Foreign Direct Investment, Environmental Quality and Economic Growth in Ethiopia: *An Empirical Study Using ARDL Model Analysis*

A Thesis Submitted to the School of Graduate Studies of Jimma University in Partial Fulfillment of the Award of the Degree of Master of Science (MSc) in Development Economics

BY:

GUDINA TOLOSSA

JIMMA UNIVERSITY

COLLEGE OF BUSINESS AND ECONOMICS

DEPARTMENT OF ECONOMICS

NOVEMBER, 2021

JIMMA, ETHIOPIA

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Under the guidance of Amsalu Dachito (Assistant Professor)

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DECLARATION

JIMMA UNIVERSITY

SCHOOL OF POSTGRADUATE

Foreign Direct Investment, Environmental Quality and Economic Growth in Ethiopia: *An Empirical Study Using ARDL Model Analysis*

By: GUDINA TOLOSSA DEMESA

Approved by Board of examiners:

Main Advisor	*date*	*Signature*
_____	_____	_____

Co-Advisor

_____	_____	_____

External Examiner

_____	_____	_____

Internal Examiner

_____	_____	_____

DECLARATION

I hereby declare that this thesis entitled *"Foreign Direct Investment, Environmental Quality and Economic Growth in Ethiopia: An Empirical Study Using ARDL Model Analysis''*, has been carried out by me under the guidance and supervision of Amsalu Dachito (Assistant Professor) and Mr. Esubalew Ayalew.

The thesis is original and has not been submitted for the award of degree or diploma in any university or institutions.

Researcher's	Date	Signature
Gudina Tolossa	_____	_____

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Lists of Acronyms

ADF……Augmented Dickey- Fuller

AIC…….Akaike Information Criterion

ARDL…….Auto-Regressive Distributed Lag

CO_2.....Carbon-dioxide

COVID-19……..Corona Virus Disease

DF……Dickey-Fuller

DI…….Domestic Investment

ECM……Error Correction Model

ECT…….Error Correction Term

EEA……Ethiopian Economics Association

FDI……Foreign Direct Investment

FMOLS…….Fully Modified Ordinary Least Squares

GMM……Generalized Method of Moment

GCF……..Gross Capital Formation

GDI……..Gross Domestic Investment

GDP……..Gross Domestic Product

HQC……..Hannan-Quinn Criterion

ILO……International Labor Organization

ISA……Internalization Specific Advantage

LSA…….Location Specific Advantage

MENA…….Middle East and North African Countries

MoFEC……Ministry of Finance and Economic Cooperation

MNCs……..Multinational Co-Operations

OLS……Ordinary Least Square

OECD……Organization for Economic Co-operation and Development

OLI……Ownership, Location and Internalization

OPEC……Organization of the Petroleum Exporting Countries

OSA……Ownership Specific Advantage

RGDP……..Real Gross Domestic Product

R & D……. Research and Development

SBC…….Schwarz Bayesian Criterion

SSA…….Sub-Saharan Africa

UNCTAD…….United Nation Conference on Trade and Development

US……United State

VAR……..Vector Auto-Regressive

VECM……...Vector Error Correction Model

WB……..World Bank

Abstract

This study examines the relationship between foreign direct investment, environmental quality and economic growth in Ethiopia over a period of 1981 to 2019 by using Autogressive Distributed Lag approach (ARDL) and vector error correction model (VECM). The result of bounds cointegration test approach shows the presence of long run equilibrium relationship between the variables under consideration. Based on economic growth equation, gross capital formation, labor force and inflation have statistically significant positive impact whereas financial development and trade openness have statistically significant negative impact at 1% significance level on economic growth in the long run. On the other hand, only gross capital formation, CO_2 emissions, human capital; trade openness and inflation have statistically significant impact on economic growth in the short run. In environmental quality equation, the estimated coefficients revealed that gross domestic product per capita has statistically significant and negative impact on CO_2 emissions in the long run. But the square of gross domestic product has statistically significant and positive impact on CO_2 emissions. This indicates that the EKC hypothesis is not valid in Ethiopia for the study period since EKC to hold the sign for GDP per capita and GDP per capita square anticipated to positive and negative respectively. Foreign direct investment has also negative and statistically significant impact on CO_2 emissions. But, in the short run, only foreign direct investment has statistically significant impact on carbon-dioxide emissions. Speed of adjustment, -0.492832 for economic growth equation and-0.798364 for environmental quality equation is showing that around 49.3% and 79.8% shocks happened in short run is restored (converge) to long run equilibrium per year respectively. The study underlined that the government should adopt CO_2 emissions reduction policy in Ethiopia should focus on environmental friendly growth, encouraging technology innovation and adopt new technologies that may lead to energy efficiency and advance low carbon economic growth. The government should be guided by policy prescriptions like Supporting High-Quality and In-Depth Cooperation with FDI-Invested Enterprises and Projects as well as Strengthening Environmental Standards and Enhance Environmental Supervision of Foreign-Invested Enterprise.

***Key Words**: Autoregressive Distributed Lag Model, Foreign Direct Investment, CO_2 emission, Economic Growth, Ethiopia*

CHAPTER ONE

1. INTRODUCTION

This section briefly deals with giving background information of the study, problem statement, objectives of the study, research questions, significance of the study, scope of the study, limitation of the study and organization.

1.1 Background of the Study

Foreign direct investment by multinational corporations (MNCs) has become a prime source of external financing for developing countries over recent decades. This is essential because, given the smallness of the economies of these countries, their revenue is also small and hence foreign direct investment can be used as a supplement to domestic saving efforts and narrow down the resource gap. Foreign Direct investment has been recognized as an important resource for economic progress of developing countries. Moreover, FDI is also important for both developed and emerging economies (Asajile, 2014).

Foreign direct investment has an important role on the economic growth of developing countries. It affects the production, income, prices, imports, exports, employment, overall welfare of the recipient country and balance of payments. In developing countries, foreign direct investment is the one of the vital sources of economic growth, and besides the importance of capital, foreign direct investment leads to several profits (Aga, 2014).

As stated by (Hossain and Hossain, 2012) the most important advantage for developing countries is FDI's contribution of bringing and introducing new technology, skills, training and other important as well as vital materials to their economies. Moreover, the opportunity of employment is a crucial advantage for the host country. When foreign firms expand to operate in their countries, they also bring in efficiency in management and advanced technology production. It helps the developing countries capacity, in order to compete with foreign competitors and produce superior quality services and goods in the future. Nonetheless, the main demand for foreign direct investment comes from the requirement for funds for investment in developing countries. Thus, foreign direct investment could support them improve the level of living and develop their countries by providing more employment and executing strategic projects that need large funds.

The inflow of foreign direct investment is an important element in providing a means for creating stable and long-lasting real gross domestic product or economic growth OECD

(2008). It improves the competitive position of a given economy, encourages the transfer of modern technology, and provides an opportunity for the host economy to encourage its products more broadly in international markets, positive effect on the development of international trade, and significant source for capital accumulation.

Foreign direct investment is one of the most dynamic resource inflows into developing countries which can play an important role in economic development such as exchanging modern technology and creating employment generation. It is useful in supplementing domestic savings in capital accumulation, income growth and creating innovation. It is also used to bring integration into the global economy, enrich efficiency, and raise the skills of domestic labor as advocated by some scholars (Anyanwu, 2006, 2012; Dupasquier and Osakwe, 2006). An increase in foreign direct investment may be associated with improving economic growth due to the inflow of capital and increase tax revenues for the host country. These make a channel of foreign direct investment into new infrastructure and other projects to boost development endeavors. Moreover, foreign direct investment can result in the transfer of soft skills through training, availability of more advanced technology for the domestic economy and access to research and development resources (UNCTAD, 2010).

One of the most effective methods of drawing flows from external sources has become foreign direct investment. The use of this approach as capital source has also become a significant aspect of building capital in developing countries around the world. But, the share of investment from these countries in other states has been declining over the past years. In developing countries, the positive impact of foreign direct investment (FDI) is becoming progressively popular as a tool for economic growth and strengthening economic growth. The strongest positive impact of implementing foreign direct investment includes increased opportunities, the rise in aggregate productivity and greater outflows of exports and exchange of technological advancement between the country and the investor (Khan, 2007).

Foreign direct investment in developing countries is a significant source of private finance, accumulation of physical capital and fulfilling the inadequate domestic savings (UNCTAD, 2017). This is important due to the low private sector capital and investment capacity in many developing countries (World Bank, 2013). Furthermore, it could explain the numerous efforts by developing countries to attract foreign direct investment to their economies in the past three decades. This has been done through a range of policies including exchange rate, liberalization policies, tax holidays, and subsidies among others (Basemera et al., 2012). FDI

is one of the drivers of economic growth which is the ultimate goal to achieve (Basemera et al., 2012). Moreover, this view is supported by traditional and endogenous growth models which emphasis the technology and efficiency improvements as stimulants of economic growth.

The effects of foreign direct investment inflows and carbon-dioxide emissions on economic growth become a very significant topic both at the national and international level in the second decade of twenty-first century. Economic growth is the backbone of any country's economic development because of its overall benefits in the different sectors of the economy. Moreover, economic growth can raise the level of living if the nation's wealth is fairly distributed. Growth can raise employment rates since it has positive impact on the aggregate demand. Furthermore, growth provides fiscal dividend through extra tax revenue that can be used to finance public projects. Indeed, it improves the effect by encouraging investment in new technology which can then help sustain economic growth through increased aggregate supply and boost business confidence through its positive impact on the firm's gains, which in turn advance their stock exchange values resulting in the growth of big companies (Razmi and Refaei, 2013).

Foreign direct investment inflows and environmental quality are well known as very important factors in the economic growth process. The foreign direct investment inflows can play essential role through increasing and raising the supply of funds for domestic investment in the host country. This can be possible through the production chain when foreign investors buy locally produced inputs and sell intermediate inputs to local enterprises. Moreover, the foreign direct investment inflows can raise the host country's export capacity, causing the developing country upsurge its foreign exchange earnings. Foreign direct investment can also inspire the formation of new jobs, increase technology transfer and enhance overall economic growth in the host countries (Belloumi, 2014).

The helpful impact of foreign direct investment in encouraging economic growth gets a more or less widespread recognition. In fact, empirical evidence shows that foreign direct investment inflow has played a vital role in generating growth in the host countries through innovative activities, technology transfers and spillover effects. However, its impact on environmental quality has not been sufficiently investigated and the existing evidence on the foreign direct investment environment nexus is inconclusive or there is no general agreement whether FDI harms or improves the environment (Kostakis et al., 2017).

The foreign direct investment-environment relationship is viewed mainly through two competing hypotheses: the pollution heavens hypothesis and the pollution haloes hypothesis. Firstly, more advanced economies implement strict or stringent environmental laws. Secondly, some most developing countries have less stringent environmental laws thereby attracting "dirty" industries (Blanco et al., 2013; Cole and Elliott, 2005; Hassaballa, 2014). This phenomenon leads to the emergence of specialisation in polluting industries in developing economies and in nonpolluting industries in advanced ones. Therefore, there is a positive relationship between environmental pollution and foreign direct investment. On the other hand, neo-technology school of thought supports the pollution haloes hypothesis stating that there is a direct relationship between foreign direct investment inflows and environmental quality through technological upgrading and knowledge spillovers with a transfer of more environmental friendly technologies from advanced economies to developing countries (Albornoz et al., 2009; Görg and Strobl, 2005). Therefore, there is a negative or neutral relationship between foreign direct investment and environmental pollution in developing countries or foreign direct investment has a positive or neutral relation to clean energy use (Lee, 2013).

Environment pollutants disturb economic growth. There is an evidence of a global nature of air pollution and its effects on the earth's surface. The painfulness and the long-term damaging impact of environmental pollution can contribute to destructive consequences on human wellbeing and the economy. This will cause the increase of health and social costs (Borhan et al., 2012). Thus, pollution may directly decrease the output by reducing productivity of man-made capital and labor. At this point, pollution appears as a negative externality. Because of health problems, there are losses of labor-day, and due to polluted air and/or water, there are deteriorations in the quality of the industrial equipment. Secondly, the firm's production costs are increased when firms abate pollution emissions.

In Ethiopia there are some studies that investigated the relationship between environmental quality and economic growth. For example (Adem et al., 2020; Adinew, 2020; Kebede, 2017) examined the impact of economic growth on environmental quality measured as carbon dioxide emissions. However, all of them not included foreign direct investment in their investigation. Adinew (2020) examined the relationship between renewable energy consumption, economic growth and CO_2 emissions in Ethiopia over the period of 1990 to 2017 and the result of the study indicated that economic growth affects the environment negatively. Adem et al., (2020) investigated the link between economic growth and

environmental quality. Their results revealed that economic growth has positive impact on CO_2 in the short run while it has negative impact in the long run. The study by (Kebede, 2017) indicated that economic growth and its square (measured by real GDP) have statistically significant positive and negative impact on CO2 emissions (proxy of environmental degradation) respectively. This confirms the validity of EKC hypothesis in Ethiopia which in turn implies that economic growth leads to environmental degradation at the early stage of economic growth and becomes a solution to environmental damage at the higher level economic growth.

1.2 Statement of the Problem

The impact of foreign direct investment on economic growth of a country is hotly debated topic in academic arena. It is one of the main debates among policy advisors, scholars and researchers. School of economist sharply divided on the impact of foreign direct investment on economic growth. For example, the modernization theory and dependency theory argue differently on the impact of foreign direct investment on economic growth and there is no general consensus on this topic (Rahman, 2015). Even though different studies were undertaken by applying various econometric estimation techniques to investigate the relationship between foreign direct investment and economic growth they were unsuccessful to come up with undoubted conclusion about the relationship between foreign direct investment and economic growth.

Moreover, empirical evidences showed that the relationship between foreign direct investment and economic growth were positive, negative and mixed. There were also evidences that concluded foreign direct investment has no impact on economic growth. The studies conducted by (Alabi, 2019; Ali and Malik, 2017; Jean Marie Vianney, 2018; Muhammad and Ijirshar, 2015; Sokang, 2018; Urgaia, 2016; and Zekarias, 2016) were found that there was positive relationship between foreign direct investment and economic growth. Contrary to this, (Philip O Alege, 2016; Ergül et al., 2016; Kummer-Noormamode, 2015; and Rahman, 2015) found negative relationship between economic growth and foreign direct investment. (Belloumi, 2014; Carkovic and Levine, 2005; Louzi and Abadi, 2011; and Lyroudi et al., 2004) were examined the impact of foreign direct investment on economic growth and their investigation supports that foreign direct investment have no impacts on economic growth. Therefore, there is no clear consensus on the empirical findings among scholars and as a result this study wants to add to the existing literature and unsolved puzzle.

On the other hand, environmental degradation or pollution has been observed as a hot issue in the economic growth and development process. Environmental degradation has a direct effect on the quality of human and economic performance as well; it is clear that pollution has some ruthless effect on health, resource reduction and natural disasters related to climate change and necessitated the decline of the economic growth and development (Abdouli and Hammami, 2017).

In fact, global warming has become prominent universal concern, where pollution is mainly as a result of excessive uncontrolled CO_2 emission which is commonly considered as one of the key atmospheric gases which basically lead to planetary heating. As a result, environmental degradation badly affects available scant resources and leads to inefficient human capital to add much to enhance the economic growth. Actually, environmental pollution grows due to industrialization, modernization, and urbanization that have major environmental problems not merely for advanced world but equally in the developing world too (Azam et al., 2016).

Certainly, the available resources are largely inadequate and scanty; thus, humans need to employ practices that allow effective and long-lasting use of the available scarce resources in the environment. Sustainable development then becomes a tool that supports guarantee of the persistent and long-term utilization of resources. The environmental degradation problem is expanding largely in developing economic systems. For instance, the extreme use of natural resources is related to negative environmental effects, including damage of forest and forested undergrowth, damage of habitat, loss of biodiversity, the reduction of fish stock, soil erosion, and pollution (Eric K W Aikins, 2012; 2014). The critical objective of every economy is to achieve the desired level of economic growth and development for a long term. Most probably, accomplishing this target may harm environmental quality (Bozkurt and Akan, 2014).

The relationship between foreign direct investment, environmental degradation and economic growth has been a crucial topic; therefore, it is important to examine the impact of FDI on economic growth and whether the growing level of CO_2 emissions has any impact on the economic growth or none at all under the same study. As we require sustainable economic growth and development, which would not be at the cost of coming generation and would be without environmental degradation, environmental suitability needs to be maintained. Therefore, the main objective of this study is to look into the impact of FDI and

environmental degradation proxied by CO_2 emission per capita on economic growth in Ethiopia. Moreover, the impact of FDI on environment is not well investigated and motivated the current study to examine the FDI-environment nexus to provide further evidences and a fresh look on the issue.

Different studies were conducted to make a superior understanding of the impact of foreign direct investment, local investment, imports and others on economic growth (Athukorala, 2003; Batten and Vo, 2009; and Mun et al., 2008). Many researchers pointed out that foreign direct investment has positive impact on economic growth by advancing capital accumulation (Alguacil et al., 2011; Bosworth and Collins, 1999). On the other way, there are other several studies that obtained foreign inflows do not have a strong impact on economic growth (Akinlo, 2004; Carkovic and Levine, 2005; Herzer and Klasen, 2008).

In Ethiopia there are some studies conducted to investigate the impact of foreign direct investment on economic growth that includes the works of (Menamo, 2014) over the time period of 1974 to 2011 by using ordinary least square (OLS). (Betelhem, 2016) examined the impact of foreign direct investment on economic growth of Ethiopia during the period of 1981 to 2015 by employing vector error correction (VECM) model and found that foreign direct investment affects economic growth negatively and significantly in the long run and has insignificant effect in the short run. Gizaw (2015) also studied the impact of foreign direct investment on economic growth of Ethiopia by utilizing annual data that ranges from 1974 to 2013 employing vector autoregressive model (VAR). The results of the study showed that there is a stable, long run relationship between foreign direct investment and economic growth. The previous studies conducted in case of Ethiopia employed either ordinary least square (OLS), VAR or VECM estimation technique which might have the problem of endogeneity bias, serial correction and may run spurious regression if proper care is not followed. Thus, the present study wants to apply Autoregressive Distributed Lag Model (ARDL) approach to cointegration, since this approach is more robust than other methods and has the ability to handle the problem of endogeneity and serial correlation problem.

Furthermore, the aforementioned studies showed that the prior studies dedicated on the relationship between economic growth and foreign direct investment and very few attempt was made to investigate the effect of environmental degradation (proxied by CO_2 emissions in this case) on economic growth in case of Ethiopia. Moreover, very few attempts were made to test the relationship among FDI inflows, CO_2 emissions and economic growth under the

same framework in Ethiopia. Therefore, the present study mainly dedicated to examine the impact of foreign direct investment and environmental degradation on economic growth as well as the impact of FDI on environmental quality in context of Ethiopia. The impact of FDI on environmental quality has not been sufficiently examined and the existing empirical evidences on the FDI-environment relationship are inconclusive. As a result, investigating the impact of foreign direct investment and environmental degradation on economic growth as well as the impact of FDI on the environment will certainly fill the gap in study and contribute to the related existing literature on the topic under investigation. To the best of the researcher's knowledge, the choice of Ethiopia is motivated by the fact that very few known study has been undertaken previously to examine the relationship between foreign direct investment, environmental degradation and economic growth in Ethiopia.

The study also preferred a country-specific case study to a cross-sectional study since empirical studies investigated at the aggregate level are unable to capture and account for the complexity of the environments and histories of each individual country. Hence, any inferences drawn from aggregate level studies give only a general understanding of how the variables are broadly associated, and therefore offer little guidance for policy formulation. In this essence, a country-specific in-depth case study seems to be more promising in order to obtain deeper understandings for the issue at hand. Therefore, this study will examine the relationship between foreign direct investment, environmental degradation and economic growth in Ethiopia from 1981-2019 chosen based on data availability for all variables under consideration.

1.3 Research Questions

To effectively handle the research objectives at hand, this study would answer the following research questions.

i. What is the impact of foreign direct investment and environmental quality on economic growth of Ethiopia?
ii. What is the impact of foreign direct investment on environmental quality of Ethiopia?

iii. Is Environmental Kuznet's Curve (EKC) hypothesis valid for Ethiopian Economy?

1.4 Objectives of the Study

1.4.1 General Objective of the Study

The general objective of the study is to investigate the relationship between foreign direct investment, environmental quality and economic growth in Ethiopia.

1.4.2 Specific Objectives of the Study

Specifically the study has the following objectives:

i. To examine the impact of foreign direct investment and environmental quality on economic growth of Ethiopia.
ii. To examine the impact of foreign direct investment on environmental quality of Ethiopia.
iii. To test the validity of Environmental Kuznet's Curve (EKC) Hypothesis in Ethiopia.

1.5 Significance of the Study

This study makes several contributions to the existing empirical literatures. It will contribute to the knowledge of the relationship between foreign direct investment, environmental degradation and economic growth by bringing new evidences. Since the impact of foreign direct investment on economic growth is highly debated issue this study will give rise to some essential policy debate that is important to policy makers. This study will also bring some important current situations about foreign direct investment in host country particularly Ethiopia. It will also bring further evidences on the impact of FDI on environmental quality. The empirical findings will guide the policy makers to draw appropriate policy in order to control pollution, and consequently, it will help to boost sustainable economic growth and development. Furthermore, the findings of the study will also be used as reference by the subsequent studies that investigate about the relationship between foreign direct investment, environmental degradation and economic growth.

1.6 Scope of the Study

This study examined the relationship between foreign direct investment, environmental degradation and economic growth in Ethiopia for the period of 1981 to 2019. The study period is selected based on availability of data for all variables included in the study. This study is also limited to the analysis of the relationship between foreign direct investment, environmental degradation and economic growth of Ethiopia and other countries are not considered or included in the analysis.

1.7 Limitation of the Study

The study faces certain limitations even though we cannot shade its important contributions to understand the problem at hand. The major problem encountered in this study was data unavailability especially prior to 1980 for some variables and also the available data were different from one source to another source making the problem complex. The necessary data was needed from 1970 so as to obtain a more comprehensive picture of the relationship between the variables that have been a concern for this study, but the data was not available for the whole period intended to be included. Therefore, the study forced to consider only the period that has full data for all variables included in this study and reduce the sample size of the study. However, the result of this study seems not affected significantly by this problem since autoregressive distributed lag model was employed due to its predictive capability and more applicable with small sample size like the present study used. Therefore, future researches should look for samples ranging above the period specified in this study provided that only data is available.

1.8 Organization of the Study

The study was organized as follows. The first chapter includes background of the study, statement of the problem, objectives of the study, research hypothesis, and significance of the study, scope of the study, and limitation of the study. The second chapter investigates both theoretical and empirical evidences available on the study of the relationship between foreign direct investment, environmental quality and economic growth. The third chapter deals with the methodology employed; including data type and sources, description of variables, model specification and method of estimation. The fourth chapter concerned with presentation and discussion of the findings or results obtained. Both the descriptive analysis and econometrics analysis were undertaken. Finally, the last chapter or the fifth chapter presents the conclusion and recommendation part of the study based on the findings.

CHAPTER TWO

2. REVIEW OF LITERATURE

This chapter deals with literature review that are relevant to the study of the relationship among foreign direct investment, environmental quality and economic growth of Ethiopia. Both the theoretical as well as empirical literatures were reviewed. Three strands of literature were reviewed. The first strands of literature presents the main theoretical and empirical reviews regarding the impact of foreign direct investment on economic growth. Theoretical literatures based on neoclassical growth theory, the endogenous growth theory, dependency theory and eclectic theory are presented on the first step followed by the empirical studies regarding the impact of foreign direct investment on economic growth which further organized as studies that found positive impact of foreign direct investment on economic growth and negative or inconclusive impact on economic growth. Empirical literature reviews on Ethiopia were also separately analyzed. The second strands of literature focus on the impact of environmental quality on economic growth and thirdly literatures that related to the relationship between foreign direct investment and environmental quality were also reviewed. Finally the conceptual framework is drawn based on the theoretical and empirical literatures reviewed.

2.1 Review of Theoretical Literature

2.1.1 The Neoclassical Growth Theory

The neo-classical growth theory was developed by (Solow, 1956) and (Swan, 1956). This theory also known as Solow model, explains the accumulation of physical capital is not able to explain the large growth of output per person. This is owing to geographical differences, income differences, differences in the advancement of technology and lack of positive economic externalities. The long run economic growth cannot depend on the accumulation of physical capital as Solow model shows. Without an accompanying expansion in the labor force, a rise in fixed investments would lead only to a transitory acceleration of output per capita. There is another factor that can produce and sustain the high rate of economic growth, given that an economy's labor force cannot be increased without limit. Technological progress is one of the central sources of long term growth. In Solow growth model technological progress is assumed as residual of economic growth means that cannot

contribute to growth in labor or growth in capital. The residual is associated with a rise in economic efficiency, discovery of new ideas and knowledge or know-how. Therefore, this growth model treats technological advancement as exogenous or unexplained.

The free movement of capita, associated with finance and innovation in communication technology as well as the reduced distances between nations enabling better recognition of people and capital in 1980s marked the triumph of neoclassical theory. As a result, the capital flows go upwards in developing countries. Theoretically, like endogenous growth models, neoclassical growth models offer the foundation with their empirical work on the relationship between FDI and GDP, although it does not under the same perspectives. The growth rate of production is exogenous in the neoclassical framework (Kida, 2014).

The aggregate production function approach is commonly applied in the early studies of economic growth. They tried to describe the relationship between an economy's products or output and capital and labor that are the tangible primary factors of production. The seminal papers of (Solow, 1956, 1957), basically created the starting point for much of applied growth analysis within the neoclassical model. Notably, by using macroeconomic data he integrated the aggregate production. In this framework, the role of investment can be generalized from the following two equations.

$$Y = A * f(K, L) \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \quad (2.1)$$

The above equation (1) shows an aggregate production function showing the association between aggregate output (Y), capital factor or input (K) labor factor or input (L) and Hicks neutral technology.

$$\Delta K_t = I_t - \alpha K_{t-1} \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \quad (2.2)$$

The above equation (2) explores the link between investment in tangible assets (I) and capital stock (K).

Where Δ represents discrete changes, α represents amount of depreciation rate and I_t is the level of gross investment. The gross investment term (I_t) can be determined by either profit maximizing firms or assumed to be fixed proportion of output (Y), written as sY_t. The neoclassical model also assumes that there is competitive factor markets, constant returns to scale and each factors of production are paid a wage which is equal with their marginal products. When the production function is decomposed by taking natural logarithms on both

the left-hand side and right-hand side output growth is a weighted function of change in primary inputs, capital and labor in the present case and multi-factor term that is referred to as Solow residual or ΔlnA. when it is written in equation form it becomes:

$$\Delta lnY = \beta_K \Delta lnK + \beta_L \Delta LnL + \Delta lnA \dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots (2.3)$$

Where, β_k shows capital's share of total output or product β_L represents labor's share of total output. According to the neoclassical assumptions, it is shown that $\beta_K + \beta_L = 1$. It is also assumed that the technological term (A) to be exogenous to the model and it can be explained by the following equation.

$$A = A_0 e^g \dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots (2.4)$$

The neoclassical framework has been the backbone of the applied and theoretical work on capital accumulation and economic growth because of its appealing simplicity. Both equation (2.1) and (2.3) above show the direct relationship between investment in tangible assets (capital and labor) and economic growth. The contribution of capital accumulation to economic growth in this case is in proportion to capital's share of national output. The neoclassical model results in several disturbing results despite its popularity. Without exogenous technical progress steady state growth in per capita income cannot be realized because of diminishing returns in capital accumulation. Therefore, the main weakness of the Solow model is that it does not incorporate the technical progress at all. Solow (1957) attributed 90 percent of U.S per capita output growth to exogenous technical progress despite being totally unexplained about technical progress. In Solow neoclassical model the other limitation comes from the definition of the term capital accumulation. The Solow model considers investment to be merely in tangible assets. But, far more has been discussed on the definition of capita itself. As an example, (Mankiw et al., 1995) stated that "there is an increasing agreement that the role of capita in economic growth should be widely interpreted" (p.308). Additional to this, (Jorgenson, 1996) contended: "Investment is the commitment of current resources in the expectation of future returns and can take a multiplicity of forms" (p.57).

According to this theory, capital accumulation contributes directly to economic growth in proportion to capital's share of the national output. Moreover, the growth of the economy depends on the augmentation of the labor force and technological progress. Foreign direct

investment increases the capital stock in the host country and this would in turn affect economic growth as postulated by exogenous growth theory.

It has been explained that foreign direct investment can affect economic growth directly through capital accumulation, the inclusion of new inputs (latest) and foreign technologies in the production function of the host country as explained by the exogenous growth model. Thus, the neoclassical growth model indicates that FDI promotes economic growth by rising the quantity and/or the efficiency of investment within the host country (Mahembe and Odhiambo, 2014).

