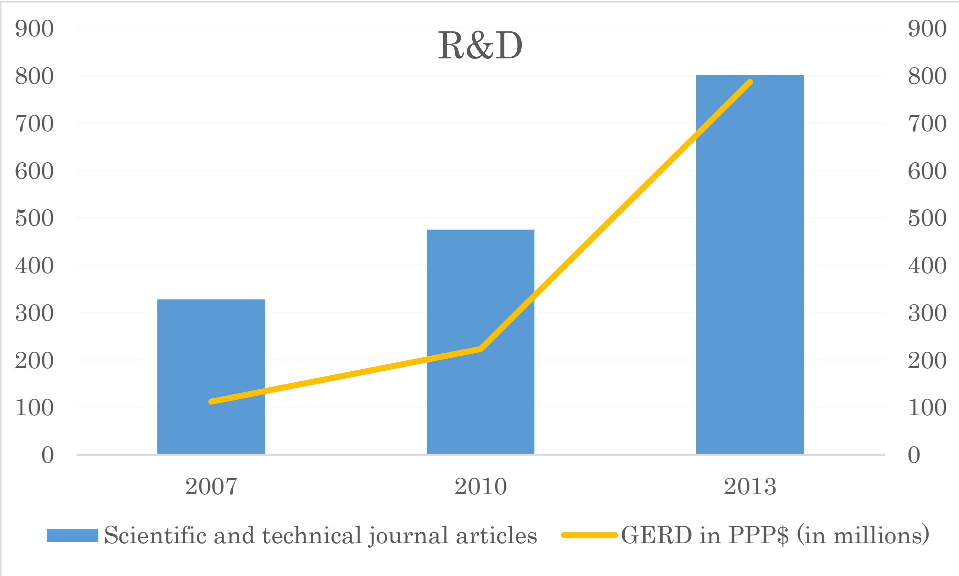


Figure 6-27. Growth expenditure on R&D and Scientific and technical journal articles (Source: author`s compilation of WEF, GCI)

Figure 6-27 presents the gross domestic expenditure on R&D and Scientific and technical journal article increased in upward direction simultaneously with different growth rate. During this period average economic growth rate was 10.6 percent, which was the highest growth rate in the history of Ethiopia. Surprisingly, gross domestic expenditure on R&D is much higher than GDP growth rate. Figure 6-28 illustrates that government has the largest contributions on gross expenditure on R&D from 2007 to 2013 (on average 69 percent). Followed by funds from abroad takes second place on average 17 percent during the same period. At the same time not specified source of fund has increased its shares.

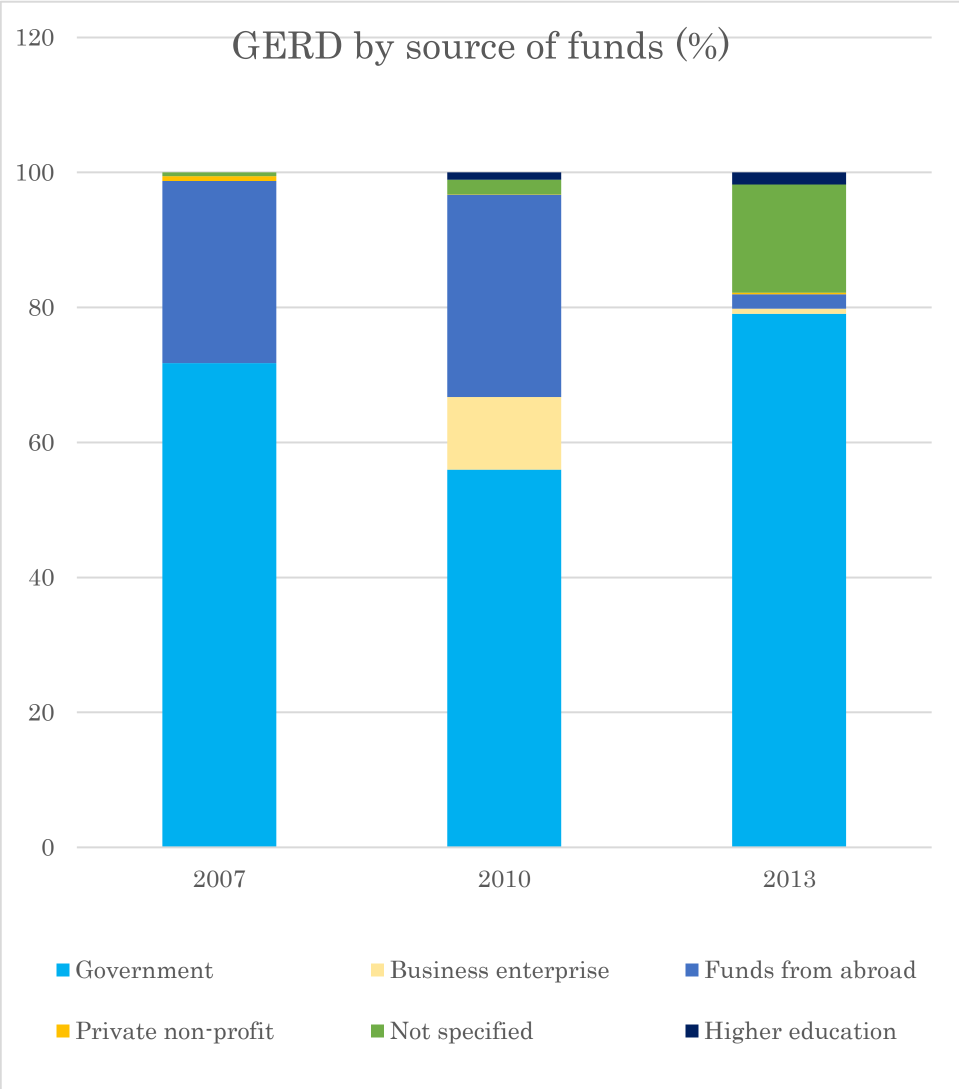


Figure 6-28. Percentage of Gross expenditure on R&D by fund source (Source: author`s compilation of WEF, GCI and ESTA)

Table 6-6: Correlations among Gross expenditure on research and development and, macroeconomics and innovation indicators

		ETHEG	SCJETH	GERDETH	PAT	INNV	GDPP
ETHEG	Pearson Correlation	1	-0.624	-0.737	-0.614	-0.497	-0.606
	Sig. (2-tailed)		0.571	0.472	0.059	0.143	0.064
	N	10	3	3	10	10	10
SCJETH	Pearson Correlation	-0.624	1	0.988	0.953	0.742	.997*
	Sig. (2-tailed)	0.571		0.098	0.196	0.468	0.048
	N	3	3	3	3	3	3
GERDETH	Pearson Correlation	-0.737	0.988	1	0.988	0.63	0.974
	Sig. (2-tailed)	0.472	0.098		0.098	0.566	0.147
	N	3	3	3	3	3	3
PAT	Pearson Correlation	-0.614	0.953	0.988	1	.892**	.777**
	Sig. (2-tailed)	0.059	0.196	0.098		0.001	0.008
	N	10	3	3	10	10	10
INNV	Pearson Correlation	-0.497	0.742	0.63	.892**	1	.886**
	Sig. (2-tailed)	0.143	0.468	0.566	0.001		0.001
	N	10	3	3	10	10	10
GDPP	Pearson Correlation	-0.606	.997*	0.974	.777**	.886**	1
	Sig. (2-tailed)	0.064	0.048	0.147	0.008	0.001	
	N	10	3	3	10	10	10

*. Correlation is significant at the 0.05 level (2-tailed).
**. Correlation is significant at the 0.01 level (2-tailed).

Pearson correlation indicates gross domestic expenditure on R&D has insignificant relationships with innovation, economic growth, GDP per capita income, patent application and scientific and technical journal articles. However, the statistical figure shows that optimistic growth of expenditure on R&D, if this positive growth rate continue with the same pace, it will have positive correlation in near future. Pearson correlation coefficient for scientific and technical journal articles indicates strong positive correlation with GDP per capita and the significant P-value (4.8 percent), therefore the result reject the null hypothesis and accept alternative. But scientific and technical journal articles have insignificant relationships with all other indicators. Innovation pillar has strong coefficient with patent application and GDP per capita income with strong significant p-value of one percent. Whereas, Innovation has poor association with other indicators. Patent application has positive correlation with GDP per capita with p-value of 0.8 percent.

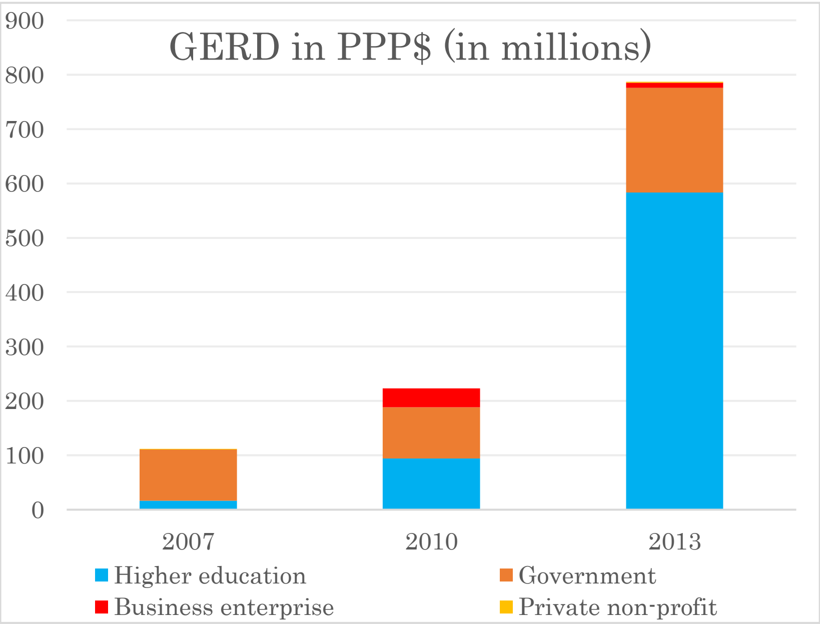


Figure 6-29. Gross expenditure on R&D in terms of PPP (Source: author`s compilation of WEF, GCI and ESTA)

Figure 6-29 illustrates the result of changing the performance of R&D expenditure from a period of 2007 to 2013. The gross domestic expenditure on R&D has raised by seven fold, at the same time, the expenditure and performance structures also have changed. Government is a major source of finance for research and development, which occupied 79 percent of share in 2013. On the other hand, expenditures by sector performance is less than higher education by one third, which is 24 percent ($127 million in terms of Purchasing Power Parity) in 2013. Whereas higher education has the largest share of expenditure performance during the same period (not by allocation of fund), which is 74 percent of gross expenditure on R&D ($583 million in terms of PPP). The least share goes to business enterprise, which has declined from $34 million in purchasing Power parity (PPP) in 2010 to $1.8 million PPP in 2013.

This finding is highly undesirable and alarming signal to policy makers in order to wake them up from dormant and ineffective policy. It presents the weakness of private sectors in terms of research and development. This requires critical analysis and thoughtful policy dialogues with private enterprises to draft more effective and efficient policy framework that encourage business institutions involvement in research and development activities. The current reality confirmed that business firms in Ethiopia are more reluctant to engage on R&D and they have weak perception toward innovation, which eventually affect productivity and competitiveness. Therefore, policy amendment and improvement by itself is not enough to solve innovation bottleneck that has dragged private enterprises from being competitive in global stages. To break through innovation bottleneck, the policy makers need to develop a systematic platform that bring private enterprise into innovation ecosystem through providing direct or indirect financial incentive. Above all, a fundamental problem beyond policy issues is a perception of the private sectors in Ethiopia, they have misconceived the value of innovation to their firms. Instead of investing on R&D, they highly prefer less risky way of doing things, also they heavily relay on import of necessary goods and services (import is about three time higher than Export, which is 27 percent and 8 percent of GDP respectively in 2016). This could be solved through different kinds of policy measurement. First and foremost, to provide executive level training and conferences in order to bring attitude change with regards to R&D, establishing a fair and transparent R&D tax credits mechanism as well as improving access to risk capital with preferential interest rate, without easy access to risk capital it is unlikely to change the current landscape of innovation. Last but not least, giving preferential treatment to innovative companies is not luxury but it is an unavoidable strategy to create competitive advantage and increase productivity. Thus, Innovative enterprise be worthy to get preferential income tax treatment as well as preferential treatment to get government procurement or public procurement of goods and services. These policies are inevitable from the perspective of national security to promote domestic industry and to strength technology capability.

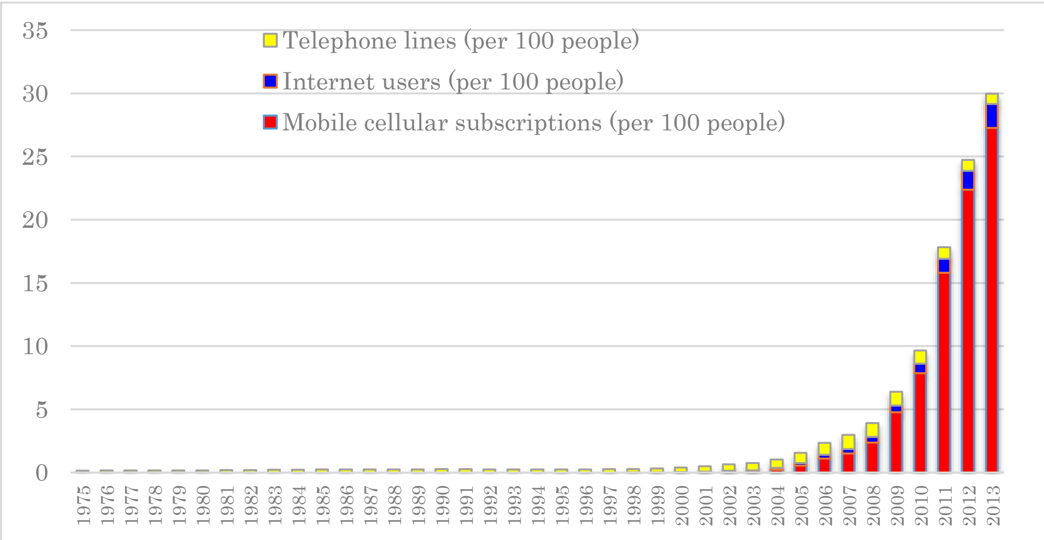


Figure 6-30. The trend of Information Communication Technology (ICT). (Source: author`s compilation of MoFED and World Bank Development Indicators)

In the middle of 2000, telecommunication industry has been expanding remarkably, this improvement is due to aggressive government investment on infrastructure. As the result, number of mobile cellular subscriber dramatically increased from 2% to 30% per hundred people. In 2013, total number of mobile and fixed line users reached more than 30 million. Internet user are also increasing slightly but fixed telephone lines user are declined after 2010. The expansion of communication network is means to increase ICT users. This leads to enhance a transmission of information and communication technology that improve innovation performance. Diffusion of innovation theory argued that ICT and innovation has strong correlation. Table 6-7 employed the Ordinary Least Square (OLS) method that indicates the correlation between GDP per capita income and scientific and technical journal articles. The significant value of factors coefficient for scientific and technical journal articles is (4.86) that indicates positive correlations with GDP per capita income. And also the significant value of factors coefficient for communication is (5.02), this also strongly correlated with GDPPC.

$$GRT_{it}== \alpha + \beta_1 COM_{ijt} + \beta_2 .JOR_{ijt} + \varepsilon_{it}$$

Table 6-7 Correlations between GDP per capita and innovation indicators

GDPPC	Coef.	Std. Err.	t	P>t	[95% Conf.	Interval]
COM	4.529908	0.9016473	5.02	0	2.608092	6.451724
JOR	0.5707357	0.1173424	4.86	0	0.3206263	0.8208451
_cons	84.85615	11.74784	7.22	0	59.81623	109.8961

FDI inflow

Since Ethiopia implemented IMF structural adjustment program and introduced liberal economic policy, foreign direct investment has been grown gradually. Literature on international trade theory argued that FDI is one of the ultimate sources of capital inflow. The investment of multinational corporations in Ethiopia has brought capital inflow and technology transfer in light industry. According to United Nation Conference on Trade and Development (UNCTAD)'s world investment report (2017), East Africa FDI inflow performance has improved and reached to $7.1 billion in 2016 (higher by 13 percent from 2015 level). Exceptional, FDI performance of Ethiopia has been dramatically increasing since 2012. The inflow of FDI to Ethiopia was $3.2 billion in 2016, and it became a top receiver of FDI in East Africa, which account for 45 percent of FDI inflow.

