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EFFECT OF INFRASTRUCTURE DEVELOPMENT ON RURAL POVERTY REDUCTION IN ETHIOPIA: PANEL DATA ANALYSIS

BY:

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Statement of Declaration

I Mesfin Negash Shenbu, hereby declare that this thesis entitled ***"Effect of Infrastructure Development on Rural Poverty Reduction in Ethiopia",*** has been carried out by me under the guidance and supervision of Badassa Wolteji (PhD) And Mr.Biruk Birhanu (Assistance professor) and submitted by me for the award of the degree of Master of Science in Economics of Wolkite University. The thesis is original work and it hasn't been presented for the award of any other Degree, Diploma, and Fellow ship or other similar titles of any other university or institution.

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STATEMENT OF CERTIFICATION

This is to certify that the thesis entities **"Effect of Infrastructure Development on Rural Poverty Reduction in Ethiopia"** submitted to Wolkite University for the award of the Degree of Master of Science in economic development and is a record of valuable research work carried out by Mr.Mesfin Negash Shenbu, under our guidance and supervision. Therefore we hereby declare that no part of this thesis has been submitted to any other university or institutions for the award of any degree of diploma.

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Wolkite University

As members of Board of Examiners of the MSc. thesis open defense examination, we certify that we have read and evaluated the thesis prepared by **Mesfin Negash Shenbu** and examined the candidate. We recommended that the thesis be accepted as fulfilling the thesis requirement for the Degree of Master of Science in Economics (**Development Economics**).

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ABBREVATION

ADF	Augmented Dickey-Fuller
AR	Auto regression
CLRM	Classical Linear Regression Model
CSA	Central statics Agency
DF	Dickey-Fuller
FE	Fixed Effect
EAs	Enumeration Areas
ERA	Ethiopia Road Authority
EEPC	Ethiopia Electric Power Corporation
GDP	Gross Domestic Product
GNI	Gross National Income
HCI	Head Count Indices
HICES	Household Income and Consumption Exp. Surveys
ICT	Information Communication Technology
MDGs	Millennium Development Goals
MOFED	Minister of Finance and Economic Development
MOWR	Minister of Water Resource
NBE	National Bank of Ethiopia
GNI	Gross National Income
OLS	Order List Square
RE	Random Effect
RSDP	Road Sector Development Program
SSA	Sub-Sahara Africa
TFP	Total Factor Productivity
VIF	Variance inflation factor

Abstract

The purpose of this study is to explore the effect of infrastructure development on rural poverty in Ethiopia. The effect of infrastructure development and rural poverty is examined by using panel data from the period 1995/96 to 2016. The data was sourced from the National Bank of Ethiopia, Central Statics Agency, and World Bank. To undertake this study, eleven regions of the country were used. The study used both descriptive statistics and econometric analyses. The descriptive statistical analysis displays the trend of infrastructure development on rural poverty reduction and the improvement of rural poverty is largely concerned with raising the quality of life of people living standards of the society. The Random effect model was used for econometrics analysis in order to show the effect of rural poverty. In analyzing the effect of infrastructure development on rural poverty in Ethiopia, the study were applied Unit root tests, and Granger causality test. Based on the findings, the study highlights major variable such as water, education, inflation and government expenditure has a significant effect on rural poverty reduction. The estimation result suggested that, an increasing infrastructure development reduces rural poverty. The causality estimation shows both electrification and road has a positive effect infrastructure development on rural poverty reduction. Furthermore, the study found unidirectional causal relationship moving from electrification and road while there is no causality between foreign direct investment, inflation, government expenditure, education and rural water with rural poverty. There is no bidirectional relation between variables. This finding is consistent with the standard economic theory. Based on the findings the study highlights major issues policymakers should give due attention towards the effective formulation and implementation of infrastructure development policies to reduce and eliminate rural poverty.

Keywords: Ethiopia, Infrastructural Development, Random Effect, Rural Poverty

CHAPTER ONE

1. INTRODUCTION

1.1. Background of the study

Nowadays, the economy of African is insufficient and poor quality of infrastructure development. The economic growth calls the attentions of many policy makers as the size of the potential impacts of resolving both rural and urban poverty. Thus Africa is still at lower economic benefit that most rejoins could draw from improved infrastructure are higher than other global community (Antonio et al., 2012).

In Ethiopia, the infrastructure development has been maintained a bottleneck over the last quarter century. Many researchers have devoted their own skill and attentions to enhance the progress of infrastructure development on rural poverty reductions. Thus, infrastructure is a tool that facilitates the poor's access to productive opportunities and raising the value of their assets. Furthermore, it improves their health problems education status and enhances their human capitals (World Bank, 2009).

The usages of infrastructural services play a key role in the integration of individuals and households into social and economic development. Infrastructures development enhances both income levels of the society and reduces income inequality as well as a powerful tool for reduction of both rural and urban poverty. Therefore, infrastructure development has become a policy priority in many countries particularly in Ethiopia, and directly influences the progress of poverty (UN, 2015).

Ideally, different schools of thought exist on the effectiveness of infrastructure as a poverty reduction strategy. Investment in social infrastructure which is embraces on investment in education and health is more relevant to the goal of poverty reduction than physical infrastructure. Both physical and social infrastructure reduces poverty and infrastructure is general has no effect on poverty reduction (Aschauer et al., 2005).

Infrastructural development is important instrument for the enhancement of economic growth and relevance to poverty reduction. The actual paybacks of infrastructure have been significantly lower than anticipated event. There is now wider recognition that when the governance and institutional frameworks are strengthened the linkage between improved infrastructure and poverty reduction can also become stronger. Rural roads were reported to be the most important infrastructure contributing

to rural development where electrifications, irrigations and communication technology are the most demanding ones (Ghosh et al., 2017).

The need for appropriate infrastructure is still the hot spot of the country. Due to the fact, the vast majority of rural population depends directly or indirectly on different kinds of infrastructural activities like rural road, irrigation, electricity and communication technology, water sanitation, rural credit institution, market for input and output and, installation drainage building, that are the main activities of infrastructure development (MOFED, 2012).

In developing countries, there are weak governance institutions and the tendency for administration officials to be corrupt is very high. This scenario decisions to invest in infrastructure may be distorted, thereby lowering the contribution of infrastructure to growth and diverting benefits intended for the poor (Pernia et al., 2003).

A reduction in the incidence of poverty has also been observed both in rural and urban areas of the country during the last fifteen years of stable economic growth. Between 2001/2 and 2016/17, the incidence of poverty declined by 10% and 8.1% in urban and rural area respectively (MOFED, 2017).

Ethiopia had one of the highest poverty rates in the world, households have experienced a decade of remarkable progress in well-being and the country has seen a 33 percent reduction in the share of the population living in poverty. Agricultural growth drove reductions in poverty, bolstered by pro-poor spending on basic services and effective rural safety nets. This progress has been underpinned by strong and sustained economic growth averaging 10.9 percent annually (World Bank, 2000).

The pace of poverty reduction in Ethiopia since 2000 has been impressive, and particularly so when compared to other African countries. Ethiopia is one of the most equal countries in the world and low levels of inequality have and large which has been maintained throughout this period of economic development. This progress is not without its challenges, however, and poverty remains widespread in Ethiopia. The poorest households have become poorer than they were and high food prices that improve incomes for many poor farmers make buying food more challenging for the poorest. Despite improvements, Ethiopia still has relatively low rates of educational enrollment, access to sanitation, and attended births, and challenges remain around investment in the health, safety and education of women and girls (World Bank, 2005).

Although there is some evidence of manufacturing growth starting to reduce poverty in urban centers than rural area at the end of the decade, structural change has been remarkably absent from Ethiopia's story of progress. The majority of Ethiopian households are still engaged in agriculture and in living in rural areas. Additional drivers of poverty reduction will be needed to end poverty in Ethiopia, particularly those that encourage the structural transformation of Ethiopia's economy.

Policies that encourage further agglomeration through urbanization would help increase poverty reduction is the motivation of the study. This will in turn require policies that favor the entry and growth of firms, in addition to support to self-employment in non-agricultural activities. Programs targeted to improving the well-being of the rural poor will also become increasingly important. Generally, the motivation of the researcher focuses on a serious challenge and the problem of rural poverty as well and to show the effect of infrastructural development on rural poverty. The role of infrastructure development has been extensively conducted in developed nations, yet evidences are scarce in Ethiopia. Therefore, this paper looks the role infrastructure development plays on poverty reduction and extends the debate to the Ethiopia case.

1.2. Statement of the Problem

Many of the developing countries of Africa remain behind developed countries due to lack of infrastructure, education, health services and higher incidence of poverty. Especially, poverty is continued to be a highly threatening social problem that has claimed the lives of millions directly or indirectly in most of these developing world. The complicated is widespread in Sub-Saharan Africa including Ethiopia where poverty is chronic in rural areas (Teshome et al., 2012).

Especially, poverty is continued to be a highly threatening social problem that has claimed the lives of millions directly or indirectly in most of these developing world. The problem is widespread in Sub-Saharan Africa including Ethiopia where poverty is chronic in rural areas. Lack of modern infrastructure is an obstruction to Africa's economic development and a major constraint on poverty reduction, as well as the attainment of the Millennium Development Goals (MDGs). To this fact that infrastructure development on rural poverty reduction of Ethiopia in relation to social and economic prospects of the rural dwellers is still problematic and inaccessible factors (UN, 2015).

The sort of infrastructural problem like rural roads, transport, irrigation and access to electricity power, are the main hinders of agricultural development. The alleviation of poverty has been examined and pointed out that the existing effect of infrastructure development in most sub-Sahara regions of Africa. However, Ethiopia has been exposed by infrastructural problem and not yet put in to influence in many respects. That is why the government tries to adopt these activity of infrastructure speared in the rural areas. Because of these infrastructures have sound impacts on rural poverty reductions strategy that has been rendered in the different regions of the country so far (Chakraborty et al., 2009).

In fact, both theories and evidences are diverging and still the researchers are not reaching the ultimate decision is one gap to fill the study. Hence, this study is deemed to fill the existing knowledge gap concerning the extent of infrastructure and rural poverty. The main point of analysis that put clear research gap is; majority of studies was done by cross sectional data. In this case, where it is difficult to make conclusion. In this study, the researcher tried to use panel data to fills the knowledge gaps and it reaches the ultimate decision. However, in this finding intuition is providing the detail explanation to the area of the regions effect on rural poverty alleviation in Ethiopia.

In addition the relationship of infrastructural development, there is a blurred thought and a clear weight not vividly shown whether infrastructural development and rode infrastructural is leaning towards economic growth which explained in the empirical review. In case of Ethiopia still now there is no adequate effect assessment on infrastructure development on rural poverty reduction. So lack of the assessment's gap leads to rural dwellers to chronic poverty did not show by scientific research. To this end, the government has been striving to address infrastructures which are prime importance in rural poverty reductions in many instant across the country.

In other side the methodology taken into account and variables incorporated in the econometric model for further analysis based on the expected the results is also another area of disparity among these researchers. Thus, this paper tries to address and fill the gap by taking into account the above noted issues and investigates the effect of infrastructural development on rural poverty in Ethiopia by taking eleven regions of Ethiopia, the period from 1995/96-2015/2016 using by panel data analysis so as to fill the existing gap completely.

1.3. Hypothesis of the study

The hypotheses to be testing in this study are:

First, regarding the relationship of variables;

H_0: Infrastructure development has no significant effect to alleviate rural poverty.

Ha: Infrastructure development has a significant effect to alleviate rural poverty.

Second, regarding the nature of panel data from;

H_0: Random effect model is appropriate and

H_a: Random effect model is not appropriate.

Third, regarding the causality of variables

$H_{0:}$ Infrastructure does no causal relation between rural poverty

$H_{1:}$ Infrastructure does causal relation between rural poverty.

1.4. Objective of Study

1.4.1. General Objective of the Study

The main objective of the study is to investigate the effect of infrastructure development on rural poverty reduction in Ethiopia.

1.4.2. Specific Objectives

The specific objectives of the study are:

- To assess the trend of infrastructure development on rural poverty reduction in Ethiopia.
- To analyze the effect of infrastructure development on rural poverty in Ethiopia.
- To identify the causal relationship between infrastructure development and rural poverty in Ethiopia

1.5. Significance of Study

Initially, this study could be used to promote the participation in infrastructure development in the country and to reduce poverty in the region. It is important to show the recent activity that helps to address the poverty problem needs in rural areas and to focus on poverty reduction. It also shows some directions for policy makers to come up with appropriate policy to develop the regions so as to expand the infrastructural in the country. In line with this, policymakers have shown some inroads in reducing rural poverty in the region and injecting and expanding infrastructure in the region.

1.6. The Scope and Delimitation of the Study

The study was bounded by only investigating the Effect of Infrastructure Development on Rural Poverty reduction in Ethiopia and the direction of causality with a time frame of 20 years, from 1995/96 to 2015/16 and eleven regions of Ethiopia were included to conduct the research. The study focused on eleven regions in the country of Ethiopia. Namely, Tigray, Afar,Amhara,Oromia, Somale, Beneshangul Gumuz, Southern Nation Nationality People, Gambela, Hareri,Addis Abeba, Dira Dawa. Lack of organized data regarding Infrastructure and Rural poverty in Ethiopia another limitation of the study that imposed lots of work on the researcher in organizing different sorts of data to get consistent information.

1.7. Organization of the Thesis

This paper is organized as follows. Chapter one presents the introduction for the main part of the paper. Chapter two consists of review of the relevant theoretical, empirical findings and conceptual frameworks are discussed. Chapter three is designed to provide some clue about the methodology of the study and chapter four result and discussions are explained. Finally, fifth chapter deals with conclusion and recommendations of the results has already discussed.

CHAPTER TWO

2. LITERATURE REVIEW

2.1. THEORETICAL LITERATURE

This chapter is organized as three main parts; the first part deals with theoretical literatures about description and brief review of different literature of the effect of infrastructural development on rural poverty in Ethiopia. The second part contains review of empirical literature on different countries and regions experiences were done by different researcher. Various disciplines and scholars define poverty in multiple ways based on a certain indicators. The third part deals with the economic and conceptual frameworks of the thesis, regarding on the structure as well as the performance of developing countries implementation of the infrastructural improvement and reduction of rural poverty.

Theory of Rural Poverty

Poverty is an unacceptable deprivation in well-being of the society. It exists when there is lack of the means to satisfy critical needs. Some aspects of poverty which includes not were having enough to eat, high rate of infant mortality, low life expectancy, low educational opportunities, and lack of active participation in decision making (Gosh et al., 2017).

Lack of incentives issue for improving poverty problem is blame for welfares system. This root cause is created by transmission over generations of a set of beliefs values and skills that are socially generated but individually held. The progressive of economic, political and social systems causes people to have limited opportunities, geographical disparities and resources to achieve income and wellbeing (Aluko et al., 2000).

The poverty looks at the individuals and their community as being caught in a spiral of opportunity and problems and that once problems dominates it closes other opportunities and create a cumulative set of problems that make any effective response nearly impossible (Teshome et al., 2012).

2.1.1 Measurements of Rural Poverty

In spite of this, the current UNDP, HDI is widely used in measuring poverty. HDI considers three key aspects of poverty indicators including education, health and per capita income status of a certain societies. Two basic approaches to the concept of poverty were found in economic literature, namely, absolute poverty and relative poverty. Absolute poverty is based on absolute norms for

living laid down according to specify minimum standard and all such individuals or groups whose consumption expenditure is found to be below this standard are classified as poor. This concept is directly related to the minimum level of consumption. In most of Ethiopia studies on poverty the focus has been mainly on measuring the number of people living in absolute poverty as this problem looms large in vast parts of the country and affects the majority of the population (Todaro, 2009).

2.1.2. Approaches of Measuring Rural Poverty

Approach of measuring poverty line considered with the previous surveys, consumption rather than income was used in the conduct of poverty analysis. Consumption to be an indicator of household's welfare, it has to be adjusted for differences in the calorie requirement of different household members. This adjustment could be made by dividing real household consumption expenditure by an adult equivalent scale computed on the basis of the nutritional requirement of each family member. Total poverty now refers to an aggregate measure of poverty that takes into account both the food and non-food requirements. Here, it is worth noting how poverty lines are established (MOFED, 2016).

The most widely used method of estimating poverty line is the cost of basic needs method because the indicators will be more representative and the threshold will be consistent with real expenditure across time, space and socio economic groups. First, the food poverty line is determined by choosing a bundle of food typically consumed by the poor. The quantity of the bundle of food is determined in such a way that the bundle meets the predetermined level of minimum caloric requirement (2200 kilocalorie). This bundle is valued at local prices or at national average prices if the objective is to get a consistent poverty line across regions and socio economic groups. Then a specific allowance for the non-food goods consistent with the spending pattern of the poor is added to the food poverty line. To account for the non-food expenditure, the food poverty line is divided by the food share of the poorest quartile or quintile (MOFED, 2016).

