NEXUS BETWEEN ECONOMIC GROWTH AND ENVIRONMENTAL DEGRADATION IN PAKISTAN

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CERTIFICATE

This is to certify that this thesis entitled: **"Nexus Between Economic Growth and Environmental Degradation in Pakistan"** submitted by Mr. Yahya Khan accepted in its present form by the School of Public Policy, Pakistan Institute of Development Economics (PIDE), Islamabad as satisfying the requirements for partial fulfillment of the degree in Master of Philosophy in Environmental Economics.

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DEDICATION

This piece of research endeavor is dedicated to those daughters and sons of the soil who adhere the ideology of nationalism and to those great martyrs; the symbol of sacrifice, with the blood of whom, the life of the soil is sustained.

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Abstract

The research endeavor was aimed to investigate the existence of Environmental Kuznet curve for Pakistan over a time period of 1971 -2014. The time series covers environmental and various macroeconomic indicators such as CO_2 emission Per capita, ecological foot print consumption per capita, Real GDP per capita, energy use per capita, trade openness, FDI inflow and Urban Population. Findings of the ADF test affirmed the stationarity of all the variables at first difference. The ARDL bound test to co integration and Dynamic ECM was applied to examine the co integration relationship among variables. Findings ensured significantly positive relationship between GDP and environmental degradation in both the CO_2 and ecological models. The significantly negative impact of per capita GDP^2 on environmental degradation in both the CO_2 and ecological model confirms the validity of Environmental Kuznet curve for Pakistan. The energy consumption per capita on shows significantly positive association with CO_2 emission and ecological foot print consumption per capita both in the short run and long run implies the excessive use of non - renewable energy. Foreign direct investment have significantly positive response towards CO_2 emission and ecological foot print in the long run supporting the pollution haven hypothesis, while shows significantly positive relation with CO_2 only in the short run. Trade openness show insignificant effect on CO_2 emission, while negatively significant effect on ecological foot print both in the short run and long run. Finally, the urban Population have insignificant effect on CO_2 emission and negatively insignificant impact on ecological foot print in the long run and positively significant impact in the short run. The study recommended effective implementation of National environmental Policy, shift towards clean and green technologies through formulation of emission trading policies, sustainable agriculture practices and proper implementation of CDM and REDD+ projects to reduce deforestation and promote sustainable development.

Key words: ARDL, CO_2 emission, ecological foot print, energy consumption

I. INTRODUCTION

Over the past 100 years, several challenges and threats happened to the survival of humanity due to unusual climatic changes. The IPCC has reported that the atmospheric concentration of CO_2 has surged up by 2 parts per million (ppm) every year. Due to this unusual increase in Greenhouse Gas emissions the issue of global warming is worsening day by day (Li *et al*, 2019). The rising issue of environmental changes and anthropogenic emission made the 21^{st} century a challenging for humanity (Han, 2012). Globally, the economies are now shifting towards adoption of green technology to reduce their carbon emissions due to severe impacts of climate risks. Some studies asserts that due to rapid economic growth, developed countries will release more carbon dioxide into atmosphere. In the epoch of globalization, reduced obstructions on investment, trade liberalization as well as mobility of labour, capital and transfer of technology and rise in pollution due to high demand of non- renewable energy resources were the factors uplifted the economies of developing countries (Ahmed and Long, 2013). In this scenario the world agreed on sustained, inclusive and sustainable economic growth to promote economic growth without sacrificing the ecosystem under the Sustainable development goals through 2030.

Now to promote sustainable development, sustainable growth and sustainable environment should go side by side. In 1955, Kuznet find that income inequality have inverted U shaped association with economic growth that leads to the concept of Kuznet hypothesis. This relationship also holds between environment degradation and economic growth, which shows that in the transformation of economy from agriculture sector to industrial sector pollution level is surged up while it goes downward when the economy is shifted to services sector (Ahmed and Qazi, 2013). The existence of non- linear relationship was also confirmed between economic growth and environmental quality by Grossman and Krueger (1991) that at the beginning with enhanced production environmental pollution rises which declines after reaching a threshold point. During the earlier stages of development due to increased extraction of natural resources, high concentration of pollutants in atmosphere result in environmental deterioration and loss in human welfare despite of rise in income (Dasgupta *et al.*, 2002). However after reaching a turning point further increase in income would not occur at the cost of environment but restore the environmental quality and life standard due to luxurious life and increased investment on environment friendly technologies.

In the past several efforts have been made to check the existence of Environmental Kuznet curve relationship between growth in economy and environment. Some studies reveal that at initial stages of development, with the growth in economy the environmental quality start deteriorating but after the transition of economy into services sector environmental quality is improved (Rahman *et al.*, 2019, Nazir *et al.*, 2018, Shahbaz *et al.*, 2013, Waluyo & Teraki., 2016, Ozturk *et al.*, 2015). However the economic growth is not the only factor affecting environmental quality, the other factors affecting environmental quality includes energy consumption, trade openness, foreign direct Investment, urbanization (Haq *et al.*, 2019, Parajuli *et al.*, 2019, Poudel *et al.*, 2009, Apergis *et al.*, 2010).

1.1 Global Scenario

Due to increased globalization and integrated economies and societies, the issue of global warming is intensifying day by day (Agenor, 2003). Some recent studies described that economic growth is affected due to modification in natural environment and natural environment is in turn affected due to environmental degradation. Thus environmental degradation poses economic and social challenges to human life. Due to heavy use of Polluted technologies in the industrialized economies, increased waste and pollution affects the balance of natural resources. Due to rapid economic growth and uncontrolled population, the increased demand for energy consumption disturbs the absorption and carrying capacity of the environment (Alam *et al.*, 2007 and Lorente *et al.,* 2019). The Climate crisis is a common issue across the globe but with differentiated responsibilities for each country. In this situation it becomes the utmost responsibility of World economies to become resilient and adaptive to climatic disasters and natural calamities to meet sustainable development goal of climate change through 2030 (Mohiuddin *et al*., 2016). Through evidence it has been cleared that severe effect of pollution on human health and biodegradation that can affect the intensity and frequency of natural disasters can bring decline in economic growth.

Now the evidence shows that across the world economy is shifting towards inorganic economy, which is assumed as the main culprit behind the issue of global warming. Rise in air-water pollution, increased temperature and irregular rainfall are the signs of environmental degradation and these factors are closely associated with the rapid industrialization (Ahmad et al., 2015). According to World Bank report (2013) it is Pre-industrial era which has witnessed the rise in global temperature by about 4%. Further these studies corroborated that marine ecosystem, sea level rise, extreme heat waves and water are at severe risk in future.

Based on historical trend of carbon emission it has been reported that 79% of Annex-I (Developed) countries are held responsible for global warming. Due to relative increase in CO2 emission, Asia is leading and followed by European Union and USA, with the cumulative contribution of 88% to global greenhouse gas emissions in 2012 (EPAUS, 2016). Some countries such as USA and China are responsible for 60% of the global carbon emission. Some other countries such as India with its population approaching to 1.4 billion reported 2.5 billion tons of Carbon dioxide emission followed by 2 billion tons carbon emission in Russia having 143 million population and 1.4 billion tons of carbon emission in Japan with 127 million population, in 2013(YuSheng and khan, 2019).

According to recent studies, energy consumption globally show upward trend and since 1950 the energy consumption has surged up twice with the twice increase in per capita carbon emission. To meet the increasing demand of industrialization, the demand for energy consumption rises but the volume of nonrenewable resources is shrinking. Based on these facts, with high usage of fossil fuel the developing countries are promoting the economy at the cost of ecosystem (Shahbaz et al., 2013). Based on Kuznet curve theory, to promote the environmental sustainability the country is to become rich (Paraskevopoulos, 2009).

According to Pollution haven hypothesis those countries with comparative advantage in polluting industries exhibit the high pollution intensity and will experience high environmental degradation. While those countries that possess comparative advantage in clean industries will experience environmental improvement and relatively lesser pollution intensity. To promote sustainable low carbon development, it is necessary to enhance use of renewable energy, promote carbon trading and clean technology transfer (World Economic outlook, 2017).

1.2 Pakistan Scenario:

Any economy that promote sustainable development should give utmost importance to sustainable environment development. The manufacturing and industrial sector were recorded the major contributors towards economic growth, while these sectors also raise the demand for energy that causes environmental degradation (Shahbaz et al., 2012). Though contribution of Pakistan to global pollution was only 0.4%, while on vulnerability index it holds the 7th most Vulnerable status. The worst climate change has been recorded in Karachi due to accidental death of 1200 citizens due to heat waves (Rahman et al., 2019).

Energy sector demand is met from four major sources like oil, coal, gas, renewable energy. Based on utilization, oil consumption in transportation and Power sector is 55 and 35 percent respectively. Under the China Pakistan Economic Corridor, a huge amount of 33 billion dollars is expected to be invested on 26 energy projects. These projects include coal power plants which comprises of 69% of the energy projects and the remaining demand will be fulfilled through renewables, mostly hydropower, with smaller portions of wind and solar (GOP, 2018). Due to major contribution of coal power plants to meet the energy demand, it may cause environment degradation and will affect the environmental sustainability of Pakistan.

Now to attain the sustainable development and sustainable environment, robustness and sustainability in economy should be promoted. To meet this objective, government of Pakistan has established National Environment Policy (2005) which aims to control environmental degradation through enhance use of environment friendly practices. In Pakistan energy sector comprises of 51% greenhouse gas emission. Due to higher demand of energy consumption, the supply of energy has been surged up from 28 million tons to 68 million tons in 2014 compared with the base year 1990 at increasing rate of carbon emissions (Mohiuddin, 2016). In transport sector due to higher consumption of Petroleum, this sector has major contribution to overall carbon emission, while the consumption of gas and coal for power production increases the carbon dioxide emission upto 50%.

Now becoming one of the eleven emerging economic power, Pakistan has been marked as the 5th best market in the world and top ranking market in Asia on the basis of developed and frontier market (Neil, 2007). Due to higher GDP growth, center for global capital and investment make it an evolving leader in market (Farwa, 2016). According to statistics of government the annual GDP growth rate for fiscal year 2019 was estimated at 3.29 % against the ambitious target of 6.2% which is the aggregate of 0.85, 1.40 and 4.71 from agriculture, industrial and service sector respectively (Economic Survey of Pakistan 2018-19). Rapid urbanization has further exacerbated the issue of environmental degradation. Based on 2017 census of population, about 36.4% of the population are residing in urban areas which has placed Pakistan on the highest rank across the South Asian countries and the trend is continuously upward. (Planning commission, 2018-19).

1.3 Significance of Study:

There are large number of studies conducted on estimation of Environmental Kuznet curve relationship between growth in economy and environment degradation in different countries and regions using diverse approaches and environmental indices. In the past some studies such as Shahbaz *et al.,* (2012), Ali *et al.,* (2014) and Nazir *et al.,* (2018) were conducted to focus on Environmental Kuznet curve in Pakistan using environmental indicator and various macroeconomic indicators. However these studies have frequently used CO_2 emission as an indicator for environmental degradation. Some of the studies divulge that CO_2 emissions represent 80% of the total greenhouse gas emissions and is considered suitable indicator for environmental degradation. The recent literature claims that CO_2 emission represent only slight share of whole dynamic changes in environment, while ecological foot print (EFP) presents anthropogenic pressure on environment, that's why it is considered the most suitable indicator for environmental damages (Ozturk *et al.,* 2016, Ulucak and Bilgili, 2018). Based on the brief review of literature, not a single study has considered the ecological foot print as an indicator for environmental degradation within the framework of environmental Kuznet curve in Pakistan. To cover the existing gap in the literature, the endeavor of this study aims to ensure the validity of environmental Kuznet curve by comparing the two environmental indicators such as Co_2 emission and ecological foot print. As Climate crisis is one of the main concern of global atmospheric changes affecting agriculture, forestry, and socio economic welfare of human being. The single country analysis of environmental Kuznet curve are very effective in formulation of effective policies for sustainable development. In the past, the bivariate model was frequently used to examine the environment and growth nexus. However, this study used a single model to critically examine the environment growth nexus for Pakistan. This study is of immense importance by contributing the variable of ecological foot print to the growth and environment literature of Pakistan which is the most widely used measure by policy makers to evaluate the ecological performance. This study also contributed two new variables such as FDI and Urbanization to the growth – environment and energy literature of Pakistan. The combine effect of per capita energy use, foreign trade, FDI and urbanization on environment will provide inclusive and positive insight for Policy makers to formulate an effective policy that promote economic growth without sacrificing environment.

1.4 Objectives of the Study:

1. To examine the non- linear relationship between economic growth and environmental degradation.
2. To study the impact of Per capita energy consumption, trade openness, urban Population, foreign direct investment on CO_2 emission.
3. To study the impact of Per capita energy consumption, trade openness, urban Population, foreign direct investment on ecological foot print consumption.

1.5 Research Questions:

1. Is Environmental Kuznet Curve exist for Pakistan based on environment-growth Nexus?
2. Are the joint impact of Per capita energy consumption, trade openness, urbanization and FDI inflow effect CO2 emission positively or negatively?
3. Are the joint impact of Per capita energy consumption, trade openness, urbanization and FDI inflow effect ecological foot print consumption positively or negatively?

II. Review of literature

Literature review play a significant role in providing background to any research issue. Review of literature helps in developing knowledge and understanding of major objectives. Through brief review of literature research gap is easily identified. In this study review of literature is further sub-divided into four parts i-e section 2.1 presents review of studies related with economic growth and environmental degradation. Section 2.2 highlight studies on EKC and its validity for Pakistan. Section 2.3 discusses the literature covering the impact of FDI on CO_2 emission. Section 2.4 illustrates the studies focusing on impact of energy consumption on CO_2 emission. Section 2.5 presents the studies focusing on impact of Trade openness on CO_2 emission. Section 2.6 illustrates the studies focusing on impact of urban population on CO_2 emission. Section 2.7 covers the studies focusing on impact of other factors on ecological foot print.

2.1 Economic growth and Environmental degradation:

Haq et al. (2019) studied the growth- environment nexus to check the validity of Environmental Kuznet Curve for South Asian economies for time Period of 1990-2015 through an application of Panel ARDL approach. Findings Confirmed Kuznet curve for south Asian countries with significantly positive impact of GDP and negatively significant effect of square term of GDP on environmental degradation. The estimated turning point for south Asian economies were USD 921.1, beyond which there occur decline in carbon emission. Dispirited

Rafindadi and Usman (2019) investigated the validity of environmental Kuznet curve for South Africa though an association between economic growth and environmental quality using CO_2 as an indicator for environment during the period of 1970 - 2011. The significantly positive value of per capita income and significantly negative impact of its square term ensures the existence of environmental Kuznet curve for South Africa.

Lorente et al. (2019) assessed agriculture induced environmental Kuznet curve validity for BRICS countries using panel data over a period of 1990-2014 using fully modified and dynamic ordinary least square estimation technique. Both the FMOLS and DOLS confirmed the existence of environmental Kuznet curve for BRICS with significantly positive effect of GDP and negative effect of its square term on Carbon emission.

Rahman (2019) used Cobb – Douglas function to examine the association among per capita CO_2 emission as an environmental indicator, GDP growth, energy use, financial development, trade to GDP ratio and urbanization in Turkey. The ARDL model was used to analyze the co integration relation among variables. The significantly positive value of GDP and negative value of square terms of GDP confirms the validity of EKC for turkey.

Alexendra et al. (2017) examined the N shaped environmental Kuznet curve for 74 economies using panel series over a period of 1994-2012. The Pooled OLS regression ensured the validity of N shaped environmental Kuznet in lower middle income countries and high income countries, but no significant relationship was found for upper middle income countries. Also no significant relationship was found through FEM and quantile regression confirms N shaped Environmental Kuznet curve for some of the quantiles due to heterogeneity in various income groups.

Waluyo and Teraki (2016) applied ARDL approach to investigate the long run relationship in Indonesia between growth in income per capita and deforestation over period of 1962-2007. The model also taken into consideration the impact of rural population density, agriculture indicators and round wood production on deforestation. Finding revealed significantly positive impact of GDP and significantly negative impact of Square term of GDP in short and long run which confirms the validity of environmental Kuznet curve for Indonesia.

Mrabat and Alsamara (2016) studied the environment growth nexus using CO_2 and Ecological foot print both as a proxy for environmental degradation over a time period of 1980-2011 through an application of ARDL with unknown structural breaks. The negative value of GDP and positive value of its square term shows that EKC is invalid for Qatar using CO_2 as an environmental indicator while it becomes valid when ecological foot print is taken as a proxy for environmental degradation based on positive value of real GDP and negative value of square term of real GDP.

Hervieux and Darne (2015) investigated environmental Kuznet curve hypothesis for seven Latin American countries using ecological foot print as an indicator of environmental degradation by employing Johanson cointegration approach. Data covers the time period of 1967-2007. Results corroborated that EKC was not supported for Latin American countries except Chile and Uruguay that shows negative value of square term of GDP.

Asici and Acar (2015) applied fixed effect Model to analyze inverted U shaped relationship between Ecological foot print using domestic production foot print and import foot print as an indicators for environmental degradation and economic growth for 116. The Panel series covers the time period of 1961-2008. The significantly positive value of GDP and significantly negative value of square term of GDP confirms the EKC for these countries.