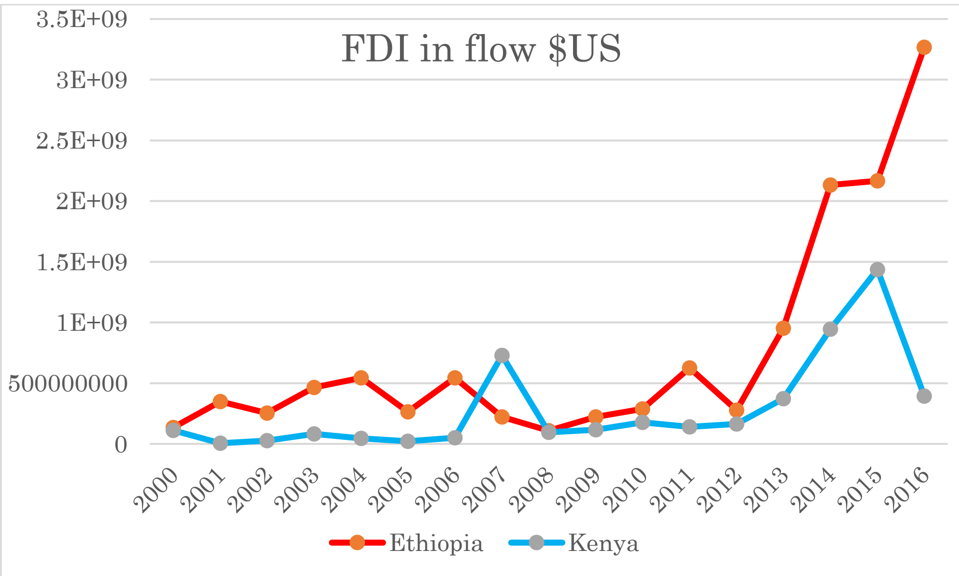


Figure 6-31. FDI inflow $USD (Source: author`s compilation of WDI)

Figure 6-13 indicates that Ethiopia has been performing better than Kenya in terms of FDI inflow. According to Africa Economic Outlook (2017), the FDI inflow to Africa are expected to increase gradually than previous year by about 2% in 2017. The investment value is reaching USD 57.5 billion. The largest share goes to Egypt, which accounts about 17 percent recipient (USD 9.5 billion). At the same time, Ethiopia is expected to be the second largest recipient of FDI in Africa with 8 percent (USD 4.4 billion), followed by Morocco with 7 percent share (USD 4.3 billion). The nature of FDI is different from country to country. For instance, according to Ethiopia Investment Commission, industries (in Ethiopia) are diversifying away from single commodity (agriculture) to consumer goods and services. The highest number of FDI inflow was gone to manufacturing sector (43 percent) and agriculture sector (27 percent).

Table 6-8 Correlations between FDI and technology transfer, Innovation, GDP per capita income and Nature of competitive advantage.

Correlations

		FDITEC	GDPP	INNV	NATCOMPAD
FDITEC	Pearson Correlation	1	-.465	-.225	.048
	Sig. (2-tailed)		.175	.532	.894
	N	10	10	10	10
GDPP	Pearson Correlation	-.465	1	.886**	.598
	Sig. (2-tailed)	.175		.001	.068
	N	10	10	10	10
INNV	Pearson Correlation	-.225	.886**	1	.822**
	Sig. (2-tailed)	.532	.001		.004
	N	10	10	10	10
NATCOMPAD	Pearson Correlation	.048	.598	.822**	1
	Sig. (2-tailed)	.894	.068	.004	
	N	10	10	10	10

**. Correlation is significant at the 0.01 level (2-tailed).

Table 6-8 showed Pearson correlation to evaluate the relationship of FDI and technology transfer with Innovation and macroeconomic indicators. The result indicates, FDI has insignificant relationship with innovation and GDP per capita income. Whereas nature of competitive advantage has positive correlation with innovation. It is most likely the FDI inflow is based on labor intensive industry and agricultural based economy, which has little contribution for innovation.

University and Industry collaboration

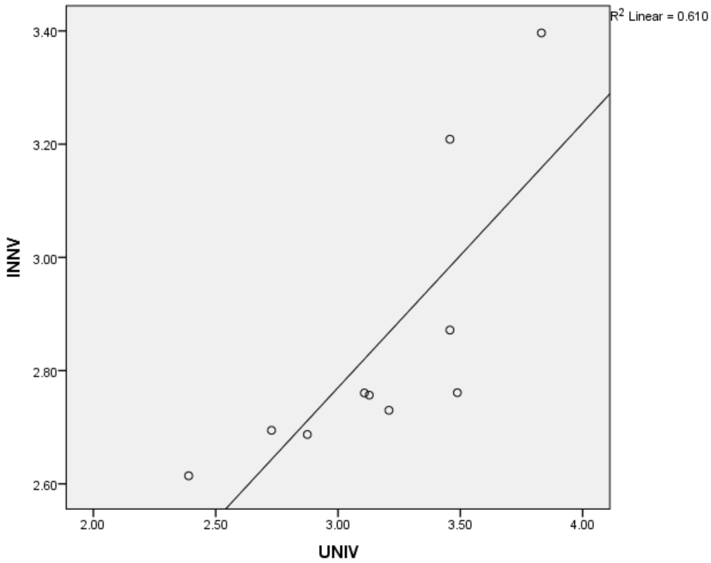


Figure 6-32. University and Industry collaboration on R&D (Source: author`s compilation of WEF, GCI)

Table 6-9 Correlations between University-industry collaboration in R&D, Innovation, GDP growth

Correlations

		UNVX	ETHEG	INNV
UNVX	Pearson Correlation	1	-.465	.781**
	Sig. (2-tailed)		.176	.008
	N	10	10	10
ETHEG	Pearson Correlation	-.465	1	-.497
	Sig. (2-tailed)	.176		.143
	N	10	10	10
INNV	Pearson Correlation	.781**	-.497	1
	Sig. (2-tailed)	.008	.143	
	N	10	10	10

**. Correlation is significant at the 0.01 level (2-tailed).

According to OCED study, R&D center (research institution and universities) are a source of innovation as well as enhance economic growth. Table 6-9 Pearson correlation coefficient result shows university-industry collaboration has positive relationship with significant p-value (1 percent). On the other hand, university-industry collaboration has no association with economic growth and insignificant p-value, which is undesirable result and against theory.

Company Spending on R&D

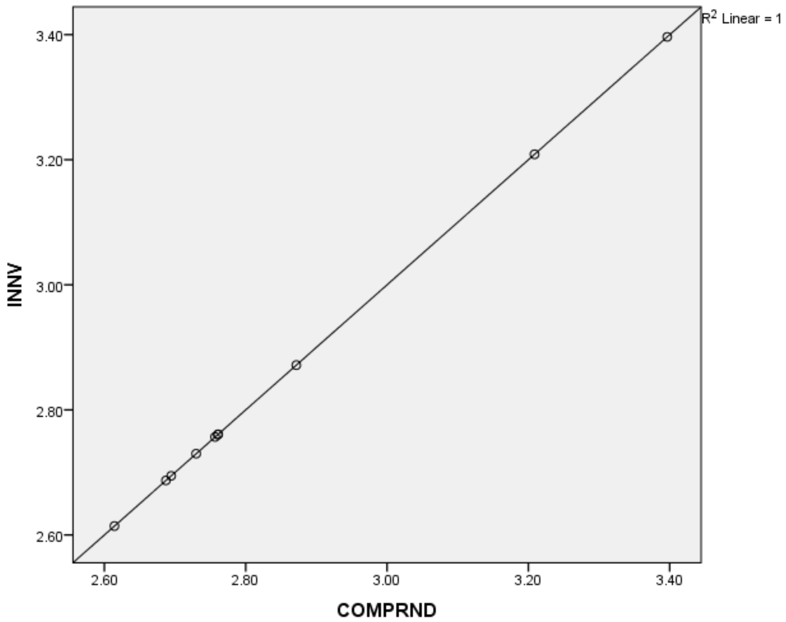


Figure 6-33 Correlations between Company spending on R&D, and Innovation

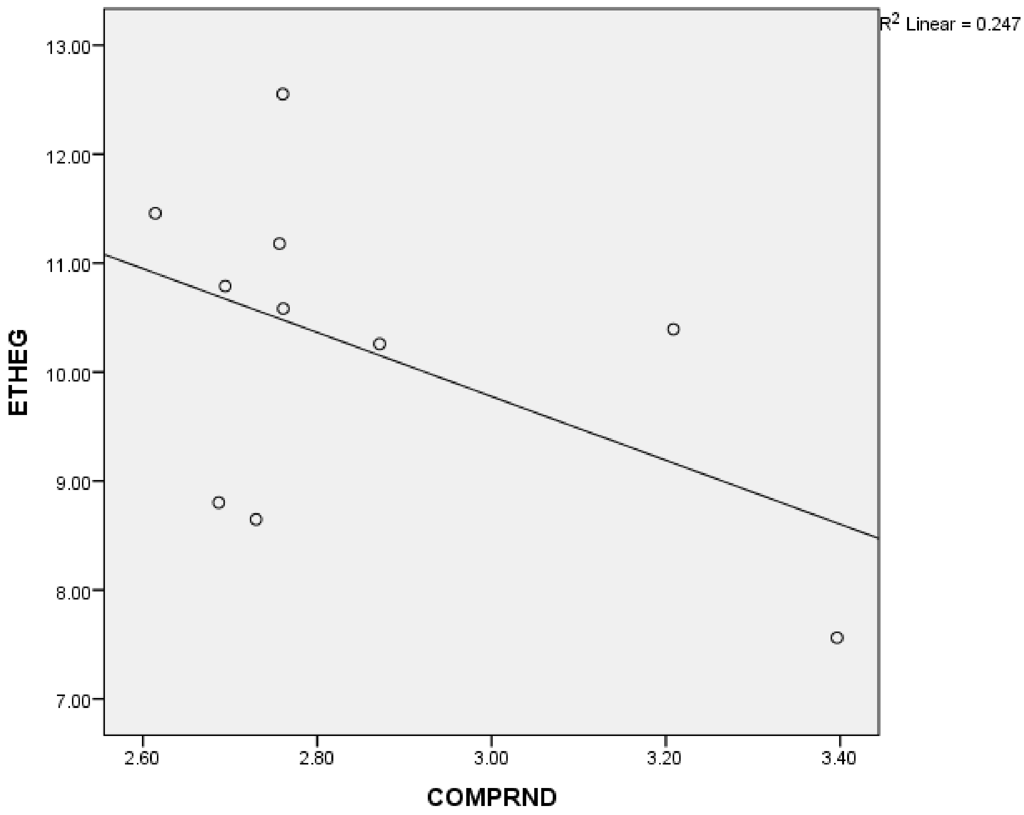


Figure 6-34 Correlations between Company Spending on R&D and Economic Growth

Private sector is the driver of economic growth and innovation. The Pearson correlation coefficient result shows company spending on R&D has a negative and poorly correlated with economic growth (-0.47). But it has very strong relationship with innovation by significant p-value (1.00).

Table 6-10 Correlations between Company Spending on R&D, Innovation, GDP growth

Correlations

Control Variables			INNV	COMPRND	ETHEG
-none-[a]	INNV	Correlation	1.000	1.000	-.497
		Significance (2-tailed)	.	.000	.143
		df	0	8	8
	COMPRND	Correlation	1.000	1.000	-.497
		Significance (2-tailed)	.000	.	.143
		df	8	0	8
	ETHEG	Correlation	-.497	-.497	1.000
		Significance (2-tailed)	.143	.143	.
		df	8	8	0
ETHEG	INNV	Correlation	1.000	1.000	
		Significance (2-tailed)	.	.000	
		df	0	7	
	COMPRND	Correlation	1.000	1.000	
		Significance (2-tailed)	.000	.	
		df	7	0	

To end with, the below correlation analysis is one of the fundamental parts of this research. It evaluate the relationship between innovation and economic growth and also the relationship between innovation and GDP per capita income.

Table 6-11 Correlations between GDP per capita, Innovation, and GDP growth

Correlations

Control Variables			GDPP	INNV	ETHEG
-none-[a]	GDPP	Correlation	1.000	.886	-.606
		Significance (2-tailed)	.	.001	.064
		df	0	8	8
	INNV	Correlation	.886	1.000	-.497
		Significance (2-tailed)	.001	.	.143
		df	8	0	8
	ETHEG	Correlation	-.606	-.497	1.000
		Significance (2-tailed)	.064	.143	.
		df	8	8	0
ETHEG	GDPP	Correlation	1.000	.848	
		Significance (2-tailed)	.	.004	
		df	0	7	
	INNV	Correlation	.848	1.000	
		Significance (2-tailed)	.004	.	
		df	7	0	

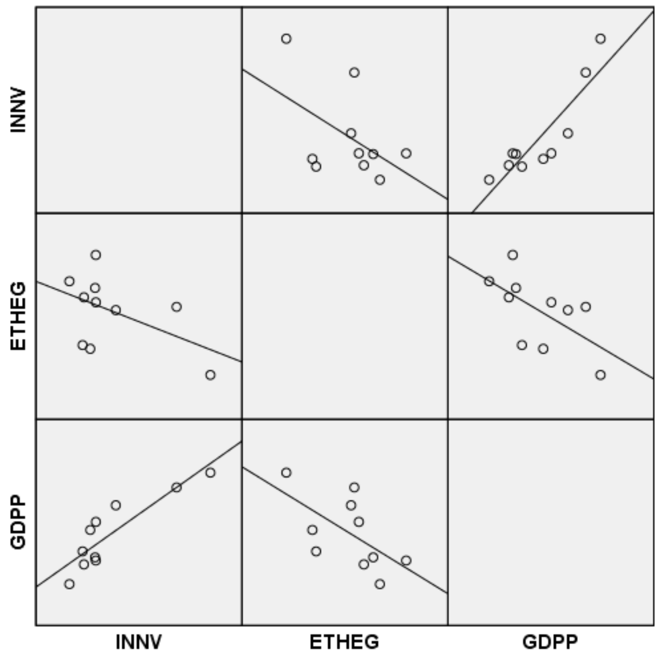


Figure 6-35. Correlations between GDP per capita, Innovation, and GDP growth

(Source: author`s compilation World Bank Development Indicators, and Global Competitiveness Index)

Exogenous theory argued that innovation enhances competiveness and productivity, which in turn increase economic growth. Furthermore, several theoretical and empirical evidences show the positive relationship of economic growth and human development and innovations. (Hafner & Mayer-Foulkes, 2013; Hanushek, 2013). GDP per capita income is one of the indicators to measure human development. This study try to address the relationships between innovation, economic growth and human development by using Pearson coefficient correlation. The findings of a coefficient in Table 6-11 indicates innovation has no association with economic growth with p-value above 5 percent. However innovation has positive association with GDP per capita income with significant p-value (less than one percent). Therefore, Ethiopia innovation has little or no contribution for current fastest economic growth, Ethiopia should take serious policy measurers.

6.6 Human Development

This section evaluate human development of Ethiopia with regarding to economic growth and innovations indicators. Human capita is one of the determinants of human development, which is the major engine for economic growth (Barro, 2002;

Meier & Rauch, 2000; Nelson & Phelps, 1966). According to Nobel laureate Amartya Sen, human development is the transformation of the nations to a high level of living standard rather than the size of the advancement of economy. The empirical studies suggest that Economic growth has direct relationship with human development. The significant value of factors coefficient for human development is positive correlation with GDP growth (Hafner & Mayer-Foulkes, 2013; Musai & MEHRARA, 2013; Suri, Boozer, Ranis & Stewart, 2011). According to UNDP baseline of human development index, we address the following human development indicators. Such as, education, life expectancy, GDP per capita income, and also we included innovations and trades.

6.6.1 Education background

Since the Imperial period modern education had got attention and new education system had introduced. According to Bishaw and Lasser (2012) during the Imperial period (1930-1974) a western education system had adopted and they had implemented universal education policies. The expansion of education based on urban areas only. There were less access to education for rural areas, due to lack of human capital as well as lack of financial resources. Moreover, a modern education policy had faced resistance from church, because it reduced the dominance of church as the sole educator of the society, and also the church was dogmatic institution little open to innovation and change. As the result, there were little progress had been achieved. With regard to the enrolment ratio for primary and secondary school were only 17.7 percent and 4.9 percent respectively (WDI, 2014).

The importance of a modern education had been continued to be recognized during the Derg regime (1974 to 1991) as well. Unlike the previous regime, the education curriculum was designed, based on Eastern European education system to expand the communist ideology. In 1970s, the regime had provided free universal education for all citizens under the slogan of “Meserete Timhirt” which means basic education for all. It was one of the most successful and highly creditable policy (Seyoum, 1996; Bishaw & Lasser, 2012). This policy had contributed to reduce illiteracy in Ethiopia. Accordingly, the Derg regime successfully managed to expand basic education and increased the primary education enrolment ratio from 19.2 percent in 1975 to 42.3 percent in 1983, which was the highest achievement of the Derg regime (WDI, 2014; Ministry of education, 2008). However, the growth rate did not continue due to intensive civil war in the country. The primary school enrolment ratio started to decline sharply from 1989 to lowest level in 1993 that registered 21.7 percent level.