Findlay (1978) modified Solow's model and assumed that the growth rate of technology diffusion is an increasing function of foreign direct investment. He divides inputs into two: foreign capital (developed country) and domestic capital (developing country). He argues that an increase in foreign capital increases domestic capital. However, he finds that the speed of technological transfer in a developing country is a decreasing function of both the relative technology gap and the share of FDI in the total capital stock. Moreover, (Mankiw et al., 1992) also modified Solow's model and argued that omitting human capital accumulation in Solow's model would cause biased estimation of the coefficient on saving and population growth. They also argued that cross-country variations in income-per-capita are a function of variations in the rate of saving, the rate of population growth, and the level of labor productivity.

2.1.2 The New theory of Endogenous Growth Model

A new growth theory pioneered by (Lucas, 1988, 1990; Romer, 1986, 1987) and (Mankiw et al., 1992) considered economic growth rates as endogenous. According to this theory, investments in both physical and human capital would create a permanent rise in growth rate of an economy. The role of human capital was emphasized in endogenous growth theory (Lucas, 1990). It states that the differences in skill levels and the abilities of workers or laborers to use technology leads to differences in productivity or efficiency among nations. The effect of technological spillovers on economic growth is another key argument of theory of endogenous growth model (Aghion et al., 1998; and Howitt, 2000). The effects of technology spillovers are indirectly associated to the effects of technological change on the economy.

According to the endogenous growth theory foreign direct investment can affect growth endogenously if increasing returns in production through externalities and spillover effects are generated. Therefore, the new growth theory focuses on externalities arising from physical and human capital accumulation as major forces behind long-term productivity growth.

Proponents of endogenous growth theory view technological progress as product of economic activity in contrast to Solow Model which quoted technological progress as a given or a product of economic growth. Supporters of this theory argue that in opposite to physical objects, knowledge and technology are not bound by diminishing returns to scale, but instead drive the process of growth. This is contrary to the exogenous economic growth model that the impact of foreign direct investment on the growth rate of output is constrained by the existence of diminishing returns to the physical capital, in which foreign direct investment affects only the level of income and leaves the long-run growth rate unchanged (De Mello , 1997; and Solow, 1957).

Moreover, the endogenous growth theory has shown that if human capital is added into the production function alongside physical capital and unskilled labor diminishing returns to capital can be delayed or completely avoided (Gan and Soon, 1996). Sala-i-Martin and Barro (1995) demonstrate that the existence of human capital slows down diminishing returns to physical capital while in the growth model suggested by (Rebelo, 1991), the production function holds its constant return to scale while capital is no longer subject to diminishing returns. The acceptance and application of advanced technologies spillover stated above require the accumulation of a substantial amount of human capital in the host economy. This means that the stock of human capital in the host country acts as a limit to the absorptive capability of that country's economy (Borensztein et al., 1998).

The quality of the labor force is subject to its accumulated experience, and vis-a-vis the education system. This quality of labor will determine an economy's ability to adapt old technology along with new learning and creation of new ideas. In other words, high quality human capital is a major factor that can absorb technological spillovers resulting from FDI, and thus is a key determinant of the effects of FDI upon economic growth.

It is worth mentioning that human capital is a significant absorbent of technology brought by MNCs as long as the latter brings a significant contribution to economic growth and as long as indigenous technological development is not established. To be actually competitive needs

a complete shift from recipients of foreign technology to being technology innovators. In endogenous growth theory model foreign direct investment is envisaged to have two effects on economic growth. The first is a direct effect through the rise in capital stock in terms of financing capital formation. Foreign direct investment contributes to growth directly in the same way domestic capital contributes to growth. The second is through the indirect impact of the spillover effect. Foreign direct investment is assumed to be more productive than domestic investment. Foreign direct investment help growth through enhancing human capital and encouraging new technologies in the host country by diffusing marketing techniques, labor training, managerial skills, skill acquisition, promoting exports, stimulating R & D activities. The effects of diminishing returns to capital will be offsetted by technology and knowledge spillovers thereby keeping the economy on a long-term growth path. Human capital is assumed to affect growth directly by local workers who learn the technology and new knowledge from MNC firms (Hassan et al., 2013).

Foreign direct investment is taken as a main source of technological and knowledge diffusion. Foreign direct investment can add considerably to human capital through several possible channels such as introducing new organizational arrangements, management practices and training the labor. The impact of foreign direct investment on research and development (R & D) could encourage innovation thereby contributing to the growth of the host country (Grossman and Krueger, 1991; Sanchez-Robles and Bengoa-Calvo, 2003). Thus, factors such as innovation, trade openness, R and D, human capital formation and increasing returns to scale are key factors in explaining the growth process.

The new growth model postulates that economic growth is driven by two main factors; the stock of human capital and technological progress unlike neoclassical growth model which assumes technological progress to be exogenous (Lucas, 1988; Romer, 1986, 1990, 1994). The new endogenous growth models take into account the long run growth as a function of technological progress; and as a result offer a framework in which FDI can perpetually increase the rate of economic growth in host country through technological transfer or exchange, diffusion and spillover effects (Nair Reichert and Weinhold, 2001).

Capital accumulation or capital formation is taken into account as important determinants of economic growth both by the exogenous and endogenous growth theories even though; they differ in their treatment of technological progress. The neoclassical model treats technological advancement as exogenous to the model whereas, the new growth (endogenous growth

model) assumes that technological advancement is improved endogenously by innovation and knowledge (Al Nasser, 2010; Borensztein et al., 1998; De Mello, 1997; and Elboiashi, 2011).

In addition to human capital accumulation, which creates positive or negative externalities (through growth spill-over) that would affect the host country's firms and the economy, FDI by multinational corporations (MNCs) is assumed to bring research and development (R &D) (Sala-i-Martin and Barro, 1995). The tangible capital, human capital and R & D expenditures are assumed to cause growth factors or FDI spill-overs.

The two growth theories (the exogenous and endogenous growth theories) reveal that FDI can contribute to economic growth through direct impact and indirect impact. According to the exogenous growth theory view, the host country's economy can be enhanced by FDI through capital accumulation, introduction of new goods and foreign technology and also according to the endogenous growth theory by boosting the stock of knowledge in the host country through the transfer of skills (Elboiashi, 2011).

2.1.3 Harrod-Domar Model

Harrod (1939) and (Domar, 1946) were developed a model called Harrod-Domar which is also widely used in explaining the growth of an economy. A unique characteristic of Harrod-Domar model is that it combines both the Keynesian and Classical growth theories. The model explains the usefulness and the role investment plays in economic growth of countries (Maji and Odoba, 2011). The model supports in determining the requisite investment level that is required to attain a specified level of output growth in an economy.

The model represented as follows: $\frac{\Delta Y}{Y} = \frac{s}{k} = g$, where s, k and g represent saving ratio, capital-output ratio and growth rate of national output respectively. According to Harrod-Domar model, if the level of saving(s) is high, firms have access to credit and therefore the ability to borrow more for their investment purposes. The increase in investment consequently results in an increase in output or production that causes economic growth. From capital-output ratio (k) perspective, a fall in (k) leads to the economy increasing production with fewer inputs due to the efficiency in production in the economy.

From the model, it can be shown that a developing economy that wants to achieve economic growth has to resort to the promotion of savings and also encourage technological advancement as a means of reducing the capital-output ratio. Since the transfer of technology

from developed economies to developing economies is a form of foreign direct investment, it can be concluded that foreign direct investment through technological advancement can be an engine for economic growth and therefore, it is important for the government of developing countries to promote technological advancement if it is focused on achieving economic growth. From the above analysis, economic growth can be stated as a function of foreign direct investment. $Economic\ Growth = f(FDI)$.

A critique of the model is that factors such as labor productivity, technological innovation, and levels of corruption are ignored. The model is an oversimplification of complex factors which go into economic growth. Also, it assumes the existence of reliable finance and transport system. Often the problem for developing countries is lack of investment. Moreover, the model explains boom and bust through the importance of capital. However, in practice businesses are influenced by many things other than capital such as expectations.

2.1.4 The Dependency Theory

Dependency theory researchers on other hand, argue that transnational companies (TNC) can prevent economic development by crowding out local entrepreneurs, reducing consumer welfare, worsening income distribution, and introducing inappropriate consumption patterns in host countries. It is also important to understand that the favorable impact of foreign direct investment is not a specific true; rather it may largely depend on favorable conditions available in the host country, institutional capacity, political and macroeconomic stability, infrastructure, and education system (Kuada and Hansen, 2006) and (Rugraff and Hansen, 2011). The most widespread statement of the theory of dependence is that developing countries "suffer" from the negative consequences of foreign capital in the country due to the repatriation of profits, reduction of reinvestment, and increase of income inequality. For instance, (Dixon and Boswell, 1996) argued that foreign direct investment, although positively affecting economic growth at the very beginning, however, in the long run, the dependence of the national economy on foreign direct investment has a negative impact on its growth.

Similarly, (Moran, 1978) empirically investigated and found that foreign investors adversely affect political processes in the host country; and the benefits of foreign direct investments are poorly distributed between TNCs and the host country. In general, supporters of the theory of dependence, for example, (Alfaro, 2003) and others, blamed TNCs for exploiting developing countries and, as a result, the underdevelopment of the periphery of the world

economy. In support of this, in a study by (Kentor and Boswell, 2003) it was proved that countries with a relatively high dependence on foreign capital (measured as accumulated foreign reserves) demonstrate slower economic growth than less dependent countries. Contrary to endogenous growth theory, dependency theories argue that foreign direct investment affects economic growth negatively. The dependency theories stated that foreign direct investment can abolish local capabilities and extract natural resources without adequately compensating poor nations. In spite of this claim on foreign direct investment, countries are recognizing the important role of foreign direct investment on economic growth and begin to liberalize their foreign direct investment regime (Velde, 2006). According to the dependency theory, foreign direct investment generates a monopoly industrial structure that result in underutilization of prolific forces (Bornschier and Chase-Dunn, 1985; Santos, 1970).

Furthermore, (Reis, 2001) formulated a model that examine the impacts of foreign direct investment on economic growth when investment profits may be repatriated. She states that after the opening up to foreign direct investment, domestic firms will be replaced by foreign firm in the R&D sector. This may reduce domestic welfare due to the transfer of capital returns to foreign firms. In this model, the effects of foreign direct investment on economic growth depend on the relative strength of the interest rate effects. If the world interest rate is higher than domestic interest rate, foreign direct investment has a negative effect on growth, while if the world interest rate is lower than domestic interest rate, foreign direct investment has a positive effect on growth.

In addition, (Firebaugh, 1992) explains several additional reasons why foreign direct investment inflows may be less profitable than domestic investment and may even be detrimental. The country may gain less from foreign direct investment inflows than domestic investment, because of multinationals are less likely to contribute to government revenue; foreign direct investment is less likely to encourage local entrepreneurship; multinationals are less probable to reinvest profits; are less probable to develop linkages with domestic firms; and are more probable to use wrongly capital-intensive techniques. Foreign direct investment may be harmful if it off-set domestic businesses and stimulates unsuitable consumption pattern.

2.1.5 The Eclectic Theory of Foreign Direct investment (FDI)

The eclectic theory developed by (Dunning, 1977) and popularly known as OLI (Ownership, Location and Internalization) specific advantages and as a result it is an integration of three of

theories. This theory postulates that firms undertake foreign direct investment when the advantages of Ownership, Location and Internalization combine to make it appealing to undertake foreign direct investment. The ownership specific advantages (OSA) refers to specific competencies and benefit that a company gets due to its ownership of some special assets, such as knowledge, powerful brand, intellectual property, technical knowledge or management skills or abilities, capabilities, relationships or physical assets. Location specific advantages (LSA) refer to specific advantages that exist in the host country market such as low cost labor or skilled labor, natural resources. It is the benefit of setting an economic activity in a place because of the natural resources or acquired characteristics of the location. Internalization specific advantages (ISA) refer to the degree of control over foreign operations, such as foreign based manufacturing, distribution or other value activities. It is the gain or benefit from undertaking a business activity in house rather than leaving it to a relatively unproductive market. The theory therefore holds that FDI is the result of possessing Ownership specific (income generating) advantages (O) that they want exploit in foreign Locations (L), which they cannot profitably do except through Internalization.

This theory further introduces the new concept of seekers, in which a company or an individual, is described as a seekers looking into investing and is normally motivated by four motives. Firstly, there are the natural resource seekers who are looking for abundant natural resources at a lower cost than that of their home country. Secondly, there are market seekers who are interested in gaining access to larger markets. Thirdly, there are also efficiency seekers who are looking for investment in different countries so as to gain economies scale. Finally, there are strategic asset seekers who want assets that will help them strengthen their competitiveness in the global marketplace.

2.2 Empirical Literature Review

2.2.1 Review of Empirical Literature that Show Positive or Direct Relation between Economic Growth and Foreign Direct Investment

There is still an abundance of contradictory evidence in the literature on the economic growth impact of foreign direct investment despite the considerable high volume of research studies on foreign direct investment-growth nexus on developing economies. In this literature, researches that connect economic growth and foreign direct investment as well as that found positive results were reviewed. From the group of researches that found positive relationship between economic growth and foreign direct investment, it was shown that foreign direct

investment tends to increase capital accumulation in the receiving country, boosts local businesses' productivity by contracting and exposing them to health competition, technological transition, increase in human capital, and thereby rising exportation of goods. Researches by (Adegboye et al., 2020; Akinlo, 2004; Ejemeyovwi and Osabuohien, 2018) shows that foreign direct investment has a significant investment inflow that can complement domestic investment, generate more new job opportunities, develop technology transfer, and economic growth.

The relationship between foreign direct investment and economic growth has attracted great attention from scholars around the world (Basu et al., 2003; Vo and Zhang, 2019). It is broadly recognized that this relationship has been intensively investigated using data from a single country or a sample of many countries. Unfortunately, no agreement on empirical findings has been reached among scholars. Regarding a single country study, the empirical work that found positive effect of foreign direct investment includes; (Aga, 2014; Alabi, 2019; Ali and Malik, 2017; Antwi et al., 2013; Hassen and Anis, 2012; Jean Marie Vianney, 2018; Muhammad and Ijirshar, 2015; Ray, 2012; Sokang, 2018; and Umoh et al., 2012). Alabi (2019) empirically investigated the impact of foreign direct investment on economic growth of Nigeria from 1986 to 2017 by utilizing time series datasets. He employed OLS method to estimate the relationship between gross domestic product which is the dependent variable and explanatory variables such as foreign direct investment, interest rate, real exchange rate and domestic investment. This study found positive relationship between gross domestic product (economic growth) and foreign direct investment.

Similarly, (Jean Marie Vianney, 2018) investigated the impact of foreign direct investment on economic growth of Ghana over the period of 1970 to 2014 by using the vector autoregressive (VAR) model and ECM. The variables included in the study were annual real gross domestic product growth, Official Development Assistance, domestic capital formation, foreign direct investment inflows, labor force, trade and inflation. The results of the study showed positive relationship between economic growth and foreign direct investment in Rwanda during the study period. Sokang (2018) also examined the impact of foreign direct investment on economic growth of Cambodia by using time series data during 2006-2016. The study employed Two-Stage Ordinary Least Squares (2SOLS) method of simultaneous equation and the variables included were gross domestic product as dependent variable and foreign direct investment, consumer price index (inflation rates) and foreign exchange rate were included as independent variables. The study found positive relationship between

economic growth (GDP) and foreign direct investment for Cambodia over study period of 2006-2016.

Another empirical investigation of Nigeria by (Muhammad and Ijirshar, 2015) on the impact of foreign direct investment on economic growth over the time period of 1970 to 2013 also found positive relationship between foreign direct investment and economic growth. The study used real gross domestic product as endogenous variable which measure economic growth (proxy for economic growth) and foreign direct investment, domestic capital, government expenditure, real exchange rate and inflation rate as exogenous variables. The econometrics techniques used by the study were Augmented Dickey-Fuller unit root test to test for Stationarity, Johansen cointegration test to test for cointegration, Granger causality test to test for directional causality and error correction model to indicate the speed of adjustment from short run shocks to long run equilibrium.

Ali and Malik (2017) examined the impact of foreign direct investment on economic growth of Pakistan by using time series data that ranges from 2008-2013. Variables used for this purpose was gross domestic product as dependent variable and domestic capital, labor force, foreign direct investment and total export as explanatory variables. The methods used for the analysis was co-integration analysis, regression analysis and Durbin Watson test. The results of their study also showed positive relationship between foreign direct investment and economic growth.

There are also some other single country studies that found positive relationship between economic growth and foreign direct investment. For example, (Aga, 2014) investigates the effect of foreign direct investment on economic growth of Turkey by using ordinary least square (OLS) and vector autoregressive (VAR) model over the period of 1980-2012. Gross domestic product was dependent variable and foreign direct investment, domestic investment and trade liberalization were the explanatory variables. Umoh et al., (2012) conducted study on Nigeria found foreign direct investment boosts economic growth. Umoh et al., (2012) investigate the empirical relationship between economic growth rate and foreign direct investment in Nigeria between 1970 and 2008. In order to study this relationship, they employ simultaneous and single equation systems. They used variables like real gross domestic product (dependent variable) and labor, stock private capital, stock of foreign capital, real government consumption, trade openness, human capital, financial depth, budget balance to GDP ratio, time trend to capture the cyclical or secular trend and adjustment

dummy in their analysis. Their results suggest that there is a positive causal from growth rate to foreign direct investment and from foreign direct investment to growth rate. Additionally, the results acquired demonstrate that economic growth rate in Nigeria and foreign direct investment inflows are jointly determined. According to this analysis, the growing private contribution and higher openness are key causes that can obtain higher economic growth rates and to attract more foreign direct investments to flow into Nigeria.

In addition to researches based on the single-country data, there were various researches conducted based on cross-country data. For instance, (Zekarias, 2016) conducted study on the impact of foreign direct investment on economic growth in 14 Eastern African Countries during the period of 1980 to 2013 by utilizing dynamic Generalized Method of Momentum (GMM) estimators. The variables used in the study were growth rate of per capita real gross domestic product, initial per capita real gross domestic product, foreign direct investment, domestic private investment, human capital, labor force, infrastructure, openness, inflation, dummy variable for intergovernmental authority on development, dummy variable for Eastern African Community and dummy variable for common markets for Eastern and Southern Africa. The results confirm that FDI has a positive and marginally significant effect on economic growth. This leads to the conclusion that FDI is important driver of economic growth and a catalyst to economic conditional convergence in Eastern Africa countries.

Additionally, (Urgaia, 2016) in an empirical investigation of the impact of foreign direct investment on economic growth of East African countries, using annual panel data for seven selected countries in the region over the period of 1970 to 2015 showed positive relationship. The variables included in the study were real gross domestic product as indicator of economic growth or proxy of economic growth whereas, foreign direct investment, official exchange rate, index of openness and terms of trade were as explanatory variables. The econometrics method of panel autoregressive distributed lag (PARDL) and random effect models combined with time scaling wavelet decomposition analysis were utilized to show a panel of short, medium and long run effects for the entire region and individual countries. It was shown that long-run estimated coefficients have positive and statistically significant relationship between foreign direct and economic growth in the selected countries.

Agrawal and Khan (2011) apply linear multiple regression model covering the period of 17 years from 1993–2009. This study investigates the impact of foreign direct investment on economic growth rate of India and China. They use growth model and include a number of

factors in this model which are gross capital formation, FDI, human capital, GDP and labour force. Subsequently, they use Ordinary Least Square method and they find 0.02% rise in GDP of India and 0.07% rise in GDP of China as a result of 1% rise in FDI. Further, this study finds that the economic growth in India is less affected by FDI than China, since the later can utilize FDI better than India.

2.2.2 Review of Empirical Literature that Show Negative or Ambiguous Effect of FDI on Economic Growth

There are also some works that found negative effect or no effect of foreign direct investment on economic growth. The empirical works that support negative effects of FDI on economic growth also include works on single country data and cross country data. Some empirical works based on single country data that found negative effect or no relationship between economic growth and foreign direct investment includes the works of (Athukorala, 2003; Ergül et al., 2016; and Rahman, 2015). Rahman (2015) conducted study on Bangladesh to examine the impact of foreign direct investment on economic growth over time period of 1999 to 2013. Multiple regression analyses were utilized to measure the relationship between dependent variable (gross domestic product) and independent variables such as inflation rate and balance of trade. The result of the study signifies negative relationship between foreign direct investment and economic growth. Ergül et al., (2016) analyzed the relationship between foreign direct investment and economic growth in Turkey over the period of time ranging from 1989-2014 by employing the vector autoregressive (VAR) model. The study includes only two variables; economic growth represented by gross domestic product and foreign direct investment as independent variable. The results of the study revealed that foreign direct investment has no effect on economic growth in case of Turkey over the study period.

Athukorala (2003) also study on the impact of foreign direct investment on economic growth in Sri Lanka between 1959 – 2002 by applying VAR model and using gross domestic product as dependent variable and foreign direct investment, domestic investment and trade liberalization as independent variables. The results of study do not provide much support for the view of robust link between FDI and growth in Sri Lanka. He states that the situation is due to lack of better investment climate such as good governance, accountability, political instability and disturbance, bureaucratic inertia, among other reasons. (Ayadi, 2009) Study the relationship between FDI and economic growth in Nigeria (1980 – 2007) and obtains a

very weak association and causality between the variables and recommends that infrastructural development, human capital building and strategic policies towards attracting FDI should be intensified.

There are also cross-country level or panel data studies that found negative relationship between foreign direct investment and economic growth. For example, (Brenner, 2014) empirically conducted a research in 112 developed and less developed economies excluding oil exporting countries for the period of 1974 to 2010 and found a mixed result of the effects FDI on economic growth. By employing the generalized method of moment (GMM) technique for his analysis, he pointed out the evidence of negative effect of FDI on economic growth in less developed countries and positive effect of FDI on economic growth in more developed economies. Lund (2010) employing panel data from selected economies in Latin America and East Asia for the years 1980 to 2003 investigated the effect of FDI on economic growth and found an ambiguous link between the two variables and he found much evidence of causality in the long run in most countries while evidence of short-run causality exists especially in higher income countries.

Alege and Ogundipe (2014) also empirically investigated the relationship between foreign direct investment and economic growth in ECOWAS by employing the System-GMM panel estimation method covering the period 1970 to 2011. The variables of the study were GDP per capita which was the dependent variable and foreign direct investment, stock of capital, labor force, human capital, regulatory quality, openness, inflation as explanatory variable. The results of the research revealed that there is negative relationship between economic growth and foreign direct investment. (Jyun-Yi and Chih-Chiang, 2008) by means of threshold regression techniques developed by (Caner and Hansen, 2004) conducted whether the effect of foreign direct investment (FDI) on economic growth is dependent upon different absorptive capacities by including threshold variables such as initial GDP, human capital and volume of trade based on cross-sectional study of 62 countries covering the period of 1975 - 2000.

The empirical evidence suggests that there is conflicting effects of FDI. The findings of the threshold regression indicate that FDI can support economic growth when the host country has achieved a certain threshold of development, initial GDP and human capital. This is an indicative of the recipient countries learning and /or benefiting from foreign investors.

Therefore, initial GDP and human capital are important factors for FDI and consistent with (Blomstrom et al., 1992) and (Borensztein et al., 1998).

Another study conducted by (Kummer-Noormamode, 2015) applied vector autoregressive technique for her study of 58 developed and developing countries making use of time series data during the period of 1980 to 2004 and reported an ambiguous relationship between FDI and economic growth. Her finding results showed that there is no clear cut evidence of the impact of FDI on economic growth. Moreover, the results showed that the impacts of FDI are felt depending on the level of income of the country leading her to draw a conclusion that the flows of FDI does not necessarily enhance economic growth. Abdul and Ilan (2007) to examine the impact of FDI on economic growth considered sectoral annual FDI flow data for the period 1997 to 2006 by applying the panel fixed effects methodology. Although, he observed a positive and statistically significant effect of FDI on economic growth, he found that the impact in terms of sectoral analysis differs from one sector to another and specifically observed the negative effect of foreign direct investment in the manufacturing sector in Indonesian economy.

Lyroudi et al., (2004) limiting their study to transition economies, empirically investigated the impact of FDI on economic growth in Ukraine, Russia, Albania and Latvia among others. After using the Bayesian estimation technique on data from 17 transition economies spanning over the period 1995 to 1998 found no significant relationship between FDI and economic growth. They observed no significant connection between FDI and economic growth after grouping the data into high and low-income countries and trying to establish a relationship between these two variables. To analyze data from nine Central and East European countries covering the period 1995 to 2003, (Ciftcioglu and Begovic, 2008) in their study applied panel and pooled classical regression technique and their study reported a mixed result by establishing that FDI and impacts negatively on economic growth, unemployment and the share of manufacturing and agriculture in GDI while impacts positively on the share of export in GDP.

Alfaro (2003) in an effort to look at the effect of foreign direct investment on economic growth by employing OLS method of estimation shows that the advantages of FDI vary greatly across sectors by examining the effect of foreign direct investment on growth in primary, manufacturing and services sectors. The study contains 47 countries and ranges between 1981 and 1999. It suggests that total foreign direct investment exerts an ambiguous

effect on growth. However, the impact of foreign direct investment on primary sector tend have a negative effect on growth. But, it has positive effect on investment in manufacturing sector and ambiguous evidence from the service sector. (Agosin and Machado, 2005), examined the impact of foreign direct investment on economic growth by employing generalized method of moment (GMM) for 12 countries with data that covers 1971-2000. Another empirical analysis carried out by (Schneider, 2005) utilizing a unique panel dataset of 47 developed and developing countries from 1970 to 1990 focusing on the role of high technology trade, intellectual property rights and FDI in determining a country's rate of innovation and economic growth. The results revealed that foreign technology has stronger impact on per capita GDP growth than domestic technology; high technology imports are relevant in explaining domestic innovation both in developed and developing countries; intellectual property rights affect the innovation rate, but its impact is more significant for developed countries and therefore the finding regarding FDI are inconclusive.

2.2.3 Studies Previously Conducted on the Impact of Foreign Direct Investment on Economic Growth in Case of Ethiopia

There are also some empirical studies conducted in Ethiopia to investigate the impact of foreign direct investment on economic growth. For instance, (Menamo, 2014) investigated the impact of foreign direct investment on economic growth of Ethiopia over the time period of 1974 to 2011 by using ordinary least square (OLS). She used annual time series data of real gross domestic product, labor force, gross fixed capital formation, foreign direct investment, export, import, liberalization, war and drought and interaction between liberalization and foreign direct investment. The work of (Menamo, 2014) indicated that foreign direct investment affects economic growth positively.

(Betelhem, 2016) also examined the impact of foreign direct investment on economic growth of Ethiopia during the period of 1981 to 2015 by employing vector error correction model. In her study, she included variables such as gross domestic product per capita as dependent variable and foreign direct investment, gross capital formation, gross domestic saving, external debt stock and real effective exchange rate as explanatory variables. She found that foreign direct investment affects economic growth negatively and significantly in the long run and has insignificant effect in the short run. (Gizaw, 2015) also studied the impact of foreign direct investment on economic growth of Ethiopia by utilizing annual data that ranges from 1974 to 2013 employing vector autoregressive model (VAR) model. The study used real per

capita gross domestic product as proxy for economic growth (dependent variable) and gross domestic saving, foreign direct investment, inflation, trade deficit and government consumption as explanatory variables. The results of the study showed that there is a stable, long run relationship between foreign direct investment and economic growth.

Fite (2020) empirically investigated the impact of foreign direct investment on economic growth in Ethiopia by utilizing yearly time series data that ranges from 1982 to 2018. The ordinary Least Square (OLS) technique of estimation was applied to assess the model in the long term. He incorporated variables like gross domestic product as dependent variable and other variables such as foreign direct investment, inflation rate, trade openness, labor force, human capital, gross capital formation, gross domestic saving and infrastructure as independent variables. The findings of the analysis revealed that as foreign direct investment has positive and significant impact on the economic growth of Ethiopia. He also employed the error correction model (ECM) to investigate the existence of stable long run relationship and proved deviation from the long run equilibrium.

Another study with the aim to empirically examine the effect of foreign direct investment on economic growth of Ethiopia was conducted by (Chanie, 2017). To achieve the objectives of the study, variables included in the study were the growth rate of real gross domestic product, growth rate of foreign direct investment, growth rate of domestic capital, growth rate of labor force, growth of exports, inflation rate, real interest rate, real exchange rate, growth rate of total foreign debt, growth rate of per capita income and the interaction of growth rate of foreign direct investment and growth rate of domestic capital. The study employed simultaneous equation econometric technique and three stages least square (3SLS) estimation method by using a time series data that covers the period of 1974 to 2014. The study revealed a positive and statistically significant impact of FDI on economic growth of Ethiopia.

Thus, the present study wants to depart from the previous studies by applying Autoregressive Distributed Lag Model (ARDL) bounds test approach for cointegration, since this approach is more robust than other methods and has the ability to handle the problem of endogeneity. Furthermore, the previous studies did not include the financial development in their analysis which the present study want to incorporate and since the association between economic growth and foreign direct investment is essential issue for making proper policy that calls for further study and this study re-investigate the relationship between variables under

consideration by extending the study period from 1981-2019 chosen based on data availability for all variables.

2.3 Literatures on the Impact of Environmental Quality on Economic Growth

Several past studies dealt with the nexus between economic growth and foreign direct investment inflows and economic growth and carbon-dioxide emissions but, this study in addition to reviewing the impact of foreign direct investment on economic growth it is interested in reviewing the impact of environmental degradation on economic growth. It is well known that higher level of carbon-dioxide emissions which used as a proxy variable for environmental degradation might lead to the reduction of the productive capacity of a country and also to climate change, which show that there is a negative effect on economic growth.

