ST.MARY'S UNIVERSITY

SCHOOL OF GRADUATE STUDIES

INSITUTE OF AGRICULTURE AND DEVELOPMENT STUDIES

CONTRIBUTION OF INFRASTRUCTURE ON ECONOMIC GROWTH OF ETHIOPIA

By

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ID Number: SGS/0715/2010A

JULY, 2019

ADDIS ABABA, ETHIOPIA

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Acronyms

ADF	Augmented Dickey Fuller
AT	Air Transport, Freight million tons per kilometre
EPC	per capita electricity consumption
ERA	Ethiopian road authority
MOFED	Ministry of finance & economic development
NBE	National bank of Ethiopia
PCGDP	PER CAPITA Gross Domestic Product
RO	paved roads as percentage of total roads
TS	Telephone line per 100 population
VECM	vector error correction model

Abstract

Infrastructure serves as the backbone of a functioning society by providing a well-suited environment for upgrading the economic status of a country. From the perspective of Ethiopia the most important question is whether infrastructure contributed on economic growth of Ethiopia. The objectives of the study were to examine the contribution of infrastructure development on the economic growth of Ethiopia. The study follows an empirical research using secondary data from1981-2010E.C. The research proceeds to test empirically whether Electric production , Air Transport, Telephone line $ Road has been contribution on Ethiopian economy. the paper used dicky-fuller and Johannessen tests to check the stationarity of the variables and employs Cobb Douglas production function model,. Based on the finding of the study, all variables were unit root I(0) after first order they became stationary, All the variables are also confirmed cointegration based on Johansen tests. based on vector error correction model estimation result, all the independent variables whether Electric production, Air Transport, , Telephone line & Road has a positive and significant impact on economic growth in the long run. and becomes insignificant in the short run. Based on the finding the study highlights From the policy perspective, greater emphasis is needed on infrastructure development to sustain the high economic growth which Ethiopian economy has been experiencing for the last few years.

Keywords: *Economic growth, Ethiopia, Infrastructure*.vecm *model*

Chapter one

1.0 Introduction

1.1 Background of the study

The Ethiopian economy is highly dependent on agriculture, which accounts for around 50 percent of the gross domestic product (GDP). An estimated 85 percent of the population is directly or indirectly depending on the agricultural sector. More than 90 percent of export earning is generated from the agricultural sector. Second to the agricultural sector, services account for more than one-third of economic activity. The composition of service earnings has shifted only slowly in response to economic liberalization, with recent slight growth in the construction, transport, and tourism sectors. Contribution of the construction industry to GDP at constant factor cost is about 6 percent for 2006/07 (Central Statistical Authority 2008). On the other hand, industry accounts for almost 12 percent of economic activity where most of the manufacturing firms are concentrated in Addis Ababa. However, these days it is also common to see manufacturing industries being established in some other cities and towns. Industrialization of towns outside of Addis Ababa obviously requires more infrastructure and efficient transportation operation. Road Sector Development Program in 1997 (RSDP 1997-2007).

One of the most vital elements that can serve as the key to achieving competitiveness is the provision of infrastructure. In general, infrastructure serves as the backbone of a functioning society by providing a well-suited environment for upgrading the economic status of a country. Research conducted by Aschauer (1989) and Munnell (1990) report a positive correlation between public infrastructure and productivity aggregated to the national level Infrastructure contribute economic growth through its impact on profitability, levels of output, income and employment through lessening production costs.

Investment in physical and social infrastructure positively affects the poor directly and indirectly in multiple ways (Estache 2004, Jones 2004). Infrastructure development is one of the major factors contributing to overall economic development in many ways, such as: (1) direct investment in infrastructure creates production facilities and stimulates economic activities; (2) it reduces transaction costs and trade costs, improving competitiveness; and (3) it provides employment opportunities and physical and social infrastructure to the poor. In contrast, lack of infrastructure creates bottlenecks for sustainable growth and poverty reduction. Therefore,

infrastructure development contributes to investment and growth through an increase in productivity and efficiency and acts as a link between resources to factories, people to jobs and products to market.

Infrastructure investment is an important driving force to achieve rapid and sustained economic growth. The presence of sufficient infrastructure will require for the modernization and commercialization of agriculture and the achievement of income surpluses for the capital accumulation. It can provide a basis for the expansion of local manufacturing industries, as well as enlarging markets for the output of these industries. (Human Development Report of India 2011)

There is a precise link between infrastructure and development. Infrastructure investment directly affects the economic development. Therefore, that the only way to build up a country's productive potential and raise per capita income is to expand the capacity for producing goods, this need not refer simply to the provision of plant and machinery, but also to roads, railways, power lines, water pipes, schools, hospitals, houses and even "incentive" consumer goods such as consumer durables, all of which can contribute to increased productivity and higher living standards. The prosperity of a country depends directly upon the development of Agriculture and Industry.(Dr.B.Srinivasu &P.Srinivasa Rao, Jan 2013)

Agriculture production, however, requires power, credit, transport facilities, etc. Industrial production requires not only machinery and equipment but also skilled manpower, management, energy, credit facilities, marketing facilities, transportation services which include railways, roads, shipping, communication facilities, etc. All these facilities and services constitute collectively the infrastructure of an economy. Regions with inadequate infrastructure usually have lower per capita income, bigger proportion of the primary sector, and smaller population density. Regions with high infrastructure level usually have higher per capita income, a smaller proportion of the primary sector and bigger population density. In which regions having a good basic facilities like health, educational, transport, communication, water, sanitation, energy, housing, etc. it will attract more investments especially the small and marginal entrepreneur starts their production activities. Good transportation, low cost of electricity, availability of skilled lobar facilities always negative effects on the cost of production, positive effects on production as well as profit levels. Inadequate infrastructure and services become the burden for infrastructure suppliers, and led the low efficiency of output. (Dr.B.Srinivasu &P.Srinivasa Rao, Jan 2013)

World Development Report(1994) published by the World Bank under the title 'Infrastructure for Development' rightly mentions that "the adequacy of infrastructure helps determine one country's success and another's failure in diversifying production, expanding trade, coping with population growth, reducing poverty, or improving environmental conditions" Socioeconomic development can be facilitated and accelerated by the presence of social and economic infrastructure. It has been universally recognized that an adequate supply of infrastructure services is an essential ingredient for productivity and growth. If these facilities and services are not available in that place development will be very difficult, it will lead negative effect on the production activities of the economy, which means lower levels of production capacity is always leads to the underutilization of the resources, scarcity of goods and services. People will spend more money for obtaining basic needs and facilities. It can be linked to a very scarce commodity that can only be secured at a very high price and costs. The pursuit of higher level of welfare for the citizens of countries in the era of globalization requires efficiency, productivity and growth in all spheres of economic activities.

1.2 Statement of the Problem

With infrastructure a key driver of economic growth, developing countries are particularly aware of their infrastructure needs. For low-income countries infrastructure investment providing access to energy, clean water and basic transport may mean the difference between life and death. Basic infrastructure helps alleviate poverty directly and provides the poor with the environment in which they can grow their way out of poverty. (Lee, 2010)

The construction and maintenance of infrastructure generate more jobs per rand spent than most other sector of the economy. This investment appears to satisfy national development needs as well as driving the priority of our developing country, the creation of much needed jobs (Department of Transport, 2011). This provision has too often been made in a flawed, through an isolated focus on capital expenditure than through life cycle costing model. Innovation and creative procurement is a specialised process essential to sustain infrastructure especially in the province beset with skills and financial constraints (SAICE Infrastructure Report Card, 2011).

Infrastructure development contributes to investment and growth through an increase in productivity and efficiency and acts as a link between resources to factories, people to jobs and products to market. Infrastructure investment is an important driving force to achieve rapid and

sustained economic growth. The presence of sufficient infrastructure will require for the modernization and commercialization of agriculture and the achievement of income surpluses for capital accumulation. It can provide a basis for the expansion of local manufacturing industries, as well as enlarging markets for the outputs of these industries. However, Ethiopia needs to maintain its growth momentum in a sustainable manner to improve the overall standard of living of poor people and reduce regional inequality.

During the 2000s, Ethiopia's annual economic growth has averaged 4.8 percent, compared with only 0.5 percent in the previous decade. Notwithstanding this improvement, current annual growth levels still fall short of the sustained 7 percent needed to meet the Millennium Development Goals. Improved structural and stabilization policies generated an estimated 4.2 percent of Ethiopia's improved per capita growth performance during the 2000s, and improvements in the country's infrastructure platform over that period contributed up to 0.6 percentage points to growth. This was due almost entirely to the introduction of mobile telephony in Ethiopia. Simulations suggest that if Ethiopia's infrastructure platform could be improved to the level of the African leader, Mauritius, annual per capita growth rates could increase by 3.8 percent. This potential impact would come equally from improvements to transport, power, and ICT infrastructure.(Eric,2013)

Evidence from enterprise surveys suggests that infrastructure constraints are responsible for an estimated 50 percent of the productivity handicap faced by Ethiopian firms. The remainder is caused by governance, red tape, and financing constraints.

This study sought to examines whether infrastructure investment has indeed contributed to Ethiopia economic growth.

1.3 Research questions

- Does infrastructure contributed for the Ethiopian economy?
- Does infrastructure contribute to economic growth in the long & short run?

1.4 Objectives

1.3.1 General objectives

- The general objectives of this analysis is to examine the contribution of infrastructure development on the economic growth of Ethiopia.

1.3.2 Specific objectives

- To assess if there is any growth contribution from infrastructure in Ethiopia.
- To assess how the infrastructure contributes to growth.

1.4 Hypotheses

- There is no contribution of Electric production to the economic growth
- There is no contribution of Telephone line to the economic growth
- There is no contribution of roads to the economic growth
- There is no contribution of Air Transport to the economic growth

1.5 Scope & limitations of the Study

The study find out the contribution of infrastructure onto the Ethiopia economic growth from 1981 to 2010 Ethiopian calendar due to the unavailability of data..

Data used for the analysis of the association between economic growth and infrastructure was sourced secondary data from world bank, ERA, EPC,MOFED, NBE. Even though these are official sources of secondary data for economic variables, the study has identified limitations in terms of data reliability as secondary data usually make estimates for missing data.