During the EPRDF period, from 1991 to present, the gross primary education enrolment ratio has been increasing dramatically from its bottom line 21.7 percent to about 102 percent in 2015 (WDI, 2017). Since 1991, the government of Ethiopia gave priority for human capital development by improving access to education and reforming the education systems (Bishaw & Lasser, 2012; Ministry of education, 2008; Overseas Development Institute, 2011). The ultimate objective of education is to attain sustainable development in order to alleviate poverty. According to the study of Overseas Development Institute:

> the government's commitment to the equitable expansion of the education system has also manifested itself in initiatives aimed at reducing the opportunity cost of education, by bringing schools closer to children, increasing the number of teachers to keep up with rapidly growing demand, fostering community involvement and, most notably, integrating previously marginalized and excluded groups, such as the rural poor, girls and pastoral communities (2011, pp.13).

Figure 6-36 indicates the total government expenditure on education increased to peak level from 12.3 percent in 1980 to 31 percent in 2015, which is twice higher than average expenditure of world and Sub Saharan African countries. The dramatic shift of expenditure contributed for equitable expansion of schools throughout the country. Simultaneously, government established training centers and provided capacity building for new teachers and administrators (Ministry of education, 2008; Overseas Development Institute, 2011).

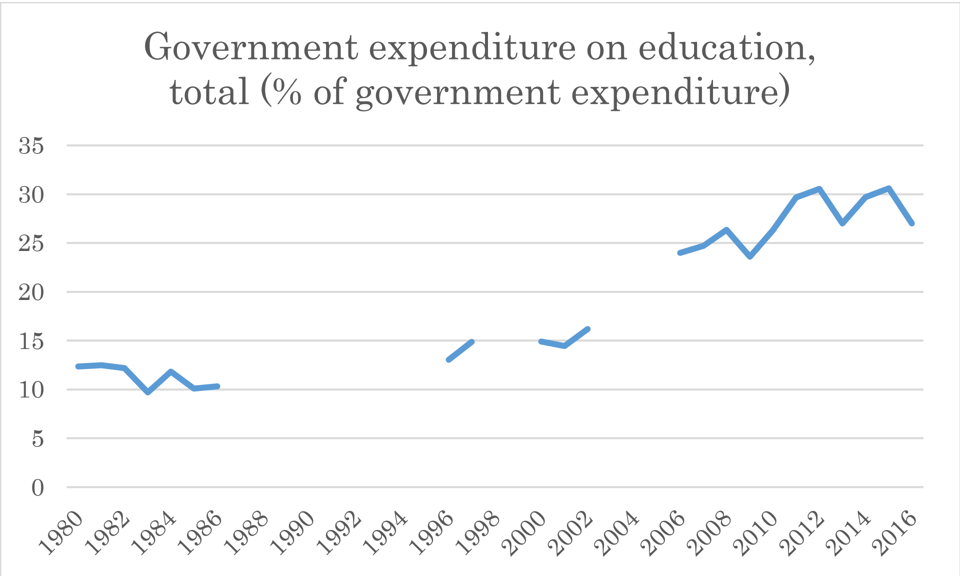


Figure 6-36 The percentage of total government expenditure on education (Source: author`s compilation of World Bank Development Indicators)

Figure 6-37 shows government of Ethiopia has given higher priority to increase human capital by investing on education. The total GDP percentage of expenditure on education has increased sharply by more than two fold, compared to three decades ago. In 2012, the percentage of expenditure had reached to 5.7 percent of

GDP from 2.1 percent in 1982, which is above global average expenditure by 26 percent and higher than Sub Saharan African countries by 40 percent.

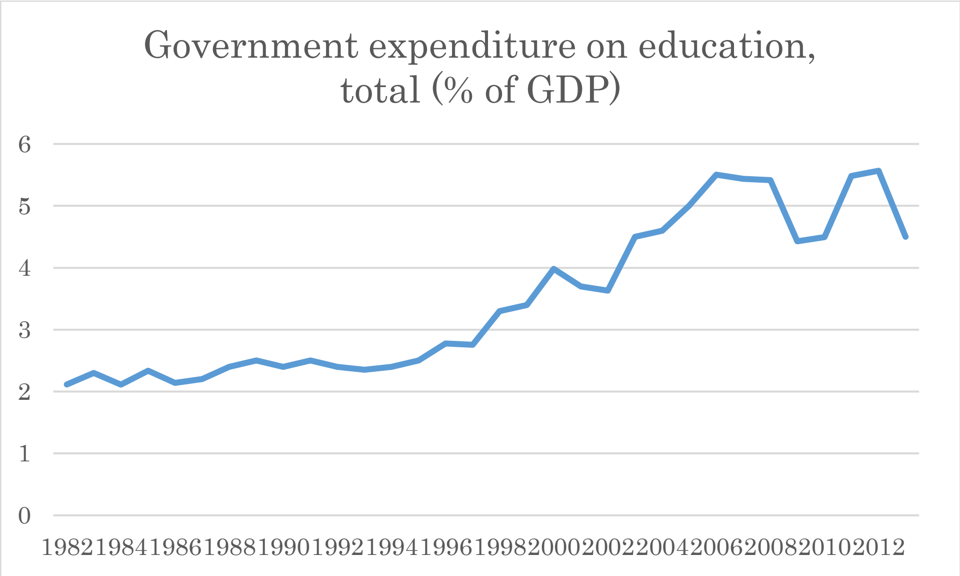


Figure 6-37. The percentage of GDP total government expenditure on education (Source: author`s compilation of World Bank Development Indicators)

To summarize the education progress on Figure 6-38, Ethiopia has achieved remarkable growth of school enrolment but different growth rate at different education levels. Particularly the primary education enrolment ratio registered the highest growth followed by secondary education enrollments that showed slight improvement and tertiary education enrolments growth rate has been flat growth until 2000. Secondary school enrolment ratio increased substantial in the Derg regime as well as in the EPRDF regime. During the Derg regime the secondary education enrolment ratio increased by three fold from 5 percent to 15.3

percent. However after 1989, secondary school enrolment ratio was also declined slightly due to civil war and instability in the country. Again during EPRDF regime the growth rate was declined for a decade with the enrolment ratio of about 10 percent. However, from 1999 the growth ratio has been increasing gradually and the enrollment ratio reached to 36 percent in 2015. Tertiary education has showed steady growth (MoFED 2014; WDI 2017).

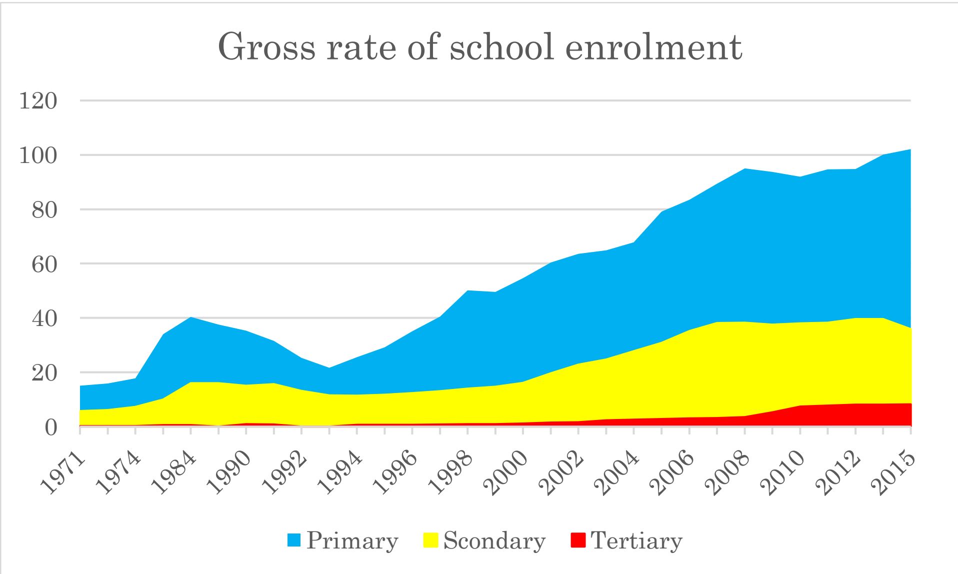


Figure 6-38. The gross ratio of school enrolment for Primary, Secondary and Tertiary. (Source: author`s compilation of World Bank Development Indicators (WDI)

The education policy had impact on school enrolment ratios. The Millennium Development Goal (MDG)'s main objective is providing basic education for all citizens, under the principle of "Universal Education" for all. In addition, World Bank and external donors have been providing finance for primary education rather than secondary education and tertiary education. Therefore, this might be one of the main causes for sluggish growth of secondary and tertiary school enrolment ratios. At the same time, primary education enrolment ratio has reached above 102 percentage in 2015 for the first time in the history of Ethiopia.

6.6.2 Literacy rate

Ethiopia effectively implemented education policy to develop human capital. Literacy rate is one of the tools to measure human development and also has impact on economic growth (Bhargava, 2008). As Figure 6-39 shows that the adult literacy rate has been increasing in Ethiopia for the population above 15 years and older (UNESCO Institute for Statistics, 2012; Ministry of Education, 2008; MoFED, 2006; UNDP, 2014). The World Education Forum in Dakar in 2000 set out the target to reduce adult illiteracy rate by 50 percent in 2015. The forum created momentum for Ethiopia to expand equitable education for all citizens. Hence, the adult literacy rate increased from 21 percent to 47 percent by 2012. Specially, the female adult literacy rate increased from 17 percent in 2000 to 39 percent in 2012, whereas adult male literacy rate slightly increased to 55 percent in 2012 from 40 percent in 2000.

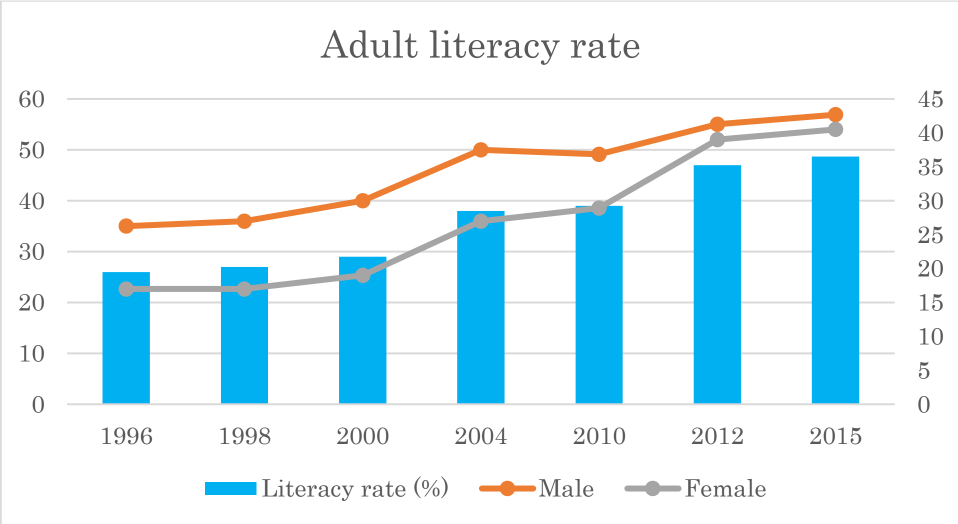


Figure 6-39. Adult literacy rate, 2015 date is predicted or forecasted. (Source: author`s compilation of World Bank Development Indicators and UNDP Human Development Index report 2013)

The Gender Parity Index (GPI) has been improving gradually (UNDP, 2014). Figure 6-40 shows that the female literacy ratio was less than 0.5 GPI in 2000 that indicates the ratio of female literacy rate was less than half of the male literacy rate. In 2012, the gender disparity has improved remarkably. The GPI gap reduced by 49 percent and reached 70.9.

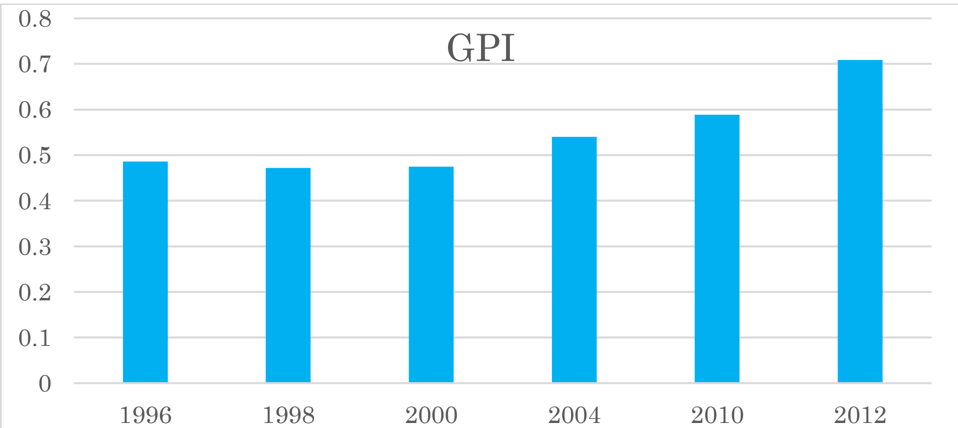


Figure 6-40. The Gender Parity Index (GPI) trend. (Source: author`s compilation of World Bank Development Indicators and UNDP Human Development Index

report 2013)

Ordinary Least Square (OLS) finding indicates that the correlation between GDP per capita income and education have positive correlation with the significant value for education is (2.48).

$$GDPPC_{it} = \alpha + \sum \beta_1 EDU_{ijt} + \varepsilon_{it}$$

6.6.3 Life expectancy

Health sectors are playing vital role for improving the well-being of the nation. The remarkable progress on education and the growth of GDP per capita has improved the literacy rate that has been accompanied by improvement in life expectancy (AfDB, 2014; IMF, 2014; MoFED, 2014; UHDP, 2014; World Bank, 2014). Health sector is one of human development indicators that have made a great contribution to sustainable economic development. Since 1991, Ethiopian government has introduced preventive health care policy and invest in health sectors. As a result, Ethiopia has made significant improvement in people's health care. This achievement increased life expectancy remarkably.

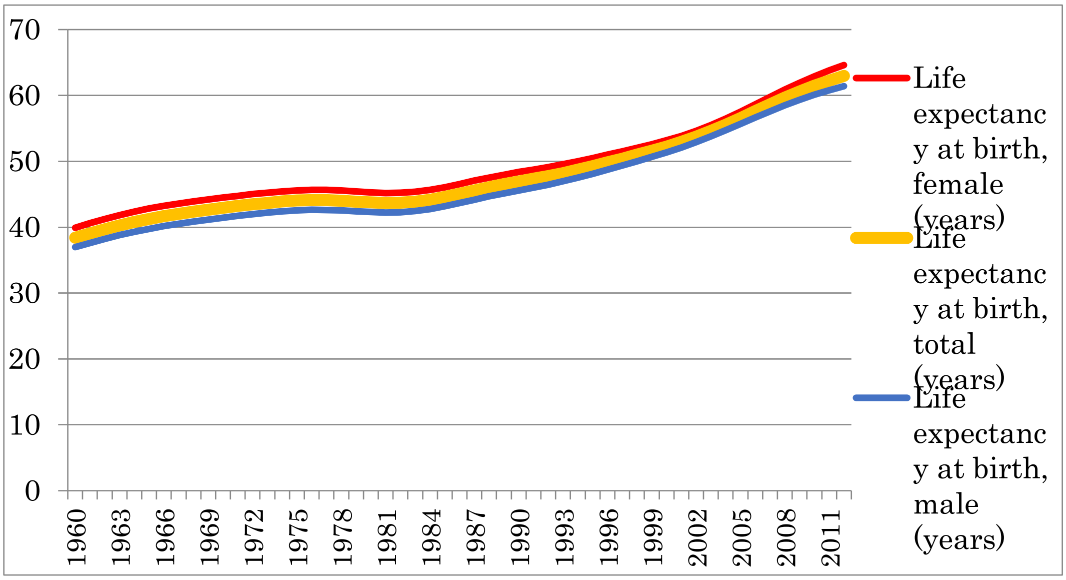


Figure 6-41. Life expectancy trends (Source: author`s compilation of World Bank Development Indicators and UNDP Human Development Index report 2013)

The preventive health care policy focused on expanding physical infrastructures and human capital development. According to MoFED (2014), Ethiopia has made impressive progress in health sectors through expanding hospitals, clinics, and health stations in all parts of the regions. Simultaneously, the government invested in human capital development. In 2013, Ministry of Health deployed about forty thousand health extension workers and more than thirty seven thousands nurses throughout the country, consequently, the primary health coverage reached 93.4 percent (MoFED, 2014; World Bank, 2014).

This innovative policy has impressive contribution to improve universal access to basic health services. As a result, Ethiopia managed to reduce the mortality ratio. Specially the child mortality ratio under five years have been reducing and achieved Millennium Development Goals. The child mortality ratio per thousand children declined by fivefold from 204 in 1991 to 44 in 2013. At the same time, infant mortality ratio per thousand children decreased to 46.5 in 2012 from 121 in 1991. Similarly, maternal mortality ratio (the number of women die during childbirth and pregnancy per hundred thousand live births) declined by more than 300 percent from 1400 in 1991 to 420 in 2013. However, it requires more work to be done in order to improve maternal mortality.

