Sectoral Growth and Environmental Degradation: A Case Study of Pakistan

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Abstract

The main target behind this research is to overview the empirical linkage between sectoral growth and environmental degradation in Pakistan. For empirical enquiry, this study has used data from 1980 to 2013. Agricultural growth, energy consumption, globalization, industrial growth and population density have been selected as explanatory variables while environmental degradation (CO2 emissions) has been taken as dependent variable. Augmented Dickey-Fuller (ADF), Phillips-Perron (PP) and DF-GLS unit root tests have been applied whether the selected variables are stationary or not. Autoregressive Distributive Lag (ARDL) co-integration test has been applied to analyze co-integration among the variables of the model. The empirical findings of this study reveal that there is co-integration among the concerned variables. The empirical analysis of this study reveals that agricultural growth, energy-consumption, industrial growth and population density has significantly positive impact on environmental-degradation. The long run results explain that globalization has insignificant impact on environmental-degradation. The short-run results show that agricultural growth, globalization, industrial growth and population density have insignificant impact on environmental degradation in case of Pakistan. The results show that energy consumption has significantly impact on environmental degradation in short run. The results reveal that Pakistan is producing most efficient and environmental friendly agricultural and industrial products. Granger Causality test is applied in this study to check the causal relations among the variables. Lindmark (2008) point out that environmental degradation is a long run phenomenon. This research has proved that environmental degradation is long run phenomena in Pakistan. The government of Pakistan must increase the agricultural growth in positive way to reduce the environmental degradation. There should be a policy to protect environmental quality with a non-polluted agricultural growth. The Government must also increase the industrial growth in efficient manner to control environmental degradation in Pakistan. There should be a proper control on the energy consumption, negative impacts of globalization and population density to overcome the environmental degradation in Pakistan. By considering a long run phenomenon, Pakistan must treat environmental degradation as its primary issue for its coming generations.

Key words: Agriculture growth, Energy consumption, Globalization, Industrial growth, CO2 emissions, Pakistan

Introduction

In the present era of human history, climate changes and global warming have become a critical issue of discussion both for policymakers and social scientists. The uprising level of CO2 emissions and other greenhouse gases are becoming the main inputs of global warming. The patterns of world energy production and consumption has become major causes of rising CO2 emissions and global environmental degradation. This change in environment has significant impacts on human wellbeing, wildlife viability and smooth functioning of ecosystems. It is known fact that economic growth is very necessary for the survival of a country and for

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attaining a desired level of economic growth there must be improved and better industrialization. This improved and better output of industry produces sufficient amount of greenhouse gases (Shahbaz and Lean, 2012). Following the importance of environmental quality for all living being, United Nations took serious steps to control the environmental degradation by introducing the binding agreements such as Kyoto Protocol (1997). This Kyoto Protocol forces developing and developed countries to produce specific amount of greenhouse gases.

Following the severe environmental degradation, the developed countries and some international organizations are worried for the large amount of carbon-dioxide-emissions (CO2). Most of developed economies are trying to reduce those energy consumptions which are producing enough amount of CO2-emissions in order to meet their international commitments. Especially there is a greater pressure on China to reduce its domestic CO2 emissions. During last two decades, there is a substantial increase in economic growth, energy consumption and CO2-emissions. The modern world is now divided into different blocks and globalization has the potential impact of socio-economic well-being of the nations. In these blocks developed countries favor environmental quality whereas developing countries prefer economic growth (MacArthur 2001; Todaro and Smith 2002; Callan 2004 and Baylis and Smith 2005). Frankel and Rose (2002) point out that CO2 emissions and its analytical approach have great deal of international political concern. It is very important to know that CO2 emission is a global externality. The national regulations of developing nations do not favor to reduce CO2 emissions.

