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Empirical Existence of Environmental Kuznets Curve

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Abstract
In this dissertation Environmental Kuznets Curve (ECK) is conjectured to investigate the affiliation among co2 emission per capita, gross domestic product P_C, trade openness, number of vehicles and services sector output by using time series data from 1972 to 2014. To explore association among indicators ARDL (a tactic of co-integration) is utilized in the dissertation. By the dint of statistical data study puts two and two together and Sum and substance of results is Environmental Kuznets Curve between Co2 Emission per capita and Gross Domestic Product P_C exists. Square of Gross Domestic Product $P_C$one and only device which is environmental friendly and give some relief from the pollution but remaining all stimulus e.g. Trade openness, number of vehicles and services sector also incorporate into smog of the economy.

Keywords: Environmental Kuznets Curve, Co2 Emission, Gross Domestic Product P_C, Trade Openness
JEL Codes: Q1, B17, O

I. Introduction

The concept letting humankind "have our cake and eat it" (Rees, 1990) gradually polluting environment of the planet. Scale effect and materialism are polluting bluntly, environment of the earth. According to social scientist economic growth require more usage of energy and raw material which produce a sound quantity of byproducts, extraction of natural resources, waste accumulation, water contamination and co2 emission are continually polluting air, water and land quality. All these activities increase coerce on biosphere. In result degradation of environment leads to climate change and almost all economies paying for it in the figure of low productivity in agriculture and extra expenditure in health sector. This situation is insufferable for developing countries because they are polluting less but paying much for these negative externalities. "Are there trade- offs between economic growth and environmental degradation" question is unanswered till date.

Complete elimination of environmental problems like hard nut to crack. In 1990s phenomenon environmental degradation was blue eye boy for economist. Recent studies suggest that large part of pollution contributed by co2. Very vast range of studies stress on environmental friendly growth. A large number of article already exist in literature which call attention to a common point of view that environmental deterioration positively linked with fortune of the country in early stage but after to gain ground, situation reversed. *Environmental Kuznets Curve* basically shows a systematic relationship between different pollutants of the economy and income per capita. The Environmental Kuznets Curve for brevity study will call ECK describe degradation of environment firstly increase, after making headway, environment tends towards improvement. In simple words ECK shows inverted "U" shape relation of pollution and growth in the economy. Environmental Kuznets Curve shows transition of polluting economy to industrialization and then as a services intensive economy Pandelismitsis (2012). Rich economies can afford better environmental conditions Dinda (2003). The Environmental Kuznets Curve(ECK) is fundamentally empirical Incidentstern, (2004). Research involve in letter and spirit but some investigators do bad econometric or apply unsuitable techniques to prove the relationship. The Environmental Kuznets Curve is facing a burst of condemnation both theoretical and conceptual viewpoints stern (2004) and Wagner (2015). But when study takes under consideration correct statistical techniques in reality, the EKC do not happen Perman and Stern (2003). As a substitute study find monotonically increase in pollution due to some air pollutants CO_2, SO_2, CO, NO_X.

Discussion on appropriate technique and strategy for model specification to be continue. To bridge over among the economist out of the question, so a long list of researchers has doubtful arguments on modeling and specification of environmental Kuznets curve; see for example, Perman and Stren (2003), Galeotti et al (2006), Dinda and Coondoo (2006), Harbaugh et al (2002), Jalil and Muhammad (2009), Wagner (2015). Environmental degradation is a global problem and major element to change in climate. Seasonal variation can interrupt the agricultural output of the economy. Study incorporates two-year extra data from previous researchers and uses relative measure of pollution or emission. Study also introducing services sector output as explanatory variable to understand more precisely changeability in the economy. Environmental degradation will be tested by using time series data for the period of 1972 to 2014 although data source are different official websites e.g. world development indicators, hand book of statistic published by state bank of Pakistan and various economic survey on Pakistan's economy. Methodology depends on the stationarity level of the variables. The most important focus of this study is to find out empirically existence of inverted "U" shaped Environmental Kuznets Curve in Pakistan.

1. First part of the research roofed with idea about Environmental Kuznets Curve, meaningfulness of study, research query, objective, supposition and body of the study
2. Second part present conceptual and theoretical background of Environmental Kuznets Curve.
3. Third part concentrate on the review of the earlier literature. It has four sections: introduction, review from past study (literature review), summary table and conclusion. Most of the literature focus cross sectional analysis.
4. Fourth part discuss the data and methodology of the study and elaborate some hypotheses. Short and long run equation and estimation of ECM model included also in the 4th chepter.
5. Results and discussion is the fifth part of this study, it consists of six sections that are, introduction, descriptive analysis (including mean, median, S.D, skewedness and kurtosis), unit root test statistic, result table for ARDL and conclusion also part of present part.
6. Sixth part is about the conclusion and policy recommendation about this study.
7. Part 7th is the Last part that shows references of all those studies which are helpful to the researcher's.

II. Conceptual and Theoretical Background

Conceptual and theoretical background of Environmental Kuznets Curve is helpful in understanding major reasons for environmental deterioration. Present part will discuss both perspective of phenomenon more accurately. Firstly, study will explore all possible economic reasons of turning point in ECK by considering conceptual `point of view. After then theoretical reason will be described in this part. At the end conclusion will be presented.

Growth controversy and related polices are responsible in emergence of Environmental Kuznets Curve (EKC). Previous dissertation stress level of income increases environmental pollution and then at higher level of income develops the environment Beckerman, (1992). Economic growth could a powerful factor for the betterment of global pollution (Panayotou, 1993). The question *'which economic growth is helpful in maintenance of the environment'* still answerable. Relationship between both indicators of Environmental Kuznets Curve (EKC) growth and pollutants are object of long debate. Before 1970 economist harp on the same string that raw material positively linked with economic growth but Club of Rome's limit to growth view emphasis at limitlessness of raw material. Empirical and theoretical weakness of this point of view is rationale for the criticizers to step in and debate.

In 1990s with the availability of empirical data on environmental degrading indicators like co_2, it was very easy to prove the validity and health of Environmental Kuznets Curve. 1991 was the year when silent breakdown and empirically tested inverted 'U' shaped curve introduced by the Grossman and Krueger in NBER working paper. After then a list of researcher follow the NBER working paper.