1.6 Significance of the Study

The research findings hence help policy makers determine how this four sector of infrastructure to bring about the desired sustainable economic growth and the determining of the precise economic contribution of infrastructure to output growth were great used to policymakers and researchers.

1.7 organization of the study

This study structured into five chapters. The first chapter discuss on the introduction part and the second chapter discuss about the conceptual framework of empirical review and conceptual frameworks regarding on the contribution of infrastructure and economic growth. The third chapter is about the methodology of the study . the fourth chapter presents the result and discussions of the study and the fifth chapter includes conclusion and recommendation.

CHAPTER TWO

2. LITERATURE REVIEW

2.1 CONCEPTUAL FRAMEWORK OF INFRASTRUCTURE

Infrastructure, in general, defines as a set of facilities through which goods and services are provided to the public. Its installations do not produce goods and services directly but provide inputs for all other socio-economic activities. Infrastructure is the stock of basic facilities and capital equipment needed for the functioning of a country or area; the term to refer collectively to the roads, bridges, rail lines, and similar public works that are required for an industrial economy, or a portion of it, to function. The term originated during the World War II as a military term to mean „underlying" structures in the early days of Marshall Plan, as preferable to Social Overhead Capital", to avoid confusion with hospitals,schools and similar welfare type facilities. Since then, the term has been widely used byeconomists but does not have a precise definition till now. (Dr.B.Srinivasu &P.Srinivasa Rao, Jan 2013)

2.2 THEORETICAL FRAMEWORK OF INFRASTRUCTURE

The provision and development of Infrastructure has been subject of much theoretical analysis and empirical studies. It is referred as an umbrella term for many activities and named as "SocialOverhead Capital", "Economic Overheads", "Overhead Capital", "Basic Economic Facilities", and so on. Nurkse elaborated the concept of overhead capital. According to him "overhead investment aims at providing the services – transport, power, and water supply, which are basic for any productive activity, cannot be imported from abroad, required large and costly installations and in the history of western economics outside England, have usually called for public assistance or public enterprise. Typically overhead investments take a considerable time to reach maturity in growing. To be sure, all investments depend on expectations but the time range of expectations is opt to be particularly long in overhead projects because of their lumpiness combined with their high operational capital intensity. Other development economists like Rostow and Hirschman have also used the word of social overhead capital. (Nurkse, 1961)

W. W. Rostow (1960) in his 'Theory of Stages of Growth' According to him SOC is a pre-condition for take-off into self-sustained growth. Investment in SOC and development of those services encourages potential entrepreneurs to invest in risk bearing business. Those SOC prepare the base for expansion of economic activities by decreasing the cost and increasing the profitability of productive activities. It also helps in the creation of an educated labour force, superstructures of communication networks, and mechanism to provide energy, basic civic amenities and law and order. According to Rostow, "All these create an atmosphere that breeds entrepreneurial capabilities and sustains a climate which is throbbing with economic activities and optimistic decision." Consequently, he made investments in SOC, especially in the fields of transport and power, one of the main preconditions for take-off. In the precondition to take – off stage the investment in social overhead capital should create literate and technically trained personnel in the working force. They are necessary condition for self-sustaining economic growth.

Hirschman's concept of social overhead Capital (Infrastructure)Comprises of these basic services (include all public services like transportation, communication, power, health, water supply, irrigation and drainage system) without which the primary, secondary and tertiary activities in the economy cannot function. In its wider sense, it includes all public services from law and order through education and public health to transportation communications, power and water supply, as well as such agricultural overhead capital as irrigation and drainage system. The hard core of the concept can probably be restricted to transport and power.(Hirschman ,1958):According to the theory of unbalanced growth by Hirschman no LDC has a sufficient endowment of resources as to enable it to invest simultaneously in all sectors of the economy in order to achieve balanced growth. Hirschman maintains that investments in strategically selected industries or sectors of the economy will lead to new investment opportunities and so pave the way for further economic development. He stresses that development to take place a deliberate strategy of unbalancing the economy should be adopted. This is possible by investing either in social overhead capital or indirect productive activities. Investments in social overhead capital are advocated not because of its direct effect on the final output, but it permits and invite DPA to come in some SOC is required as a prerequisite of DPA investment.

"Let us build railways, roads, canals, hydroelectric power-stations, the rest will follow automatically." where the lack of transport facilities is a flagrant obstacle to economic progress, as for instance, in China and parts of Latin America, that may indeed be the best start of

development investment. If sufficient capital is available for investment in basic industries the normal Multiplier effect will "naturally" lead to further industrialization. Hansen (1965), in looking at the role of public investment in economic development, divides public infrastructure into two categories Economic Overhead Capital (EOC) and Social Overhead Capital (SOC). EOC is oriented primarily toward the direct support of productive activities or toward the movement of economic goods and includes most of the public works projects listed above. SOC is designed to enhance human capital and consists of social services such as education, public health facilities, fire and police protection, and homes for the aged. Other classifications of public infrastructure include investments by the private sector. Hansen theorizes that the potential effectiveness of economic overhead capital will vary across three broad categories of regions: congested, intermediate, and lagging. Congested regions are characterized by very high concentrations of population, industrial and commercial activities, and public infrastructure. Any marginal social benefits that might accrue from further investment would be outweighed by the marginal social costs of pollution and congestion resulting from increased economic activity. Intermediate regions are characterized by an environment conducive to further activity an abundance of well-trained labor, cheap power, and raw materials. Here, increased economic activity resulting from infrastructure investment would lead to marginal social benefits exceeding marginal social costs. Lagging regions are characterized by a low standard of living due to small-scale agriculture or stagnant or declining industries.

The Economic situation offers little attraction to firms, and public infrastructure investment would have little impact. Kindleberger and Herric (1973) however, while defining infrastructure introduced two more concepts such as Economic Overhead Capital (EOC) and Strictly Social Overhead Capital (SSOC) which are two different components of Social Overhead Capital. According to them EOC are nothing but public utilities in the form of transport, communication, road, railways, electricity, etc. whereas SSOC includes the plants and equipment's required for providing services in the form of education, health and housing.

According to development economist Michael P. Todaro (1981) Emphasis capital accumulation including all new investments in land, physical equipment and human resources, results when some proportion of present income is saved and invested in order to augment future output and income. New factories, machinery equipment's and materials increase the physical "capital stock" of a Nation (i.e. the total "net" real value of all physical products capital goods) and make it possible for expanded output levels to be achieved. These directly productive investments are

supplemented by investments in what is often known as social and economic “Infrastructure” roads, electricity, water, and sanitation, communications etc. Which facilitate and integrate economic activities for example investment by a farmer in a new tractor may increase the total output at the vegetables he can produce, but without adequate transport facilities to get this extra product to local commercial markets, his investment may not add anything to national food production.To sum up all the above economists views on infrastructure in the form of overhead capital or overhead costs. This was the theoretical base of socio economic infrastructure of the economy.

2.3 Contribution of Infrastructure

Contribution of Infrastructure’s on Economic Development-An Overview

Infrastructure contributes to economic development both by increasing productivity and by providing amenities which enhance the quality of life. The services generated by infrastructure investment lead to growth in the production of firm in two ways:

(i) infrastructure services, such as transport, water, and electricity, are intermediate inputs to production, and any reduction in these input costs raises the profitability of production, thus permitting higher levels of output, income, and/or employment;

(ii) infrastructure services raise the productivity of other factors labour and other capital)-for example, by permitting the transition from manual to electrical machinery, reducing workers' commuting time, and improving information flows through electronic data exchange. Infrastructure is thereby often described as an "unpaid factor of production", since its availability leads to higher returns obtainable for other capital and labour. The existence of infrastructure in a given location may attract flows of additional resources ("crowding-in" private investment); this can lead to reduced factor costs and transaction costs at that site. The resulting "economies of agglomeration" are the great advantage of urbanization. However, when the available infrastructure becomes congested or begins to create a predominantly negative impact on the environment, the quality of services declines and their contribution to productivity suffers. Both effects contribute to economic growth by stimulating aggregate supply as well as demand.

The consumption of infrastructure services by households contributes to economic welfare because many of these services, notably clean water and sanitation, are essential for health and create environmental amenities; others (e.g., recreational transport, residential telecommunications) are valued items of consumption in their own right. These services also provide access to jobs, education, and opportunities for consumption of other goods. Thus,

reductions in the cost and improvements in infrastructure services to households can have the beneficial effects of increasing their real income and consumption, raising the productivity of their labour, and freeing time of individuals for higher-value activities-analogously to the benefits realized by firms.

It is worth emphasizing that all of the above contributions of infrastructure to economic growth and the quality of life, which are long recognized in economic theory, derive not from the mere existence or creation of the physical facilities but from their operation and the value of the services generated. Yet very little of the empirical research which has attempted to establish the linkages between infrastructure and economic growth examines the infrastructure variable directly in terms of characteristics of a flow of services (such as the actual availability, diversity, quality, reliability, and price of services obtained by users).

There is also a set of important economic effects which do occur specifically from the flows of expenditure on Investment In infrastructure, as opposed to the operation or generation of service. The Jim Is the multiplier effect of the expenditure on wages and inputs used in the construction of physical infrastructure facilities, and the derived demand thus generated for the output of other sectors. Under certain conditions (such as where markets are rigid and factors not mobile), the pressures generated by infrastructure investment may "crowd out' private investment by bidding up the cost of labour and inputs. The second linkage concerns the way in which the infrastructure is financed. Expenditure on infrastructure investment affects the availability of financial capital for other uses; it may also affect fiscal balance and external creditworthiness, and therefore macroeconomic stability.

How Can the Potentially Favourable Outcomes of Infrastructure Activities be Achieved?

The positive impacts from infrastructure indicated above derive not primarily from the investment in the physical facilities, but from the services generated. Four conditions are necessary to realize these impacts on economic development:

The basic macroeconomic climate should be conducive to an efficient allocation of resources; this reduces the potential for investment in infrastructure to take resources away from ('crowd-out") other more productive investment.