The most widely used poverty indices are the percentage of the poor below the poverty line (headcount index), the aggregate poverty gap (poverty gap index), and the distribution of income among the poor (poverty severity index). The poverty measure itself is a statistical function that translates the comparison of the indicator of household well-being and the chosen poverty line into one aggregate number for the population as a whole or a population subgroup. Many alternative

measures exist, but the three measures described below are the ones most commonly used (World Bank, 2016).

Incidence of poverty (headcount index**)**: Head count index indicates the share of the population whose income or consumption is below the poverty line that is, the share of the population that cannot afford to buy a basic basket of goods. Depth of poverty (poverty gap index): Poverty gap index provides information regarding how far households are from the poverty line. This measure captures the mean aggregate income or consumption shortfall relative to the poverty line across the whole population. It is obtained by adding up all the shortfalls of the poor (assuming that the non-poor have a shortfall of zero) and dividing the total by the population. In other words, it estimates the total resources needed to bring all the poor to the level of the poverty line (Todaro, 2009).

Poverty severity (squared poverty gap): Poverty severity index measures not only the distance separating the poor from the poverty line (the poverty gap), but also the inequality among the poor, that is, a higher weight is placed on those households further away from the poverty line. Poverty reports in developing countries use all the three poverty indices described above. Poverty report uses also all the three poverty indices above namely headcount poverty, the poverty gap, and the severity of poverty. The measures of depth and severity of poverty are important complements of the incidence of poverty (World Bank, 2016).

In Ethiopia, the methods described above were first applied in the context of the 1995/96 Poverty Analysis Report. This was based on the cost of 2,200 kcal per day per adult food consumption with an allowance for essential nonfood items. The food and total poverty lines used since 1995/96 in the country are 648 and 1075 birr at national average prices, respectively. To use these poverty lines and compute poverty indices, per adult consumption expenditure has been updated by deflating all food and nonfood consumption items by spatial price indices and temporal price indices (MoFED, 2016).

The HICE survey is of great importance among other household surveys conducted by the Central Statistics Agency of Ethiopia. The survey provides empirical evidence that enable to understand the income through the use of consumption expenditure as proxy to income dimension of poverty. The survey specifically aims at furnishing series of data for assessing poverty situations; for analyzing changes in the households' living standard over time; and for monitoring and evaluation the effect of socio-economic policies and programs on the welfare of people, and Establishing databases that serve for compiling household accounts in the System of National Accounts (SNA) such as the

PFCE component of the demand side of GDP and for construction and rebasing of Consumer Price Indices in the country (MOFEC, 2015).

2.1.3. National Level Consumption and Caloric Intake

To analyze the growth poverty effect, the nationally defined poverty line is adopted in the model rather than using the World Bank's 'a-dollar-a-day' measure. National poverty lines are typically measured by household total expenditure since household income is often significantly underreported in developing countries. The average total calories consumed in Kcal per day by an adult person was 2928 with 2973 for rural people and 2706 for urban people, which are all well above 2200 Kcal per day, an amount required to walk and perform light works (World Bank, 2016).

Nationally, food consumption, as a share of total consumption, has fallen from 60 percent to 56 percent between 1995/96 and 2004/05 and to 52 percent in 2010/11. In per capita and adult equivalent terms, unlike the consumption expenditure, the level of calories consumed is higher for rural areas than for urban areas. However, the level of calories consumed in per adult equivalent terms is very similar across regions in both rural and urban areas. Per adult calorie consumption in SNNP is the highest at 3288 Kcal per day while the lowest level is recorded for Addis Ababa, which is 2556 Kcal per day per adult, showing similarities in calorie intake across regions (MOFEC, 2015).

The components of non-income poverty, such as health, nutrition, education and literacy, sanitation, access to services and assets. There is an overall improvement in most indicators that mirrors the trend in consumption poverty. Rural areas in particular have seen quite dramatic improvements in water and sanitation, as well as primary school enrolment. The biggest differences are still between rural and urban residents, however, and policy efforts need to continue in order to maintain the gains achieved in education, as well as improve secondary enrollment. The reduction in self-reported illness, and examining differences across the wealth distribution, richer people tend to report ill health more often. Richer households are more likely to consult a healthcare provider which suggests that better-off households are accessing available health providers more than worse off households. Similarly, child nutrition has improved considerably since 2000 in all the measured indicators. However, a high proportion of Ethiopian children have low height for their age, and there are significant differences between urban and rural areas (World Bank, 2015).

Consumption expenditures in this report are reported in terms of 2010/11 national average prices in Ethiopian Birr. Both per capita and per adult equivalent figures are used. Per capita real household

consumption expenditure is obtained by dividing real household consumption expenditure by family size. Per adult real household consumption expenditure is per capita real household consumption expenditure adjusted for age and gender of household members, obtained by dividing real household expenditure by adult equivalent family size. We use the adult equivalent scale to calculate adult equivalent family size (Dercon and Krishnan, 1985).

2.1.4. Non-Consumption Dimensions of Poverty in Ethiopia

This division therefore examines no income aspects of wellbeing such as health, nutrition, education and literacy, sanitation, access to services and assets using data from the 2011 Welfare Monitoring Survey. By merging the WMS data with the HICE we are also able to compare differences across the consumption distribution as well as a breakdown by location and gender. Whilst there are many improvements since 2004. Some aspects of non-monetary poverty remain stark in Ethiopia and are areas for improvement. Rural road quality appears to be driving the low secondary school enrolment rates seen in rural areas. Electrification rates also remain low in rural areas at below five percent. Nationally, the average rate is 18% which is lower than the average for sub-Saharan Africa (24%). The rate of stunting remains just above that compared to other African countries (the average rate in sub-Saharan Africa is 40% compared to 44% in Ethiopia), but the gap has narrowed substantially between Ethiopia and the rest of the continent (Thomas et al., 2015).

More common is a non-welfares' approach based around the idea of basic needs. A core basic need is having an adequate diet and so the starting point for this type of poverty line is often minimum caloric requirements. There are three methods of setting poverty lines that use caloric requirement: direct caloric intake, food energy intake, and cost of basic need methods. In the direct caloric intake method**,** the poverty line is defined as the minimum calorie requirement for survival. Individuals who consume below a predetermined minimum calorie intake are deemed to be poor. However, this approach does not account for the cost of obtaining these calories and ignores nonfood needs (Frankenberg et al., 2012).

Non-welfare method of setting a poverty line is use food energy intake methods. The basic idea in this method is to find the per capita consumption at which a household is expected to fulfill its caloric requirement. The poverty line then defined is the level of per capita consumption at which people are expected to meet their predetermined minimum caloric requirement. It is estimated by regressing per capita consumption expenditure on caloric intake. Then the predicted value of the per-

capita consumption expenditure at the predetermined caloric intake is taken as the poverty line. This method improves over the direct caloric intake method because it provides a monetary value. However, if applied to different regions and periods within the same country, this method does not yield a consistent threshold across regions and periods because food consumption patterns differ across them. The method of setting a poverty line is the cost of basic needs method which is defined by choosing a bundle of food typically consumed by the poor. The quantity of the bundle of food is determined in such a way as to supply the predetermined level of minimum caloric requirement (2,200 kcal). This bundle is valued at local prices (or it is valued at national prices if the desire is to get a consistent poverty line across regions and groups). Then a specific allowance for the nonfood goods consistent with the spending pattern of the poor is added to the food poverty line. To account for the nonfood expenditure, the food poverty line is divided by the food share of the poorest quartile or quintile.

2.1.5. The Theory of Infrastructural Development

The theory of infrastructure has been variously defined by different researchers on productive economic infrastructure and social infrastructure. Economic infrastructure produces services that directly facilitate and are basic to the carrying out of a wide variety of economic activities. Rural infrastructure includes investments that directly and indirectly affect productivity in agriculture and other rural non-farm activities. The main categories of economic infrastructural activity are investments in rural electrification, rural credit institutions, scientific agricultural research and extension, flood control and drainage, irrigation works, rural roads, rural transport, markets for inputs and outputs, storage structures and warehousing facilities, common property resources, and watershed development (UN, 2011).

In addition, it includes infrastructure for developing allied and non-farm activities like dairy development and agro-processing and other village industries and crafts. While some infrastructures like irrigation, credit and agricultural research enable the adoption of new technology, some others, like transport, provide intermediate services to facilitate interaction between productive activities (Ibid).

Social infrastructure includes activities like access to schools, primary health centers, safe piped drinking water, and sanitation, pavement of streets and building of community centers. While investment in economic infrastructure primarily plays a complementary role in increasing

productivity of existing assets, generating more employment for labor and providing increased access to urban markets including labor markets, investment in social infrastructure results in creating a healthy working environment as well as facilitating human capital formation in rural areas. Infrastructure generally includes both physical and social overhead capital. In that broad sense, infrastructure would include public utilities, ports, water supplies and electricity ; transport, public utilities, schools and hospitals; transport, power, law and order, education, public health, communications, water supply, irrigation, and drainage (Man, 2010).

2.1.6. The Effect of Infrastructure on Rural Poverty Reduction

Infrastructure is a key element of poverty alleviation. It often acts as a catalyst to development and enhances the effect of interventions to improve the poor's access to other assets (Mabogunje, 2005). Its effect is felt both on the economic and social sectors. Without roads, the poor are not able to sell their output on the market. In Ethiopia, it has been shown that roads alone high account for of the growth in aggregate output of the rural areas. Without electricity, the industrialization process not achieves the goal, which provides the poor an important source of employment, is unlikely to take off. Without potable water and sanitation health is at risk. The retrospective evaluation of a feeder road project in Ethiopia shows that beyond its effect on agricultural production, it was associated with a trebling in the enrollment of girls in primary schools. Electrification has been shown to have a substantial effect on the reduction in women's fertility (Idachaba et al., 2008).

2.2. Empirical Review

The main empirical evidence supports the argument that the effect of infrastructural development on rural poverty in Ethiopia on regional level. The empirical literature shows a mixed result for both developed and developing countries as well as panel and single country in the regional level. According to Aschauer et al. (2016) the literature examining the effect of infrastructure development, most of which includes electricity infrastructure as one variable of interest and the stock of public infrastructure capital including electricity is a significant determinant of aggregate total factor productivity. The outcomes submit that, infrastructure played an important role in the productivity. The former studies exploring this phenomenon had ignored the role of infrastructure and focused on other factors such as energy prices. Later studies applied more sophisticated econometric techniques to correct for these methodological problems.

According to Fan and Chan-Kang et al. (2005) estimated that development of rural roads and other infrastructure proficiently widened the growth and reduced the poverty. They used provincial level data and following a simultaneous equation model to capture the effect of infrastructural development on growth and poverty. The exception of the study was to disaggregate the roads on the basis of quality, and also to obtain the results on the basis of different regions. The peripheral outcome of road development was proved different for different regions, and also different for different quality of roads. Low-quality road contributed much, as compare to high-quality roads, for growth and poverty reduction. Rural development is largely concerned with raising the quality of life of people living in the rural areas through electrification, nutrition, housing, health, education, as well as creating opportunities for employment. In the words, the provision of basic social and infrastructural facilities at the grassroots will lower rural poverty.

Chen and lin et al. (2010) found that rural infrastructure such as irrigation, transportation, storage, primary products market and wealth forecasting service can decrease production cost ,transportation cost ,storage expense, dealing cost and operation risk and enhance production expense. The effect of specific infrastructure, such as rural roads, transport, power, irrigation and access to electricity, on agricultural development and poverty alleviation has also been examined.

According to UN (2010) the important finding that should be our first concern is that the rural poor are relatively more vulnerable to economic shock, especially inflation than urban poor which are reflected in the magnitude of the elasticity. In more detail analysis we show that inflation on food

price do have higher effect on poverty level relative to non-food commodity. The effect is much higher on rural poverty than urban or national level. Moreover, the study also found that in the last three years, changes in the inflation rate cause a relatively higher effect on poor people in national level, urban and rural level relative to non-poor ones.

According to UN (2011) the lack of adequate transport, power, communication networks, water, sanitation and other infrastructure puts severe constraints on economic growth and poverty reduction across the region. Taken as a whole, these infrastructure constraints erode Africa's competitiveness and make bringing African goods and services to the world market place a challenge, investment in maintaining existing infrastructure has also lagged behind, leaving many African countries with degraded and inefficient infrastructure services; poor quality roads, railways, and ports and an inadequate ICT backbone.

According to Égert et al. (2009) the empirical study by OECD shows the contribution of infrastructure including road to the long-run productivity and income growth is more significant compared to investment on other capital.

According to Shimokawa et al.(2007) deficiencies in transportation, energy, telecommunications, and related infrastructure translate into poorly functioning domestic markets with little spatial and temporal integration, low price transmission, and weak international competitiveness. The failure to invest in rural infrastructure would be a critical bottleneck for future growth in agricultural and economic output and poverty alleviation in developing countries. Indeed, severe rural infrastructure deficiencies undermine the huge potential of the agriculture sector in developing countries to contribute to growth and poverty reduction. Improved rural infrastructure will reduce poverty through improved agricultural productivity and through improved wages and non-farm employment.

According to Majumder et al. (2012) studies on the basis of regression analysis of the State level cross-section data for each of the years from 1971 to 1995 indicated that among various physical infrastructures, it was the transport infrastructure that significantly affected the agricultural output level and the agricultural development index. On the other hand, an expansion of regional infrastructure facilities in certain regions and districts of India was found to have improved average living standards and lowered the share of people living below the poverty line, even when infrastructure investment was accompanied by divestitures in education and health.

According to Demombynes et al. (2008) found that fluctuation on macroeconomic indicators, one of them is inflation rate, do have significant effect on poverty level. This issue is really important in terms of poverty alleviation program. If inflation rate has substantial effect on rural poverty, thus government should control rural inflation rate along with poverty alleviation program since most poor people lives in rural area.

According to Devoto et al. (2011) recent evidence shows that the benefits to the poor of improved access to water may go beyond the conventional health effects. Better access reduces time devoted to water collection, and thus it frees up time for additional leisure or production. It reduces important sources of stress and tension within the household and/or community. Moreover, it provides women greater mobility and opportunity to socialize and improve their well-being. Overall, welfare gains may result even in the absence of income or health gains for evidence from the city of Tangiers.

According to Fan et al. (2004) discovered the effect of infrastructural investment on economic growth and poverty for rural India, rural China and rural Thailand respectively. While criticizing single equation model for biased results and using simultaneous equations model, these studies investigated effect of 'government is spending' in factor and product market. In these studies, Importance of investment in infrastructure (especially for roads) was crystal clear for economic growth and poverty reduction. In case of India, roads and research and development investments had not only significant effect on poverty reduction but also had powerful effect on economic growth. Investments in education and other sectors had modest effect on economic growth and poverty reduction. In case of China investment in education had the largest effect on poverty reduction, and education investment also experienced high returns to growth whereas investment in agricultural research and development had the largest effect on growth.

According to Hazell et al. (2012) assess and they see the Thailand's experience also pointed out a significant relationship between infrastructure investment, economic growth and poverty reduction. India by looking at the relationship between government expenditure incurred on R and D, irrigation, roads, education, power, soil and water, rural development, health and family welfare, and the effect of each of these expenditures on the incidence of poverty in rural areas by employing a simultaneous equation regression model. The study is based on time series of state-wise data on poverty, rural employment, wages and government expenditure on specified infrastructures. By using a simultaneous equation regressive model, the authors bring out that government expenditure on roads had the highest

effect on reduction of poverty, followed by that on welfare, health, rural development, education, and soil and water.

Another perspective by Fan (2010) indicates that productivity and wage of a region increases with the proportion of infrastructure endowment. The argument is that regions with advanced infrastructure such as road network could have better regional integration and factor mobilization leading to productivity and economic growth (World Bank, 2009). Most the existing research explores the influence of infrastructure on agriculture production, rural growth and poverty reduction.

According to Hall et al. (2013) the trend of infrastructure accelerates economic growth by raising productivity and lowering production costs. Criticizing the existing growth theories for not explicitly considering infrastructure as an input in production function, and exploring the mechanisms through which infrastructure can influence economic growth and poverty alleviation. This section examines the relationship between infrastructure and rural development by estimating the effects of both individual indicators as well as composite indices of rural infrastructure on various dimensions of rural development and poverty improvement.