II.I. Admittance of Environmental Kuznets Curve

Simon Kuznets a researcher who pointed out relationship between growth and income inequality. Income inequality firstly rise then approaching after a specific level of growth, inequality diminishes referred by Kuznets curve. After 1990s Kuznets curve represented with a new theory. Parabolic image can be seen at graph when somebody wants to draw Environmental Kuznets Curve. Homogeneously Kuznets curve and Environmental Kuznets Curve (ECK) are similar graphically but oscillate in variables. Both firstly rise and then fall after accomplishing growth in previous decade Environmental Kuznets Curve was a highway for understanding, up and down relationship but interestinglyPanayotou(1993) was first who coined as Environmental Kuznets Curve.

II.II. Conceptual downplay

Economic growth can alter the environmental condition in both ways. It just depends upon environmental awareness and environmental friendly technologies. Pollution increases with the increase in per capita income but after threshold level pollution deteriorate.

Pollutants

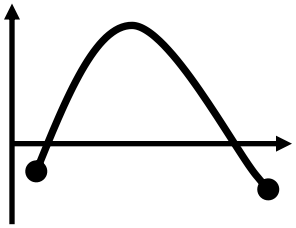

Fig 1

Environmental Kuznets Curve

Vertical axis shows pollutants and horizontal ones shows income percapita. Curve shows degradation firstly increase after growth in income, pollution deteriorate

Fortune of the Economy

Relationship can be seen in fig 1 very similar case to Kuznets curve (1955) but definitional point of view of Environmental Kuznets Curve shows systematic relationship between growth and pollutants in the long run. At take off stage more resources used by the industries then regeneration of the resources. Waste of the industries and by products increase toxify ratio. When economy changes from industrialization to services economy awareness of environmental friendly technique provoke among the generations then better knowledge and higher expenditure on environmental cleanliness, then before, a cause to downfall of Environmental Kuznets Curve (EKC). It's a natural process of economic development from clean agrarian economy to dirty industrial economy and finely economy bow down services intensive economy (arrow et al 1995).

II.III. Enlightenment of Environmental Kuznets Curve

Environmental Kuznets Curve is a long run phenomenon in true sense,because in the long run pollution increases at low level of income after a threshold level, relationship reversed. In simple words it's a development trajectory approach which express stages of development in an economy. By assuming a single Environmental Kuznets Curve for all countries in cross section data anyone reach on conclusion that underdeveloped countries or low income economies belong to increasing part of environmental Kuznets curve, developing countries or middle income nations moving along turning point or decreasing stage and developed countries or high income countries touching decreasing level of pollution on Environmental Kuznets Curve. Under ceteris Paribus various economic indicators are responsible for shaping Environmental Kuznets Curve.

II.IV. Income elasticity of environmental worth and demand

A transition of economy from developing to developed is an indication of growing income. As income grows people demand for luxurious goods and defensive expenditure e.g. donation to environmental organizations and demand for environmental friendly products, help to change structure of an economy. Generally, researcher thought income elasticity is greater than unity but it's wrong because in low income communities as income rise pollution in the environment also raise. Its mean there are several more variables who are responsible to declining in Environmental Kuznets Curve rather than income. Most of the research articles stress upon income elasticity of environment Beckerman (1992), Carson et al., (1997) Chaudhuri and Pfaff, (1998)McConnell, (1997). Poor people have little demand for environmental health but as well as income rise, rich people demand for better environment also. In literature major contribution in degradation of environment just because of institutional reforms, through legislation and market based reforms.

II.V. Scale effect

Economic growth alters the environment by three different channels i) scale effect ii) composition effect iii) technological effect Grossman and Krueger (1991). Increase in output requires more inputs, in result increase in waste and by products or environment enemies' product. Extensive use of natural resources reduces environmental quality. By this way scale effect negatively impact the environmental quality.

II.VI. Composition effect

Scale effect is negative in relation to environmental improvement but economic growth through composition effect positively alter the environmental quality. As income grows structure of economy also change due to increase in demand in environmental friendly products and defensive expenditure on environmental correction. Economies introduce more environmentally suitable technology. More pollution can be seen as structure of economy change from rural to urban but decline when structure change from urban to services economy So economic growth has also positive effect on environment through composition effect.

II.VII. Technological effect

Rich nations can spend more on research and development. In result economy introduce more latest technology. When economic growth occurs due to high income obsolete technology replaced by more clean environmental friendly technology. By this way economic growth helps in environmental improvement. The environmental Kuznets Curve express that environment degrade firstly by scale effect but after achieving economic growth its outweigh by composition effect and technological effect (Vukina et al., 1999).

II.VIII. International trade

Through international trade one can describe Environmental Kuznets Curve with a greater confidence. Trade helps to increase size of economy and expands export side. For export fulfillment scale effect occur and trade pollute the environment, but some economists thought differently. Trade can also improve the environment through composition effect and technique effect (Birdsall and Wheeler, 1993; Lee and Roland-Holst,1997; Jones and Rodolfo, 1995). Degradation from polluted goods can be shifted from one country to another. Through *Displacement Hypothesis and Pollution Haven Hypothesis* which are actually same one can understand more surely.

II.IX. Displacement Hypothesis

Environmental Kuznets Curve shows displacement of dirty industries from high level environmental protection legislative economies to low level regulation economies. Change in the structure of the production of economy do not emphasizes that consumption pattern also changed. Movement of polluted goods production industries from one country to other countries cannot be accompanied by similar changed in consumption. The displacement theory tells

that pollution intensive goods industries transfer from high level legislative economies toward more relax legislative economies.

II.X. Pollution Haven Hypothesis

Economic integration can helpful to improve the environment (Antweiler et al., 2001; Liddle, 2001). Pollution haven hypothesis suggest that high level environmental restricted economies lose all polluted industries and low level economies get them all. Displacement hypothesis and pollution haven hypothesis are different in names but vary similar in theory.

II.XI. Foreign direct investment (FDI)

A pollution haven hypothesis may not be rejected if developing economies set their regulations below the efficiency level and it's an ideal condition for polluting industries to displace. Mostly change of technology among nations take place by foreign direct investment. Through FDI improved techniques can reduce Environmental Kuznets Curve and then degradation in environment.