Ozturk et al. (2015) investigated the validity of Environmental Kuznet curve through an association between ecological foot print and GDP from tourism by extending the model to examine the impact of other factors such as openness of trade, urban population, use of energy, using system panel generalized method of moment regression technique. The generalized method of moment confirmed the existence of environmental Kuznet curve for countries in the range of upper middle income and high income compared to lower income and low middle income countries.

Lapinskiene et al. (2013) studied the environmental Kuznet curve relationship between greenhouse gases and GDP for Baltic States over the time period of 1995-2008. Results confirmed the validity of non - linear relationship through significantly positive impact of per capita real income and its square term on greenhouse gases.

Tsiantkioudis et al. (2019) checked the validity of environmental Kuznet curve for Bulgaria using Carbon emission from deforestation as dependent variable through an application of ARDL approach. The data over a time period of 1990-2014 was attained from the secondary sources. Results affirmed the validity of inverted N shaped EKC for Bulgaria with again increase in environmental degradation beyond the second turning point both in the short and long run.

To et al., (2019) applied FMOLS and DOLS methods in order to examine the Panel cointegration relationship between growth in income and Carbon dioxide emission in a framework of N shaped EKC for 25 ASIAN countries using Panel data over a time period of 1980 – 2016. Findings confirmed the existence of N shaped Environmental Kuznet curve for a region due to negative, positive and negative sign of per capita GDP and its square and cubic term.

Gokmenaglu and Tespinar (2018) Check the existence of agriculture induced environmental Kuznet curve using Carbon dioxide as a proxy for environmental degradation and GDP, use energy per person, agriculture value added by each worker as an independent variable using fully modified ordinary least square method (FMOLS). The data set covers the time period of 1971-2014. The findings reveals the existence of environmental Kuznet curve due to negative sign of square term of GDP.

Wang et al. (2013) using spatial econometric approach investigated the environmental Kuznet curve for ecological foot print across the globe over a panel of 150 countries. As this approach violates the assumption of independently distributed error of linear regression techniques. However, findings does not ensure the existence of environmental Kuznet curve relationship between GDP, square term of GDP and ecological foot print of at national level.

Seetanah et al. (2018) checked the validity of environmental Kuznet curve for a panel of twelve small island countries using panel vector autoregressive model technique. The study covers the time period of 2000-2016. Finding shows significantly negative sign of square term of GDP that ensured the validity of environmental Kuznet curve.

Koilo (2019) made an attempt to check the existence of environmental Kuznet curve considering the opportunity of fourth industrial revolution for emerging economies by applying the log- linear quadratic regression. The study covers the time period of 1990-2014. Findings shows the significantly positive sign of GDP and significantly negative impact of square term of GDP on CO_2 emission. This negative sign of square term of GDP ensures the existence of environmental Kuznet curve hypothesis for eastern European and Central Asian Countries.

Ugur and Gultekin (2018) examined the existence of environmental Kuznet curve for Turkey using Carbon dioxide emission per capita as a proxy for environment quality.

Cointegration techniques of FMOLS, DOLS and CCR were utilized to estimate the relationship between variables. Findings support the validity of environmental Kuznet curve for Turkey due to significantly negative impact of GDP per capita on CO2 emission in turkey.

2.2 EKC and Pakistan:

Haq et al. (2019) studied the growth- environment nexus to check the validity of Environmental Kuznet Curve for South Asian economies for time Period of 1990-2015 through an application of Panel ARDL approach. Findings Confirmed Kuznet curve for south Asian countries with significantly positive impact of GDP and negatively significant effect of square term of GDP on environmental degradation. The estimated turning point for south Asian economies were USD 921.1, beyond which there occur decline in carbon emission with further increase in GDP per capita.

Rahman et al. (2019) applied an ARDL model to study the role of financial development as a moderator in the framework of Environmental Kuznet Curve over a period of 1970-2016. When interaction term was not added, the significantly positive impact of income and significantly negative relation of its square term with carbon emission affirms the validity of EKC for Pakistan. After the interaction term was added, the non- linear relation between carbon emission and growth in income becomes discontinued due to moderating role of financial development.

Nazir et al. (2018) studied the association between various macroeconomic indicators mainly per capita income, openness of trade, financial development and FDI for a time period of 1970-2016. The positively significant effect of growth in GDP per person and negative impact of square of GDP support validity of EKC for Pakistan in the long run and short run respectively.

Ali et al. (2017) conducted an empirical study to check the validity of Environmental Kuznet curve in relation to green revolution by considering growth in agriculture as a proxy for economic growth. Data covers time period of 1960-1990. Results indicates insignificant relationship between agriculture growth and its square term with carbon emission (no tradeoff) in long run as well as short run and confirms that Environmental Kuznet curve does not exist for Pakistan.

Ali et al. (2014) examined the long run relationship between environmental degradation and per capita GDP by incorporating the impact of energy consumption and population density over period of 1970-2011 using ARDL approach. Findings show that EKC is valid for Pakistan due to Positive effect of GDP per capita and negative impact of its square term on environment degradation in the long run. The turning point in Pakistan was USD 338.34 beyond which further increase in economic growth result in environment improvement.

Shahbaz et al. (2012) used bound testing ARDL approach to examine the relationship between carbon dioxide and economic growth by extending the relationship to include other factors such as energy use per capita and openness of trade over period of 1971-2009. The significantly positive impact of GDP and negative effect of GDP square confirmed the validity of Environmental Kuznet curve relationship in Pakistan.

Nasir and Rehman (2011) checked an inverted U shaped association between carbon emission, and growth in income per capita, over a period of 1972-2008 using Johanson cointegration and VECM. Findings ensured the existence of Kuznet curve for Pakistan based on the significantly positive effect of per capita income and its square term. Furthermore, environmental Kuznet curve is invalid in the short run for Pakistan due to insignificant relation among carbon emission and per capita income.

Ahmed et al. (2014) investigated the validity of environmental Kuznet curve for Pakistan using deforestation as a dependent variable and GDP, energy use, and openness of trade as an independent variable. Time series covered the period of 1980-2013. The findings of ARDL bound test confirmed the validity of Environmental Kuznet curve for Pakistan based on positive and negative elasticity coefficients of GDP and its square term. Ahmed and long (2012) studied growth environment nexus in Pakistan using ARDL bound testing approach by including the impact of consumption of energy, openness of trade and population growth. The annual data covers the time period of 1971-2008. Findings corroborated the negative effect of GDP square on environmental quality that validate the environmental Kuznet curve for Pakistan in the long run and short run effectively.

Shahbaz et al., (2015) studied non- linear of economic growth on CO2 emission in Portugal using ARDL approach for cointegration over a period of 1971-2008. Finding shows that the significantly positive impact of GDP and significantly negative effect of square term of GDP on carbon emission support the inverted ∩ shaped Kuznet curve for Portugal.

Nisar et al., (2017) studied the growth- environment nexus in Pakistan to check the validity of environmental Kuznet curve over a time period of 1976-2013. The ARDL bound test of cointegration was applied to check the co integration relationship among variables. Finding show the positively significant impact of GDP and negatively significant effect of GDP^2 which supports the hypothesis of environmental Kuznet curve for Pakistan.

2.3 FDI and CO2 emission:

Foreign direct investment play a vital role in promoting the fragile economies of developing nations towards development. It helps in creating the opportunity of employment, enhanced production capacity and assist in the technological transformation. However, along with the growth in economy the environmental sustainability is necessary. FDI effects the economy either positively or negatively. If the increased FDI bring the clean technology to the country, it promotes the environmental sustainability otherwise it can further worsens the issue of environmental degradation.

Seetanah et al., (2018) analyzed the effect of foreign direct investment on CO_2 emission over a time period of 2000-2016 using Johanson co- integration test and vector panel auto regressive technique. Findings of the study ensured the significantly negative effect of FDI on CO_2 emission per capita of small island countries. This means that one percent increase in FDI inflow to the country reduces the carbon dioxide emission by 0.16 percent. Similarly the Koilo (2019) studied the impact of FDI on CO_2 emission unleashing opportunities of fourth industrial revolution for newly emerging economies of central Asia and eastern European countries through an application of log linear quadratic regression. The findings revealed the negative impact of FDI inflow on CO_2 emission in the newly emerging economies of central Asia and eastern European countries. If the foreign direct investment increases by one percent then CO_2 emission reduces by 0.12 percent. These findings shows that foreign direct investment in those countries involve the transfer of environmental friendly technologies.

To study the impact of FDI inflow on CO_2 emission in ASEAN countries, a study conducted by Ilham (2018) investigated the impact of FDI inflow on environment using simultaneous equation Model over a time period of 2004-2013. Findings of the study corroborates the significantly positive effect of FDI inflow on CO_2 emission in ASEAN countries. This shows that by increasing the FDI inflow by one percent will increase the level of CO_2 emission by 0.029 percent. Another study conducted by To et al., (2019) employed FMOLS and DOLS to check the long run association between FDI net inflow and per capita CO_2 emission over a time period of 1980-2016. Findings of Augmented Dickey Fuller and Phillips Perron tests confirm the stationarity of the variables at Ist difference. The significantly positive impact of FDI with its elasticity value of 0.57 shows that by increasing the FDI by one percent will increase the level of CO_2 emission by 0.57 percent. However, significantly negative impact of its square term shows that the relation between FDI and CO2 emission confirm the pattern of EKC.

The above literature shows that foreign direct investment was deteriorating the issue of environmental degradation. To promote the environment sustainability, these countries require appropriate environment policies that ensures the transfer of clean and green technologies to the country through foreign direct investment to promote vision of sustainable development.

2.4 Energy consumption and CO2 emission:

Developing economies are highly dependent upon the intensive use of energy consumption. To meet the rising demand of industrialization, the requirement of energy are surging upward but the volume of non – renewable energy resources are shrinking intensively.

The economy of South Africa is one of the leading economic productive system in the African region. To check whether in the epoch of globalization the development in the economy is intensifying the issue of environmental degradation or bringing ease in the level of CO_2 emission. Rafindadi and Usman (2019) studied the dynamic relationship of energy use with carbon dioxide emission over time period of 1970-2014 in South Africa using Maki Cointegration test which incorporate structural break into FMOLS and CCR to check the co integration relation among variables. The short run relationship is examined through an application of Error correctional Model. Both the model ensures the significantly positive effect of energy consumption on CO_2 emission i-e by increasing the energy use by one percent will increase the level of CO_2 emission by 0.90 percent. Error correction model also indicates significantly positive effect of energy use on CO_2 emission. The findings of Innovation accounting test reveals that high pace of globalization and CO_2 emission occurred due to intensive use of energy. The intensive use of non- renewable energy increases with the increasing level of carbon dioxide emission. The positively significant impact of energy consumption was found in eight ASEAN countries by Ilham (2018) through an application of simultaneous equation model. His findings shows that by increasing the energy consumption by one percent will increase the CO_2 emission by 0.55 percent. To minimize this adverse effect of energy consumption on the level of CO_2 emission in ASEAN, these countries need a shift from the non- renewable energy resources towards the renewable energy consumption to promote the environmental sustainability.

To study the impact of energy consumption on CO_2 emission in South Asian economies that are highly dependent on energy resources as an engine of economic growth. The study conducted by Haq et al. (2019) reveals the significantly positive effect of energy consumption on the CO_2 emission level of south Asian economies i-e by increasing the energy consumption by one percent will increase the CO_2 emission by 3.18 percent. To promote the sustainable environment, the shift from fossil fuels towards renewable energy resources is required that will promote the sustained growth in the economy side by side with the sustainable environment. Similarly the study conducted by Lorente et al. (2019) checked the association of electricity use and CO_2 emission for BRICS countries using FMOLS and DOLS technique. The findings of study ensures that by increasing the electricity use by one percent will increase the CO_2 emission by 0.0017 percent in the BRICS countries. To minimize the issue of environmental degradation, these economies need clean energy resources such as solar energy consumption.

Rahman et al. (2019) analyzed the response of CO_2 emission towards energy use per capita over a period of 1970-2016 using auto regressive distributed lag model (ARDL). Results divulge the significantly positive association of CO_2 with energy consumption in the absence of interaction term. By increasing the energy consumption by one percent the atmospheric concentration of carbon dioxide will be increased by 0.028 percent. After the interaction term was added, energy consumption shows no significant relation with the CO_2 emission. The renewable energy play a vital role in reducing the level of CO_2 emission promoting the vision of clean energy consumption as an environment friendly practice. To study the impact of renewable energy consumption on CO_2 emission, Waheed et al. (2017) studied the affiliation of CO_2 emission and renewable energy consumption in Pakistan through an application of ARDL approach. Their findings ensure the negative association between renewable energy resources and CO_2 emission.

The intensive use of energy promote the growth in economy at the cost of environmental degradation. The association between electricity consumption and CO_2 emission was studied by Rahman (2019) applying the ARDL approach. Findings assures the significantly positive effect of energy use on CO_2 emission in Turkey. It shows that by increasing the energy consumption by 1 percent the level of CO_2 emission will increase by 0.52 percent. The impact of renewable energy consumption on Carbon dioxide emission was studied by the Alexendra et al. (2017) for 74 economies comprising of lower middle income, upper middle income and high income countries within the framework of N shaped environmental Kuznet curve. Their findings shows negative relationship between renewable energy consumption and CO_2 emission i-e one percent increase in renewable energy consumption reduces the Carbon dioxide emission by.

The excessive demand of energy for industries promote the growth in the economy of the country at the cost of environmentally unsound practices. Mohiuddin et al. (2016) checked the impact of energy consumption on carbon dioxide emission in Pakistan over a time period of 1971-2013 using ARDL approach. Findings of the study assures the positive association between energy consumption and carbon dioxide emission. The increase in energy consumption by one percent triggers the level of CO_2 emission by percent. Pakistan is a developing countries and is highly dependent upon the non - renewable energy resources such as Coal. Fuel and gas. These sources of energy add high concentration of carbon dioxide to the atmosphere. Ali et al. (2014) made an effort to study the relationship between energy consumption and carbon dioxide emission using ARDL approach. Results ensures that one percent increase in energy consumption per capita worsens the atmospheric concentration of CO_2 by percent.

Pakistan economy has shown tremendous growth after 2000, but the growth in economy was occurred at the cost of environment due to excessive use of energy which has added high pollution in the form of greenhouse gases. Shahbaz et al. (2012) studied association between CO_2 emission and energy consumption using ARDL and VECM over the period of 1971-2009 in Pakistan. Findings reveals that one percent increase in energy consumption rises the level of CO_2 emission by 0.86 percent. Similarly Ahmed and long (2012) studied the association among per capita energy use and environmental quality using ARDL approach for co integration. The study shows that one percent increase in the energy consumption surge up the level of CO_2 emission by 1.272 percent.

2.5 Trade openness and CO2 emission:

Trade openness comprises of both the exports and imports of the country. Trade openness is a key enabler of growth in the economy and provide employment opportunities, enhanced production and innovation in the country. Though openness of trade work as a growth accelerator but poses several challenges to the environment of most of the economies. The previous literature shows Positive as well as negative impact of foreign trade on environment.

Trade openness shows positively insignificant relationship with the CO_2 emission as reported by the study conducted by Ahmed et al. (2015). But the positive sign indicates that one percent increase in trade openness worsens the level of CO_2 emission by percent. Likewise the study conducted in BRICS countries by Lorente et al. (2019) assessed the impact of Trade openness on carbon emission for BRICS countries over a time period of 1990-2014 through an application of FMOLS and DOLS. Results affirmed the positive association of trade openness with CO_2 emission for BRICS countries. The increase in trade openness by one percent increases the CO_2 emission by 0.023 percent.

Trade openness may have negative impact on environment through a transfer of clean and green technology to the countries. To check the association between the trade openness and CO_2 emission, Shahbaz et al. (2012) studied association between CO_2 emission trade openness using ARDL and VECM over the period of 1971-2009 in Pakistan. Findings of his study ensured the negatively significant effect of trade openness on the CO_2 emission in Pakistan in the long run, while insignificant effect was recorded in the short run. This means that by increase of one percent in the foreign trade the level of CO_2 emission declines by 0.08 percent. Trade openness have significantly negative effect on deforestation as reported by the study conducted by Ahmed et al. (2014) using the ARDL approach of co integration. This study shows that by increasing the trade openness by one percent will reduce the pace of deforestation by 0.07 percent.

Trade openness also have significantly positive effect on the CO_2 emission level through a transfer of dirty technologies in the country. The significantly positive association exist between trade openness was reported by the study conducted by Nasir and Rehman (2011) for Pakistan. This study shows that by increasing trade openness by one percent will improve the level of CO_2 emission by 0.54 percent. Trade openness shows significantly positive impact on CO_2 emission in Pakistan revealed by a study conducted by Ahmad and Long (2012) using ARDL approach of co integration. This shows that by increasing the trade openness by one percent will increase the level of CO_2 emission by 0.10 percent. From these studies, it is evident that trade policy of Pakistan are not emphasizing on the shift of clean technologies to promote the vision of sustainable development. Likewise, the study conducted by Shahbaz et al. (2015) found the positively insignificant impact of trade openness on CO_2 emission in Pakistan. Though its effect was insignificant but the positive sign ensures that trade openness contribute to the increased level of CO_2 emission in Pakistan.