According to Ewah et al. (2001) access to the rural infrastructural facilities such as roads, telecommunications, safe water supply, health, modern energy, farm structures etc. are important in reducing vulnerability, poverty and increasing prosperity. For instance in a survey conducted by UNICEF (2005) in Sub-Sharan, water supply and energy services topped the list of the most pressing needs of the rural households. In the survey, 77% of the households rated access to adequate and safe water as most critical element in escaping poverty, followed by access to electricity, as rated by 53% of the households. Linkage between rural infrastructure, agricultural growth, and rural poverty was explored empirically by Fan at el (2004), which exploited district level data from 30 districts of rural Uganda for the years 1992, 1995 and 1997. So far as data regarding poverty was concerned they followed Appleton's method so as to obtain region-specific poverty estimates

According to Dinkelman et al. (2011) recent literature examines the effect of electrification infrastructure programs on rural areas in developing Countries. Evaluates the effect of the massive roll-out of the electricity grid in rural South Africa on employment and, most notably, female employment. This roll-out started in 1995, targeted low-capacity household use in rural areas rather than industrial users. The study employs the land gradients of the communities to adjust for the endogenous location of projects. The main finding is that electrification leads to rising female employment on both the extensive and the intensive margins. Rural electrification is the process of bringing electrical power to

rural and remote areas, which can take two main forms: Grid electrification and off-grid electrification (Anderson, 2010).

According to Oladele et al. (2017) the rural areas in Nigeria have witnessed intense neglect and inadequate rural infrastructural development. This is contrary to the backdrop experienced in emerging cities where the provision of rural infrastructure was critical for improving the quality of rural life and opening up the areas for development. This study evaluated the relevance of rural electrification on households' poverty using structured questionnaire and a multistage sampling procedure to obtain cross sectional data. The results revealed that the mean age of the respondents was 52 years. The mean household size and farm size was 8 and 28.9% of the respondents had no formal education with majority engaging in farming as main occupation. The households in electrified communities spent more averagely 4,017.90/month on the alternative sources of energy than their counterpart in non-electrified communities who averagely spent 2,890.90/month. The results further revealed that households in non-electrified communities were poorer than their counterpart in electrified communities. Therefore, rural electrification can actually curb poverty and improve standard of living in rural Nigerian areas.

According to Dimnwobi et al. (2016) the findings of his study show that public spending on education is indeed important for better education outcomes in Nigeria. Government expenditure on education has significant positive effect on education outcome in Nigeria measured by primary school enrolment rate. It is well known that education is one of the drivers of economic development. The more people that enroll into primary schools, the more literate the population would be, and more possibility there is that these individuals would develop skills that would contribute to national income growth and rural poverty. Keeping in view data constraints being faced by them they developed a simultaneous equation model for capturing marginal effect of government expenditure on growth and poverty reduction, and then used double log functional form for estimation of the model. Study found robust effect of infrastructural investment on agricultural growth and poverty reduction.

According to Agbi et al. (2016) pending for agricultural extension had the highest effect, roads investment had second highest effect, and education expenditures had the third highest effect on agricultural growth and poverty reduction whereas health facilities showed no effect at all Inferior type roads played vital role as against highways and high type roads. Regional disparities of effect of such expenditures were also evident in this study, and western region of Uganda performed well in this regard. Determine the implications of public expenditure on social capital for the rural poverty

reduction of Nigeria. Their result indicated that social capital had insignificant positive effect on rural poverty reduction within the period under review. Investigated the effect of government education expenditure on economic growth in China taking into account the spatial third-party spillover effects. The results reveal that government education expenditure in China has a significant positive effect on economic growth, but expenditure in different educational level shows different results. Government education expenditure on below high-education is positive related to local economic growth and rural poverty reduction whereas the effect of education expenditure in high-education is insignificant. Also, neighboring government education expenditure shows spatial spillover effects on local economic growth and poverty reduction spatial spillover effects in two education levels is different.

According to Arnold et al (2003), defined inflation as the rise in the general prices of goods and services in an economy. It occurs as a result of money supply being higher than the rate of economic growth. When there is too much money in circulation chasing after the few available goods in the market. As a result the rise in demand causes an increase in price level of goods and services over a given period of time. The underclass, are people who are at the bottom of a society having become victims of poverty trap. This class is largely composed of the young unemployed, long-unemployed, chronically sick, disabled old, or single-parent (usually the mother) families.

According to Teshome et al. (2012) many of the developing countries in Latin America, Africa and Asia remain behind developed countries due to lack of infrastructure, education, health services and higher incidence of poverty. The adequate supply of infrastructure services has long been viewed as essential for economic development and poverty reduction. Like general infrastructure, rural infrastructure also contributes to rural economic growth and poverty alleviation by enhancing agricultural productivity, increasing rural farm and non-farm employment and improving living standard of the rural population.

According to FAO, (2016) it is argued that Roads electricity supplies, telecommunications, and other infrastructure services are limited in all rural areas, although they are of key importance to stimulate agricultural investment and growth.

According to Ghosh et al. (2017) it is argued that rural infrastructures, such as roads, electricity, telecommunications and irrigation, are crucially important for rural development and poverty alleviation through improved agricultural productivity, increased rural farm and non-farm

employment and improved human well-being. It is also argued that human development in terms of education and health depends crucially on infrastructure services, such as roads, electricity, safe drinking water and sanitation. The role of infrastructure in rural development has been evaluated in the literature mostly by examining the effects of specific infrastructure indicators on rural development. However, the relationship between rural development and various composite indices of rural infrastructure has not been given adequate attention.

Findings of the study by Akililu et al. (2012) conducted a study on effect of rural road on poverty reduction of fifteen villages in Ethiopia and eventually her finding clearly revealed that there is a strong and positive association between road access and rural poverty reduction of fifteen rural village in Ethiopia. According to a study by Fan et al. (2002) roads significantly reduce poverty incidence through agricultural productivity and nonfarm employment. In most of the studies, rural roads were reported to be the most important infrastructure contributing to rural development.

According to Biruk et al. (2016) pointed out on his finding of the impact of infrastructure development on economic growth of Ethiopia that the relationship between infrastructure and economic growth doesn't support variables move together in the long run. Moreover, the short run dynamics shows the speed of adjustment is too slow that only 6% disequilibrium correlated each year towards the long run path.

To sum up, the effect of infrastructure on rural poverty reductions of Ethiopia is a fundamental and timely issue to be conducted, since it profoundly affects the overall dimensional perspectives of the country. This clearly pinpoints that the issue of investigate the effect of infrastructure development on rural poverty of Ethiopia using panel data analyses is an urgent priority, since almost all the previous studies focused on single variables like road , electricity but not showing infrastructure indicator multiple variables. Even if the studies covered limited area of the country effect on rural poverty alleviation. In these studies show the effect of infrastructure on rural poverty reduction by using multiple infrastructure variables, additionally case of the study covered large area of the country.

2.3. Conceptual Framework

The conceptual frame work stayed designed from theoretical basis, and empirical evidences. Economists identify several factors that contribute to reduction of poverty, such as Providing adequate infrastructure such as clean sources of water, health and education facilities, markets and proper transport access, Rural road, Distribution of Electrification, controlling of inflation, encouraging FDI, Government spends is still a major task, which is yet to be achieved in large parts of developing countries. In order to provide such services to all, there is a need for effective approaches involving the users; local government institutions and private sector in order to effectively plan, develop and maintain the required infrastructure to alleviate rural poverty (Mitchell et al., 2005).

Emphasize that infrastructure development can lead to poverty reduction through direct or indirect channels. Through the direct channel it reduces poverty as people's access to health and an educational service improves, there is cleaner energy available and the government provides for protection against national disasters. The indirect effect of infrastructure provision on poverty occurs when the productivity of workers increases, transport costs are reduced and more employment is generated, thereby leading to economic growth. This implies that infrastructure provision can have economic and social effects on the lives of people.

The social dimension of better infrastructure is that it increases access to basic social services, thus improving the living conditions of the poor. The subsequent effect of infrastructure development arises from fiscal revenue generated from it. As fiscal revenue increases through growth, additional budget can be generated for programs that improve the living conditions of the poor. Additionally macro-economic variables have their effects that are government more spend on rural area its create job opportunity and they earn more income. The theoretical exposition presented above has indicated that the link between infrastructure and poverty is not simple, but is rather a complex one. Infrastructure development can directly or indirectly lead to poverty reduction. It has also been emphasized that the extent to which infrastructure leads to poverty reduction through economic growth depends on the quality of governance and the institutional setting UN (2012). Generally, these conceptual frameworks adopted from the empirical literature and research model regarding the effect of infrastructure on rural poverty. The indicator variables of infrastructure road, electrification, potable (water sanitation), FDI, government expenditure, education, inflation are direct influence on rural poverty.

The general framework of rural poverty and infrastructure is explained in the following diagram.

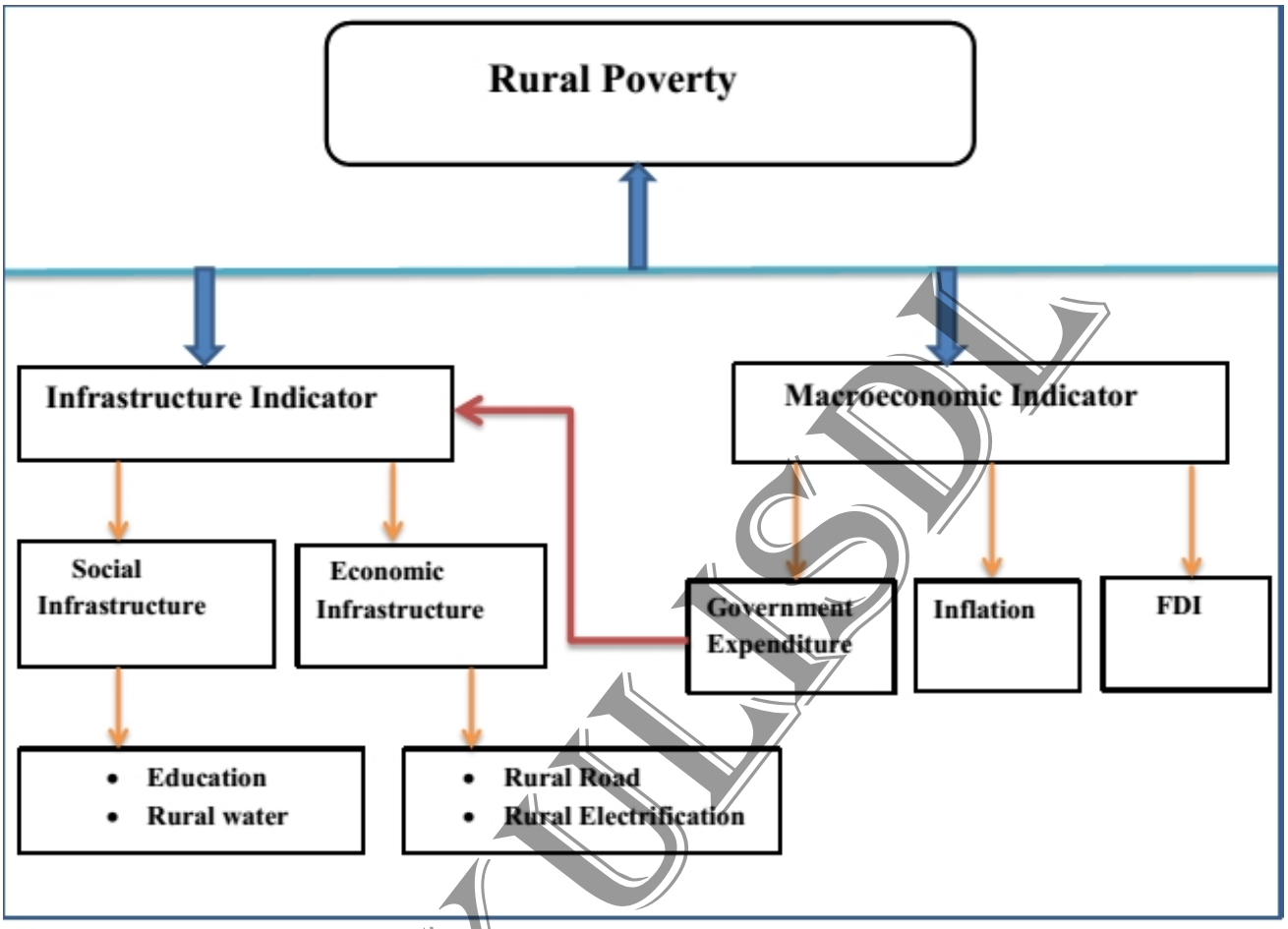


Figure 1.1 The General conceptual frameworks of the thesis to the effects of infrastructure on Rural Poverty

CHAPTER THREE

3. RESEARCH METHODOLOGY

3.1. Types and Source of Data

The study is based on secondary data. This study used panel data which cover annual data from 1995/96-2015/16. The data was sourced from National Bank of Ethiopia, Central statics Agency and World Bank. The level of rural poverty of Ethiopia is dependent variable and Rural Road, Rural electrification, rural water sanitation, Government expenditure (capital expenditure), Education expenditure, Regional Inflation (CPI), Direct Foreign investment, (independent variables).

3.2. Methods of data collection

The data is collected HICE survey has taken place for one full year from 1995/96 to 2015/16 by five year time intervals. A total of 82 data collection team, each composed of two enumerators and one supervisor/field editor, were organized in order to execute the field work. Furthermore, these 82 teams were organized in 25 CSA branch offices, each headed by an experienced statistician. Each team was responsible to collect data in at most 24 enumeration areas (EA).

3.2.1. Method of Measuring Poverty

As we have mentioned at literature review, Income or consumption is traditionally used to material deprivation. Especially consumption rather than income is viewed as the preferred welfare indicator because consumption better captures the long-run welfare level than current income. Consumption may better reflect households' ability to meet basic needs. Income is only one of the elements that allow consumption. Consumption reflects the ability of household's access to credit and saving at times. When their income is very low, hence, consumption reflects the actual standard of living (welfare). Therefore, consumption is better measured than income. In most developing countries, income report of households is likely to be understated compared to consumption expenditure report. Income is so erratic and seasonal that it may be very difficult for respondents to recall. Hence, many of the income poverty measures such as the head count rate, poverty gap ratio, and the squared poverty gap ratio use consumption rather than income in the conduct of poverty analysis (CSA, 2007).

Consumption to be an indicator of household's welfare, it has to be adjusted for difference in the calorie requirement of different household members (for age and gender of adult members). Total poverty here refers to an aggregate measure of poverty that takes into account both the food and non-food requirements. Here it is worth noting how poverty lines are established. The most widely used method of estimating poverty line is the cost of basic needs method because the indicators will be more representative and the threshold will be consistent with real expenditure across time, space and groups. First, the food poverty line is defined by choosing a bundle of food typically consumed by the poor. The quantity of the bundle of food is determined in such a way that the bundle supplies the predetermined level of minimum caloric requirement (2200 kilocalorie). This bundle is valued at local prices or at national average prices if the objective is to get a consistent poverty line across regions and groups. Then a specific allowance for the non-food goods consistent with the spending of the poor is added to the food poverty line. To account for the non-food expenditure, the food poverty line is divided by the food share of the poorest quartile or quintile. More precisely, these measures can be defined in terms of the well-known (Foster, Greer, and Thorbecke, 1984) P_α class of poverty measures.

$C = F(Y_1 \leq Y_2 \ldots\ldots\ldots\ldots\ldots\ldots Y_q \leq Z < {}_{q+1} \ldots\ldots\ldots\ldots\ldots\ldots\ldots \leq Y_n)$---------- (3.1)

When C is consumption, y is real per-adult (per capital) household expenditure. Where Z is poverty line, N is the total population, and q is the number of poor, and then $P_\alpha$is given by:

$P_\alpha = \frac{1}{N}\sum_{i=1}^{q} \left(\frac{\mathrm{Z}-\mathrm{Y}_i}{\mathrm{Z}}\right)^{\alpha}; \alpha \geq 0, for\ Y \leq Z$---------- (3.2)

Here the parameter α reflects the policymaker's degree of aversion to inequality among the poor. If α = 0, there is no concern about the depth of poverty and the corresponding poverty index.

3.2.2. Function of the Variable

Thus, we can describe the Head count induces function of Ethiopia in the following way:

HCI= f (RW, RE, EDUD, GEXP, CPI, RRD, FDI)

All variables are changed to logarithm to minimize the variation among the data and hence to reduce the heteroscadastcity and multicollinearity problems.