Economic growth is an increase in the productive capacity of a country identified by a sustained increase in real GDP over a long period of time. Economic development and growth are both economic concepts which are related. Dudley Seers (1969) emphasized that economic development should not be equated to growth, as it embodies qualitative aspects such as, reduction and elimination of poverty and inequality. Todaro (1989) widened the scope of economic development to be conceived of asa multi-dimensional process involving major changes

in social structures, popular attitudes and national institution, as well as the acceleration of economic growth, reduction of inequality and the eradication of absolute poverty". Defining economic development as such result to potential factors which are qualitative and difficult to quantify (Jomo and Reinert (2005).

The contribution of infrastructure on long-run economic growth has been studied extensively. The basic theoretical framework of the contribution of public capital on economic growth was developed first by Arrow and Kurz (1970). Based on this framework, the endogenous growth literature shows that an increase in the stock of public capital can raise the steady state growth rate of output per capita, with permanent growth effects (Barro 1990, 1991, and Barro and Sala-I-Martin, 1992). Other studies focus on the differential contribution of capital and current components of public spending on growth (Devarajan et al., 1996), showing a positive effect from capital expenditures and often negative effects from current or consumption expenditures. The body of empirical literature on infrastructure and its link to economic performance has adopted various estimation methodologies on a variety of data (panel and time series data) and measures of infrastructure.Aschauer (1989). A majority of the literature finds a positive impact on the relationship between infrastructure and output, growth, or productivity. However, the results largely depend on the measures of infrastructure employed in the analysis. The empirical literature uses various measures of infrastructure such as physical units of infrastructure, stocks of public capital, and infrastructure spending flows.Sanchez-Robles (1998) . Straub (2008) claims that the positive effect of infrastructure on growth is often obtained when physical indicators of infrastructure are used. The results are not so clear when infrastructure spending flows are used as proxies for infrastructure. This might be due to the fact that political and institutional factors (i.e. inefficient government) (not the level of infrastructure investment) often affect the level of infrastructure stocks.

2.3. INFRASTRUCTURE DEVELOPMENT AND ECONOMIC GROWTH LINKAGE

Provision and maintenance of adequate infrastructure facilities are absolutely necessary if rapid economic growth is to be achieved and sustained. The availability of infrastructure like power, telecommunication and transport is absolutely vital for accelerated development and modernization of a country. "The link between infrastructure and development is not a once for all affair, it is a continuous process and progress in development has to be preceded, accompanied and followed by progress in infrastructure, if are to fulfil our declared objectives of self-accelerating process of economic development." (Dr. V. K.R.V. RAO).An infrastructural facility

both economic and social constitutes the core of development strategy and efforts. Efficient and affordable infrastructural services are key bone to the higher productivity and output growth. Energy, transportation, electricity, telecommunication, availability of skilled labours, technical and general education, health facilities, agricultural and rural infrastructure like rural roads, irrigation facilities, fertilizers and pesticides, credit facilities, availability markets all the social and economic infrastructure services are made positive and strong impacts on output growth of as well as eliminates the poor performance the different sectors of the economy. Fedderke.Et al (2006)

The linkage between infrastructure and economic growth is multiple and complex, because not only does it affect production and consumption directly, but it also creates many direct and indirect externalities, and involves large flows of expenditure thereby creating additional employment. In this framework infrastructure affects output in two ways. One is the direct channel where infrastructure increases the output by reducing the cost of intermediate goods. The other channel is through externality effect. This channel works through higher human capital returns due to education, good quality health and higher efficiency of human capital due to lower marginal depreciation of capital. The experience across the world has shown that increase in stock of infrastructure is associated with the increase in output and the quality of life of the people. Fulfil and achieve the objective of economic and non-economic dimensions of the development especially the standards of living and quality of the life of the people is directly depends on the availability infrastructural facilities. Progress in the developing countries will require a combination of three elements: maintaining high rates of growth in incomes; modifying the pattern of growth so as to raise the productivity and incomes of the poorer sections of the population; and improving the access of the poor to essential public services. The poor suffer not only from low incomes but also from inadequate access to public services essential to their health and productivity. As many of these services, such as sanitation and water supply, cannot be privately purchased, an expanded public program for wider distribution of services must be an important element of strategies to alleviate poverty. Evidence and analysis shed some light on the magnitude of the impact of infrastructure on economic development, defined in these ways. (Dr.B.Srinivasu &P.Srinivasa Rao, Jan 2013)

World Development Report (1994) on the vital role of infrastructure in growth has been reinforced by subsequent research for example on Africa's economic performance. Not only does development of infrastructure services contribute to growth, but growth also contributes to

infrastructure development, in a virtuous circle. Moreover, investments in human capital and in infrastructure interact, each increasing the returns to the other. identified the various channels through which investment in infrastructure can contribute to growth. These are:

- Reducing transaction costs and facilitating trade flows within and across borders;
- Enabling economic actors individuals, firms, governments to respond to new types of demand in different places;
- Lowering the costs of inputs for entrepreneurs, or making existing businesses more profitable;
- Creating employment, including in public works (both as social protection and as a counter-cyclical policy in times of recession);
- Enhancing human capital, for example by improving access to schools and health canters; and
- Improving environmental conditions, which link to improved livelihood
- Better health and reduced vulnerability of the poor.

2.4.Types of Infrastructure

One way of organizing the assessment of the drivers of infrastructure priorities is suggested by Estache and Garsous (2011). Infrastructure could depend on:

- the time period over which the impact is assessed, and
- the type of infrastructure

A, **On the time dimension**

As too often in economic research, the importance of very basic facts and assumptions for the extent to which a conclusion can be generalized tends to be underestimated. One such characteristic is the relevance of the time period analyzed. The older the studies on a given country or regions, the more like they are to cover time periods in which the stock of infrastructure was lower and hence any improvement would have a higher payoff. This is the case for Spain or the US for instance (EstacheFay (2010). But this is just another way of validating the point that the stage of development matters. Indeed, infrastructure mattered a lot more to Spain in the 60s when it was simply trying to catch with the more advanced parts of Europe. This is what the old studies picked up. More recent studies, include time periods as of which, the gap has closed and the payoffs to additional infrastructure are still positive, but simply lower. Estache (2011) provide a somewhat more subtle argument to explain the relevance of time. Ceteris paribus, studies covering a longer period are more likely to find a positive impact of infrastructure

on output or growth. This result should not be surprising. Infrastructure has an unusual cash flow profile, with high short-term costs and slow but long income flows. Therefore, for a given project and discount rate, the longer the analysis, the more likely a positive impact assessed on GDP, growth and, in facts, jobs. Even if these arguments seem robust, the hard evidence continues to raise questions. It is intriguing that many of the studies covering the fifties and eighties were more likely to find a positive impact of infrastructure. The opposite is true for many of the studies covering the sixties and the seventies. Clearly, other factors matter as well. For instance, Albala-Bertrand and Mamatzakis (2004) show for Chile that infrastructure impact became higher after liberalization.

B, On the type of infrastructure

This explains for instance why the growth impact of the telecoms sector so often come out to be high. But for specific countries or regions, this could also be true for transport or electricity. In general, however, all infrastructure subsectors can be good examples of sectors in which such network externalities can matter. Their social return will however evolve with time, with stock size and with market size. This section reviews the main lessons available on each subsector on the growth impact of each infrastructure subsector.

- **Energy:-** The importance of access to electricity to human development has been documented in a large number of case studies and cross-country econometric studies across regions. It is a recurring item in all studies on the impediments to the business environment. (see Dethier et al. (2008 et al.) for instance). Among these studies, those focusing on developing countries all find a positive impact of energy infrastructure on output/growth. In fact, in his survey, Garsous (2012) finds that, ceteris paribus, studies focusing on the energy sector are more likely to find a robust positive impact than any other infrastructure sector. In other words, investing in the energy sector may be the safest bet to achieve a high social rate of return. This should not be a surprise, energy is indeed an input into any of the other infrastructure subsectors—for instance, water is often pumped thanks to electric pumps.
- **Telecommunications**:- The impact of telecoms for growth may be the best documented impact. To a large extent, it is because telecoms data is relatively easy to access, including for developing countries. Zhan-Wei Qiang and Pitt (2009) and Chakraborty and Nandi (2011), more recently, survey this literature. But it continues to grow.4 Most studies find a positive impact of telecommunication infrastructure on GDP, on growth—and also on labor productivity. As with other infrastructures, there is a debate on the precise magnitude of its contribution. But this is quite normal, the interdependency between fixed and mobile

telephone for instance still requires a significant amount of regulation of access. Its effectiveness strongly drives the social return of return for the sector.

The IMF has produced a few working papers on the topic. The latest one is by Andrianaivo and Kpodar (2011) focusing on the growth effect of ICT in Africa and it features a interesting focus on the impact of mobile telephony and financial inclusion.

- **Transports**:- For developed countries, the estimated growth effects of transport investments have not been very strong. This has been a common finding in research over the last 20 years or so. This is not surprising since their transport stocks are mature. The main impact at advanced stages of development has to come from quality, from addressing bottlenecks or from capturing new network or separational effects which have not been internalized in older designs of the transport networks. For developing countries, the picture looks quite different. Whatever the GDP growth related focus, most cross-country studies find a positive impact. For instance, roads are needed for Africa to catch with the rest of the world (Buys et al. (2006). Roads are essential to reduce differences across regions within countries (Estache–Fay (2010). Port quality is central to the evidence collected on the gains from trade facilitation for instance. In the case of APEC countries, Wilson et. Al (2003) for instance found that increasing port capacity for countries below capacity average could increase APEC average per capita GDP by 4.3%.

Road infrastructure is at the heart of the society. Individual mobility is essential for most working and leisure activities. Modern mobility is an expression of lifestyle and social form and is essential for the economy. Road infrastructure is synonymous with the essential to develop and has a significant impact in term of poverty alleviation as they provide the poor with the better physical access to employment (Papi&Attane, 2001).

2.5. Empirical Study

Yoshida (2000) presented a positive analysis from various angles of the correlations between economic growth and the infrastructure in Japan, such as the energy, electricity, and transportation sectors over the last century in order to derive lessons that can be useful to developing countries. He divided Japan's economic development phase into five with major characteristics, and discussed the patterns of demand and investment in infrastructure over one century. He found out that the growth rate of demand in infrastructure was much higher than that of per capita GNP in the early stage of development, and public investment in infrastructure was big. He also found that infrastructure investment in rural areas had a trend to correct the regional income disparities. He insisted that the lessons learned from Japan's development experience are a major intellectual asset for developing countries. He emphasized that developing countries expect Japan and Korea, (former developing countries), to take reasonable leadership in international aid.