II.XII. Race to bottom

Pollution intensive industries faces high level of restriction in developing countries and pay more than their counterparts in developing countries. By this reallocation procedure take place and capital outflow come into existence. Increase in capital outflow vibrates the government to relax in environmental regulation. This process can be a cause in increase in environmental degradation.

II.XIII. Diffusion of technology

Also known as displacement of technology or dive through reason of Environmental Kuznets Curve. Economies spend more on Rand D to maintain income level. These type of expenditure helps to new invention and innovation. Which can reduce environmental pressure.

II.XIV. International assistance

Environmental degradation is a global issue. International organization can be helpful in reduction of environmental pollution. Awareness about polluters, pollution damages, techniques to overcome pollution problem, cost of abatement pollution site, strict regulation and the most importantly, education can play an admirable role in reduction of Environmental Kuznets Curve.

II.XIII. Globalization

Globalization helps to improve income level of whole globe. Induce in income can reduce environmental cons. Self-regulatory market mechanism for natural resources can deteriorate environmental pollution. Economic development may helpful in determine the markets because many economies have no locally traded natural resources markets. Because of long run phenomenon developing countries can shift from polluting energy resources to more environmental friendly energy resources. Extensive use of natural resources can be a reason for environmental degradation. As well as natural resources used supply for that particular resource diminishes and environment improves. When an economy establishes market mechanism prices goes higher and use for that natural resources reduces. Increase oil prices in 1970, introduced new ways to produce energy. Residents, companies, rule makers, watchdogs, non-government officialdoms and other market participants are all agents and important in reduction and increment of environmental pollution. Banker may refuse to advance loan to heavy polluter industries this can be helpful for environmental health. Consumer can refuse to consume heavily polluting products. Transition of centrally planned economy to market economy or at least, complete market failure economy to less market failure economy is suitable for environmental improvement. It can lead peak point of Environmental Kuznets Curve towards downfall.

III. Literature Review

Grossman and Kruger (1992) broke a new ground in environmental discussion and let the cat out of the bag that environmental degradation firstly increases but with the rise in income it declines. After that a number of economist gave ear and made faces of the same phenomenon. Scope of Environmental Kuznets Curve still a moot point. Sum and substance of previous literature will be discussed in the present part. A summary table and conclusion also part of this part.

Ahmed and long (2012) established empirical analysis on environmental Kuznets curve in Pakistan by using time series data from 1971 to 2012 and found significant relation between fortune of the country and pollution indicators. Study concluded that significant existence of Environmental Kuznets Curve in Pakistan. Researchers blamed at low level of gross domestic product, energy consumption, trade openness, and population density for environmental deterioration. Higher level of per capita income linked with improvement of the environment. Researcher also propose Some regulation imposed on traffic side for the improvement of environment.

Shahbaz et al. (2005) investigated the Environmental Kuznets Curve and the role of energy consumption in Pakistan by using Auto Regressive Distributed Lag (ARDL) technique. For this purpose, study used time series data from 1971 to 2009 with the objective of finding relationship involving Co_2 emission and energy consumption. Study showed energy consumption significantly degrading the environment in short and long run but trade openness improving environment in both time period cases. Study concluded with the existence of environmental Kuznets curve in Pakistan in short and long time period. Import of cleaning technology reexamination of scale effect transition into green economy, were Policy recommendations by the study organizers

Ali et al. (2014) showed a new economic dimension of environmental Kuznets curve in Pakistan by using time series analysis from 1972 to 2011. Auto Regressive Distributed Lag (ARDL) technique used by the researcher because some variables were stationary at level. Researchers were interested to find out validity of environmental Kuznets in case of Pakistan. Study showed satisfaction with previous founder of Environmental Kuznets Curve. Researcher suggested that sustain able economic development was necessary for the improvement of bad quality environment. Concentration on public investment and increase in Gross Domestic Product (GDP) growth were important initiative.

Ismail et al. (2014) organized study environmental Kuznets curve and so2 emission in Pakistan by using Auto Regressive Distributed Lag (ARDL) estimation technique. Researcher try to clear the doubt about correlation among so2 emission energy consumption trade liberalization population density in Pakistan. Study Utilized time series data from 1970 to 2008. According to study real income, trade liberalization and energy consumption are positively related with so2 emission but population growth and growth in Gross Domestic Product (GDP) improving the environment. Trade openness also improve the environment but in long run.

The study by FanandZheng (2013) examined relationship between economic growth and environment in Sichuan province of china. The study has been done weather in the province of china, Sichuan Environmental Kuznets Curve decline or not as well as per capita income increase. Quadratic and cubic model used by the investigators to prove theoretical point of view. In result discussion quadratic model support Environmental Kuznets Curve and cubic model emphasize inverted N shaped curve. Study conclude that environmental improvement closely related with awareness for the betterment of environment not with income.

Shahbaz et al. (2013) revisited the relationship between income of the country and pollutants. interestingly study conclude that environmental degradation firstly rise then fall when economy achieved a particular level of income per capita. Auto Regressive Distributed Lag (ARDL) bound test technique used to improve the econometric quality of the work. Green investment technologies and replacement of energy sources from coal to geothermal, biodiesel, wind, solar recommended by the researchers

Chaudhuri and pfaff (2004) conducted a study to examine rich person consume more cooking and heating services and poor generation spend less income. Researcher suggested that rich spoilless environment and poor persons pollute more. Reason given by the researcher that rich people purchase latest environmental friendly technology.

Cole and neumayer (2004) examined mutual understanding among demographic factors and pollutants. Cross-nation data used by examiners to reflect the conclusion that Co2 emission and population growth were unitary elastic. Urbanization and small size of household were responsible for pollution. Result table showed that both indicators were insignificant.

Basarir and arman (2014) studied about effects of economic growth on environment. By using Auto Regressive Distributed Lag (ARDL) method researchers found that income per capita positively linked with environmental deterioration. In short, in the era of 1970 to 2010 there is no any existence of environmental degradation. Study

incorporated opening ratio, energy consumption and human development index (HDI) as explanatory variables and all three showed negative understanding with Co_2 emission.