The early sets of environmental Kuznets curve studies focused on the environmental impacts of economic growth. The study by (Grossman and Krueger, 1995) was the first attempt to test the relationship between the air quality and economic growth in 42 countries. Their results showed the global impact of CO_2 emissions has provided little incentive for countries to implement unilateral actions for these emissions and confirmed the existence of an inverted-U shape for the relationship between per-capita gross domestic product and several air pollutants. This is consistent with a scenario in which industrial development initially leads to greater emissions, but net emissions eventually decline as the concomitant increase in income raises the demand for health and environmental quality.

Ang (2008) also investigated the long-run relationship between pollutant emissions, energy consumption and output during the period from 1971 to 1999 by employing the vector error correction model. The result of the study indicated that pollution is positively related to the output in the long run. Sari and Soytas (2009) tested the relationship between carbon emissions, energy, total employment and income in selected five OPEC countries including Algeria and Saudi Arabia for the 1971-2002 by using an Autoregressive Distributed Lag bounds test approach to cointegration. Their result shows that none of them needs to sacrifice economic growth to decrease its emission levels. Similarly, (Arouri et al., 2012) examined the relationship between carbon dioxide emissions, energy consumption and real gross domestic product for 12 Middle East and North African Countries (MENA) for the period 1981 to 2005 by means of a unit root test and cointegration techniques. Their findings revealed that CO_2 emissions have a positive impact on economic growth. This indicates that reduction in CO_2

emissions per capita might be achieved at the same time as gross domestic product per capita in the MENA region continues to growth.

Another study conducted by (Halicioglu, 2009) tested the link between CO_2 emissions, energy consumption, foreign trade and gross domestic product in Turkey for the period 1960-2005 using cointegration procedure. The results indicated that environmental degradation damages economic growth. The same result was also obtained for a panel of the BRIC countries over the period of 1992-2004 by (Pao and Tsai, 2010). On the other hand, (Jayanthakumaran et al., 2012) using the ARDL methodology test investigated the links between CO_2 emissions, energy consumption, trade and income for China and India over the period of 1971-2007. Their investigation found that a high level of pollution emissions might lead to the reduction of the production capacity of a country. Likewise, (Borhan et al., 2012) empirically investigated the nature of causality between CO_2 emission and income for the period of 1965-2010 using two-stage least square (2SLS) and their findings revealed that CO_2 has a negative significant relationship with income. This follows the theory that as pollution level increases, the income level decreases and therefore, pollution may directly decrease output by decreasing the productivity of man-made capital and labor.

Omri et al., (2014) have conducted study on the relationship between FDI inflows, CO_2 emissions and economic growth for 54 countries over the period 1990-2011 using a dynamic simultaneous equation. Their results indicated the existence of a one-way directional causality running from CO_2 emissions to economic growth. Contrary to this, (Richmond and Kaufmann, 2006) found no association between CO_2 emissions and economic growth in their investigation between energy, carbon emission and income in both OECD and non-OECD countries using the fixed and random effect estimators during the period 1973-1997. Similarly, (Zhang and Cheng, 2009) obtained no association between economic growth and carbon-dioxide in china.

Furthermore, the study by (Bastola and Sapkota, 2015) employing the Johansen cointegration and ARDL models investigated the relationship between energy consumption, pollution emission and economic growth in Nepal for the period 1980 to 2011 proved that CO_2 emissions have no impact on economic growth. Abdouli and Hammami (2017) analyzed the impact of foreign direct investment inflows, capital stock and environmental quality on economic growth in 17 Middle East and North African (MENA) Countries. They conducted their analysis in panel framework employing both the static (ordinary least squares method

(OLS), fixed effect (FE), and random effect)) and dynamic (difference-generalized method of moments (Diff-GMM) and system-generalized method of moments (Sys-GMM) panel approaches. Their empirical findings show positive association between foreign direct investment, capital stock and economic growth process in MENA countries. On the other hand, their results indicated that economic growth responds negatively to environmental degradation. Similarly, (Azam et al., 2016) reported negative relationship between energy utilization, CO_2 emissions and economic growth in Japan, USA, India and China during 1971-2013. The recent study by (Bekun and Agboola, 2019) also revealed a negative relationship between CO_2 emissions and economic progress of the economy in 16 European Union countries.

2.4 Foreign Direct Investment and the Environment

The relationship between environmental degradation and economic growth (income) is hypothesized as Environmental Kuznets Curve (EKC) hypothesis. The central idea of EKC theory is that environmental degradation rises with the rise in income in the early phases of economic development and then after starts to decline after a certain level of income is reached. In other words, EKC states that the existence of an inverted U-shaped relationship between environmental degradation and economic growth.

There are sizeable amount of research works analyzed the EKC hypothesis and environmental degradation proxied by either CO_2 emissions or any other element, such as sulphur dioxide (SO_2), methane (CH_4) and nitrous oxide (N_2O). The pioneering work of (Grossman and Krueger, 1991) was explained well about the theory of EKC and it was followed by plentiful empirical studies to check the existence of EKC hypothesis. Among others, it includes the empirical work of (Coondoo & Dinda, 2008; Dinda & Coondoo, 2006; Friedl & Getzner, 2003; Heil & Selden, 1999; Nasir & Rehman, 2011; Salahuddin et al., 2018; Shafik & Bandyopadhyay, 1992; Shahbaz et al., 2013, 2016; Solarin et al., 2017; and Haq et al., 2016). However, empirical studies point out mixed evidences about the existence of the EKC hypothesis.

The results of the existing empirical studies discloses that the impact of foreign direct investment on environment is controversial (Abdouli and Hammami, 2018; Al-Mulali and Tang, 2013; Chandran and Tang, 2013; Sapkota and Bastola, 2017). First and foremost, a substantial amount of empirical works argued that foreign direct investment has a detrimental effect on environment (Seker et al., 2015). For example, (Shahbaz et al., 2015) have studied

the impact of FDI on environment and found that FDI increases environmental degradation, which confirms the pollution haven hypothesis. Baek, (2016) also shows that FDI deteriorates the environment. Zugravu-Soilita (2017) also employed panel data to check that FDI increases pollution.

Besides that, some studies found that FDI has a positive influence on environment. To explore the validity of the pollution haven hypothesis in the Gulf Cooperation Council countries (Al-Mulali and Tang, 2013) utilized multivariate framework and they found that foreign direct investment inflow has a long run negative relationship with CO_2 Emission. Asghari (2013) found that FDI inflow has a weak and statistically significant negative relationship with CO_2 emission, which suggested weak support for the halo pollution hypothesis. FDI inflows might bring cleaner technologies to the environment and improves environmental-management practices of the host countries.

The results of the previous empirical study indicate that the impact of FDI on environment is non-consistent. This ambiguity of the empirical results among studies on the FDI environment relationship might arise from differences in scope, approach, institutional setting, data comparability, and level of development and therefore the specific character of FDI in various countries. Studies using FDI data at firm level come up with more detailed results but they are not easily comparable. The problem is further complicated since the size, regional distribution and sectoral composition of FDI have changed rapidly over time.

2.5 Summary of the Reviewed Literature

In contrast with more settled theoretical evidence, the existing empirical evidences have shown mixed results about the relationship between foreign direct investment and economic growth of the host countries. There are several reasons that can be mentioned to explain such disparity of empirical findings. Among them, some of it can be mentioned as below. Firstly, tests are traditionally examined by employing data sets usually belonging to heterogeneous groups of countries. Secondly, past researches have applied different theoretical models. Thirdly, the existing empirical evidences have usually employed a variety of econometrics methods in testing and estimation purpose. Existing empirical evidences for developed countries seems to support the idea that foreign direct investment is positively related to economic growth. But, FDI's impact on economic growth remains ambiguous with some finding show positive spillovers while others reporting limited evidence for the case of developing countries.

Therefore, from the various literature reviewed it can be shown that the impact of foreign direct investment on growth is inconclusive. This necessitates the importance for further research into the area to add to the literature so as to find a more conclusive decision on the topic. Furthermore, the literature on the impact of environmental degradation proxied by CO_2 emissions on economic growth has shown different results from study to study, from time to time, across countries and to the best of the knowledge of the researcher very little or no study investigated the impact of FDI and environmental degradation on economic growth under the same framework in the case of Ethiopia. As a result the main aim of this study is to examine the relationship between foreign direct investment, environmental degradation and economic growth in Ethiopia.

2.6 Conceptual Framework

A Conceptual framework is a construction which the researcher considers as a way that can best explain the relationship of the variables to be studied (Camp, 2001). It is the investigator's explanation of how the research problem would be explored. The conceptual framework presents an integrated way of looking at a problem under study (Liehr and Smith, 1999). In a statistical viewpoint, the conceptual framework describes the relationship between the main concepts of a study. It is arranged in a logical structure to help provide a picture or visual display of how ideas in a study relate to one another (Osanloo and Grant, 2016). Furthermore, (Miles and Huberman, 1994, p.18) state that conceptual frameworks can be graphical or in a narrative form showing the key variables to be studied and the presumed relationships between them.

Conceptual frameworks are always constructed by researchers. (Ravitch and Carl, 2019) stated that conceptual frameworks are generative frameworks that reflect the thinking of the entire research process. Mostly, diagrams are created to clearly define the variables of the research topic and their relationships are shown by the use of arrows. (Latham, 2017) argue that the whole methodology must agree with the variables, as well as their relationships and context. Researchers are at liberty to take existing frameworks, but have to modify it to suit the nature of the context of their research as well as the nature of their research questions (Fisher, 2007). Fisher stated that a good conceptual framework must also be articulated in writing for it to be understood clearly. This means that after a researcher has craftily formed a diagrammatic representation of the main variables of the study, she/he has to explain the

relations among them and how their complementation helps in answering the major research problem defined.

The present study focuses on the impact of foreign direct investment and environmental degradation on economic growth of Ethiopia and also on the impact of foreign direct investment on environmental quality. The nature of the relationship between foreign direct investment and economic growth can decompose into three main impacts. These are; through the direct impact, the indirect impact and the reverse impact. The direct impact is shown by the arrow flowing directly from foreign direct investment to economic growth. This direct impact is of FDI on economic growth is explained by using the neo-classical economic growth model. Identifying the direct impact of FDI on economic growth only gives an incomplete understanding of the relationship between FDI and economic. Therefore, it is essential to notice beyond the direct impact of FDI. As a result, the new growth theorists are reviewed to validate the indirect impact related with foreign direct investment. The conceptual framework is constructed for this study based on the literatures reviewed. Below figure 2.1 shows the proposed relationship between variables of interest.

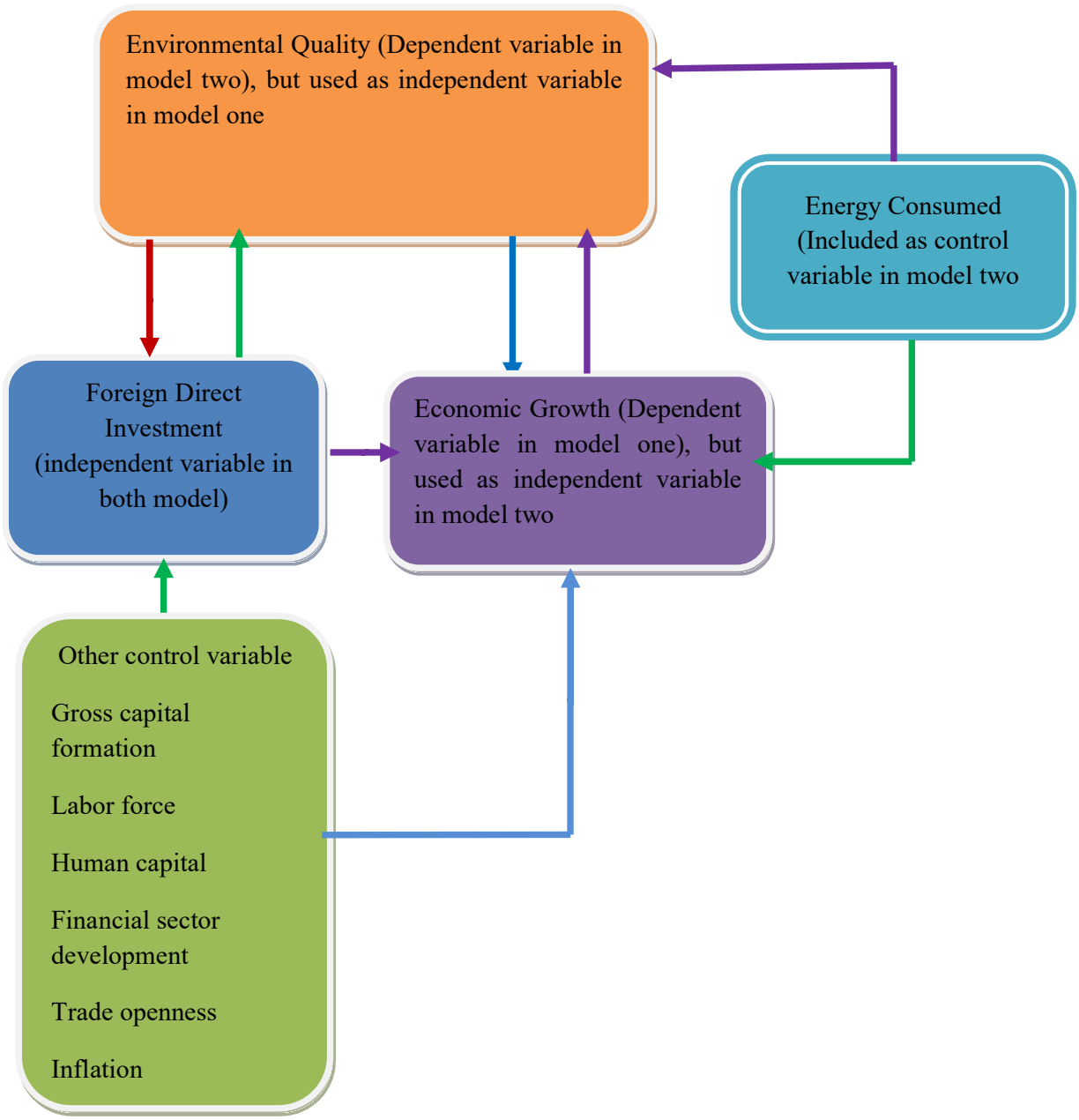


Figure 2. 1 The Proposed Framework for the Study, Adopted from the works of (Zekarias, 2016) **with modification.**

CHAPTER THREE

3. METHODOLOGY OF THE STUDY

This chapter starts with the explanation of the research design, functional form and model specification, description of variables included in the study, highlighting of method of estimation and data analysis. It also describes about stationarity tests and bound cointegration test. Then it proceeds to the description of the data type and the sources from where the necessary data is collected.

3.1 Research Design

The study employed a quantitative approach for the analysis of the impact of foreign direct investment and environmental degradation on economic growth of Ethiopia over the time period that ranges from 1981 to 2019. Since quantitative research approach dependent on numerical data and objective facts, it can help researchers to generate statistics which can be generalized and also help to look at the relationship between variables as well as to determine the cause and effect between them. The quantitative research approach was adopted by several researchers who studied similar topic on foreign direct investment. For example, (Bokpin et al., 2015; Dellis et al., 2017; Djokoto, 2012; Meyer and Habanabakize, 2018). Dellis et al., (2017) empirically investigate the role of economic structures by adopting quantitative and statistical artifacts like financial round tripping. Bokpin et al., (2015) quantitatively demonstrate that natural resources influence foreign direct investment inflow to Africa. Djokoto (2012) examined the factors attracting foreign direct investment into the agricultural sector of Ghana between 1970 and 2009. This study employed the quantitative research approach to establish relationship between foreign direct investment, environmental degradation and economic growth with other influential variables.

3.2 Functional Form and Econometrics Model Specification

3.2.1 Economic Growth Model Specification

Solow (1956) pioneered neoclassical growth model that generated theoretical basis for growth. The contribution to output growth can be generated from the growth rates of different inputs such as capital, labor, technology, inward foreign direct investment or by including vector of additional variables such as exports, imports and institutional dummies. The main assumptions in neoclassical production function includes diminishing returns to each factor of

production, constant return to scale, some positive and smooth elasticity of substitution between the inputs.

The general functional form from which the growth accounting framework derived can be represented as below:

$$Y = f[K, L,] \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (3.1)$$

Where the symbols in the above equation have the following definition;

Y = Output

K = Capital

L = labor

Then to endogenize the total factor productivity variable A as a function of FDI it is written as below:

$$Y = AK^{\beta_1}L^{\beta_2} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (3.2)$$

Where, A represent total factor productivity or efficiency of production and β_1, β_2 are the elasticity of capital and labor respectively.

Foreign direct investment influence total factor productivity through positive externalities and spillover effects according to endogenous growth theory. Therefore, we can express total factor productivity as a function of foreign direct investment.

$$A = f(FDI)$$

Thus the above equation can be expressed as: $A = \beta_0 FDI^{\beta_3} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (3.3)$

Substituting equation (3.3) into equation (3.2), we can get a production function that has the following general form:

$$Y = \beta_0 FDI^{\beta_3} K^{\beta_1} L^{\beta_2} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (3.4)$$

The endogenized total factor productivity function A can be extended to include the effects of initial conditions which include the level of human capital development, financial market development, macroeconomic stability (inflation rate), carbon-dioxide emissions and trade openness (Wanjiku, 2016).

$$A = \beta_0 FDI^{\beta_3} {CO_2}^{\beta_4} HC^{\beta_5} FD^{\beta_6} OPEN^{\beta_7} INF^{\beta_8} \dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots (3.5)$$

After substituting the total factor productivity function (equation 3.5) above into the production function (equation 3.4) above, we obtain the following equation.

$$Y = \beta_0 FDI^{\beta_3} {CO_2}^{\beta_4} HC^{\beta_5} FD^{\beta_6} OPEN^{\beta_7} INF^{\beta_8} K^{\beta_1} L^{\beta_2} \dots\dots\dots\dots\dots\dots\dots\dots\dots\dots (3.6)$$

Then the above equation (3.6) transformed to linear form using logarithms.

$$LNY = \beta_0 + \beta_1 LNK + \beta_2 LNL + \beta_3 LNFDI + \beta_4 LNCO_2 + \beta_5 LNHC + \beta_6 LNFD + \beta_7 LNTRO + \beta_8 LNINF + \varepsilon_i \dots\dots\dots\dots\dots\dots\dots\dots (3.7)$$

Where the variables in the above model are defined as follows:

$Y_t =$ is the per capita gross domestic product at a time t.

$GCF_t =$ is the Gross Capital Formation as a percentage of gross domestic product or domestic investment (represent capital) or K at time t.

$LF_t =$ is the level of the labor force at a time t

$FDI_t =$ is represent the Foreign Direct Investment as a percentage of gross domestic product at a time.

CO_2= Represent carbon-dioxide emissions in metric tons per capita at time t

$HC_t =$ Represent the level of human capacity or human capital at time t

$FD_t =$ Represent financial development at time t

$TRO =$ Measures trade openness, which is the ratio of the sum of exports and imports to gross domestic product at time t.

$INF_t =$ is the rate inflation measures the percentage change in consumer price index at time.

LN= is the logarithm of variables included

$\beta_0 =$ is constant term or the intercept.

$\beta_1 - \beta_8 =$ represent the co-efficients of explanatory variables

ε_t= is stochastic error term or factors not included in the model and unobservable factors.

The specific ARDL model is formulated as shown below on equation (3.8) and is called conditional ECM or unrestricted ECM (Pesaran et al., 2001).

$$\begin{aligned}\Delta LNY_t = \alpha_0 &+ \sum_{k=1}^{p} \alpha_{1k}\, \Delta LNY_{t-k} + \sum_{k=0}^{q_1} \alpha_{2k}\, \Delta LNGCF_{t-k} + \sum_{k=0}^{q_2} \alpha_{3k}\, \Delta LNLF_{t-k} \\ &+ \sum_{k=0}^{q_3} \alpha_{4k}\, \Delta LNFDI_{t-k} \sum_{k=0}^{q_4} \alpha_{5k} \Delta LNCO_{2_{t-k}} + \sum_{k=0}^{q_5} \alpha_{6k}\, \Delta LNHC_{t-k} \\ &+ \sum_{k=0}^{q_6} \alpha_{7k}\, \Delta LNFD_{t-k} + \sum_{k=0}^{q_7} \alpha_{8k}\, \Delta LNTRO_{t-k} + \sum_{k=0}^{q_8} \alpha_{9k}\, \Delta LNINF_{t-k} \\ &+ \beta_1 LNY_{t-1} + \beta_2 LNGCF_{t-1} + \beta_3 LNLF_{t-1} + \beta_4 LNFDI_{t-1} + \beta_5 LNCO_{2_{t-1}} \\ &+ \beta_6 LNHC_{t-1} + \beta_7 LNFD_{t-k} + \beta_8 LNTRO_{t-1} \\ &+ \beta_9 LNINF_{t-1} \ldots\ldots\ldots\ldots\ldots\ldots (3.8)\end{aligned}$$

Where, Δ represents the difference operator; $\alpha_1 - \alpha_9$ are the short run coefficient terms, $\beta_1 - \beta_9$ are the long run coefficients, $p\ and\ q_1 - q_8$ are the optimal lag length of the model that will be determined by the Akaike information criterion (AIC) or Schwarz Bayesian Information Criteria (SBIC).

3.2.2 Environmental Quality Model Specification

In this study, the environmental quality model is mainly based on the econometrics model proposed by (Shahbaz et al., 2013). The form of the empirical model is shown as below.

$$CO_{2t} = f(Y_t, Y_t^2, FDI, EC, TRO, FD) \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (3.9)$$

Mathematically, the above equation can be expressed as follows.

$$CO_{2t} = \beta_0 + \beta_1 Y_t + \beta_2 Y_t^2 + \beta_3 FDI_t + \beta_4 EC_t + \beta_5 TRO_t + \beta_6 FD_t + \varepsilon_t \ldots\ldots\ldots\ldots\ldots (3.10)$$

Where, t and ε_t denote time and disturbance or error term respectively. CO_2 is carbon-dioxide emissions metric ton per capita, Y is per capita gross domestic product, Y^2 is the square of per capita gross domestic product, FDI foreign direct investment as percentage of GDP, EU is energy consumption per capita, TRO is trade openness measured as the sum of export and import as ratio of GDP and FD is financial development proxied by broad money as percentage of GDP.

The above equation can be written as below in its log version.

$$LNCO_{2t} = \beta_0 + \beta_1 LNY_t + \beta_2 LNY_t^2 + \beta_3 LNFDI_t + \beta_4 EC_t + \beta_5 TRO_t + \beta_6 FD_t + \varepsilon_t \dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots (3.11)$$

The UECM for this model can be represented as below.

$$\Delta LNCO_{2t} = \alpha_0 + \sum_{k=1}^{p} \alpha_{1k} \Delta LNCO_{2t-k} + \sum_{k=0}^{q_1} \alpha_{2k} \Delta LNY_{t-k} + \sum_{k=0}^{q_2} \alpha_{3k} \Delta LNY_{t-k}^2 + \sum_{k=0}^{q_3} \alpha_{4k} \Delta LNFDI_{t-k} + \sum_{k=0}^{q_4} \alpha_{5k} \Delta LNEC_{t-k} + \sum_{k=0}^{q_5} \alpha_{6k} \Delta LNTRO_{t-k} + \sum_{k=0}^{q_6} \alpha_{7k} \Delta LNFD_{t-k} + \beta_1 LNCO_{2t-1} + \beta_2 LNY_{t-k} + \beta_3 Y_{t-k}^2 + \beta_4 LNFDI_{t-k} + \beta_5 LNEC_{t-k} + \beta_6 LNTRO_{t-k} + \beta_7 LNFD_{t-k} \dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots (3.12)$$

Where, Δ stands for the difference operator; $\alpha_1 - \alpha_7$ stands for the short run coefficient terms, $\beta_1 - \beta_7$ stands for the long run coefficients terms, $p \; and \; q_1 - q_6$ represent the optimal lag length of the model that will be determined by the Akaike information criterion (AIC) or Schwarz Bayesian Information Criteria (SBIC).

To investigate the presence of long run relationship among the variables for the proposed model above, we test the null hypothesis of no cointegration on the level variables, which is $H_0 := \beta_1 = \beta_2 = \beta_3 = \beta_4 = \beta_5 = \beta_6 = \beta_7 = 0$ against the alternative $H_a : \beta_1 \neq \beta_2 \neq \beta_3 \neq \beta_4 \neq \beta_5 \neq \beta_6 \neq \beta_7 \neq 0$ which suggests the presence cointegration (long run relationship) among the variables. The presence of cointegration is decided based on the value of computed *F*-statistic. This computed *F*-statistic value is then compared with critical value developed by (Pesaran et al., 2001). If the computed *F*-statistics is larger than the upper bound value of the table, we can reject the null hypothesis and accept the alternative hypothesis that cointegration exists. On the other hand, if *F*-statistic is lower than the lower bound, the null hypothesis cannot be rejected and thus the cointegration in the proposed model does not exist.

3.3 Description of the Variables

3.3.1 Dependent Variable

i. Gross Domestic Product per Capita (Y)

GDP per capita is a basic economic indicator and measures the level of total economic output relative to the population of a country. In this study GDP per capita is used as proxy variable for economic growth. Data are in constant 2010 U.S. dollars.

3.3.2 Independent (Explanatory) Variables

i. Gross Capital Formation

Also called gross domestic investment consists of outlays on additions to the fixed assets of the economy plus net changes in the level of inventories. Fixed assets include land improvement (like fences, ditches, and drains) and machinery, plant and equipment. Fite (2020) investigated the impact of foreign direct investment on economic growth of Ethiopia. The results of his study show positive relationship between gross capital formation and economic growth. Similarly, (Jean Marie Vianney, 2018) found positive relationship between gross capital formation and economic growth. Thus, based on these previous studies the present study also expects positive association between gross capital formation and Economic growth.

ii. Labor Force

Total labor force consists of population who ages 15 years and above 15 years that are economically active population who supply their labor for the production of goods and services who meet the International Labor Organization (ILO) definition as defined by World Bank. Some previous studies that found positive relationship between labor force and economic growth include (Chanie, 2017; Menamo, 2014; and Zekarias, 2016). The present study also expected positive impact of labor force on economic growth.

iii. Foreign Direct Investment (FDI)

Foreign direct investment are the net inflows of investment to acquire a lasting management interest (10 percent or more of voting stock) in an enterprise operating in an economy other than that of the investor. It is the sum of equity capital, reinvestment of earnings, other long-term capital, and short-term capital as shown in the balance of payments. This series shows net inflows (new investment inflows less disinvestment) in the reporting economy from foreign investors, and is divided by GDP. FDI is measured as a percentage of gross domestic products and it is expected that there is positive relationship between FDI and Economic Growth. The impact of foreign direct investment on economic growth is controversial. Some studies found positive and some others found negative impact. Among empirical studies found positive impact of foreign direct investment on economic growth were; (Alabi, 2019;

Chanie, 2017; Gizaw, 2015; Jean Marie Vianney, 2018; and Sokang, 2018). On other hand, studies by (Philip O Alege, 2016; Brenner, 2014; and Rahman, 2015) found negative relationship between foreign direct investment and economic growth. Accordingly, the present study expected either positive or negative effect of foreign direct investment on economic growth.

iv. Carbon Dioxide Emissions

A carbon-dioxide emission is used as a proxy variable for environmental quality. Previous studies were found different results for carbon-dioxide effects on economic growth. Among several empirical researches, (Ang, 2008) and (Arouri et al., 2012) found positive impact of CO_2 emissions on economic growth. In contrast, (Azam et al., 2016; Bekun and Agboola, 2019; Borhan et al., 2012; Halicioglu, 2009; Pao and Tsai, 2010) were found negative relationship between CO_2 emissions and economic growth. This particular study expected also negative relationship between CO_2 emissions and economic growth for the study period.

v. Human Capital

Human capital involves increase in investment in education and training of individuals. Individuals abilities can be enhanced through education and training that bring about effective change in the performance of jobs (Schultz, 1979). Human capital amounts to investment on education and training which can be undertaken by individual or group of individual workers of any institution or organization as postulated by (Marshal, 1998). The importance of human capital to economic growth is highlighted by (Mankiw et al., 1992) and (Sala-i-Martin and Barro, 1995). Human capital in addition to a direct impact on economic growth can be critical for absorbing foreign knowledge and it is also an important determinant of positive spillover of foreign direct investment that can be realized. Human capital has been measured in various methods as it can be realized from different literatures. Average years of schooling and school completion rates are often favored (Lee and Barro, 2001). The present study uses education expenditure to capture human capital (as proxy for human capital) since this variable has the most widely available data for Ethiopia. The impact of human capital on economic growth was found positive by many studies. For example, (Agrawal and Khan, 2011; Fite, 2020; and Wanjiku, 2016) were found positive relationship between human capital and economic growth. Positive relationship between economic growth and human capital is expected in this particular study.

vi. Financial Market or Financial Sector Development

Financial sector contains the set of institutions, instruments, markets, as well as the legal and regulatory framework that allow transactions to be made by extending credit. Basically, financial sector development is about overcoming "costs" incurred in the financial system. This process of reducing the costs of acquiring information, enforcing contracts, and making transactions resulted in the emergence of financial contracts, markets, and intermediaries. Different types and combinations of information, enforcement, and transaction costs in conjunction with different legal, regulatory, and tax systems have motivated distinct financial contracts, markets, and intermediaries across countries and throughout history.