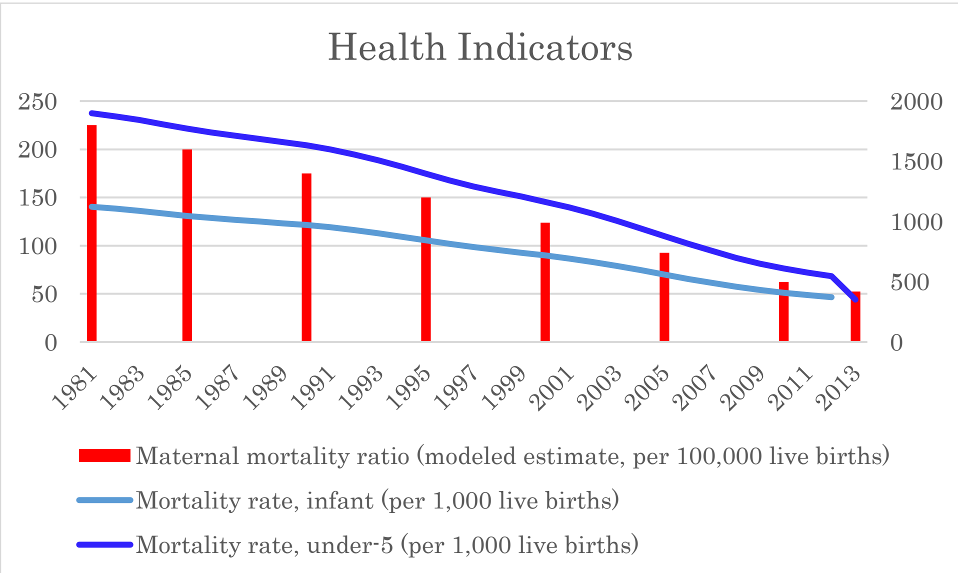


Figure 6-42. Health indicators trends. (Source: author`s compilation of MoFED, World Bank Development Indicators and UNDP Human Development Index report 2013)

We employed the Ordinary Least Square (OLS) method and examined the correlation between income and health. We find GDP per capita income has positive correlation with life expectancy with R-square value (5.449). Table 6-1 indicates the significant value of factors coefficient for GDP per capita income is (5.99) that indicates strong correlation with life expectancy.

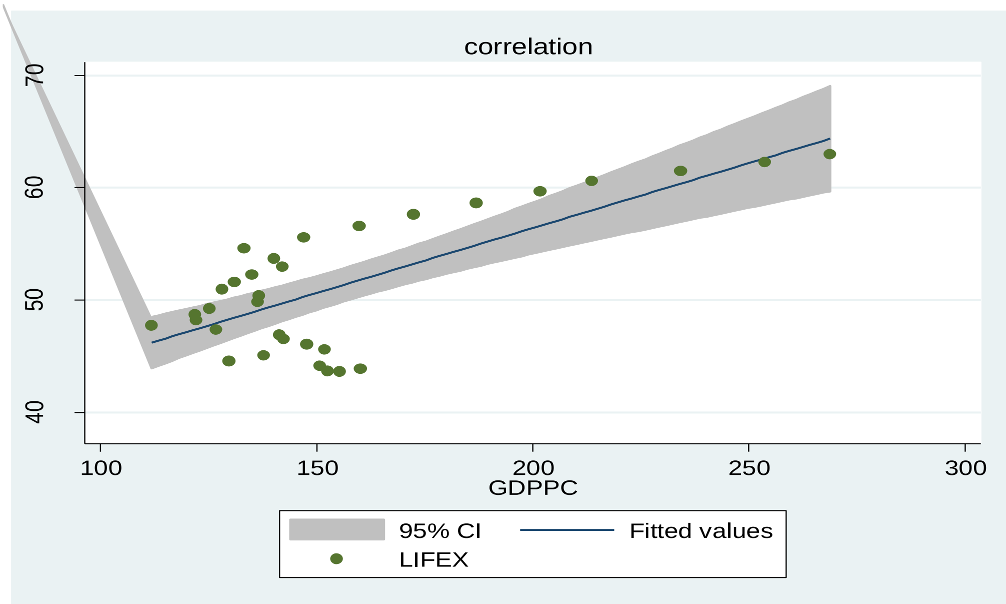


Figure 6-43. Scatter plot of life expectancy and GDP per capita with 95 percent confidence interval.

$$LIFEX_{it} == \alpha + \beta_1 GDPPC_{ijt} + \varepsilon_{it}$$

Table 6-12: Correlations between life expectancy and GDP per capita

LIFEX	Coef.	Std. Err.	t	P>t	[95% Conf.	Interval]
GDPPC	0.1155041	0.0192713	5.99	0.000	0.0761469	0.1548614
_cons	33.31101	3.097898	10.75	0.000	26.98426	39.63776

In addition, we explored the relationship between life expectancy with education, the finding of education has positive correlation with Life expectancy with strong R-square value (0.8811). The OLS regression analysis of data also indicates in Table 6-12. The significant value of factors coefficient for education is (8.17) that indicates a strong correlation with life expectancy.

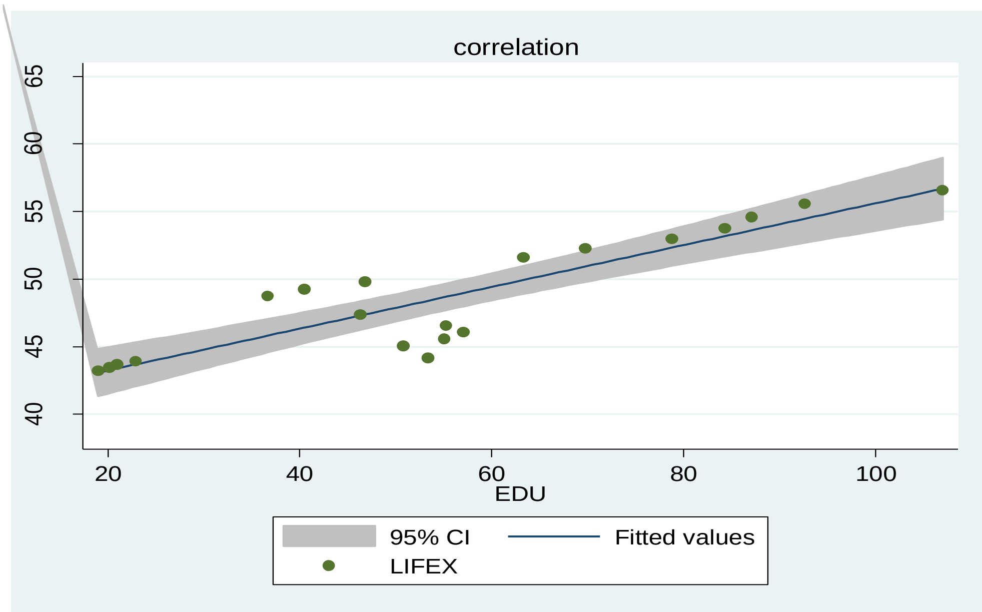


Figure 6-44. Scatter plot of life expectancy and educations with 95 percent confidence interval.

$$LIFEX_{it} == \alpha + {}_{\Sigma}\ \beta_1 ED_{ijt} + \varepsilon_{it}$$

Table 6-12. Correlations between life expectancy and educations

LIFEX	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
EDU	0.1546336	0.0189296	8.17	0.000	0.114864	0.1944033
_cons	40.14186	1.148326	34.96	0.000	37.72932	42.5544

6.7 Comparative Analysis of Economic Growth and Human Development between Ethiopia and Sub Saharan African Countries

Global economic growth slightly peaked up in 2013 (World Bank, 2014). For the first time after global financial crisis, the production showed the recovery signs and the productivity expanded by 2.4 percent. The growth momentum came from good performance of high income countries but still the recovery speed on these countries are slow. In Euro area and Japan, GDP had lifted up by strong export, whereas, in the United States' economic growth stimulated from strong consumer spending. The economy of developing countries recovered earlier and grew much faster than high income countries. China's GDP growth rate is 7.7 percent, which is higher than 4.8 percent average growth rate of developing countries. Sub Saharan African countries' output also grew by 4.7 percent in 2013. However, excluding South Africa, Sub-Sahara African countries achieved average output growth by 6.1 percent. This figure is higher than developing countries average output except Southeast Asia and Pacific that grew by 7.1 percent (AfDB, 2014; World Bank, 2014).

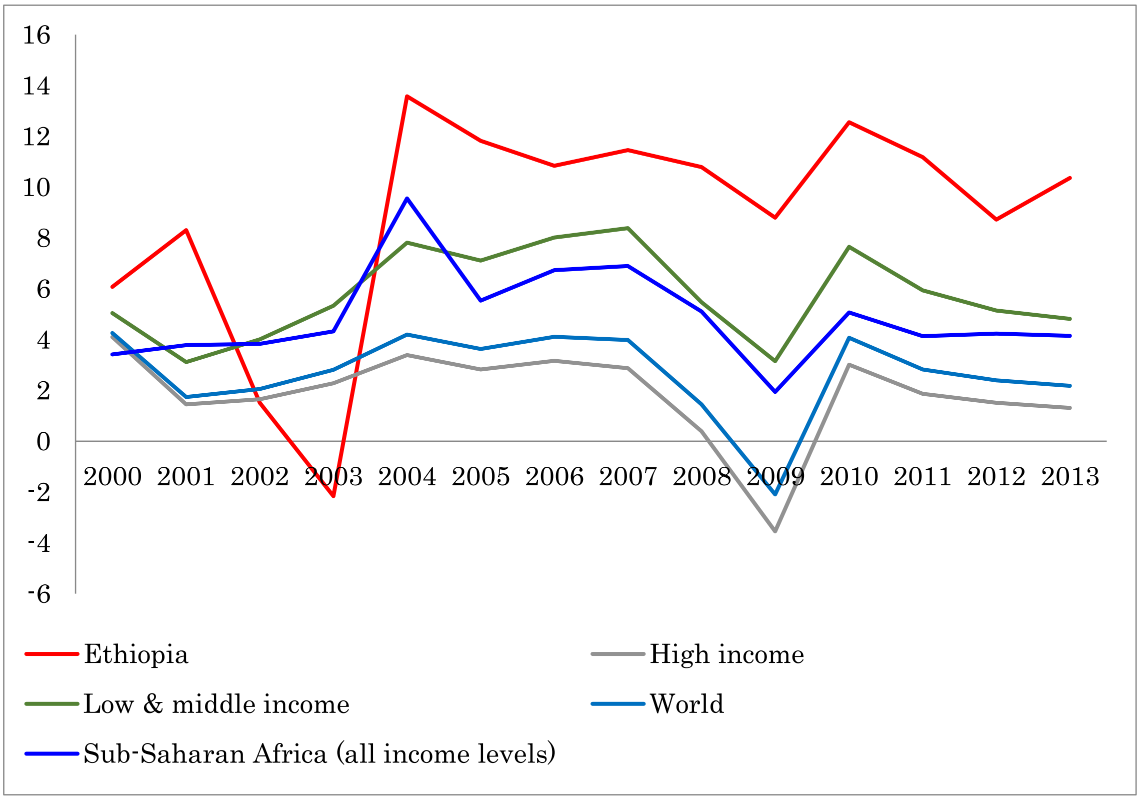


Figure 6-45. Comparative growth trends of Sub-Saharan African and worlds. (Source: author`s compilation of MoFED and World Bank Development Indicators)

We used Stata Software and employed Random-effects GLS regression for 258 countries` GDP per capita income, growth rate function was estimated based on panel data of 2445 observations. The result of panel data for the world shows all factors predictors are positively correlated with the significant value of factors coefficient except ICT sector (see Appendix for the descriptive statistics of the variables which are presented in Table B-1 to Table B-7 in Appendix B, C and D).

$$Y_i^t = \alpha_i + \sum_i^n \beta_i X_i + \varepsilon_i$$

$$GRT_{it} = \alpha + \sum \beta_1 EDU_{ijt} + \beta_2 .EXP_{ijt} + \beta_3 INV_{ijt} + \sum \beta_6 ICT_{ijt} + \varepsilon_{it}$$

Table 6-13: Random-effects GLS regression for world

GRT	Coef.	Std. Err.	z	P>z	[95% Conf.	Interval]
EDU						
L1.	0.013902	0.00389	3.57	0.000	0.006277	0.021526
EXP						
L1.	0.043114	0.007813	5.52	0.000	0.027801	0.058427
INV						
L1.	0.07135	0.016339	4.37	0.000	0.039326	0.103374
COM						
L1.	-0.00993	0.001802	-5.51	0.000	-0.01346	-0.0064
GDPPC						
L10.	-9E-05	2.16E-05	-4.15	0.000	-0.00013	-4.8E-05
_cons	-1.98904	0.82069	-2.42	0.015	-3.59756	-0.38051

6.7.1 Sub Saharan African Countries

The economic growth of Sub Sahara African countries has been registering sustainable and dynamic growth. They have been attracted world attention as investment destinations. The growth moment was driven by strong domestic demand and the production of natural resources. Those countries came out from hopeless continent to economic success (McMillan & Harttgen, 2014). The growth trend across Sub-Sahara African countries was diversified. According to African

Economic Outlook report 2014, there are four types of growth trends. Such as; first, resource-driven growth, these countries have abundant natural resources, like the Democratic Republic of Congo and Sierra Leone. The growth of those countries pushed up by high output of mining sectors. Second, Ethiopia and Tanzania were leading non-oil producer or non-resource rich countries. The growth of those two East African countries has been driven by the investment in infrastructure and increasing the agricultural productivity that created robust growth of domestic demand. Third, the countries that recovered from civil wars, such as Mali and Côte d'Ivoire. Their growth achieved due to post-conflict political stability. Lastly, the negative economic growth due to political instability and civil war that unrested the countries; such as, the newly independent country of South Sudan and the Central Africa Republic, the two countries' production output were shrunk (IMF, 2014; World Bank, 2014).

In general, the robust economic growth of Sub Sahara African Countries was lifted up by strong infrastructural investment and the high productivity of mining sectors. Moreover, the stable macroeconomic policies contributed for the productivity of agricultural output and also strong domestic consumers demand. Consequently, the GDP per capita growth rate of Sub Saharan African countries increased dramatically. Human development situations has improved due to high enrollment rate of primary education and the high improvement on years of schooling. These factors had contributed for the improvement of health service as well as contributed for reducing mortality ratio. Specially, maternal and infant mortality ratio have declined significantly. Some of SSA countries attained substantial improvement in human development indicators. To mention few of the successful countries, the resource rich countries like Ghana, Angola and Mozambique. Whereas, non-resource dependent countries like Ethiopia, Tanzania and Rwanda among the list who improved human development (IMF, 2014; UNDP, 2013; World Bank, 2014).

We employed Random-effects GLS regression for 50 Sub Saharan African countries` GDP per capita income, growth rate function was estimated based on panel data of 332 observations.

$$Y_i^t = \alpha_i + \sum_i^n \beta_i X_i + \varepsilon_i$$

$$GRT_{it} == \alpha + \sum \beta_1 ED_{ijt} + \beta_2.EXP_{ijt} + + \sum \beta_5.INNO_{ijt} + \sum \beta_6 ICT_{ijt} + \varepsilon_{it}$$

The result of panel data for the SSA shows all factors predictors are positively correlated with the significant value of factors coefficient except education and ICT sectors. The education level shows different value of factors coefficient at different period and at level of educations (see Appendix for the descriptive statistics of the variables that are presented in Table B-1 to Table B-7 in Appendix B, C and D).

Table 6-14: Random-effects GLS regression for Sub Saharan Africa

GDPPGRT	Coef.	Std. Err.	z	P>z	[95% Conf.	Interval]
EDU						
L1.	-0.01179	0.013036	-0.9	0.366	-0.03734	0.013759
EXP						
L1.	0.055506	0.026949	2.06	0.039	0.002687	0.108325
INV						
L1.	0.209121	0.032824	6.37	0.000	0.144787	0.273454
COM						
L1.	-0.00393	0.013021	-0.3	0.763	-0.02945	0.021594
GDPPC						
L10.	-0.00094	0.000475	-1.99	0.047	-0.00187	-1.3E-05
_cons	-1.36023	1.78082	-0.76	0.445	-4.85057	2.130112

6.7.2 East African Countries

East African countries have been achieving sustainable economic growth that was supported by strong public investment on agriculture and infrastructure as well as natural resource (AfDB, 2014, IMF, 2014; World Bank, 2014). The regional growth led by Ethiopia 10 percent economic growth, followed by Rwanda 9.5 percent, and Uganda 6.8 percent. The east African region comparison mainly focused on Ethiopia, Kenya, Uganda, Rwanda, and Tanzania. Particularly focus on Ethiopia and Kenya. According to Henze (1989), Ethiopia and Kenya have more in common than any other neighboring countries. Their commonalities are not limited to geographical features and proximity, both countries' majority of population live in highland area and surrounded by tropical lowland and desert, and also dependent on livestock and agricultural products. The two countries' export depended on commodity products specialty coffee and horticulture. They used to have similar economic policy and political system. Before 1974, Ethiopia and Kenya used to implement market oriented economic policy that was initiated by the World Bank and the IMF. In 1974, Ethiopian military junta grabbed the power and changed the regime at the same time had changed in political and economic policies. Ethiopia had implemented a command economy until 1991. However in 1978 Kenya changed the leadership, after the death of Jomo Kenyatta, without changing economic policy. In additions, Ethiopia and Kenya have regional integration protocols; the two countries are member of the Inter-governmental Authority on Development (IGAD) and the Common Market for Eastern and Southern Africa (COMESA).