3.3. Model Specification

In this paper, the researcher used panel data to study the effect of infrastructure on rural poverty in Ethiopia. Following the convention adopted by the model.

$$HCI_{it} = \alpha_{it} + \beta_1 RRD_{it} + \beta 2RE_{it} + \beta 3RW_{it} + \beta_4 CPI_{it} + \beta_5 EDUD_{it} + \beta_6 GEXP_{it} + \beta_7 FDI_{it} + \varepsilon_{it} ------------------------------------ (3.3)$$

The following final log linear model will be as follow

$$LogHCI_{it} = \beta_0 + \beta_1 (LogRRD)_{it} + \beta_2 \, log(RE)_{it} + \beta_3 \, log(RW)_{it} + \beta_4 \, log(CPI)_{it} + \beta_5 log(GEXP)_{it} + \beta_6 log(EDUD)_{it} + \beta_7 log(FDI)_{it} + \varepsilon_t \ldots \ldots (3.4)$$

The lower case variables are expressed in the natural logarithmic and ε refers to the error terms. Where

i is the respective regions in the sample and t denotes the years.

HCI it is head count induces in regional i at t,

RE it is rural electrification in regional i at a time t,

RW it is rural water sanitation/potable water in regional level i at a time t,

CPI it is inflation rate in regional level i at a time t,

GEXP it is government expenditure/capital in regional level i at a time t,

EDUD it is education Decepercement in regional level i at a time t,

FDI it investment in regional level i at a time t.

3.4. Description of the Variables and their Expected Signs

Head Count Induces (HCI): The dependent variable its refers to poverty in rural areas, including factors of rural society, rural economy, and systems that give rise to the poverty found there poor people in rural areas face an acute poor rural administrative lack of basic social and economic infrastructure such as health and educational facilities and access to safe drinking water. Generally rural people who cannot meet their minimum basic needs. They are below the poverty line and the percentage is calculated each region under the poverty line. It measured by consumption. Hence, this study used HCI to proxy the rural poverty (World Bank, 2016).

Rural Road Expansion (RRE): Total investment for road construction, expansion, and maintenance of roads remained one of the key investments for the government. Hence, large sum of finance (it measures by using regional budget which planed on the explanation of road) has been mobilized for road construction and maintenance both from foreign and domestic sources for remote area, The relation between rural road and head count induces expected sign is negative (ERA, 2010).

Rural Electrification (RE): refers to the process of bringing electricity to rural areas that are far away from electricity infrastructure and very remote and measure in Kilo watt distributed. The purpose of electrification is to make life easier for people living in rural areas and help them to be able to sustain themselves better. By having electricity, they will be more capable of keeping food for longer, they will increase productivity on farms, they may be able to do work and other activities after dark because they will now have light, etc. It has refused the heightened interest in infrastructure in relation to the part it can play positively improving welfare. The expected sign between rural electrification and HCI is negative. It measured kilowatt distributed each region (UN, 2000).

Government expenditure for region (GEXR): capital also known as government spending, refers to the resources a government allocates to achieve its strategic objectives and satisfy the needs of the members of the nation. Governments spend money (disbursement birr) on, benefits, and infrastructure and defense activities. Annual government budgets specify the breakdown of funds for a fiscal year. Total government expenditure includes federal government expenditure, as well as state and local government expenditure. Government expenditure relates to the objectives of a government, such as price stability, financial control and economic growth. Government expenditures state to the expenses that the government incurs for its own maintenance, for the society and the economy as a whole. Government spending reflects the policy choices of government. Once governments have decided up on the type and quantity of goods and services to provide, government spending represents the cost of carrying out these policies to alleviate poverty (Wondmu et al., 2016).

Governments spend to maintain bridges, harbors and canals, on defense activities, to protect trade, to generate coinage, to provide Social Security and other entitlements and to facilitate to sustain poverty. The expected sign in government expenditure and HCI negative relation (Shenggen Fan, 2008).

Education Expenditure (EDUE): Indicators related to education expenditure help to show what financial resources are directed to education. The resource allocation issues they provide insight into include government emphasis on education compared to other sectors, the relative priority of specific school levels in national education strategies, and spending on teacher salaries. In combination with other indicators, such as school participation and learning outcomes, expenditure data can be used to consider the efficiency and effectiveness of resource allocation in the education sector disbursed in birr. The expected sign of education expenditure and HCI is negative relationship (NBE, 2010/11).

Regional Inflation Rate (CPR): The rate of increase in prices for goods and services in regional level. Measures of inflation and prices include consumer price inflation, producer price inflation, the house price index, index of private housing rental prices, and construction output price indices. The regional simple average food & nonalcoholic beverages inflation in rate, the expected sign of inflation and HCI is positive (NBE, 2015).

Water and Sanitation/Potable water (RW): Access to Water supply rural population with access to potable water 15 l/c/d for rural at a radius of 1.5 kilo meters in rate. It measured by potable water access in rate. The expected sign of water sanitation and HCI is negative (MOWR, 2015).

Foreign Direct Investment (FDI): This refers to direct investment equity flows in the reporting economy. All the investment projects were private and public; those are invested different sectors of regional levels disbursed in Birr. Foreign direct investment reflects establishing a lasting interest by a resident enterprise in one economy (direct investor) in an enterprise (direct investment enterprise) that is resident in an economy other than that of the direct investor. The expected sign of foreign direct investment and HCI is negative (World Bank, 2010).

3.5. Data analysis

Data analysis is a process applying statistical practices to organize, represent, describe, evaluate and interpret data. There are differences between qualitative data analysis and quantitative data analysis. Since this study is mainly used secondary data, the study involves critical analysis and interpretation of figures and numbers, and attempts to find rationale behind the emergence of main findings. Comparisons of primary research findings to the findings of the literature review are critically important.

The data collect with the use of secondary method of data collection are subject to statistical analysis with the use of both inferential and descriptive statistics. The Econometric (Eviews) version 9 and Stata version 13.00 was used in analyzing the data that were obtained. Based on this, descriptive analysis, unit root, Granger Causality tests and Random effect analyses were used for this study to examine the effect of infrastructure development on rural poverty of Ethiopia.

3.5.1. Panel Unit Root and Stationary Test

After choosing between random and fixed models then step in the panel data analysis is to carry out panel unit root tests and verify the order of Integration. Panel unit root testing arise from the time series nature of the data and its unit root. The major difference between time series testing of unit roots and panel unit root tests is that we have to consider asymptotic behavior of the time-series dimension (T) and the cross-sectional dimension of individual observation (N).Using Statistical software we can implements a variety of tests for unit roots or stationary in panel datasets. Maddala and Wu (1999) and Choi (2001) Augmented Dickey Fuller (ADF) unit root test and Ordinary Least Square (OLS) technique are employed to estimate the model of the study. The choice of OLS is mainly because it minimizes the error sum of squares and has a number of advantages such as un biasedness, consistency, minimum variance and efficiency. On the other hand, ADF test is applied to ensure that the time series data used in the analysis have constant mean and variance. The motivation is to hedge against spurious regression that may result from applying OLS to non-stationary time series data. Also, the ADF test addresses a shortcoming of the Dickey Fuller test – its lack of consideration of autocorrelation in the error term by adding lagged difference terms, thereby correcting for serial correlation.

Furthermore, the models, before estimation, are subjected to multicolinearity test. After estimation, the models are subjected to tests of heteroskedasticity and autocorrelation described in the next section. Both tests are crucial so as to prevent either serial correlation or heteroskedasticity from biasing the standard errors on which inferential decisions are based. Evidence of either heteroskedasticity or autocorrelation in the model will warrant re-estimating the model by the Newey-West method, which produces Heteroskedastic and Autocorrelation Consistent (HAC) standard errors. Choi (2001) tries to overcome these limitations and proposes a very simple test based on the combination of p-values from a unit root test applied to each group in the panel data.

There exist a number of possible p-value combinations to this aim, but the Fisher's one turns out to be the better choice. Choi (2001) considers the model:

$y_{it} = d_{it} + x_{it}$……..…….. (3.5)

with i= 1,2,..., N, t= 1,2,..., T and:

$d_{it} = \alpha_{i0} + \alpha_{i1}t + \cdots . + \alpha_{im}t^{mi}$……..……..(3.6)

$x_{it} = \rho_i x_{i(t-1)} + u_{it}$…….……...…… (3.7)

And it u is integrated of order zero. Note that the observed data it y are composed of a no stochastic process it d and a stochastic process it x. Each time series it y can have different sample size and different specification of no stochastic and stochastic component depending on i. The null hypothesis is:

H_0:$\rho_i = 1$for all i…….……..……..…….....(3.8)

Which implies that all the time series are unit root no stationary. The alternative hypothesis may be:

H_a: $|\rho_i| < 1$For at least one I finite N ……. (3.9)

That is some time series are no stationary while the others are not, or

H_a: $|\rho_i| < 1$ For some i's for infinite N……..…..... (3.10)

Which includes as a special case the alternative that all the time series are stationary, as it is considered in LLC. Let G_{it}be a one-sided unit root test statistic (DF tests) for the i[th] group in model. Assume that: a).under the null hypothesis as$T_i \to \infty$, $G_{iT_i} \to G_i$(where $G_i$is a non-degenerate random variable); b). u_i is independent of u_{js} for all t and s when i≠ j c). N_k/N →k (a fixed constant) as N→ ∞. Let p_i be the p-value of a unit root test for cross section i.e,,p_i =F(G_{iTi}),where F(.) is the distribution function of G_i.

The proposed Fisher type test is:p=-2$\sum_{i=1}^{N} ln_{pi}$which combines the p-value from unit root tests for each cross-section i to test for unit root in panel data. Under null hypothesis of unit root, P is distributed as X^2(2N) as $T_i \to \infty$ for all N.Fisher test holds some important advantages: 1) it does not require a balanced panel as in the case of IPS test; 2) it can be carried out for any unit root test derived; 3) it is possible to use different lag lengths in the individual ADF regression. The main disadvantage of this test is that the p-values have to be derived by Monte Carlo simulation.

When N is large, it is necessary to modify the P test since in the limit it has a degenerate distribution. Having for the P test E$[-2\ln pi] = 2$ and Var$[-2\ln pi] = 4$. Choi (2001) proposes a Z test:

$$Z = \frac{1}{2\sqrt{N}}\sum_{i=1}^{N}(2lnpi - 2) \quad (3.11)$$

Choi (2001) also studies the effects of serial correlation in it u on the size for the panel unit root tests and concludes that this is an important source of size distortions

3.5.2. Fixed Effects and Random Effects Models

In panel data analysis the most commonly estimated models are the fixed effects (FE) and random effects (RE) models. These two main models used in estimation with panel data. Due to the two-dimensional nature of panel data, there exist both unit and time fixed effects models, the first of which assumes the differences in data occur in a fixed manner across individuals and not at all across time and the second of which assumes fixed differences across time and no differences across individuals. We most often assume, especially in cases where the number of years measured in the data is small, that more of the differences occur across individuals, so unit fixed effects is a much more common estimator to use. Because of this convention, for the remainder of this paper, the term fixed effects refers to the unit fixed effects model. The unit fixed effects model is given by the following equation:

$$\boldsymbol{Y_{it} = \beta_{1i} + \beta_2 X_{2it} + \beta_3 X_{3it} + e_{it}} \quad 1$$

The fixed effects model assumes that variation between individuals is fixed with respect to time. This model includes an individual specific, time invariant intercept such that each individual has their own intercept. This intercept is the β term in the model, and these intercepts represent the fixed effects that the models. The fixed effects model is estimated by the given data. This process first averages the data across time to get the following equation: Thus the equation for the fixed effects model becomes:

$$\boldsymbol{\overline{y}_{it} = \beta_{1i} + \beta_2 \overline{X}_{2i} + \beta_3 \overline{X_{3i}} + \overline{\varepsilon}_{it}} \quad 2$$

Then, by subtracting this equation from the underlying model, the transformed model is obtained with the demeaned y depending on the demanded x's and the error term. The process of demeaning the data also serves to eliminate the individual intercepts β1 from the model being estimated, thus decreasing the number of degrees of freedom used. This transformed equation can be estimated using OLS and the β2 and β3 in the transformed model are the same as in the underlying model. The

fixed effects model is appropriate when there is some factor that makes individuals different from one another, but this factor is constant over time. Such time invariant factors include innate ability for individuals or historical and institutional factors for countries.

The random effects model used for panel data assumes that the differences between individuals are random as opposed to fixed. This is modeled by including a fixed intercept β1 and a random variable u which varies across individuals in place of the individual intercept in the fixed effects β1in model. The ui term is assumed to have constant variance and mean zero, similar to a random error term. It is also assumed to be uncorrelated with the x in the regression, as the e term is. It models for each individual i at each unit of time t is thus:

$$Y_{it} = \beta_1 + u_i + \beta_2 X_{2it} + \beta_{3X_{3\,it}} + e_{it} \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots 3$$

The random effects estimator allows us to look at variables that vary over time as well as those that do not. For example, characteristics of individuals in the sample such as gender or race, which do not vary over time, can be factored into random effects while they cannot in fixed effects. Additionally, a random effect is estimated using GLS while fixed effects is estimated using OLS and as such, random effects estimates will generally have smaller variances. As a result, the random effects model is more efficient. While random effects are more efficient than fixed effects, problems often arise that make it not applicable as a model. Most often, the random effects themselves, u, are correlated with the x's. Simply, the random variation across individuals is often related to other observations of the individuals. This violates our assumptions about u, and makes random effects an invalid estimator.

To decide between fixed effect and random effects model for this study, we are seeing after running a Haussman test where the null hypothesis is that the preferred model is RE versus the alternative the FE. It is basically tests whether the idiosyncratic error ($\boldsymbol{U_{it}}$) is correlated with the regresses. The null hypothesis says there is no correlation against the alternative (there is correlation) (Masuku, 2015).

The random effects model can be consistently estimated by both the RE estimator or the FE estimator. We would prefer the RE estimator, if we can be sure that the individual-specific effect really is an unrelated effect. This is usually tested by a (Durbin-Wu-) Hausmann test. However, the Hausman test is only valid under homoscedasticity and cannot include time fixed effects. The assumption of FE is better tested by running an auxiliary regression. Not rejecting RE does not mean

accepting it. Interest in the effect of a time-invariant variable is no sufficient reason to use the RE estimator (Wooldridge, 2010).

3.5.3. Panel Granger Causality Test

Granger causality tests measures the causal relationship with bivariate data sets and these relationships can be expressed as unidirectional or bidirectional. The panel Granger causality tests takes the following form;

$$Y_{it} = \alpha_0 + \sum_{j=1}^{m} \alpha_j Y_{it-j} + \sum_{j=1}^{m} \delta_j X_{it-j} + f_{yi} + u_{it} \quad \text{---------- (3.7)}$$

$$X_{it} = \beta_0 + \sum_{j=1}^{m} \beta_j Y_{it-j} + \sum_{j=1}^{m} \gamma_j X_{it-j} + f_{xi} + \nu_{it} \quad \text{---------- (3.8)}$$

Where Y_{it} and X_{it} are the two co-integrated variables, i=1,…..,N represents cross-sectional panel members, u_{it} and ν_{it} are error terms. This model differs from the standard causality model in that it adds two terms, f_{xi} and f_{yi} which are individual fixed effects for the panel member i.

In the equations above, the lagged dependent variables are correlated with the error terms, including the fixed effects. Hence, estimates of the above model will be biased. The remedy is to remove the fixed effects by differencing. The resulting model is:

$$\Delta Y_{it} = \sum_{j=1}^{m} \alpha_j \Delta Y_{it-j} + \sum_{j=1}^{m} \delta_j \Delta X_{it-j} + \Delta u_{it}$$

$$\Delta X_{it} = \sum_{j=1}^{m} \beta_j \Delta Y_{it-j} + \sum_{j=1}^{m} \gamma_j \Delta X_{it-j} + \Delta \nu_{it} \quad \text{…… (3.9)}$$

Assuming that u_{it} and ν_{it} are serially uncorrelated, then, to test for the causality, the joint hypotheses $\delta_j = 0 \quad for\ j = 1,....., m$ and $\beta_j = 0 \quad for\ j = 1,....., m$ is simply tested.

3.6. Model Diagnostic Test

3.6.1. Hetersecdastic Test

The test of hetroskedasticity is conducted in this study to know the weather the variance of the error term is constant or varying. This theoretically assumed that the variance of the error term is assumed to be constant or var ($\in_t$) =δ^2, this also known as homoscedasticity assumption. Heteroscedasticity arises as a result of the presence outliers. The inclusion or exclusion of such observations, especially when the sample size is small, can substantially alter the results of regression analysis. The standard errors and *t* statistics are justified only as the sample size becomes large, even if the CLRM assumptions are true. With small sample sizes, the *t* statistics can have distributions that are not very close to the *t* distribution, and that could throw off our inference.