From the above literature, it is clear that trade openness needs a technological shift from dirty technologies to environmental friendly technologies. Such a technological shift will enhance the productive capacity of a countries and will promote the vision of sustainable development.

2.6 Urbanization and CO2 emission:

The uncontrolled urbanization and hasty exit from rural to urban areas exacerbating the issue of environmental degradation due to lack of smart policies for sustainable urban development. The increasing rate of urbanization is associated with many problems like land insecurity, unbalanced natural resources and excessive air pollution.

The high pace of urbanization contributing to the increased level of CO_2 emission in most of the countries. Rahman (2019) made an attempt to check the long run association between CO_2 emission and urban population in Turkey. Findings of the study ensured that by increasing the urban population by one percent, the level of CO_2 emission will be increased by 0.44 percent. Similarly the study conducted by Rafael and Toledo (2016) studied association between vegetation cover as proxy for environmental degradation and urbanization using Johanson method of co integration over a time period of 1971-2010. Results affirmed that by increasing the urban population by one percent will increase the rate of reduction in vegetation cover by percent. Both of these studies ensure that due to lack of urban planning the pressure on environmental resources are increases with rising urbanization.

The intensive urbanization associated with a growing industrial sector are exacerbating the issue of environmental degradation in Bangladesh. To check whether the urban population affecting positively or negatively the level of CO_2 emission in the Bangladesh, Faridul and Muhammad (2012) studied the association between urban population and CO_2 emission in Bangladesh within the context of environmental Kuznet curve. Their findings ensure the significantly positive effect of urban Population on the level of CO_2 emission in Bangladesh. This means that by increasing the urban population by one percent will increase the CO_2 emission by 0.27 percent.

Shahbaz et al. (2015) analyzed the impact of urbanization on CO_2 emission using FMOLS over a time period of 1971-2008. Time series has been tested for various diagnostic tests such as ADF, CUSUM and CUSUMSQ tests. The time series were found stationary at first difference and exhibit unit root at level. Findings affirms the significantly positive impact of urbanization both in the long run and short run with its elasticity values of 0.60% and 0.12% on per capita CO_2 emission in Portugal. The negative value of error correction term indicates that any error in the system will be adjusted towards equilibrium by 10.83% within a year.

The above studies shows that at present the rural to urban migration is unsustainable. To bring sustainability in the urban areas and slowing down the rate of urbanization, government needs to create the jobs opportunities at rural level and encourage the small and medium scale enterprises.

2.7 Impact of other factors on ecological foot print:

Mrabat and Alsamara (2016) studied the environment growth nexus using CO_2 and Ecological foot print both as a proxy for environmental degradation over a time period of 1980. ARDL with unknown structural break were employed to analyze the long run and short run relationship between environmental degradation and economic growth, energy use, financial development and trade openness. All the unit root tests such as ADF, PP and Narayan & Popp (NP) confirmed stationarity at first difference and variables are integrated at order one. Results affirmed the significantly positive effect of per capita energy use, foreign trade and significantly negative impact of development in financial sectors on carbon emission. Moreover, except per capita energy use, the openness of trade and financial development have significantly negative and positive impact on ecological foot print of Qatar. The value of error correction term indicates that any shock in the system will be adjusted during a year by 80% towards equilibrium.

Hervieux and Darne (2015) investigated environmental Kuznet curve hypothesis for seven Latin American countries using ecological foot print as a proxy of environmental quality over the time period of 1967-2007. To check stationarity characteristics of time series various unit root tests were employed such as ADF and ADF- GLS techniques. To detect the long run relationship between ecological foot print and GDP Johansson cointegration test were employed. Results corroborated that EKC was not supported for Latin American countries except Chile and Uruguay that shows negative value of square term of GDP. Error correction model indicates that any shock to ecological foot print in later period will be adjusted by 32% every year in Chile.

Asici and Acar (2015) applied fixed effect Model to study the impact of trade openness, Per capita energy use , population growth and environmental regulation on Ecological foot print using domestic production foot print and import foot print as an indicators for environmental degradation for 116 countries. Panel data covers the time period of 1961-2008. Results confirmed significantly positive effect of trade openness, energy use, Population density whereas negative impact of bio capacity on import foot print. Results also ensured the significantly positive impact of bio capacity and negatively significant impact of population density, energy use and enforcement of environmental regulation on the domestic production foot print.

Ozturk et al. (2015) investigated the environmental Kuznet curve relationship among the ecological foot print and GDP from tourism by extending the relation to examine the impact of other factors such as total trade, urban population, Per capita energy use using system panel generalized method of moment regression technique. The panel series of 144 countries were selected using the data for a period of 1988-2008. Results also confirmed the significantly negative impact of Per capita energy use, urban Population and energy price on ecological foot print both in high income countries and upper middle income countries.

Table: Literature review

Authors	Sample Period	Methodology	Results
Shahbaz et al. (2012)	1971-2009	ARDL and VECM	GDP and square terms of GDP with its positive and negative value ensured Environmental Kuznet curve for Pakistan.
Nasir & Rehman (2011)	1972-2008	Johanson cointegration	The Positive impact of per capita income and negative impact of Per capita GDP^2 indicates the validity of Kuznet curve for Pakistan.
Lapinskiene et al. (2013)	1995-2008	Cubic form equation	The implicit tax rate on energy use and primary production of coal have significantly positive impact while negatively significant impact of R&D and environmental tax on greenhouse gas emissions is recorded.
Nazir et al. (2018)	1970-2016	Unit root and ARDL Cointegration	Results corroborated significantly positive effect of energy use per capita, foreign trade and negatively significant impact of financial development on carbon emission.
Rahman et al. (2019)	1970-2016	Ng- Perron unit root test & ARDL approach	Positive impact of income and energy consumption on CO_2 emission. Financial development have negative effect on CO_2 emission.
Haq et al. (2019)	1990-2015	Panel ARDL	Energy consumption and Population density have positive while afforestation have significantly negative and impact on carbon emission.
Lorente et al. (2019)	1990-2014	FMOLS & DOLS	FMOLS and DOLS confirms existence of Environmental Kuznet curve for BRICS. Agriculture, Trade openness, electricity use have positive and mobile use have negative effect on carbon emission

Ali et al. (2017)	1960-1990	Augmented Dickey Fuller Johanson Cointegration	No tradeoff between agriculture growth and carbon emission revealed that EKC is invalid for Pakistan. Total irrigated area and production of tractors have negatively insignificant impact while foreign trade have recorded significantly positive impact on carbon emission
Waheed et al. (2017)	1990-2014	ARDL, FMOLS DOLS	A negatively insignificant effect of Renewable energy consumption and forest were found while the impact of agriculture was positive and significant on carbon dioxide emission.

Studies Using Ecological foot print as an environmental indicator

Author	Sample Period	Methodology	Results
Mrabat and Alsamara (2016)	1980-2011	ARDL	Environmental Kuznet curve is valid using ecological footprint as an environmental indicator while it is invalid using CO_2 as an environmental indicator
Hervieux and Darne (2015)	1967-2007	Johansson cointegration	EKC was not supported for Latin American countries.
Asici and Acar (2015)	1961-2008	Fixed effect Model	The significantly positive value of GDP and significantly negative value of square term of GDP confirms the EKC for these countries
Ozturk et al. (2015)	1988-2008	Generalized Method of Moment	Negative relationship between Tourism GDP and ecological footprint confirms the existence of EKC in upper middle income and high income countries.

III. Data Collection and Methodology

3.1 Universe of the Study:

This study was focused on single country analysis and Whole Pakistan was taken as a universe of the study.

3.2 Data Collection:

To meet the objectives of the study, data on various macroeconomic indicators and Pollutant substitute was taken over the period of 1971-2014. For environmental degradation indicator CO_2emission per capita and ecological foot print consumption per capita was considered while macro - economic indicators on real GDP per capita, energy use, Trade (% of GDP), urban population and foreign direct investment were taken for the study. Data on all the parameters was attained from World Development Indicators and Global Foot Print Network.

3.3 Theoretical Framework of time series analysis:

Time series variables often have the problem of non- stationarity that violate the constant mean and variance assumption of classical linear regression model. As time series are trended over time and often leads to spurious regression associated with high R^2 than durbon Watson statistics that indicates misleading results and may lead to type- I error (Granger and Newbold, 1974). To deal with the problem of non stationarity and spurious regression, it is necessary that time series should be transformed into stationarity either through trend stationary process or difference stationarity process. The process becomes trend stationary when a non- stationary time series is regressed over time and it is more appropriate when time series show deterministic trend (Nkoro and Uko, 2016). Other methods used to tackle the issue of spurious regression is through uninterrupted differencing of unit root variables until the series becomes stationary (Box and Jenkins, 1976). The time series is said to be over differencing when it is TSP but handled as DSP, while it becomes under differencing when the series is DSP but considered as TSP (Gujarati and Porter, 2009).

The process of differencing was much criticized in a way that long run equilibrium relationship of time series is highly distorted when it is differenced to deal with the issue of non- stationarity. Unlike differencing approach, cointegration approach is effective in maintaining the long run equilibrium relationship between variables. In the previous literature various cointegration techniques were employed such as Johanson and Juselius (1990) and Engel and Granger test (1987). Johanson cointegration deals with large sample size and same order of integration. Engel and Granger cointegration deals with two variables possessing same order of integration. These limitations urged the researchers to propose a new method that deals with mixed order of integration. To meet the objectives of the study, bound testing ARDL approach suggested by Pesaran et al., (2001) was used because it provides reliable results in case of small sample size and also deal with mixed order of integration (Ghatak and Siddiki, 2001). The ARDL approach have certain distinguishable characteristics compared to other cointegration approaches, because there is no need of pre-testing of parameters for unit root to confirm stationarity at level and first difference and avoid complication of endogeneity by lag selection. This approach becomes more efficient when sample size is less than 30 and long run relationship is confirmed among variables through bound test. Moreover, to check short run relationship among variables, through simple linear transformation an error correction model (ECM) will be derived from ARDL. The ARDL approach involves three basic steps: To check the order of integration using stationarity tests. Secondly, to investigation the existence of long run relationship using bound test approach. Lastly, error correction model (ECM) will be used for identification of short run association among variables.

3.3.1 Econometric Model:

Based on the theoretical concept of environmental Kuznet curve, various methods were taken into account to investigate the relationship between economic growth and environmental degradation. This study applied a recent approach of ARDL proposed by Pesaran et al., (2001) to estimate the association among variables in the long run. To find the short run relationship among variables, simple linear transformation technique will be used to derive error correction model from ARDL. The recent literature used ARDL approach because it provides more reliable result in case of small sample size and mixed order of stationarity. Some studies conducted by Nazir et al., (2018) and Rehman et al., (2019) checked the environment - growth nexus in Pakistan using Auto regressive distributive lag model.

Through review of the following studies, the quardratic relationship in EKC was confirmed following Nazir et al., (2018) and Rehman et al., (2019) which is mathematically expressed as:

$$\mathrm{ED} = \mathrm{f}(\mathrm{Y}, \mathrm{Y}^2, \mathrm{EN}, \ \mathrm{FDI}, \ \mathrm{TO}, \ \mathrm{UR}) \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots (3.1)$$

In case of environment - growth nexus, the choice between linear and log- linear model is interest dependent. We will use the log- linear model following Nazir et al., (2018) and Shahbaz et al., (2013) and its coefficient is known as elasticity.

The model in which both the dependent and independent variables are log transformed can be interpreted as percentage change in Y due to percentage change in X. Such a relation is often termed as elastic in econometrics and the coefficient of log X is known as elasticity. This type of log transformed relation can be generally expressed as:

$$lnY = lna + blnX$$

The elasticities can be calculated through logarithmic differentiation and be expressed as;

$e_{y,x}$ = b= $dlnY/dlnX$

So, our econometric model which includes both the log transformed dependent and independent variable is given as;

$$lnED_t = \propto_o + \beta lnY_t + \beta_2 lnY_t{}^2 + \beta_3 \ lnEN_t + \beta_4 lnFDI_t + \beta_5 lnTO_t + \beta_6 lnUR_t + \varepsilon_t \ldots \ldots \ldots \ldots \ldots \ldots \ldots (3.2)$$

Where,

ED = Carbon dioxide emissions per capita (metric tons), Ecological Foot print (global hectare per person)

Y= Per capita real GDP (Constant 2010 US $)

TO= Trade openness (% share of GDP)

EN= Energy use (KGs of Oil equivalent per capita)

FDI = Foreign Direct Investment (Million US$)

UR = Urban Population (% of Total Population)

e_t = error term

As this study aims to compare the two environmental indicators such as CO_2 emission and ecological foot print to check the validity of environmental Kuznet curve for Pakistan. So two different specified models will be derived from equation 3.2 given as;

$lnCO_{2t} = \propto_o + \beta lnY_t + \beta_2 lnY_t^2 + \beta_3\ lnEN_t + \beta_4 lnFDI_t + \beta_5 lnTO_t + \beta_6 lnUR_t + \varepsilon_t \dots \dots$
$\dots \dots \dots \dots \dots$ (3.3)

$lnEF_t = \beta_o + \propto_1\ lnY_t + \propto_2\ lnY_t^2 + \propto_3\ lnEN_t + \propto_4\ lnFDI_t + \propto_5\ lnTO_t + \propto_6\ lnUR_t + \propto_7$
$+ \varepsilon_t \dots \dots \dots \dots \dots \dots \dots$ (3.4)

According to the theoretical concept of environmental Kuznet curve, the expected sign of the real income per capita should be positive, while the expected sign of per capita real income square will be negative. The literature shows that expected sign of energy consumption per capita should be positive. This relationship holds due to increased energy consumption to promote economic growth. Similarly, the literature shows that foreign direct investment would have expected negative sign that during the inflow of FDI from developed nations to developing nations involve the transfer of clean and green technologies. The Foreign direct investment would have expected positive sign due to inflow of dirty technologies to developing countries from developed Countries. According to review of literature, trade openness tends to have positive sign when trade between two countries involve the transfer of environmentally polluted technologies and Pollution intensive commodities, while the impact of trade openness may be negative when the trade involves the exchange of environmental friendly technologies and commodities between two countries. The efficient technologies lessen the pollution, save non-renewable energy resources and contribute in shift towards cleaner production process (Batool and Muhammad, 2016). According to literature the sign of Urban Population should be Positive due to excessive demand for energy resources that exacerbate the issue of environmental degradation.

There are very few studies in the previous literature using ecological foot print as an indicator for environmental degradation within the context of EKC approach (Hervieux & Darne. 2015, Ozturk et al., 2015, Mrabat & Alsamara, 2016). But in Pakistan the past literature on environmental Kuznet curve has not employed ecological foot print as a substitute of pollutants rather employed the CO_2 emission as a proxy for environmental degradation (Nasir et al., 2011, Ahmad &long. 2012, Rehman et al., 2019, Shahbaz et al., 2013, Nazir et al., 2018). To fill the research gap, this study aims to analyze the impact of per capita energy use, foreign trade, FDI and urbanization on environment in Pakistan using both Co_2 emission and ecological foot print as an indicator for environmental degradation to explore the validity of environmental Kuznet curve. The ecological foot print is taken as an indicator for environmental degradation because it is broad based adopted measure for sustainability perspective (Nijkamp et al., 2004). Secondly, it is widely used measure by policy analyst and authorities to judge the ecological performance (Wiedmann et al., 2006). Thirdly, its limitation are identified.

Some studies conducted such as Pang (2007) and Omri et al., (2014) that have considered the impact of FDI on environmental degradation which is not covered by the growth environment literature of Pakistan. This study will contribute the impact of additional variable on foreign direct investment to the environment and growth literature of Pakistan. According to Beckerman (1992) the economy exhibit structural transformation and passes threshold level to improve the environmental quality with increase in income beyond the turning point which bring decline in environmental degradation.

According to Akazaki and Naito (2008) the inverted U shaped EKC is due to technological advancement. Following Alstine et al., (2010) and Bernard et al., (2011) the threshold Point can be calculated as follows:

$$Y_p = \exp(-\alpha_1/2\alpha_2) \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \text{(3.5)}$$

Where α_1 and α_2 are the symbols of elasticity coefficient of Per capita income and its square term.

3.3.2 Unit root test:

A time series have unit root problem when it violates the assumption of constant mean and variance required for stationarity. The ordinary least square becomes useless in the presence of non- stationary dependent and explanatory variables. Therefore, it is necessary to check unit root of time series prior to co integration regression. The time series is said to be unit root that have time varying mean and auto covariance. The augmented dickey fuller unit root test is commonly used that is effective in identification of unit root in time series variables.

When a time series is regressed over the same time series with its lag is known as unit root test. Mathematically it can be expressed as:

$$\Delta Y_t = \beta_1 + \beta_{2t} + \beta 3\, Y_{t-1} + \sum_{i=1}^{m} \alpha 1\, \Delta Y_{t-1} + e_t \dots \dots \dots \dots \dots \dots \dots \dots \dots \quad (3.6)$$

In the above equation Δ denotes the change, Y_t indicates the series of variable to be tested. The small t denotes the trend in variable, e_t shows white noise error term, Y_{t-1} is the lag value of variable series. The lag value of the non- explanatory variable is represented by ΔY_{t-1} while m shows the maximum length of the lags for dependent variable and $\alpha 1$ works as a coefficient of lagged value of dependent variable.