Saboori et al. (2012) put efforts to explore an empirical analysis of environmental Kuznets curve in Indonesia by observing role of energy consumption and foreign trade. Examination of previous record of Indonesia from 1971 to 2007 including variables real Gross Domestic Product (GDP), openness ratio and energy an evidence for Environmental Kuznets Curve. By using Auto Regressive Distributed Lag (ARDL) technique significantly Environmental Kuznets Curve appeared on graph paper.

Wagner (2015) studied about most common problem almost described in all literature that Environmental Kuznets Curve were econometrically weak and some researcher have ignored statistical properties of data. Appropriate technique suggested by Wagner reduced the evidence for Environmental Kuznets Curve. Researcher studied the Environmental Kuznets Curve co-integration and nonlinearity to clarify some conceptual shortcoming of Environmental Kuznets Curve in literature that arisen because of inadequate application of unit root and co-integration technique. Study used data 1870 to 2000 for this purpose and applied different techniques. After then researcher comparison all methods and in remarks suggested that fully modified Ordinary Least Square (OLS) method was the best technique to estimate polynomial co-integration. Researcher concluded as 'literature ignore the reality that powers of integrated processes are themselves not integrated processes". Existence of environmental Kuznets curve reduced when anyone use appropriate technique of co-integration. Author collected data of 19 countries and applied different estimation techniques. By using linear Ordinary Least Square (OLS) Environmental Kuznets Curve exist for Co_2 emission in 13 countries out of total 19 and for so_2 emission Environmental Kuznets Curve exist in just four countries. Fully modified Ordinary Least Square (OLS) estimation technique reduced evidence of Environmental Kuznets Curve but did not alter the sign strongly.

Dinda (2004) reviewed theoretical and empirical developments regarding Environmental Kuznets Curve and concluded only some local and air pollutants were showing inverted "U" shape relationship. Author defined Environmental Kuznets Curve in three stages increasing, constant and decreasing. In reality Environmental Kuznets Curvetransition of economy agrarian to industrialization and after that move toward services economy. Moreover, researcher described there was no any agreement of at a particular level of income per capita where Environmental Kuznets Curve start diminishes. Researcher suggested by reviewing previous existed literature that a need for accurate econometric model which expressed relationship of economic growth and environmental degradation, identification of dominants factors, estimation of structural model instead of reduced form of model, decomposition analysis, time series analysis, courageous policy measurement at political level and society should be informed about new technology pollutants.

Grossman and Krueger (1994) estimated Environmental Kuznets Curve for three variables, so2 fine smoke and suspended particles (SPM) in assessing the impact of North American Free Trade Agreement on atmosphere for Mexico. World Health organization published data used in dissertation taken from GEMS (global environmental monitoring system) dated 1977 to 1988. Data collected Summer and Hesston (1991) utilized for real Gross Domestic Product (GDP). Each regression involved in cubic function. Researchers concluded amount of pollutants gradually increasing of all three but after the turning point environment improved.

Shafik and Bandyopadhyay (1992) studied ten different variables e.g. unavailability of clean water, insufficient urban sanitation, levels of suspended particle matter, ambient sulfur oxide, forest density during he collected data period, dissolved oxygen in rivers, waste per capita and carbon emission per capita for the period of 1960 to 1990 in 149 countries as background study for the world bank report (1992). The sample included some cities and some countries as whole and three different form of model utilized log linear, log quadratic and logarithmic cubic. Gross domestic product use in the research measured in term of PPP. Researchers also included some policy related variables e.g. trade orientation electricity prices etc. Results were so difficult to interpret. With the increment in income availability of clean water and urban sanitation also improved. There was no any correlation between income and Deforestation. Rivers water contamination was increasing with the increase in income. Sulfur oxide and Co_2 were conforming hypothesis of Environmental Kuznets Curve. More doubtful result presented by shafik and bandyopadhyay then Grossman and Krueger. Shafik and bandyopadhyay concluded as *It is potential to "grow out of" some environmental troubles, but there is nothing robotic about doing so. Action tends to be taken where there are popularized local costs and substantial private and social gains.*

Table 1

Author	**Variables**		**Data range**	**Estimation strategy**	**Contribution in literature**
	regressed	**Covariate**			
Grossman and Krueger (1994)	So2, fine smoke and SPM	NAFTA	1977-1988	Polynomial Regression	Brainchild of Eck
Shafik and Bandyopadhyay (1992)	So_2 and co_2	Ten different variables	1960-1990	log linear, log quadratic and logarithmic cubic	No correlation between income and deforestation
Selden and Song (1994)	So_2, NO_X, SPM, and Co	GDP	1991	Logarithmic quadratic	ECK exists but different turning points
Ahmed and Long (2012)	Co_2	GDP, Energy consumption, trade openness and population	1971-2012	auto regressive distributed lag	gross domestic product, energy consumption, trade openness, and population are causes of ED
Shahbaz Et Al (2013)	CO_2	ENERGY CONSUMPTION,	1971 - 2009	ARDL Auto Regressive Distributed Lag	Long and short run environmental Kuznets curve
Ismail Et Al (2014)	So_2	energy consumption trade liberalization population density	1970-2008	ARDL Auto Regressive Distributed Lag	real income, trade liberalization and energy consumption are contributing environment
Fan and Zheng (2013)	CO_2	Income per capita		Quadratic and cubic model	cubic model emphasizes inverted N shaped curve ECK
Cole and Neumayer (2004	$C0_2$	Urbanization			Urbanization and small size of household were responsible for pollution
Basarir and Arman (2014)	CO_2	opening ratio, energy consumption and human development index (HDI)	1970-2010	ARDL	All Variables Were Improving the Environment
Wagner 2015	CO_2	GDP	1870-2000	FM-OLS	In case of Appropriate Technique Reject, the Hypothesis of Eck
Saboori Et Al (2012)	CO_2	real Gross Domestic Product (GDP), openness ratio and energy	1971-2007	ARDL	ECK exist

Selden and song (1994) estimated environmental Kuznets curve for So_2, NO_X, SPM, and Co emissions. Researchers used pooled, cross sectional and time series data collected from WRI (1991). 30 countries were included in sample categorized as high income, middle income and low income. Model specified as "$m_{it} = b_\circ + b_1 y_{it} + b_2 y_{it}^2 +$

$b_3 d_{it} + c_i + v_t$"where 'm' was emission per capita 'y' showing Gross Domestic Product (GDP) and 'd' stands for population density. Turning points were very different from previous studies.