The distribution of one or more repressors' included in the model is another source of heteroscedasticity. Even sometimes incorrect data transformation, incorrect functional form (linear or log-linear model) is also the source of heteroscedasticity. There are many ways of testing hetroscedacitsity tests of problem, like the White (1980), and Breash Pagan. This study uses the formula for testing hetroskedasticity, given by Calculated value or test statistics is = NR^2(T-1), Where N refers to number of groups or observations R^2 is the goodness of fit from the regression of the residual square on the independent variable and T is the time series dimension. The hypothesis is, the null Ho: There is homoscedasticity and the alternative H_1: There is hetroscedasitcity.

3.6.2. Autocorrelation Test

Autocorrelation is the measure of the linear statistical relationship among the error terms. Empirically, this assumption of OLS regression and theoretically expressed by the numbers of researchers among others (Brooks et al., 2008). They expressed as; cov($\in_i, \in_j$) = 0, this is another assumption that is made of the CLRM disturbance terms is that the covariance between the error terms over time (or cross-sectionally, for that type of data) is zero. In other words, it is assumed that there is no correlation between the error terms. If the errors are correlated with one another, it would be stated that they are auto correlated or that they are serially correlated.

The most common test of this assumption is by using the Durbin–Watson test, Pesaran CD test and the Breusch-Godfrey test (2008). This study is going to use Breusch and Pagan Lagrangian multiplier test for random effects, test for serial correlation by using the command *xtseria*. The

hypothesis stated as Ho: there is no autocorrelation against the alternative (HA): There is autocorrelation. The null is no serial correlation and the alternative says there is serial correlation.

Accordingly, we fail to reject the null and conclude the data does not have first-order autocorrelation at 5% level of significant. Thus P- value is around 0.05 and this indicates that the errors are not seriously correlated. Accordingly as shown in the above we reject the null and conclude the data have first-order serial correlation at 5% level of significant. Thus P- value is less than 0.05 and this indicates that the errors are serially correlated. Of course it is not much of the concern of panel data model, we can correct by using first order autoregressive estimation techniques.

3.6.3. The Normality (Bera-Jarque) Test

Another third important diagnostic test conducted in this paper is the normality assumption (i.e the normally distributed errors). Brooks (2008) stated that the normality assumption ' ($ut \sim N(0, \sigma 2)$)' is required in order to conduct single or joint hypothesis tests about the model parameters. One of the most commonly applied tests for normality is the Bera Jarque (BJ) test. BJ uses the property of a normally distributed random variable that the entire distribution is characterized by the first two moments - the mean and the variance (Brooks, 2008, p.161). In case of this study, the researcher used BJ normality test to test the null hypothesis of normally distributed errors assumptions.

To execute this assumption the data distributional pattern should have a kurtosis value of three and follow the normal distribution pattern with mean equals to median which also equals its mode. Normality test can be conducted either Graphical plot or numerically through commands. The hypothesis is as follows; Ho: there is normality or normally distributed against the alternative (HA): it is not normally distribute. Accordingly it is one of the most commonly applied tests for normality. The decision rule is when the *p*-value is greater than 5% then accept the null hypothesis of normally distribute. According to the Jarque-Bera test result the variables have is normality distribute.

CHAPTER FOUR

4. RESULT AND DESCUSIONS

4.1. Descriptive Analysis

This section describe and deals with the regression result and analyze the effect of infrastructure on rural poverty in Ethiopia by using regional level data and strongly balanced panel data analysis from 1995 to 2016. Rural poverty rates calculated in Ethiopia started 1995, 2000, 2005, 2010, and 2015, respectively. It is collected every five years so there is gap between the years. In order to introduce the time interval to the consecutive time, we need to replace the streak of data in 1995 Data 2000, 2000 Data 2001, 2005 Data 2002, 2010 Data 2003, 2015 Data 2004, into the time series changed. All included data on this research is similar to rural poverty calculated years. In this case, all the important variables are observed and estimated for each cross section and each time period. An estimation of the model consists of deciding whether the estimated co-efficient are theoretically meaningful and statistically satisfactory. For this study there is need for all results to satisfy both statistical criteria (first order test) and econometric criteria (Second order test).Head count induce is the proxy of rural poverty.

The dataset takes two segments, a time series segment running and across section segment across the regions which are consisting of eleven regions of Ethiopia namely: Tigray, Amahara, Oromyia, Southern Nations, Nationalities & Peoples Regional Government, Afar, Ethio-Somali,Benshangul-Gumuz National Regional State, Harari, Dire Dawa and Addis Ababa city Administration.

The analysis comprises: descriptive statistics of the variables in the model, Hausman test is used to determine whether fixed or random effect model is appropriate. Diagnostic Tests/ tests for the assumptions of Classical Linear regression Model (CLRM) like ,Heteroscedasticity, Normality, and Autocorrelation is conducted. Finally discussion of the results and comparisons with the existing empirical literature were done.

Before going to the empirical results of the model it is important to discuss the characteristics and the distributional patterns of the variables included in the model. This helps to have the overall look at the variables being studied. It covers annual observation for the selected regions of Ethiopia. In this descriptive case rural poverty untitled group containing all of the specified series, and opens a statistics view of the group. By default, if more than one series is given, the statistics are calculated

for the common sample. The table below shows the descriptive statistic values of the variables which consist of both dependent and independent variables for 55 observations. Head count induce is the proxy of rural poverty.

It consists of one dependent variable and seven independent variables. The minimum and maximum values of each variable indicate that the minimum and maximum values from each region used in this study respectively. Mean indicates; Mean value the average value of each sampled regions in each variable.

Table 4.1: Summary of Descriptive Statistics Regression Results

	Variable	Mean	Median	Max	Min	Std. Dev.	Skewness	Kurtosis	Jarque-Bera	Prob.	Sum	Sum Sq. Dev.	Ob
Tigray	HCI	49.54	51.0	67.50000	31.10	15.65417	-0.068286	1.403710	0.534748	0.765387	247.7000	980.2120	5
	CPI	8.86	8.9	12.30000	6.3	2.355419	0.407917	1.960230	0.363897	0.833644	44.30000	22.19200	5
	EDUD	3285.040	3156	5897	1541	1640.118	0.743760	2.440645	0.526165	0.768678	16425.20	10759954	5
	FDI	2453.117	163.0	11112.00	11.0	4852.327	1.482121	3.224878	1.841105	0.398299	12265.59	94180320	5
	GEXP	1.91E+09	9.25E+08	6.11E+09	2.75E+08	2.40E+09	1.326062	3.001096	1.465367	0.480617	9.57E+09	2.31E+19	5
	RE	5.40E+08	4.56E+08	9.46E+08	1.97E+08	3.09E+08	0.270351	1.550741	0.498481	0.779392	2.70E+09	2.66E+17	5
	RRD	3.80E+08	3.70E+08	6.76E+08	4235689	2.58E+08	-0.363572	2.018761	0.310743	0.856097	1.90E+09	3.82E+17	5
	RW	43.90000	42.10	60.40000	24.00000	14.40069	-0.208905	1.797309	0.337715	0.844629	219.5000	829.5200	5
AA	HCI	31.23400	30.07000	38.70000	27.10000	4.377817	1.135937	2.896607	1.077522	0.583471	156.1700	76.66112	5
	CPI	12.04000	10.30000	19.40000	7.200000	4.629579	0.772674	2.386570	0.575916	0.749793	60.20000	85.73200	5
	EDUD	4044.940	4154.200	6542.000	1546.000	2109.084	-0.026429	1.452781	0.499309	0.779070	20224.70	17792947	5
	FDI	10856.08	6147.600	30627.00	722.0000	12637.40	0.794002	2.133114	0.681927	0.711085	54280.40	6.39E+08	5
	GEXP	7.12E+08	35487521	3.42E+09	19874854	1.51E+09	1.499590	3.249450	1.886938	0.389275	3.56E+09	9.18E+18	5
	RE	1.04E+08	7365945.	3.29E+08	1104807	1.46E+08	0.793639	1.979103	0.742017	0.690038	5.20E+08	8.53E+16	5
	RRD	8.05E+08	8.25E+08	1.46E+09	2.43E+08	5.61E+08	0.026441	1.329958	0.581633	0.747653	4.03E+09	1.26E+18	5
	RW	70.76400	67.00000	82.22000	61.00000	9.972085	0.282677	1.248480	0.705718	0.702676	353.8200	397.7699	5
Afar	HCI	46.12000	42.9	68	26.50000	15.28895	0.232757	2.169829	0.188727	0.909952	230.6000	935.0080	5
	CPI	11.76000	10.3	19.6	2.900000	7.209230	0.015221	1.445543	0.503597	0.777402	58.80000	207.8920	5
	EDUD	1828.080	1548	3451	984.0000	995.3228	0.938512	2.451341	0.796718	0.671421	9140.400	3962670.	5
	FDI	93.53610	16.00000	399.000	5.000000	171.3482	1.474900	3.214782	1.822386	0.402044	467.6805	117440.9	5
	GEXP	1.02E+09	7.57E+08	5.000000	2.15E+08	9.46E+08	1.257176	2.993621	1.317084	0.517605	5.11E+09	3.58E+18	5
	RE	20495102	18564315	2.15E+08	8957854	11877394	0.791027	2.353765	0.608440	0.737698	1.02E+08	5.64E+14	5
	RRD	48529201	34568956	17265894	17265894	30877152	0.498058	1.700517	0.558521	0.756343	2.43E+08	3.81E+15	5
	RW	35.58000	31.00000	17.00000	17.00000	20.18940	0.586097	1.923204	0.527818	0.768043	177.9000	1630.448	5

Amara	HCI	40.70	40.4	60.70000	28.80000	12.71358	0.724351	2.273570	0.547175	0.760646	203.5000	646.5400	5
	CPI	10.4	10.3	15.90000	6.200000	3.665379	0.469049	2.165276	0.328499	0.848530	52.00000	53.74000	5
	EDUD	7768.340	7243.000	10224.00	5587.000	1905.742	0.225337	1.546899	0.482210	0.785759	38841.70	14527412	5
	FDI	1493.782	117.000	6507.310	13.60000	2822.170	1.450546	3.177971	1.760001	0.414783	7468.910	31858575	5
	GEXP	6.65E+09	4.35E+09	1.98E+10	8.75E+08	7.59E+09	1.291804	2.984664	1.390680	0.498905	3.32E+10	2.31E+20	5
	RE	4.32E+08	2.08E+08	9.59E+08	1.27E+08	3.71E+08	0.587657	1.597873	0.697359	0.705619	2.16E+09	5.50E+17	5
	RRD	1.14E+09	9.88E+08	2.24E+09	3.23E+08	7.02E+08	0.638693	2.480053	0.396262	0.820262	5.68E+09	1.97E+18	5
	RW	57.44000	46.00000	89.90000	36.00000	24.07141	0.466387	1.457173	0.677164	0.712780	287.2000	2317.732	5
Benishangul	HCI	44.32000	45.80000	61.20000	28.70000	14.70636	-0.031684	1.329333	0.582321	0.747396	221.6000	865.1080	5
	CPI	7.520000	7.400000	9.500000	4.600000	2.075331	-0.317479	1.754612	0.407117	0.815822	37.60000	17.22800	5
	EDUD	584.1800	550.0000	1050.000	225.0000	335.1140	0.325300	1.721056	0.428954	0.806963	2920.900	449205.4	5
	FDI	16340.47	11.00000	81611.00	0.000000	36487.35	1.499997	3.249996	1.888012	0.389066	81702.33	5.33E+09	5
	GEXP	5.99E+08	2.99E+08	1.84E+09	1.85E+08	7.01E+08	1.404741	3.113086	1.647079	0.438876	2.99E+09	1.97E+18	5
	RE	29687859	19801290	68954231	11564864	23750864	1.032002	2.518773	0.935768	0.626326	1.48E+08	2.26E+15	5
	RRD	2.88E+08	3.59E+08	4.56E+08	62263685	1.70E+08	-0.397790	1.469870	0.619635	0.733581	1.44E+09	1.15E+17	5
	RW	47.66000	36.40000	86.90000	22.00000	25.94317	0.653529	1.993615	0.566919	0.753174	238.3000	2692.192	5
DD	HCI	28.06000	30.80000	39.80000	14.20000	9.711231	-0.323724	1.994400	0.298005	0.861567	140.3000	377.2320	5
	CPI	9.440000	8.300000	14.70000	6.200000	3.308021	0.808366	2.321769	0.640380	0.726011	47.20000	43.77200	5
	EDUD	383.5400	401.0000	524.0000	201.0000	126.4739	-0.403561	1.908190	0.384061	0.825282	1917.700	63982.63	5
	FDI	1437.958	1063.000	2995.000	68.80000	1123.612	0.260788	1.885796	0.315311	0.854144	7189.790	5050015.	5
	GEXP	3.33E+08	2.03E+08	9.90E+08	84546897	3.72E+08	1.402947	3.124947	1.643468	0.439669	1.67E+09	5.54E+17	5
	RE	1.08E+08	54383539	3.66E+08	2968547	1.47E+08	1.349054	3.053467	1.517218	0.468317	5.42E+08	8.63E+16	5
	RRD	10171053	8945698.	15269874	5269817	3905020	0.126947	1.759865	0.333833	0.846270	50855263	6.10E+13	5
	RW	65.84000	64.00000	78.00000	52.00000	10.44165	-0.095330	1.682462	0.369220	0.831428	329.2000	436.1120	5
Gambela	HCI	39.68000	32.90000	54.60000	26.40000	12.73055	0.293624	1.290472	0.680697	0.711522	198.4000	648.2680	5
	CPI	9.020000	8.700000	11.30000	7.800000	1.430734	0.825884	2.300270	0.670408	0.715192	45.10000	8.188000	5
	EDUD	413.2200	442.0000	654.0000	124.0000	224.6370	-0.208650	1.490542	0.510959	0.774545	2066.100	201847.2	5
	FDI	790.3000	5.500000	3920.000	0.000000	1749.578	1.499902	3.249869	1.887762	0.389115	3951.500	12244098	5
	GEXP	4.84E+08	2.88E+08	1.28E+09	2.22E+08	4.49E+08	1.437515	3.162001	1.727508	0.421576	2.42E+09	8.08E+17	5
	RE	55901050	38456421	1.36E+08	16895745	46728802	1.214330	2.895643	1.231100	0.540344	2.80E+08	8.73E+15	5
	RRD	1.36E+08	1.51E+08	2.09E+08	23950600	73862580	-0.620759	2.052408	0.508187	0.775619	6.81E+08	2.18E+16	5
	RW	56.72000	51.00000	74.00000	41.00000	16.00912	0.261561	1.230604	0.709254	0.701435	283.6000	1025.168	5
Hare ri	HCI	14.16000	14.90000	20.60000	8.500000	4.796666	0.118899	1.739724	0.342676	0.842537	70.80000	92.03200	5
	CPI	11.40000	11.00000	19.30000	5.900000	5.070010	0.644700	2.313715	0.444487	0.800720	57.00000	102.8200	5