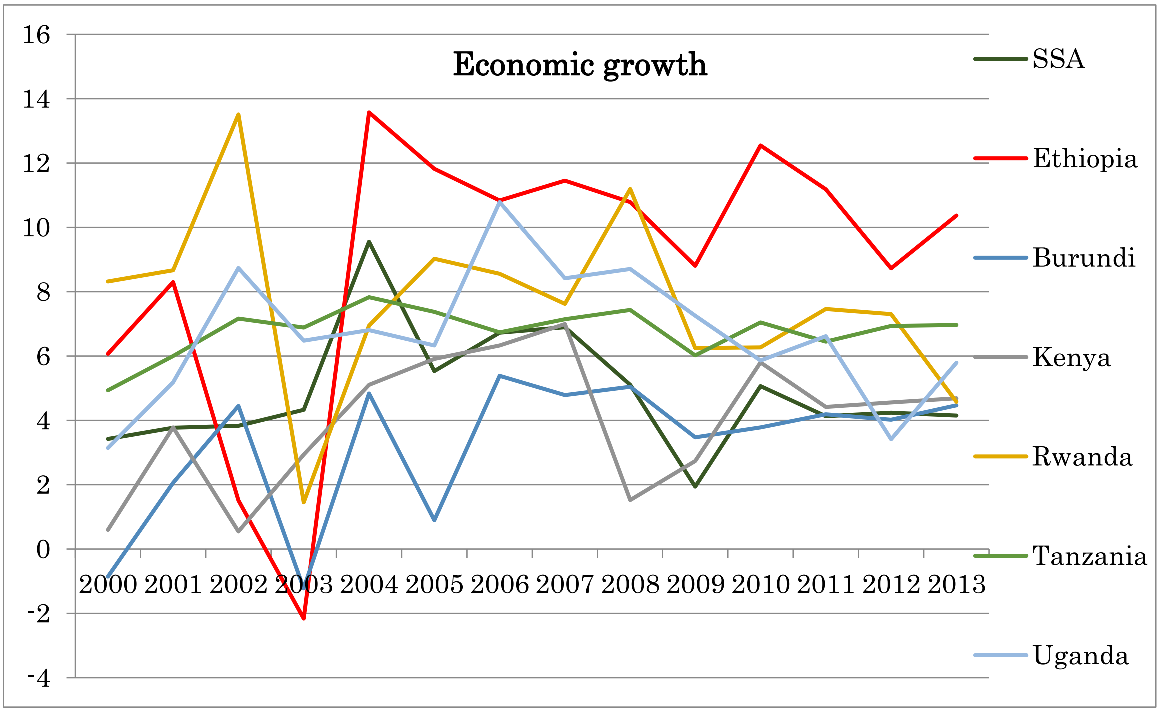


Figure 6-46. Comparative growth of Sub-Saharan African and focused on East Africa. (Source: author`s compilation of World Bank Development Indicators)

The recent East African countries' sustainable growth was attained through implementing the structural transformation of an economy (IMF, 2013). They expanded to a broad based economic structure that shifted from agricultural dependence to other value added sectors that allows them to pull out of poverty and help them to enhance their living standard (McMillan & Harttgen, 2014). East African region (excluding Ethiopia)'s share of agriculture GDP was declined from above 36 percent in 2000 to 28 percent in 2010. The value of service sectors have been increasing dramatically than any other sectors to 43 percent in 2010 from 37 percent in 2000 (AfDB, 2014).

However, Ethiopia's GDP structure is different than regional countries, still GDP share dominated by agricultural output account for 42.7 percent in 2014, which is higher than east African region by 5.7 percent. Ethiopian agricultural production increased by 20 percent in 2010, and the productivity increased to 1.7 tons per hectares up from 1.21 tons per hectares in 2004, and also land under cultivation for key crops also increased by 15 percent. At the same time, service sectors of Ethiopia are growing very fast by 9.9 percent in 2013, which account for 45 percent of GDP in the same period. The growth factors of service sectors are mainly due to expanding financial service, retail trading, transportation and public services. Furthermore, the expansions of mining sectors are other factors that contribute to reduce agricultural dependence. However, the share of mining is still low as 1.6 percent of GDP (MoFED, 2014).

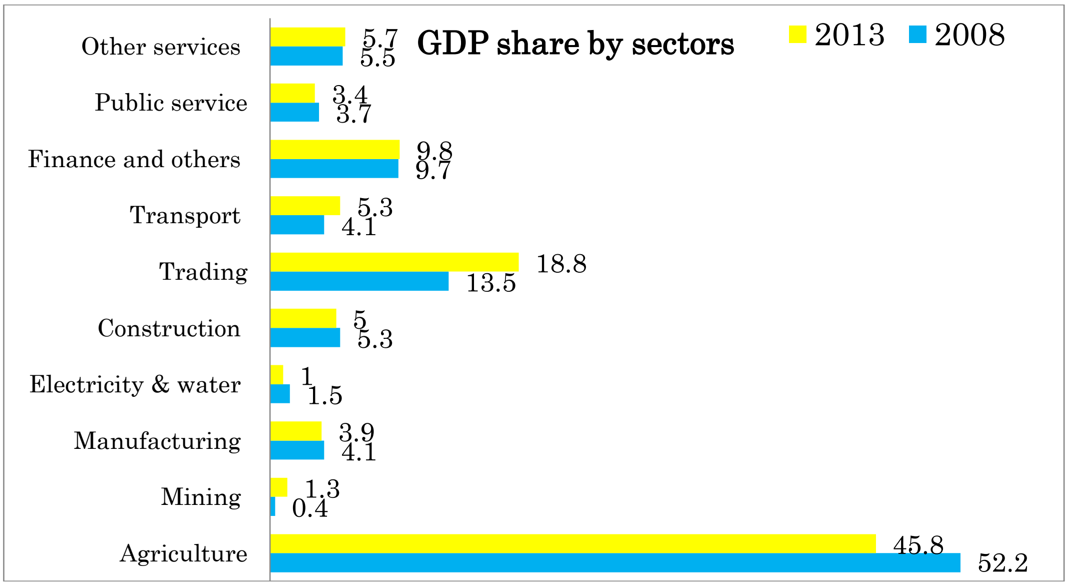


Figure 6-47. Ethiopia GDP shares by sectors that indicate structural transformations. (Source: author`s compilation of MoFED)

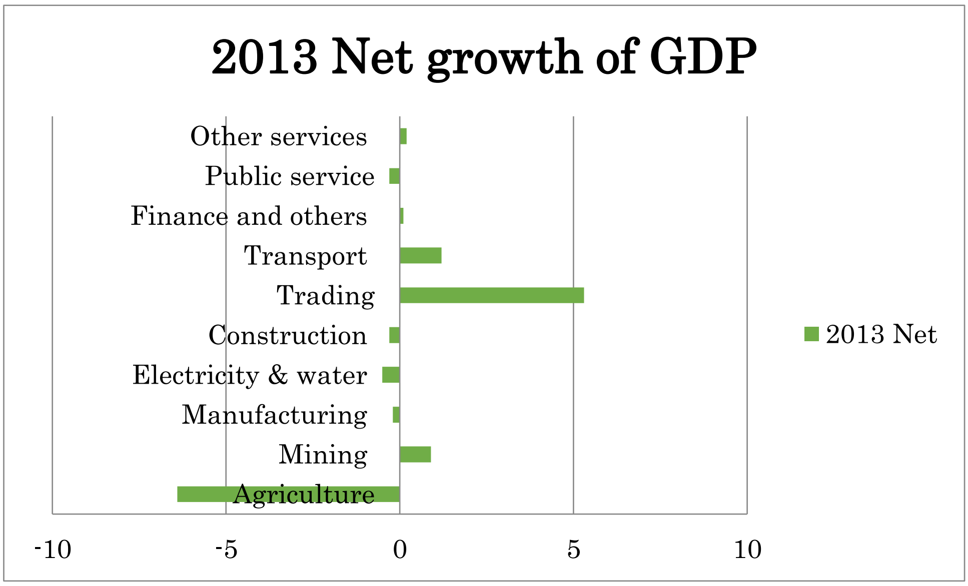


Figure 6-48. Net growth of GDP. (Source: author`s compilation of MoFED)

In general, east African countries are in progress to bring the structural transformation in their economies. Despite Ethiopia lagged behind due to high agricultural share of GDP and low share of industrial output, the structural transformation of macroeconomic policy helped to increase human development. Subsequently, the share of labor force had been shifted from low productive agriculture sectors to value added sectors like service and industry sectors (AEO, 2014; McMill & Harttgen, 2014). According to the research of McMillan and Rodrik (2011) who presented the movement of labor forces from agriculture sectors to services and manufacturing. In Sub-Saharan African labor forces of agriculture sector failed by 10 percent during 2000 to 2010. The labor force moved to other sectors by 10 percent, such as service sectors gained 8 percent and manufacturing sectors gained 2 percent.

These structural transformations are positively associated with economic growth and human development (African Economic Outlook, 2014). Human development in East African countries has improved slightly. According to UNDP human development index report on East Africa, Kenya ranked 147 in 2013 and at top position among east African countries, the HDI value increased to 0.535 in 2013 up from 0.455 in 2000. Ethiopia ranked 173 during the same period, HDI value increased to 0.435 up from 0.284, still Ethiopia positioned below average HDI value of Sub-Saharan African countries which is 0.501. Figure 6-49 shows, the average annual growth rate of Ethiopia, HDI are one of the top performing countries in east Africa as well as in the world that registered average growth of 3.35 percent from 2000 to 2013. Kenya's average growth rate was 1.25 percent which is the least among East African countries.

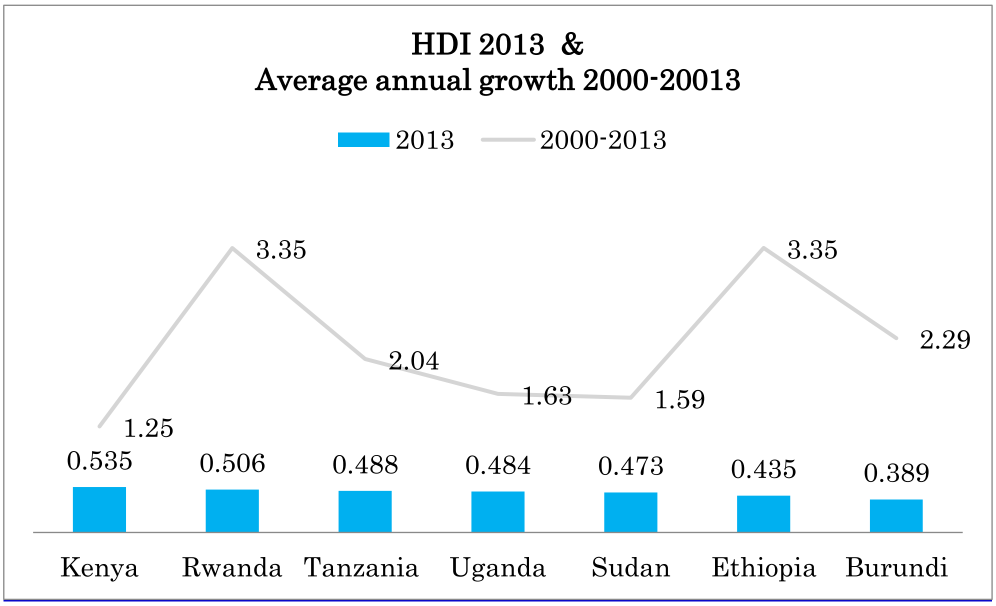


Figure 6-49. Human Development Index and HDI growth rate (Source: author`s compilation of UNDP HDI report 2014 and World Bank Development Indicators)

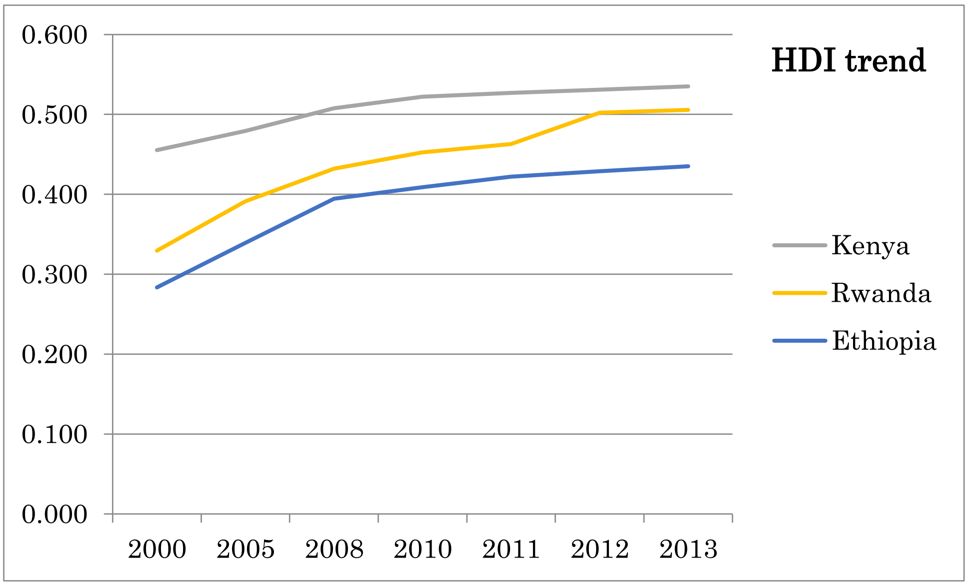


Figure 6-50. Comparative trend of HDI for East African countries. (Source: author`s compilation of UNDP HDI report 2014 and World Bank Development Indicators)

There are four major indicators to measure human development index. Such as life expectancy at birth, expected year of schooling, mean year of schooling and Gross National Income (GNI) per capita in Purchasing Power Parity (PPP US$). Kenya is in better position in all indicators than Ethiopia, but Kenya showed little progress since 1980. First we examine life expectancy at birth. Ethiopia showed dramatic progress in all HDI indicators and outperformed Kenya in life expectancy at birth in 2005. Ethiopia's life expectancy was 43.8 in 1980 and increased by 19.8 year and reached 63.6 in 2013. During this period, Kenya life expectancy at birth was 57.8 and increased to 61.7 in 2013, Kenya improved only 3.9 year.

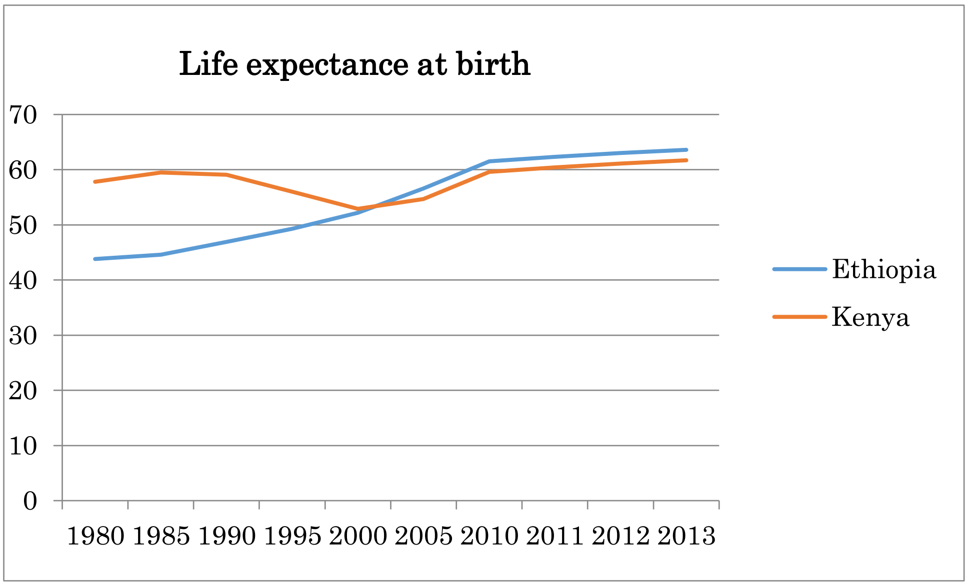


Figure 6-51. Comparative trend of life expectancy for Ethiopian and Kenya. (Source: author`s compilation of UNDP HDI report 2014 and World Bank Development Indicators)

Second, The expected year of schooling for Ethiopia increased by 5.3 year to 8.5 year from 3.2 year in 1980; Kenya also increased by 1.7 to 11 year. Third, Mean year of schooling increased by 3.9 year for Kenya and by 0.9 for Ethiopia that revealed very few progress. Fourth, GNI per capita of Ethiopia increased sharply by 104 percent from $637 in 1990 to $1303 in 2013. During this period, Kenyan GNI per capita was $1894 increased by 18.4 percent to $2158; this figure was three times higher than Ethiopian GNI per capita in 1990 but the gap has narrowed in 2013 and became about only double.