Panayotou (1993) estimated four variables e.g. SO_2, NO_X, SPM in 54 countries and deforestation in 64 countries. Pollution indicator were measured similar to Seldon and Song (1994) but deforestation was measured as a mean value of mid 1980s. According to some social scientist measurement of deforestation was biased researcher had ignored afforestation already during data period. Author's fitted equation for three pollutants were logarithmic quadratic in income and for deforestation researcher managed trans log function. In addition, some dummy variables were also included in the tropical countries. All resulted curves were Environmental Kuznets Curve. Turning points were different from previous researchers but fall within similar range.

Cropper and Griffiths (1994) estimated environmental Kuznets curve for three regions Africa, Latin America and Asia by using cross section pooled time series data from 1961 to 1991 for 64 countries. Explanatory variables in estimation were GDP, time trend, GDP square, rural population density and dummy variables also included in the research. Time trend and population growth rate were insignificant in the region of America and Africa but significantly different from zero. All coefficients in the Asia were insignificant. Author concluded that economic growth clearly unable to solve deforestation problem in any region.

Literature review communicates that Economist are at cross purpose with the existence of environmental Kuznets curve. The curve link with economic growth or not still on the horns of dilemma. Line's share of the literature seems to support real Gross Domestic Product (GDP), openness ratio and energy are major reasons to decline in the environmental Kuznets curve. Role of trade is a bone of contention among economist regarding environmental Kuznets curve.

IV. Data and Methodology

This part will discuss data sources and traditional methodology. Expected relationship among the variables will be debated. Some co-integration technique and significance of ARDL method also included in this part. After then present episode will deliberate long run short run equation forms and error correction model to measure the shock in the short run also will be part of discussion. Study demonstrates empirical existence of Environmental Kuznets Curve in Pakistan by considering time series data from 1972 to 2014. Different websites used to obtain numeric data. Statistics on 'co2' emission taken from world development indicators and data for 'GDP' per capita taken by visiting different surveys on Pakistan economy. Data for number of vehicles collected from federal Bauru of statistic government of Pakistan. Trade openness computed by using Import, exports and GDP data from world development indicators.

In 90s co-integration was a hard nut to crack. Men of parts Engle Granger (1987), Johansen (1988, 1991) and Pesaran et al. (1999) single equation methods such as Fully Modified OLS, or Dynamic OLS either require all variables to be I (1) while autoregressive distributed lag (ARDL) developed by Pesaran and Shin (1998), and Pesaran et al. (1999) can be used without taking under consideration that given time series is stationary at first difference or at level.Engle Granger (1987) and Johansen's (1988, 1991) are used for bivariate analysis. ARDL and Johenson also required pre-test of unit root. Johenson co-integration technique specially designed for that time series which are stationary at first difference

IV.I. Model Specification

As mention in the name, this part discuss source of data, model specification and econometric methodology in detail. ARDL equation form ECM model also incorporate in the part.

Cob-Douglas form of equation as follows:

$$co_2p = \theta_\circ gpc^{\theta_1} gpcsq^{\theta_2} nv^{\theta_3} to^{\theta_4} ser^{\theta_5} e^{\mu}$$

Multiply with log both side of the equation

$$lnco_2p = ln\theta_\circ + \theta_1 lngpc + \theta_2 lngpcsq + \theta_3 lnnv + \theta_4 lnto + \theta_5 lnser + \mu$$

Where '$\theta_\circ$' shows intercept and '$\theta_1, \theta_2, \theta_3, \theta_4$ *and* θ_5' are elasticities which will show proportionate change in regressed due to one percent change in explanatory variables.

IV.II. Carbon Die Oxide

Colorless odorless chief GHG that contribute to global warming is co2. The co2 have a single atom of corban with to two oxygen atoms sometimes called carbonic acid gas. after seeking Mauna Loa Observatory Co2 emission seems

to trending upward year by year. Acceptable ratio for co2 is 350 parts per million but from 1981 its more than acceptable range. **Mauna Loa Observatory** in Hawaii claim 400.16 ppm in 2015 really not acceptable.

IV.III. Gross Domestic Product Per Head

GDP per head is a measure of per person gross domestic product (resources produced by an economy within the boarder of the country in given time period).

$$GDP = C + I + G + NX$$

Pakistan's gross domestic product per person gradually increasing year by year. GDP per capita can be computed by using following formula

$$GDP\ per\ head = \frac{Gross\ Domestic\ Product}{Population}$$

Economics theory speculated that environmental degradation firstly increase and after making headway its decline. Present study also hypothesis that environmental degradation positively linked with GDP. Same link found by Grossman and Krueger (1995), Jalil and Mahmud (2009), sayed and sek (2013), Andreoni and Levinson (,2001).

IV.IV. Trade Openness

Invitation letters or obstacles on the high way of trade measured by trade openness. Trade openness measures institutional policies regarding trade that particular policies are helpful or against. Openness can be measure by adding import exports of the given country and then divided by gross domestic product of the same country.

$$Trade\ Openness = \frac{Imports + Exports}{Gross\ Domestic\ Product}$$

Present study hypothesizes that trade openness can both degrade or improve the environment. Mixed result found by Antweiler et al., (2001) and Liddle, (2001).

IV.V. Services Sector Output

Portion of the economy that produced intangible goods. Individuals applied in this sector produced services rather than products. Services sector consist health sector output, entertainment and recreation services, professional, scientific and technical services, financial investment services, information sector service, truck and transportation services and administrative and support services.

IV.VI. Vehicles

A mobile machine that transport people or cargo. Mostly vehicles are manufactured such as bicycle motorcycle car wagon. In previous decade major vehicles are major contributors into environmental degradation. Land vehicles are classified broadly by what is used to apply steering and drive forces against the ground. Current study conjectured that as vehicles increase in the economy it will deteriorate the environmental conditions. Study in line with Sahibzada (1993) who has investigated positive sign between both indicators.