A large body of study suggests that financial sector development plays a large role in economic development. It promotes economic process through capital accumulation and technological progress by escalating the savings rate, mobilizing and pooling savings, producing information about investment, facilitating and inspiring the inflows of foreign capital and also optimizing the allocation of capital.

Countries with developed financial systems tend to grow faster over long periods of time, and a large body of evidence suggests that this effect is causal: financial development is not simply an outcome of economic growth; it contributes to this growth. (Alfaro et al., 2006) suggested that financial sector development influences the extent to which foreign direct investment promotes higher economic growth in host countries through backward linkages. In this study broad money as percentage of gross domestic product is used as proxy for financial development. (Alzaidy et al., 2017) found positive relationship between financial sector development and economic growth in case of Malaysia. The impact of financial sector development on economic growth is also expected to be positive in this present study.

vii. Openness of Economy

Trade openness is the fraction of the sum of exports and imports to GDP. Thus, the ratio of trade (the sum of exports and imports) to gross domestic product is used to capture this variable. It has a role in improving technological advancement through competition. It opens the economy to international market and bridge the gap of foreign exchange. Exports have been considered as an explanatory variable in the growth accounting literature. Foreign direct investment inflows are expected to result in improved competitiveness of host countries exports. They will have a multiplier effect on gross domestic product as exports and investment increase. Increased exports and investments may also produce foreign exchange that can be used to import capital goods. Zekarias (2016) in his investigation found positive

association between trade openness and economic growth. The relationship between openness and economic growth is expected to be positive in this study.

viii. Inflation

Inflation as measured by the consumer price index reflects the annual percentage change in the cost to the average consumer of acquiring a fixed basket of goods and services that may be fixed or changed at specified intervals, such as annually. It is measured as percentage change in consumer price index. It is included to represent macroeconomic situations in the economy. For investment to have more conducive environment, lower inflation rate is preferred. The previous studies of (Gizaw, 2015) and (Fite, 2020) revealed the negative impact of inflation on economic growth of Ethiopia. Therefore, the present study also expected negative relationship between economic growth and inflation.

3.4 The Autoregressive Distributed Lag (ARDL) Model

Johansen cointegration technique has been employed to determine the long run or long term relationships between variables in large number of previous studies by researchers. The Johansen cointegration technique remains the technique of choice for many researchers who argue that this is the most accurate method to apply for I(1) variables. However, recently, a series of studies by (Pesaran and Pesaran, 1997; Pesaran et al., 2001; Pesaran and Shin, 1996; Pesaran and Smith, 1998) have introduced Autoregressive Distributed Lag (ARDL) bound test as an alternative cointegration method. The ARDL model has a many advantages over Johansen cointegration technique. ARDL approach unlike other cointegration technique does not require all of the explanatory variables to be integrated of the same order. As a result the ARDL approach can be applicable regardless of the explanatory variables are integrated of I(1) and/or I(0). In other words, the ARDL approach has the ability to overcome the pre-testing problems associated with standard cointegration techniques, which demands that the variables should be classified into I(1) or I(0). Also, the ARDL approach is the more statistically significant approach to determine the cointegration relation in small samples (Ghatak and Siddiki, 2001), while large data samples are required for Johansen cointegration technique to be valid.

Even, in the case that different variables have different optimal numbers of lags, the ARDL approach estimation is possible. In the ARDL model cointegration bound approach is free of residual correlation and hence endogeneity is less of problem.

3.5 ARDL Model Long Run Representation

If the long run relationship between the variable under consideration is exist, the ARDL model long run representation will have the following form:

$$Y_t = \beta_0 + \sum_{i=1}^{p} \beta_1 GCF_{t-i} + \sum_{i=1}^{p} \beta_2 LF_{t-i} + \sum_{i=1}^{p} \beta_3 FDI_{t-i} + \sum_{i=1}^{p} \beta_4 CO2_{t-i} + \sum_{i=1}^{p} \beta_5 HC_{t-i} + \sum_{i=1}^{p} \beta_6 FD_{t-i} + \sum_{i=1}^{p} \beta_7 TRO_{t-i} + \sum_{i=1}^{p} \beta_8 INF_{t-i} + \varepsilon_t \dots\dots\dots\dots\dots\dots (3.13)$$

3.6 ARDL Model Short Run Representation

The ARDL short run dynamics model is specified as below:

$$\Delta Y_t = \alpha_0 + \sum_{i=1}^{q} \alpha_{1i} \Delta Y_{t-i} + \sum_{i=1}^{p} \alpha_{2i} \Delta GCF_{t-i} + \sum_{i=1}^{p} \alpha_{3i} \Delta LF_{t-i} + \sum_{i=1}^{p} \alpha_{4i} \Delta FDI_{t-i} + \sum_{i=1}^{p} \alpha_{5i} \Delta CO2_{t-i} + \sum_{i=1}^{p} \alpha_{6i} \Delta HC_{t-i} + \sum_{i=1}^{p} \alpha_{7i} \Delta FD_{t-i} + \sum_{i=1}^{p} \alpha_{8i} \Delta TRO_{t-i} + \sum_{i=1}^{p} \alpha_{9i} \Delta INF_{t-i} + \phi ECT_{t-1} + \varepsilon_t \dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots (3.14)$$

3.7 Vector Error Correction Model

The error correction model (ECM) is very crucial in the co-integration test as it drives from the fact that, if macroeconomic variables are integrated of order zero, I(0) i.e., they are co-integrated, they can be modeled as having been generated by the ECM .The ECM results in better short run forecasts that hold together in economically meaningful way. Even when there is no cointegration, the ECM produces good forecasts (LeSage, 1990). The long run model will then be reformulated into an ECM, which can integrate short run and long run dynamics of the model. ECM will have the following form:

$$\Delta y_t = \alpha + \phi_i \Delta y_{t-i} + \sum_{i=0}^{p} \delta_i \Delta X_{t-i} + \pi ECM_{t-i} + \varphi_t \dots\dots\dots\dots\dots\dots\dots\dots (3.15)$$

Where, ECM_{t-i} represents the residual term or disequilibrium from the long run relationship, α, ϕ_i, δ_i and π are parameters. φ_t is a white noise error term. Having these facts in mind, the above equation can be estimated by the usual ordinary least square (OLS) technique since all

its terms (in their first difference) are integrated of order zero and thus standard hypotheses testing employing the usual t-statistics and related diagnostic tests can be conducted on the error term. The estimable ECM will have the following form:

$$\Delta LNY_t = \alpha_0 + \sum_{k=1}^{p} \alpha_{1k}\,\Delta LNY_{t-k} + \sum_{k=0}^{q_1} \alpha_{2k}\,\Delta LNGCF_{t-k} + \sum_{k=0}^{q_2} \alpha_{3k}\,\Delta LNLF_{t-k} + \sum_{k=0}^{q_3} \alpha_{4k}\,\Delta LNFDI_{t-k} + \sum_{k=0}^{q_4} \alpha_{5k}\Delta LNCO_{2\,t-k} + \sum_{k=0}^{q_5} \alpha_{6k}\,\Delta LNHC_{t-k} + \sum_{k=0}^{q_6} \alpha_{7k}\,\Delta LNFD_{t-k} + \sum_{k=0}^{q_7} \alpha_{8k}\,\Delta LNTRO_{t-k} + \sum_{k=0}^{q_8} \alpha_{9k}\,\Delta LNINF_{t-k} + \alpha_9 LNY_{t-1} + \alpha_{10} LNGCF_{t-1} + \alpha_{11} LNLF_{t-1} + \alpha_{12} LNFDI_{t-1} + \alpha_{13} LNCO_{2\,t-1} + \alpha_{14} LNHC_{t-1} + \alpha_{15} LNFD_{t-k} + \alpha_{16} LNTRO_{t-1} + \alpha_{17} LNINF_{t-1} + \Phi ECM_{t-1} + \varepsilon_t \dots\dots\dots\dots\dots\dots (3.16)$$

Where, α_0 is the drift parameter, Δ represents the difference operator; $\alpha_9 - \alpha_{17}$ are the coefficient terms, $p\ and\ q_1 - q_8$ are the optimal lag length of the model that will be determined by the Akaike information criterion (AIC) or Schwarz Bayesian criterion (SBC). The coefficient of ECM_{t-1}, ϕ is the speed of adjustment at which equilibrium is achieved.

3.8 Method of Estimation

To investigate the relationship between the dependent variable and independent variables the study was employed Autoregressive Distributed Lag (ARDL) Model. The ARDL model contains two basic stages. Firstly, the F-statistic is computed for testing the significance of the lagged levels of the variables in the error correction model of the underlying ARDL model, in order to check the existence of the long run relationship between the variables under consideration. Secondly, the estimation of the parameters or coefficients of the long run relationship was estimated. For estimation purpose the study was applied E-views Version 10 statistical software.

3.9 Method of Data Analysis

The study was employed both descriptive and econometrics analysis to achieve its objectives. Descriptive analysis used tables and graphs as tools of analysis. Econometrics techniques were also utilized to make inferences.

3.10 Stationarity Test or Unit Root Test

3.10.1 Augmented Dickey-Fuller (ADF) Test

Time series data are not generally stationary, that means they usually show or exhibit unit root which can be removed by differencing. When variables exhibit a unit root, it indicates that the expected value is not constant or the mean and variance are changing over time, either increasing or decreasing (Studenmund, 2014). When this a case, it causes, the regression model to be wrong while the R-squared and t statistics show the opposite, leading to spurious results of the regression. If a series contains stochastic trends it is non-stationary and violates OLS assumptions (Stock and Watson, 2012).

Most of the time, the non-Stationarity in variables can be removed by taking the first difference. Whenever the distribution of t-statistics is not normally distributed, the Dickey-Fuller table is employed to determine the overall fit. This study was employed the Augmented Dickey-Fuller (ADF) test, which also follows the same features as the Dickey-Fuller statistic, by adding the lagged value of the dependent variables (Gujarati and Porter, 2009). ADF test objective at checking for the presence of a unit root in a time series.

ADF can be applied under four different cases as described by (Hamilton, 1994). The null hypothesis is always stated that as there is unit root in the variable under consideration. They differ in whether the regression used to obtain the test statistic includes a constant term and time and whether the null hypothesis includes a drift term. Becketti (2013) provides additional examples showing how to conduct these tests. The general form of the ADF is assumed to have the following regression form.

$$\Delta y_t = \beta_0 + \beta_1 y_{t-1} + \sum_{i=1}^{n} \beta_i \Delta y_{t-i} + e_t \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (3.17)$$

$$\Delta y_t = \beta_0 + \beta_1 y_{t-1} + \sum_{i=1}^{n} \beta_i \Delta y_{t-i} + \delta_t + e_t \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (3.18)$$

Where, y_t is a time series and linear time trend, Δ is the first difference operator, α_0 is a constant, n is the optimum number of lags in dependent variable and e is the random error term or disturbance term.

3.10.2 Phillip Perron Test

The Phillip Perron test would serve as a confirming approach to the outcomes from the ADF test. A consistency of the results from the Phillip Perron test and Augmented-Dickey –Fuller (ADF) test would ascertain stationarity of variables whether at level, first difference and

second difference. The Phillip Perron test is assumed as a modification of the Augmented-Dickey-Fuller test since it helps to check and correct the issues of heteroskedasticity and serial correction.

3.11 ARDL Bounds Cointegration Test

To ascertain whether there exists co-integration in the model is also an important issue in time series study. In this particular study, a bounds test would be performed to confirm whether or not there exists a long run relationship. There exist different types of Cointegration method like Johansen Cointegration; however, the present study choice the bounds test as an important method since this method has some advantages than other methods. Bounds test can be applied in case of variables with different combination of integration such as I(0) and I(1), it is efficient and appropriate in situations where the sample size is finite and small and it produces unbiased estimate for the long run model. It is for these reasons; the study chooses the bounds tests as method of Cointegration. There are two hypotheses in bounds test. The null hypothesis states that there is no Cointegration against the alternative hypothesis that postulates there is co-integration. The UECM contains both the long run and short run coefficients and based on it we can test for Cointegration of variables included in the model. Mathematically we can express it as follows.

$$\Delta LNY_t = \alpha_0 + \sum_{k=1}^{p} \alpha_{1k}\,\Delta LNY_{t-k} + \sum_{k=0}^{q_1} \alpha_{2k}\,\Delta LNGCF_{t-k} + \sum_{k=0}^{q_2} \alpha_{3k}\,\Delta LNLF_{t-k} + \sum_{k=0}^{q_3} \alpha_{4k}\,\Delta LNFDI_{t-k} + \sum_{k=0}^{q_5} \alpha_{5k}\Delta LNCO_{2_{t-k}} + \sum_{k=0}^{q_6} \alpha_{5k}\,\Delta LNHC_{t-k} + \sum_{k=0}^{q_7} \alpha_{6k}\,\Delta LNFD_{t-k} + \sum_{k=0}^{q_8} \alpha_{7k}\,\Delta LNTRO_{t-k} + \sum_{k=0}^{q_9} \alpha_{8k}\,\Delta LNINF_{t-k} + \beta_1 LNY_{t-1} + \beta_2 LNGCF_{t-1} + \beta_3 LNLF_{t-1} + \beta_4 LNFDI_{t-1} + \beta_5 LNCO_{2_{t-1}} + \beta_6 LNHC_{t-1} + \beta_7 LNFD_{t-1} + \beta_8 LNTRO_{t-1} + \beta_9 LNINF_{t-1} + \phi ECT_{t-1} + \varepsilon_t \ldots\ldots\ldots\ldots\ldots\ldots (3.19)$$

Where Δ is the operator that shows the first difference of the variable α_0 is the intercept or the component, $p, q_1 - q_9$ is the optimal lag lengths that will be obtained by Akaike information criterion (AIC) or Schwarz Bayesian criterion (SBC) for the dependent variable and independent variables respectively, $\beta_1, \beta_2, \beta_3, \beta_4, \beta_5, \beta_6, \beta_7, \beta_8, \beta_9$ are the long run coefficients and $\alpha_1, \alpha_2, \alpha_3, \alpha_4, \alpha_5, \alpha_6, \alpha_7, \alpha_8, \alpha_9$ are the short run coefficients in the model

above, ECT is error correction term lagged one period and ϕ is coefficient of error correction term which show the speed of adjustment at which equilibrium is restored in the long run when disequilibrium or shocks occur in the short run. ϕ should have negative sign and lies between -1 and 0. The autoregressive distributed lag bounds testing approach to Cointegration was conducted to check for the existence of a long run relationship among the variables included in the study over the period of study. The hypothesis of Cointegration can be shown as below:

$H_0 := \beta_1 = \beta_2 = \beta_3 = \beta_4 = \beta_5 = \beta_6 = \beta_7 = \beta_8 = \beta_9 = 0$ (The null hypothesis of no Cointegration) is tested against $H_a : \beta_1 \neq \beta_2 \neq \beta_3 \neq \beta_4 \neq \beta_5 \neq \beta_6 \neq \beta_7 \neq \beta_8 \neq \beta_9 \neq 0$ (The alternative of Cointegration).

The decision rule for the above hypothesis depends on the comparison of computed F-statistic with lower and upper critical values tabulated for different significance levels. Decision rule of the bounds test states that once the value of the F-statistics is lower than the I(0) bounds, it supports the null hypothesis of no co-integration. On the other hand, if the value of the F-statistics is greater than the upper limit of I(1), it justifies that there exist a long run relationship. If it found between lower and upper bounds the decision is inconclusive.

3.12 Granger Causality Test

F statistic has a useful application in time series forecasting to test whether the lags of one of the explanatory variable included has useful predictive content, above and beyond the other explanatory variables included in the model. The null hypothesis corresponds to the claim that a variable has no predictive contents and the coefficients on all lags of that variable are zero. So, the F-statistics testing this null hypothesis is known as the Granger causality statistic and Granger causality test is the associated test after (Granger, 1969). Granger causality test will be conducted by estimating the following equation form.

$$\Delta y_t + \alpha_0 + \sum_{i=1}^{m} \alpha_{1,i} \Delta y_{t-1} + \sum_{i=0}^{m} \alpha_{2,i} \Delta x_{t-i} + \delta ECM_{t-1} + \varphi_t \dots\dots\dots\dots\dots\dots\dots (3.20)$$

$$\Delta x_t + \beta_0 + \sum_{i=1}^{m} \beta_{1,i} \Delta x_{t-1} + \sum_{i=0}^{m} \beta_{2,i} \Delta y_{t-1} + \gamma ECM_{t-1} + u_t \dots\dots\dots\dots\dots\dots\dots (3.21)$$

Where, φ_t and u_t are white noise disturbance terms and are independently and normally distributed; m are the number of lags necessary to induce white noise in the residuals, and ECM_{t-1} is the

error correction term from the long run relationship. Accordingly, x_t is said to Granger cause y_t if one and more $\alpha_{2,i}$, i= 1, 2,…, m) and δ are statistically different from zero. Likewise, y_t is said to Granger cause x_t if one and more $\beta_{2,i}$, i=1, 2, …, m and γ are statistically different from zero.

3.13 Lag Selection Criteria

Finding the appropriate lag length for each of the underlying variables in the ARDL model is an important issue because we want to have Gaussian error terms; that is the standard normal error term that is free from autocorrelation, non-normality, and heteroskedasticity. In order to choice the appropriate model of the long run underlying equation, it is necessary to determine the optimum lag length (k) by employing proper model of order selection criteria such as; Schwarz Bayesian Criterion (SBC), Akaike Information Criterion (AIC) and Hannan-Quinn Criterion (HQC). The model with the smallest value estimates or smallest standard errors and high R-squared has better performance relatively.

3.14 Data Type and Sources

3.14.1 Type of Data

The study was employed annual secondary time series data set ranging from the time period of 1981 to 2019. Due to the nature and purpose of the study only secondary data type was used. The secondary data of country level macroeconomic variables such as gross domestic product per capita, gross capital formation, labor force, foreign direct investment, carbon-dioxide emissions per capita, human capital, financial market development, openness of the economy and inflation were used based on yearly time series data. The period of study is chosen based on the availability of necessary data for the variables included in the study.

3.14.2 Sources of Data

To achieve the objectives of the study the relevant data was collected from different sources such as National Bank of Ethiopia (NBE), World Development Indicators of World Bank (WDI), African Development Bank (AFDB) and Penn World Table. Variables such as gross domestic product measured as current USD, foreign direct investment measured as foreign direct investment net inflows as a percentage of gross domestic products, carbon-dioxide emissions measured in metric tons per capita, human capital proxied by education expenditure as a percentage of gross national product and inflation were collected from World Development Indicators.

Furthermore, the data for gross capital formation measured as a percentage of gross domestic product and labor force proxied by labor force participation as a percentage of total population were sourced from African Development Bank (AFDB). Trade openness proxied by summation of exports and imports of goods and services as a percentage of gross domestic products was collected from Penn World Table database. Financial sector development proxied by broad money supply as a percentage of gross domestic products was collected from National Bank of Ethiopia. Table 3.1 below gives description or definition of the variables with their expected sign and sources from where they were collected.

Table 3. 1 Definition of Variables, Their Measurement and Sources

variable	Description or Definition of variables	Expected sign	Source(s)
Y	Y-represents gross domestic product per capita in current US$	Dependent variable	WDI
GCF	GCF is gross capital formation measured as a percentage of gross domestic product	+	AFDB
LF	LF is labor force measured as labor force participation as percentage of total population	+	AFDB
FDI	Foreign direct investment net inflows as percentage of gross domestic product	+/-	WDI
CO_2	Carbon-dioxide emissions in metric tons per capita	-	WDI
HC	Human capital proxied by education expenditure as percentage of gross national income	+	WDI
FD	Financial development proxied by broad money supply as percentage of gross domestic product	+	NBE
TRO	Trade openness measured as the sum of export and import of goods and services as percentage of gross domestic product	+	PWT & AFDB
INF	Measured as percentage change in consumer price index	-	WDI
EC	Kg of oil equivalent per capita		IndexMundi

CHAPTER FOUR

4. RESULTS AND DISCUSSIONS

This chapter presents both descriptive and econometrics analysis of the study based on the data collected. Results of empirical analysis are largely dependent on the econometric model specified in chapter three. Before the formal estimation of autoregressive distributed lag bounds approach to cointegration, the various preliminary tests results are presented. The unit root test, bounds cointegration test, the various diagnostic tests and model stability tests were conducted followed by the core analysis of the study.

4.1 Descriptive Statistics

4.1.1 Summary Statistics

The descriptive statistics of variables included in the model is summarized before formal estimation of the model. The descriptive statistics give a snapshot of the characteristics of the variables used in empirical analysis. The summary statistics of variables included in the model is given in Table 4.1 in compact way.

The study used 39 observations that range from 1981-2019. The result shows the mean value, median, maximum, minimum, standard deviation, Skewness, kurtosis, Jarque Bera statistics with its probability value and summation of all variables included in the analysis. Descriptive result shows that the mean value of log of gross domestic product is 5.56, gross capita formation is 22.61, labour force is 45.19, foreign direct investment is 1.69, log of carbon-dioxide emissions is -2.77, human capital is 2.67, financial development is 32.15, trade openness is 32.43 and inflation is 9.37 for the study period. The square of GDP has the mean value of 31.31, median of value of 30.35 with maximum and minimum value of 47.17 and 22.60 respectively. Energy consumption has mean value of 6.17, median value of 6.17, maximum value of 6.20, minimum value of 6.16 and normally distributed.

The result reveals that the median value of log of gross domestic product, gross capital formation, labour force, foreign direct investment, log of carbon-dioxide emissions, human capital, financial development, trade openness, inflation and energy consumption is 5.51, 19.55, 44.11, 0.68, -2.82, 2.80, 33.60, 33.66, 8.10 and 6.17 respectively. The maximum value, minimum value and the standard deviation for all variables were also presented in table

below. The Skewness statistics shows that except financial development and trade openness, all the other variables were positively skewed. Regarding the kurtosis statistics, it reveals that variables such as labour force, carbon-dioxide emissions and inflation are platykurtic that means, it is greater than three, while the other variable are leptokurtic that means, it is less than three. Based on Jarque-Bera statistics through its probability value, all variables are normally distributed except labour force, log of carbon-dioxide emissions and inflation which are not normally distributed during the period of study.

Table 4. 1 Summary of Statistics Result

Var	Obs.	Mean	Median	Max	Min	St. Dev
LNY	39	5.56	5.51	6.87	4.75	0.61
LNYSQ	39	31.31	30.35	47.17	22.60	7.03
GCF	39	22.61	19.55	40.83	4.72	10.53
LF	39	45.19	44.11	50.68	43.10	2.14
FDI	39	1.69	0.68	5.58	0.00	1.90
LNCO$_2$	39	-2.77	-2.82	-1.94	-3.22	0.32
HC	39	2.67	2.8	4.00	1.50	0.70
FD	39	32.15	33.60	45.40	16.10	8.13
TRO	39	32.43	33.66	51.09	11.79	11.41
INF	39	9.37	8.10	44.40	-9.10	10.42
EC	39	6.17	6.17	6.20	6.16	0.01

Summary statistics continued

Var	Obs.	Skewness	Kurtosis	Jarque Bera	Probability	Sum	Sum Sq. Dev
LNY	39	0.63	2.45	3.11	0.21	216.94	14.15
LNYSQ	39	0.80	2.66	4.32	0.12	1220.93	1879.37
GCF	39	0.28	1.95	2.32	0.31	881.80	4210.38
LF	39	1.07	3.11	7.40	0.02	1762.33	173.80
FDI	39	0.71	2.04	4.78	0.09	65.97	136.77

$LNCO_2$	39	0.95	3.53	6.31	0.04	-108.04	3.92
HC	39	0.09	1.85	2.21	0.33	104.00	18.65
FD	39	-0.34	2.28	1.63	0.44	1253.90	2513.42
TRO	39	-0.13	1.79	2.49	0.29	1264.85	4948.56
INF	39	1.06	5.14	14.65	0.00	365.40	4125.02
EC	39	0.66	2.43	3.39	0.18	240.75	0.01

Source: Authors computation by E-Views 10 Software

4.2 Presentation of the Econometrics Findings

4.2.1 Correlation Matrix of the Variables

The correlation among the variables included in the study is given in Table 4.2 below. The result of the correlation coefficients indicates that all independent variables are positively correlated with dependent variable. The correlation coefficients between the independent variables are also positive except between foreign direct investment and inflation which is negative. The correlation coefficient between LF and GCF, LF and $LNCO_2$ is 0.88. This may cause multicollinearity problem in dataset utilized in this study. However, the mean value of VIF (variance inflation factor) is less than ten ($6.99 < 10$) (see Appendix) showing that there is no high multicollinearity problem in dataset. That is variables under the study are not suffered from high problems of multicollinearity.

Table 4. 2 Correlation Matrix

	LNY	**GCF**	**LF**	**FDI**	**$LNCO_2$**	**HC**	**FD**	**TRO**	**INF**
LNY	1								
GCF	0.64	1							
LF	0.85	0.88	1						
FDI	0.21	0.64	0.51	1					
$LNCO_2$	0.80	0.73	0.89	0.46	1				
HC	0.26	0.60	0.50	0.42	0.54	1			
FD	0.06	0.56	0.44	0.74	0.51	0.66	1		
TRO	0.1	0.74	0.51	0.60	0.42	0.73	0.75	1	
INF	0.33	0.19	0.33	-0.08	0.38	0.51	0.22	0.25	1

Source: Authors Computation by Stata 11 Software

4.2.2 Unit Root Test Results

The study employed the ARDL model and conducted unit root tests prior to its estimation to check its applicability or appropriateness to use the model. In any case, both the Augmented Dickey-Fuller (Dickey and Fuller, 1981) and (Phillips and Perron, 1988) tests were conducted on every variable included in the model to ascertain whether they are stationary or not and in case they are non-stationary, what their order of integration is and to avoid the ARDL model crashing in presence of a variable(s) integrated of an order higher than 1.

It is important to sketch graph of the underlying variables before conducting any formal tests for stationarity by using ADF or other tests of stationarity since it is always advisable to graphically plot the time series of variables of interest as the eye visualization from the plot of the data is the first step in any time series analysis. Such a plot gives a preliminary hint about the likely nature of the time series such as inclusion of trend and whether the trend is constant or changing over time. The plots of the variables of interest are given in appendix. From the plots it seems that some of the time series have upward trending with fluctuations. The variable log of gross domestic product per capita has upward trending. Variables such as gross capital formation, labor force, log of carbon-dioxide emissions seem to have upward trending starting from certain period of time.

On the other hand, variables such as financial development and trade openness have upward trending up to certain period of time and then after it seems they show downward trending. Human capital variable seems to have upward trending at first and downward trending with fluctuations. Foreign direct investment and inflation show clear upward or downward trending. From the graph of the variables, it seems that the mean value of almost all variables might be changing which indicates that they are not stationary at level or there is unit root. Therefore, this preliminary test gives an initiative feel that is important as starting point for more common tests of unit roots. In this study both the standard method of testing for stationarity, ADF and PP are utilized to test for stationarity and determining the order of integration of all variables included in the model.

Accordingly, all the time series datasets for each of variables are tested for stationarity by employing both ADF and PP. The results of both ADF and PP stationarity tests were presented in Table 4.3 and Table 4.4 respectively. While testing for the stationarity of all the variables included in the model all the three scenarios (constant or intercept only, with constant and trend, without constant and trend) were included in the test equations and the

optimal lag length for each of the variable is selected by Akaike Information Criteria. The Augmented Dickey-Fuller test for unit root was employed and the result of test is given in below Table 4.3. The test was conducted both at level and first difference and also the order of integration was determined. The ultimate goal of this is basically to make sure that none of the variables included in the model were integrated of order two or integrated of order higher than one. In the existence of variables integrated order higher than one the computed F-statistics provided by (Pesaran et al., 2001) are not valid since the bounds test is based on the assumption that the variables are I(0) or I(1) as stated by (Ouattara, 2006).