World Bank, (1994) reported that there was a close relationship between road infrastructure and economic growth in Asia and in many case studies, such as those on the direct and indirect economic impact of infrastructure in farming sector in India. In the case of China, the coverage of intercity transport networks is one of the thinnest in the world. China's transportation investments amounted to only 1.3 percent of GNP annually during 1981-90, a period of rapid growth in transportation demand. Since the onset of China's open door policy in 1979, economic growth averaging 9 percent a year has resulted in an unprecedented expansion in intercity traffic with growth averaging 8 percent a year for freight and 12 percent a year for passengers.

Sheng-Tung et al (2007) revealed that a sufficiently large consumption of electricity can ensure a high level of economic growth. Their work was based on 10 Asian countries. Sharif (2012), in his work investigating causality between economic growth, electricity consumption, exports and remittance, revealed that there is a positive and significant long run effect of electricity consumption on economic growth in South Asian countries. Therefore the researcher found that it necessary to use an annual time series data for electricity consumption in Ethiopia. Solarin (2011) reveal that electricity consumption is positively related with the real GDP in the long run.

SRIDHAR et al (2007) investigated empirically the relationship between telephone penetration and growth using data for developing countries. They concluded that telephone penetration has a positive impact on growth in developing countries. Roller and Waveman (1996) traced how telecommunication infrastructure affects economic growth in 21 OECD countries over the past twenty years. They concluded that there exists a positive causal relationship. Keck and Calvin (2006) studied the liberalization of telecommunication services and their impact on growth in Africa.

Aschauer(1989) found that the output elasticity of public capital is very high, ranging from 0.38 to 0.56. Further, he suggests that lack of infrastructure spending leads to slowdown of productivity growth in the US. Aschauer (1989) uses annual macroeconomic time series data for the US spanning the 1949–1985 period and estimates the public sector capital to be at least twice as productive as the private sector capital in the aggregate. Supporting Aschauer, Munnell(1990) find high output elasticity, though comparatively lower than Aschauer's, of public investment on infrastructure.

To overcome the aforesaid limitations, Sahoo and Saxena (1999) estimated a Cobb-Douglas production function to measure the elasticity of various stocks of infrastructure with respect to output. Various stocks of infrastructure like railways, other transport, electricity, gas and water supply, communication and storage facilities along with total employment were included as inputs in the model, whereas gross domestic product at factor cost was considered as output. The transport, electricity, gas, water supply and communication sectors were found to be positively related to output, whereas storage was found to be inversely related with output. All the variables were non-stationary at levels and were first-differenced stationary or I(1). The existence of a long-run relationship was validated by using cointegration analysis in a multivariate framework. From the cointegrated model it was also found that there exists increasing returns to scale.
The time series model estimated through the cointegration approach, however, just establishes the long-run relationship between output and various stocks of infrastructure. The cointegration approach also does not talk about the historical behaviour of the series and has poor predictive power.As (Sargan (1964)VECM model is used in this study this approach enables the long run equilibrium relationship and the short-run dynamics to be estimated simultaneously (Gujarati, 2003)

In the Ethiopian context, researches are scarce. According to Teklebirhan Alemu (2015), physical public infrastructure investment has a crowding in effect on private investment and shows significant positive impact on output growth, and above stimulate private investment both in the short and long run. Admasu Shiferaw et.al, (2013), in his study on road infrastructure and enterprise development dynamics showed that better road access increases a town's attractiveness for manufacturing firms. The study also confirms towns with initially large number of firms continue to attract more firms, and there is a tendency towards convergence in the distribution of firms through reducing their geographic concentration. YetnayetAyalneh (2012), in evaluating transport network structure in Addis Ababa identified there is inadequate levels of infrastructure in parts of the current road network, particularly, the peripheral areas suffer from lack of roads and roads in the central areas have capacity limitation. Generally, the brief review suggests that the effect of public capital or infrastructure differs across countries, regions, and sectors depending upon quantity and quality of the capital stock and infrastructure development.

BirukBirhanu(January 2017), working on the relationship between infrastructure development and economic growth and investigated for Ethiopia during the period 1974/75-2014/15, and analysed the long run and short run dynamics between these variables the study applied ARDL; bounds tests, and ECM.in his study long run estimation shows both economic and social sector infrastructure development have a positive impact on economic growth. the short run dynamics shows the speed of adjustment is too slow, only 6% disequilibrium corrected each year towards the long run path.

This paper provides an empirical result on how infrastructure contribute growth and development in the Ethiopia context. How infrastructure plays a dynamic role to fulfil the growth targets. It provides insight for government in building infrastructure facilities from stimulating growth point of view.

2.6. Conceptual Frame Work

Infrastructure investment generally has two types of effects. First, it has demanded creation effect in other economic activities which is flow impact. Second, it has stock impact which makes better availability of services and improves productivity of the private sector and the economy as a whole. Therefore, infrastructure development contributes to investment and growth through increase in productivity and efficiency as it links between resources to factories, people to jobs and products to markets. But many of the benefits of infrastructure services accrue to firms – in France, for example, that input-output tables reveal that firms consume two-thirds of all infrastructure services (Prud'homme 2004)5.Thus it is through this channel that costs are lowered and, most importantly, market opportunities are expanded(especially through telecommunications and transport). The resulting gains in competitiveness and production are what drive the gains in economic growth and ultimately welfare.

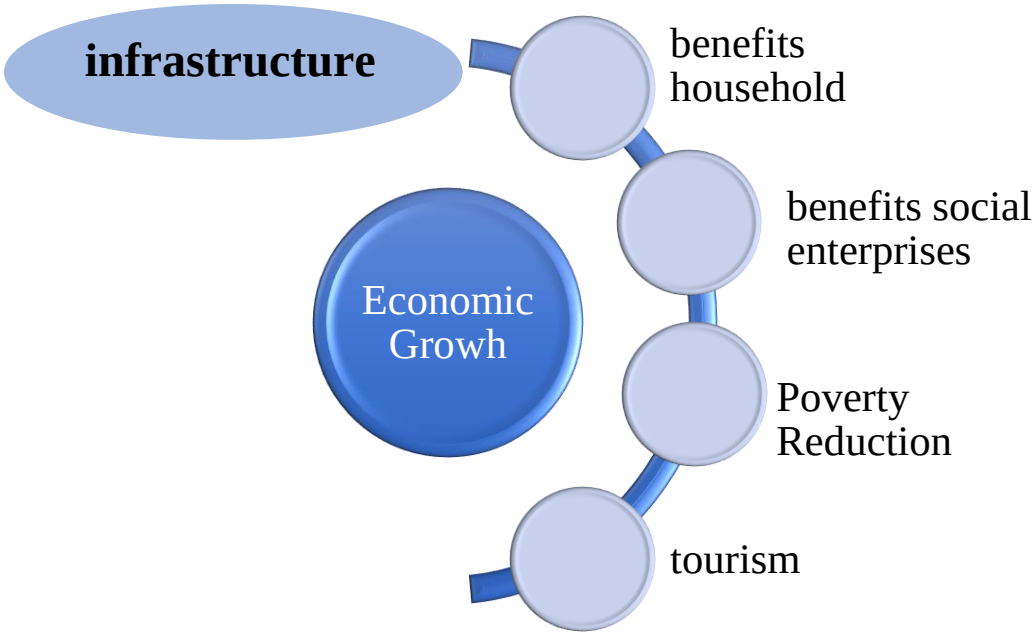

Figure 1 ***Error! Bookmark not defined.****: conceptual frame work*

CHAPTER THREE

3,0 RESEARCH METHODOLOGY

3.1. Data types, Sources and methods of collection

As economic growth is a dependent variable on this thesis, the Ethiopia PCGDP is obtained from 1981-2010. The amount of investment put on infrastructure were collected from MOFED , NBE , WORLD BANK , and ERA.

The study used secondary data. The data spanning from the years covering the 1981-2010E.c period used . This study conducts the empirical analysis by employing data sets for this period.

3.2. Method of Data analysis

Cointegration is used to establish the long run relationship between infrastructure and economic growth of Ethiopia. OLS estimator used to estimate the independent variables

The data analysed by using Stata software. After the relevant data were collected descriptive method of data analysis used. The analysis indicates transformation of raw data in to a form that makes easy to understand and interest it.

3.2.1. Unit Root and Co Integration Tests

The researcher used the Augmented Dickey Fuller test (ADF) to find out the degree of differencing required to induce stationarity. First, the researcher test for unit roots in levels and the results are not shown.

3.2.1.1. Unit root test

According to Cheung and Lai ,(1999)and Pedroni,(1998a) there are considerable evidence for presence of unit roots in PCGDP time series data as such there was need to make the data stationary. There are various statistical ways of testing for unit roots of time series data; specifically the researcher employed the Dickey-Fuller (DF) and Augmented Dickey-Fuller (ADF) test. Since it is a common characteristic of time series data to be integrated of order one (Gujarati, 2003 pp822).

Null (HO):- variable is not stationery or got unit root

Alternative (H1): stationery

$$\Delta y_t = \alpha + \mu_t + (B-1)y_{t-1} + \sum_{t=1}^{P} \gamma_i \Delta y_{t-i} + \varepsilon_t$$

3.2.1.2. Co-integration

The idea of cointegration is to take care of the non-stationarity of the variables and confirm whether there exists a long-run equilibrium relationship. It's important to note that expenditure on road infrastructure comes as a result of diversion of funds from directly productive capital investment, as such there was need to determine the growth maximizing level of road coverage to bring about sustainable growth in the economy.

(Granger,1986) states that' a test for cointegration can be thought of as a pre-test to avoid 'spurious' situations, from the economic point of view at exploring whether variables have an equilibrium or a long run relationship (Gujarati, 2003). In an attempt to determine whether there exists equilibrium between road infrastructure and national income .

3.2.1.2.1. Tests of Co-integration

Tests for cointegration identify stable, long run relationships between sets of variables. However, if the test fails to find such a relationship, it isn't proof that one doesn't exists-it only suggests that one doesn't exist.