Grossman and Krueger (1991) have started the debate of environment pollution and economic growth, after that investigating the effect of economic growth on environmental quality has become the policy debate all around the world. Economic growth may have positive or negative relationship with environmental quality by various aspects. The issue on environmental conditions is still unsolved because of those parties how have different point of view about business, unemployment and international market conditions. It has common benefits for human being so a large number of theoretical and empirical research is conduct on this subject. Grossman and Krueger (1993) have tested the environmental standard which is known as environmental Kuznet curve. The environmental Kuznet curve (EKC) represents the inverted U-shape relation between environmental-degradation and economic growth. EKC gives the evidences in the favor of this hypothesis that growth in income increases environmental degradation in poor countries whereas growth in income discourages environmental-degradation in rich countries. Selden and Song (1994) point out that in beginning phases of economic development a rise in economic growth is associated with rising environmental-degradation but after a threshold level the rising economic growth discourages environmental degradation. Many other researchers argue that growth may be helpful for the better environmental conditions. If environmental condition is normal, then an increase in income increases the demand for better environmental conditions. This process forces the governments to increase investment in reducing environmental degradation. The study of EKC hypothesis has made two most important and significant contributions in literature. First, it indicates that how the environment is impacted by economic growth and second environmental quality is raised by the income effect.

Pakistan is situated in South Asia, which is recognized to be an agro-based country and as vulnerable zone contended to the negative effects of climate-change concerned with public health. Climate change is considered to be a result of air pollution which is increasing day by day. Global challenges are including a higher rate of population growth, inefficiency of water availability, soil-degradation and animal-based diet with climate-change. Alam et al., (2007) mention that the outcome of economic growth, urbanization and population growth on environmental-degradation in Pakistan. The estimated this article show that population growth

and urbanization growth are positively related with environmental degradation. However, in 2002-03, the use of energy of the total consumption is 36 percent in the industrial-sector and 33 percent in the transport sector in Pakistan. In 2008-09, the total use of energy decreased at 29 percent. But the consumption of energy has been increased by 43 percent in the industrial sector. The energy-consumption per capita had grown from (489.36) kg in 2006 to (522.66) kg in 2009. This leads a rise in CO2-emissions per capita from (0.7657) MT to (1.026) MT from the period of 2006-09. Following the environmental conditions in Pakistan, this study contributes towards environmental improvements.

Literature Review

Lea and Holst (1994) deal the case of developing countries. Comparative advantage in dirty industries exists in these countries that face the risk of environmental related problems unless the effective policies are imposed. The empirical results show that uni-directional relationship is existed from trade liberalization to environmental degradation in Indonesia. Furthermore, if the removal of is combined with an effective-cost policy, then the main purposes concern with welfare and improving the environmental quality seems to appear feasibly. It highlights the role of trade that lead to a sustainable development. Asymmetric environmental conditions prevailed in Indonesia's historical trade orientation. While the liberalization of trade would increase the real income. The tradeoff between the environment and the industrialization show the comparative cost of pollution. The results highlight the uniform effluent tax that is the important cost effecting tool to control SO2 (Sulphur Dioxide) emissions. The basic instrument like uniform tax resulting a decrease in real GDP that is greater than the achieving target significantly using a uniform effluent tax.

Copeland and Taylor (1997) empirically examine the effect of trade-liberalization on environment. This study analyzes that if the capital-abundant country trade with the labor-abundant country then free trade reduces the pollution of the world. Trade displaces the production of pollution-intensive industries to the capital-abundant country dislike its strict pollution rules. The study shows that the pollution level grows in the North and falls in the South. The result shows the reversing trend if the North-South gap in income is too larger for, then in this regard, the structure of trade is determined by the income-induced policy changes across different countries. It reveals that the world-pollution dependent by the structure of trade. The study examines that the pollution is derived by the demand and supply analyses. The supply of the pollution is derived by the policy of the Government and the pollution demand is derived by the behavior of the producers and consumers. The results of the study reveal that free-trade and the capital mobility must lead to unchanged world pollution from its autarky point.

Dean (2000) elaborates the environmental standard that lead to have comparative advantage in developing countries. According to this study, there are some chances that trade will harm the environmental conditions in the developing-countries. This research collects the existing literature on trade openness and economic-growth and on environmental kuznet curve (EKC). A simultaneous equation system is derived to determine the effects of the liberalization of trade on environmental status. Pooled data on the water pollution in China is used for the estimation. It also suggests that free trade will cover the environmental degradation through the better terms of trade. The negotiation of NAFTA and Uruguay Round shows the effects of the liberalization of trade on the environmental status on the part of both the developed and developing countries. In this study another approach is developed by using a simple Heckscher Ohlin model that shows the endogenous concept of clean environment. The simulations of this research indicate that per unit emissions will lead to increase in all of the provinces. The exchange regime deals with the beneficial effects of the liberalization of trade which may be very important during the period 1992-1995