Table 4. 2 ADF Unit Root Test Result for Stationarity: At Level and First Difference

Variables	With C only	With C and T	Without C and T	Order of Integration
LNY	0.1102	-0.7714	1.1145	
d(LNY)	-3.8046***	-3.8016**	-3.6300***	I(1)
LNYSQ	0.3850	-0.0830	1.2862	
d(LNYSQ)	-3.7989***	-3.9064**	-3.5724***	I(1)
GCF	-0.9102	-2.7625	0.4348	
d(GCF)	-7.3283***	-7.2529***	-7.2147***	I(1)
LF	2.6401	-0.0842	2.4983	
d(LF)	-7.3928***	-9.2736***	-0.0995	I(1)
FDI	-2.3108	-3.0961	-1.4684	
d(FDI)	-7.1988***	-7.0919***	-7.2718***	I(1)
$LNCO_2$	0.0349	-1.2895	-1.7704*	(0)
d($LNCO_2$)	-6.6196***	-4.0421**	-6.3548***	
HC	-1.8652	-2.9492	0.7422	
d(HC)	-3.3186**	-3.5547*	-3.4267***	I(1)
FD	-1.9172	-1.8454	0.7467	
d(FD)	-6.0008***	-6.0675***	-5.8510***	I(1)
TRO	-1.3925	-0.3408	-0.0337	
d(TRO)	-2.4394	-3.9769**	-2.4370**	I(1)
INF	-2.0560	-2.2995	-0.9411	
d(INF)	-9.1039***	-8.9655***	-9.2200***	I(1)
LNEC	0.2387	-1.8126	2.1163	

d(LNEC)	-6.1170***	-6.1856***	-5.5260***	(1)

Source: E-Views 10 Software Output

Note: ***, **, * indicates significance at 1%, 5% and 10% respectively and d represent first difference of the variable. C, T represent constant and trend respectively.

The above (Table 4.3) shows the results of Augmented Dickey-Fuller stationarity test for all the variables included in this study. As ADF test indicates, all the underlying variables are not stationary at level except for carbon-dioxide emissions which is stationary at 10% significance level. But they become stationary at their first difference. Variables such as LNY, $LNCO_2$ and TRO are stationary at the conventional 5% level of significance when they differenced once under intercept and trend included in the test. The rest of variables are stationary at 1% significance level under the case of only intercept included in test as well as under the case of both intercept and trend are not included in the test at their first difference.

Table 4. 3 Result of PP Stationarity Test: At Level and First Difference

Variables	With C only	With C and T	Without C and T	Order of Integration
LNY	0.4031	-0.4934	1.3326	
d(LNY)	-3.8078***	-4.2102**	-3.6190***	I(1)
LNYSQ	0.7069	-0.2686	1.5667	
d(LNYSQ)	-3.7981***	-4.3229***	-3.5724***	(1)
GCF	-0.8114	-2.6444	0.8523	
d(GCF)	-7.3545***	-7.3025***	-7.1489***	I(1)
LF	2.3776	-0.0974	2.3936	
d(LF)	-7.2768***	-10.1638***	-6.6429***	I(1)
FDI	-2.3099	-3.1120	-1.4003	
d(FDI)	-7.1988***	-7.0919***	-7.2718***	I(1)
$LNCO_2$	0.1075	-1.2999	-1.7503*	
d($LNCO_2$)	-6.5781***	-7.0499***	-6.3127***	I(1)
HC	-2.5566	-4.1398**	0.3491	I(0)
d(HC)	-9.2020***	-9.1744***	-9.1096***	
FD	-1.9163	-1.8160	0.7508	
d(FD)	-6.0006***	-6.0675***	-5.8457***	I(1)

TRO	-1.3861	-0.7869	-0.0494	
d(TRO)	-4.4665***	-4.4954***	-4.5483***	I(1)
INF	-4.4269***	-4.7396***	-2.8405***	I(0)
d(INF)	-13.9637***	-13.6627***	-13.9741***	
LNEC	1.2289	-1.8518	3.1742	
d(LNEC)	-6.5949***	-7.5582***	-5.5273***	(1)

Source: E-Views 10 Software Output

Note: ***, **, * indicates stationarity at 1%, 5% and 10% significance level respectively. d stands for the first difference operator. C and T represent constant and trend respectively.

The above (Table 4.4) presents the outcomes of Phillips-Perron unit root test conducted on all the variables in included in the model. The result of PP unit root test is different from the ADF unit root test for HC and INF variables since these variables are stationary at level in the case of PP. Therefore, except for HC and INF which are stationary at 5% and 1% significance level respectively the null hypothesis of presence of unit root cannot be rejected at levels for all variables included in the model as PP unit root test indicated. The rest of the variables become stationary at their first difference.

The stationarity tests conducted by both Augmented Dickey-Fuller (ADF) and Phillip-Perron (PP) were important to make sure that none of the variables included in the model were not integrated of order higher than one since the existence of variable(s) integrated of order higher than one invalidates the applicability of the autoregressive distributed lag bounds testing approach to cointegration. In the presence of variables integrated order two and above the ARDL model estimation technique cannot be applied since the ARDL model requires variables under consideration is integrated of order zero or one and the critical values proposed by (Pesaran et al., 2001) are valid only for variables stationary at level or at first difference. This shows even though ARDL bounds testing approach to cointegration technique does not need pretests for unit roots unlike other techniques, it may be advisable to conduct unit root tests so as to avoid the ARDL model crashing in to the existence of variables integrated of order two and above.

Therefore, in order to avoid the wrongful application of the ARDL model both Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) unit root test were conducted. The results of the tests conducted demonstrated that the underlying variables are integrated of order zero or one. As a result, the ARDL model can be applied for this study as the underlying variables

fulfilled one of the requirements of the application of the model. The ARDL bound testing approach to cointegration model does not require variables integrated of the same order. However, it is preferable when dealing with variables integrated of different order such as I(0), I(1) and mixture of both with small sample size as in the present study. It is confirmed that there is no variable(s) I(2) or beyond I(2). Regarding the stationarity of the underlying variables, the assumptions of ARDL model are satisfied so that the model can be employed for this study.

4.2.3 Selection of the Optimal Lag Length for the Autoregressive Distributed Lag Model (ARDL) Bounds Testing Approach to Cointegration

In economics, the dependence of a variable Y (dependent variable) on another variable X (explanatory variable) is rarely instantaneous. Very often Y responds to X with a lapse of time. Such a lapse of time is called a lag (Stock and Watson, 2012). Many lags can lead to loss of degrees of freedom; can cause multicollinearity, serial correlation in error terms and misspecification of the model. So how many lags could be included in a given model is an empirical issue.

The number of lags to be included in the model is typically small, usually 1 or 2 in annual dataset like the present study. The easiest way to decide on the number of optimal lag length to be selected can include Akaike information criteria (AIC) or Schwarz Bayesian information criteria (SBIC). Moreover, econometrics packages easily compute these optimal lag lengths. But, some trial and error is inevitable. Therefore, when deciding the optimal lag length for a model, it can be done by considering the most common information criteria like Akaike information criteria (AIC) or Schwarz Bayesian information criteria (SBIC). As a result, by employing information criteria, the empirical issue is to some extent resolved since the information criteria which minimize the value is the one that is preferred (Stock and Watson, 2012).

The various lag order selection criteria employed are Akaike Information Criteria (AIC), Likelihood Ratio test statistics (LR), the Final Prediction Error (FPE), Hannan-Quinn Criteria (HQC) and Schwarz Bayesian Information Criteria. The best suitable model is the one that minimize either of the criteria employed.

The optimal lag order selection criteria result is displayed in the Table 4.5 below. As the result illustrated in Table 4.5 indicates, all the information criteria used was selected the

maximum lag of 2 except Schwarz Information Criteria which selected the maximum lag order of one. From the most popular lag order selection criteria such as Akaike Information criteria (AIC), Schwarz Bayesian Information Criteria (SBIC) and Hannan-Quinn Information Criteria (HQIC), AIC is the one that minimize the value. Therefore, the maximum possible lag length that can be allowed in this study is 2 lags and AIC is the best model since it has the lowest value.

Table 4. 4 Optimal Lag Length Selection Criteria

Lag	LogL	LR	FPE	AIC	SBIC	HQIC
0	-585.0180	NA	712.1630	32.10908	32.50093	32.24723
1	-362.0498	325.4131	0.374622	24.43512	28.35357*	25.81656
2	-256.0154	103.1686*	0.225959*	23.08192*	30.52697	25.70665*

Source: E-Views 10 Software Output

Note: * denotes lag order selected by criterion

LR: sequential modified LR test statistic (each test at 5% level)

FPE: Final prediction error

AIC: Akaike information criterion

SBIC: Schwarz Bayesian information criterion

HQIC: Hannan-Quinn information criterion

4.2.4. ARDL Model Bounds Cointegration Test Result

The ARDL cointegration technique is used in determining the long run relationship between series with different order of integration (Pesaran et al., 2001; Pesaran and Shin, 1996). The reparameterized result gives the short-run dynamics and long run association of the considered variables. At the first stage the existence of the long-run relation between the variables under investigation is tested by computing the Bound F-statistic (bound test for cointegration) in order to establish a long run relationship among the variables.

The null of no long-run relationship is defined by;

$H_0 = \beta_1 = \beta_2 = \beta_3 = \beta_4 = \beta_5 = \beta_6 = \beta_7 = \beta_8 = \beta_9$ (Null hypothesis, i.e. the long run relationship does not exist).

$H_a = \beta_1 \neq \beta_2 \neq \beta_3 \neq \beta_4 \neq \beta_5 \neq \beta_6 \neq \beta_7 \neq \beta_8 \neq \beta_9$ (Alternative hypothesis, i.e. the long run relationship exists).

Irrespective of whether the variables in the model are integrated of order zero or one, the distribution of the F-statistics in bounds test is non-standard. The critical values of the F statistics for different number of variables (K), and whether the ARDL model include an intercept and/or trend are available in (Pesaran and Pesaran, 1997) and (Pesaran et al., 2001). They give two sets of critical values. One set assuming that all the variables are I(0) (i.e. lower critical bound which assumes all the variables are I(0), meaning that there is no long run association among the variables under consideration) and another set assuming that all the variables in the ARDL model are I(1) (i.e. upper critical bound which assumes all the variables are I(1), meaning that there is cointegration among the underlying variables). For each application, there is a band covering all the possible classifications of the variables into I(0) and I(1).

A conclusive decision can be made, without the need to know whether the underlying variables are I(0) or I(1) or fractionally integrated, if the computed F-statistics for the joint significance of the level variables falls outside bounds. That is, when the calculated F-statistics is higher than the upper bound critical value, then the null hypothesis which assumes no cointegration is rejected. That means, there is cointegration among the variables in included in the model. On the other hand, if the computed F-statistics is less than the lower bound critical value, the null hypothesis cannot be rejected. Therefore, we can conclude that as there is no cointegration among the variables under consideration.

However, the result of the inference is inconclusive and depends on whether the underlying variables are I(0) or I(1) when the computed F-statistic falls within the lower and upper bound critical value. As a result, the investigator may have to carry out unit root tests on the variables at this stage to be sure about the order of the variables in the model (Pesaran and Shin, 1996). Moreover, in case the variables are integrated order higher than one, the computed F-statistics of the bounds test are rendered invalid since they are based on the assumption that variables are integrated of order zero or one or mutually cointegrated (Chigusiwa et al., 2011). However, to forestall an effort in futility, it may be advisable to first

perform unit roots, though not as a necessary condition in order to ensure that none of the variables are I(2) or beyond, before carrying out the bound F-test.

After we determine that the orders of integration of the variables included in the model are either zero or one, we can then surely apply the autoregressive distributed lag bounds cointegration test to our model. We conducted ARDL bounds F-test for cointegration that presented in Table 4.6 below to test for presence of the cointegration relationship among the variables under consideration. To determine the existence or not of a long-run relationship between the variables under investigation, we applied the cointegration test developed by (Pesaran et al., 2001). The maximum lag of two was set in the proposed model since the dataset is relatively small and determined by using Akaike Information criterion (AIC). The ARDL model bounds cointegration test result is displayed in Table 4.6.

The relevant computed F-statistics of the joint null hypothesis that there is no long-run relationship between the variables is 6.71, a value which is larger than the higher bound of 10%, 5% and even 1% significance level (2.79, 3.11 and 3.79) respectively. This indicates the rejection of the null hypothesis that there is no cointegration or no long-run relationship exists between the variables. Therefore, it is possible to conclude that there is evidence of long-run relationship or cointegration between the variables included in the model.

Table 4. 5 ARDL Model Bounds Cointegration Test Result

F-Statistic	**Critical Values**					
	10%		5%		1%	
	L-bound	U-bound	L-bound	U-bound	L-bound	U-bound
6.71* **	1.66	2.79	1.91	3.11	2.45	3.79

Source: E-Views 10 Software Output

Note: *** represent significance at 1%. L= Lower, U= Upper

4.2.5. Diagnostic Tests

It is very important to make sure that the proposed model is free from any econometrics problems before proceeding to the formal analysis of the long-run and short-run analysis. In this investigation different diagnostic tests were conducted. The major diagnostic tests

performed in this study are serial correlation test, functional form test, normality test, heteroscedasticity test and multicollinearity test. The results of the diagnostic tests conducted in this model are displayed in Table 4.7 below in compact way.

Table 4. 6 Results of the Diagnostic Tests Performed (Model One)

Problem	Test performed	Null hypothesis	F-statistic	(P-value)	Conclusion
Serial correlation	Breusch-Godfrey LM test	No serial correlation	0.770062	0.3940	Fail to reject null hypothesis
Heteroscedasticity	Breusch-Pagan/Cook-Weisberg test	Error term has constant variance or Homoscedasticity	0.448421	0.9551	Fail to reject null hypothesis
Model Specification	Ramsey RESET test	Model has no omitted variable	2.712105	0.1204	Fail to reject null hypothesis
Normality	Jarque-Bera test	Residual are normally distributed	1.898374(Jarque Bera value)	0.387056	Fail to reject null hypothesis
Multicollinearity	VIF	No multicollinearity problem	6.99(Mean of VIF)	Not applicable	Fail to reject null hypothesis
Parameter Stability	CUSUM and CUSUMSQ	Parameters of the model are stable	Not applicable	Not applicable	Fail to reject null hypothesis

Source: E-Views 10 Software Output

The diagnostic tests carried out in this model shows that the stochastic error term is white noise, the model specification is correct, error term is normally distributed with zero mean and constant variance, no multicollinearity problems among the explanatory variables and the parameters of model are stable over the long-run indicating that the model is robust.

4.3 Long-Run Estimation of the ARDL Model (Bounds Cointegration Test Approach)

After the data is checked for stationarity, made sure that the proposed model is free from any econometrics problems and the existence of long-run cointegration is confirmed the study can safely proceed with the long run and short run analysis which is the core part of the analysis. The estimation of the long run model is performed, given that all the variables incorporated in the economic growth equation are either integrated of order zero (I (0)) or integrated of order one (I(1)) or fractionally integrated. Before estimating the long run model, the study checked the existence of cointegration or long run relationship and this is conducted in the previous section by using the F-statistics.

The F-statistic confirmed the existence of long run relationship among the variables under consideration. Therefore, the study can proceed to the estimation of the long run and short run model. For estimating the results of the model the study used E-Views 10 statistical software. The maximum lag length used in this study is two which is appropriate for annual time series data since the data used in this study is based on annual time series data. Moreover, the ARDL model selected is based on Akaike Information Criterion since it is best appropriate for small sample size like the present study.

Table 4. 7 Long Run Coefficients for Autoregressive Distributed Lag Model, ARDL (1, 1, 2, 1, 2, 1, 2, 1, 2). Selected Based On Akaike Information Criterion (AIC).

Variable	coefficient	Std. Error	t-Statistic	Prob.
GCF	0.043029	0.011374	3.783003	0.0016***
LF	0.120976	0.018132	6.671981	0.0000***
FDI	0.041482	0.036231	1.144935	0.2691

$LNCO_2$	-0.059247	0.215987	-0.274309	0.7874
HC	0.078947	0.098094	0.804812	0.4327
FD	-0.019068	0.008860	-2.152241	0.0470**
TRO	-0.027918	0.007503	-3.720993	0.0019***
INF	0.029618	0.006542	4.527212	0.0003***

Source: E-Views 10 Software Result

*** and ** denotes significance at 1% and 5% respectively.

The relationship between foreign direct, environmental quality and economic growth can be analyzed as follows. The empirical result shows that FDI has positive and insignificant impact on GDP per capita in Ethiopia both in the long run and short run analysis. Therefore, this result indicates that FDI has no impact on GDP per capita in Ethiopia over study period. As a result, Ethiopia is not benefitting from FDI inflows as indicated by the study result. So due emphasis should be given to FDI inflows in Ethiopia to benefit from its positive impacts such as technology exchange/technology spillover, creation of new jobs, labor training, stimulating R and D activities, knowledge spillover and gain of new inputs. The impact of FDI on economic growth obtained in this study is in line with the empirical works of (Chanie, 2017; Fite, 2020; Gizaw, 2015; Menamo, 2014) in terms of sign (positive), but it contradicts in terms of significance (insignificant). Moreover, this result contradicts with empirical studies of (Betelhem, 2016) and (Rahman, 2015) both in terms of sign and significance.

Regarding the impact of environmental degradation (which is proxied by carbon-dioxide emissions) in this study, the result indicated that carbon-dioxide emissions has negative and insignificant impact on GDP per capita in long run. This indicates that environmental degradation has no impact on GDP per capita (economic growth) in Ethiopia in the long run. But CO_2 emissions have positive and significant impact on GDP per capita in the short run. This result is consistent with the studies of (Ang, 2008; Arouri et al., 2012) and contradicts with the empirical works of (Abdouli and Hammami, 2017; Bekun and Agboola, 2019; Borhan et al., 2012; Halicioglu, 2009; Pao and Tsai, 2010) who found negative and significant impact of CO_2 emissions on economic growth. Since growth at the cost of environmental quality is not desirable condition, this indicates that reduction in CO_2

emissions per capita might be achieved at the same time as gross domestic product per capita continues to growth in Ethiopia through energy conservation method without negatively affecting long run economic growth.

Moreover as it is displayed in the above (Table 4.8), gross capital formation, labor force, financial development, trade openness and inflation were found to have statistically significant impacts on economic growth of Ethiopia in the long run at 5% level of significance. The outcomes from the estimated model show that in long run foreign direct investment, carbon-dioxide emissions and human capital have insignificant impact in the determination of economic growth in Ethiopia. Gross capital formation has statistically significant impact on economic growth at 1% level of significance and impacts economic growth positively. Keeping all other factors constant, a one percent change in gross capital formation is associated with 0.043 percent change in economic growth in the same direction. This result is in line with the works of (Fite, 2020) and (Jean Marie Vianney, 2018).

Labor force has positive and statistically significant impact on gross domestic product per capita at 1% level of significance in the long run. A one percent increase in labor force leads to 0.121 percent increase in gross domestic product ceteris peribus. This outcome is consistent with the empirical works of (Chanie, 2017; Menamo, 2014; and Zekarias, 2016).

Financial development has statistically significant impact on economic growth at 5% level of significance and negatively related to gross domestic product per capita. Holding all other factors remain unchanged a one percent increase in financial development causes 0.019 percent decline in gross domestic product per capita indicating negative relationship between financial development and gross domestic product per capita. This may indicate that financial sector of Ethiopia is underdeveloped. This result agrees with the empirical study of (Demetriades and Luintel, 1996) and (Fowowe, 2008). But it contradicts with empirical findings of (Alfaro et al., 2006) and (Alzaidy et al., 2017) who found that financial development has positive impact on economic growth.

The study result also shows that trade openness affects gross domestic product per capita negatively and statistically significant at 1% level of significance. Keeping all other factors remain unchanged, a one percent rise in trade openness leads to 0.028 percent decline in gross domestic product per capita. The negative impact of trade openness on economic growth deserves special attention. This may be due to the fact that, developing countries like Ethiopia

have weak industrial base compared to more advanced countries. The manufacturing sector of Ethiopia cannot compete with that of advanced nations which negatively affect economic growth if Ethiopia is too open to the global economy. This finding is similar to the study of (Guei and Le Roux, 2019; Rahman et al., 2020; Vlastou, 2010) but it contradicts with the results found by (Fite, 2020; Owusu, 2019; Zekarias, 2016).

Inflation has also statistically significant impact on gross domestic product at 1% level of significance and affects economic growth positively. A one percent increase in inflation leads to 0.030 percent increase in gross domestic product per capita. This result is consistent with the empirical investigation of (Gizaw, 2015) and (Sokang, 2018), but it contradicts with the findings of (Fite, 2020; Owusu, 2019; and Zekarias, 2016) who found negative relationship between inflation and economic growth.

The other remaining variables such as foreign direct investment, carbon-dioxide emissions and human capital are found to have insignificant impacts on gross domestic product per capita. Moreover, foreign direct investment, carbon-dioxide emissions and human capital have insignificant impact on economic growth at all levels of significance such as 1%, 5% and 10% in the long run.

4.4 Short-Run Estimation of the ARDL Model (Bounds Cointegration test Approach) ECM

Table 4. 8 ARDL Short Run Estimated Coefficients (Model One)

Dependent variable: Per capita gross domestic product				
Regressors	Coefficient	Std. Error	t-Statistic	Prob.
D(GCF)	0.007488**	0.003033	2.468449	0.0252
D(LF)	-0.009288	0.018254	-0.508830	0.6178
D(LF(-1))	-0.077703*	0.020757	-3.743506	0.0018
D(FDI)	0.005429	0.007450	0.728725	0.4767
D(LNCO$_2$)	0.245897**	0.093466	2.630873	0.0182
D(LNCO$_2$(-1))	0.263515*	0.083122	3.170233	0.0059
D(HC)	0.086101*	0.020019	4.301055	0.0005
D(FD)	0.003011	0.003589	0.838756	0.4140
D(FD(-1))	-0.008945***	0.004268	-2.095819	0.0524
D(TRO)	-0.029951*	0.003346	-8.951182	0.0000

D(INF)	0.007065*	0.001084	6.515106	0.0000
D(INF(-1))	-0.003125**	0.001218	-2.566364	0.0207
CointEq(-1)*	-0.492832	0.051799	-9.514311	0.0000
R-squared	0.908215	Mean dependent var	0.039725	
Adjusted R squared	0.862323	S.D. dependent var	0.140247	
S.E. of regression	0.052038	Akaike info criterion	- 2.803835	
Sum squared resid	0.064992	Schwarz criterion	-2.237837	
Log likelihood	64.87096	Hannan-Quinn criterion	2.604295	
Durbin-Watson stat	2.312104			

Source: E-Views 10 Software Result

Note: The asterisks *, **, *** indicates significance at 1%, 5% and 10% respectively.

The above result reveals that the value of adjusted coefficient of determination (adjusted R^2) is 0.86 which shows that the dependent variable is explained about 86% by the explanatory variables included in the model. Approximately, 86% of total variation of the dependent variable is explained by explanatory variables included in the model and the remaining 14% is unexplained proportion which account for other factors not included in the model. The results of the short run model indicates that the first difference of one period lagged labor force, the first difference of one period lagged carbon-oxide emissions, the first difference of human capital level, the first difference of trade openness and the first difference of inflation rate have statistically significant impact on per capita gross domestic product. The first difference of one period lagged carbon-oxide emissions and the first difference of human capital level have positive impact and significant at 1% level of significance. The impact of the first difference of one period lagged labor force, the first difference of trade openness and the first difference of inflation rate is found to be negative and statistically significant at 1% level of significance.

Furthermore, the first difference of gross capital formation, the first difference of carbon-dioxide emissions and the first difference of one period lagged inflation are found to have statistically significant impact on per capita gross domestic product at 5% level of significance. The first difference of gross capital formation, the first difference of carbon-dioxide emissions have positive relation with per capita gross domestic product and the first difference of one period lagged inflation has negative relation with per capita gross domestic product. However, the remaining variables such as first difference of labor force, first difference of foreign direct investment and first difference of financial development are found to have insignificant impact even at the weak 10% level of significance.

The short run coefficient of gross capital formation shows that there is positive relationship between gross capital formation and per capita gross domestic product and it is statistically significant at 5% level of significance. All other factors hold constant, 1% rise in gross capital formation leads to 0.0075% increases in gross domestic product per capita on average. The current value of labor force is negatively related with gross domestic product and it is insignificant. However, the first lag of labor force is statistically significant at 1% critical value and negatively related to gross domestic product per capita. An increase of labor force by 1% will lead to 0.078% decline in per capita gross domestic product ceteris paribus. The current value and first lag of carbon-dioxide emissions are positively related to gross domestic product per capita and statistically significant at 5% and 1% significance levels respectively. Holding all other factors fixed, 1% increase in carbon-dioxide emissions causes 0.264% increase in per capita gross domestic product on average.

Furthermore, human capital has positive relationship with gross domestic product per capita and statistically significant at 1% level of significance. The coefficient value of human capital 0.086 suggest that 1% increase in human capital will lead to about 0.086% increase in per capita gross domestic product with other factors held constant. The first lag of financial development shows negative relationship with per capita gross domestic product and significant at the weak 10% critical value. Additionally, the estimated coefficient of trade openness reveals negative relationship between trade openness and per capita gross domestic product and statistically significant at 1% significance level. The coefficient value 0.023 of trade openness indicates 1% increase in trade openness results in about 0.023% declines in per capita gross domestic product with holding other factors constant. The current value of inflation rate was positively related to per capita gross domestic product and significant at 1%

level of significance. In contrast, the first lag of inflation rate is negatively related to per capita gross domestic product and significant at 5% critical value.

The speed at which how variables move to their equilibrium level is captured through the error correction term (ECM_{t-1}) and it is expected to be statistically significant with negative value. Moreover, its value should be lie between negative one and zero. That is, $-1<ECM_{t-1}<0$. The error correction term is one period lagged residual obtained from the estimated long run dynamic model. The coefficient of the error correction term indicates how fast variables converge to long run equilibrium after short run shocks takes place. The short run dynamics are captured through the individual coefficients of the differenced terms. These coefficients are called the adjustment coefficient. Therefore, ECM_{t-1} measures this adjustment to bring back equilibrium in the dynamic model. ECM_{t-1} has negative sign, correct magnitude and statistically significant at 1% significance level as it was expected, confirming the presence of cointegration or long-run relationship between variables under consideration.

A highly significant error correction term adds evidence for further proof of the presence of stable long run relationship as stated by (Banerjee et al., 1998). In fact, he maintained that testing the significance of ECM_{t-1}, which is supposed to carry out negative coefficient, is relatively more efficient way of establishing cointegration. As it is pointed out earlier, under bounds test approach for cointegration, the results of computed F-statistic is higher than the upper bounds of the critical values at the convectional level of significance which indicates the presence of cointegration or long run relationship among the variables included in the model. Since the ECM_{t-1} term found with both the expected sign and magnitude, it further strength the existence of long run relationship among the variables incorporated in the model and this tells us that there is a reasonable adjustment towards the long-run steady state. The estimated coefficient of ECM_{t-1} in this model is -0.492832 which indicates that around 49.3% deviations from the long run equilibrium are restored per year and the remaining 50.7% are restored next year. This indicates that it takes almost two years to bring long run equilibrium after short run shocks takes place.

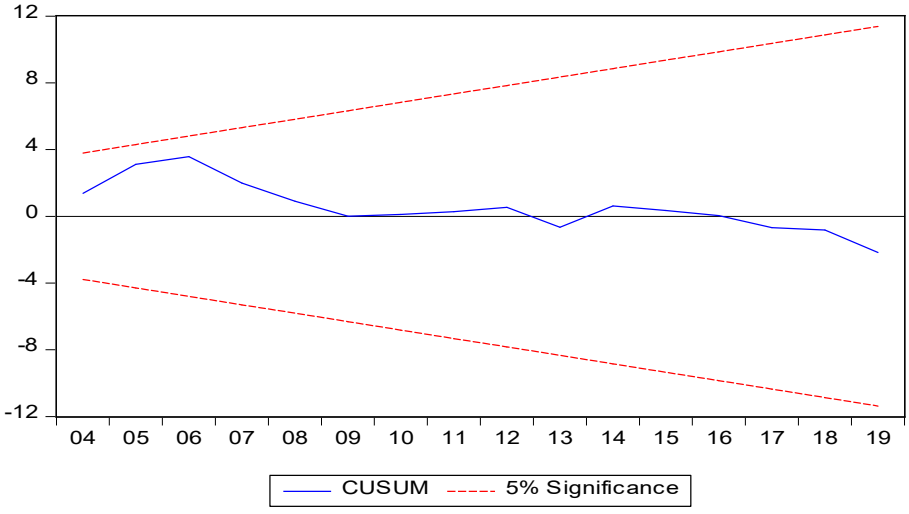
4.5 Stability of the Model (Testing for Structural Breaks in Model)

In econometrics and statistics, structural break is an unexpected change over time in the parameters of regression models, which can lead to huge forecasting errors and unreliability of the model in general. This issue was popularized by David Hendry, who argued that lack of stability of coefficients frequently caused forecast failure, and therefore we must routinely

test for structural stability. Structural stability which indicates the time-invariance of regression coefficients is a central issue in all applications of linear regression models.

The model of the study was diagnosed with stability tests using the cumulative sum of recursive residuals (CUSUM) and the cumulative sum of the square of recursive residuals (CUSUMSQ) to further enhance the reliability of study results. Therefore, it is important to test whether the short- and long-term relationships found previously are stable over the entire period of the study. To conduct this, we must test for the stability of the model parameters. The method we apply here is based on the cumulative sum (CUSUM) and the cumulative sum of squares (CUSUMSQ) tests suggested by (Brown et al., 1975). In contrast to the Chow test which requires the breakpoints to be specified, the CUSUM tests may be used even when the breakpoints are not known. The CUSUM test employs the cumulative sum of recursive residuals based on the first *n* observations, and it is recursively updated and plotted against the breakpoint. The CUSUMSQ test also utilizes the recursive residuals squared and follows the same procedure as of CUSUM. The decision rule is that, if the plots of the CUSUM and CUSUMSQ remain within the boundary of critical limits of the 5 percent significance level, the null hypothesis that states all the coefficients are stable cannot be rejected. However, if either of the parallel lines crossed, then the null hypothesis of parameter stability is rejected at the 5 percent significance level.