Two of the most popular tests are:

- Engle granger

Engel and Granger (1987) proposed a testing procedure for the null hypothesis that there is no cointegration relation and, therefore, the residual process is non-stationary against the alternative of co-integration, the process is stationary. It requires running a regression and testing for unit root in the residual. This can be done using the ADF test on the OLS residuals, applying appropriate critical values. If the unit root hypothesis is rejected, the hypothesis of no cointegration is also rejected. In this case the static regression gives consistent estimates of the cointegration vector. In the second stage, we could combine the error term with the first difference of the variable to estimate the final model which is called the error correction model (ECM).

This shows the deviation from equilibrium position and how an adjustment towards the equilibrium is made by combining both the long-run and short-run versions of the model in one regression.

According to Alemayehu et al., (2011), the basic problems with this approach are:

1. The residual based test tends to lack power because it does not exploit all the available information about the dynamic relationship of the variables

2. There is no unique vector when we have more than two variables in an equation

3. It is possible to have more than one cointegration relationship between the variables For these reason the researcher will applies the alternative approach; the Johansen Approach proposed by Johansen (1988).

- The Johansen Approach

This approach allows us to estimate and test for the presence of multiple cointegration relationships. In this method there is no a priory separation of variables into endogenous and exogenous variables. The VECM model is formulate to determine cointegrating vector in Johansen procedure.

Null HO:- there is no cointegration

Alt : there is cointegration among variables

TRACESTATISTIC

$$(\eta_r) = -T \sum_{i=r+1}^{M} \ln[1 - \lambda_i]$$

3.3. Model Specification

Cobb Douglas production function model used by Pravakar et al (2010). They extended their model by including an infrastructure index (It) computed using the principal component approach. From the general model, the major problem is that their work cannot bring out the specific role played by any of this four economic infrastructure indicators used to compute the infrastructure index that can help the government to undertake specific policy recommendations.

To investigate the relationship between infrastructure and economic growth, this paper used the Neo-Classical Growth Model developed by Solow et.al (1956) .assuming a generalized Cobb Douglas production function and extending this Neo-classical growth model to include some selected infrastructure indicators as additional inputs of the production function, alongsidewhich is given by:

PCGDP=$f(EPC, AT, TS, RO)$…….(1)

Generalized model in the equation(1) in the form of linear regression model

$$\text{PCGDP}=\alpha 0 + \beta\,1\, EPC + \beta 2\, AT + \beta 3\, TS + \beta 4\, RO + \varepsilon t$$

Where ;-

$\alpha 0$ is the constant term, $\beta 1, \beta 2, \beta 3, \beta 4$ are parameters of the independent variables and εt stochastic error term. It is expected that $\beta i > 0$.

PCGDP = PER CAPITA Gross Domestic Product

EPC = Electric production from hydroelectric

AT= Air Transport, Freight million tons per kilometre

TS=Telephone line per 100 population

Ro = paved roads as percentage of total roads

εt=error term

3.4. Estimation Technique

- **Stationarity and Non-stationarity of Variables**

In this study, time-series data of macroeconomic nature are used for the estimation of the model and thus the data generating processes exhibit trends and volatility which could result in a non-stationary issue. Stationarity in time-series data refers to a stochastic time series that has three characteristics; the variable over time has a constant mean, the variance of a variable over time is constant, covariance between any two time periods is correlated. If one or more of these criteria is violated, then the data generating process of the time-series data is a non-stationary series (Gujarati 1995). The usage of ordinary least squares (OLS) methodology on time series data usually requires that the data be stationary to avoid the problem of spurious regression. To establish the order of integration of a series, unit root tests are performed. The most common unit root test, the Augmented Dickey-Fuller (ADF) is used in this study. The following decision rule is used;

- If the ADF test statistic is greater than the test critical value in absolute terms, then the series is stationary.
- If the ADF statistic is less than the test critical value in absolute terms, the series is non-stationary.

If the series is non-stationary at level form, then the test is carried out successively on the differenced series until it becomes stationary. The order of integration is then established. From preliminary test, all variables in the equation are found to be non-stationary at level form I(0) but stationary at first difference I(1), then the cointegration test is conducted to find the existence of a long-run (L-R) equilibrium relationship. If the variables confirm the existence of cointegration, then the conventional Vector Error Correction Model (VECM) is

estimated using OLS, confirming short run dynamics and long-run equilibrium, as an error correction term is constructed to estimate for coefficients.

- **Co-integration**

If two variables are co-integrated at the first differenced order I(1), their relationship can be expressed as the error correction model (Granger & Weiss (1983), Engle &Granger (1987)). Cointegration refers to the existence of long-run equilibrium relationship between two or more time series variables which are individually non-stationary at their level form but stationary after difference (Gujarati (1995)). The theory of cointegration can therefore be used to study series that are non-stationary but a linear combination of which is stationary. The Engle and Granger cointegration test is not used since it's a two steps approach which is valid only when we study the relationship between two variables. In multivariate time series like our case, we can have more than two cointegrating equations which can only be depicted by the Johannsen's cointegration test. As such, the Johansen cointegration test will be used in this work given its ability to dictate more one cointegration relationship among variables.

- **Vector Error Correction Model (VECM) of Real Gross Domestic Product**

Initially, VECM was devised to describe a relationship between the short-run dynamic and the long-run equilibrium (Sargan (1964). Granger and Weiss (1983) and Engle and Granger (1987) pointed out that if two variables are cointegrated at the first difference order, their relationship can be expressed as the VECM by taking past disequilibrium as explanatory variables for the dynamic behaviour of current variables (Maddala and Kim 1998). Some studies compile, in a single model both the short and long run variables (e.g. Fielding, 1997, Agrawal, 2001). For that, an Error Correction Model (ECM) can be used. This approach enables the long run equilibrium relationship and the short-run dynamics to be estimated simultaneously (Gujarati, 2003). This type of technique helps to correct the potential bias in the estimation of the coefficients in models with differences that do not take into account cointegration relationships. When these long-term restrictions are ignored, there could be an omitted variable bias (Gujarati, 2003).

Harris (2000), summarises the four desirable features of ECM as follows:

- it avoids the possibility of spurious correlation among strongly trended variables;
- the long-run relationships that may be lost by expressing the data in differences to achieve stationarity are captured through inclusion of lagged levels of the variables on the right-hand side;

- the specification attempts to distinguish between short-run (first-differences) and long-run (lagged-levels) effects; and
- it provides a more general lag structure, and does not impose too specific of a structure on the model.

The VECM used in this work is specified as:

$\Delta PCGDP_t = \alpha O_t + \Delta B_1 EPC_t + \Delta B_2 AT_t + \Delta B_3 TS_t + \Delta B_4 RO_t + B_5 EPC_{t-1} + B_6 AT_{t-1} + B_7 TS_{t-1} + B_8 RO_{t-1} + \varepsilon_t$

Where; Δ represents the change in the variable, ε_t stochastic error term, is the coefficient of the error correction term which shows the speed at which short run dynamics are adjusted to long run equilibrium.

- **What is Serial Correlation / Autocorrelation/**

Christopher & mark, July 2013 described Serial correlation (also called Autocorrelation) is where error terms in a time series transfer from one period to another. In other words, the error for one time period *a* is correlated with the error for a subsequent time period *b*. This can result in a myriad of problems, including:

Inefficient Ordinary Least Squares Estimates and any forecast based on those estimates. An efficient estimator gives you the most information about a sample; inefficient estimators can perform well, but require much larger sample sizes to do so.

- Exaggerated goodness of fit (for a time series with positive serial correlation and an independent variable that grows over time).\Standard errors that are too small (for a time series with positive serial correlation and an independent variable that grows over time).
- T-statistics that are too large.
- False positives for significant regression coefficients. In other words, a regression coefficient appears to be statistically significant when it is not.

Null(HO): autocorrelation at lag order

If the p-value < 5% significance we accept the null or if the p-value > 5% significance we reject the null.

- **Model stability**

Coefficients may change over time

- the Evolution of the economy
- Policy changes.

Time-Varying Parameters

$$y_t = \alpha_t + x_t\beta_t + e_t$$

- Coefficients depend on the time period
- If the coefficients vary randomly and are unpredictable, then they cannot be estimated
  - As there would be only one observation for each set of coefficients or

    We cannot estimate coefficients from just one observation!

CHAPTER FOUR

RESULTS AND DISCUSSION

4.1.Infrastructure Performance in Ethiopia

A, Air Transport

Ethiopia is endowed with an immense tourism potential owing to its natural, cultural and historical. However, Ethiopia tourism is still at its infant stage. The sector's share to GDP is very small (0.77% in 2008). In 2012, the country earned US $ 462 million (US $ 204.9 million in 2008) from the tourism sector according to the Ministry of Culture and Tourism. Of the 383,399 in 2008 (584,000 in 2012) tourists who visited the country's historical sites 27 percent came from Europe with a significance percentage from Germany, England, France and Italy; 18 percent from the United States; 27 percent from Africa; 9 percent from the Middle East and Asia each. According to the Ministry of Culture and Tourism 86 percent of the 2008 visitors (330,157) arrived by air.

Ethiopian Airlines operates with a fleet of 42 passenger and 6 freighter planes and offers services to 62 international and 17 domestic destinations.

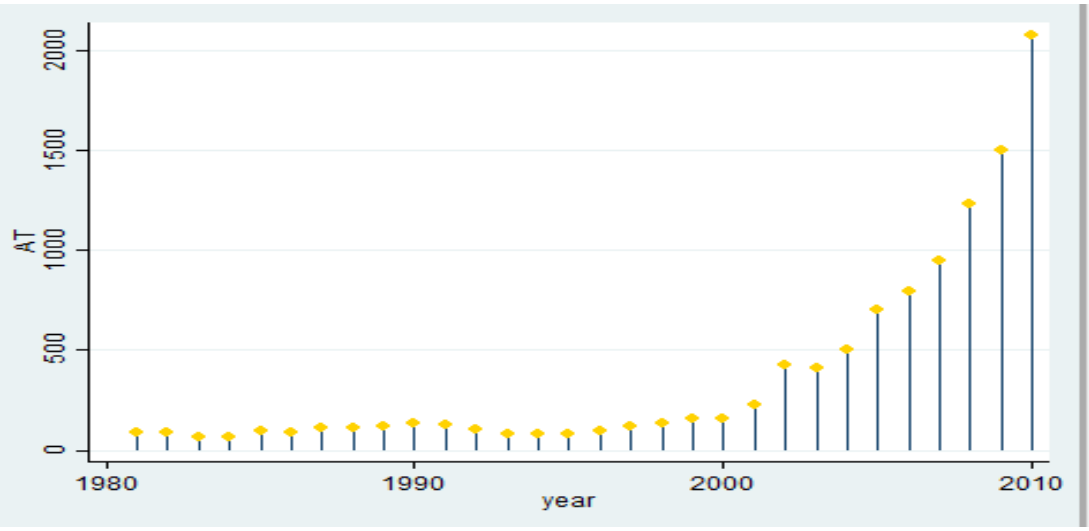

Figure 2 ***Error! Bookmark not defined.****: Ethiopian air freight trend from 1991-2010*

Source:- own computation using world bank data

From fig 1 there was an incremental of air transport, but starting from-2008 the increment of air transport, freight is high.