The null hypothesis (non- stationarity) is tested against the alternative hypothesis (stationarity) in case of ADF test and is usually expressed as:

Ho: $\beta 3$ = (1- ρ) = 0 (Data is non stationary)

Ho: $\beta 3$ = (1- ρ) < (Data is stationary)

If the calculated value of test statistics exceed the tabulated value then null hypothesis is not accepted, while it is accepted when the tabulated value is above the calculated value of test statistics.

3.3.3 Bound Test:

The bound testing procedure was applied by ARDL approach in order to check the cointegration relation among variables. This test generates two critical bound values i-e lower bound and upper for comparison with F – statistical values.

To critically examine the long run relationship between variables, an ARDL approach applies bound testing procedure to identify the presence of co integration. The bound test generate two critical values i-e upper critical bound and lower critical bound. The bound test compares the calculated value of F- statistics with the tabulated value obtained from Pesaran and Pesaran (1997). Under the bound testing approach, it is necessary to test the null hypothesis (no co integration) against the alternative hypothesis (Co integration exist). These hypothesis are expressed below:

H0: $\delta 1 = \delta 2 = \delta 3 = \delta 4 = \delta 5 = \delta 6 = \delta 7 = 0$

H1: $\delta 1 \neq \delta 2 \neq \delta 3 \neq \delta 4 \neq \delta 5 \neq \delta 6 \neq \delta 7 \neq 0$

Among the two critical value, the lower critical bound value is an indication of non - existence of cointegration, while the upper critical bound is an indication of existence of cointegration. Any calculated value of F statistics exceeding the critical value of upper bound implies the rejection of null hypothesis otherwise null hypothesis is accepted. The results of bound test becomes inconclusive, if the calculated value of F statistics lies in between critical bounds. To estimate the equation of environmental degradation, the ARDL model can be expressed as:

$$\Delta lnED_t = \delta_o + \delta_1 lnED_{t-j} + \delta_2 lnY_{t-j} + \delta_3 \left(lnY_{t-j}\right)^2 + \delta_4 lnEN_{t-J} + \delta_5 lnFDI_{t-j} + \delta_6 lnTO_{t-j} + \delta_7 lnUR_{t-j} + \sum_{i=1}^{n} \beta_1 \Delta lnED_{t-j} + \sum_{i=1}^{n} \beta_2 \Delta lnY_{t-j} + \sum_{i=1}^{n} \beta_3 \Delta\left(lnY_{t-j}\right)^2 + \sum_{i=1}^{n} \beta_4 \Delta lnEN_{t-J} + \sum_{i=1}^{n} \beta_5 \Delta lnFDI_{t-j} + \sum_{i=1}^{n} \beta_6 \Delta lnTO_{t-j} + \sum_{i=1}^{n} \beta_7 \Delta lnUR_{t-j} + e_i \text{ .... } (3.7)$$

In the above equation theΔ is an indication of Ist difference and natural logarithm is denoted by ln. Similarly, t-1 shows the optimal lag length selected by AIC and SIC criterion. The δ_s , β_s represent the estimated parameters of the model.

3.3.4 Auto regressive distributed lag approach:

According to Rehman et al. (2019), an ARDL approach is more effective and provides unbiased and reliable estimation for a small sample size. The ARDL model becomes useful for a mixed order stationarity of the variables and even if the variables are stationary at first difference. Some of the explicit tests are provided by this approach to check whether co integration exist despite of assuming the presence of vector variables. Finally the Pesaran and Shin (1997) proposed that lag selection is effective in dealing with endogeneity problem and control of serial correlation problem. After the long run co integration relationship is established, ARDL approach was utilized to find the long run elasticities:

$$\Delta lnED_t = \delta_o + \sum_{j=1}^{n} \delta_1 \Delta lnED_{t-j} + \sum_{j=1}^{n} \delta_2 \Delta lnY_{t-j} + \sum_{j=1}^{n} \delta_3 \Delta\left(lnY_{t-j}\right)^2 + \sum_{j=1}^{n} \delta_4 \Delta lnEN_{t-J} + \sum_{j=1}^{n} \delta_5 \Delta lnFDI_{t-j} + \sum_{j=1}^{n} \delta_6 \Delta lnTO_{t-j} + \sum_{j=1}^{n} \delta_7 \Delta lnUR_{t-j} + e_i \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \quad (3.8)$$

Where δ_s shows the elasticities of the concerned variables in the long run. For selection of maximum number of lags, both AIC and SIC will be used. Furthermore, short run elasticities were determined through an application of error correction model (ECM).

$$\Delta lnED_t = \delta_o + \sum_{j=1}^{n} \gamma_1 \Delta lnED_{t-j} + \sum_{j=1}^{n} \gamma_2 \Delta lnY_{t-j} + \sum_{j=1}^{n} \gamma_3 \Delta\left(lnY_{t-j}\right)^2 + \sum_{j=1}^{n} \gamma_4 \Delta lnEN_{t-J} + \sum_{j=1}^{n} \gamma_5 \Delta lnFDI_{t-j} + \sum_{j=1}^{n} \gamma_6 \Delta lnTO_{t-j} + \sum_{j=1}^{n} \gamma_7 \Delta lnUR_{t-j} + \theta ECT_{t-1} + e_i \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \quad (3.9)$$

In the above equation the γ_s are the symbols of short run elasticities, whereas the ECT_{t-1} represent the error correction term that shows the percentage of adjustment of any shock in the system towards equilibrium in a year and is denoted by θ. The coefficient (θ) value of ECT_{t-1} falls within the range of 0 and -1. Therefore, zero value of ECT (-1) corroborates lack of convergence towards equilibrium, whereas the negative value of coefficient is an indication of convergence of any shock towards equilibrium in the next period.

The Problem of autocorrelation, structural stability and normality will be identified through an application of various diagnostic tests such as CUSUM and CUSUMSQ test, Breush Godfrey LM test.

IV: Results and Discussion

This section presents the growth – environment nexus scenario of Pakistan through graphical analysis, unit root tests, Lag Selection Criterion, ARDL bound testing procedure based on review of literature.

4.1 Graphical Analysis:

Before proceeding to stationarity tests, it is necessary to do graphical analysis of time series data to get the primary signs of stationarity. Most of the researchers are asking about an issue in time series analysis without graphical analysis of the series (Gujarati and Porter, 2009). The Descriptive statistics are presented in Appendix I. During the period 1971-2014, mean value of carbon emission was 0.64 metric tonnes, mean value ecological foot print consumption was 0.756 gha, mean value of real GDP per capita was 558.90 (Constant 2010 US $), mean value of energy consumption was 405.10 KGs of oil equivalent, mean value of foreign direct investment was 833.18 million US dollars, mean value of trade openness was 30.38 percent and mean value of urban population was 31.36 percent respectively. The detailed graphical analytics are described below:

The average Carbon dioxide emission per capita was reported 0.33579 metric tons per capita during the year 1971-74. In Pakistan the carbon emission are showing upward trend due to its rising industrial sector which rely heavily on fossil fuels as clear from the figure 4.1. The energy and agriculture sector are two main contributors towards the increased carbon emissions in the country. Due to extensive agriculture practices and deforestation the level of CO_2 emission is increasing. This average Carbon dioxide emission per capita was surged upto 0.34511 metric tons during the period of 1975-78 showing a little growth rate of 2.7 percent. The average Carbon dioxide emission per capita was increased to 0.41473 metric tonnes in 1979-82 with the growth of 18 percent. During the year 1983-86 the average Carbon dioxide emission per capita has risen to 0.4945 metric tonnes depicting the growth rate of 15.96 percent and followed by average growth rate of 15.38 percent during 1987-90 with the average Carbon dioxide emission per capita of 0.58439 metric tonnes. Furthermore, during the period 1991-94 there is an increase by 11.21 percent with the average Carbon dioxide emission per capita of 0.65819 metric tonnes. There was a small increase recorded during the period 1995-1998 by 9.52 percent with the average Carbon dioxide emission per capita of 0.72748 metric tonnes. There was an insignificant rise in average Carbon dioxide emission per capita to 0.7658 metric tonnes with growth rate of 5 percent during 1999-02 followed by a rise of 12.36 percent with the average Carbon dioxide emission per capita of 0.87385 metric tonnes during the time period of 2003-2006. Government of Pakistan has planned to reduce the energy use since 2000, but the carbon intensity of energy sector has increased during the period. Though the increase in carbon emission is relatively small, but due to diversified climatic condition the vulnerability is increasing. Afterward, the average Carbon dioxide emission per capita increased to 0.96505 metric tonnes with the growth rate of 9.4 percent in 2007-10 and a slight decline was recorded by 5.7 percent with the average Carbon dioxide emission per capita of 0.91234 metric tonnes in 2011-14.

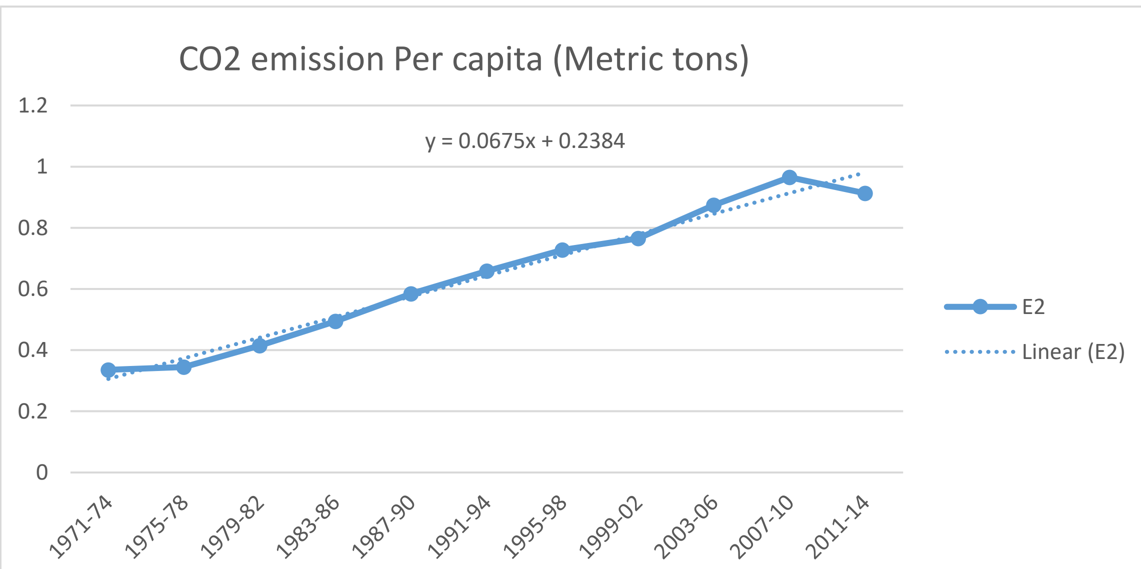

Figure 4.1 Average CO_2 emission Per capita (Metric tons) during 1971-2014

The major sectors that contributes to the increased GDP growth rate of Pakistan was agriculture, industrial and services sector that promote the growth in the economy. In Pakistan these key sectors were considered the major economic drivers that shows relatively positive growth trend. Industrial sector has recorded the growth rate of 9.7% in

2002-2003. The agriculture sector has recorded 3.4% growth rate, while the services sector shows the recorded growth rate of 5.5%. Due to positive growth rate in these sectors, the GDP of Pakistan was surging upward as the trend is shown in figure 4.2. The average real GDP per capita was recorded 466.15 dollars during the year 1971-74. This average real GDP per capita was surged upto 496.78 dollars during the period of 1975-78 showing growth rate of 6.1 percent. The GDP per capita was increased to 564.24 dollars in 1979-82 with the growth of 12 percent. During the year 1983-86 the real GDP per capita has risen to 641.69 dollars depicting the growth rate of 12.78 percent and followed by average growth rate of 12.14 percent during 1987-90 with the average real GDP per capita of 719.77 dollars. Furthermore, during the period 1991-94 there is an increase by 8.56 percent with the real GDP per capita of 784.23 dollars. There was a small increase recorded during the period1995-1998 with the growth rate of 4.64 percent with the real GDP per capita of 823.30 dollars. There was an insignificant rise in average real GDP per capita 845.78 with growth rate of 2.72 percent during 1999-02 followed by a rise of 12.07 percent with the real GDP per capita of 947.67 dollars during the time period of 2003-2006. Afterward, the Real GDP per capita increased to 1041.05 dollars with the growth rate of 9.84 percent in 2007-10 and a little increase was recorded by 3.31 percent with the real GDP per capita 1075.54 dollars in 2011-14.

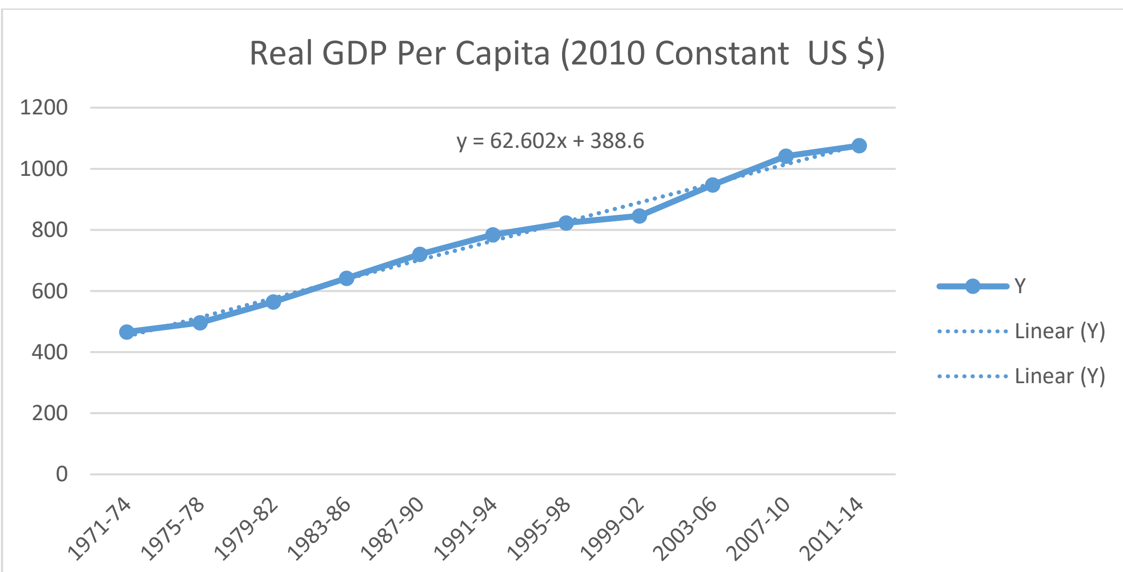

Figure 4.2 Average Real GDP per capita during 1971-2014

The energy consumption in Pakistan shows historically upward trend due to its high population and rising demand for household and industrial sector. From the beginning the country is facing the energy crisis due to rising demand from industrial sector which are relying on the non- renewable energy resources. The average energy consumption per capita was recorded 290.49 KGs of oil equivalent during the year 1971-74. The average energy consumption per capita was raised upto 302.99 KGs of oil equivalent during the period of 1975-78 showing a relatively small growth by 6.1 percent. During the period of 1979-82 energy consumption per capita was increased to 323.94 KGs of oil equivalent showing the growth rate of 7.3 percent. For the time period of 1983-86 the average energy consumption per capita has risen to 347.56 KGs of oil equivalent with the recorded growth rate of 6.91 percent and followed by average growth rate of 10.34 percent with the average energy consumption per capita of 387.37 KGs of oil equivalent during 1987-90. Furthermore, during the period 1991-94 the average energy consumption per capita was recorded as 414.73 KGs of oil equivalent with growth rate of 6.5 percent. There was a small increase recorded during the period 1995-1998 with the percentage growth rate of 6.7% and average energy consumption per capita of 823.30 KGs of oil equivalent. The average energy consumption per capita was increased to 459.56 KGs of oil equivalent revealing an insignificant growth rate of 3.12 percent during 1999-02 followed by a rise of 6.2 percent with the average energy consumption per capita of 489.96 KGs of oil equivalent during the time period of 2003-2006. According to the censuses report of 2006-2007, about 44% of the country export earnings were spent on import of oil due to increasing consumption of oil in the industrial sectors as evident from the upward trend in its consumption per capita. However, with the fluctuation in the international oil price the macroeconomic condition of the country was highly affected. Afterward, the average energy consumption per capita increased to 507.12 KGs of oil equivalent with the growth rate of 3.2 percent in 2007-10 and a slight decline in average energy consumption per capita was reported at 487.92 KGs of oil equivalent with the decreasing growth rate of 3.7 percent in 2011-14.