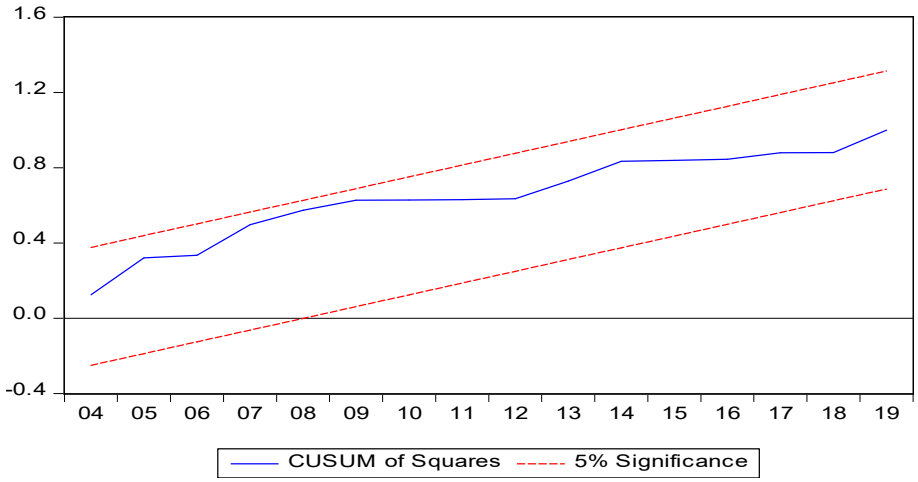
Plot of Cumulative sum of recursive residuals



The straight lines represent critical bounds at 5% significance level

Figure 4. 1 CUSUM Test for Model One

Plot of Cumulative sum of square of recursive residuals



The straight lines represent critical bounds at 5% significance level

Figure 4. 2 CUSUMSQ Test for Model one

The above Figure 4.1 and Figure 4.2 show the results of CUSUM and CUSUMQ stability tests respectively. The pair of the two straight red lines in the above two graphs which are parallel lines to one another represent the critical lower and upper bounds of the region specifying the 5% significance level. The visual inspection of these two graphs indicates no evidence of parameters instability in the regression over the study period since both the plotted CUSUM and CUSUMSQ graphs remain inside the 5% significance level. Both plots disclose that the plot of CUSUM and CUSUM of squares tests stay within the critical bounds of the 5% level of significance leading to the acceptance of null hypothesis that states parameters of the model is stable over the study period. Moreover, the results of stability tests suggest that the coefficients of the model are stable and consistent as the plots of graphs are still within the critical bounds (indicated by 5% significance level straight lines). Therefore, the results show that the parameters of the model do not suffer from any structural instability during the study period.

4.6 Granger Causality Wald Test Result

This Test is employed in order to establish the direction of causality between the variables. The causality can be flow in bi-directional i.e both directions, flow in uni-directional i.e only in one direction and there is no causality i.e not flowing in either direction. Granger causality (Granger, 1969) splits cause and effect in order to identify which is the cause and which is the effect. More importantly granger founds the cause of every economic variable. Therefore

given two variables X and Y the variable X is said to Granger-cause the variable Y, if the present value of Y depends on the past values of X. in other words knowing the past value of X the future value of Y can be well predicted (Konya, 2004). However the variables must be stationary, if not it has to be made stationary before conducting the test for the nature of granger causality. The Granger causality test will enable the capturing of the possible causality relationships between economic growth, foreign direct investment and carbon-dioxide emissions. It also indicates the existence or non-existence and nature of causality in terms of the variables under consideration.

Table 4. 9 Pairwise Granger Causality Wald Test Result

Null Hypothesis	Obs	F-Statistic	Prob.	Decision
FDI does not Granger Cause LNY	37	1.98209	0.1543	Do not reject
LNY does not Granger Cause FDI	37	0.18133	0.8350	Do not reject
$LNCO_2$ does not Granger Cause LNY	37	2.32545	0.1140	Do not reject
LNY does not Granger Cause $LNCO_2$	37	1.41527	0.2577	Do not reject
$LNCO_2$ does not Granger Cause FDI	37	0.76506	0.4736	Do not reject
FDI does not Granger Cause $LNCO_2$	37	3.03602	0.0620	Do not reject

Pairwise Granger Causality test is conducted in order to determine whether foreign direct investment, environmental quality and economic growth affect each other over time. The results of granger causality test displayed in Table 4.10 above disclose that there is no causality running in either direction between all the variables of interest. Therefore, the result of Granger Causality test indicate that the past values of foreign direct investment and carbon-dioxide emissions have no predictive ability in determining the present value of gross domestic product. In the same way, the test shows that the past values of foreign direct investment and gross domestic product have no predictive ability in explaining the current level of carbon-dioxide emissions for the study period.

4.7 Analysis of Model Two (Environmental Quality)

4.7.1 ARDL Bounds Test for model Two

Table 4. 10 ARDL Model Bounds Cointegration Test Result for Model Two

F-Statistics	Significance level	Critical values for bounds test	
		Lower bounds	Upper bounds
5.219263* **	1%	3.27	4.39
	5%	4.39	3.62
	10%	2.33	3.25

Source: E-Views 10 Software Result

*** denote significance at 1% significance.

To determine the presence of the long run relationships and short run dynamic connections among the variables the ARDL bounds test to cointegration approach was applied. The result of ARDL bounds test is displayed in the above Table 4.11. The computed F-statistics of the test is 5.22, which is higher than the upper bounds of all the commonly used significance levels. Therefore, the bounds test supports the existence of long run relationship between the dependent variable and independent variables. Depending on this, we reject the null hypothesis that assumes absence of long run relationship and accepted the alternative hypothesis that states existence of long run relationship.

4.7.2 Diagnostic Test for Model Two

Table 4. 11 Diagnostic Test Result for Model Two

Problem	Test Conducted	Null hypothesis	F-statistic	(P-value)	Conclusion
Serial correlation	Breusch-Godfrey LM test	No serial correlation	0.352156	0.7079	Fail to reject null hypothesis
Heteroscedasticity	Breusch-Pagan/Cook-Weisberg test	Error term has constant variance or Homoscedasticity	0.529142	0.8997	Fail to reject null hypothesis

Model Specification	Ramsey RESET test	Model has no omitted variable	0.196695	0.6624	Fail to reject null hypothesis
Normality	Jarque-Bera test	Residual are normally distributed	0.837088(The value of Jarque Bera	0.658004	Fail to reject null hypothesis
Parameter Stability	CUSUM and CUSUMSQ	Parameters of the model are stable	Not applicable	Not applicable	Fail to reject null hypothesis

The model of environmental quality is also diagnosed to make sure that the model is free from problems such as serial correlation, heteroskedasticity, functional form misspecification and non-normality of the errors. The diagnostic tests conducted were Breusch-Pagan-Godfrey test for heteroskedasticity, Breusch-Godfrey LM test for serial correlation, Ramsay's RESET test for functional form specification error test and Jarque-Bera test for normality. Accordingly, (Table 4.12) above shows the diagnostic test results performed. The results show that the stochastic error term is free from serial correlation and it is white noise, the functional form of the model is correctly specified, the residuals are normally distributed with zero mean and constant variance.

4.7.3 ARDL Long Run Estimated Results for Model Two

Table 4. 12 Long Run Estimated ARDL Model (Model Two) ARDL (1, 1, 2, 2, 1, 0, 2)

Dependent variable: $LNCO_2$				
Variable	Coefficient	Std. Error	t-Statistic	Prob. value
LNY	-7.768144	2.208037	-3.518121	0.0022***
LNYSQ	0.783866	0.210272	3.727872	0.0013***
FDI	-0.178645	0.053879	-3.315678	0.0034***
LNEC	-14.41497	9.358162	-1.540363	0.1391
TRO	0.024326	0.007173	3.391262	0.0029***
FD	0.058869	0.013371	4.402859	0.0003***

Source: E-Views 10 Software Output

Note: The asterisk *** indicates significance at 1% significance level.

The long run estimated coefficients for environmental quality model is displayed in the above Table 4.13. The long run result shows that except for energy consumed, all the remaining variables have statistically significant impacts on environment quality in Ethiopia. Energy used has positive impact on environmental quality, but it is weak and not significant even at 10% significance level. All the other variables are significant at 1% level of significance and indicating that they were important factors at affecting environmental quality of Ethiopia. The square of economic growth, trade openness and financial development has strong positive impact on environment degradation. An increase of square of economic growth, trade openness and financial development by 1% could increase environmental degradation by about 0.784%, 0.024% and 0.059% respectively, all other factors kept constant. The square of GDP per capita has positive relationship with CO_2 emissions in Ethiopia based on the environmental quality model specified in the study. Higher economic growth in the country might result in higher energy consumption and further lead towards a higher release of CO_2 emissions as stated by (Ang, 2008) and (Halicioglu, 2009). Furthermore, study result cannot confirm the existence of EKC. According to EKC hypothesis, environmental quality deteriorates at the early stages of economic growth, attains its maximum at certain level of economic growth (income) and starts to improve at higher level of economic growth, postulating an inverted U-shaped relation between environmental quality and economic growth. Since the coefficient estimated indicate that GDP and the square of GDP has negative and positive sign respectively which is not the case for EKC to hold, this study cannot confirm the EKC hypothesis in Ethiopia for the study period. This finding is similar to the research finding of (Adinew, 2020) who found the expansion of Ethiopian economy leads to environmental degradation.

Contrary to this, economic growth, foreign direct investment and energy consumed have negative impact on carbon-dioxide emissions in the country for the study time. The negative coefficients of economic growth and foreign direct investment on CO_2 emissions indicate that EG and FDI inflows reduced environmental degradation in the country. To be more accurate, a one percent increase in EG and FDI will decrease the release of CO_2 emissions by about 7.768% and 0.179% respectively other variables remain fixed. The negative sign of FDI might be indicate that Ethiopia might emphasis on modern and cleaner technologies in the

production process to confirm best environmental practices that could reduce air pollution. Therefore, this leads to the conclusion that FDI aid enterprises to encourage technology innovation and adopt new technologies, then after increase energy efficiency and advance low carbon economic growth. As a result, increase in FDI inflows are linked with lower levels of per capita CO_2 emissions.

4.7.4 ARDL Short Run Estimated Results for Model Two

Table 4. 13 ARDL Short Run Coefficients for Model Two, ARDL (1, 1, 2, 2, 1, 0, 2)

ECM Regression				
Case 4: Unrestricted Constant and Restricted Trend				
Variable	Coefficient	Std. Error	t-Statistic	Prob. value
D(LNY)	1.729954	1.064477	1.625168	0.1198
D(LNYSQ)	-0.145889	0.095851	-1.522039	0.1437
D(LNYSQ(-1))	-0.017616	0.009138	-1.927660	0.0682*
D(FDI)	-0.037921	0.009742	-3.892612	0.0009***
D(FDI(-1))	0.063582	0.012029	5.285962	0.0000***
D(LNEC)	2.963837	3.783319	0.783396	0.4426
D(FD)	0.007836	0.004245	1.846112	0.0797*
D(FD(-1))	-0.018733	0.005022	-3.729826	0.0013***
CointEq(-1)*	-0.798364	0.106337	-7.507865	0.0000***
C	82.47311	10.98519	7.507662	0.0000***
R-squared	0.764907	Mean dependent var		0.026626
Adjusted R-squared	0.686543	S.D. dependent var		0.109010
S.E. of regression	0.061032	Akaike info criterion		-2.529390
Sum squared resid	0.100571	Schwarz criterion		-2.094007
Log likelihood	56.79372	Hannan-Quinn criter.		-2.375897
F-statistic	9.760908	Durbin-Watson stat		1.963850
Prob(F-statistic)	0.000002			

Source: E-Views Software Output

*** and * denotes significance at 1% and 10% respectively.

The above (Table 4.14) display the short run estimated coefficients based on error correction model. The short run results shows that only FDI, past value of FDI and past value of FD have statistically significant impact on CO_2 emissions at 1% level of significance. The past value of square of GDP and FD at level are found to have impact on CO_2 emissions at 10% significance level. GDP, square of GDP and EC at level do not have any relationship with CO_2 emissions as it is indicated by the short run results, their P-values is not significant at all the commonly used significance of 1%, 5% and 10%. The short run impact of FDI on CO_2 emissions is the same as that of long run results. FDI is found to have negative impact on CO_2 emissions. But the past level of FDI is found to have positive impact on CO_2 emissions. This indicates the impact of FDI on environmental quality might depend on the time (past and current time). The impact of FD on CO_2 emissions is also found to vary with time showing that the past level of FD is negatively related with CO_2 emissions and statistically significant at 1% level of significance whereas the current level of FD is positively related to CO_2 emissions but at 10% significance level.

The ECM_{t-1} is found with the expected sign and magnitude. The negative sign of ECM_{t-1} term indicates the anticipated convergence of the system to the long run from short run dynamics. The ECM coefficient is highly significant at1% significance level indicating high speed of adjustment and convergence to long run equilibrium. The ECM_{t-1} term has a value of -0.798364 implying that about 79.8% of disequilibrium in the short run is restored back to long run equilibrium every year. The remaining 20.2% will be adjusted to equilibrium in the coming year.

Generally, this study found negative relationship between CO_2 emissions which was used as proxy variable for environmental quality and foreign direct investment both in the long run and short run analysis. This implies that FDI leads to improvement in environmental quality both in long run and short run. However, FDI has no significant impact on economic growth. This may suggest that FDI is not contributing to economic growth via environmental quality in Ethiopia. In the long run the coefficient of GDP is negative and statistically significant while that of the square of GDP is positive and statistically significant. Therefore, both the long run and short run results were unable to confirm the existence of EKC hypothesis in the Ethiopian economy for the study period. In the presence of EKC hypothesis, the impacts of GDP and GDP square on carbon dioxide emissions is anticipated to be positive and negative respectively. The EKC is not valid in Ethiopia for the study period, since it is not the case for

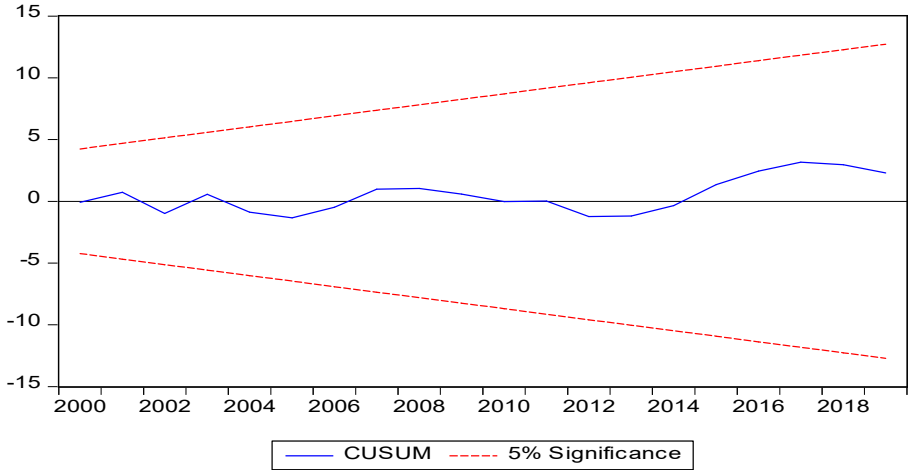
the analyzed data. The result supports the existence of U-shaped relationship between the environment and economic growth in Ethiopia instead of inverted U-shaped relationship.

Therefore, the increase in the level of economic growth leads to environmental improvements until a certain point, then after the increase in the level of GDP causes environmental degradation which contradicts with EKC hypothesis. This suggests that economic growth (income growth) alone is not enough to improve environmental quality (reduce environmental degradation) and the Ethiopian economy is not at level to bring solution for environmental degradation. This finding is consistent with papers of (Al-Mulali et al., 2015a; Baek, 2015; Friedl and Getzner, 2003; Saboori and Sulaiman, 2013) who failed to obtain an inverted U-shaped relationship between economic growth and environmental degradation. However, this result is inconsistent with the empirical studies of (Balaguer and Cantavella, 2016; Bölük and Mert, 2015; Jebli and Youssef, 2015; Kebede, 2017) that found the validity of EKC in their investigation.

4.7.5 Stability Test for Model Two

Pesaran et al., (2001) proposed the cumulative sum of recursive residuals (CUSUM) and cumulative sum of square of recursive residuals to examine the long run stability of regression parameters of ARDL model. Thus, the study applied both the cumulative sum of recursive residuals (CUSUM) and cumulative sum of square of recursive residuals (CUSUMSQ) to evaluate the stability of the model. If the plots of these tests remain within the lower and upper critical bounds of 5% significance level, the null hypothesis of all coefficients of the regression are stable cannot be rejected. Therefore, both the CUSUM and CUSUMSQ plots confirm the stability of long run coefficients of the model since they lie within the boundary lines. The plots of CUSUM and CUSUMSQ are given below.

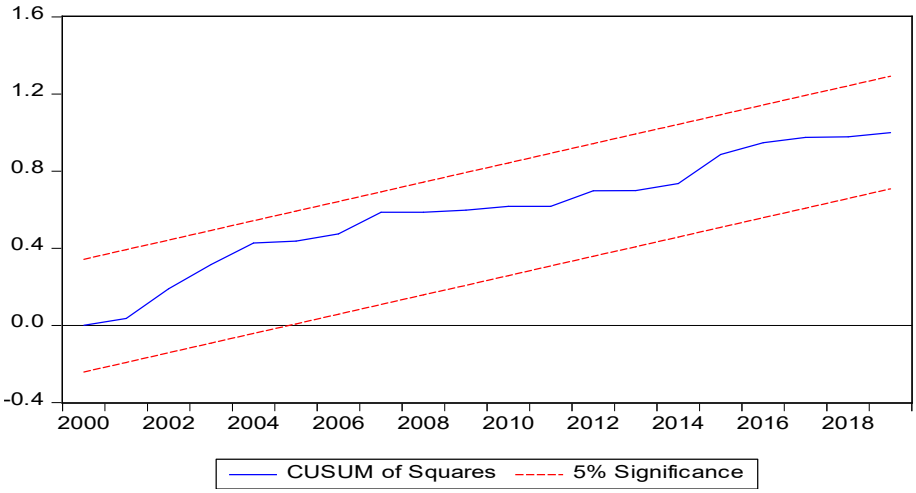
Plot of Cumulative sum of recursive residuals



The straight lines represent critical bounds at 5% significance level

Figure 4. 3 CUSUM Test for Model Two

Plot of Cumulative sum of square of recursive residuals



The straight lines represent critical bounds at 5% significance level

Figure 4. 4 CUSUMSQ Test for Model Two

CHAPTER FIVE

5. SUMMARY, CONCLUSIONS AND POLICY RECOMMENDATIONS

This section comprises of summary of the main findings of the study, finalizes its work and puts policy recommendations. It also proposes area(s) for further researches.

5.1 Summary

The primary objective of the study was to empirically investigate the relationship between foreign direct investment, environment quality and economic growth in Ethiopia over the period of 1981-2019 through the application of autoregressive distributed lag bounds cointegration test approach. In addition, the study aims to test the validity of EKC hypothesis in Ethiopian economy over the period under consideration.

Before conducting the core analysis of the study, the preliminary tests were performed to safely proceed to the main analysis of the study. The stationarity tests, cointegration test, diagnostic tests and stability tests were conducted.

The data were checked for stationarity property and an attempt was made to avoid running of spurious regression or obtaining of wrong empirical findings. Therefore, both the Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) unit root tests were performed. The results of the unit root tests conducted were showed that the data used in the analysis were free from the problem of non-stationarity. The variables included in the model were either integrated of order zero or integrated of order one and none of the variables included were integrated of order higher than one thereby confirming the applicability of autoregressive distributed lag bounds cointegration approach.

The ARDL bounds cointegration test approach was also conducted to check for the existence of cointegration or long run relationship among the variables under consideration and the test result confirms the existence of long run relationship among the variables incorporated in the model. The various econometrics diagnostic tests were also performed to make sure that the model is free from issues such as serial-correlation, heteroskedasticity, model misspecification, non-normality of errors and multicollinearity problems. Accordingly, the Breusch-Godfrey Lagrange multiplier statistics test for serial correlation, Breusch-Pagan-

Godfrey test for heteroskedasticity test, Ramsey's RESET test for functional form misspecification, Jarque-Bera test for non-normality of errors and VIF for multicollinearity issues were under taken. The result of the diagnostic tests conducted indicate the residuals were free from serial correlation (white noise), has zero mean and constant variance, the model is well specified or its functional form is correctly specified, the stochastic error term is normally distributed and absence of high multicollinearity problem among the variables used for the analysis.

FDI is found to have positive and insignificant impact on economic growth both in the long run and short run. The impact of carbon-dioxide emissions is mixed both in its significance and sign, having insignificant negative impact and significant positive impact on economic growth in long run and short run respectively. Gross capital formation has significant positive impact on economic growth both in the long run and short run. Human capital has positive impact on economic growth, but significant only in the short run. Labour force is found to have positive impact on economic growth in the long run and negative impact in the short run. Trade openness affect economic growth negatively both in the long run and short run. Financial development shows mixed results in its sign and significance both in the long run and short run. It has significant negative impact and insignificant positive impact on economic growth in long run and short run respectively. Inflation affects economic growth in the long run and has mixed results in the short.

Based on environmental quality model specified, the study result shows that there is positive relationship between trade openness, financial development, the square of GDP and carbon-dioxide emissions in the long run. But, there is negative relationship between GDP, FDI, EC and CO_2 emissions. In the short run, GDP affects CO_2 Emissions positively and insignificantly even at 10% significance level. The square of GDP affects CO_2 emissions negatively and insignificant. The result also shows negative relationship between FDI and CO_2 emissions in the short run. EC positively related to CO_2 emissions in the short run, insignificant even at the weaker 10% significance level. FD contributes to CO_2 emissions positively in the short run.

The models were also diagnosed with stability tests using the cumulative sum of recursive residuals (CUSUM) and the cumulative sum of the square of recursive residuals (CUSUMSQ) to further enhance the reliability of the results. The results of both CUSUM and

CUSUMSQ stability tests confirmed that the regression parameters were stable over the period.

The coefficient of error correction term measures how quickly the short run shocks back to long run equilibrium. In both economic growth and environmental quality models, ECM_{t-1} has the expected sign and magnitude. This confirms the validity of the presence of long run relationship among the variables included in the models. In the economic growth model the estimated coefficient of ECM_{t-1} is -0.492832 which shows that around 49.3% deviations from the long run equilibrium are restored per year and the remaining 50.7% are restored in the coming year. This indicates that it takes almost two years to bring back long run equilibrium after short run shocks takes place. For environmental quality model the computed coefficient for ECT_{t-1} is -0.798364 which indicates that around 79.8% of variation in carbon-dioxide emissions in the short run adjusts itself to long run equilibrium annually and the remaining 20.2% adjustment take place in the next year.

5.2. Conclusion

Generally, the study examined the relationship between FDI, CO_2 emissions and economic growth in Ethiopia by using annual time series data that spans from 1981-2019 through the application of ARDL approach to cointegration. The main findings of this study are that, FDI has positive and insignificant impact on economic growth for the time period under investigation both in the long run and short analysis. CO2 emission has insignificant negative impact and significant positive impact on economic growth in the long and short run analysis respectively. This study found negative relationship between CO2 emissions which was used as proxy variable for environmental quality and foreign direct investment both in the long run and short run analysis. In the long run the coefficient of GDP is negative and statistically significant while that of the square of GDP is positive and statistically significant. But in the short run, GDP and its square have insignificant impact on CO2 emission. Therefore, both the long run and short run results were unable to confirm the existence of EKC hypothesis in the Ethiopian economy for the study period. Even this is done; still the door is for further investigations. Future researchers can extend this study by including other environmental quality indicator variables and institutional quality indicator variable.

5.3 Policy Recommendation (Policy Implication)

Based on the findings obtained, the main policy implications that can be forwarded are drawn below.

- The impact of CO_2 emissions on economic growth in the short run is positive. So increase in CO_2 emissions are not desirable for improved environmental quality. Thus, the government should be adopt climate-smart national policies to find out alternative sources of energy like renewable energy sources in order to minimize the CO_2 emissions of energy use. Secure, clean, cost effective reliable and sustainable energy should be targeted. Cordial efforts should be made for further supervisory and institutional reforms to confirm the efficient supply of growing energy needs.
- The impact of FDI on CO_2 emissions is found to be negative in Ethiopia for the study period. So the government should be guided by the following policy prescriptions to benefit more from FDI impacts on environment.
  - ✓ Support High-Quality and In-Depth Cooperation with FDI-Invested Enterprises and Projects
  - ✓ Strengthen Environmental Standards and Enhance Environmental Supervision of Foreign-Invested Enterprises
- ✓ The government should adopt proper national policies and CO_2 emissions reduction policy in Ethiopia should focus on environmental friendly growth, encouraging technology innovation and adopt new technologies that may lead to energy efficiency and advance low carbon economic growth.
- Since Ethiopia has large population and huge working forces (labor forces) which contribute to economic growth, the government and non-government organizations should deliver the skill based training and quality education in order to produce more competent and skilled labor forces (workers) which are important for economic growth.
- Human capital has been considered as an important factor that enhances economic growth. The result shows that human capital has positive impact on economic growth in Ethiopia for the study period. Therefore, the government should increase its investment on human capital through spending on education, on research and development to bring economic advancement in the long run.

- Unexpectedly, trade openness has negative impact on economic growth. This may be due to the fact that the production capacities in Ethiopia are not internationally competitive and matured enough compared to the more advanced nations. The government of Ethiopia should undertake proper steps in this regards. Rather than consumption goods, import of intermediate and efficient capital goods should get priority. This will raise export capacity and domestic production. Therefore, the government of Ethiopia should formulate and execute proper development oriented trade policies along with other macroeconomic policies to achieve the desired goals both in the long run and short run.
- Trade openness contributes positively to CO_2 emissions. Trade openness has negative effect for developing countries because relatively low-income developing countries like Ethiopia will made dirtier with trade due to the fact that pollution intensive manufacturing relocates from advanced nations to developing nations where environmental regulations are assumed to be less strict. Therefore, Ethiopia should give considerations to having standard trade policies and restrictions to reduce import of environmentally pollutant goods and investments.

5.4 Area(s) of Further Research

The current study limited itself to examine the relationship between foreign direct investment, environmental quality and economic growth in Ethiopia that spans from 1981 to 2019. This study is motivated by lack of consistence of empirical literatures on the impact of FDI on economic growth (EG). Moreover, very little is done to examine the impact of FDI and CO_2 emissions on EG in Ethiopia. By the same point of view the study on the impact of FDI and EG on environmental quality in the case of Ethiopia is scanty and therefore, there is a need for further study to contribute to the existing literatures. This study might be different from previous studies by including FDI together with EG to examine their impacts on environmental quality and found that FDI has negative impact on CO2 emissions. Additionally, the study cannot validate the existence of Environmental Kuznets Curve hypothesis. However, still there is direction for further studies. As a result, it would be important that to explore whether other types of capital inflows (foreign aid and foreign loans/ grants) also have differential impacts across sectors. Future researchers may examine the impact of omitted variables to establish their real impacts on economic growth. So, future researchers can include variables such as infrastructure and institutional quality indicators to investigate their impacts on economic growth of Ethiopia. Furthermore, the study suggests

examining the impacts of disaggregated FDI inflows by sectors on economic growth of Ethiopia to examine which sector is benefiting from the FDI and a promising extension of this would consider energy supply and environmental variables for the case of Ethiopia.

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Appendices

E-Views 10 Software Result

Appendix 1: Estimates of Long Run Model (Model One)

ARDL Long Run Form and Bounds Test
Dependent Variable: D(LNY)
Selected Model: ARDL(1, 1, 2, 1, 2, 1, 2, 1, 2)
Case 1: No Constant and No Trend
Date: 11/11/21 Time: 22:49
Sample: 1981 2019
Included observations: 37

Conditional Error Correction Regression

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LNY(-1)*	-0.492832	0.141531	-3.482145	0.0031
GCF(-1)	0.021206	0.004993	4.247134	0.0006
LF(-1)	0.059621	0.023342	2.554277	0.0212
FDI(-1)	0.020444	0.018941	1.079314	0.2965
LNCO2(-1)	-0.029199	0.102416	-0.285100	0.7792
HC(-1)	0.038908	0.052199	0.745372	0.4669
FD(-1)	-0.009397	0.005452	-1.723672	0.1040
TRO(-1)	-0.013759	0.005728	-2.402151	0.0288
INF(-1)	0.014597	0.004568	3.195661	0.0056
D(GCF)	0.007488	0.004866	1.538782	0.1434
D(LF)	-0.009288	0.029586	-0.313948	0.7576
D(LF(-1))	-0.077703	0.033019	-2.353316	0.0317
D(FDI)	0.005429	0.015157	0.358184	0.7249
D(LNCO2)	0.245897	0.183448	1.340420	0.1988
D(LNCO2(-1))	0.263515	0.145894	1.806208	0.0897
D(HC)	0.086101	0.036517	2.357848	0.0314
D(FD)	0.003011	0.005705	0.527745	0.6049
D(FD(-1))	-0.008945	0.007074	-1.264484	0.2242
D(TRO)	-0.029951	0.006024	-4.971568	0.0001
D(INF)	0.007065	0.002024	3.490894	0.0030
D(INF(-1))	-0.003125	0.002494	-1.252940	0.2282

* p-value incompatible with t-Bounds distribution.