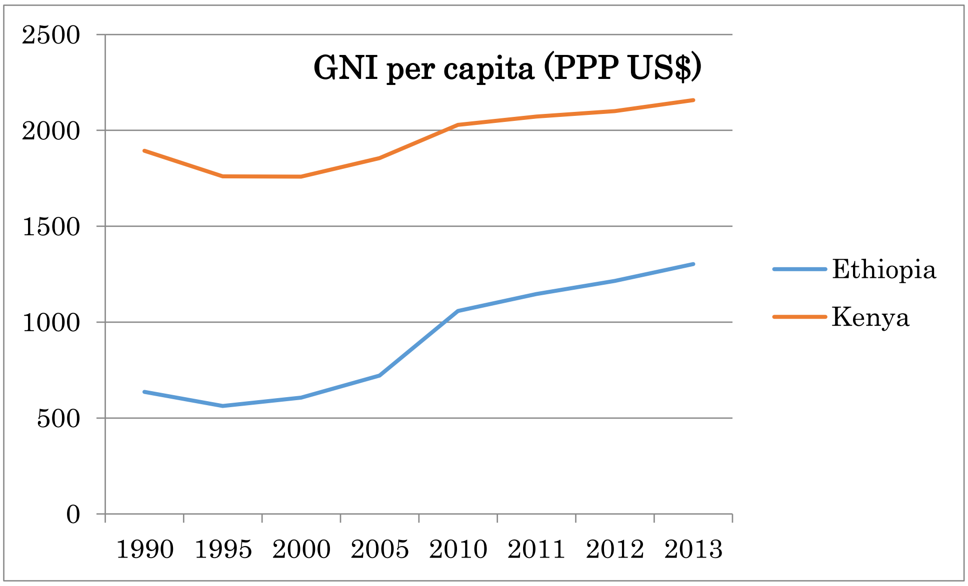


Figure 6-52. Comparative trend of GNI per capita for Ethiopia and Kenya. (Source: author`s compilation of UNDP HDI report 2014 and World Bank Development Indicators)

Economic growth has significant role by elevating wellbeing of the nation. Ethiopia has seen improvement in several human development indicators due to sustainable economic growth. As a result, GDP per capita increased, poverty head count ration decreased. The population who used to live in extreme poverty below international threshold of $1.25 per day at purchasing power parity was 60 percent in 1995. This was decreased by half down to 30.65 in 2011 (WDI, 2014). In spite of increasing number of population from 57 million in 1995 to 83 million in 2011, Ethiopia has been successfully managed to reduce poverty, Ethiopia not only alleviated the percentage poverty ratio but also the population head count that lived below poverty line decreased (African Economic Outlook, 2014). The overall growth indicates, the stability of macroeconomic policies, and HDI improvement indicate that Ethiopia is heading on right direction to achieve sustainable growth and to bring structural transformation from low value added sectors to high valued added sectors. Therefore, extraordinary attention and serious policy measures are required to improve exogenous growth factors.

6.8 Granger causality test

We employed granger causality test by using OLS equations, based on work of Stock, Watson and Green (Torres-Reyna, 2007). We hypothesised economic growth and human development. For the first OLS equations of *"Economic growth has positive influence on human development.*" The coefficients of the lag of dependent variables are statistically insignificant and the null hypothesis equal to 0, therefore there is no Granger-causality. For the second OLS equation, "*Human development has positive influence on economic growth."* The coefficients of the lag of dependent variables are statistically significant and the null hypothesis different from 0, therefore there is Granger-causality. Therefore, human development has significant impact on economic growth. There is no causality from economic growth to human development but there exist granger causality from human development to economic growth.

The third and fourth hypothesis are statically significant and also the findings support growth theory for both *"Economic policy has positive influence on economic growth"* and *"Government policy has positive influence on human development."* The empirical findings were supported for both hypothesis by AfDB (2014); MofED (2006; 2010; 2014); IMF (2013, 2014); World Bank (2014); UNDP (2014), as the Ethiopian government economic development polices have positive impact on economic growth and human development.

Chapter Seven

Conclusion

This research sought to contribute in the ongoing discourse on enhancing economic development of Ethiopia, and it aims to propose some policy measures to provide a concrete guideline. Literature review of the historical perspectives provided an in-depth insight of the matter under consideration. The economic history of Ethiopia passed through severe conflicts and civil war that were the main obstacles for the development of the country. Stable government, pro-poor development, inclusive growth strategy, and transparent and effective policy implementation are required in Ethiopia to bring structural transformation and to alleviate extreme poverty in the country. The empirical results have revealed that African economy is rising, particularly East Africa led the economic growth, exceptionally Ethiopia has experienced strong and broad-based economic growth for past decade.

This study identified the main factors behind sustainable economic growth in terms of macroeconomic indicators, policy measurement, innovation and human development indicators. The empirical findings of macroeconomic indicators have revealed that trade openness (export and import), human capital (employment and labor productivity growth) and physical investment (gross fixed capital formation) can increase the GDP growth rate in the long-run in Ethiopia. The Granger causality results presented that gross fixed capital formation does not granger-cause GDP growth in the short run. In addition, exports unilaterally granger-causes gross fixed capital formation but not vice versa.

It is worthwhile to point out development policies of Ethiopia. The evaluation of policy measurements about the replication of East Asian development model, analytical findings confirmed that East Asian countries have achieved high economic growth and reduced income inequality. The East Asian miracle was driven by high rate of investment on physical and human capital, effective macroeconomic management, and government intervention in financial system and industries. Accordingly, East Asian countries demonstrated impressive economic growth and became production powerhouse. These factors boosted technological capability of the region. Whereas, Ethiopia has adopted development policies similar to other East Asian countries by implementing state-lead development policies, since then Ethiopia has been emerging as the fastest growing economy in Africa. The empirical findings indicate, Ethiopia has achieved high economic growth and reduced income inequality like other East Asian countries. This outstanding achievement equalized Ethiopia with East Asian countries in terms of growth rate and other development indicators. On the basis of our empirical results, we can conclude that Ethiopia can replicate the East Asian growth model.

However, the existing policies for Ethiopian growth need to take aggressive action to catch up to East Asia countries. The education policy should be changed to enhance the enrolment rate of secondary education and tertiary education through encouraging and providing incentive to private sectors and reginal states to invest and expand education institutions. In addition, the export sector lagged very much behind East Asian. This needs to be given extraordinary attention to minimize the trade gap between export and import, and diversify export from primary goods into value added manufacturing goods. Unless Ethiopia becomes export powerhouse and attains trade surplus, it will be difficult to emulate East Asian growth model and achieve the same level of development as East Asian countries. To do so, Ethiopia has to increase the ability of competitiveness and productivity to compete in global market. Besides policy measurement, we take into consideration innovation factors. The findings on innovation indicators performance are significantly lag behind high performing countries in all aspect of innovation indicators. Hence, Ethiopia should improve all innovation indicators in order to replicate East Asian growth model at full scale, and to bring successful structural transformation. China’s competitiveness has increased and technological capability has impressed the world for the past decades and so, China has brought a paradigm shifted in all sectors, why not Ethiopia?

In addition to those findings, the economic growth of Ethiopia has been econometrically analyzed with the objective of determining the relationship with innovation and human development. The findings of this research is based on GLS panel regressions, OLS regression methods and Pearson correlation method by using STATA, E-views, and SPSS software. We mainly employed six independent variables such as education, gross investment that is gross fixed capital formation, GDP, export, GDP per capita income, ICT and Innovation indicators. Each estimation process is performed independently amongst the six functions with the initial assumption that all factors are mutually exclusive and have impact on economic growth.

The regression estimates affirm the theoretical expectation that investment, human capital and international trade factors are principal determinants of growth. Despite Ethiopian performance is better in terms of macroeconomic indicators, the findings on innovation indicators are statically insignificant as well as opposes endogenous growth theory. Ethiopia’s innovation performance lagged behind developing countries in all indicators in 2000s except macroeconomic performance. Nevertheless, since 2010, this record has been improved rapidly and even Ethiopia has outperformed some of African countries in some indicators. However, the macroeconomic environment performance has shown strong competitive performance better than any African countries.

The empirical finding confirm the positive relationship between economic growth and human development. Economic growth has significant role in improving the living standard of people. Ethiopia has seen improvement in several human development indicators due to sustainable economic growth. As a result, GDP per capita increased, and poverty head count ratio has decreased. It has successfully managed to reduce poverty ratio, not only alleviated the poverty ratio, but also the population head count that lived below poverty line has decreased. The overall growth indicates that stable macroeconomic policies have contributed to human development improvement. Thus, it is worthwhile to conclude that Ethiopia is heading on right direction to achieve sustainable growth while bringing structural transformation.

The study reviews the historical perspectives of economic growth during the last three regimes. The economic history of Ethiopia had passed through conflicts and civil war that had been the major bottlenecks for the development of a country. The Imperial regime had achieved progressive economic growth but it failed to produce human development (the economic growth had insignificance relationship with human development). During the Derg period, a command economic policy introduced that controlled the market and agricultural output. The agricultural productivity had decreased, as the result, Ethiopia reported the worst famine in history, which contributed for the deterioration of human development and recorded negative growth of real GDP.

However, the EPRDF regime has been achieving impressive economic growth. The aspiration of Ethiopia is to become middle income country by 2025 through sustainable economic growth. The pro-poor growth policies contributed for the improvement of human development. The recent remarkable economic growth was driven by strong state-led-growth policy that has been introduced at four different periods. The first polices were introduced during 2002 to 2005 with the title "The Sustainable Development and Poverty Reduction Program (SDPRP)". This plan had created momentums for economic growth. The second policies were implemented from 2005 to 2010 as "The Plan for Accelerated and Sustained Development to End Poverty". During this period, Ethiopia had achieved double digit economic growth and it listed among the fastest growing economy. The third policies that have implemented from 2010 to 2015; the Growth and Transformation Plan was one of the most ambitious development plan that ever implemented in Ethiopia. GTP therefore prioritized the infrastructural development to bring the structural transformation of economy and to improve economic wellbeing. The above three pro-poor polices had significant impact on economic development of Ethiopia. The fourth policy, GTP II was articulated based on the previous policy, especially focuses on science and technology innovation to accelerate structural transformation. GTP II is hopeful to fill the gap and bring paradigm shift in all macroeconomics and innovation indicators. Finally, we employed Granger causality test to evaluate the casual relationship, and the findings revealed that human development has significant impact on economic growth in Ethiopia. There is no causality from economic growth to human development but there exist granger causality from human development to economic growth.

7.1 Summary of findings

The first part of this findings explores the determinants of economic growth and causality relationships with macroeconomic and human development indicators.

The second part analyzes the adaptability of East Asian economic development model, the third part examines the relationship of innovation and economic growth. To summarize the findings, there are different factors that affect economic growth, innovation and human development, for instance, human capital (education), physical capital (investment), innovation (ICT, R&D, Triple helix model), and international trade (export, Import, FDI). Theoretical and empirical evidences support that all the determinant factors have significant and strongly correlated with economic growth and human development, (Barro, 1991; Levine & Renelt, 1992; Valdmanis, 2014).

We found that economic growth has direct relationship with human capital. However, the level of education have different impact on economic growth. In general, in Sub-Saharan African countries, the education has a significant impact on economic growth. Specifically, the primary and tertiary education have strong correlation with GDP per capita growth except secondary education that has weak correlation in all period for SSA countries. Unexpectedly, the OLS regression results for Ethiopia show insignificant figures, which is negatively correlated in all factors except exports and GDP per capita.

The panel regression result shows that world and Sub Saharan African

GDP per capita income growth has strongly correlated with all factor predictors but ICT factor predictors are negatively correlated. SSA countries appear with positive impact as expected, all factors predictors are significant, expect education. The coefficient for primary and tertiary education are significant, which are strongly correlated but secondary education coefficient is unexpectedly insignificant.

OLS result for Ethiopian case is different than both world and SSA countries' findings. All factor predictors are insignificant but GDP per capita and export are significant, which are desirable result. The significant value of factors coefficient for education and Investment are unexpected findings. Moreover, Ethiopian education levels' findings also differ with SSA countries. Unexpectedly, the insignificant value of factors coefficient for primary and secondary education. But tertiary education factor coefficient is significant. The case of Ethiopia therefore needs further research to find out the reasons behind and to identify the associated factors.

In additions, this research has measured GDP growth of Ethiopia by using Co-integration and Vector Error Correction model. The findings show that the time series data has unit root at level and become stationery at first difference. Moreover, the Co-integration test indicates that the time series data is cointegrated in long run.

VECM approach found evidence on the causality relationship between GDP and independent variable in the long run.

Besides descriptive analysis, we use Pearson correlation to measure the relationship between innovation and Economic growth and also the relationship between innovation and GDP per capita income. The findings of coefficient indicates that innovation has no association with economic growth, which is contrary to neoclassical growth theory. However innovation has positive association with GDP per capita income with significant p-value. Therefore, Ethiopia innovation has little or no contribution for current fastest economic growth.

We evaluate the interaction among different institution in Ethiopia, the coefficient result reveals that university-industry collaboration has positive relationship with significant p-value, on the other hand, university-industry collaboration has no association with economic growth and insignificant p-value. The private sector is the driver of innovation and economic growth. The correlation coefficient result shows Company spending on R&D has a negatively correlated with economic growth. But it has very strong relationships with innovation with significant p-value.

Furthermore, this research employed comparative study between Ethiopia and Kenya to evaluate the relationship among ICT, Innovation pillar and GDP per capita income. The correlation coefficient indicates different outcome for Ethiopia and Kenya. The coefficient factors for Kenya ICT shows strong relationship with innovation and GDP per capita income with significant p-value. For Ethiopia, it is undesirable coefficient value for both innovation and GDP per capita income.

7.2 Summary of Policy Recommendation

This recommendation provide insight for policy makers and all relevant bodies. The first part of this recommendation discusses on macroeconomic indicators, particularly focuses on export oriented strategy and savings. The second part provides suggestions on innovation analysis.

7.2.1 Policy Recommendation on Macroeconomic indicators

The empirical results revealed that Africa has huge market potential but Ethiopian export sector is uncompetitive despite adopting exports led growth policy. Ethiopia should learn and emulate the best practices from Kenya to increase intraregional trade in Africa. It should pay full attention to increase export through implementing aggressive expansion strategy into COMESA. In addition, Developing risk mitigation strategy is important through diversifying export destinations, eliminating tariff barriers, improving customs procedures and reducing administrative requirement while adapting internationally accepted documentations as well as expanding ICT system.

Furthermore, preparing extensive study documents that examine and analyze each target countries profile, since the current generalization strategy has failed (different countries have different business culture as they have different needs). The empirical evidence confirmed that Ethiopian export sectors have not been ready to cope up the international rivalry. Neither export sectors have experts on international market nor do they have data to analyze their customers' markets information and understand their needs. Proclaiming export oriented growth strategy by itself is not sufficient enough to boost export, unless otherwise, Ethiopia develops transparent system and build human capital to understand global business environment. It is a business phenomenon, at early stage of development, providing government support (economic incentives) to exporters is important to fill the gaps by providing technical experts, and external market information in order to understand foreign competitors (SWOT). This can be achieved either by recruiting international consultant or developing human capitals through capacity building that specialize on international trade.

The econometrics analysis result confirms a significant correlation between export and macroeconomic indicators that favored growth theory. A recent export progress is against government target, it contradicts export oriented growth model that was adopted from East Asia. Therefore, Ethiopia export sector need to bring paradigm shift from price competitive goods to quality competitiveness by increasing value add goods and services as well as enhancing productivity. Especially, export related indicators require to be improved in order to be competitive in global stage. The following indicators have strong relationships with productivity improvement, such as Cost to Export per container, Time to Export, and Time to Export Documentary Compliance. Policy makers should give serious attention to improve these indicators and increase productivity by taking up the following insight recommendation. This will contribute to strength competitive advantage and also increase efficiency and productivity.