Managi (2003) investigates the empirical question about free trade whether it is harmful or beneficial for the environment. For this study panel data is used for 63 developing countries and developed-countries from the period of 1960-1999. The empirics reveal that the liberalization of trade will increase the emissions that have the elasticity of 0.579. This study shows the whole effects of the liberalization of trade on the environmental condition. It is found that trade has not the beneficial effects to environment status. The recent tresearch of Cole and Elliott (2003) examine that the estimates are positive but do not examine the overall impacts. In contrary to the small observations of Cole and Elliott (2003) which is used the data of 32 countries, this study that is about 63 countries contributes to the previous literature at two-folds. This is the first research that estimates the whole effects of the liberalization of trade. Second, a beneficial simultaneous model is proved.

McAusland (2005) focuses on consumer generated-tailpipe-pollution against the vast research of economics on the environmental quality in open economies. It highlights the producer generated-smokestack-pollution. This study also examines political opposition to environmental regulations differs from trade regime and indicates the impacts of the movement from the absence of trade to free trade on environmental policy from this study we find that trade openness increases the opposition of industry to smokestack policy and decrease its opposition to the policy of tailpipe. This study focuses on trade and environmental relationship that may depend critically on pollution. It indicates that production related pollution should re-evaluate before the assumption for the pollution concerned with consumption. The main concern of this paper is to highlight the relation between trade-openness and the environment-politics underlying the assumption that the traditional relation can be rearward. The empirical results indicate that relationship among trade structure, politics and environmental regulations that can be different in qualitative measures.

Kaygusuz (2007) examines that the energy-demand is growing rapidly in Turkey. Energy-consumption has been increasing at the rate of 4.3 percent on average since 1990 in Turkey. It is expected that the fast increase in the production and consumption of energy has taken with a broad range of environment-related problems at different levels. The study analyzes that carbon emissions (CO2) in Turkey have raised with the energy-consumption concerned with the global environmental issues. In 2004, CO2 emissions increased at 193 mt. States have performed a very important role in giving protection to the environment by decreasing the missions of green-house gasses (GHGs). At a global scale, state emission is proved to be significant. CO2 emissions and the carbon-monoxide (CO) is the major greenhouse gases (GHGs) linked with global warming. At the current level, coal is the main reason in producing the CO2 emissions with the fossil fuels. Sulfur-dioxide (SO2) and NOx have major contribution to acid pelting. The study concludes that carbon assessment has a major contribution to control CO2 emissions while raising revenue.

Bartoletto and Rubio (2008) examine the empirical analysis of energy-consumption, the passage from organic to fossil energy carries and its impact on CO2 emissions in Italy and Spain. The study uses the data from the period of 1861-2000. This paper also employs new data for analyzing the use of energy from organic roots to the modern roots of energy. The existing studies have revealed that traditional structure of the energy transform the views about the relation between the energy-inputs and the economy. But the recent study of this paper concludes that in the long-run, the traditional energy roots must be in the series of pollution intensities of energy consumption, pollution-intensities in the economy, de-carbonization and other factors to gain a clear picture of the process include. The study also shows the trend of CO2 emissions, that changes significantly with the involved traditional energy carries. It indicates that the de-carbonization is not the long run phenomena, it prevails since 1970s in the economy. The study analyses that modification in the placement of energy basket has an

important impact on CO2 emissions in the economy. Because, the various energy baskets are the main reasons to emit the CO2 in different degrees.

Akbostanci et al., (2009) empirical examine the relation between income per capita and environmental-status of Turkey in two scenarios. First, the relation between CO2 emissions and income per capita is studied through the time series data with the help of co-integration technique and the data is used from the period 1968-2003. Second, the relation between air-pollution and income is examined through PM10 and SO2 measurement in Turkey. Panel data is used in this paper. The data is used from the period of 1992-2001 including 58 provinces of Turkey. Panel data analyze the N-shaped relationship for SO2 and PM10 emissions that have no support for the inverted U shape Kuznet curve which is showing the relation between environmental-degradation and income. The long run relation is existed between income and pollution and finds that these variables are co-integrated. The result shows that the per capita income is less than 2000 in some provinces of Turkey, it also reveals that the air pollution increases with the increase in income. The results also show that those provinces that have income per capita between (2000-6000), air-pollution decreases with per capita income. The provinces with income more than 6000, air pollution tends to increase once again. The empirical findings show that environmental Kuznet curve (EKC) is significant in some provinces during in the specific period. This study concludes that the basic need is to control the pollution that will not disappear automatically, no matter whatever their income level will be.