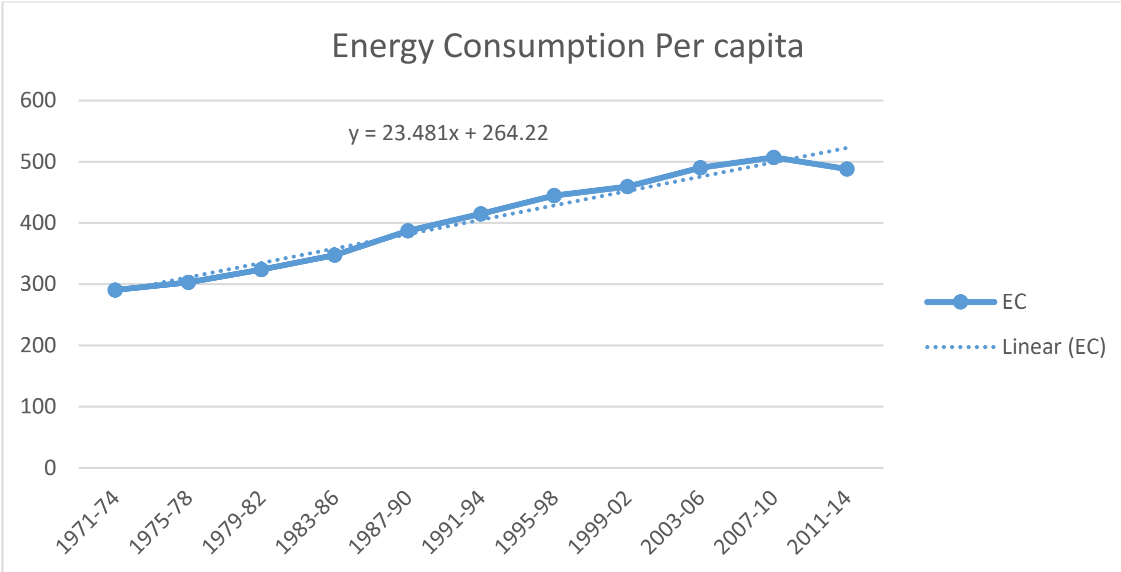

Figure 4.3 Average Per capita energy consumption during 1971-2014

Since 1970, mostly government of Pakistan took various initiative for trade liberalization policies to increase investment and production as well as technology transfer for improving social welfare. The key measures including export industries, export allowances and announcement of financing schemes for exports, elimination of import barriers provide a background for improved trade during this period. So, on average trade openness as a percentage share to GDP of the country showing a recorded rate of 27.12 during the time period of 1971-74. This contribution of trade to GDP has slightly increased to 27.74 percent during the time period of 1975-78. The trade openness showing an upward trend and risen to 31.21 percent during the time period of 1979-82 followed by a declining growth rate with a trade openness reduced to 27.87 percent during the time period of 1983-86. Then it again shows an increasing trend and risen upto 30.23 percentage share of GDP during 1987-90 and increased to 32.66 % share of GDP in 1990-94. Furthermore, it shows a downward trend and attained the value of 31.1% as a share of GDP in 1994- 98 and again declined to 28.2% share of GDP in 1999-02 at a decreasing trend. During the time period of 2003-2006 the percentage share of trade openness to GDP increased upto 33.46% and 33.14 % 2007-2010 respectively. In the year 2011-14 decreasing trend was documented with a 30.7% share of trade openness to GDP.

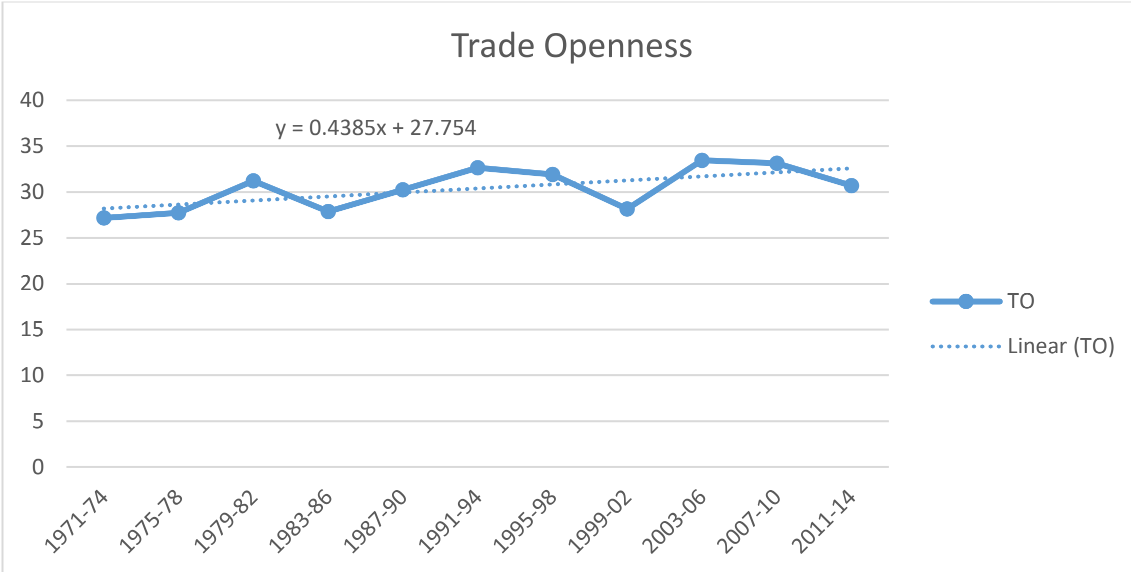

Figure 4.4 Average Trade openness (% of GDP) during 1971-2014

The average foreign direct investment was reported 4.5 million dollars during the year 1971-74. This shows an upward trend and increased to 20.18 million dollars during the period of 1975-78 showing a relatively small growth by 6.1 percent. In the earlier periods of 1970, the foreign investors were not given an attractive opportunities in Pakistan due to government vision of nationalization which has discouraged the foreign investors. The foreign direct investment showing upward trend after 1980 when the government nationalization program was not succeeded and government has increased its concentration towards foreign investors and established the export promotion zones. Also government took initiative to remove the barriers to FDI inflow such as strict licensing and high public ownership. During the period of 1979-82 average foreign direct investment was increased to 73.45 million dollars showing the growth rate of 7.3 percent. For the time period of 1983-86 average foreign direct investment has risen to 80.45 million dollars with a relatively minimum growth rate of 6.91 percent while growth rate of 10.34 percent was observed with the average foreign direct investment of 192.93 million dollars during 1987-90. Furthermore, during the period 1991-94 the average foreign direct investment was recorded as 341.12 million dollars with growth rate of 6.5 percent. The average foreign direct investment was surged up during the period 1995-1998 with the significant growth rate of 6.7% and average foreign direct investment of 716.72 million dollars. The average foreign direct investment during the year 1999-02 was declined to 511 million dollars at a declining growth rate of 3.12 percent during followed by a rise of 6.2 percent with the average foreign direct investment of 203.15 million dollars during the time period of 2003-2006. Afterward, the average foreign direct investment risen upto 3847 million dollars with the growth rate of 3.2 percent in 2007-10 and average foreign direct investment was reported at 487.92 with a highly declining percentage growth rate of 3.7 percent in 2011-14.

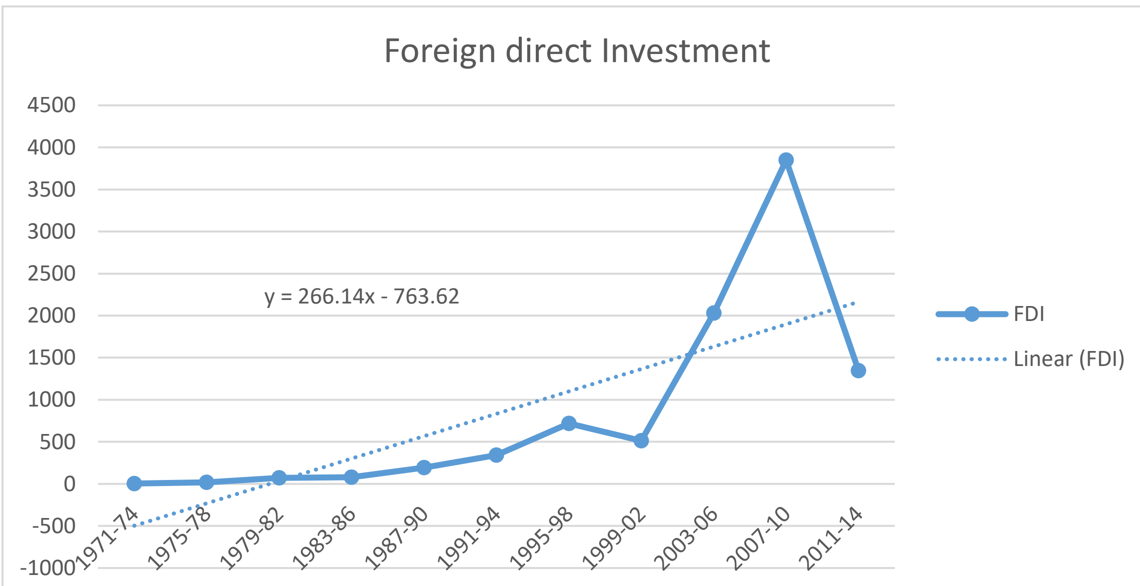

Figure 4.6 Average Foreign Direct Investment (Million US $) during 1971-2014

The average ecological foot print consumption per capita was reported 0.65118 global hectares per capita during the year 1971-74. This ecological foot print consumption per capita was slightly declined upto 0.64477 global hectares per capita during the period of 1975-78 with an average decreasing growth rate of 0.99 percent. The ecological foot print consumption per capita was increased to 0.676347 global hectares per capita in 1979-82 with the growth of 4.6 percent. During the year 1983-86 the ecological foot print consumption per capita has decreased to 0.665575 global hectares per capita showing the declining growth rate of 1.6 percent and followed by average growth rate of 7.12 percent during 1987-90 with the ecological foot print consumption per capita of 0.716633 global hectares per capita. Furthermore, during the period 1991-94 there is an increase by 6.49 percent with the ecological foot print consumption per capita of 0.766385 global hectares per capita. During the period 1995-1998 a little increase was recorded by 6.12 percent with the ecological foot print consumption per capita of 0.816354 global hectares per capita. There was an insignificant rise in ecological foot print consumption per capita to 0.825347 global hectares per capita with growth rate of 1.08 percent during 1999-02 followed by a small rise of 2.75 percent with the ecological foot print consumption per capita of 0.848718 global hectares per capita during the time period of 2003-2006. Afterward, the ecological foot print consumption per capita increased to 0.897348 global hectares per capita with the growth rate of 5.4 percent in 2007-10 and a slight decline was recorded by 1.1 percent with the ecological foot print consumption per capita of 0.809306 global hectares per capita in 2011-14.

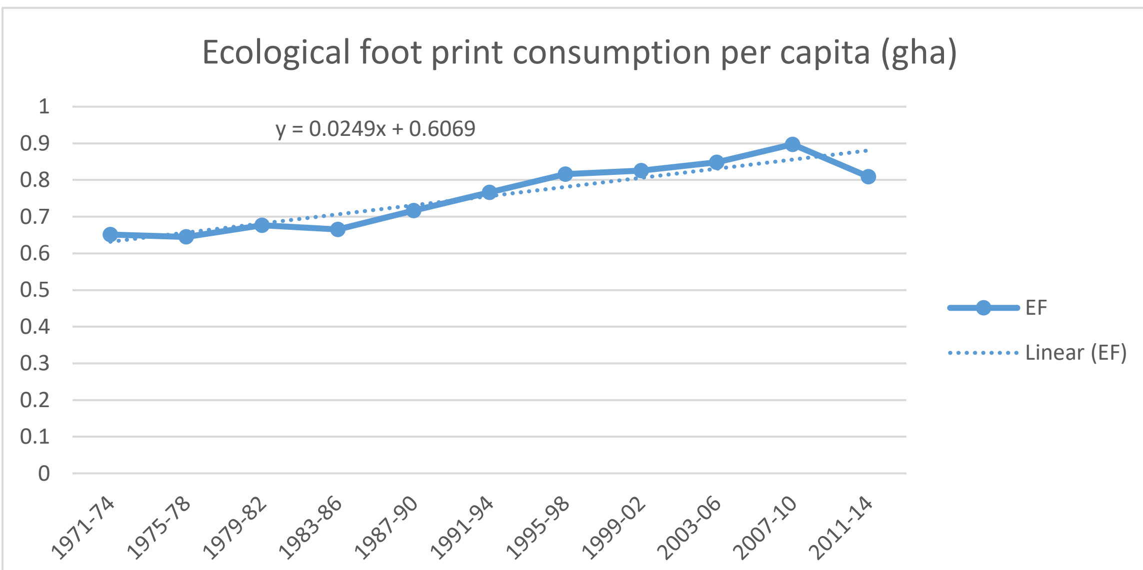

Figure 4.6 Average ecological foot print consumption Per capita (Metric tons) during 1971-2014

4.2 Augmented Dickey Fuller Unit root test:

The testing of unit root problem prior to co integration is an important characteristic of time series. To check the stationarity in time series, all the variables were subjected to stationarity tests by using ADF unit root test both at level and first difference. The Augmented Dickey fuller unit root test reveals that both the dependent variables (Carbon dioxide emission, ecological foot print) and explanatory variables such as Real GDP per capita, per capita energy use and urban population were non stationary at level with its P values higher than 5% level of significance except trade openness and foreign direct investment that is stationary at level due to its smaller P value than 5% level of significance. Above all, the variables becomes stationary on Ist difference. As ADF test reveals the mixed order stationarity, so the ARDL approach is best approach due to mixed order stationary nature of time series variables as per review of literature.

Table 4.1 Augmented Dickey Fuller test at I (0)

I(0)	ADF statistics	Mackinnon critical Value	P - value	Results
ln CO_2	-1.74	-3.518	0.7128	Non - stationary
ln EF	-2.458	-3.51	0.3461	Non- stationary
ln Y	-1.59	-3.520	0.7767	Non- Stationary
ln YS	-1.78	-3.520	0.6937	Non- Stationary
ln EC	0.33	- 3.51	0.99	Non- Stationary
TO	-6.21	-3.51	0.0000	Stationary
ln FDI	-3.64	-3.53	0.0398	Stationary
UR	-2.17	-3.52	0.4883	Non – Stationary

Source: Author own estimation from Data

Table 4.2 Augmented Dickey Fuller test at I (1)

I(1)	ADF statistics	Mackinnon critical Value	P – value	Results
ln CO_2	-10.29	-3.52	0.0000	Stationary
ln EF	-7.88	-3.52	0.0000	Stationary
ln GDP	-5.87	-3.52	0.0001	Stationary
ln GDPS	-5.61	-3.52	0.0002	Stationary
ln EC	-5.69	- 3.52	0.0001	Stationary
TO	-6.40	-3.52	0.0000	Stationary
ln FDI	-7.548	-3.52	0.0000	Stationary
UR	-4.74	-3.55	0.0030	Stationary

Source: Author own estimation from Data

4.3 Vector Auto regressive Model:

When the time series was tested for stationarity applying ADF test, then the maximum number of lags for Auto regressive distributive lag model is selected through various criterion such as AIC, SC, HQ, FPE,LR on the basis of VAR model. The Vector Auto regressive model results are given in the table 4.3 and 4.4. The findings reveals that most of the criterion suggest optimal lag length 4 for CO_2 model except LR which suggests the optimal lag length of 3 for ARDL model given in table 4.3. In case of ecological foot print, most of the criterion suggest optimal lag length 4 for model except LR and SC that recommends 2 and 1 lag for model given in table 4.4.

Table 4.3 Lag order Selection Criterion of VAR for CO2 Model

Lag	LOG L	LR	FPE	AIC	SC	HQ
0	123.8428	NA	4.26e-12	-6.315826	-6.011058	-6.208381
1	478.5996	556.1053	2.97e-19	-22.84322	-22.40508	-21.98366
2	545.4913	79.54694	1.52e-19	-23.81034	-19.23882	-22.19867
3	663.4602	95.65042*	9.14e-21	-27.53839	-20.83349	-25.17460
4	779.94	50.3728	3.01e-21*	-31.18634*	-22.34806*	-28.07044*

Table 4.4 Lag order Selection Criterion of VAR for ecological Model

Lag	LOG L	LR	FPE	AIC	SC	HQ
0	-3.203663	NA	4.10e-09	0.551549	0.856318	0.658994
1	338.7839	536.0886	5.69e-16	-15.28562	-12.84747*	-14.42605
2	420.3742	97.02635*	1.32e-16	-17.04726	-12.47573	-15.43558
3	478.8646	47.42462	1.97e-16	-17.56025	-10.85535	-15.19646
4	595.9241	50.62034	6.29e-17*	-21.23914*	-12.40086	-18.12323*

Source: Author own estimation from Data

4.4 Bound Test for Co integration:

Before proceeding to co integration, it is required to apply bound test for testing the null hypothesis of no co integration among variables. Findings affirmed the long run association among variables in both the models due to calculated value of F- statistics higher than the critical value of upper bound at 5% level of significance. The results of Model given in equation 3.5 are enlisted in Table 4.5.