Cost to Export per container; Export cost per container for Sab Saharan Africa countries is higher than South Asian countries. Particular, landlocked countries, like Ethiopia, Rwanda, and Uganda are suffering from high export cost, which is above average SSA countries. The logistic cost has direct relationship with destination distance, this cost has great impact on cost competitiveness in international market. Since their major export goods (agricultural commodity) are vulnerable to price. This cost will be reduced by establishing advance logistic system and expanding infrastructural investment through investing environment friendly railway infrastructure rather than fossil based transportation, accordingly they can reduce logistic cost and save foreign currency.

Above all, the most crucial part is creating awareness to all level of public servant to bring attitude change toward efficiency and productivity. This will not be elucidated overnight, it requires continuous improvement “Kaizen” to reduce delay time (time to market) and increase efficiency. Moreover, providing broad-based, effective and measurable training to all relevant bodies and stakeholders are not privilege but it is compulsory. Simultaneously, developing transparent evaluation criteria is equally important to provide performance based incentive for high performing public servants in addition to salary increment, and also merit based award to private sectors.

In spite of an increasing capital formation ratio to GDP there is a weak ratio of domestic saving in Ethiopia. This result highly contradicts with growth theory. As empirical evidence revealed, although Ethiopia claiming East Asian growth model, the gap of domestic saving and investment has widen at alarming rate. This requires serious policy adjustment to turn around the current trend without decreasing the ratio of gross capital formations since private saving has adverse effect on investment. Therefore, saving behavior has thought to be influenced by government policy. The following factors have to be addressed by policy, such as fiscal policy that increases public saving through tax reform and taking austerity measure on certain public expenditure by increasing quality of service and productivity, second macroeconomic stability has great contribution to increase broad-based saving and investment, while controlling high inflation (specially artificial inflation) and creating consumer confidence on economy; third improving social security system through enforcing all relevant sectors to adopt pension system that has significant effect on private saving; last but not least, financial market development is a backbone for economic establishment of a nation, hence Ethiopia financial market have to provide world class service that equipped with state of art technology in order to create easy access to user, and encourage saving. Furthermore, the government needs to promote domestic saving by improving household's income through adjusting a growth rate of inflation rate with household’s income, which literally the growth rate of household income should be higher than an inflation rate, however the current reality of Ethiopia is the other way round.

7.2.2 Policy Recommendation on Innovation Indicators

The finding on R&D expenditure is highly undesirable and alarming signal to policy makers in order to wake them up from dormant and ineffective policy. Above all, it highlights the weakness of private sectors regarding research and development. This requires critical analysis and thoughtful policy dialogues with private enterprises to draft more effective and efficient policy framework that encourage business institutions involvement in research and development activities. The current reality confirmed that business firms in Ethiopia are more reluctant to engage on R&D and also they have weak perception to ward innovation, which eventually affect productivity and competitiveness.

Therefore, policy amendment and improvement by itself is not enough to solve innovation bottleneck that has dragged private enterprises from being competitive in global stages, nor they are capable to compete locally with imported goods and services. Thus, to break through innovation bottleneck, the policy makers need to develop a systematic platform that bring private enterprises into innovation ecosystem through providing direct or indirect financial incentive. Primarily, a fundamental problem beyond policy issues, it is a perception of the private sectors in Ethiopia, they have misconceived a value of innovation to their firms. Instead of investing on R&D, they highly prefer less risk way of doing business, as the result they heavily relay on import of necessary goods and services (import is about three time higher than Export). This could be solved through different kinds of policy measurements, such as first and for most to provide executive level training and conferences in order to bring attitude change with regards to R&D, establishing a fair and transparent R&D tax credits mechanism as well as improving access to risk capital with preferential interest rate, without easy access to risk capital it is unlikely to change the current landscape of innovation.

Moreover, giving preferential treatment to innovative companies is not luxury but it is an unavoidable strategy to create competitive advantage and increase productivity. Thus, Innovative enterprise be worthy to get preferential income tax treatment as well as preferential treatment to get government procurement or public procurement of goods and services. These policies are an inevitable from the prospective of national security to promote domestic industry and to strength technology capability. Last but not least, it is important to capitalize the benefit of information and communication technologies, and build global value chains through trade openness to bring FDI and technology transfer. Unless and otherwise, government of Ethiopia acts quickly and gives high priority for innovation, it may be hard to eradicate poverty within foreseen future or Ethiopia may end up in middle income trap. The current miraculous growth may not be sustainable in long term without establishing innovation ecosystem

7.3 Study Limitation

Most of the previous empirical studies have examined the innovation effects in Ethiopia through descriptive studies, which limit the availability of theoretical and empirical studies dealing with econometric analysis. Another major limitation is the lack of access to primary data due to an absence of a well-developed institutional framework that provides information concerning the contribution of innovation and entrepreneurship to the Ethiopian economy. Moreover, the innovation survey data was based on different parameters than macroeconomic data, these lead to a major limitation for the understanding of innovation and macroeconomic relationship. Despite indigenous innovation plays vital role in developing countries innovation ecosystem, due to the absence of data, lack of system that regulates intellectual property, and time limitation, we couldn`t include the indigenous innovation and informal sectors innovation in this research, this may require separate future research.

Furthermore, the regression also has its limitations, the regression analysis does not reveals the root cause of effect, but only reveal superficial cause of effect. For example, tertiary education is a key determinant of innovation but may not be the root cause of innovation. Thus the contextual and descriptive analysis can serve huge complementary function as part of our methods. Yet despite limitation, this research has applied three different econometrics methodologies to address the objectives. We also employed descriptive analysis to measure the effectiveness of policy and the performance of selected indicators.

Moreover, the education levels findings of Ethiopian also differ with SSA countries, the case of Ethiopia, therefore, needs further research to find out the reasons behind and to identify the associated factors. Despite Ethiopia macroeconomic performance is one of the best in Africa, financial market development contradicts the establishment of neoclassical theory. Thus, the relationships of Ethiopia financial market and macroeconomic environment findings are required in-depth further investigation in future research.

In addition, due to lack of consistent and complete data, we could not examine the case of Taiwan in detail despite Taiwan is one of high performing countries and Ethiopia adopting similar development policy. We suggest that there are many of ways to expand this research through undertaking more in-depth researches when more appropriate data becomes available. Likewise, the method that has been used in this research could be tested for other similar study.

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Appendices

The appendix represents cross countries panel regression analysis of world and SSA from 1960 to 2013. We employed at six different time period to measure the impact of policies. Moreover, we employed three stage analysis of educations, such as primary, secondary and tertiary school gross enrollment. The regression model of annual growth rate of GDP per capita as independent variable. We implemented the specific regression model

$$Y_i^t = \alpha_i + \sum_i^n \beta_i X_i + \varepsilon_i$$

$GRT_{it} == \alpha + \Sigma \beta_1 EDU_{ijt} + \beta_2 .EXP_{ijt} + \beta_3 INV_{ijt} + \Sigma \beta_5 .INNO_{ijt} + \Sigma \beta_6 ICT_{ijt} + \Sigma \beta_6 H_{ijt+} \varepsilon_{it}$

Dependent variable	Independent variable					
Economic grow	Education	Trade	Investment	innovations	Income	Economy
y= GRT ➔ GDP per capita growth (annual %) y= LFE ➔ Life	PRI ➔ Primary School enrollment (% gross) SEC ➔ Secondary School enrollment (% gross) TER ➔ Tertiary School enrollment (% gross)	EXP ➔ Exports of goods and services (% of GDP)	INV ➔ Investment Gross fixed capital formation (% of GDP)	PAT ➔ Patent applications, residents MOB ➔ Mobile cellular subscriptions (per 100 people) TEL =➔ Telephone lines (per 100 people) COM ➔ Mobile & Fix line JOU ➔ Scientific and technical journal articles RAD ➔ Research and development expenditure (% of GDP)	GDPPC ➔ GDP per capita (constant 2005 US$)	GDP ➔ GDP (current US$)

Appendix A

Table A-1: Correlations between education and export

reg	EDU EXP if	ETH==1		Number of obs	=	16.0
Source	SS	df	MS	F(1, 14)	=	32.4
Model	4,375.7	1.0	4,375.7	Prob > F	=	0.0
Residual	1,891.2	14.0	135.1	R-squared	=	0.7
				Adj R-squared	=	0.7
Total	6,266.9	15.0	417.8	Root MSE	=	11.6
EDU	Coef.	Std. Err.	t	P>t	[95% Conf.	Interval]
EXP	4.8	0.9	5.7	-	3.0	6.7
_cons	16.6	8.8	1.9	0.1	-2.3	35.5

Table A-2: Correlations between life expectancy and export

reg	LIFEX EXP	if ETH==1		Number of obs	=	32
Source SS	df	MS		F(1, 30)	=	61.17
Model 761.670315	1	761.67		Prob > F	=	0
Residual 373.560955	30	12.452		R-squared	=	0.6709
				Adj R-squared	=	0.66
Total 1135.23127	31	36.6204		Root MSE	=	3.5287
LIFEX	Coef.	Std. Err.	t	P>t	[95% Conf.	Interval]
EXP	1.322282	0.16907	7.82	0	0.977	1.66757
_cons	38.21626	1.79146	21.33	0	34.5576	41.8749

Appendix B

Table B-1Finding based on primary educations for the world

Xtreg GRT L.PRI L.EXPO L.INV L10.GDPPC L.COM World

GRT	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
PRI L1.	.0221802	.0048994	4.53	0.000	.0125775	.031783
EXP L1.	.0374783	.0051016	7.35	0.000	.0274794	.0474772
INV L1.	.074709	.0097841	7.64	0.000	.0555326	.0938854
COM L1.	-.0021392	.0017668	-1.21	0.226	-.0056022	.0013237
GDPPC L10.	-.0000886	.0000139	-6.36	0.000	-.0001158	-.0000613
_cons	-2.502492	.5273117	-4.75	0.000	-3.536004	-1.46898
sigma_u	1.8648369					
sigma_e	4.2040046					
rho	.16441644	(fraction of variance due to u_i)				

Table B-2 Finding based on primary educations for the SSA

Xtreg GRT L.PRI L.EXP0 L.INV L10.GDPPC L.COM if (SSA==1)

GRT	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
PRI						
L1.	.0124842	.0077853	1.60	0.109	-.0027747	.027743
EXP						
L1.	.0591369	.0135728	4.36	0.000	.0325347	.0857391
INV						
L1.	.1112923	.0160158	6.95	0.000	.0799018	.1426827
GDPPC						
L10.	-.0012667	.0001952	-6.49	0.000	-.0016492	-.0008842
COM						
L1.	.0064563	.0076392	0.85	0.398	-.0085162	.0214288
_cons	-2.872955	.7579886	-3.79	0.000	-4.358586	-1.387325
sigma_u	1.7956219					
sigma_e	4.9109752					
rho	.11792355	(fraction of variance due to u_i)				

Finding Based on Primary Educations only for SSA before 1981

The regression result that show before 1981, the SSA countries` GDP per capita income growth is negatively correlated with primary education, investment and export are strongly collocated. GDP per capita also negatively correlated

Table B-3 Finding based on primary educations for the SSA before 1980

Xtreg GRT L.PRI L.EXP L.INV L10.GDPPC L.COM
if (SSA==1&year<1981)

GRT	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
PRI						
L1.	-.0335741	.0319155	-1.05	0.293	-.0961274	.0289792
EXP						
L1.	.0198867	.0777255	0.26	0.798	-.1324525	.1722259
INV						
L1.	.1767117	.106114	1.67	0.096	-.031268	.3846914
GDPPC						
L10.	-.0044638	.0026022	-1.72	0.086	-.009564	.0006364
COM						
L1.	3.238054	2.210328	1.46	0.143	-1.09411	7.570219
_cons	1.797104	2.86456	0.63	0.530	-3.817331	7.411538
sigma_u	2.0726929					
sigma_e	6.3007772					
rho	.09764685	(fraction of variance due to u_i)				

Finding Based on Primary Educations for world after 1981

The regression result indicates after 1981, GDP per capita income growth of the world strongly correlated with primary education, export and investment. GDP per capita also negatively correlated but its significate except communications.

Table B-4 Finding based on primary educations for the world before 1980

Xtreg GRT L.PRI L.EXP L.INV L10.GDPPC L.COM
if (World==1&year>1980)

GRT	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
PRI						
L1.	.0281941	.0051728	5.45	0.000	.0180555	.0383327
EXP						
L1.	.0431084	.0050919	8.47	0.000	.0331284	.0530884
INV						
L1.	.0707225	.0101008	7.00	0.000	.0509253	.0905197
COM						
L1.	-.0015421	.0017502	-0.88	0.378	-.0049724	.0018882
GDPPC						
L10.	-.0000875	.0000137	-6.39	0.000	-.0001144	-.0000607
_cons	-3.293858	.5471403	-6.02	0.000	-4.366233	-2.221482
sigma_u	1.7855437					
sigma_e	4.0941355					
rho	.15980694	(fraction of variance due to u_i)				

Finding Based on Primary Educations only for SSA after 1980

The regression result indicates that after 1980, the Sub Saharan African GDP per capita income growth strongly correlated with export primary education, and investment. GDP per capita also negatively correlated

Table B-5 Finding based on primary educations for the SSA after 1980

Xtreg GRT L.PRI L.EXP L.INV L10.GDPPC L.COM
if (SSA==1&year>1980)

GRT	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
PRI						
L1.	.0211922	.0079291	2.67	0.008	.0056515	.0367329
EXP						
L1.	.06138	.0133804	4.59	0.000	.0351549	.087605
INV						
L1.	.1151799	.0160026	7.20	0.000	.0838154	.1465444
GDPPC						
L10.	-.0011988	.0001912	-6.27	0.000	-.0015735	-.0008241
COM						
L1.	.0052952	.0074237	0.71	0.476	-.0092549	.0198454
_cons	-3.927251	.7662272	-5.13	0.000	-5.429028	-2.425473
sigma_u	1.7423555					
sigma_e	4.7384613					
rho	.11910331	(fraction of variance due to u_i)				

Finding Based on Primary Educations only for SSA after 1990

The regression result indicates that after 1990, the Sub Saharan African GDP per capita income growth weakly correlated with export, primary education, and investment are strongly collocated.

Table B-6 Finding based on primary educations for the SSA after 1990

Xtreg GRT L.PRI L.EXP L.INV L10.GDPPC L.COM
if (SSA==1&year>1990)

GRT	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
PRI						
L1.	.0168375	.0096372	1.75	0.081	-.0020511	.0357262
EXP						
L1.	.0431519	.0154872	2.79	0.005	.0127976	.0735063
INV						
L1.	.133245	.0174271	7.65	0.000	.0990886	.1674014
GDPPC						
L10.	-.0009819	.0002293	-4.28	0.000	-.0014313	-.0005325
COM						
L1.	.0027617	.0078966	0.35	0.727	-.0127154	.0182387
_cons	-3.443087	.9068956	-3.80	0.000	-5.22057	-1.665604
sigma_u	1.8265927					
sigma_e	4.6760773					
rho	.13238721	(fraction of variance due to u_i)				

Finding Based on Primary Educations only for SSA after 1999

The regression findings indicates that after 1999, the Sub Saharan African GDP per capita income growth weakly correlated with export, primary education and investment are strongly collocated.

Table B-7 Finding based on primary educations for the SSA after 1999

Xtreg GRT L.PRI L.EXP L.INV L10.GDPPC L.COM if (SSA==1&year>1999)

GRT	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
PRI L1.	.0066738	.014276	0.47	0.640	-.0213066	.0346542
EXP L1.	.024801	.0192711	1.29	0.198	-.0129696	.0625717
INV L1.	.1683357	.0220708	7.63	0.000	.1250777	.2115936
GDPPC L10.	-.0010099	.0002805	-3.60	0.000	-.0015596	-.0004602
COM L1.	-.0077376	.009359	-0.83	0.408	-.0260808	.0106056
_cons	-1.989404	1.393202	-1.43	0.153	-4.72003	.7412216
sigma_u	2.2907163					
sigma_e	4.5118057					
rho	.20494563	(fraction of variance due to u_i)				

Appendix C

Finding Based on Secondary Educations for the world and SSA

The regression findings result indicates that world GDP per capita income growth was strongly correlated with secondary education. But for Sub Saharan African weakly correlated, in generally the secondary education is insignificant for SSA countries. Investment and export are strongly collocated.