Levels Equation

Case 1: No Constant and No Trend

Variable	Coefficient	Std. Error	t-Statistic	Prob.
GCF	0.043029	0.011374	3.783003	0.0016
LF	0.120976	0.018132	6.671981	0.0000

FDI	0.041482	0.036231	1.144935	0.2691
LNCO2	-0.059247	0.215987	-0.274309	0.7874
HC	0.078947	0.098094	0.804812	0.4327
FD	-0.019068	0.008860	-2.152241	0.0470
TRO	-0.027918	0.007503	-3.720993	0.0019
INF	0.029618	0.006542	4.527212	0.0003

EC = LNY - (0.0430*GCF + 0.1210*LF + 0.0415*FDI -0.0592*LNCO2 + 0.0789 *HC -0.0191*FD -0.0279*TRO + 0.0296*INF)

F-Bounds Test — Null Hypothesis: No levels relationship

Test Statistic	Value	Signif.	I(0)	I(1)
			Asymptotic: n=1000	
F-statistic	6.705341	10%	1.66	2.79
k	8	5%	1.91	3.11
		2.5%	2.15	3.4
		1%	2.45	3.79
			Finite Sample:	
Actual Sample Size	37		n=40	
		10%	-1	-1
		5%	-1	-1
		1%	-1	-1
			Finite Sample:	
			n=35	
		10%	-1	-1
		5%	-1	-1
		1%	-1	-1

t-Bounds Test Null Hypothesis: No levels relationship

Test Statistic	Value	Signif.	I(0)	I(1)
t-statistic	-3.482145	10%	-1.62	-4.09
		5%	-1.95	-4.43
		2.5%	-2.24	-4.72
		1%	-2.58	-5.07

E-Views 10 Software Result

Appendix 2: Estimates of Short Run Model (Model One)

ARDL Error Correction Regression

Dependent Variable: D(LNY)

Selected Model: ARDL(1, 1, 2, 1, 2, 1, 2, 1, 2)

Case 1: No Constant and No Trend

Date: 10/29/21 Time: 23:24

Sample: 1981 2019

Included observations: 37

ECM Regression

Case 1: No Constant and No Trend

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(GCF)	0.007488	0.003033	2.468449	0.0252
D(LF)	-0.009288	0.018254	-0.508830	0.6178
D(LF(-1))	-0.077703	0.020757	-3.743506	0.0018
D(FDI)	0.005429	0.007450	0.728725	0.4767
D(LNCO2)	0.245897	0.093466	2.630873	0.0182
D(LNCO2(-1))	0.263515	0.083122	3.170233	0.0059
D(HC)	0.086101	0.020019	4.301055	0.0005
D(FD)	0.003011	0.003589	0.838756	0.4140
D(FD(-1))	-0.008945	0.004268	-2.095819	0.0524
D(TRO)	-0.029951	0.003346	-8.951182	0.0000

D(INF)	0.007065	0.001084	6.515106	0.0000
D(INF(-1))	-0.003125	0.001218	-2.566364	0.0207
CointEq(-1)*	-0.492832	0.051799	-9.514311	0.0000

R-squared	0.908215	Mean dependent var	0.039725
Adjusted R-squared	0.862323	S.D. dependent var	0.140247
S.E. of regression	0.052038	Akaike info criterion	-2.803835
Sum squared resid	0.064992	Schwarz criterion	-2.237837
Log likelihood	64.87096	Hannan-Quinn criter.	-2.604295
Durbin-Watson stat	2.312104		

* p-value incompatible with t-Bounds distribution.

F-Bounds Test — Null Hypothesis: No levels relationship

Test Statistic	Value	Signif.	I(0)	I(1)
F-statistic	6.705341	10%	1.66	2.79
k	8	5%	1.91	3.11
		2.5%	2.15	3.4
		1%	2.45	3.79

t-Bounds Test — Null Hypothesis: No levels relationship

Test Statistic	Value	Signif.	I(0)	I(1)
t-statistic	-9.514311	10%	-1.62	-4.09
		5%	-1.95	-4.43
		2.5%	-2.24	-4.72
		1%	-2.58	-5.07

E-Views 10 Software Result

Appendix 3: Estimates of Long Run Model (Model Two)

ARDL Long Run Form and Bounds Test

Dependent Variable: D(LNCO2)

Selected Model: ARDL(1, 1, 2, 2, 1, 0, 2)

Case 4: Unrestricted Constant and Restricted Trend

Date: 10/24/21 Time: 06:12

Sample: 1981 2019

Included observations: 37

Conditional Error Correction Regression

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	82.50417	46.86888	1.760319	0.0936
@TREND	-0.031063	0.012279	-2.529638	0.0199
LNCO2(-1)*	-0.798364	0.145261	-5.496069	0.0000
LNY(-1)	-6.201806	1.934814	-3.205376	0.0044
LNYSQ(-1)	0.625810	0.185774	3.368668	0.0031
FDI(-1)	-0.142623	0.047399	-3.009013	0.0069
LNEC(-1)	-11.50839	7.144473	-1.610811	0.1229
TRO**	0.019421	0.006182	3.141339	0.0051
FD(-1)	0.046999	0.012554	3.743767	0.0013
D(LNY)	1.729954	2.202931	0.785296	0.4415
D(LNYSQ)	-0.145889	0.201768	-0.723053	0.4780
D(LNYSQ(-1))	-0.017616	0.012451	-1.414866	0.1725
D(FDI)	-0.037921	0.016541	-2.292578	0.0328
D(FDI(-1))	0.063582	0.021574	2.947189	0.0080

D(LNEC)	2.963837	5.646719	0.524878	0.6054
D(FD)	0.007836	0.007140	1.097507	0.2855
D(FD(-1))	-0.018733	0.006933	-2.702091	0.0137

* p-value incompatible with t-Bounds distribution.

** Variable interpreted as Z = Z(-1) + D(Z).

Levels Equation

Case 4: Unrestricted Constant and Restricted Trend

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LNY	-7.768144	2.208037	-3.518121	0.0022
LNYSQ	0.783866	0.210272	3.727872	0.0013
FDI	-0.178645	0.053879	-3.315678	0.0034
LNEC	-14.41497	9.358162	-1.540363	0.1391
TRO	0.024326	0.007173	3.391262	0.0029
FD	0.058869	0.013371	4.402859	0.0003
@TREND	-0.038908	0.013820	-2.815226	0.0107

EC = LNCO2 - (-7.7681*LNY + 0.7839*LNYSQ -0.1786*FDI -14.4150*LNEC +

0.0243*TRO + 0.0589*FD -0.0389*@TREND)

F-Bounds Test Null Hypothesis: No levels relationship

Test Statistic	Value	Signif.	I(0)	I(1)

			Asymptotic: n=1000	
F-statistic	5.219263	10%	2.33	3.25
k	6	5%	2.63	3.62
		2.5%	2.9	3.94
		1%	3.27	4.39
			Finite Sample:	
Actual Sample Size	37		n=40	
		10%	2.634	3.719
		5%	3.07	4.309
		1%	4.154	5.699
			Finite Sample: n=35	
		10%	2.685	3.785
		5%	3.174	4.383
		1%	4.629	5.698

E-Views 10 Software Result

Appendix 4: Estimates of Short Run Model (Model Two)

ARDL Error Correction Regression

Dependent Variable: D(LNCO2)

Selected Model: ARDL(1, 1, 2, 2, 1, 0, 2)

Case 4: Unrestricted Constant and Restricted Trend

Date: 10/24/21 Time: 06:18

Sample: 1981 2019

Included observations: 37

ECM Regression

Case 4: Unrestricted Constant and Restricted Trend

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	82.47311	10.98519	7.507662	0.0000
D(LNY)	1.729954	1.064477	1.625168	0.1198
D(LNYSQ)	-0.145889	0.095851	-1.522039	0.1437
D(LNYSQ(-1))	-0.017616	0.009138	-1.927660	0.0682
D(FDI)	-0.037921	0.009742	-3.892612	0.0009
D(FDI(-1))	0.063582	0.012029	5.285962	0.0000
D(LNEC)	2.963837	3.783319	0.783396	0.4426
D(FD)	0.007836	0.004245	1.846112	0.0797
D(FD(-1))	-0.018733	0.005022	-3.729826	0.0013
CointEq(-1)*	-0.798364	0.106337	-7.507865	0.0000
R-squared	0.764907	Mean dependent var		0.026626
Adjusted R-squared	0.686543	S.D. dependent var		0.109010
S.E. of regression	0.061032	Akaike info criterion		-2.529390
Sum squared resid	0.100571	Schwarz criterion		-2.094007

Log likelihood	56.79372	Hannan-Quinn criter.	-2.375897
F-statistic	9.760908	Durbin-Watson stat	1.963850
Prob(F-statistic)	0.000002		

* p-value incompatible with t-Bounds distribution.

F-Bounds Test Null Hypothesis: No levels relationship

Test Statistic	Value	Signif.	I(0)	I(1)
F-statistic	5.219263	10%	2.33	3.25
k	6	5%	2.63	3.62
		2.5%	2.9	3.94
		1%	3.27	4.39

Stata 11 Software Result

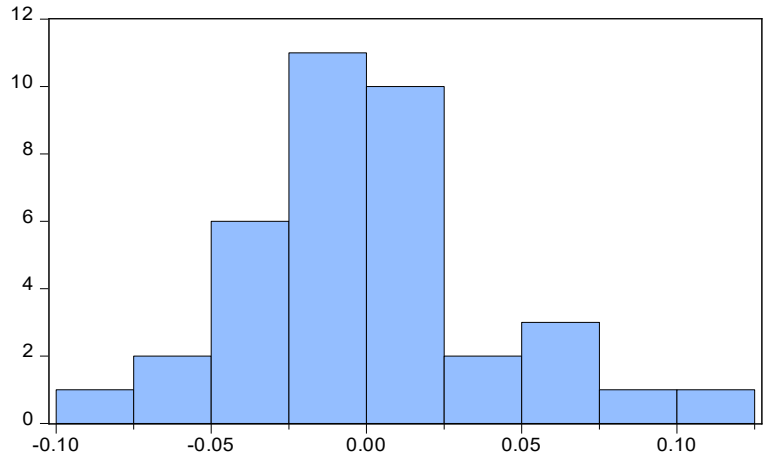
Appendix 5: Multicollinearity Test

```
. vif
```

Variable	VIF	1/VIF
lf	15.51	0.064493
gcf	13.37	0.074819
lnco2	7.08	0.141169
tro	6.14	0.162915
fd	4.86	0.205906
hc	3.49	0.286556
fdi	3.44	0.290965
inf	2.07	0.483398
Mean VIF	6.99	

E-Views 10 Software Result

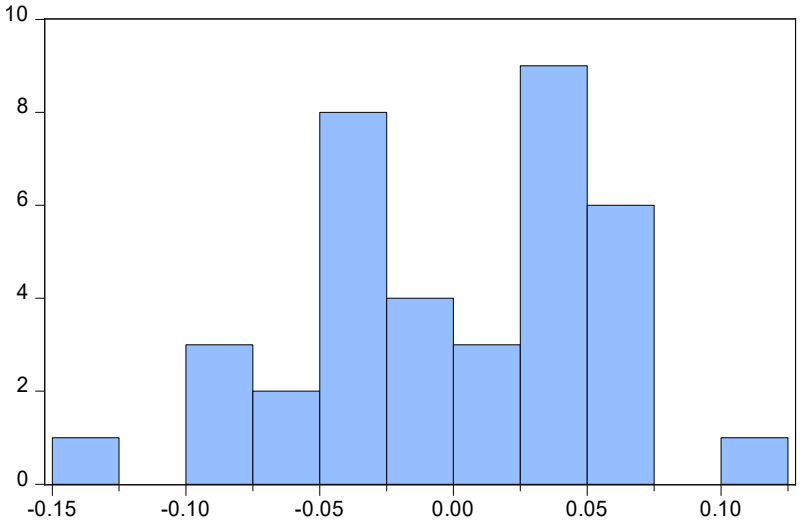
Appendix 6: Normality Test Result (Histogram) for Model One



Series: Residuals	
Sample 1983 2019	
Observations 37	
Mean	2.55e-05
Median	-0.002465
Maximum	0.111946
Minimum	-0.081565
Std. Dev.	0.042489
Skewness	0.545841
Kurtosis	3.199019
Jarque-Bera	1.898374
Probability	0.387056

E-Views 10 Software Result

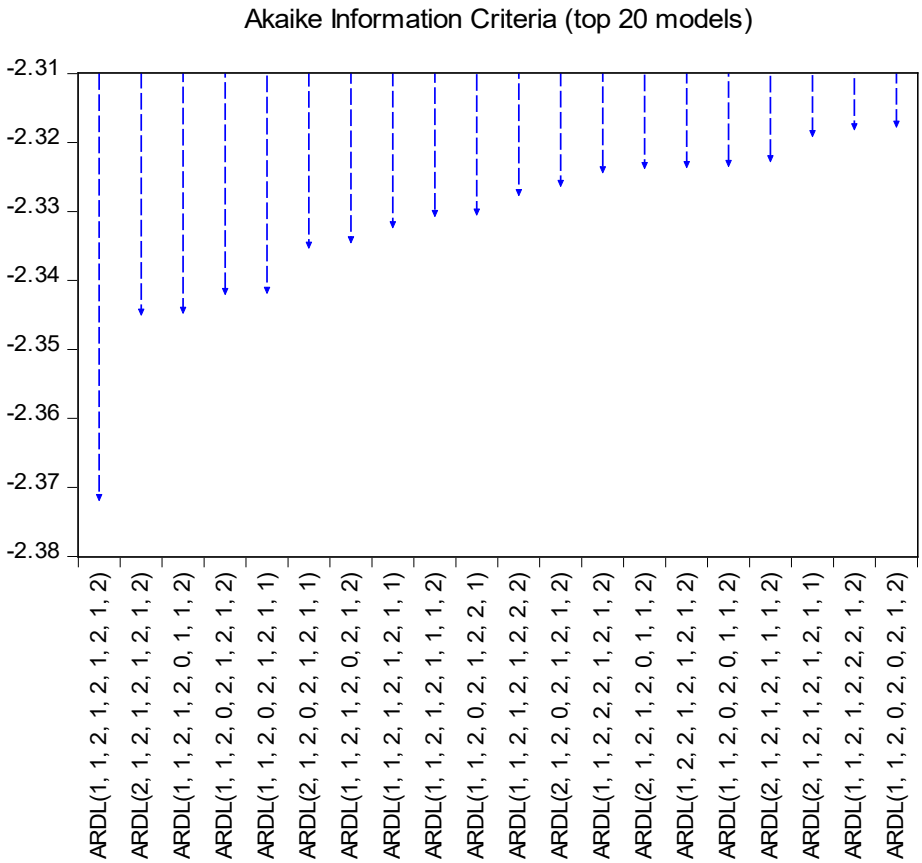
Appendix 7: Normality Test Result (Histogram) for Model Two



Series: Residuals	
Sample 1983 2019	
Observations 37	
Mean	9.63e-15
Median	0.000631
Maximum	0.112012
Minimum	-0.131083
Std. Dev.	0.052855
Skewness	-0.338724
Kurtosis	2.710105
Jarque-Bera	0.837088
Probability	0.658004

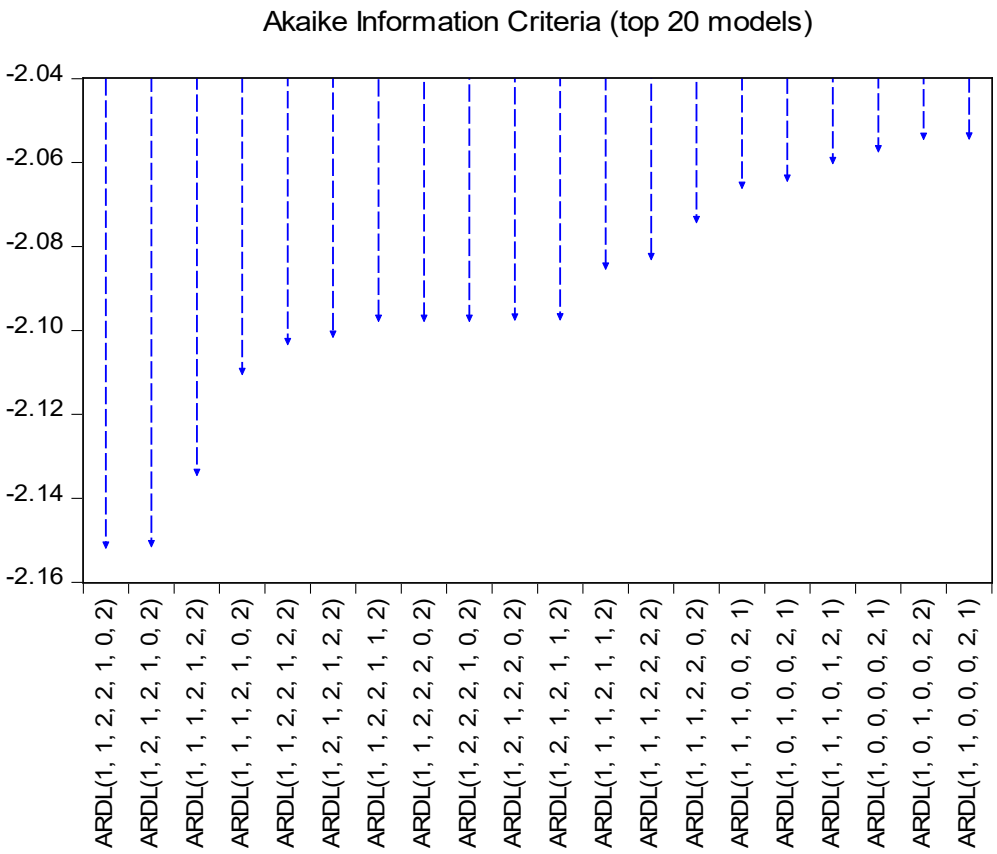
E-Views 10 Software Result

Appendix 8: Model Selection Criteria for Model One

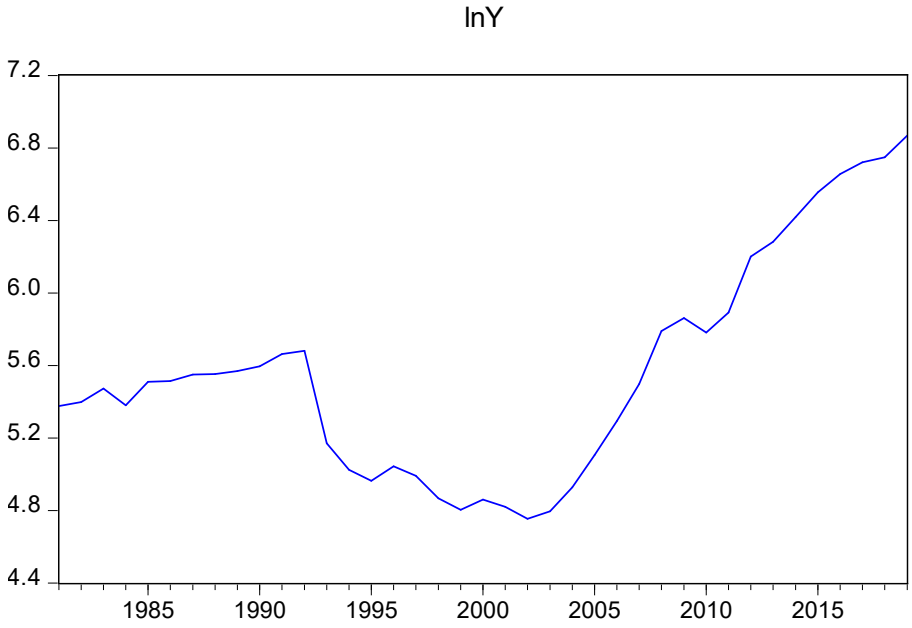


E-Views 10 Software Result

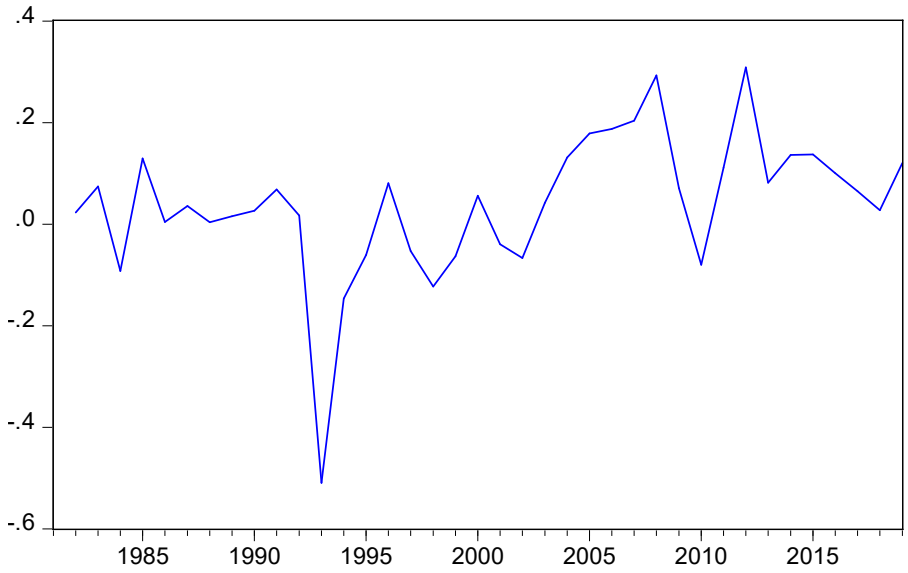
Appendix 9: Model Selection Criteria for Model Two



Appendix 10: Graphical Plots of the Variables Included in the Model both at Level and Their First Difference



DLNY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-.2
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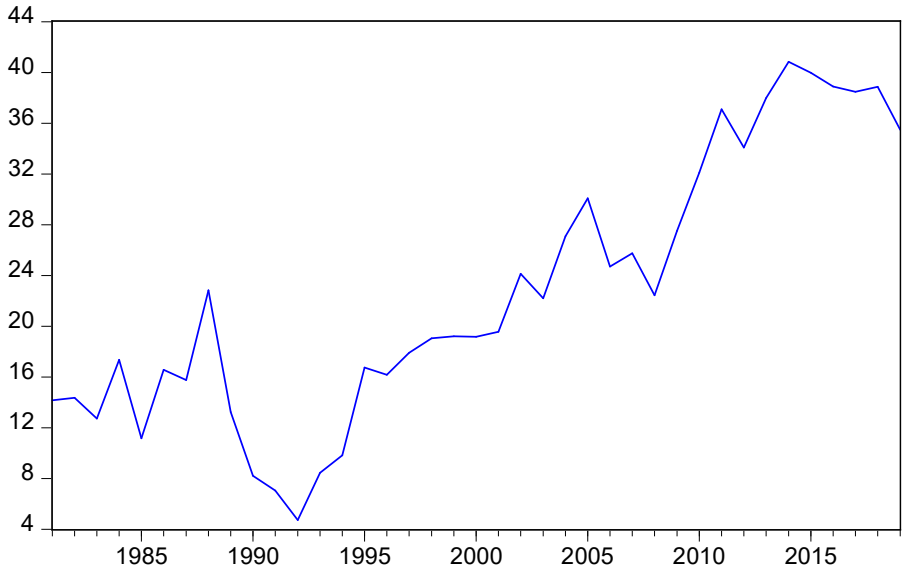
-.6
1985
1990
1995
2000
2005
2010
2015

GCF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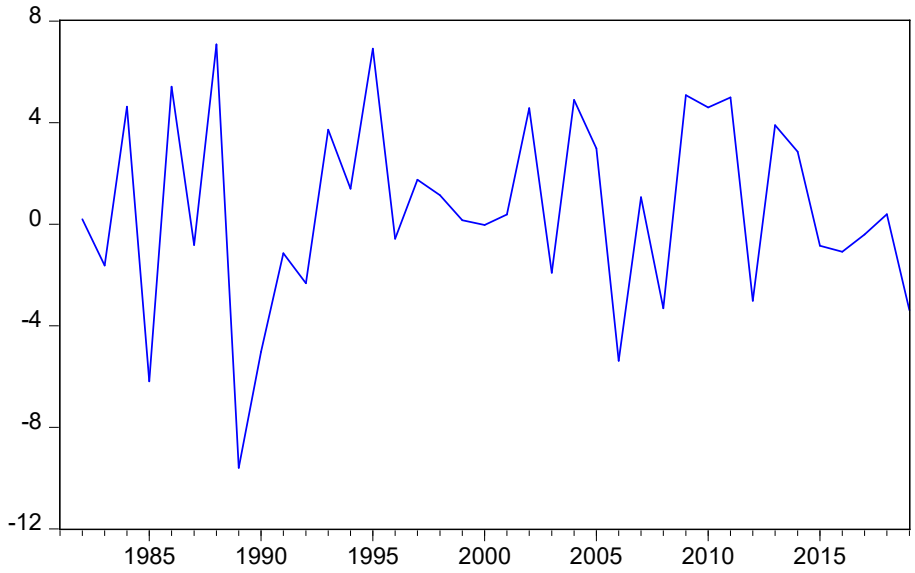
40
36
32
28
24
20
16
12
8
4
1985
1990
1995
2000
2005
2010
2015

DGCF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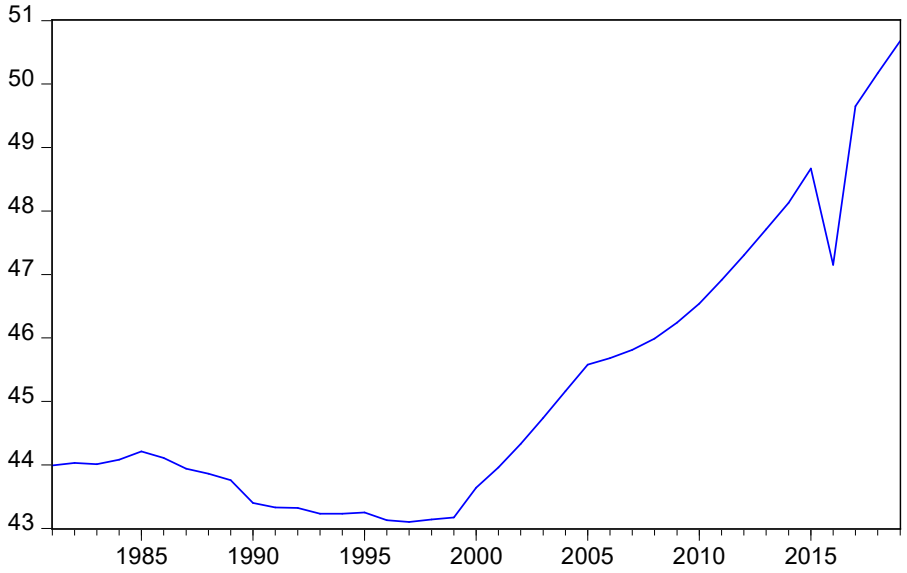
0
-4
-8
-12
1985
1990
1995
2000
2005
2010
2015

LF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50
49
48
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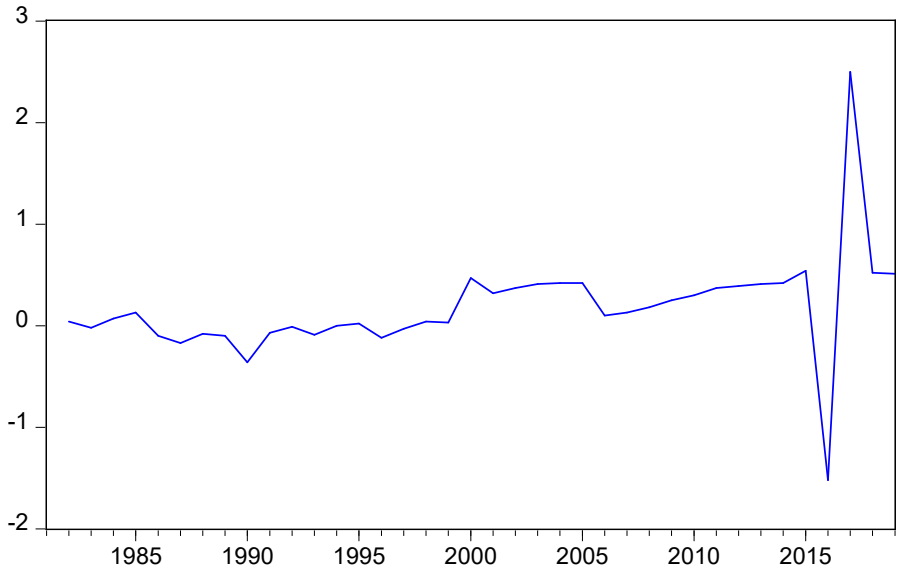
46
45
44
43
1985
1990
1995
2000
2005
2010
2015