Table 4.5

Dependent Variable	**F statistics**	**Lower Bound**	**Upper Bound**	**Conclusion**
D (ln CO_2)	**14.85**	**2.45**	**3.61**	**Co integration exist**
D (ln EF)	**6.02**	**2.45**	**3.61**	**Co integration exist**

4.5. Carbon dioxide

4.5.1 Long Run CO_2 Model Results:

When the validity of the long run association among the variables was confirmed applying bound test approach, the elasticities of long run were estimated given in equation 3.8. To evaluate the ARDL model, the study used lag length of (1, 4, 4, 3, 3, 0, 3) 4 as per recommendation of VAR model for lag order selection. The results of the model were biased due to insignificant effect and opposite sign of all the variables except energy consumption per capita and the model was highly affected with the problem of heteroscadasticity and autocorrelation problem and the results are enlisted in (Appendix II, IIA, IIB, IIC, IID, IIE, IIF). Then study evaluated ARDL model (2, 3, 3, 3, 3, 0, 3) using 3 lags as per suggestion of VAR Model. However, the results are still biased and ARDL model was associated with the problem of autocorrelation and heteroscadasticity and findings are presented in (Appendix III, IIIA, IIIB, IIIC, IIID, IIIE, IIIF). Then the study evaluated ARDL model (1, 0, 0, 0, 0, 0, 0) using 2 lags and results are presented in table 4.6.

Findings revealed that per capita emission of carbon dioxide as an indicator for environmental degradation has significantly positive association with the per capita real GDP and the long run coefficient value of 4.81 means that in the long run 1% growth in GDP per capita surge up Carbon dioxide emission by 4.81 % and the square term of GDP per capita has negative impact on Carbon dioxide emission in the long run and its coefficient value of -0.34 shows that 1% increase in square term of real GDP per capita reduce the emissions of carbon dioxide per capita by 0.34 percent. This positive value of GDP per capita and negative value of Square term of real GDP per capita confirms the validity of Environmental Kuznet curve for Pakistan. The results are in line with the findings of the studies conducted by Nazir et al. (2018), Shahbaz et al. (2012).

Similarly the energy consumption has positively significant impact on CO_2 emission and its coefficient value of 0.99 shows that one percent increase in the energy consumption in the long run enhances the environmental degradation by 0.99 percent. This means that enhance use of fossil fuels and non- renewable energy resources required for growth in the economy bring deterioration in the environmental quality. Our findings are in line with those studies conducted by Ahmed and long (2012), Ahmed et al. (2014).

Similarly, the inflow of FDI to the country has significantly positive impact on environmental degradation and its long run elasticity value depicts that one percent rise in FDI inflow to the country promote environmental degradation by 0.013 percent confirming the theory of Pollution haven hypothesis (PHH) which states that any kind of foreign direct investment by Industrialized nations in developing countries occurred at the cost of environmentally unsound practices. Moreover, our findings revealed that economy of Pakistan is not making a serious efforts for shift of clean and green technology through foreign direct investment due to its loose environmental policies. Our findings are supported by work done by Acharya (2009). If a country adopt to the globally environmental standards, the foreign direct investment by the developed countries will likely involve the shift of environment friendly technologies.

Trade openness as a percentage of GDP have positive but statistically insignificant effect on environmental degradation. Findings are supported by Shahbaz et al. (2015) and Rahman (2019) also found similar type of positively insignificant association between trade openness and CO_2 emission in Pakistan. However, Shahbaz et al, (2012) found the inverse relationship between trade openness and CO_2 emission through implementation of improved technology for production at domestic level.

Urban population also shows insignificant relationship with CO_2 emission, but its positive sign indicates that increase in urban population triggers the level of CO_2 emission.

Table 4.6 Long Run CO_2 Model Results

Dependent variable : CO_2 emissions per capita			
Variables	Coefficients	Standard Errors	P – value
ln GDP	4.8116	1.209871	0.0003
ln GDPS	-0.3478	0.104055	0.0020
ln EC	0.9953	0.112270	0.0000
ln FDI	0.0137	0.007501	0.0748
TO	0.0007	0.001373	0.5896
UR	0.0084	0.0090	0.3541
C	-23.4950	3.7025	0.0000

Source: Author own estimation from Data

4.5.2 Error Correction Model: Short run CO_2 Model Results:

The results of short run co integration and error correction model using differencing method of time series variable are presented in table 4.7.

The findings revealed that GDP per capita have significantly positive impact on CO_2 emission with its coefficient value of 4.26 suggests that one percent increase in GDP per capita worsen the environmental degradation by 4.26 percent and the square terms of GDP per capita have significantly negative effect on CO_2 emission with its coefficient value of -0.308 suggests that one percent increase in square of GDP per capita decline Carbon dioxide emission upto 0.308%.

The energy use per capita had significantly positive effect on Carbon dioxide emission per capita with its coefficient value of 0.883 suggests that one percent rise in energy use will enhance the Carbon dioxide emission by 0.883 percent.

The foreign direct investment have significantly positive effect on CO_2 emission and its coefficient value suggest that one percent increase in foreign direct investment enhance the environmental degradation by 0.012 percent confirming the validity of theory of pollution haven hypothesis.

The trade openness have positively insignificant impact on CO_2 emission in the short run and the findings are supported by Arouri *et al*. (2014) and Shahbaz *et al*. (2015).
Urban Population shows insignificant relationship with the CO_2 emission, but the sign is positive which depicts that one percent increase in urban population increases the CO_2 emission by 0.007 percent. Our findings are supported by the findings of Javaid and Zulfiqar (2017) and Faridul & Muhammad (2012).

The negative value of error correction term indicates that any shock to the system will be adjusted towards equilibrium by 88% a year.

Table 4.7 Short Run CO_2 Model Results

Dependent variable : CO_2 emissions per capita			
Variables	Coefficients	Standard Errors	P – value
D(ln GDP)	4.2689	0.934402	0.0001
D(ln GDPS)	-0.3086	0.081968	0.0006
D(ln EC)	0.8830	0.124838	0.0000
D(ln FDI)	0.0122	0.006658	0.0748
D(TO)	0.0006	0.001195	0.5826
D(UR)	0.0075	0.007869	0.3451
ECT(-1)	-0.8872	0.073200	0.0000
R^2	0.997		
Adjusted - R^2	0.996		
DW statistics	2.11		
F- statistics Probability	0.0000		

Source: Author own estimation from Data

Diagnostic Tests:

The ARDL (1, 0 0, 0 , 0 ,0 ,0) model was selected based on the selection criteria which recommended AIC criteria due to its lower value than the other models shown in Appendix IV. The CUSUM and CUSUMSQ test shows that the lines are inside the boundaries and the model is structurally stable as presented in Figure 4.7 and Figure 4.8. The negative value of error correction term indicates that any shock to the system will be adjusted towards equilibrium by 88% a year.

The value of R^2 was 0.997 that suggests that 99.7 percent variation in the model was explained by the explanatory variables. The probability value of F statistics is highly significant and revealed that the overall model is fit. The Durbin – Watson statistics is an indication of autocorrelation with its value higher than R^2 depicts the model is stationary and without any unit root.

Normality Test:

The results of JB was reported in the table. The P- value "0.54" of Jarque- Bera statistics (1.205) is greater than 0.05 which leads to accept the null hypothesis that data are normally distributed.

Table 4.7.1

Normality test	
JB- Statistics	1.205
Probability	0.547

Serial Correlation LM Test:

H_0: No serial Correlation among residuals

H_0: would be rejected if the p value is < 0.05.

As the P- value "0.755" of R- squared (0.561) is greater than 0.05, which clearly indicates to accept the null hypothesis, that there is no serial correlation among residuals.

Table 4.7.2

Serial Correlation LM Test			
F- Statistics	0.216	Probability	0.806
R- squared	0.561	Probability	0.755

Heteroscadasticity:

H_0: No heteroscadasticity
H_0 : This will be rejected if P- value is greater than 0.05.
The corresponding P- value "0.69" of R- square (4.70) is greater than 0.05. This suggests the acceptance of H_0 that there is no heteroscadasticity.

Table 4.7.3

Heteroscadasticity			
F- Statistics	0.613	Probability	0.740
R- squared	4.70	Probability	0.69

4.6. Ecological foot print

4.6.1. Long Run Ecological Foot Print Model Results:

Findings corroborated that per capita consumption of ecological foot print as an indicator for environmental degradation has significantly positive relationship with per capita real GDP and the long run coefficient value of 0.81 means that 1% growth in GDP per capita surge up ecological foot print by 0.81 % and the square term of GDP per capita has negative impact on ecological foot print in the long run and its coefficient value of -0.07 shows that 1% increase in square term of real GDP per capita reduce the ecological foot print consumption per capita by 0.07 percent. This positive value of GDP per capita and negative value of Square term of real GDP per capita confirms the validity of Environmental Kuznet curve for Pakistan. These findings are supported by the study conducted by Mrabat and Alsamara (2016) who identified that ecological foot print supports the environmental Kuznet Curve for Qatar.

Similarly the energy consumption has positively significant impact on ecological foot print and its coefficient value of 0.62 shows that one percent increase in the energy consumption in the long run rises the per capita ecological foot print consumption by 0.62 percent. This means that enhance use of fossil fuels and non- renewable energy resources required for growth in the economy bring deterioration in the environmental quality. Findings are supported by the studies conducted by Mrabat and Alsamara (2016).

The inflow of FDI to the country has significantly positive impact on ecological foot print and its long run coefficient value depicts that one percent rise in FDI inflow to the country promote per capita ecological foot print consumption by 0.05 percent that support the theory of Pollution haven hypothesis (PHH) which states that any kind of foreign direct investment by Industrialized nations in developing countries occurred at the cost of environmentally unsound practices. If a country adopt to globally environmental standards, then investment by foreign countries will be focused on shift of clean and green technologies. These findings are supported by study conducted by Acharya (2009).

Trade openness as a percentage of GDP have negatively significant impact on per capita ecological foot print consumption and its long run coefficient value of 0.006 shows that one percent increase in trade openness decreases ecological foot print by 0.006 percent. This type of relationship would occur due to transfer of clean technologies. These findings are supported by Aydin &Turan (2020).

Lastly, urban population shows negatively insignificant effect on ecological foot print consumption per capita. However the negative effect of urban Population on ecological foot print is supported by the study conducted by Ozturk et al. (2016) who find the same relationship between urbanization and ecological foot print. Such type of inverse relationship may occur with the increase in income level and increased awareness among the policy makers for urban planning that is intended to reduce escalation in environmental degradation.

Table 4.8 Long Run Ecological Foot Print Model Results

Dependent Variable: ln EF (Ecological foot print consumption per capita)			
Variables	Coefficients	Standard Errors	P – value
ln GDP	0.812	0.418	0.0612
ln GDPS	-0.070	0.032	0.0405
ln EC	0.625	0.290	0.0394
ln FDI	0.051	0.024	0.0444
TO	-0.006	0.003	0.0468
UR	-0.027	0.019	0.1736
C	-6.588	1.745	0.0007

Source: Author own estimation from Data

4.6.2. Error Correction Model: Short Run Ecological Foot Print Results:

The elasticities of short run co integration and error correction model using differencing method of time series variable are presented in table 4.9.

The findings revealed that GDP per capita have significantly positive impact on per capita ecological foot print consumption with its coefficient value of 0.66 suggests that one percent increase in GDP per capita worsen the environmental degradation by 0.66 percent and the square term of GDP per capita have significantly negative effect on per capita ecological foot print consumption with its coefficient value of -0.05 suggests that one percent increase in square of GDP per capita decline per capita ecological foot print consumption upto 0.05 %.

The energy use per capita had significantly positive effect on per capita ecological foot print consumption with its coefficient value of 0.51 suggests that one percent rise in energy use will enhance the per capita ecological foot print consumption by 0.51 percent. The foreign direct investment have positively insignificant effect on per capita ecological foot print consumption.

Trade openness show negatively significant relationship with the environmental degradation and its coefficient value corroborates that one percent increase in trade openness declines the per capita ecological foot print consumption by 0.005 percent.

Moreover, urban Population have positively significant effect on per capita ecological foot print consumption with its short run coefficient values of 0.80 depicts that rise in urban population by one percent brings 0.80 % increase in per capita ecological foot print consumption. Findings of the study are supported by lanouar (2017) who also found significantly positive relationship between ecological foot print and urbanization.

The negative value of error correction term indicates that any shock to the system will be adjusted towards equilibrium by 84.26% a year.

Table 4.9 Short Run Ecological Foot Print Model Results

Dependent Variable: ln EF (Ecological foot print consumption per capita)			
Variables	Coefficients	Standard Errors	P – value
D(ln GDP)	0.668	0.347	0.0634
D(ln GDPS)	-0.057	0.026	0.0391
D(ln EC)	0.514	0.274	0.0702
D(ln FDI)	0. 017	0.014	0.2226
D(TO)	-0.005	0.002	0.0408
D(UR)	0.807	0.217	0.0004
ECT(-1)	-0.822	0.136	0.0000
$\boldsymbol{R^2}$	0.940		
Adjusted - $\boldsymbol{R^2}$	0.922		
DW statistics	2.25		
F- statistics Probability	0.0000		

Diagnostic Tests:

The ARDL (1, 0 0, 1, 0 ,0 ,1) model was selected based on the selection criteria which recommended AIC criteria due to its lower value than the other models shown in Appendix V. The CUSUM and CUSUMSQ test shows that the lines are inside the boundaries and the model is structurally stable as presented in Figure 4.9 and 4.10. The value of R^2 was 0.940 that suggests that 94.0 percent variation in the model was explained by the explanatory variables. The probability value of F statistics is highly significant and revealed that the overall model is fit. The Durbin – Watson statistics is an indication of autocorrelation with its value higher than R^2 depicts the model is stationary and without any unit root.

Normality Test:

The results of JB was reported in the table. The P- value “0.84” of Jarque- Bera statistics (0.33) is greater than 0.05 which leads to accept the null hypothesis that data are normally distributed.

Table 4.9.1

F- Statistics	0.331
Probability	0.847

Serial Correlation LM Test:

H_0: No serial Correlation among residuals

H_0: would be rejected if the p value is < 0.05.

As the P- value “0.2525” of R-squared (2.75) is greater than 0.05, which clearly indicates to accept the null hypothesis, that there is no serial correlation among residuals.

Table 4.9.2

F- Statistics	1.043	Probability	0.365
R- squared	2.75	Probability	0.2525

Heteroscadasticity:

H_0: No heteroscadasticity

H_0 will be rejected if P- value is greater than 0.05.

The corresponding P- value “0.125” of R- square is greater than 0.05. This suggests the acceptance of H_0 that there is no heteroscadasticity.

Table 4.9.3

F- Statistics	1.76	Probability	0.1148
R- squared	13.91	Probability	0.1253

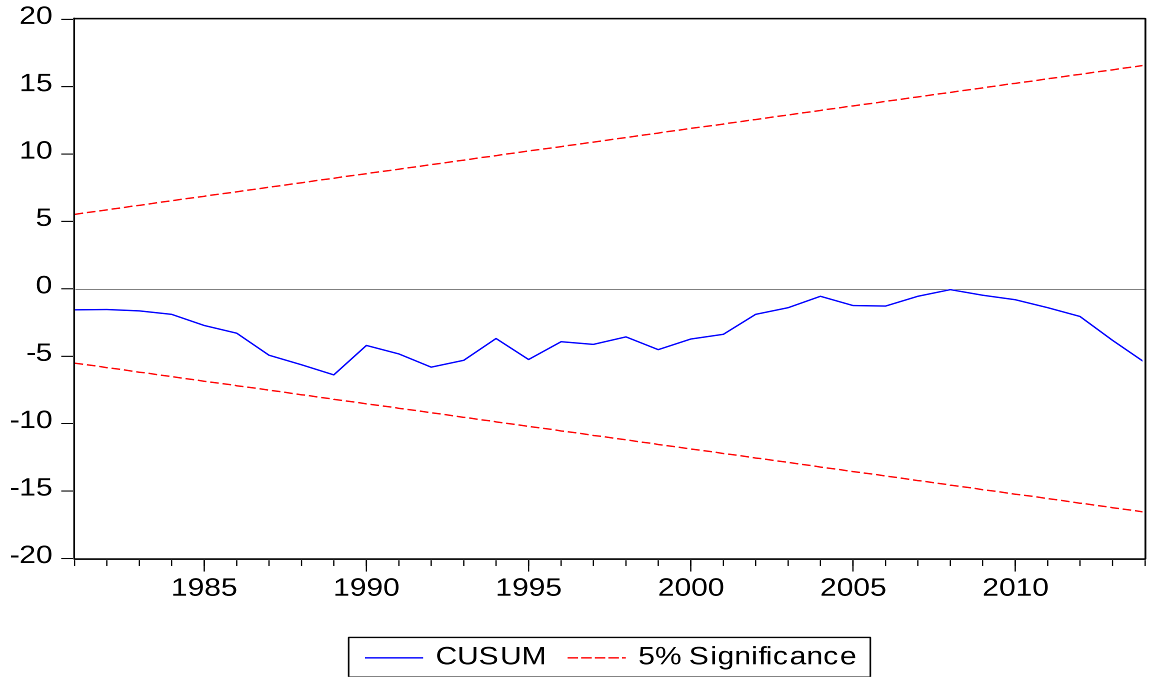

Figure 4.7: CUSUM Test OF Stability (CO_2 Model)