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Table C-1 Finding Based on Secondary Educations for the world

Xtreg GRT L.SEC L.EXP L.INV L10.GDPPC L.COM World

GRT	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
SEC						
L1.	.0224842	.0047005	4.78	0.000	.0132714	.031697
EXP						
L1.	.0323489	.0053268	6.07	0.000	.0219086	.0427892
INV						
L1.	.0695103	.0102936	6.75	0.000	.0493352	.0896853
COM						
L1.	-.0046802	.0019981	-2.34	0.019	-.0085965	-.000764
GDPPC						
L10.	-.0000972	.0000146	-6.65	0.000	-.0001259	-.0000686
_cons	-1.28559	.3952909	-3.25	0.001	-2.060346	-.5108337
sigma_u	1.860775					
sigma_e	4.1639515					
rho	.16645774	(fraction of variance due to u_i)				

Table C-2 Finding Based on Secondary Educations for SSA

Xtreg GRT L.SEC L.EXP L.INV L10.GDPPC L.COM
if (SSA==1)

GRT	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
SEC						
L1.	.0126397	.0200396	0.63	0.528	-.0266371	.0519165
EXP						
L1.	.0648821	.0157193	4.13	0.000	.0340728	.0956914
INV						
L1.	.1057555	.0180454	5.86	0.000	.0703872	.1411239
GDPPC						
L10.	-.0011154	.0002695	-4.14	0.000	-.0016437	-.0005871
COM						
L1.	.0011467	.0119414	0.10	0.923	-.022258	.0245514
_cons	-2.31463	.7368877	-3.14	0.002	-3.758903	-.8703564
sigma_u	2.2352744					
sigma_e	5.0302445					
rho	.16490043	(fraction of variance due to u_i)				

Finding Based on Secondary Educations only for SSA before 1981

The regression findings indicates that before 1981, the world GDP per capita income growth weakly correlated with secondary education. Investment and export are strongly collocated.

Table C-3 Finding Based on Secondary Educations for the SSA before 1980

Xtreg GRT L.SEC L.EXP L.INV L10.GDPPC L.COM
if (SSA==1&year<1981)

GRT	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
SEC						
L1.	.0166783	.0739098	0.23	0.821	-.1281822	.1615389
EXP						
L1.	.1576808	.0907638	1.74	0.082	-.020213	.3355747
INV						
L1.	.159886	.1087276	1.47	0.141	-.0532162	.3729882
GDPPC						
L10.	-.0100301	.0030374	-3.30	0.001	-.0159834	-.0040768
COM						
L1.	-2.447636	2.839041	-0.86	0.389	-8.012053	3.116781
_cons	.8233511	2.34961	0.35	0.726	-3.781799	5.428501
sigma_u	0					
sigma_e	6.4311597					
rho	0	(fraction of variance due to u_i)				

Finding Based on Secondary Educations only for world after 1980

The regression findings show that after 1980, the world GDP per capita income growth strongly correlated with secondary education. Investment and export are strongly collocated.

Table C-4 Finding Based on Secondary Educations for the world after 1980

Xtreg GRT L.SEC L.EXP L.INV L10.GDPPC L.COM
if (world==0 &year>1980)

GRT	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
SEC						
L1.	.028222	.0048856	5.78	0.000	.0186463	.0377977
EXP						
L1.	.0402988	.0053147	7.58	0.000	.0298822	.0507155
INV						
L1.	.061527	.0106303	5.79	0.000	.0406921	.0823619
COM						
L1.	-.0050179	.0019777	-2.54	0.011	-.0088942	-.0011416
GDPPC						
L10.	-.0001017	.0000145	-7.00	0.000	-.0001302	-.0000732
_cons	-1.772925	.4054123	-4.37	0.000	-2.567518	-.9783311
sigma_u	1.7886483					
sigma_e	4.0607407					
rho	.16249086	(fraction of variance due to u_i)				

Finding Based on Secondary Educations only for SSA after 1980

The regression findings indicates that after 1980, the Sub Saharan African GDP per capita income growth weakly correlated with secondary education. Investment and export are strongly collocated.

Table C-5 Finding Based on Secondary Educations for SSA after 1980

Xtreg GRT L.SEC L.EXP L.INV L10.GDPPC L.COM
if (SSA==1&year>1980)

GRT	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
SEC						
L1.	.0353504	.0207601	1.70	0.089	-.0053386	.0760394
EXP						
L1.	.0673356	.0154696	4.35	0.000	.0370158	.0976554
INV						
L1.	.1121974	.0180049	6.23	0.000	.0769084	.1474863
GDPPC						
L10.	-.0010983	.0002655	-4.14	0.000	-.0016186	-.0005779
COM						
L1.	-.0055209	.0117145	-0.47	0.637	-.0284808	.0174391
_cons	-3.221094	.7567399	-4.26	0.000	-4.704277	-1.737911
sigma_u	2.215819					
sigma_e	4.8260503					
rho	.17410449	(fraction of variance due to u_i)				

Finding Based on Secondary Educations only for SSA after 1990

The regression findings indicates that after 1900, the SSA countries` GDP per capita income growth weakly correlated with secondary education, Investment and export are strongly collocated.

Table C-6 Finding Based on Secondary Educations for SSA after 1990

Xtreg GRT L.SEC L.EXP L.INV L10.GDPPC L.COM
if (SSA==1&year>1990)

GRT	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
SEC						
L1.	.0405481	.0271892	1.49	0.136	-.0127416	.0938379
EXP						
L1.	.0430014	.0182634	2.35	0.019	.0072058	.0787971
INV						
L1.	.1250215	.0198388	6.30	0.000	.0861381	.1639049
GDPPC						
L10.	-.0007859	.0003745	-2.10	0.036	-.0015199	-.0000518
COM						
L1.	-.0116298	.0126258	-0.92	0.357	-.0363759	.0131163
_cons	-2.984448	.9206845	-3.24	0.001	-4.788957	-1.17994
sigma_u	2.4931992					
sigma_e	4.6907251					
rho	.22027905	(fraction of variance due to u_i)				

Finding Based on Secondary Educations for world after 1999

The regression findings indicates that after 1999, GDP per capita income growth of the world strongly correlated with secondary education. Investment and export are strongly collocated.

Table C-7 Finding Based on Secondary Educations for the world after 1999

Xtreg GRT L.SEC L.EXP L.INV L10.GDPPC L.COM
if (world==1&year>1999)

GRT	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
SEC						
L1.	.0344769	.0075006	4.60	0.000	.0197761	.0491778
EXP						
L1.	.0270563	.0069543	3.89	0.000	.0134261	.0406866
INV						
L1.	.0836926	.0141383	5.92	0.000	.0559821	.1114032
COM						
L1.	-.0194352	.0026042	-7.46	0.000	-.0245393	-.014331
GDPPC						
L10.	-.0000731	.000018	-4.06	0.000	-.0001084	-.0000378
_cons	-.935451	.6081967	-1.54	0.124	-2.127495	.2565926
sigma_u	2.4200615					
sigma_e	3.5136608					
rho	.32175221	(fraction of variance due to u_i)				

Finding Based on Secondary Educations only for SSA after 1999

The regression finding indicates that after 1999, the Sub Saharan African GDP per capita income growth weakly correlated with secondary education. Investment and export are strongly collocated. GDP per capita also negatively correlated but its significate except communication.in all period secondary education are weakly correlated.

Table C-8 Finding Based on Secondary Educations for SSA after 1999

Xtreg GRT L.SEC L.EXP L.INV L10.GDPPC L.COM
if (SSA==1&year>1999)

GRT	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
SEC						
L1.	.0516949	.042161	1.23	0.220	-.0309392	.134329
EXP						
L1.	.0151858	.0254775	0.60	0.551	-.0347492	.0651207
INV						
L1.	.1482202	.0268711	5.52	0.000	.0955538	.2008865
GDPPC						
L10.	-.0008411	.000598	-1.41	0.160	-.0020131	.000331
COM	-.0236553	.0141767	-1.67	0.095	-.0514412	.0041306
_cons	-2.192462	1.488298	-1.47	0.141	-5.109473	.7245494
sigma_u	4.2241083					
sigma_e	4.5517834					
rho	.46271389	(fraction of variance due to u_i)				

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Appendix D

Finding Based on Tertiary Educations for the world and SSA

The below regression result show that globally GDP per capita income growth was strongly correlated with tertiary education. But for SSA it is weakly correlated the primary education is insignificant for SSA country because the t(z) value is 1.6 which is too weak lease than 2 value. Export and investment are strongly collocated. GDP per capita also negatively correlated but its significate except communications. Except primary education this result are the same with the world

Table D-1 Based on Tertiary Educations for the world

Xtreg GRT L.PRI L.EXP0 L.INV L10.GDPPC L.COM world

GRT	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
TER L1.	.0423099	.0076986	5.50	0.000	.0272209	.057399
EXP L1.	.0511172	.005955	8.58	0.000	.0394455	.0627889
INV L1.	.0627579	.0121031	5.19	0.000	.0390361	.0864796
COM L1.	-.0121031	.0025656	-4.72	0.000	-.0171315	-.0070747
GDPPC L10.	-.0001207	.0000165	-7.33	0.000	-.000153	-.0000884
_cons	-.6364121	.3922367	-1.62	0.105	-1.405182	.1323577
sigma_u	2.2893252					
sigma_e	3.9743397					
rho	.24914022	(fraction of variance due to u_i)				

Table D-2 Based on Tertiary Educations SSA

Xtreg GRT L.TER L.EXP0 L.INV L10.GDPPC L.COM if (SSA==1)

GRT	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
PRI L1.	.0124842	.0077853	1.60	0.109	-.0027747	.027743
EXP L1.	.0591369	.0135728	4.36	0.000	.0325347	.0857391
INV L1.	.1112923	.0160158	6.95	0.000	.0799018	.1426827
GDPPC L10.	-.0012667	.0001952	-6.49	0.000	-.0016492	-.0008842
COM L1.	.0064563	.0076392	0.85	0.398	-.0085162	.0214288
_cons	-2.872955	.7579886	-3.79	0.000	-4.358586	-1.387325
sigma_u	1.7956219					
sigma_e	4.9109752					
rho	.11792355	(fraction of variance due to u_i)				

Finding Based on Tertiary Educations only for SSA before 1981

The below regression result show that before 1981, the SSA countries` GDP per capita income growth negatively correlated with secondary education. Export and investment are strongly collocated. GDP per capita also negatively correlated but its significate except communications.

Table D-3 Based on Tertiary Educations SSA before 1980

Xtreg GRT L.TER L.EXP L.INV L10.GDPPC L.COM if (SSA==1&year<1981)

GRT	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
TER L1.	-1.036031	1.772279	-0.58	0.559	-4.509633	2.437572
EXP L1.	.0513307	.0895659	0.57	0.567	-.1242153	.2268767
INV L1.	.1327377	.1269045	1.05	0.296	-.1159906	.381466
GDPPC L10.	-.0055222	.0038643	-1.43	0.153	-.0130961	.0020516
COM L1.	3.52453	2.567335	1.37	0.170	-1.507355	8.556414
_cons	.6678819	2.640471	0.25	0.800	-4.507346	5.84311
sigma_u	2.466398					
sigma_e	6.1467549					
rho	.13867594	(fraction of variance due to u_i)				

Finding Based on Tertiary Educations only for world after 1980

The below regression result show that after 1980. the world GDP per capita income growth strongly correlated with tertiary education.Export and investment are strongly collocated. GDP per capita also negatively correlated but its significate except communications.

Table D-4 Based on Tertiary Educations for the world after 19980

Xtreg GRT L.TER L.EXP L.INV L10.GDPPC L.COM
if (World==1&year>1980)

GRT	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
TER						
L1.	.0474006	.0078719	6.02	0.000	.0319719	.0628293
EXP						
L1.	.0566922	.0060974	9.30	0.000	.0447415	.0686429
INV						
L1.	.0805134	.0128088	6.29	0.000	.0554086	.1056182
COM						
L1.	-.0125436	.0025734	-4.87	0.000	-.0175874	-.0074999
GDPPC						
L10.	-.0001194	.0000169	-7.08	0.000	-.0001524	-.0000863
_cons	-1.410914	.4078169	-3.46	0.001	-2.210221	-.6116076
sigma_u	2.2837062					
sigma_e	3.9315949					
rho	.25227962	(fraction of variance due to u_i)				

Finding Based on Tertiary Educations only for SSA after 1980

The below regression result show that after 1980, the SSA countries` GDP per capita income growth strongly correlated with tertiary education. Export and investment are strongly collocated. GDP per capita also negatively correlated but its significate except communications.

Table D-5 Based on Tertiary Educations for SSA after 1980

Xtreg GRT L.TER L.EXP L.INV L10.GDPPC L.COM
if (SSA==1&year>1980)

GRT	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
TER						
L1.	.2946605	.0939128	3.14	0.002	.1105949	.4787261
EXP						
L1.	.1167383	.0186029	6.28	0.000	.0802773	.1531993
INV						
L1.	.1706636	.0227908	7.49	0.000	.1259943	.2153328
GDPPC						
L10.	-.0013375	.0003267	-4.09	0.000	-.0019778	-.0006972
COM						
L1.	-.0392263	.0144747	-2.71	0.007	-.0675962	-.0108565
_cons	-4.714428	.8115093	-5.81	0.000	-6.304957	-3.123899
sigma_u	2.5474886					
sigma_e	4.8504564					
rho	.21620345	(fraction of variance due to u_i)				

Finding Based on Tertiary Educations only for SSA after 1990

The below regression result show that after 1990, the SSA countries` GDP per capita income growth strongly correlated with tertiary education. Export and investment are strongly collocated. GDP per capita also negatively correlated but its significate except communications.

Table D-6 Based on Tertiary Educations for SSA after 1990

Xtreg GRT L.TER L.EXP L.INV L10.GDPPC L.COM if (SSA==1&year>1990)

GRT	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
TER L1.	.3158079	.1036616	3.05	0.002	.1126349	.5189809
EXP L1.	.1081099	.021601	5.00	0.000	.0657727	.150447
INV L1.	.184378	.0254597	7.24	0.000	.1344779	.2342782
GDPPC L10.	-.0014386	.0004084	-3.52	0.000	-.002239	-.0006381
COM L1.	-.0427139	.015005	-2.85	0.004	-.0721231	-.0133048
_cons	-4.451214	.9297108	-4.79	0.000	-6.273414	-2.629014
sigma_u	2.7850435					
sigma_e	4.735781					
rho	.25697205	(fraction of variance due to u_i)				

Finding Based on Tertiary Educations only for world after 1999

The below regression result show that after 1999, the SSA countries` GDP per capita income growth strongly correlated with tertiary education. Export and investment are strongly collocated. GDP per capita also negatively correlated but its significate except communications.

Table D-7 Based on Tertiary Educations for the world after 1999

Xtreg GRT L.TER L.EXP L.INV L10.GDPPC L.COM
if (world==1&year>1999)

GRT	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
TER						
L1.	.0289819	.0097705	2.97	0.003	.0098321	.0481317
EXP						
L1.	.0405676	.0078078	5.20	0.000	.0252646	.0558707
INV						
L1.	.1177298	.0173142	6.80	0.000	.0837946	.1516651
COM						
L1.	-.0250401	.0029921	-8.37	0.000	-.0309045	-.0191757
GDPPC						
L10.	-.0000621	.0000202	-3.08	0.002	-.0001017	-.0000226
_cons	.0088247	.5506892	0.02	0.987	-1.070506	1.088156
sigma_u	2.7456045					
sigma_e	3.4319587					
rho	.39025042	(fraction of variance due to u_i)				

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Finding Based on Tertiary Educations only for SSA after 1999

The below regression result show that after 1999, the SSA countries` GDP per capita income growth strongly correlated with tertiary education. Export and investment are strongly collocated. GDP per capita also negatively correlated but its significate except communications.

Table D-8 Based on Tertiary Educations for SSA after 1999

Xtreg GRT L.TER L.EXP L.INV L10.GDPPC L.COM
if (SSA==1&year>1999)

GRT	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
TER						
L1.	.3521859	.1201328	2.93	0.003	.1167299	.5876419
EXP						
L1.	.0900392	.0266666	3.38	0.001	.0377736	.1423047
INV						
L1.	.2164965	.0332279	6.52	0.000	.1513711	.281622
GDPPC						
L10.	-.0016181	.0005327	-3.04	0.002	-.0026621	-.0005741
COM	-.0531253	.0150456	-3.53	0.000	-.0826141	-.0236365
_cons	-3.624129	1.092913	-3.32	0.001	-5.766199	-1.482058
sigma_u	3.0896608					
sigma_e	4.6226945					
rho	.3087792	(fraction of variance due to u_i)				

Nonparametric Correlations for Kendall Kendall's tau_b and Spearman's rho to analyze the relationships among Scientific and technical journal articles, gross domestic expenditure on R&D, patent application, innovation, economic growth and GDP per capita

Appendix E

Abbreviations

For above Table indicators abbreviations ETHEG (Ethiopia Economic growth) SCJETH (Scientific and technical journal articles), GERDETH (gross domestic expenditure on R&D), PAT (Patent Applications), INNV (Innovations pillar), GDPP (GDP Per Capita Income)

The below Figures are used these abbreviations for each African countries. Cameroon (CMR), Egypt (EGY), Ethiopia (ETH), Ghana(GHA), Kenya (KEN), Morocco (MAR), Mozambique (MOZ), Nigeria (NGA), Rwanda (RWA), South Africa (ZAF), Tanzania (TZA), Tunisia (TUN), and Uganda (UGA)