	EDUD	244.2600	250.0000	321.0000	156.0000	67.05996	-0.183920	1.617082	0.426618	0.807906	1221.300	17988.15	5
	FDI	71.85800	32.00000	276.0000	0.000000	115.2458	1.427295	3.154416	1.702610	0.426857	359.2900	53126.42	5
	GEXP	3.05E+08	1.94E+08	8.54E+08	1.06E+08	3.10E+08	1.431917	3.163385	1.714218	0.424387	1.52E+09	3.84E+17	5
	RE	1.42E+08	29188373	6.02E+08	5684732	2.58E+08	1.488516	3.234897	1.857895	0.394969	7.10E+08	2.65E+17	5
	RRD	2.95E+08	2.02E+08	6.80E+08	88380000	2.29E+08	1.090573	2.743709	1.004809	0.605074	1.47E+09	2.09E+17	5
	RW	57.30000	56.50000	65.00000	48.00000	6.888396	-0.170243	1.689209	0.382105	0.826089	286.5000	189.8000	5
SNNP	HCI	38.78000	38.20000	52.10000	21.90000	13.29199	-0.115066	1.466388	0.501026	0.778401	193.9000	706.7080	5
	CPI	11.66000	10.20000	19.70000	6.400000	5.145192	0.717301	2.244058	0.547819	0.760401	58.30000	105.8920	5
	EDUD	6204.080	6784.000	8254.000	3645.000	2035.877	-0.282636	1.378233	0.614512	0.735462	31020.40	16579183	5
	FDI	10119.36	322.0000	49751.00	5.200000	22155.78	1.499655	3.249539	1.887111	0.389241	50596.80	1.96E+09	5
	GEXP	5.40E+09	2.55E+09	1.72E+10	1.15E+09	6.74E+09	1.337697	3.011374	1.491222	0.474444	2.70E+10	1.81E+20	5
	RE	1.18E+08	44880426	2.45E+08	28562348	1.12E+08	0.403252	1.178024	0.827093	0.661301	5.88E+08	5.02E+16	5
	RRD	9.70E+08	9.88E+08	1.27E+09	5.70E+08	2.65E+08	-0.501478	2.186815	0.347332	0.840578	4.85E+09	2.80E+17	5
	RW	45.46000	42.30000	63.00000	34.00000	11.73917	0.591607	1.942720	0.524550	0.769299	227.3000	551.2320	5
Oromya	HCI	34.98000	37.20000	42.70000	25.30000	7.413973	-0.315520	1.474934	0.567508	0.752952	174.9000	219.8680	5
	CPI	10.74000	9.600000	19.30000	6.800000	5.065373	1.118779	2.738324	1.057321	0.589394	53.70000	102.6320	5
	EDUD	9894.600	10245.00	15254.00	3654.000	5011.941	-0.140108	1.428877	0.530614	0.766970	49473.00	1.00E+08	5
	FDI	8419.564	657.0000	32219.00	122.0000	13791.45	1.269583	2.880274	1.346187	0.510128	42097.82	7.61E+08	5
	GEXP	9.26E+09	5.66E+09	2.77E+10	1.55E+09	1.06E+10	1.319297	3.012313	1.450486	0.484207	4.63E+10	4.47E+20	5
	RE	2.69E+08	1.68E+08	4.70E+08	1.16E+08	1.73E+08	0.380311	1.201578	0.794348	0.672217	1.35E+09	1.20E+17	5
	RRD	1.85E+09	1.49E+09	3.52E+09	6.73E+08	1.18E+09	0.468611	1.703464	0.533207	0.765977	9.24E+09	5.57E+18	5
	RW	48.62000	44.00000	70.10000	32.00000	16.36680	0.325698	1.474156	0.573441	0.750722	243.1000	1071.488	5
Somalia	HCI	37.98000	43.20000	45.20000	22.30000	9.630524	-0.979837	2.375165	0.881405	0.643584	189.9000	370.9880	5
	CPI	10.14000	8.300000	20.90000	4.100000	6.386940	1.071309	2.779931	0.966508	0.616773	50.70000	163.1720	5
	EDUD	2376.160	2421.000	3121.000	1548.000	627.8869	-0.152894	1.677962	0.383602	0.825471	11880.80	1576968	5
	FDI	556.3840	8.200000	2738.000	0.000000	1219.617	1.499652	3.249533	1.887102	0.389243	2781.920	5949864	5
	GEXP	2.38E+09	1.55E+09	6.93E+09	5.15E+08	2.61E+09	1.314962	3.003499	1.440940	0.486524	1.19E+10	2.73E+19	5
	RE	34771901	21675568	75634862	10616405	26228296	0.776796	2.123439	0.662918	0.717876	1.74E+08	2.75E+15	5
	RRD	3.54E+08	2.02E+08	9.85E+08	47895642	3.76E+08	1.092871	2.653449	1.020326	0.600398	1.77E+09	5.66E+17	5
	RW	39.50000	36.10000	67.00000	27.40000	16.17653	1.153209	2.788249	1.117584	0.571899	197.5000	1046.720	5

Source: EViews version 9 using NBE, CSA, MOFED, ERA,EEPC data

The table 4.1 represents the descriptive statistics of the model. In the above table HCI is a dependent variable and CPI, RW, RE, GEXP, EDUD, RRD and FDI are independent variables. The sample size comprises of 55 observations from the period of 2000 to 2004 of eleven regions of Ethiopia. The

minimum and maximum value of HCI in Tigray (31.10) and (67.5) respectively, whereas the mean value is (49.54) and standard deviation is (15.65417). The minimum and maximum value of CPI (6.3) and (12.3) respectively, whereas the mean value is (8.86) and standard deviation is (2.355419). RW having minimum value (24), maximum value (60.4), mean value (43.9) and standard deviation (14.4). RE having minimum value (1.97E+08), maximum value (9.46E+08), mean value (5.40E+08) and standard deviation (3.09E+08). GEXP having minimum value (2.75E+08), maximum value (6.11E+09), mean value (1.9E+09) and standard deviation (2.40E+09). EDUD having minimum value (1541), maximum value (5897), mean value (3285.04) and standard deviation (1640.118). RRD having minimum value (4235689.), maximum value (6.76E+08), mean value (3.80E+08) and standard deviation (2.58E+08) and FDI of having minimum value (11.00), maximum value (11112.00), mean value (2453.117) and standard deviation (4852.327).

The minimum and maximum value of HCI in Addis Abeba (27.1) and (38.7) respectively, whereas the mean value is (31.234) and standard deviation is (4.377817). The minimum and maximum value of CPI (7.2) and (19.4) respectively, whereas the mean value is (12.04) and standard deviation is (4.629579). RW having minimum value (61), maximum value (82.22), mean value (7.76) and standard deviation (9.972). RE having minimum value (1104807), maximum value (3.29E+08), mean value (1.04E+08) and standard deviation (1.46E+08). GEXP having minimum value (19874854), maximum value (3.42E+09), mean value (7.12E+08) and standard deviation (1.51E+09). EDUD having minimum value (1546), maximum value (6542), mean value (4044.94) and standard deviation (2109.84). RRD having minimum value (2.43E+08), maximum value (1.46E+09), mean value (8.05E+08) and standard deviation (5.61E+08) and FDI of having minimum value (722.00), maximum value (30627.00), mean value (10856.08) and standard deviation (12637.4).

The minimum and maximum value of HCI in Afar (26.5) and (68) respectively, whereas the mean value is (46.12) and standard deviation is (15.288). The minimum and maximum value of CPI (2.9) and (19.6) respectively, whereas the mean value is (11.76) and standard deviation is (7.2). RW having minimum value (17), maximum value (17), mean value (35.58) and standard deviation (20.189). RE having minimum value (8957854), maximum value (2.15E+08), mean value (2049512) and standard deviation (11877394). GEXP having minimum value (2.15E+08), maximum value (5.000000), mean value (1.02E+09) and standard deviation (9.46E+08). EDUD having minimum value (984), maximum value (3451), mean value (1828.08) and standard deviation (995.32). RRD having minimum value (17265894), maximum value (17265894), mean value (4852921) and

standard deviation (30877152) and FDI of having minimum value (5.00000), maximum value (399.000), mean value (93.536) and standard deviation (171.3482).

The minimum and maximum value of HCI in Amara (28.8) and (60.7) respectively, whereas the mean value is (40.7) and standard deviation is (12.71351). The minimum and maximum value of CPI (6.2) and (15.9) respectively, whereas the mean value is (10.4) and standard deviation is (3.665379). RW having minimum value (36), maximum value (89.9), mean value (57.44) and standard deviation (24.07). RE having minimum value (1.27E+08), maximum value (9.59E+08), mean value (4.32E+08) and standard deviation (3.71E+08). GEXP having minimum value (8.75E+08), maximum value (1.98E+10), mean value (6.65E+09) and standard deviation (7.59E+09). EDUD having minimum value (5587), maximum value (10224), mean value (7768.34) and standard deviation (1905.742). RRD having minimum value (3.23E+08), maximum value (2.24E+09), mean value (1.14E+09) and standard deviation (7.02E+08) and FDI of having minimum value (13.6), maximum value (6507.31), mean value (1493.782) and standard deviation (2822.17).

The minimum and maximum value of HCI in Benoshangule Gumuz (28.7) and (61.2) respectively, whereas the mean value is (44.32) and standard deviation is (14.70636). The minimum and maximum value of CPI (4.6) and (9.5) respectively, whereas the mean value is (7.52) and standard deviation is (2.075). RW having minimum value (22), maximum value (86.9), mean value (47.66) and standard deviation (25.94317). RE having minimum value (11564864), maximum value (68954231), mean value (29687859) and standard deviation (23750864). GEXP having minimum value (1.58E+08), maximum value (1.84E+09), mean value (5.99E+08) and standard deviation (7.01E+08). EDUD having minimum value (225), maximum value (1050), mean value (584.18) and standard deviation (335.114). RRD having minimum value (62263685), maximum value (4.56E+08), mean value (2.88E+08) and standard deviation (1.70E+08) and FDI of having minimum value (00000), maximum value (81611), mean value (16340.47) and standard deviation (36487.35).

The minimum and maximum value of HCI in Dira Dawa (14.2) and (39.8) respectively, whereas the mean value is (28.06) and standard deviation is (9.711231). The minimum and maximum value of CPI (6.2) and (14.7) respectively, whereas the mean value is (9.44) and standard deviation is (3.308021). RW having minimum value (52), maximum value (78), mean value (65.84) and standard deviation (10.44165). RE having minimum value (2968547), maximum value (3.66E+08), mean value (1.08E+08) and standard deviation (1.47E+08). GEXP having minimum value (84546897), maximum value (9.90E+08), mean value (3.33E+08) and standard deviation (3.72E+09). EDUD having

minimum value (201), maximum value (524), mean value (383.54) and standard deviation (126.4739). RRD having minimum value (5269817), maximum value (15269874), mean value (10171053) and standard deviation (3905020) and FDI of having minimum value (68.8), maximum value (2995), mean value (1437.958) and standard deviation (1123.6121).

The minimum and maximum value of HCI in Gambela (24.4) and (54.6) respectively, whereas the mean value is (39.68) and standard deviation is (12.73055). The minimum and maximum value of CPI (7.8) and (11.3) respectively, whereas the mean value is (9.02) and standard deviation is (1.430734). RW having minimum value (41), maximum value (74), mean value (56.72) and standard deviation (16.00). RE having minimum value (16895745), maximum value (1.36E+08), mean value (55901050) and standard deviation (46728802). GEXP having minimum value (2.22E+08), maximum value (1.28E+09), mean value (4.84E+08) and standard deviation (4.49E+08). EDUD having minimum value (124.000), maximum value (654.000), mean value (413.22) and standard deviation (224.6370). RRD having minimum value (23950600), maximum value (2.09E+08), mean value (1.36E+08) and standard deviation (73862580) and FDI of having minimum value (0000), maximum value (3920), mean value (790.3000) and standard deviation (1749.578).

The minimum and maximum value of HCI in Hareri (8.5) and (20.6) respectively, whereas the mean value is (14.16) and standard deviation is (4.796666). The minimum and maximum value of CPI (5.9) and (19.3) respectively, whereas the mean value is (11.4) and standard deviation is (5.070010). RW having minimum value (48), maximum value (65), mean value (57.3) and standard deviation (6.888396). RE having minimum value (5684732), maximum value (6.02E+08), mean value (1.42E+08) and standard deviation (2.58E+08). GEXP having minimum value (1.06E+08), maximum value (8.54E+08), mean value (3.05E+08) and standard deviation (3.10E+08). EDUD having minimum value (156.000), maximum value (321.000), mean value (244026) and standard deviation (67.05996). RRD having minimum value (88380000), maximum value (6.80E+08), mean value (2.95E+08) and standard deviation (2.29E+08) and FDI of having minimum value (0.0000), maximum value (276), mean value (71.858) and standard deviation (115.2458).

The minimum and maximum value of HCI in SNNP (21.9) and (52.1) respectively, whereas the mean value is (338.75) and standard deviation is (13.29199). The minimum and maximum value of CPI (6.4) and (19.7) respectively, whereas the mean value is (1166) and standard deviation is (5.145192). RW having minimum value (34), maximum value (63), mean value (45.46) and standard deviation (11.73917). RE having minimum value (28562348), maximum value (2.45E+08), mean value

(1.18E+08) and standard deviation (1.12E+08). GEXP having minimum value (1.15E+09), maximum value (1.72E+10), mean value (5.40E+09) and standard deviation (6.74E+09). EDUD having minimum value (3645), maximum value (8254), mean value (5204.08) and standard deviation (2035.877). RRD having minimum value (5.70E+08), maximum value (1.27E+09), mean value (9.70E+08) and standard deviation (2.65E+08) and FDI of having minimum value (5.2), maximum value (49752), mean value (1011936) and standard deviation (22155.78).

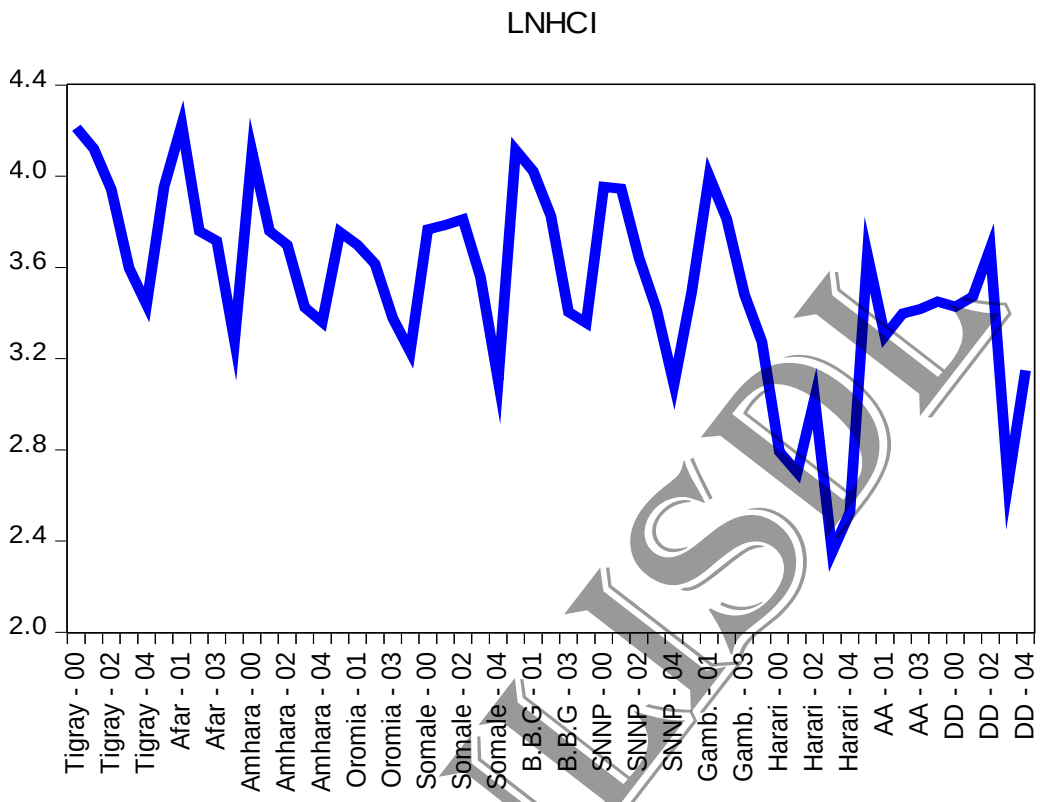
The minimum and maximum value of HCI in Oromya (25.3) and (42.7) respectively, whereas the mean value is (34.98) and standard deviation is (7.413973). The minimum and maximum value of CPI (6.8) and (19.3) respectively, whereas the mean value is (10.74) and standard deviation is (5.065373). RW having minimum value (32), maximum value (70.10), mean value (48.62) and standard deviation (16.36680). RE having minimum value (11.16E+08), maximum value (4.70E+08), mean value (2.69E+08) and standard deviation (1.73E.08). GEXP having minimum value (1.55E+09), maximum value (2.77E+10), mean value (9.26E+09) and standard deviation (1.06E+10). EDUD having minimum value (3654), maximum value (15254), mean value (9894.6) and standard deviation (5011.941). RRD having minimum value (6.73E+08), maximum value (3.52E+09), mean value (1.85E+09) and standard deviation (1.18E+09) and FDI of having minimum value (122.0000), maximum value (32219), mean value (8419.564) and standard deviation (1379145).

The minimum and maximum value of HCI in Somalia (22.3) and (45.2) respectively, whereas the mean value is (37.98) and standard deviation is (9.630524). The minimum and maximum value of CPI (64.10) and (20.9) respectively, whereas the mean value is (10.14) and standard deviation is (6.386940). RW having minimum value (24.4), maximum value (67), mean value (39.5) and standard deviation (16.17653). RE having minimum value (10616405), maximum value (75634862), mean value (34771901) and standard deviation (26228296). GEXP having minimum value (5.15E+08), maximum value (6.93E+09), mean value (2.38E+09) and standard deviation (2.61E+09). EDUD having minimum value (1548), maximum value (3121), mean value (2376.16) and standard deviation (627.8869). RRD having minimum value (47895642), maximum value (9.85E+08), mean value (3.54E+08) and standard deviation (3.76E+08) and FDI of having minimum value (0.0000), maximum value (2738), mean value (556.3840) and standard deviation (1219.617).