B, Power

Ethiopia has the potential to become one of the largest power exporters in Africa. Ethiopia is endowed with vast hydropower potential. The long term marginal cost of developing this generating capacity is around $0.04 per kilowatt-hour, significantly below that of neighbouring countries. If there were no barriers to developing and trading Ethiopia's hydropower, the country would have the potential to export more than 26 terawatt-hours of electricity per year. If a profit margin of $0.01 per kilowatt-hour could be obtained from exports, Ethiopia could generate annual net revenue of $263 million for Ethiopia, or around two percent of GDP. (Vivien foster &Elivira morella.2011).

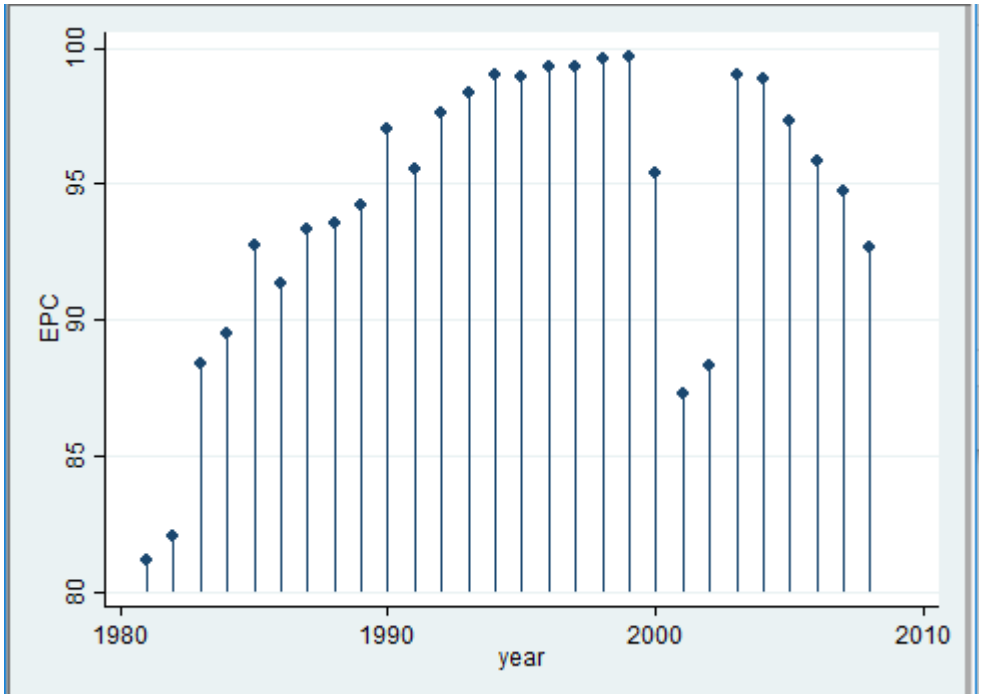

Figure 3 ***Error! Bookmark not defined.*** *:Ethiopian electric production trend from 1991-2010*

Source:- own computation using EPC data

From figure 2: EPC sector from 1984-1999 increasing while starting from 2000-2002e.c showing a decline of production of hydroelectric after 2003 it shows an incremental.

C, Surface Transport

According to World Bank (2010), only 10 percent of the rural population lives within two kilometres of all-weather roads. Thus, the remaining 90 percent of rural people live at a distance of more than two km from all-weather roads.

Rural road accessibility is very low in Ethiopia. According to a GIS-based analysis, only 10 percent of Ethiopia's rural population lives within two kilometres of an all-weather road. This is only half of the benchmark level for low-income countries in Sub-Saharan Africa. Since as much as 76 percent of Ethiopia's population lives in rural areas, this is a high degree of isolation.. (Vivien foster &Elivira morella.2011)

Ethiopian Road Authorities (2011) indicate that, between 1997 and 2011, the road network expanded from 26,550 km to 53,997 km, while the fraction of roads in good and serviceable conditions increased from 22% to 57%. These developments are mainly due to a major public investment program, known as the Road Sector Development Program (RSDP), implemented in Ethiopia over the period 1997-2010 at a total cost of about USD 7.08 billion.

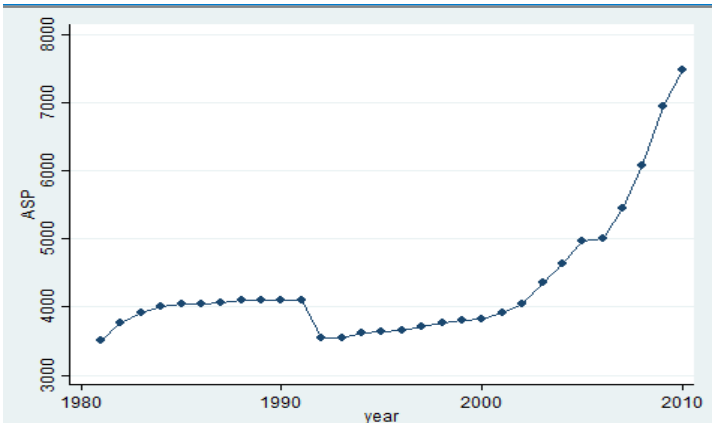

*Figure 4**Error! Bookmark not defined.** Ethiopian road trend from 1981-2010*

Source: own computation using ERA data

Fig.3: shows there was an increase in the length of roads between 1981 and 1989 , it was somewhat constant in the years 1989 to 1991. After, the takeover of EPDRF the government has invested much in construction of asphalt roads. Especially after 2001 there is a significant growth in asphalt road length.

D, Telephone Line

Fixed telephone line consists of manual, automatic, digital, analogue, semi-automatic, Rural Radio Calls (RRC) and Public Switch. In year 2004/05 installed capacity of ETC on the fixed telephone network reached 872,228 lines out of which 857,374 (98.30%) are automatic telephone lines and 14,854 (1.70%) are manual telephone lines. The telephone subscription under all categories of customers i.e. residential, business, government and others has reached 610,347 which is only 69.98% of the installed capacity. The number of main telephone line subscribers in year 2004/05 as compared to that of the previous year has increased by 26.01%. From the total main telephone lines, automatic exchanges cover 604,525 (99.05%) and the rest 5,822 (0.95%) are manual exchanges. Out of the total fixed telephone lines, 74.14% are residential, 16.44% Business, 8.11% government & 1.31% goes to Others (i.e. Embassies & International Organizations).

4.2.DATA ANALYSIS

4.2.1. Unit Root Test at Level Form

Results of Augmented Dicker-Fuller Unit Root Test

We accept the null hypothesis and reject the alternative because the absolute value of test static less than the absolute value of 5% critical value so this model is not stationery got unit root and the model is not acceptable then the author goes to first difference.

4.2.2. Unit Root Test at First Differences

Null HO:- variable is not stationery or got unit root

Alternative H1: stationery

Table 1**Error! Bookmark not defined.**: Results of Augmented Dicker-Fuller Unit Root Test at first differences

	AUGMENTED DICKER-FULLER TEST				
	First Difference I(1)				Order of
Variables	Intercept		Intercept & Trend		Integration
	test statistic	5% critical	test statistic	5% critical value	I(1)

		value			
PCGDP	-3.228	-2.992	-5.184	-3.588	I(1)
EPC	-4.334	-2.994	-4.424	-3.592	I(1)
TS	-4.411	-2.992	-4.512	-3.588	I(1)
AT					

Source: Authors calculations using stata

We reject the null hypothesis and accept the alternative because the absolute value of test static greater than the absolute value of 5% critical value so this model is stationery and acceptable. in this test, the null hypothesis is that the time series is non stationary (1=0 implying a unit root) against the alternative hypothesis of the time series is stationary (1<0) . Hence, rejection of the null hypothesis implies stationarity of the series under consideration. As indicated in Table 1, the ADF test on the levels data series does not reject the non-stationarity hypothesis at 1% and 5% significance levels at 0-lag with constant trend while it does for the first differences of all the variable.

4.2.3. Johansen Tests for Co-integration

4.2.3.1. Trace Test

Null HO:- there is no cointegration

Alt : there is cointegration among variables

Table 2**Error! Bookmark not defined.**: Results of Johansen Cointegration Test Table

Maximum rank	Eigenvalue	Trace Statistic	0.05 Critical Value
0	-	75.2083	68.52
1	0.7271	40.1448*	47.21
2	0.55276	18.4187	29.68
3	0.41375	4.0006	15.41
4	0.1142	0.7263	3.76
5	0.02654		

Source: Authors calculations using stata

At maximum(0) rank or at the null hypothesis we reject the null hypothesis because the trace statistic > greater than 5% level of significance which means that the variables are moving

together in the long run. The maximum rank 1 trace static less than 5% critical means that we accept the null hypothesis that there is one error term because of this vector error cointegration model was used.

After the trace statistic the author also check the maximum eigenvalue and similar results were found.

4.2.4. Maximum Eigenvalue Test

Table 3 : Maximum Eigenvalue Test

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

maximum rank	Eigenvalue	max Statistic	0.05 Critical Value
0	-	35.0635	33.46
1	0.7271	21.7261	27.07
2	0.55276	14.4181	20.97
3	0.41375	3.2741	14.07
4	0.1142	0.7263	3.76
5	0.02654		

Source: Authors calculations using Stata software.