V. Methodological Discussion

V.I. Dickey -Fuller-Unit Toot Test

Under this step the stationary properties of the variables are tested. A variable is said to be stationary if it's mean, variance and auto-covariance remains the same no matter at what point we measure them. A number of tests are available in the literature to crisscross the existence of the unit root problem both in the level of the variables as well as in their first difference. Present dissertation will use Dickey Fuller (DF) test. The Dickey-Fuller test is applicable if error terms (U_t) are uncorrelated. In case the error terms (U_t) correlated, DF test is useless.

Test for a unit root:

$$\nabla y_t = \delta y_{t-1} + u_t$$

2. Test for a unit root with drift:

$$\nabla y_t = a_0 + \delta y_{t-1} + u_t$$

3. Test for a unit root with drift and deterministic time trend:

$$\nabla y_t = a_0 + a_1 t + \delta y_{t-1} + u_t$$

V.I. ARDL Bound test approach for long run relationship

Study will follow two steps procedure to estimate long run relationship among the variables. Result of the following model will clear that unrestricted long run relationship exists or not.

$$\Delta lnco2p = \left[\theta_0 + \sum_{j=1}^{u} \theta_{1j} \Delta lnco2\ p_{t-j} + \sum_{j=0}^{u} \theta_{2j} \Delta lngpc_{t-j} + \sum_{j=0}^{u} \theta_{3j} \Delta lngpcsq_{t-j} + \sum_{j=0}^{u} \theta_{4j} \Delta lnnv_{t-j} + \sum_{j=0}^{u} \theta_{5j} \Delta lnto_{t-j} + \sum_{j=0}^{u} \theta_{6j} \Delta lnser_{t-j} + \theta_0 lnco2p_{\ t-1} + \theta_1 lngpc_{t-1} + \theta_2 lngpcsq_{t-1} + \theta_3 lnnv_{\ t-1} + \theta_4 lnto_{t-1} + \theta_5 lnser_{t-1} + \omega_{1t}\right]$$

Wald test or f-statistic followed for existence of long run relationship among variables. The null hypothesis for no co-integration is

$$[H_0: \theta_0 = \theta_1 = \theta_2 = \theta_3 = \theta_4 = \theta_5 = \theta_6 = 0]$$

Against the alternative hypothesis

$$[H_0: \theta_0 \neq \theta_1 \neq \theta_2 \neq \theta_3 \neq \theta_4 \neq \theta_5 \neq \theta_6 \neq 0]$$

this can be denoted by

$$\langle lnco2p \mid lngpc, lngpcsq, lnnv, lnto, lnser \rangle$$

Conclusion will be based upon two set of critical values given by Pesaran et al. (2001). If f-statistic exceed from tabular value given in the column of 1(1) any one can conclude that association happen among the variables. Whole procedure denoted as bound test Pesaran et al. (2001). Two stage long run model estimation strategy will be followed again. Firstly, study will explore accurate lag length criteria with the help of famous Akaike Information Criterion (AIC), Schwarz Bayesian Criterion (SBC), Hanan criteria. Maximum lag length suggested by Pesaran and Shin (1999) is 2. Then by regressing following equation study discuss results. ARDL (m, n, p, q, r, s) models

$$\mathrm{lnco2p} = \left[\rho_0 + \sum_{j=1}^{m} \rho_1\, \mathrm{lnco2p}_{\,t-j} + \sum_{j=0}^{n} \rho_2\, \mathrm{lngpc}_{\,t-j} + \sum_{j=0}^{p} \rho_3\, \mathrm{lngpcsq}_{\,t-j} + \sum_{j=0}^{q} \rho_4\, \mathrm{lnnv}_{\,t-j} + \sum_{j=0}^{r} \rho_5\, \mathrm{lnto}_{\,t-j} + \sum_{j=0}^{s} \rho_6\, \mathrm{lnser}_{\,t-j} + V_{1t}\right]$$

V.II. ECK Short Run Result Estimation Strategy

after exploring long run results study also interested in computing short run relation among the variables. Study will follow following equation to analysis short run results

$$\Delta \mathrm{lnco2p} = \left[\tau_0 + \sum_{j=1}^{m} \tau_1\, \Delta \mathrm{lnco2p}_{t-j} + \sum_{j=0}^{n} \tau_2\, \Delta \mathrm{lngpc}_{t-j} + \sum_{j=0}^{p} \tau_3\, \Delta \mathrm{lngpcsq}_{t-j} + \sum_{j=0}^{q} \tau_4\, \Delta \mathrm{lnnv}_{t-j} + \sum_{j=0}^{r} \tau_5\, \Delta \mathrm{lnto}_{t-j} + \sum_{j=0}^{s} \tau_6\, \Delta \mathrm{lnser}_{t-j} + \zeta_1 \mathrm{ECM}_{t-1} + \varepsilon_{1t}\right]$$

Where '$\tau_1, \tau_2, \tau_3, \tau_4\ and\ \tau_5$' are short run elasticity and 'ζ' parameter of 'ECM' show speed of adjustment. if 'ζ' is negative that's mean speed of adjustment is convergence. In the case of any economic shockwave variables have strength to reach at equilibrium

VI. Result And Discussion

This part discusses the statistics measures of mean, median, standard deviation, skewness and kurtosis. Graphical analysis of all the selected variables with discussion also part of episode. Econometric analysis, graphical analysis and econometric explanation including tables of results and some other econometric technique etc.

VI.I. Descriptive Analysis

The given table demonstrate descriptive statistical analysis which pronounce useful values of average, standard, deviation, skewness and kurtosis. Data spread on the period of 1972 to 2014 total 43 observation used in the analysis. Average co2 per capita emission in atmosphere recoded from world development indicators is 0.000634 with standard deviation 0.000216. GDP per capita have 28083 average value with 36371 standard deviations. GDP^2per capita, trade openness, number of vehicles and services sector output have average values respectively 0.335300, 3996684 and 2294428. Skewness is a measure of the asymmetry of the probability distribution of a definite value arbitrary variable about its mean value. Co_2per capita, trade openness, are negatively skewed remaining are opposite. Top of data shown by kurtosis. Mesocratic is recognized as normal distribution, the value of any variables is equal to 3. Leptokurtic has wider tail than the normal distribution; the value of any variables is greater than 3. Platy-kurtic is has a flatter top and relatively narrow tail than the normal curve, the value of any variables is less than 3.