Jobert et al., (2012) focus on economic growth, energy-consumption and carbon-dioxide emissions. The study is employing the iterative aspect of Bayesian Shrinkage method. The Environmental-Kuznet-Curve (EKC) hypothesis is checked by using this procedure at the first time in this study. The obtained empirics suggest that: first, the Environmental-Kuznet-Curve hypothesis is rejected for 49 countries out of 51 countries, considering when heterogeneity in the economies is present, energy-efficiencies across countries and differences in the CO2 emissions are accounted; second, is that a categorization of the of the empirical results in the countries, the growth levels reveal that an inverted U shape curve is because of the matter of fact that the growth in the GDP in the developed or higher-income countries reduces emissions, while, in the developing or lower-income countries it raises emissions. The EKC hypothesis is applied to check the dependency of environmental-degradation on the level of economic-development. Jobert et al., (2010) examine that during the betterment of the economic structure, these economies decreased their share of industrial sector in GDP and hence, they might be qualified as “ecologists despite themselves”.

Theoretical Model

The economic model is the simplification of economic reality of an individual as well as society as whole. This is a simple procedure covering the complicated process of different economic entities based on economic theory. It is easy method to convey one’s thoughts and logic behind an idea. The model can help economists to sort out the complications of their efforts logically following different assumptions. So, an economic model represents the actual economic situations with the help of some assumptions and abstractions. Following the methodologies of different studies the model of this study become as:

$CO_{2=} f(AGR_{t,} ENG_t\ GLO_t\ IND_t\ POPD_t)$

Where,

CO_2 = CO2 emissions as a proxy of environmental degradation

AGR= agriculture sector growth

ENG= energy consumption

GLO = globalization

IND= industrial sector growth

POPD = population density
T=time period
The objective behind this study is to explore the effect of agricultural growth, consumption of energy, globalization, industrial-growth and population density on environmental-degradation in the case study of Pakistan. This study uses the data from 1980 to 2013. Data for these selected indicators is obtained from the World Development Indicators (WDI) data bases maintained by the World Bank and various issues of Pakistan Economic Survey.

Econometric Methdology

The existing literature of applied econometrics has many co-integration tests for analyzing the cointegration among time series and panel variables. Most known and traditional co-integration tests are the Engle-Granger (1987) co-integration based on residuals, Johansen (1991/1992) coitegration based Maximum Likelihood and Johansen-Juselius (1990) cointegration methods. An important point in these techniques that they demand for the same order of integration for empirical estimation. But if there is mixed order of integration these tests become invalid and inefficient. ARDL technique has suggested by Pesaran and Pesaran (1997), Pesaran and Shin (1999), and Pesaran et al., (2001). This method has a number of benefits over the conventional techniques of co-integration. First, ARDL may be employed irrespective of integration order. Second, it can be applied and best for small data size (Mah, 2000). Third, it can be used for getting the data collecting procedure in an unspecific to particular framework by taking the sufficient lags (Laurenceson et al., 2003). At the end it can provide the sufficient information about the structural breaks in data (pattichis, 1999). Pesaran and Shin (1997) and later on Pesaran et al., (2001) claim that long term association among macro-economic factors under certain environmental condition can be analyzed with the assistance of Autoregressive Distributive Lag Model (ARDL). After selection of lag order criteria for ARDL technique, simple OLS can be employed to identify and estimate the model. Validity of the coefficients and implications can be driven by the immanence of exclusive long-run confederation that is important to co-integration.