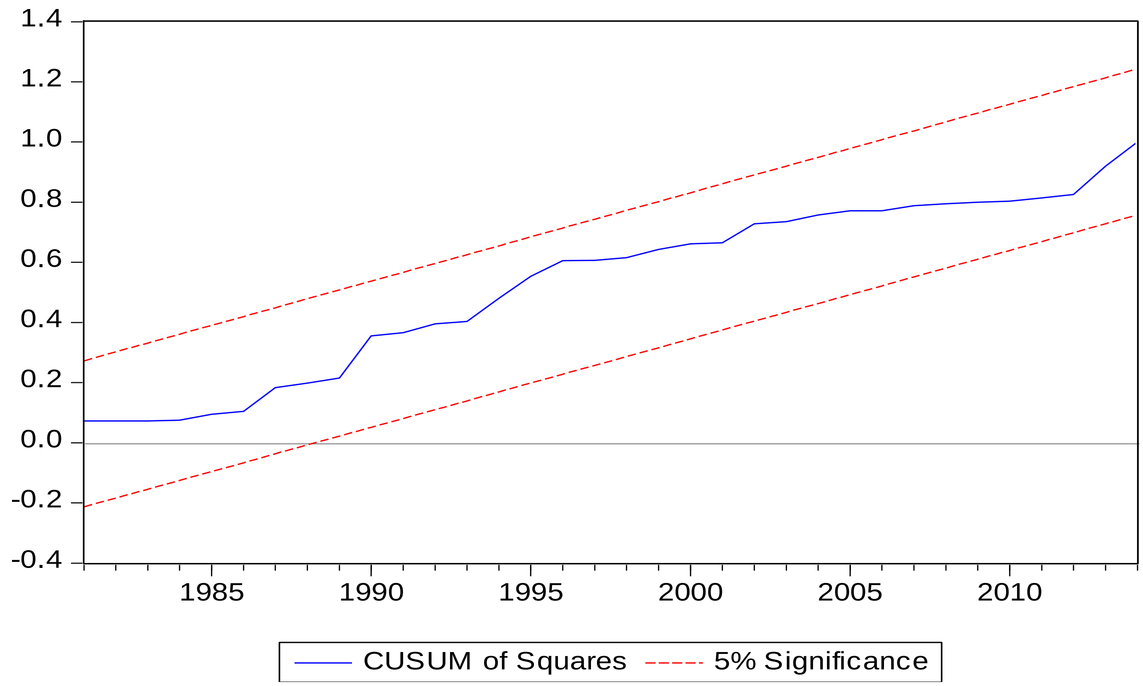

Figure 4.8: CUSUMSQ Test of Stability (CO_2 Model)

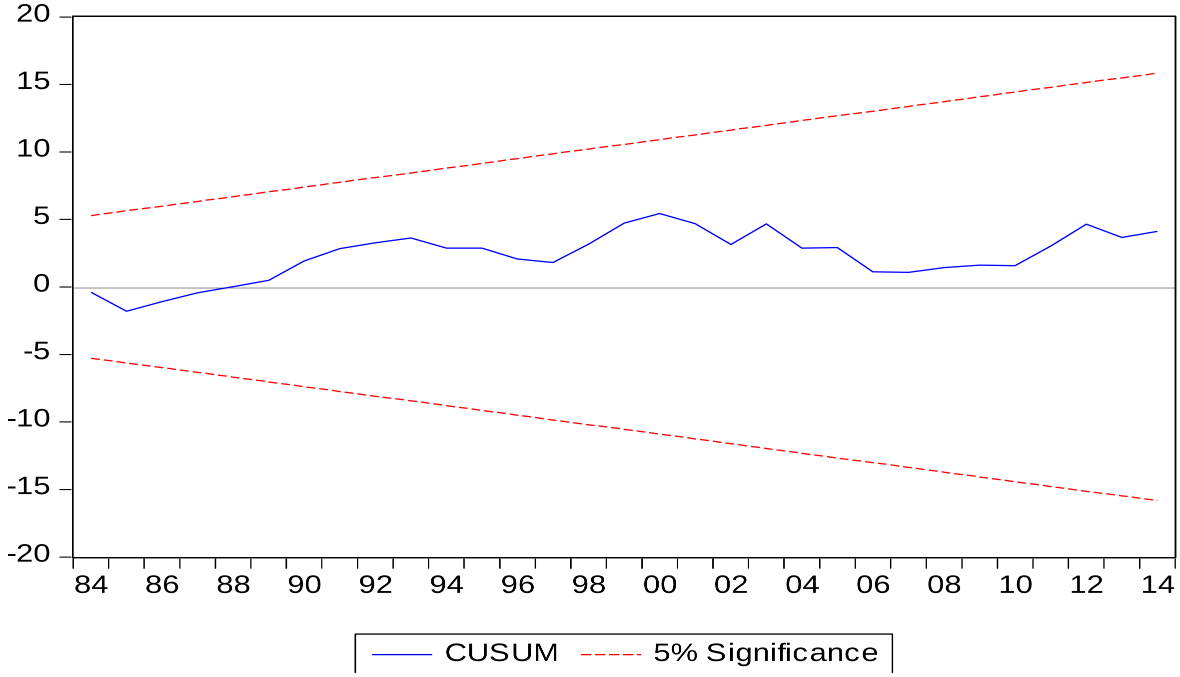

Figure 4.9: CUSUM Test of Stability (Ecological Model)

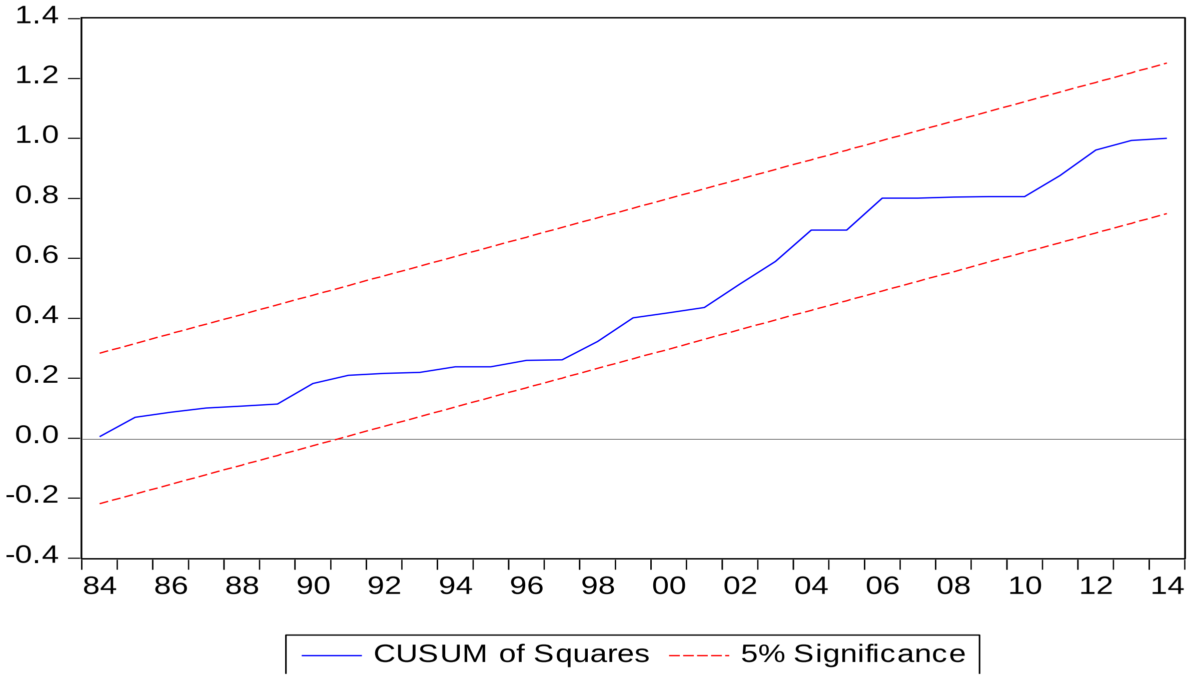

Figure 4.10: CUSUMSQ Test of Stability (Ecological Model)

Threshold Level Of income

The coefficient value of Per capita real GDP and its square term are 4.81 and – 0.34 and its turning point will be calculated from equation 3.3 given as:

$$Y_p = \exp(-4.81/-2(-0.34)$$

$$Y_p = \$ \ 1180.15$$

The threshold level of Income was 1180.15 dollars that implies that any growth in GDP per capita beyond this level of income will promote environmental sustainability. However, the calculated threshold level of income is greater than the highest value in our sample.

V. Summary, Conclusion and Recommendations

5.1 Summary

This research is an effort to check the validity of inverted U shaped Environmental Kuznet curve for Pakistan using a quadratic function between growth in per capita real GDP, Carbon dioxide emission and ecological foot print as an indicators for environmental degradation. The annual time series data was used to meet the objectives of the study over the time period of 1971-2014. The annual data on environmental and various macroeconomic indicators such as CO_2 emission, ecological foot print consumption per capita, Per capita real GDP, energy use per capita, trade openness, FDI inflow and Urban Population was accessed from World Bank development indicators and Global foot print network. Before proceeding to co integration analysis, all the variables were tested for stationarity through an application of Augmented Dickey Fuller (ADF) test. Findings of the Augmented Dickey Fuller test revealed mixture of stationarity as some of the variables are stationary at level and some are differenced stationary. This mixed order stationarity suggests use of ARDL model which has been favored over the other models due to its certain distinguishable Characteristics. This model provide reliable results for all the 3 cases where variables are stationary at level, Ist difference or mixed order of integration and it becomes more effective when the sample size is below 30. This approach offers us with some explicit tests to check whether co integration exist despite of assuming the presence of vector variables. Finally the Pesaran and Shin (1997) proposed that lag selection is effective in dealing with endogeneity problem and control of serial correlation problem.

The Auto regressive distributive lag model involves the selection of maximum numbers of lags for the model and the lags were selected using the AIC, SC, HQ, FPE, LR on the basis of VAR model. The findings of VAR model suggests the selection of 4 lags to be utilized in ARDL model. To investigate the existence of long run relationship among variables, bound testing approach was applied and its findings confirmed the existence of co integration relationship for both the models. Finally, the ARDL approach to co integration was used to find the short run elasticities associated with the long run relationship.

In the first stage, the study evaluated ARDL model (1, 4, 4, 3, 3, 0, 3) for CO_2 emission using 4 as well as 3 lags on the recommendation of selection criterion of VAR model but all the variables were statistically insignificant except energy consumption per capita and the model was highly affected with the problem of heteroscadasticity and autocorrelation problem. Then the study evaluated ARDL model (1, 0, 0, 0, 0, 0, 0) using 2 lags and the findings show that the impact of Per capita real GDP on environmental quality was highly significant with its coefficient values of 4.81 and 4.26 in the long run as well as short run. This shows that 1 percent rise in real GDP per capita aggravate the environmental degradation by 4.81% and 4.26% both in the long run and short run respectively. The coefficient values of Per capita GDP^2 was -0.347 and -0.308 in the long and short run and it implies that with one percent increase in square of GDP per capita the environmental degradation will be declined by 0.347 percent and 0.308 percent in both period of time that confirms the validity of environmental Kuznet curve for Pakistan. Similarly the impact of energy use was positively significant and its long run coefficient value of 0.99 percent and short run coefficient value 0.88 percent revealed that one percent increase in the energy consumption enhances the environmental degradation by 0.99 percent and 0.88 percent. The inflow of FDI has positively significant effect on environmental degradation and its coefficient values depicts that one percent rise in inflow of the foreign direct investment promote environmental degradation by 0.013 and 0.012 percent in the long as well as the short run confirming the validity of theory of pollution haven hypothesis. Furthermore, trade openness and urban Population have positively insignificant impact on environmental degradation. The ECT was statistically significant with its calculated value of -0.8872, and the negative value indicates that any shock to the system will be adjusted towards equilibrium by 88.72 percent in a year. To test the structural stability the CUSUM and CUSUMSQ were used. The findings support the structural stability in the model as the lines are within boundaries lines. All the diagnostic tests such as Serial Correlation LM test, Heteroscadasticity, and Structural Stability tests ensured the validity of the estimation.

Next, the study evaluated ARDL model for ecological foot print and the findings revealed that the impact of Per capita real GDP on environmental quality was highly significant with its elasticity values of 0.81 and 0.66 in the long run as well as short run. This shows that 1 percent rise in real GDP per capita aggravate the environmental degradation by 0.81% and

0.66% both in the long run and short run respectively. The coefficient values of Per capita GDP^2 was -0.07 and -0.05 in the long and short run and it implies that with one percent increase in square of GDP per capita the ecological foot print will be reduced by 0.07 percent and 0.05 percent respectively in both period of time. Similarly the impact of energy use was positively significant and its long run coefficient value of 0.625 and short run coefficient value 0.514 revealed that one percent increase in the energy consumption surge up the ecological foot print by 0.625 percent and 0.514 percent. The inflow of FDI has positively significant effect on ecological foot print in the long run and its coefficient values depicts that one percent rise in inflow of the foreign direct investment increases the ecological foot print by 0.05 percent. This type of relationship confirms the validity of theory of pollution haven hypothesis. However, FDI has positively insignificant effect on ecological foot print in the short run. Furthermore, trade openness have negatively significant impact on environmental degradation with its long run and short run coefficient values of -0.006 and -0.005 which corroborates that one percent increase in the trade openness declines the ecological foot print by 0.006 and 0.005 % respectively. Finally, urban population shows negatively insignificant relationship with the ecological foot print in the long run while its effect was positively significant in the short run and its coefficient value depicts that one percent increase in the urban population triggers the level of ecological foot print by 0.80% in the short run. The ECT was statistically significant with its calculated value of -0.822, and the negative value indicates that any shock to the system will be adjusted towards equilibrium by 82.2 percent in a year. To test the structural stability in the model, the CUSUM and CUSUMSQ tests were used. The findings support the structural stability in the model as the lines are within boundaries lines. All the diagnostic tests such as Serial Correlation LM test, Heteroscadasticity, and Structural Stability tests ensured the validity of the estimation.

5.2 Conclusion:

The study conducted was aimed to ensure the validity of Environmental Kuznet Curve for Pakistan through comparing CO_2 emission and ecological foot print as an indicator for environmental degradation by applying ARDL Bound testing procedure of co integration. The Findings confirmed the existence of long run and short run relationship among the variables in both the CO_2 and ecological model. The GDP per capita having positive impact on environmental degradation. The Per capita GDP^2 have negative impact on environmental quality both in the short run and long run and its negative coefficient values depicts that any increase in Per capita income beyond the turning point will improve the environmental quality which ensured that both CO_2 emission and ecological foot print are suitable indicators for environmental degradation that supports Environmental Kuznet curve for Pakistan. The significantly positive impact of energy consumption per capita on CO_2 emission and ecological foot print in the short run and long run implies the excessive use of non - renewable energy resources. Foreign direct investment have significantly positive response towards CO_2 emission and ecological foot print in the short and long run that confirms the pollution haven hypothesis. Furthermore, the urban Population and Trade openness have positively insignificant impact on Carbon dioxide emission. Finally, trade openness shows significantly negative relationship with ecological foot print consumption both in the short and long run, while urban population have significantly positive impact on ecological foot print in the short run and its negatively insignificant effect was found in the long run.

5.3 Recommendations:

Following recommendations are given based on the findings of the research:

- Findings of the study shows positively significant association of energy consumption with environmental degradation. To promote sustainable development and sustainable environment, a policy needs to be implemented that is effective in promotion from non- renewable energy resources towards renewable energy resources to promote environmental sustainability. Beside these measures, at first reduction of subsidies fixed on fossil fuels and its elimination is of utmost importance. The consumption of coal energy needs to be minimized.

- The findings of the study revealed the positive association between foreign direct investment and environmental degradation. Based on these findings an effective implementation of National environmental policy of 2005 is required that ensure the shift of environment friendly technology to the country.
- In fiscal reforms, Climate change and environment protection programs should be prioritized.
- The Clean development mechanism projects and REDD+ projects needs to be implemented to promote forest cover in country that reduces the risk of natural calamities and reduce emissions.