4.3. Results of Vector Error Correction Model

Table 4: Vector error correction model

Vector error correction model

Variable	coefficient	St. Error	Z	p > z	95% CONF. INTERVAL	
D-DFPCGDP	-0.0583	0.0219981	-2.65	0.008	-0.1013699	-0.151388
D-FEPC	-36.106	465.8267	-0.08	0.938	-1011.681	876.8981
DFTS	32.64	465.2936	0.07	0.944	-949.1088	944.6034
D-AT	-0.1573	0.2006723	-0.48	0.433	-0.550635	0.2359854
DFRO	-0.0057	0.0046236	-2.58	0.217	-0.147744	0.0033497

Source: Authors calculations using Stata

The VECM model show that , the error correction terms also known as speed of adjustment is negative and significant , meaning there is a long run relationship between Per capita GDP and explanatory variables .The Error Correction term -0.05825 tells us there is 5.8 percent adjustment to the long run equilibrium annually, at 5% level of significance, and there is no short run relationship running from independent variables(EPC, TS ,AT, RO) to Per Capita GDP since all

variables are 0.938,0.944,0.433 & 0.217 respectively and statistically insignificant at 5% of significance level.

4.4. Auto correlation Test

Table 5 Results of diagnostic test

Lagrange-multiplier test			
Lag	chi2	Df	prob > chi2
1	21.5393	16	0.1587
2	13.5092	16	0.6352

Source: own computation

Null: autocorrelation at lag order

The diagnostic test of the p value greater than 5% significance ,so that we reject the null hypothesis and accept the model. This model has not got autocorrelation and it is desirable model.

4.5. Model stability

Eigen value stability condition

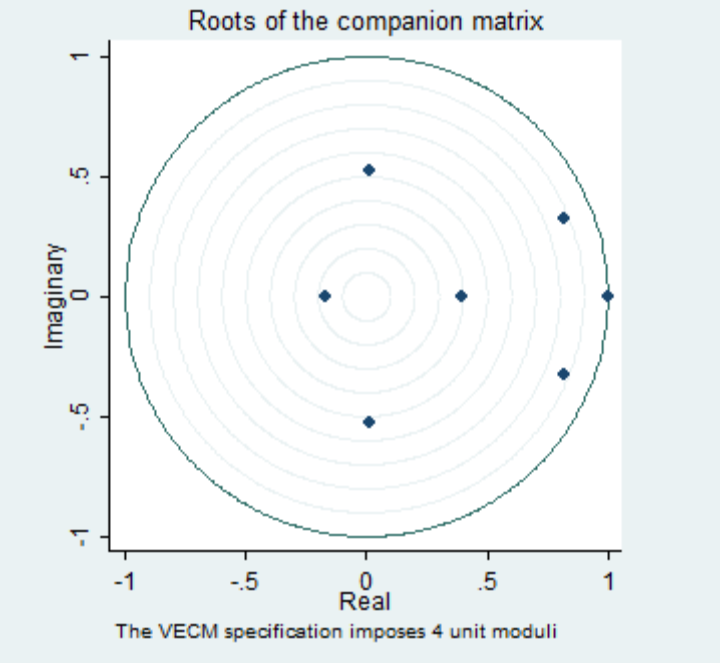

Figure 5 ***Error! Bookmark not defined.*** *Eigen value stability condition*

Source: own computation

L¨utkepohl (2005) and Hamilton (1994) both show that if the modulus of each eigenvalue of the matrix is strictly less than one, the estimated VECM is stable .

Number of obs = 28						
F(4, 23) = 150.01				R-squared = 0.9631		
Prob > F = 0.0000				Adj R-squared = 0.9567		
PCGDP	COEF	STD.Err	T	p>(t)	95% Conf.int	
EPC	0.0129117	0.0594862	0.22	0.0083	-0.000110145	0.001359684
TS	0.0532132	0.0525476	1.01	0.00322	-0.000554899	0.001619163
AT	0.0027471	0.000848	3.24	0.004	0.0009929	0.0045012
RO	0.0000534	0.0000201	2.65	0.014	0.0000118	0.0000951
_cons	1.996531	0.8379194	2.38	0.026	3.729899	0.2631629

All the eigenvalues lie inside the unit circle suggesting that the VECM representation normalized satisfies stability condition.

4.6. OLS ESTIMATION COFFICIENTS

Table 6 OLS ESTIMATION RESULT

Source: own computation

The coefficient of determination, Adj-R-squared (0.9567) show that the independent variables accounted for 95.67 % variations in per capita GDP, the p-value(0.000) of the f statistic indicated that the overall model is significant in explaining the relationship.

The significant positive effect EPC in Ethiopia (0.0129) on economic growth. All independent variables has significance effect on economic growth.

4.7. Discussion on the contribution of the independent variables on PCGDP

Discussion on the contribution of the electricity consumption on the Ethiopia PCGDP

Findings from the result in table 4 , reveal that electricity power consumption has a positive and significance contribution on economic growth in Ethiopia in the long run, when we see the short run causality from EPC to PCGDP the value of the p-value is 0.938 from table 4 which is greater than 5% significance value it tells us there is no short run causality running from EPC to PCGD but it has positive contribution. which answers first specific alternative hypothesis of electricity power consumption has appositive and significance effect on economic growth . This result is equally in line with most of what is found in literature

Discussion on the contribution of the air transport consumption on the Ethiopia PCGDP

Still from the result in table 4, reveal that electricity power consumption has a positive and significance contribution on economic growth in Ethiopia in the long run, which also answers the second hypothesis. however, it has insignificant effect on economic growth in the short run.

Discussion on the contribution of the telephone subscription on the Ethiopia PCGDP

from the result in table 4 , reveal that telephone subscription has a positive and significance contribution on economic growth in Ethiopia in the long run, which answers the fourth alternative hypothesis. This result is equally in line with SRIDHAR et al (2007) which concluded that telephone penetration has a positive impact on growth in developing countries.

Discussion on the contribution of the road on the Ethiopia PCGDP

The finding from the table 4 reveals that construction of road infrastructure which has significance effect on economic growth of Ethiopia in the long run. But it has a positive(-0.0057)& insignificant (0.217) effects on economic growth in the short run. Which answer the third hypothesis.

CHAPTER FIVE

CONCLUSION AND POLICY IMPLICATIONS

5.1. Conclusion

This study investigated the contribution of construction infrastructure on economic growth in Ethiopia, as its main objective from 1981-2011.

To meet the objective of the study, the author used standard theoretical neoclassical growth model, based on a generalized Cobb Douglas production framework with some extensions. The ADF test were used to test for stationarity.

From the above mentioned findings of the study the following conclusions are drawn. Infrastructure on Electricity production , Air transport, Telephone subscription & Road are important contribution to economic growth of Ethiopia.

5.2. Policy Implications

- Given the high and significant coefficient of electricity consumption with respect to the PCGDPin the long run the Ethiopia government better to put in place policies to stimulate electricity consumption, to construct more electric power as it has significant for the Ethiopian economy.
- Incremental on telephone subscription has significant effect on economic growth in Ethiopia in the long run. This is mainly due to increase usage of modern means of communication such as mobile phones and the internet .
- Economic growth is positively affected by air transport and road construction has also significant in the long run.so as to sustain the economic growth of Ethiopia the gov't have to give more emphasis on the needed of infrastructure.

- Based on the finding the study highlights From the policy perspective, greater emphasis is needed on infrastructure development to sustain the high economic growth which Ethiopian economy has been experiencing for the last few years.

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APPENDICES

```
. dfuller d.PCGDP, regress lags(0)
```

Dickey-Fuller test for unit root — Number of obs = 28

	Test Statistic	1% Critical Value	5% Critical Value	10% Critical Value
		Interpolated Dickey-Fuller		
Z(t)	-3.228	-3.730	-2.992	-2.626

MacKinnon approximate p-value for Z(t) = 0.0184

D2.PCGDP	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
PCGDP						
LD.	-.5706752	.1767913	-3.23	0.003	-.9340748	-.2072755
_cons	13.1672	8.975525	1.47	0.154	-5.28226	31.61665

Dickey-Fuller test for unit root — Number of obs = 28

	Test Statistic	1% Critical Value	5% Critical Value	10% Critical Value
		Interpolated Dickey-Fuller		
Z(t)	-5.184	-4.352	-3.588	-3.233