$$\Delta lnY_{t=}\beta_1 + \beta_{2^t} + \beta_3 lnY_{t-1} + \beta_4 lnX_{t-1} + \beta_5 lnZ_{t-1} + \cdots +$$

$$\sum_{h=1}^{p} \beta_h \, \Delta lnY_{t-h} + \sum_{j=0}^{p} \gamma_j \, \Delta lnX_{t-j} + \sum_{k=0}^{p} \emptyset_k \, \Delta lnZ_{t-k} + \cdots + \mu_{it}$$

If the long term co-integration among the indicators is approved, then to find the short term dynamic among variables can be examined with the help of Vector Error Correction Model (VECM). The simple methodology of VECM is given as following:

$$\Delta lnY_{it} = \beta_1 + \beta_2^t + \sum_{h=1}^{p} \beta_h \, \Delta lnY_{it-h} + \sum_{j=0}^{p} \gamma_j \, \Delta lnX_{t-1} + \sum_{k=0}^{p} \emptyset_k \, \Delta lnZ_{it-k} + \omega ECT_{t-1} + \mu_t$$

Results and Discussion

The aim of this research is to overview the effect of sectoral growth on environmental degradation in Pakistan. For empirical analysis, this study has used data from 1980 to 2013. Agricultural growth, energy consumption, globalization, industrial growth and population

density have been selected as independent variables whereas environmental degradation (CO2 emissions) has been taken as dependent variable. The table 1 presents the estimated results of descriptive statistics.

Table-1
Descriptive Statistics

	Co2	AGR	ENG	GLO	IND	POPD
Mean	4.933961	1.411170	2.629716	1.658492	1.367803	2.206618
Median	4.975796	1.414205	2.651223	1.698096	1.375986	2.217712
Maximum	5.212349	1.499196	2.718724	1.819567	1.432987	2.371154
Minimum	4.506071	1.331739	2.501250	1.444855	1.305297	2.005508
Std.Dev.	0.221207	0.040009	0.063222	0.117290	0.031179	0.108654
Skewness	-0.373917	0.251311	-0.536337	-0.451508	-0.083122	-0.249945
Kurtosis	1.954537	2.712126	2.037049	1.944162	2.642549	1.897396
Jarque-Bera	2.340686	0.475294	2.943697	2.734495	0.220161	2.076302
Probability	0.310260	0.788481	0.229501	0.254807	0.895762	0.354109
Sum	167.7547	47.97980	89.41033	56.38872	46.50531	75.02502
Sum Sq. Dev.	1.614777	0.052824	0.131900	0.453980	0.032081	0.389589
Observations	34	34	34	34	34	34

The results in the table 1 show the Mean, Median, Maximum, Minimum, Standard Deviation, Skewness, Kurtosis and Jarque-Bera values. The Skewness and Kurtosis analyze the predictability of the variables and normality of the data. The estimated descriptive statistic reveals that environmental degradation, energy-consumption, globalization, industrial growth and population-density are negatively skewed whereas agricultural growth has positive skewed value. Descriptive statistic of the table 1 indicates that the kurtosis values of selected variables is positive. The empirical findings of kurtosis and skewness reveal that selected variables normally distributed having probability different from zero The estimated Jarque-Bera indicate that all variables have zero mean and finite co-variance, which approves that the data of all variables is normally distributed.

Table-2
Correlation Metrix

CO2	1.000000					
AGR	-0.842588 -8.850297 0.0000	1.000000				
ENG	0.986461 34.02686 0.0000	-0.855481 -9.345345 0.0000	1.000000			
GLO	0.990399 40.52789 0.0000	-0.811948 -7.868490 0.0000	0.974412 24.52338 0.0000	1.000000		
IND	-0.261264 -1.531115 0.1356	-0.094856 -0.539020 0.5936	-0.187723 -1.081142 0.2877	-0.247168 -1.442967 -0.1587	1.000000	
POPD	0.994817 55.34268 0.0000	-0.815636 -7.974775 0.0000	0.970152 22.63134 0.0000	0.992285 45.27682 0.0000	-0.288583 -1.705010 0.0979	1.000000
	CO2	AGR	ENG	GLO	IND	POPD

Table 2 represents the correlation matrix between the selected variables of the model. The estimated findings reveal that environmental degradation is negatively and significantly correlated with agricultural growth but has negative and insignificant correlation with industrial growth. The given results in the table 2 specify that environmental degradation has significant and positive correlation with energy consumption, globalization and population density. The results reveal that agricultural growth has significant and negative correlation with energy consumption, globalization and population density. The estimate shows that agricultural growth has negative but insignificant correlation with industrial growth. The estimates highlight that consumption of energy has significant and positive correlation with globalization and population density but it has insignificant and negative correlation with industrial growth. The empirical results indicate that globalization has positive but insignificant correlation with industrial growth and it has significantly and positively correlated to population density. Population density and industrial growth has significant and negative correlation with each other. Overall estimated results reveal that most of the variables have significant relationship with each other.