Table 2

Descriptive statistics	Co2p	GDP Per capita	Trade openness	Number of vehicles	Services sector output
Mean	0.000634	28083	0.335300	3996684	2294428
Median	0.000648	11077	0.334499	3351300	599228
Maximum	0.000969	137209	0.389095	15168100	12901802
Minimum	0.000303	864	0.277198	426153.0	20608
Std. Dev.	0.000216	36371	0.028554	3439732	3440758
Skewness	-0.016875	1.62058	-0.182718	1.555083	1.771123
Kurtosis	1.709550	4.650764	2.480214	5.346771	5.039637
Observations	43	43	43	43	43

The most common question in econometric analysis that given time series is stationary or not. Various test introduced by different econometricians. Such as Augmented Dickey Fuller (ADF), Dickey Fuller (ERS), Phillips-Peron, Kwiatkowski, Phillip-Schmidt-Shin (KPSS), Elliott- Rothenberg-Stock Point-Optimal and Ng-Peron test. All have their own properties and characteristics. Study use Dickey Fuller test to check the unit root problem in given time series. The results of unit root are mention in table below.

VI.II. DF-GLS Test Statistic

In this table first column designate the name of variables and second column tells about the condition of test. Last column labels the results and explore that all variables are stationary at integrated process one or I (1) except trade openness. The main focus of this research to examine empirical relationship among environmental degradation due to various pollutants. For this purpose, the annual data on carbon die oxide, predicted variable of research, obtained from World Development Indicators and by combining various issues of Pakistan economic surveys, gross domestic product per capita and services sector output indicators receive values. Auto Regressive Distributed Lag (ARDL) use to discover Environmental Kuznets Curve in Pakistan. Beautifulness and convenience of ARDL technique can be grasp when read about properties of ARDL method. Specially ARDL co-integration technique can be used without considering that given variables are stationary either I (0) or I (1) Ouattara (2004).

Predictor variable Gross domestic product (GDP) per capita shows monotonic relation with predicted carbon die oxide (co2) per capita. Probability value 0.0036 conforms the significance of relationship. Value 15.92 shows percentage increase in environmental degradation due to one percent increase in gross domestic product (GDP) per head. More GDP per capita requires more value of gross domestic product P_c. TO increase domestic production economy use more natural resources in production process. More output accumulates more byproducts and waste. Unwanted waste and low quality products increase emission and pollutants degrade environment. Scale effect seem working behind the phenomenon. Over utilization of resources result in environmental deterioration. The study same in line with Grossman and Krueger (1995), Jalil and Mahmud (2009), sayed and sek (2013), Andreoni and Levinson (,2001), hamani (2010), Shafik and Bandyopadhyay (1992), Galeotti and Lanza (1999), and specially in Pakistan ali et al (2014), shehbaz et al (2013) and ismail et al (2013) support same link between gross domestic product P_C and carbon die oxide P_C.

Inverse sign of Control indicator LGPCSQ or square of gross domestic product per capita obey the existence of Environmental Kuznets Curve in case of Pakistan which suggest that initially environmental degradation increase but beyond achieving handsome level of income per capita relation reversed. Likelihood value 0.0039 suggests relationship has economic meaning. A percent increase in squared income per capita will clean the environment by 8.48 percentage. Naturally when people become rich they can afford better environment than before. Richness adumbrate from demand for clean goods and services. So environmental degradation gradually decline. Same Relationship expressed by Wagner (2015), Stern (1996), Dinda (2002), Dinda and Coondoo (2006) and researchers that described in previous passage. Exogenous variable Number of Vehicles inside the economy clearly polluting the environment. Stimulus variable significantly responsible for environmental corrosion in the Pakistan economy. In

the long run 0.08 percent environment deteriorate because of one percent upsurge in number of vehicles of the economy Sahibzada (1993) also examined the positive results between vehicle and the environmental degradation.

Covariate Trade openness interestingly shows uprising trend toward co2 P_C emission. It seems to be strange because free trade can be good for environment Antweiler et al., (2001) and Liddle, (2001) but lower trade barriers could upset environment if contaminators move towards countries with feebler regulations dinda (2002) dinda (2004) dinda and coondoo (2006) and stren (2004). PHH also suggest polluter find lower regulation countries when strict environmental regulation faced by them in any economy. Displacement hypothesis also supports same directional link between trade openness and environmental degradation Copeland and Taylor (1995). Polluters move developed to developing country because of much lax environmental conditions. Pollution depress in one country but increase in other because consumption of polluted goods remains same. Study shows significant relation between trade openness and co2emission. The Displacement Hypothesis describe that trade liberalization or openness will lead more rapid growth of pollution-intensive industries in less developed economies as developed economies enforce strict environmental regulations Harrison (1996), Rock (1996) and Tobey (1990).

Table 3

Variable	**Test for Unit Root in**	**Include in test equation**	**Test statistics**	**DF-GLS test statistic**	**Results**
Lco_2p	Level	Intercept	-2.625606	-0.183969	1(1)
		Trend	-3.770000	-0.7827	
	1^{st} Diff	Intercept	**-2.624057**	**-3.412853**	
Log of GDP Per Capita	Level	Intercept	-2.625606	1.3297	1(1)
		Trend	-3.77000	-2.047810	
	1^{st} Diff	Intercept	**-2.622585**	**-4.563273**	
Log of GDP Per Capita Square	Level	Intercept	-2.625606	1.329712	1(1)
		Trend	-3.77000	-2.047810	
	1^{st} Diff	Intercept	**-2.6225**	**-4.6547**	
Log of Trade Openness	Level	Intercept	**-1.948886**	**-2.466142**	1(0)
Log of Number of Vehicles	Level	Intercept	-2.622585	0.222476	1(1)
		Trend	-3.770000	-2.199408	
	1^{st} Diff	Intercept	**-1.949097**	**-2.5268**	
Log of Services Sector Output	Level	Intercept	-2.625606	1.137656	1(1)
		Trend	-3.77000	-2.2604168	
	1^{st} Diff	Intercept	**-2.622585**	**-4.489725**	