MacKinnon approximate p-value for Z(t) = 0.0001

D2.PCGDP	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
D.PCGDP						
L1.	-1.061133	.2046786	-5.18	0.000	-1.482677	-.6395898
_trend	4.008186	1.154603	3.47	0.002	1.630237	6.386135
_cons	-33.97198	15.5216	-2.19	0.038	-65.93931	-2.004654

```
. dfuller d.TS, trend regress lags(0)

Dickey-Fuller test for unit root                    Number of obs   =        28

                                 ------------ Interpolated Dickey-Fuller ------------
                 Test         1% Critical         5% Critical        10% Critical
               Statistic           Value               Value              Value
------------------------------------------------------------------------------
 Z(t)           -4.512             -4.352              -3.588             -3.233
------------------------------------------------------------------------------
MacKinnon approximate p-value for Z(t) = 0.0014

------------------------------------------------------------------------------
        D2.TS |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
        D.TS |
         L1. |   -.8962669   .1986322    -4.51   0.000    -1.305358   -.4871762
       _trend |    .0712999   .0733933     0.97   0.341    -.0798565    .2224563
       _cons |   -1.599179   1.242513    -1.29   0.210    -4.158182    .9598246
------------------------------------------------------------------------------

. dfuller d.EPC, regress lags(0)

Dickey-Fuller test for unit root                    Number of obs   =        26

                                 ------------ Interpolated Dickey-Fuller ------------
                 Test         1% Critical         5% Critical        10% Critical
               Statistic           Value               Value              Value
------------------------------------------------------------------------------
 Z(t)           -4.252             -3.743              -2.997             -2.629
------------------------------------------------------------------------------
MacKinnon approximate p-value for Z(t) = 0.0005

------------------------------------------------------------------------------
       D2.EPC |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
        EPC |
         LD. |   -.8602943   .2023261    -4.25   0.000    -1.277875   -.4427137
             |
       _cons |   -.5889465   .6417303    -0.92   0.368    -1.913413    .7355198
------------------------------------------------------------------------------
```

```
. dfuller d.EPC, trend regress lags(0)

Dickey-Fuller test for unit root                    Number of obs   =        26

                                 ------------ Interpolated Dickey-Fuller ------------
                 Test         1% Critical       5% Critical      10% Critical
               Statistic           Value             Value            Value
------------------------------------------------------------------------------
 Z(t)            -4.334            -4.371            -3.596           -3.238
------------------------------------------------------------------------------
MacKinnon approximate p-value for Z(t) = 0.0028

------------------------------------------------------------------------------
      D2.EPC |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
       EPC |
         L1. |  -.8975201   .2070777    -4.33   0.000    -1.325893   -.4691472
      _trend |   .0778905   .0852718     0.91   0.370    -.0985076    .2542886
       _cons |  -1.66736    1.344812    -1.24   0.228    -4.449315    1.114595
------------------------------------------------------------------------------

. dfuller d.TS, regress lags(0)

Dickey-Fuller test for unit root                    Number of obs   =        28

                                 ------------ Interpolated Dickey-Fuller ------------
                 Test         1% Critical       5% Critical      10% Critical
               Statistic           Value             Value            Value
------------------------------------------------------------------------------
 Z(t)            -4.411            -3.730            -2.992           -2.626
------------------------------------------------------------------------------
MacKinnon approximate p-value for Z(t) = 0.0003

------------------------------------------------------------------------------
       D2.TS |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
          TS |
         LD. |  -.8569892   .1942635    -4.41   0.000    -1.256303   -.4576749
             |
       _cons |  -.5392892   .5939466    -0.91   0.372    -1.760164    .6815854
------------------------------------------------------------------------------
```

```
. vecrank PCGDP EPC TS AT RO, trend(constant) lags(1) max

                    Johansen tests for cointegration
Trend: constant                                      Number of obs =      27
Sample:  1982 - 2008                                       Lags =       1
```

maximum rank	parms	LL	eigenvalue	trace statistic	5% critical value
0	5	-536.40906	.	98.0014	68.52
1	14	-510.68568	0.85124	46.5546*	47.21
2	21	-498.28613	0.60088	21.7555	29.68
3	26	-491.81525	0.38080	8.8137	15.41
4	29	-488.22925	0.23328	1.6417	3.76
5	30	-487.40839	0.05899		

maximum rank	parms	LL	eigenvalue	max statistic	5% critical value
0	5	-536.40906	.	51.4468	33.46
1	14	-510.68568	0.85124	24.7991	27.07
2	21	-498.28613	0.60088	12.9418	20.97
3	26	-491.81525	0.38080	7.1720	14.07
4	29	-488.22925	0.23328	1.6417	3.76
5	30	-487.40839	0.05899		

```
. dfuller d.TS, trend regress lags(0)

Dickey-Fuller test for unit root                    Number of obs   =        28
```

	Test Statistic	Interpolated Dickey-Fuller: 1% Critical Value	5% Critical Value	10% Critical Value
Z(t)	-4.512	-4.352	-3.588	-3.233

```
MacKinnon approximate p-value for Z(t) = 0.0014
```

D2.TS	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
D.TS						
L1.	-.8962669	.1986322	-4.51	0.000	-1.305358	-.4871762
_trend	.0712999	.0733933	0.97	0.341	-.0798565	.2224563
_cons	-1.599179	1.242513	-1.29	0.210	-4.158182	.9598246

```
. vec PCGDP EPC TS AT RO, trend(constant)

Vector error-correction model

Sample:  1983 - 2008                            Number of obs     =         26
                                                AIC               =   37.25378
Log likelihood = -445.2991                      HQIC              =   37.79721
Det(Sigma_ml)  =  5.17e+08                      SBIC              =   39.14092

Equation           Parms      RMSE     R-sq      chi2     P>chi2
------------------------------------------------------------------
D_PCGDP                7     36.837   0.6171   30.61614   0.0001
D_EPC                  7    2.63001   0.4962   18.71278   0.0091
D_TS                   7    2.63349   0.4953   18.64828   0.0094
D_AT                   7     41.034   0.8462   104.5293   0.0000
D_RO                   7    1640.51   0.7839    68.9164   0.0000
------------------------------------------------------------------

------------------------------------------------------------------------------
             |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
D_PCGDP      |
        _cel |
         L1. |  -.0582543   .0219981    -2.65   0.008    -.1013699   -.0151388
             |
       PCGDP |
         LD. |   .0632586   .2552205     0.25   0.804    -.4369643    .5634815
             |
         EPC |
         LD. |  -36.10537   465.8267    -0.08   0.938    -949.1088    876.8981
             |
          TS |
         LD. |   32.64463   465.2936     0.07   0.944    -879.3141    944.6034
             |
          AT |
```

	RO					
	LD.	-.0057123	.0046236	-1.24	0.217	-.0147744	.0033497
	_cons	11.04773	10.91014	1.01	0.311	-10.33575	32.43121
D_EPC							
	_cel						
	L1.	-.0021933	.0015706	-1.40	0.163	-.0052716	.000885
	PCGDP						
	LD.	.0312328	.0182217	1.71	0.087	-.004481	.0669467
	EPC						
	LD.	8.623899	33.2581	0.26	0.795	-56.56078	73.80858
	TS						
	LD.	-8.504237	33.22004	-0.26	0.798	-73.61433	56.60585
	AT						
	LD.	-.0329932	.0143272	-2.30	0.021	-.0610739	-.0049125
	RO						
	LD.	-.0004086	.0003301	-1.24	0.216	-.0010556	.0002384
	_cons	-.109563	.778939	-0.14	0.888	-1.636255	1.417129
D_TS							
	_cel						
	L1.	-.0022046	.0015727	-1.40	0.161	-.005287	.0008777
	PCGDP						
	LD.	.0311273	.0182458	1.71	0.088	-.0046338	.0668884
	EPC						

	EPC					
	LD.	8.342314	33.30211	0.25	0.802	-56.92862	73.61324
	TS					
	LD.	-8.222925	33.264	-0.25	0.805	-73.41917	56.97332
	AT					
	LD.	-.0330661	.0143461	-2.30	0.021	-.061184	-.0049482
	RO					
	LD.	-.0004089	.0003305	-1.24	0.216	-.0010568	.0002389
	_cons	-.1040317	.7799697	-0.13	0.894	-1.632744	1.424681
D_AT						
	_cel					
	L1.	-.1178173	.0245045	-4.81	0.000	-.1658452	-.0697894
	PCGDP					
	LD.	.1552438	.2842987	0.55	0.585	-.4019715	.7124591
	EPC					
	LD.	444.023	518.9001	0.86	0.392	-573.0026	1461.049
	TS					
	LD.	-438.1625	518.3064	-0.85	0.398	-1454.024	577.6994
	AT					
	LD.	-.2918468	.2235357	-1.31	0.192	-.7299687	.1462751
	RO					
	LD.	-.0108174	.0051504	-2.10	0.036	-.020912	-.0007228
	_cons	34.39994	12.15318	2.83	0.005	10.58015	58.21972

D_RO						
_ce1						
L1.	1.950717	.9796731	1.99	0.046	.0305928	3.870841
PCGDP						
LD.	2.881535	11.36608	0.25	0.800	-19.39558	25.15865
EPC						
LD.	4068.251	20745.3	0.20	0.845	-36591.79	44728.29
TS						
LD.	-4135.464	20721.56	-0.20	0.842	-44748.98	36478.05
AT						
LD.	6.614863	8.936816	0.74	0.459	-10.90097	24.1307
RO						
LD.	1.184078	.2059089	5.75	0.000	.7805035	1.587652
_cons	2.407328	485.8763	0.00	0.996	-949.8928	954.7074

Cointegrating equations

Equation	Parms	chi2	P>chi2
_ce1	4	337.5587	0.0000

Identification: beta is exactly identified

Johansen normalization restriction imposed

Cointegrating equations

Equation	Parms	chi2	P>chi2
_ce1	4	337.5587	0.0000

Identification: beta is exactly identified

Johansen normalization restriction imposed

beta	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
_ce1						
PCGDP	1	.	.	.	.	.
EPC	3792.61	745.6467	5.09	0.000	2331.169	5254.05
TS	-3794.37	746.4784	-5.08	0.000	-5257.441	-2331.299
AT	2.209965	1.362833	1.62	0.105	-.4611395	4.881069
RO	-.0973034	.0260904	-3.73	0.000	-.1484396	-.0461671
_cons	1359.544	.	.	.	.	.

. vecnorm, jbera

Jarque-Bera test

Equation	chi2	df	Prob > chi2
D_PCGDP	3.343	2	0.18801
D_EPC	0.368	2	0.83203
D_TS	10.493	2	0.00527
D_AT	0.496	2	0.78017
D_RO	0.582	2	0.74737
ALL	15.282	10	0.12210

. vecstable,graph

Eigenvalue stability condition

Eigenvalue	Modulus
1	1
1	1
1	1
1	1
.8213299 + .3251587i	.883352
.8213299 - .3251587i	.883352
.01410276 + .5225668i	.522757
.01410276 - .5225668i	.522757
.3952438	.395244
-.1712021	.171202

The VECM specification imposes 4 unit moduli.

. veclmar

Lagrange-multiplier test

lag	chi2	df	Prob > chi2
1	21.5393	16	0.15870
2	13.5092	16	0.63522

H0: no autocorrelation at lag order

DECLERATION

I, The under signed, declare that this thesis is my original work, prepared under the guidance of GomerawAdnew, my thesis advisor. All sources of materials used for the thesis properly acknowledged, I further confirm that the thesis has not been submitted either in part or in full to any other higher learning institution for the purpose of earning any degree.

_____ _____

Medhanit G/medhin SIGNNATURE & DATE

ST MARY'S UNIVERSITY, ADDIS ABABA

ENDORESEMENT

THIS THESIS HAS BEEN SUBMITTED TO ST.MARY'S UNIVERSITY, SCHOOL OF GRADUATE STUDIES FOR EXAMINATION WITH MY APPROVAL AS A UNIVERSITY ADVISOR.

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GOMERAW ADNEW SIGNNATURE & DATE

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