Table-3
Unitroot Test Results

At level			
Variables	ADF	PP	DF-GLS
LAGRGDP	-1.667498	-1.646234	-1.185758*
LCO2kt	-3.514497**	-3.74553***	-0.779787
LENGkg	-2.978085**	-2.850010*	-0.414899
LGLO	-1.629253	-3.923429***	-0.468658
LINDGDP	-2.486466	-2.553663	-2.369436
LPOPD	0.223068	-10.90278***	-1.134513
At 1st difference			
dLAGRGDP	-5.606733***	-5.606424***	-4.739693***
dCO2kt	-3.514497**	-4.915912***	-1.654092*
dLENGkg	-4.161353***	-4.216457***	-3.874130***
dLGLO	-5.888288***	-5.888288***	-5.729752***
dLINDGDP	-6.374639***	-6.520068***	-1.696453**
dLPOPD	-20.38594***	-2.018468**	-1.377954*

Augmented Dickey-Fuller (ADF), Phillips Perron (PP) and Dickey-Fuller Generalized Least Square (DF-GLS) have been applied for finding the variables' stationarity and the estimated outcomes are presented in table 5.3. Estimated ADF highlight that agriculture growth, globalization, industrial growth, population-density variables are nonstationary at I(0) but all these are stationary at I(1). Environmental degradation and energy consumption are stationary at level. The findings of PP unit root test show that agricultural growth and industrial growth are not stationary at level but these are stationary at 1st difference. Environmental degradation, energy-consumption, globalization and population density are stationary at level. The empirical findings of DF-GLS unit root test indicate that consumption of energy, environmental degradation, globalization, growth of industry and population-density are nonstationary at I(0) but at I(1) all variables become stationary. The agricultural growth is stationary at I(0). The overall outcomes of unit root tests highlight the model has mix integration order. This is the ideal and best situation for utilizing the ARDL cointegration method.

Table-4
Lag Length Selection Criteria

VAR Lag Order Selection Criteria						
LCO2, LAGR, LENG, LGLO, LIND, LPOPD						
Time Period: 1980-2013						
Lag	LogL	LR	FPE	AIC	SC	HQ
0	449.2250	NA	5.92e-21	-29.54834	-29.26810	-29.45868
1	686.3606	363.6079	9.37e-27	-42.95738	-40.99570	-42.32982
2	763.8701	87.84403	8.07e-28	-45.72467	-42.08156	-44.55921
3	866.1917	75.03585	2.63e-29	-50.14611	-44.82156	-48.44274
4	1316.578	150.1287*	5.43e-40*	-77.77185*	-70.76586*	-75.53057*

*indicates lag order selected by the criterion
LR: sequential modified LR test statistic (each test at 5 % level)
FPE: Final prediction error
AIC: Akaike information criterion
SC: Schwarz information criterion
HQ: Hannan-Quinn information criterion

Table 4 presents the findings of lag-order selection criterions. Normally, Hannan-Quinn information criterion, Akaike information criterion, Final prediction error, sequential modified LR test-statistic and Schwarz criterions are used optimal selection. The findings indicate that all criterions refer the optimal-lag length is 4. Hence, following the Hannan-Quinn information criterion, Akaike information criterion, Final prediction error, sequential modified LR test-statistic and Schwarz criterion maximum 4 lag length is employed in this study.