Services sector output also contributing in environmental degradation significantly. Pakistan with the slogan of agrarian economy more than 50 percent share of output receiving from services sector. To perform different services electricity is necessary and Load shedding as a major problem of Pakistan economy require more usage of oil, coil and gas for electricity generation. This process continually degrading environment. Critical values suggest meaningful relationship amongst both services sector and co_2 emission $P_{C.}$

Remarkably in the short run environmental Kuznets curve also exist in the Pakistan. Likelihood values of D(LGPC) and D(LGPCSQ) respectively 0.0042 and 0.0036 give a clean chit of meaningful relationship. Just like in the long run initially emission is double but beyond income per capita economy take apart into cleanliness of surrounding and half pollution controlled due to richness. Co-integration recommends that in the short run also relationship exist and in the case of any alteration in the equilibrium 0.89 percent recovered in one-time period or shortly converge to equilibrium. Results propose that the environmental Kuznets curve exist in the Pakistan for both type of time periods. Study sees eye to eye with Grossman and Krueger (1992) that co_2 emission in the beginning upswing, but because of increase in income per capita, make compensations of the bad environment. Ambiguous variable, trade openness, as a crux of the problem also have been showed behavior. In case of LDC, trade contribute into the environmental problems. after the examination of result table relationship are above the board. in lieu of GDP^2 per

capita all reaming forecasters, finance in environmental deterioration. The Square of GDP per capita seems to clear the smoke from atmosphere. All introductory variables in the study are significantly polluters. Short run results are also in line with the long run results in lieu of number of vehicles, which looks to be insignificant.

Table 4

Variable	Coefficients	Standard Error	t-statistics	Probability
Long run coefficient				
LGPC	15.92	5.39	2.95	0.0036
LGPCSQ	-8.48	2.69	-3.14	0.0039
LNV	0.08	0.036	2.42	0.021
LSER	0.946	0.16	6.14	0.00
LTO	0.94	0.16	5.89	0.00
CONSTANT	-24.309	2.29	-10.61	0.00
Co integrating Form	LCO2P - (15.9209 LGPC -8.4844 LGPCSQ+0.0888 IINV+ 0.9532 LSER + 0.9462 LTO -24.3092)			
SHORT RUN RESULTS				
D (LCO2P (-1))	-0.24	0.12	-1.91	0.06
D(LGPC)	14.23	4.56	3.120	0.0042
D (LGPCSQ)	-7.19	2.2662	-3.1763	0.0036
D(LTO)	0.5717	0.15	3.77	0.0008
D (LNV)	0.096	0.13	0.74	0.4642
D (LNV (-1))	-0.44	0.15	-2.835	0.00830
D(LSER)	0.29	0.21	1.35	0.18
CointEQ (-1)	-0.89	0.14	-6.09	0.0000
ARDL bound test				
F statistics	6.50	Significance 1%	I (0) BOUND 3.41	I (1) BOUND 4.68

VII. Conclusions and Policy Recommendations

The view of development that "grow now, clean up later" has become a slogan of developing countries and unluckily LDC's could not reach at ECK turning point for decades. The true form of income-environment relationship is monotonic but the curve takes some time to slope downward. Conceptual and theoretical background of the study discuss useful economic reasons, link among various indicators of environmental degradation. In developing countries scale effect, pollution haven hypothesis and hypothesis of displacement have lines share in environmental degradation and guilty for stress of co2 in atmosphere. Grossman and Kruger (1992) were first whose discovered Environmental Kuznets Curve. Latter on Cole and Neumayer (2004), Ahmed and long (2012), Shahbaz et al (2013), Ismail et al (2014), Fan and Zheng (2013), Saboori et al (2012), Wagner (2015) and many more also investigated the same phenomenon. All seem to in favor of Environmental Kuznets Curve but after raising some question at previous researches. Time series data of Pakistan's economy from 1972 to 2014 collected from official sites of SBP and World Bank. Dickey-Fuller test utilized to test the stationarity and by using Auto Regressive Distributed Lag (ARDL) technique produced by Pesaran et al. (1999) to verify the existence of Environmental Kuznets Curve. Study sees eye to eye with Grossman and Krueger (1992) that co_2 emission in the beginning upswing, but by dint of increase in income per capita, make amends of the bad environment. A fishy theory, trade openness, as a crux of the problem also solved. In case of developing country, trade enhances the environmental problems. The long and short of whole discussion is Environmental Kuznets Curve exist in the Pakistan for both type of time periods.

After the examination of result table relationship is above the board. all variable in the research are polluters. In lieu of GDP^2 per capita all reaming predictors, funding in environmental deterioration. GDP^2 per capita seems as model variable which give a bit of environmental deprivation's mind and provide clearer environment for the economy.

Number of vehicles also a pollution contributor. Grippingly service sector in Pakistan due to load shedding dilemma has turn into an electric power generation sector by fuel and persistently polluting the economy. static shows services sector more polluting then both of trade openness and number of vehicles. Short run results are also in line with the long run results in lieu of number of vehicles, which looks to be insignificant. The research finds that hokey stick type relationship between a component of GHG co2 and income per head.

- Economic growth is sufficient criteria to safe guard the environment. Achievement in sustainable growth defiantly will be helpful in protection of environment.
- The surest way for better environment in the long run to become wealthy. Its quit difficult for LDC's during take-off stage to implement any environmental policy. Environmental care is better and cheaper than environmental cure.
- Government can play a meaningful role to appreciate environment but in Pakistan command and control policies are in efficient and in effective by dint of corruption. There is needed for efficient and honest policy implementers.
- Each and every step to increase in GDP will help to maintain environmental standards.
- Education, awareness and know how to damages of environmental degradation also evoke the demand for better environment among the communities.
- In slower growing economies like Pakistan emission reducing technologies can overcome and/or at least reduce the pollution from the atmosphere. Introduction of these kinds of technology can be also helpful.
- One of the most important things, technology which could be gauged the existence of pollution and try to find out there generations points.

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