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APPENDICES

APPENDIX I: Descriptive Statistics

Variables	Mean	Std. deviation	Minimum	Maximum
ED	**0.643**	**0.220**	**0.308**	**0.991**
EF	**0.756**	**0.088**	**0.633**	**0.926**
GDP	**764.21**	**202.45**	**453.78**	**1111. 20**
EN	**405.107**	**76.908**	**285.178**	**523.76**
FDI	**833.18**	**1331.76**	**-40000**	**5590**
TO	**30.38**	**4.50**	**10.37**	**38.74**
UR	**31.35**	**3.70**	**25.08**	**38.30**

APPENDIX II. ARDL Model (1, 4, 4, 3, 3, 0, 3) 4 lags

APPENDIX IIA: Bound Test:

Dependent Variable	F statistics	Lower Bound	Upper Bound	Conclusion
D (lnED)	**11.18**	**2.45**	**3.61**	**Co integration exist**

APPENDIX IIB: Long Run CO_2 Model Results

Variables	Coefficients	Standard Errors	P – value
ln GDP	-10.597	5.086	0.0575
ln GDPS	0.925	0.413	0.0434
ln EC	1.910	0.245	0.0000
ln FDI	-0.045	0.024	0.0825
ln TO	0.001	0.0016	0.4818
ln UR	-0.022	0.017	0.2183
C	19.857	15.008	0.2086

APPENDIX IIC: Short Run CO_2 Model Results

Variables	Coefficients	Standard Errors	P – value
D(LGDP)	12.1940	6.731	0.0932
D(LGDPS)	-0.866	0.522	0.1215
D(LEC)	0.774	0.234	0.005
D(LFDI)	0.007	0.011	0.551
D(LTO)	0.001	0.0017	0.4976
D(LUP)	-0.0456	0.489	0.9271
ECT (-1)	-1.066	0.153	0.0000

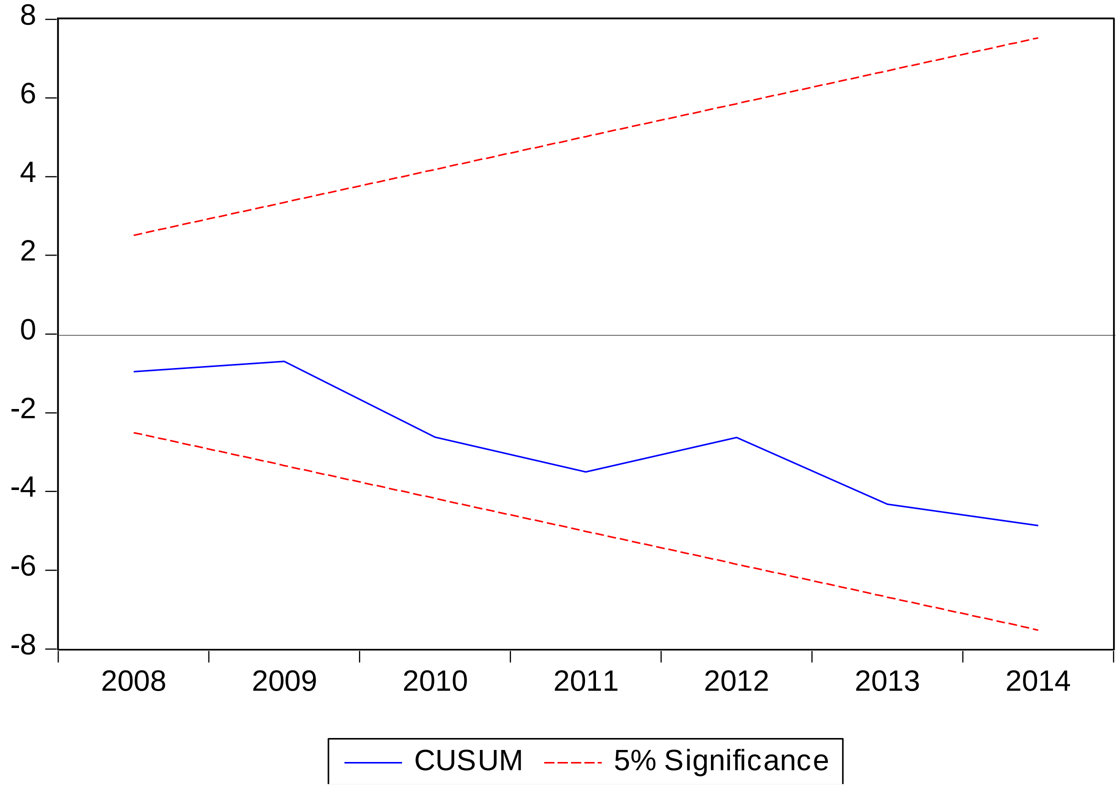
Source: Author own estimation from Data

APPENDIX IID: Diagnostic Tests:

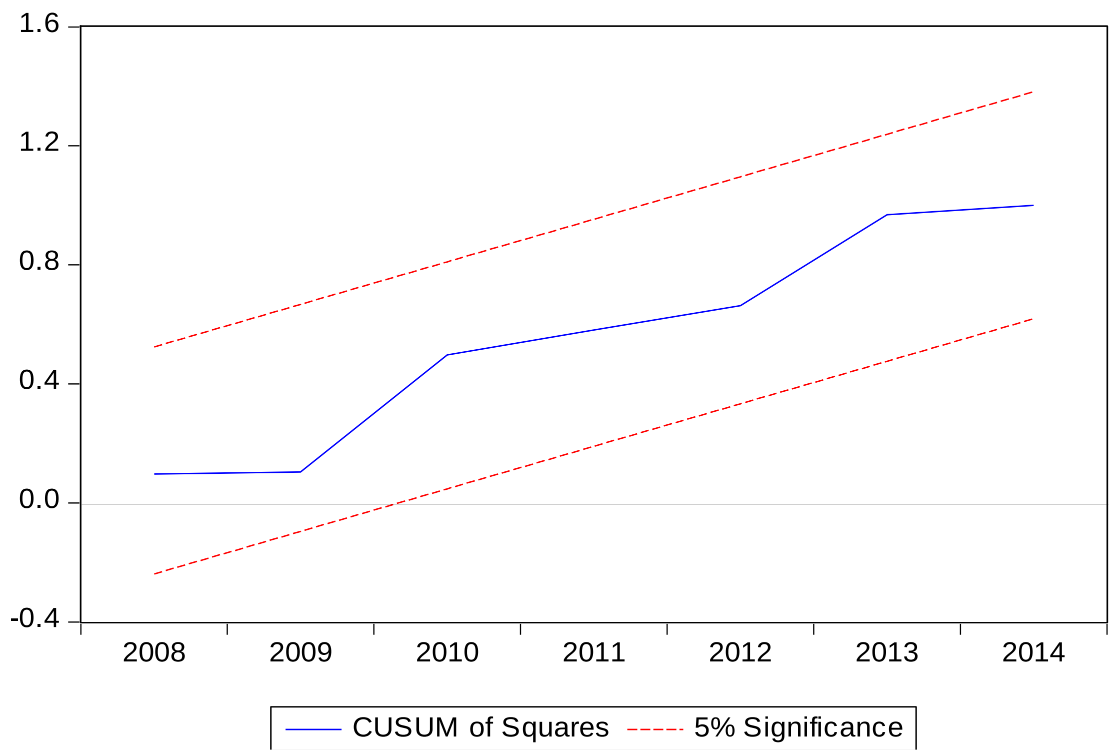
R- Square	0.999
Adjusted R- Square	0.998
DW statistics	2.68
F- statistics Probability	0.0000
JB statistics Probability	0.726
Heteroscadasticity: Breush Pagan Godfrey	1.0000
Breush Godfrey Serial correlation LM Test Probability value	0.0001

Source: Author own estimation from Data

APPENDIX IIE: CUSUM Test OF Stability



APPENDIX II F: CUSUM Square Test OF Stability



ARDL Model (2, 3, 3, 3, 3, 0, 3) 3 lags

APPENDIX IIA: Bound Test:

Dependent Variable	**F statistics**	**Lower Bound**	**Upper Bound**	**Conclusion**
D (lnED)	**4.38**	**2.45**	**3.61**	**Co integration exist**

APPENDIX IIIB: Long Run CO_2 Model Results

Variables	Coefficients	Standard Errors	P – value
ln GDP	-5.606	4.386	0.2220
ln GDPS	0.512	0.355	0.1715
ln EC	1.432	0.205	0.0000
ln FDI	-0.022	0.020	0.3048
TO	0.0009	0.001	0.4907
UR	-0.003	0.012	0.7734
C	6.615	13.104	0.5451

APPENDIX IIIC: Short Run CO_2 Model Results

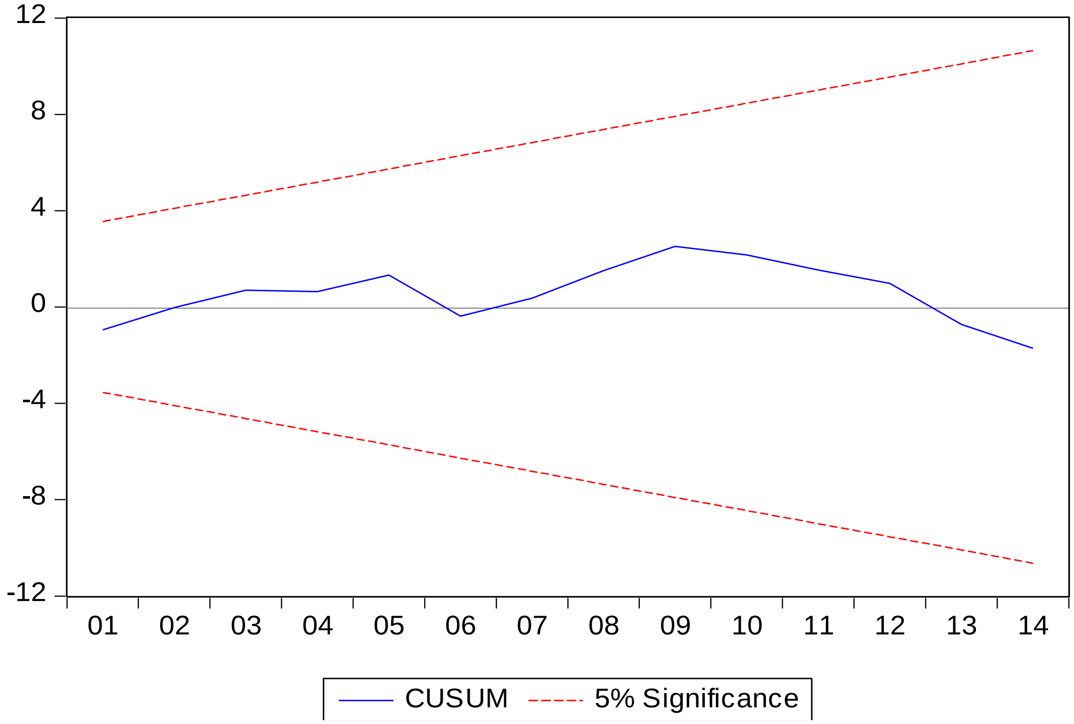
Variables	Coefficients	Standard Errors	P – value
D(ln GDP)	12.23	7.81	0.139
D(ln DPS)	-0.83	0.61	0.1961
D(ln EC)	0.457	0.255	0.0947
D(ln FDI)	0.012	0.012	0.325
D(TO)	0.001	0.001	0.502
D(UP)	0.370	0.525	0.4917
ECT (-1)	-1.403137	0.369	0.0020

Source: Author own estimation from Data

APPENDIX IIID: Diagnostic Tests:

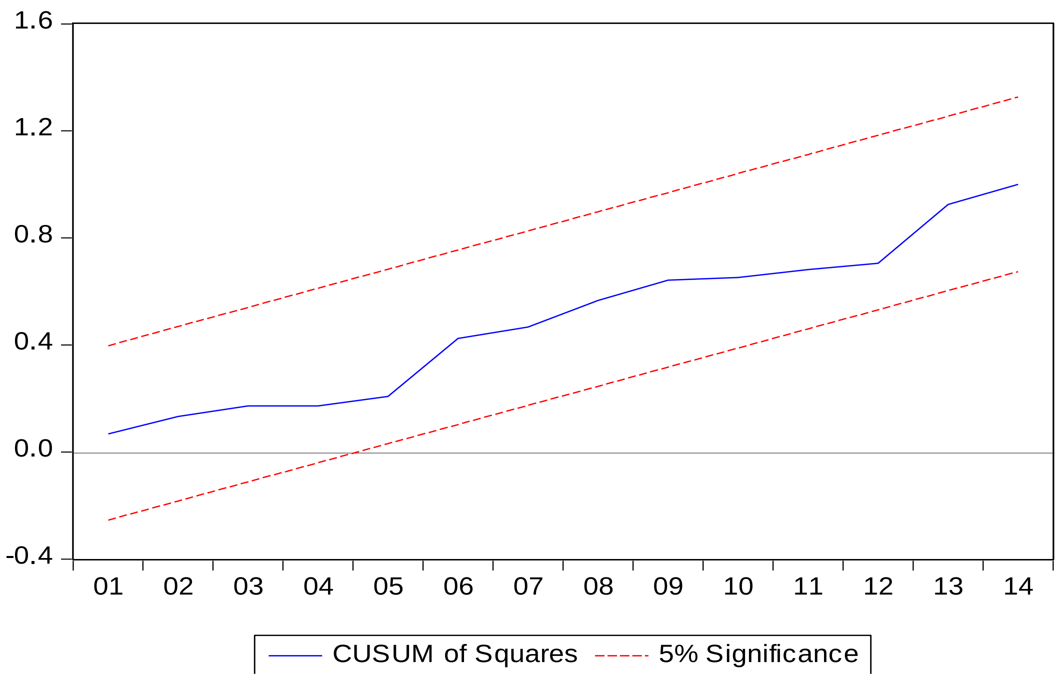
R- Square	0.999
Adjusted R- Square	0.998
DW statistics	2.41
F- statistics Probability	0.0000
JB statistics Probability	0.95
Breush Pagan Godfrey	1.0000
Breush Godfrey Serial correlation LM Test Probability value	0.0010

APPENDIX III F: CUSUM Test OF Stability



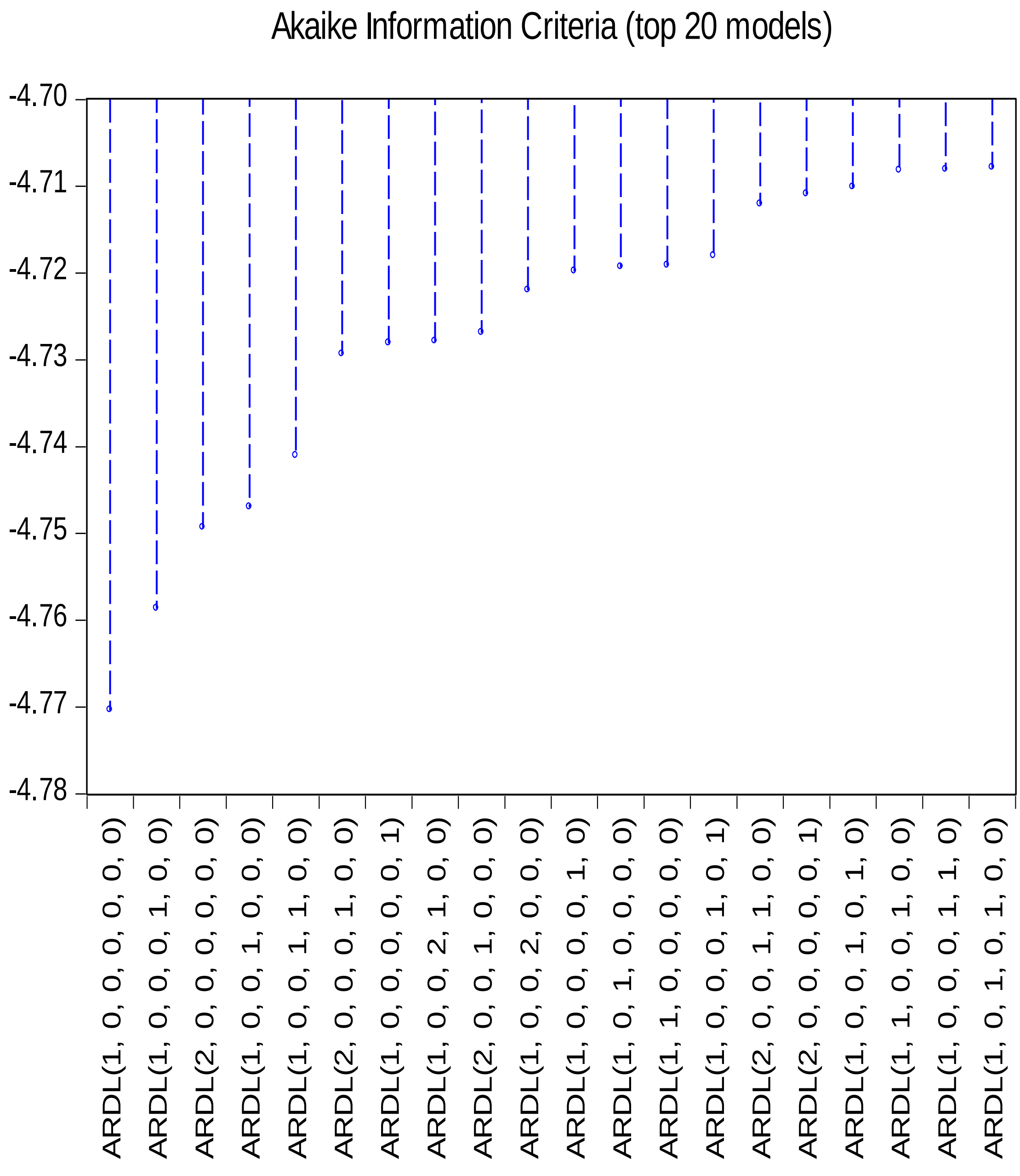
Source: Author own estimation from Data

APPENDIX III F: CUSUM Square Test OF Stability



Source: Author own estimation from Data

APPENDIX IV: Model Selection Summary (AIC):



APPENDIX IV: Model Selection Summary (AIC):