In most regions, rural poverty rates are highest in Tigray, Benishangul-Gumuz, Amhara, Afar, South Nation Nationality People, Somali, and Gambella, while in rural areas, Dire-Dawa, Addis Ababa, Oromia and low rural poverty rates are estimated in Hareri. It should therefore be emphasized that the region's poorest regions are highly rated, and the infrastructure development should be promoted and encouraged to reduce rural poverty.

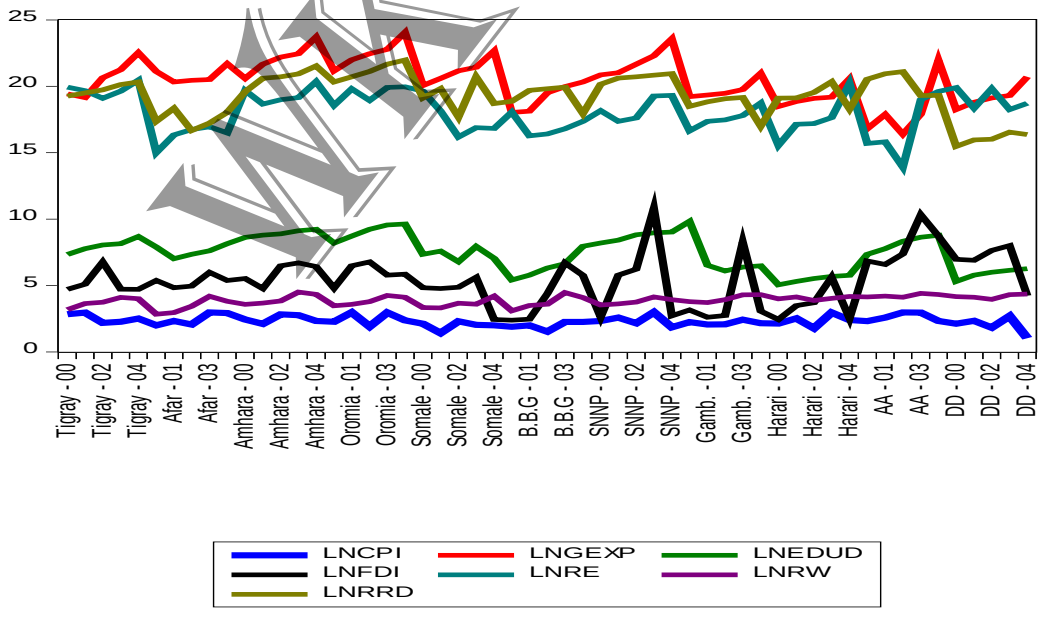
4.2. The Trend of Infrastructure Development on Rural Poverty Reduction in Ethiopia

Figure 4.2.1.The Trend of Dependent Variable



Source: Eviews version 9 using NBE, CSA, MOFED, ERA and, EEPC, 2019

Figure 4.2.2.The Trend of Independent Variable



Source: Eviews version 9 using NBE, CSA, MOFED, ERA and, EEPC, 2019

The figure above indicates the growth of average independent variables fluctuation through times on the regions of Ethiopia. Among the trend of the independent variable is looks like above, the potential for the expense of government expenditure, the progress of road, the access of electrification and the capacity of investment so as to invest and invite foreigners is better on the region of Amhara, Oromia, SNNP and Addis Ababa. However, the remaining region needs different support and subsidies from the government and the policymakers should give attentions on these regions. Therefore, the effect of rural infrastructure development is positive and open good opportunity to reduce the problem rural poverty in the region of Ethiopia. To sum up this discussion result, the progress and the trend of infrastructure development plays an important role on the reduction of regional poverty and achieves our objectives.

4.3. Panel Unit Root Test

Table 4.3. Below shows the results for the unit root tests conducted for the variables under this study. The null hypothesis proposes that some variables have unit root test. This means that the error terms of the variable in question is serially correlated. If the data has unit root test, it is non-stationary, non-stationary process is when the error term of the variables are serially correlated, the mean is not zero and variance is not constant. It is the opposite of stationary process where the data must satisfy the assumptions underlying the classical regression model. The non-stationary of the variables cause's previous values of the error terms yt-1 to have none declining effect on the current value of yt as time progresses which in turn leads to spurious regression.

Table 4.3.1. Summary of Fisher Chi-square Unit Roots Tests Result

Level			**Level of integration**
Variables	**statistics**	**probability**	**Level of Integration**
LNHCR	70.5884	0.0000	I(1)
LNRW	45.5211	0.0023	I(1)
LNEDUD	64.1444	0.0000	I(0)
LNCPI	56.2821	0.0001	I(0)
LNFDI	42.6962	0.0051	I(1)
LNRE	34.8854	0.0398	I(0)

LNRRD	51.7883	0.0003	I(1)
LNGEXP	49.8269	0.0006	I(1)

Source: Eviews version 9 using NBE, CSA, MOFED, ERA, EEPC Data

As described above table, shows that certain variables are non-stationary at level but with first difference all variables become stationary.

4.4. The Effect of Infrastructure Development on Rural poverty Reduction in Ethiopia

Table 4.4.1. Summary Regression Result of Random Effect Estimation

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	7.769928	1.604953	4.841218	0.0000
LNLNRE	0.462160	0.475448	0.972053	0.3373
LNCPI	0.170175	0.083018	2.049844	0.0475*
LNEDUD	-0.087988	0.042968	-2.047768	0.0477*
LNFDI	0.026650	0.018439	1.445310	0.1568
LNGEXP	-0.100372	0.035966	-2.790743	0.0083*
LNRRD	-0.050838	0.037825	-1.344049	0.1871
LNRW	-0.421102	0.105134	-4.005370	0.0003*
	Effects Specification			
Cross-section fixed (dummy variables)				
R-squared	0.885883	Mean dependent var		3.529504
Adjusted R-squared	0.833450	S.D. dependent var		0.418287
S.E. of regression	0.170705	Akaike info criterion		-0.439630
Sum squared resid	1.078187	Schwarz criterion		0.217315
Log likelihood	30.08982	Hannan-Quinn criter.		-0.185584
F-statistic	16.89573	Durbin-Watson stat		2.497978
Prob(F-statistic)	0.000000			

Source: Eviews version 9 using NBE, CSA, MOFED, ERA and, EEPC, 2019

The regression results have their own implications, and hence the coefficient indicates each variable's level of influence on the dependent variable. The influence or the relationship may be positive or negative. The P- value and Z- statics shows the level of significant of the variables. Except foreign direct investment, CPI and rural electrification, all variables are negative coefficient and the behavior of expected signs. Even rural water, Education, Inflation and Government Expenditure variables are significant. The theory suggests that infrastructure developments are

reducing rural poverty. The empirical result tells that as infrastructure increases which rural poverty decreases. The statistical tests previously conducted revealed that the Hausman Specification Test result most appropriate model (Random Effect) which indicates, the regression model fits well for the regression model.

The p-value is given by 0.000 which is less than 0.05, which shows the high significance of our model. The values of Durbin-Watson statistics for dependent variable in our case is very near to 2.00(2.497978), this indicates that there is no autocorrelation exists in our study and the regression models assume that the error deviations are uncorrelated. Beta coefficient shows the tendency of an independent variable to respond against dependent Variables. Therefore, greater value of beta indicates the larger effect on dependent variable and vice versa. LNEDUD (0.08), LNGEXP(0.10) and LNRW(0.42) are having negative and significant, LNCPI(0.17) is having positive and significant effect on the rural poverty because the p-value is less than 0.05.

To sum up, the result from the Eview software shows that the Adjusted R^2 is 0.885. This means that the explanatory variables affect with 88% of rural poverty or the estimated model shows a fair goodness of fit with a coefficient of determination of 0.88, indicating that about 88% of the variation in rural poverty is explained by the explanatory variables.

The capital expenditure of government is highly significant. This implies that, the more government expense to region leads to a greater reduction of rural poverty. It implies that, government expenditure plays a significant role for the rural poverty reduction in regions of Ethiopia. Government expenditures are to the expenses that the government incurs for its own maintenance, for the society and the economy as a whole. The policy choices of the government are decided on the type and quantity of goods and services provides and the government is increase spending and reduce cost of carrying out the policies to increase the development of infrastructure (Bhatia et al., 2003).On the other hand The effect of education infrastructure is highly significant. This implies that the more expended on education leads to a significant effect on both economic growth and poverty reduction. The effect of education also have a positive effect on the non-farm wages and employment opportunities of the rural poor and on rural urban migration, leading to an increased overall effect on rural poverty reduction. More education Expenditure will contribute to the reduction of poverty in rural areas in terms of the availability of education and training in the rural areas.

As a result, in the rural areas, the agricultural sector is able to grow agricultural and modernize the agricultural sector, enabling agriculture to increase the income of the rural as the result of rural poverty reduce. Rural primary education often has a substantially larger effect than secondary and tertiary education and achieves the objectives of poverty reduction (Shenggen and Fan, 2008).

The access of water and sanitation/potable water is highly significant. This implies that, to obtain more water sanitation to be greater reduction of rural poverty. The well-being of clean drinking water areas is better protected than others, and they are better protected from waterborne disease and better maintain their sanitation. And clean water is available to the community by their water near them. The theory suggest that the increasing of rural water decrease rural poverty**.** The contribution of water and sanitary infrastructure to be positive effect on rural poverty from a panel of sub-Saharan countries is the other achievements of our objective (Estache et al., 2005)

The consumer price index of is also highly significant. The sign for the coefficient of region of CPI is positive and significant as expected. And the coefficient is statically significant. The theory suggest that the increasing of inflation its increases rural poverty. Annual regional inflation rate, do have significant effect on poverty level. This issue is really important in terms of poverty alleviation program. The inflation rate has substantial effect on rural poverty, thus government should control rural inflation rate along with poverty alleviation program since most poor people lives in rural area (Kakwani N.2006).

The diagnostic test of residuals shows that the model has desirable and fulfills the properties of OLS estimation. In line with this, it measure and test the Residual test of normality, auto correlation and heteroskedasticity problem are tested and conducted. (See Appendix, 2,3 and 4)

4.5. Causal Relationship between Infrastructure Development and Rural Poverty

Table4.5.1: Summary of Granger causality Tests Results

Null Hypothesis:	Obs	F-Statistic	Prob.
LNCPI does not Granger Cause LNHCI	44	0.99963	0.3233
LNHCI does not Granger Cause LNCPI		0.25838	0.6140
LNRE does not Granger Cause LNHCI	44	0.24495	0.6233
LNHCI does not Granger Cause LNRE		4.60047	0.0379
LNRW does not Granger Cause LNHCI	44	1.96513	0.1685
LNHCI does not Granger Cause LNRW		0.02329	0.8795
LNFDI does not Granger Cause LNHCI	44	0.94418	0.3369

LNHCI does not Granger Cause LNFDI		1.80994	0.1859
LNGEXP does not Granger Cause LNHCI	44	0.36605	0.5485
LNHCI does not Granger Cause LNGEXP		1.24416	0.2712
LNEDUD does not Granger Cause LNHCI	44	1.19480	0.2807
LNHCI does not Granger Cause LNEDUD		0.70544	0.4058
LNRRD does not Granger Cause LNHCI	44	0.45145	0.5054
LNHCI does not Granger Cause LNRRD		4.67485	0.0496

Source: Eviews version 9 using NBE data

The causality estimation shows both electrification and road has a positive effect infrastructure development on rural poverty reduction. Furthermore, the study found unidirectional causal relationship moving from electrification and road while there is no causality between foreign direct investment, inflation, government expenditure, education and rural water with rural poverty. There is no bidirectional relation between variables. This finding is consistent with the standard economic theory.

Generally to summarize there is unidirectional granger causality between LNRE, and LNRRD with LNHCI but not vice versa, LNFDI, LNGEXP, LNRW, LNCPI and LNEDU. The reason why rural poverty cannot granger because rural poverty is not successful in relation to intended objectives, because of this is due to the fact that, rural poverty in Ethiopia has faced a number of inhibiting factors mainly stemming from the economic structure of the economy, and rural poverty in Ethiopia seems to suffer from a lack of basic necessities, it is very slow and seems to be ineffective as we were unable to find notable productivity, market structure and business environment prevailing in Ethiopia (Wadajo et al., 2017).. After applying the causality test we found the unidirectional causal relationship of rural electrification and rural road with head count induces. On the other side we found no causal relationship of foreign direct investment, inflation, government expenditure, education and rural water with head count rate.

CHAPTER FIVE

5. CONCLUSION AND POLICY RECOMMENDATIONS

5.1. Conclusion

Infrastructural development is a key important instrument for the improvement of poverty alleviation and relevance to poverty reduction. It often acts as a catalyst to development and improves the poor's access to other assets. This study investigates the effect of infrastructure development on rural poverty in Ethiopia. For investigation purpose the study has used electrification, rural road, rural water, education, government expenditure, foreign direct investment, inflation is selected as an explanatory variable while head count induces taken as a proxy and dependent variable.

The Random effect model was used for econometrics analysis in order to show the effect of rural poverty. In analyzing the effect of infrastructure development on rural poverty in Ethiopia, the study were applied Unit root tests, and Granger causality test. Based on the findings, the study highlights major variable such as water, education, inflation and government expenditure has a significant effect on rural poverty reduction. The estimation result suggested that, an increasing infrastructure development reduces rural poverty. The causality estimation shows both electrification and road has a positive effect infrastructure development on rural poverty reduction. Furthermore, the study found unidirectional causal relationship moving from electrification and road while there is no causality between foreign direct investment, inflation, government expenditure, education and rural water with rural poverty. There is no bidirectional relation between variables. This finding is consistent with the standard economic theory.

5.2. Policy of Recommendation

Based on the analysis made and conclusion arrived the following policy implication are derived. As it existed and observed from the estimation results, infrastructure is one of the major contributions of rural poverty reduction significant variable.

- This implies that regions of Ethiopia should eliminate or at least minimize rural poverty duties so as to improve infrastructure performance. This is confirmed the fact that, the device of Government expenditure is a positive effect on reduction of rural poverty and more pronounced with the consideration of infrastructure. Since infrastructure to be significantly affecting economic growth enhancement and reduction rural poverty of Ethiopia. The aim of policies government of the Ethiopia should to encourage their infrastructure development to eliminate rural poverty. An increase in infrastructure was statistically significant on reduction of rural poverty.
- The Government of Ethiopia should continue to intensify efforts to expand infrastructure in rural areas and in particular to promote, expand clean water, and expand education access, stabilize macro indicator variables that manage inflation, make additional subsidies, and expand rural electrification efforts to reduce rural poverty. This study shows that infrastructure development has a positive effect on rural poverty reduction.
- The policymakers should give due attention towards the effective formulation and implementation of infrastructure development policies to reduce and eliminate rural poverty, and there should give attention for the potential impacts of resolving the problem of rural poverty.
- Generally, the policy makers of Ethiopia should emphasis for infrastructure development performance and the efficient potential utilization of regions Ethiopia is concerned. The empirical investigation of this study indicates that infrastructure is essential in reduction of rural poverty in regions of Ethiopia.

5.3. Areas for Future Studies

This study examines infrastructure development effect on rural poverty by using infrastructure indicator variables and due to absences of organized data and time. The other challenge is the incompatibility of data from different sources; from World Bank, CSA, ERA, NBE and other sources. Some variables are not consistence. Thus, Future research should continue the quest for a better data and including other additional economic and social infrastructure indicators to show the performance of infrastructure and that effect on rural poverty by considering the effect of other factors such as whether condition of the regions, human capital development for innovation of technology.