DLF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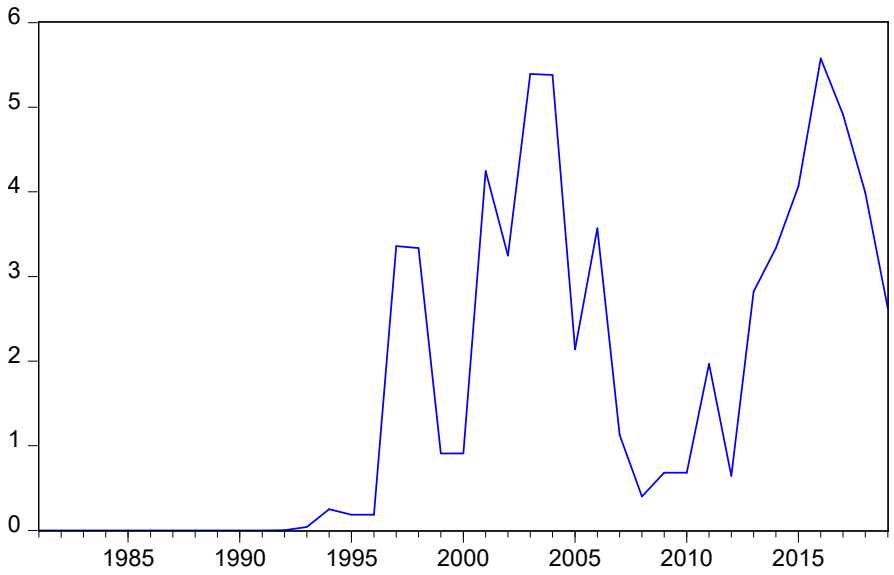
2
1
0
-1
-2
1985
1990
1995
2000
2005
2010
2015

FDI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5
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3
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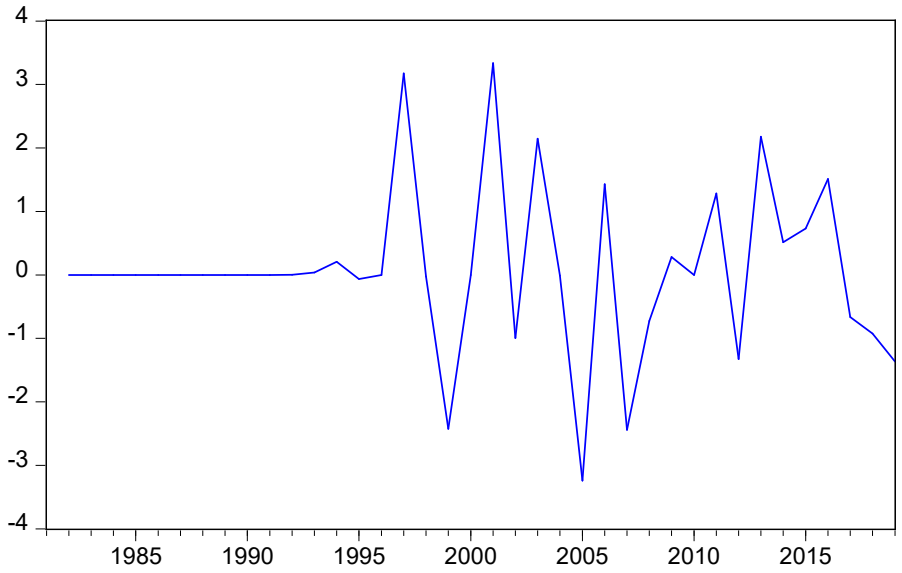
1
0
1985
1990
1995
2000
2005
2010
2015

DFDI


4
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2
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0
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-2
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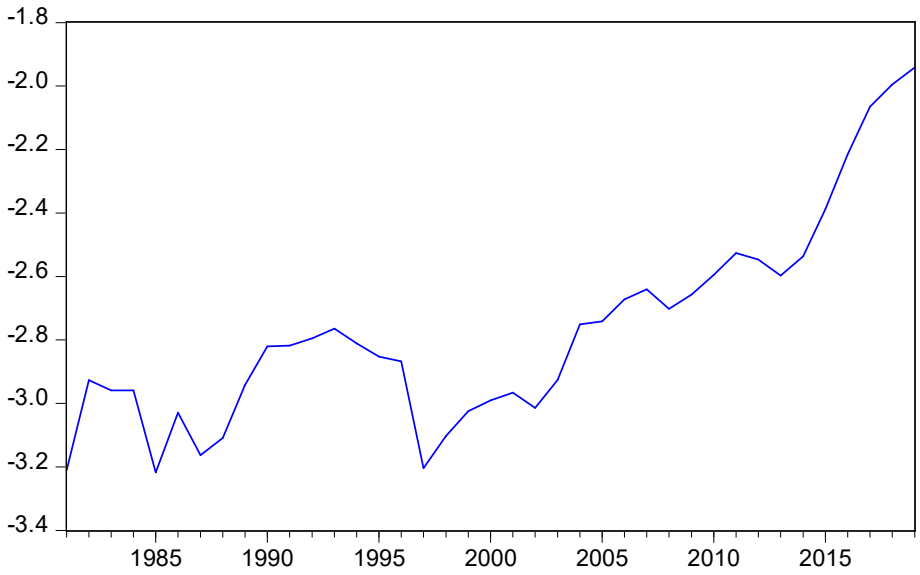
-4
1985
1990
1995
2000
2005
2010
2015

LNCO2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-2.4
-2.6
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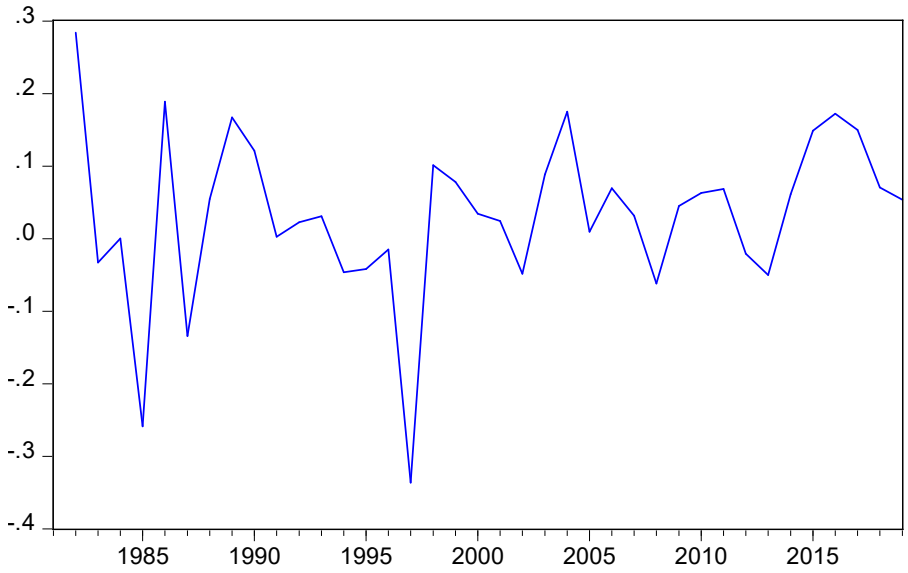
-3.0
-3.2
-3.4
1985
1990
1995
2000
2005
2010
2015

DInco2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.1
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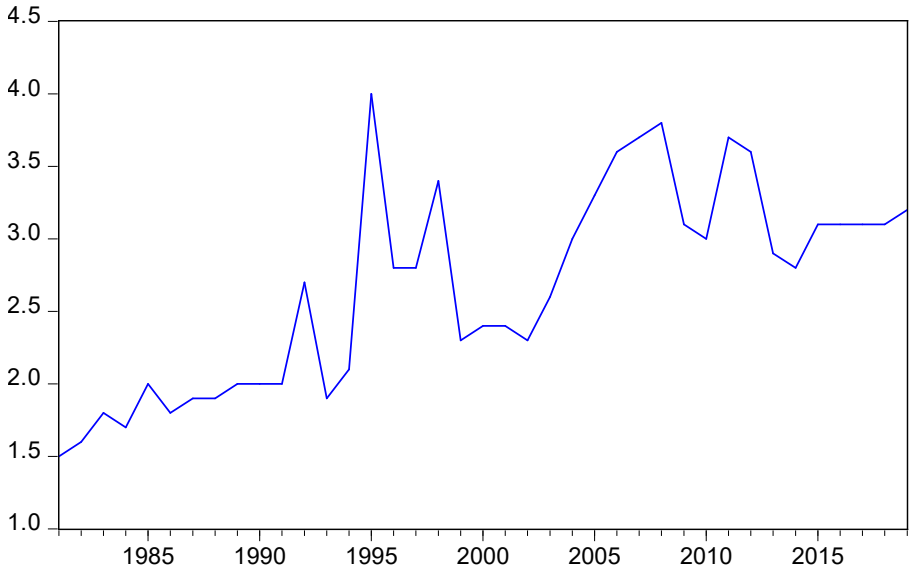
-.1
-.2
-.3
-.4
1985
1990
1995
2000
2005
2010
2015

HC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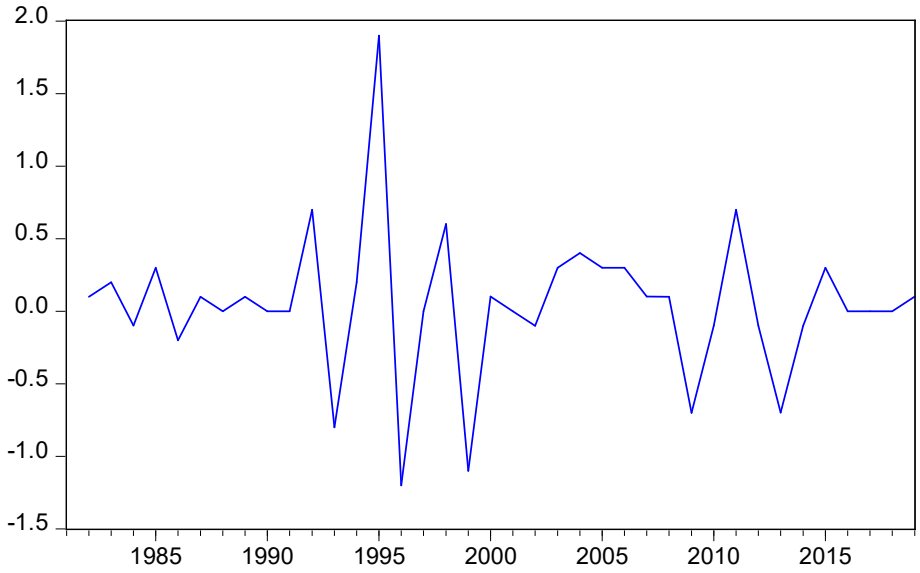
3.0
2.5
2.0
1.5
1.0
1985
1990
1995
2000
2005
2010
2015

DHC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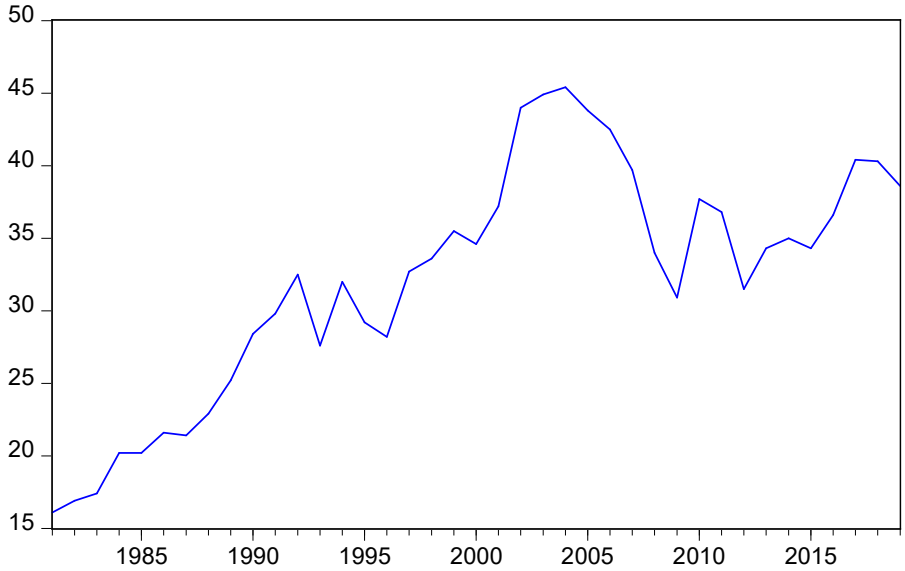
1.5
1.0
0.5
0.0
-0.5
-1.0
-1.5
1985
1990
1995
2000
2005
2010
2015

FD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30
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20
15
1985
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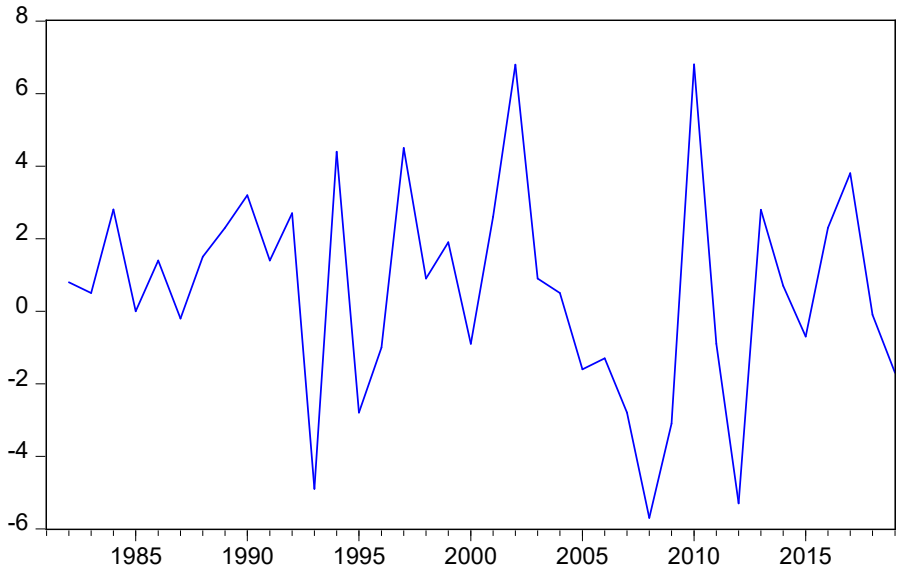
1995
2000
2005
2010
2015

DFD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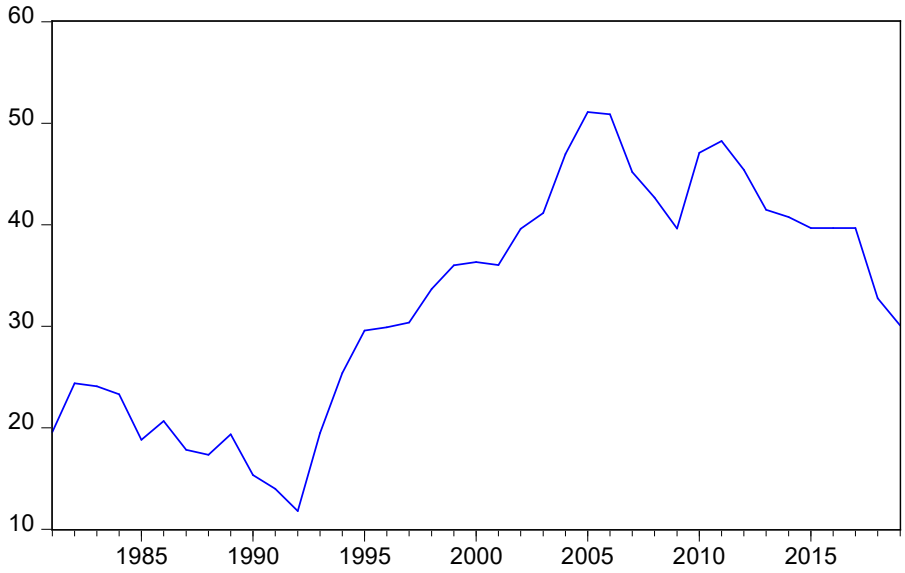
6
4
2
0
-2
-4
-6
1985
1990
1995
2000
2005
2010
2015

TRO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20
10
1985
1990
1995
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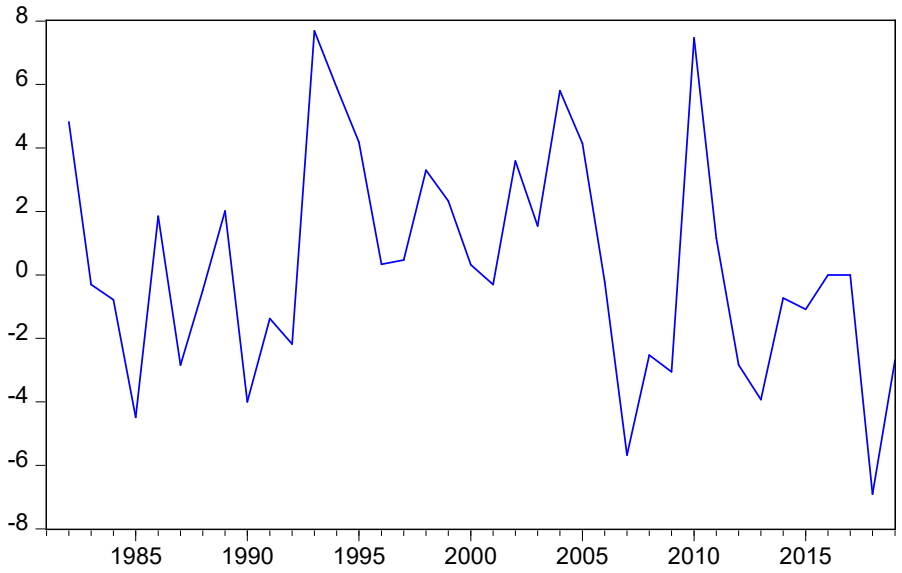
2005
2010
2015

DTRO


8
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4
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0
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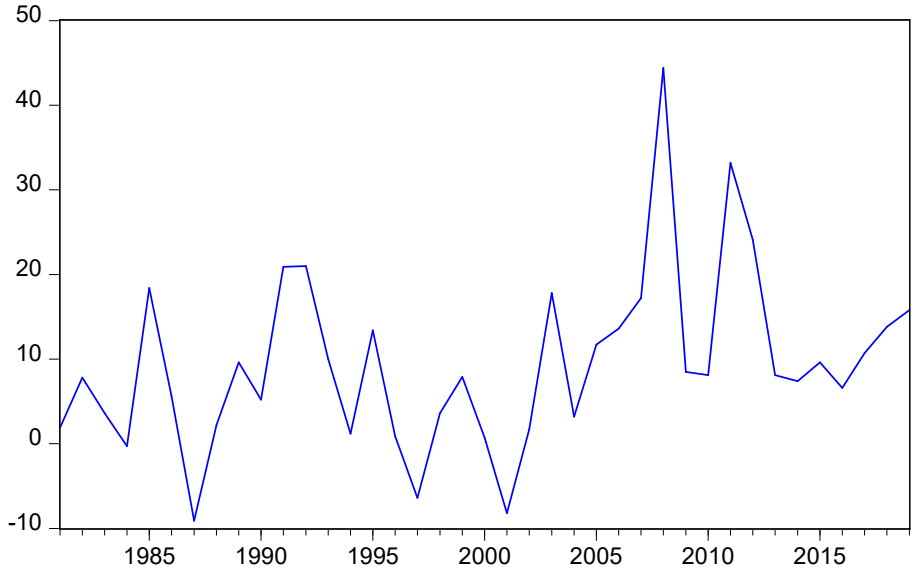
-4
-6
-8
1985
1990
1995
2000
2005
2010
2015

INF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20
10
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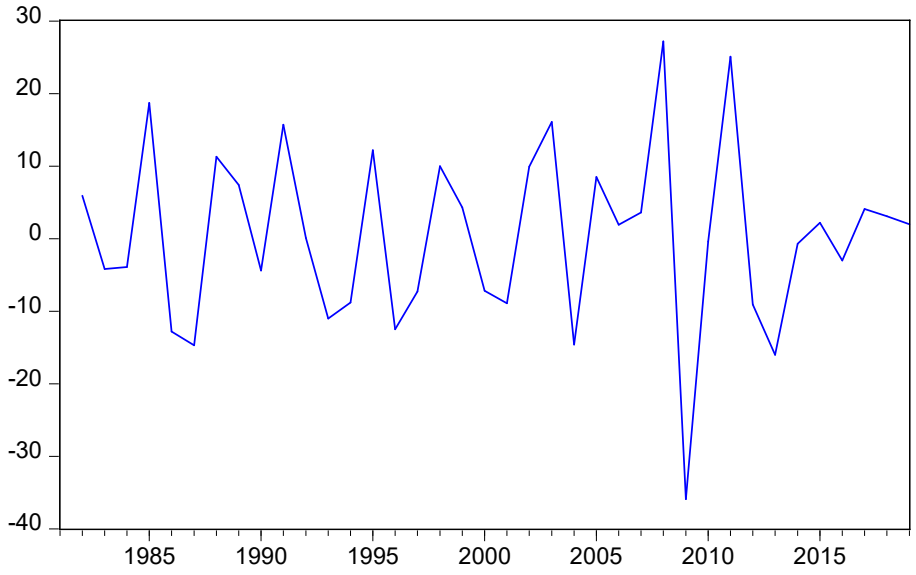
-10
1985
1990
1995
2000
2005
2010
2015

DINF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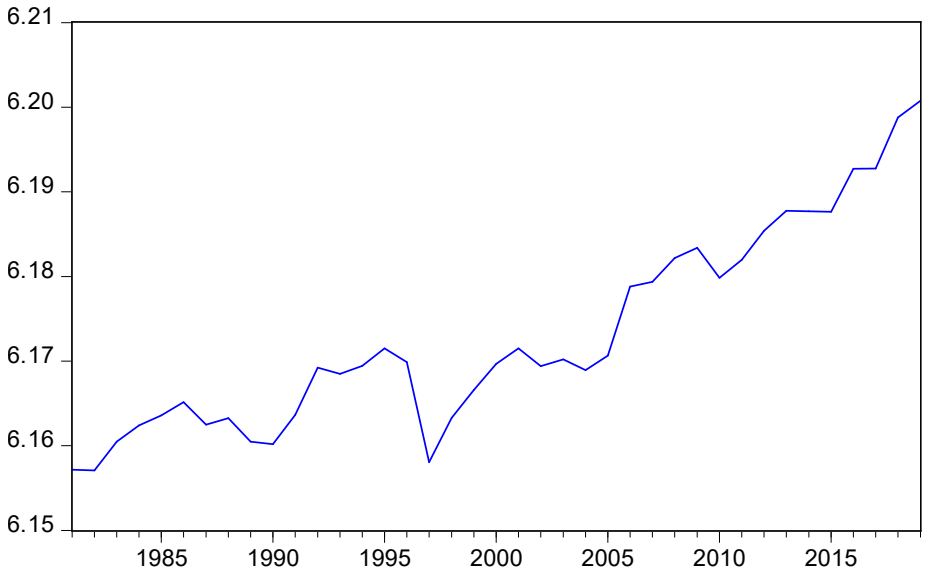
-30
-40
1985
1990
1995
2000
2005
2010
2015

lnEC


6.21
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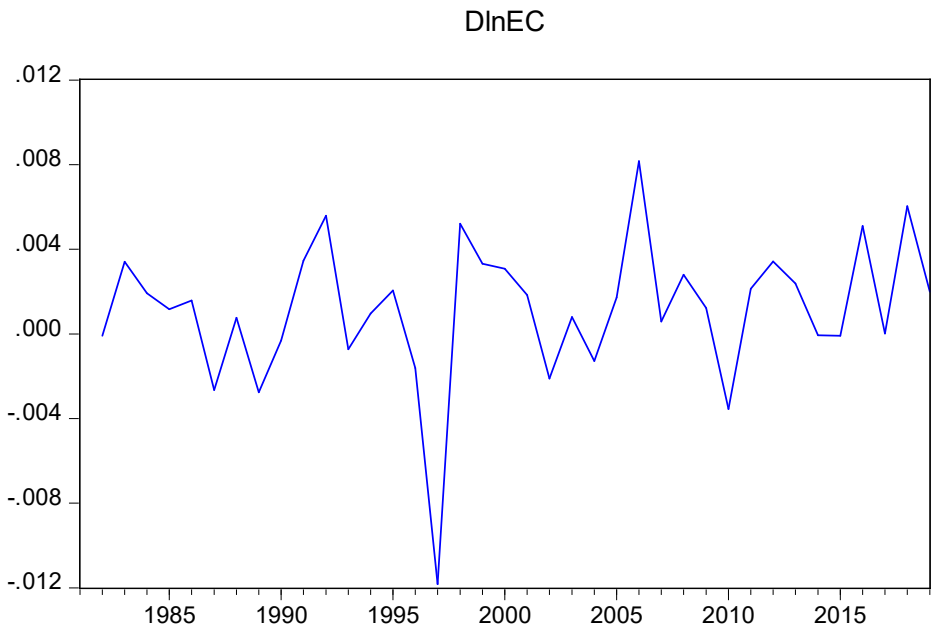
6.18
6.17
6.16
6.15
1985
1990
1995
2000
2005
2010
2015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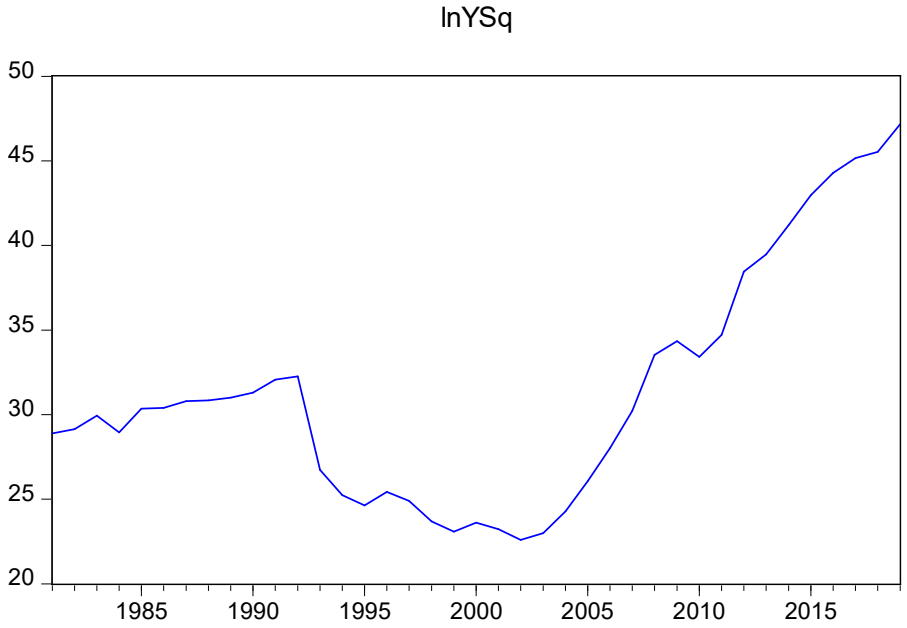
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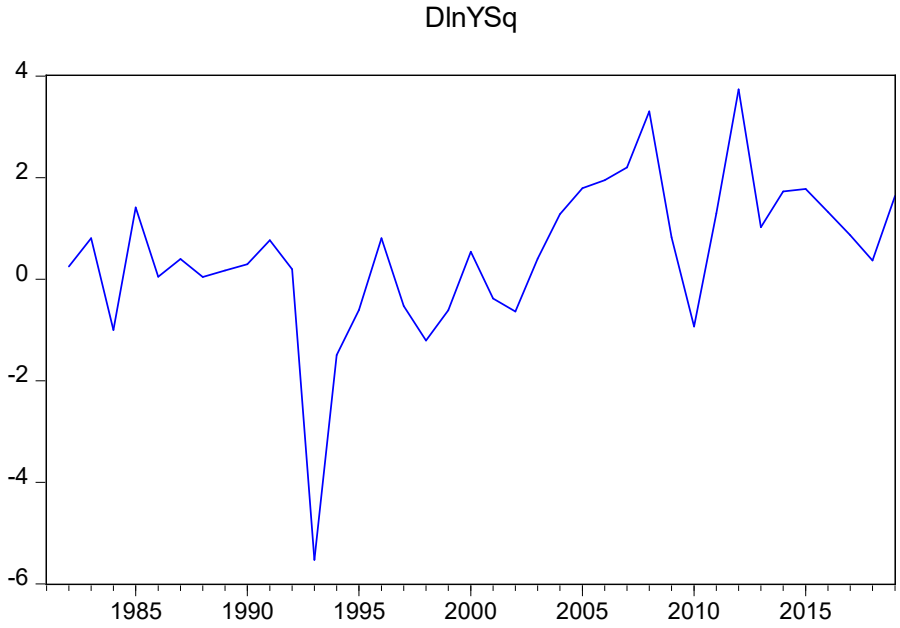
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