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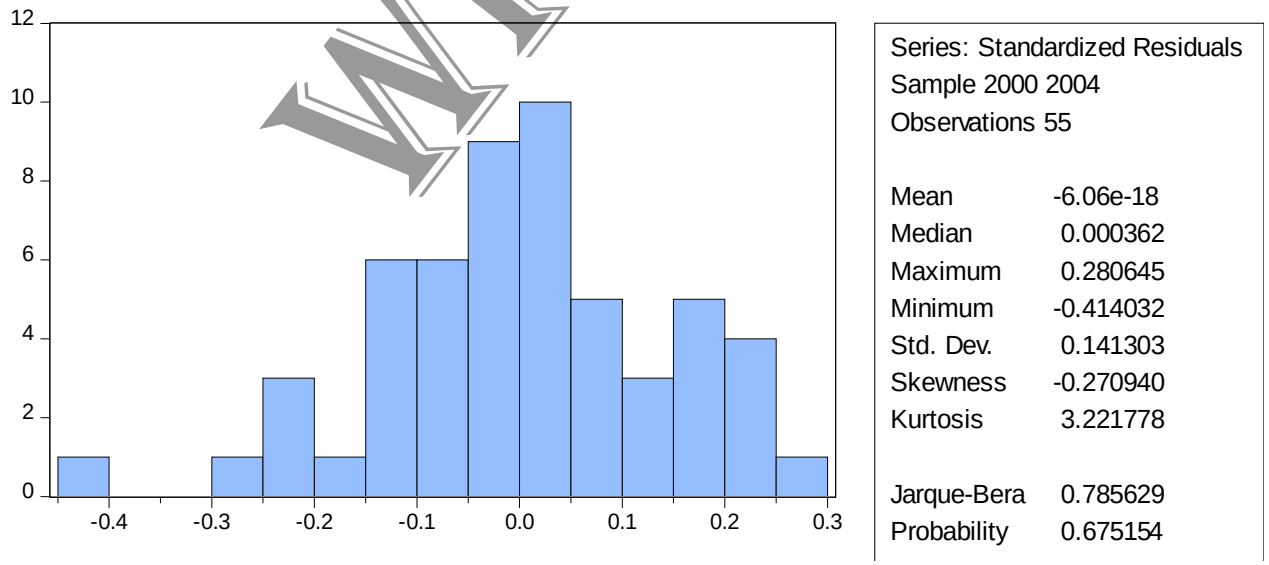
List of Appendix

Appendix 1: Trends of Regional Poverty Head Count Indices

Region	***1995/96***	***1999/2000***	***2004/2005***	***2010/11***	***2015/16***
	Rural	*Rural*	*Rural*	*Rural*	*Rural*
Tigray	67.5	61.6	51	36.5	31.1
Afar	52.1	68	42.9	41.1	26.5
Amhara	60.7	42.9	40.4	30.7	28.8
Oromia	42.7	40.4	37.2	29.3	25.3
Somale	43.2	44.1	45.2	35.1	28.7
B.B.G	61.2	55.8	45.8	30.1	22.3
SNNP	52.1	51.7	38.2	30	21.9
Gamela	32.9	54.6	52	32.5	26.4
Harari	16.3	14.9	20.6	10.5	8.5
AA	38.7	27.1	29.9	30.07	30.4
DD	30.8	32.2	39.8	14.2	23.3

Appendix 2: Residual test of normality



Appendix 3: Serial correlation test

Test	Statistic	d.f.	Prob.
Breusch-Pagan LM	66.68134	55	0.1344
Pesaran scaled LM	1.113772		0.2654
Bias-corrected scaled LM	-0.261228		0.7939
Pesaran CD	-0.016626		0.9867

Appendix 4: Heteroskedasticity test

Heteroskedasticity Test: Breusch-Pagan-Godfrey

F-statistic	1.943982	Prob. F(7,47)	0.0835
Obs*R-squared	12.34878	Prob. Chi-Square(7)	0.0897
Scaled explained SS	8.009708	Prob. Chi-Square(7)	0.3317

Appendix 5. Granger Causality Tests

Pairwise Granger Causality Tests
Date: 06/03/19 Time: 14:31
Sample: 2000 2004
Lags: 1

Null Hypothesis:	Obs	F-Statistic	Prob.
LNCPI does not Granger Cause LNHCI	44	0.99963	0.3233
LNHCI does not Granger Cause LNCPI		0.25838	0.6140
LNRE does not Granger Cause LNHCI	44	0.24495	0.6233
LNHCI does not Granger Cause LNRE		4.60047	0.0379
LNRW does not Granger Cause LNHCI	44	1.96513	0.1685
LNHCI does not Granger Cause LNRW		0.02329	0.8795
LNFDI does not Granger Cause LNHCI	44	0.94418	0.3369
LNHCI does not Granger Cause LNFDI		1.80994	0.1859
LNGEXP does not Granger Cause LNHCI	44	0.36605	0.5485
LNHCI does not Granger Cause LNGEXP		1.24416	0.2712
LNEDUD does not Granger Cause	44	1.19480	0.2807

LNHCI			
LNHCI does not Granger Cause LNEDUD		0.70544	0.4058
LNRRD does not Granger Cause LNHCI	44	0.45145	0.5054
LNHCI does not Granger Cause LNRRD		4.67485	0.0496
LNRE does not Granger Cause LNCPI	44	0.44167	0.5100
LNCPI does not Granger Cause LNRE		6.92983	0.0119
LNRW does not Granger Cause LNCPI	44	0.05125	0.8220
LNCPI does not Granger Cause LNRW		2.59651	0.1148
LNFDI does not Granger Cause LNCPI	44	0.00496	0.9442
LNCPI does not Granger Cause LNFDI		0.03397	0.8547
LNGEXP does not Granger Cause LNCPI	44	0.16016	0.6911
LNCPI does not Granger Cause LNGEXP		8.16490	0.0067
LNEDUD does not Granger Cause LNCPI	44	3.42726	0.0713
LNCPI does not Granger Cause LNEDUD		4.39873	0.0422
LNRRD does not Granger Cause LNCPI	44	2.64786	0.1114
LNCPI does not Granger Cause LNRRD		0.02052	0.8868
LNRW does not Granger Cause LNRE	44	4.10532	0.0493
LNRE does not Granger Cause LNRW		0.08290	0.7749
LNFDI does not Granger Cause LNRE	44	3.54051	0.0670
LNRE does not Granger Cause LNFDI		0.27038	0.6059
LNGEXP does not Granger Cause LNRE	44	0.85070	0.3618
LNRE does not Granger Cause LNGEXP		3.77789	0.0588
LNEDUD does not Granger Cause LNRE	44	2.22459	0.1435
LNRE does not Granger Cause LNEDUD		1.47383	0.2317
LNRRD does not Granger Cause LNRE	44	2.16395	0.1489
LNRE does not Granger Cause LNRRD		1.57330	0.2168
LNFDI does not Granger Cause LNRW	44	0.29899	0.5875
LNRW does not Granger Cause LNFDI		0.11755	0.7335
LNGEXP does not Granger Cause LNRW	44	0.01352	0.9080
LNRW does not Granger Cause LNGEXP		8.60441	0.0055
LNEDUD does not Granger Cause LNRW	44	0.03195	0.8590
LNRW does not Granger Cause LNEDUD		1.36215	0.2499

LNRRD does not Granger Cause LNRW	44	0.80720	0.3742
LNRW does not Granger Cause LNRRD		0.60328	0.4418
LNGEXP does not Granger Cause LNFDI	44	0.74304	0.3937
LNFDI does not Granger Cause LNGEXP		10.6563	0.0022
LNEDUD does not Granger Cause LNFDI	44	0.75003	0.3915
LNFDI does not Granger Cause LNEDUD		3.49923	0.0685
LNRRD does not Granger Cause LNFDI	44	0.09193	0.7633
LNFDI does not Granger Cause LNRRD		1.47464	0.2316
LNEDUD does not Granger Cause LNGEXP	44	3.31106	0.0761
LNGEXP does not Granger Cause LNEDUD		1.44428	0.2363
LNRRD does not Granger Cause LNGEXP	44	1.57459	0.2166
LNGEXP does not Granger Cause LNRRD		2.55285	0.1178
LNRRD does not Granger Cause LNEDUD	44	3.24019	0.0792
LNEDUD does not Granger Cause LNRRD		2.88065	0.0972

Appendix 6: Unit root Test Results

Null Hypothesis: Unit root (individual unit root process)
Series: LNCPI
Date: 05/25/19 Time: 04:38
Sample: 2000 2004
Exogenous variables: Individual effects
Newey-West automatic bandwidth selection and Bartlett kernel
Total (balanced) observations: 44
Cross-sections included: 11

Method	Statistic	Prob.**
PP - Fisher Chi-square	56.2821	0.0001
PP - Choi Z-stat	-3.50326	0.0002

** Probabilities for Fisher tests are computed using an asymptotic Chi-square distribution. All other tests assume asymptotic normality.

Intermediate Phillips-Perron test results LNCPI

Cross section	Prob.	Bandwidth	Obs

Tigray	0.4996	3.0	4
Afar	0.6695	1.0	4
Amhara	0.4015	1.0	4
Oromia	0.0073	1.0	4
Somale	0.1447	0.0	4
B.B.G	0.4307	0.0	4
SNNP	0.0019	0.0	4
Gamb.	0.3025	0.0	4
Harari	0.1180	0.0	4
AA	0.4514	1.0	4
DD	0.0003	0.0	4

Null Hypothesis: Unit root (individual unit root process)
Series: D(LNRW)
Date: 05/25/19 Time: 04:40
Sample: 2000 2004
Exogenous variables: Individual effects
Newey-West automatic bandwidth selection and Bartlett kernel
Total (balanced) observations: 33
Cross-sections included: 11

Method	Statistic	Prob.**
PP - Fisher Chi-square	45.5211	0.0023
PP - Choi Z-stat	-3.48681	0.0002

** Probabilities for Fisher tests are computed using an asymptotic Chi-square distribution. All other tests assume asymptotic normality.

Intermediate Phillips-Perron test results D(LNRW)

Cross section	Prob.	Bandwidth	Obs
Tigray	0.1981	0.0	3
Afar	0.4206	2.0	3
Amhara	0.1370	2.0	3
Oromia	0.1332	2.0	3
Somale	0.0224	0.0	3
B.B.G	0.0150	1.0	3
SNNP	0.0946	2.0	3
Gamb.	0.1519	2.0	3
Harari	0.3194	0.0	3
AA	0.1338	1.0	3
DD	0.4147	2.0	3
Afar	0.0170	0.0	3
Amhara	0.0058	0.0	3
Oromia	0.4525	2.0	3

Somale	0.9765	2.0	3
B.B.G	0.1894	2.0	3
SNNP	0.0315	2.0	3
Gamb.	0.0037	2.0	3
Harari	0.1715	1.0	3
AA	0.0001	2.0	3
DD	0.1289	2.0	3

Null Hypothesis: Unit root (individual unit root process)
Series: LNRE
Date: 05/25/19 Time: 04:42
Sample: 2000 2004
Exogenous variables: Individual effects
Newey-West automatic bandwidth selection and Bartlett kernel
Total (balanced) observations: 44
Cross-sections included: 11

Method	Statistic	Prob.**
PP - Fisher Chi-square	34.8854	0.0398
PP - Choi Z-stat	-1.04484	0.1480

** Probabilities for Fisher tests are computed using an asymptotic Chi-square distribution. All other tests assume asymptotic normality.

Intermediate Phillips-Perron test results LNRE

Cross section	Prob.	Bandwidth	Obs
Tigray	0.6776	0.0	4
Afar	0.0058	2.0	4
Amhara	0.6040	0.0	4
Oromia	0.1456	0.0	4
Somale	0.0375	3.0	4
B.B.G	0.1050	0.0	4
SNNP	0.7589	0.0	4
Gamb.	0.9254	1.0	4
Harari	0.9251	1.0	4
AA	0.7141	0.0	4
DD	0.0419	0.0	4

Null Hypothesis: Unit root (individual unit root process)
Series: D(LNRRD)
Date: 05/25/19 Time: 04:43
Sample: 2000 2004
Exogenous variables: Individual effects
Newey-West automatic bandwidth selection and Bartlett kernel
Total (balanced) observations: 33

Cross-sections included: 11

Method	Statistic	Prob.**
PP - Fisher Chi-square	51.7883	0.0003
PP - Choi Z-stat	-1.46820	0.0710

** Probabilities for Fisher tests are computed using an asymptotic Chi-square distribution. All other tests assume asymptotic normality.

Intermediate Phillips-Perron test results D(LNRRD)

Cross section	Prob.	Bandwidth	Obs
Tigray	0.1592	2.0	3
Afar	0.2955	0.0	3
Amhara	0.0443	2.0	3
Oromia	0.1418	2.0	3
Somale	0.0788	0.0	3
B.B.G	0.9960	2.0	3
SNNP	0.0001	2.0	3
Gamb.	0.9999	2.0	3
Harari	0.8170	2.0	3
AA	0.2957	2.0	3
DD	0.0101	0.0	3

Null Hypothesis: Unit root (individual unit root process)
Series: LNEDUD
Date: 05/25/19 Time: 04:43
Sample: 2000 2004
Exogenous variables: Individual effects
Newey-West automatic bandwidth selection and Bartlett kernel
Total (balanced) observations: 44
Cross-sections included: 11

Method	Statistic	Prob.**
PP - Fisher Chi-square	64.1444	0.0000
PP - Choi Z-stat	-2.75659	0.0029

** Probabilities for Fisher tests are computed using an asymptotic Chi-square distribution. All other tests assume asymptotic normality.

Intermediate Phillips-Perron test results LNEDUD

Cross section	Prob.	Bandwidth	Obs
Tigray	0.9309	3.0	4

Afar	0.5381	0.0	4
Amhara	0.8634	3.0	4
Oromia	0.0818	1.0	4
Somale	0.0030	3.0	4
B.B.G	0.9994	3.0	4
SNNP	0.1911	3.0	4
Gamb.	0.0004	0.0	4
Harari	0.0086	1.0	4
AA	0.0674	3.0	4
DD	0.0022	1.0	4

Null Hypothesis: Unit root (individual unit root process)
Series: D(LNFDI)
Date: 05/25/19 Time: 04:48
Sample: 2000 2004
Exogenous variables: Individual effects
Newey-West automatic bandwidth selection and Bartlett kernel
Total (balanced) observations: 33
Cross-sections included: 11

Method	Statistic	Prob.**
PP - Fisher Chi-square	42.6962	0.0051
PP - Choi Z-stat	-2.73407	0.0031

** Probabilities for Fisher tests are computed using an asymptotic Chi-square distribution. All other tests assume asymptotic normality.

Intermediate Phillips-Perron test results D(LNFDI)

Cross section	Prob.	Bandwidth	Obs
Tigray	0.3997	1.0	3
Afar	0.1936	2.0	3
Amhara	0.2003	0.0	3
Oromia	0.1224	2.0	3
Somale	0.0508	2.0	3
B.B.G	0.4835	2.0	3
SNNP	0.0986	0.0	3
Gamb.	0.0994	2.0	3
Harari	0.0070	1.0	3
AA	0.1747	2.0	3
DD	0.9554	1.0	3

Null Hypothesis: Unit root (individual unit root process)
Series: D(LNGEXP,2)
Date: 05/25/19 Time: 05:05
Sample: 2000 2004

Exogenous variables: None
Newey-West automatic bandwidth selection and Bartlett kernel
Total (balanced) observations: 22
Cross-sections included: 11

Method	Statistic	Prob.**
PP - Fisher Chi-square	49.8269	0.0006
PP - Choi Z-stat	-1.73794	0.0411

** Probabilities for Fisher tests are computed using an asymptotic Chi-square distribution. All other tests assume asymptotic normality.

Intermediate Phillips-Perron test results D(LNGEXP,2)

Cross section	Prob.	Bandwidth	Obs
Tigray	0.0002	0.0	2
Afar	0.2339	0.0	2
Amhara	0.4359	1.0	2
Oromia	0.5046	1.0	2
Somale	0.0022	0.0	2
B.B.G	0.0147	0.0	2
SNNP	0.2794	0.0	2
Gamb.	0.9989	0.0	2
Harari	0.8795	1.0	2
AA	0.2071	0.0	2
DD	0.7895	1.0	2

Null Hypothesis: Unit root (individual unit root process)
Series: D(LNHCR)
Date: 06/03/19 Time: 08:53
Sample: 2000 2004
Exogenous variables: Individual effects
Newey-West automatic bandwidth selection and Bartlett kernel
Total (balanced) observations: 33
Cross-sections included: 11

Method	Statistic	Prob.**
PP - Fisher Chi-square	70.5884	0.0000
PP - Choi Z-stat	-4.44889	0.0000

** Probabilities for Fisher tests are computed using an asymptotic Chi-square distribution. All other

tests
assume asymptotic normality.

Intermediate Phillips-Perron test results D(LNHCR)

Cross section	Prob.	Bandwidth	Obs
Tigray	0.2249	2.0	3
Afar	0.0170	0.0	3
Amhara	0.0058	0.0	3
Oromia	0.4525	2.0	3
Somale	0.9765	2.0	3
B.B.G	0.1894	2.0	3
SNNP	0.0315	2.0	3
Gamb.	0.0037	2.0	3
Harari	0.1715	1.0	3
AA	0.0001	2.0	3
DD	0.1289	2.0	3

Appendix 7: Hausman Specification Test

Correlated Random Effects - Hausman Test
Equation: Untitled
Test cross-section random effects

Test Summary	Chi-Sq. Statistic	Chi-Sq. d.f.	Prob.
Cross-section random	12.47	7	0.0861