Table-5
ARDL Bounds Testing Approach

ARDL Bounds Testing Approach		
Dependent Variables LCO2kt ARDL(1,1,1,1,1,1)		
Critical values	F-Statistics 6.165914	
	Lower Bound	Upper Bound
95%	2.62	3.79
90%	2.26	3.35

The table 5 provides the empirical findings of ARDL co-integration among environmental degradation, agriculture growth, consumption of energy, globalization, industrial growth and population density. F-statistics has been employed for testing the null hypothesis of ARDL. The empirical findings reveal that the calculated F-statistics (6.165914) is greater as compare to upper bound (3.79) at 5 percent given by Pesaran et al., (2001). So, H1 is accepted and H0 is rejected. This confirms that CO2 emissions, agriculture growth, energy consumption, globalization, industrial growth and population density have long run cointegration in Pakistan.

Table-6
ARDL Long Run Form

Estimated Long Run Coefficients using the ARDL Approach ARDL(1,1,1,1,1,1) Dependent variable is LCO2kt Time Period 1980-2013			
Regressor	Co-efficients	Standard-Error	T-Ratio (Prob)
LAGRGDP	-0.422201	0.125721	-3.358245(0.0030)
LENGkg	1.434771	0.195186	7.350787(0.0000)
LGLO	0.008260	0.167089	0.049437(0.9610)
LINDGDP	-0.236545	0.109983	-2.150743(0.0433)
LPOPD	1.135385	0.193774	5.859332(0.0000)
C	-0.490974	0.679463	-0.722591(0.4779)

After the confirmation of co-integration among the selected indicators of the study. Now it is easy to examine long run association among variables. Table 6 presents the long run relations among environmental degradation, agricultural growth, consumption of energy, globalization, industrial growth and population density. The findings show that agricultural growth has negative and significant effect on environmental degradation. The empirics highlight that an increase of 1 percent in agricultural growth in Pakistan reduces (-0.422201) percent environmental degradation at 5 percent level of significance. There is strong negative relation between environmental degradation and agricultural growth in Pakistan. In the rural areas water quality is affected by the agricultural growth. In the case of Pakistan, it is estimated that almost 60 percent of the population live in the rural-areas. Crops are watered with waste water which is polluted by domestically as well as industrial sector comprising of metals that is potentially engrossed by vegetables in Pakistan (Economic Survey of Pakistan, 2014). The findings show that energy-consumption has significant and positive effect on environmental degradation. The calculated outcomes reveal an increase of 1 percent in energy-consumption brings (1.434771) percent increase in environmental degradation at 5 percent. These findings are opposed to Wang et al., (2011) in case of China. This study suggest that the government of China should increase energy efficient methods to reduce environmental-degradation. The estimated outcomes of our study in the case of Pakistan is different from this study. But Audi and Ali (2016) find the same results that there is significant and positive relation between consumption of energy and environmental degradation in case of Lebanon. The empirical outcomes indicate that globalization has positive and insignificant impact on environmental degradation in Pakistan. These findings are opposed to Shahbaz et al., (2013) in the case of Turkey. Shahbaz et al., (2013) find that globalization negatively affect the environmental degradation, in Pakistan this relationship is positive at this stage of development but insignificant and cannot play important role in determining environmental degradation. The coefficient of industrial growth shows that there is negative and significant relation between growth of industry and environmental degradation over the selected time period in Pakistan. This show a 1 percent rise in industrial growth reduces (-0.236545) percent environmental degradation at 5 percent level. The estimated outcomes reveal that population density puts positive and significant effect on environmental degradation in Pakistan, Audi and Ali (2016) also have same result in case of Lebanon. The empirical findings of this research reveal that a 1 percent rise of population density lead to a (1.135385) percent rise in environmental degradation. The general long run empirics indicate that for the reduction of environmental degradation, Pakistan must increase

use efficient energy source as a factor of production and control its population density and at the same time agricultural and industrial output must be enhanced.

Table-7
Error correction representation for the Selected ARDL model

Error Correction Representation for the Selected ARDL Model ARDL(1,1,1,1,1,1) Dependent variable is LCO2kt Time Period 1980-2013			
Regressor	Co-efficients	Standard-Error	T-ratio (Prob)
dLAGRGDP	-0.139541	0.158050	-0.882888(0.3873)
dLENGkg	0.969040	0.241890	4.006112(0.0006)
dLGLO	-0.058371	0.169986	-0.343385(0.7347)
dLINDGDP	0.013879	0.096429	0.143935(0.8869)
dLPOPD	6.154846	4.911122	1.253246(0.2239)
ECM(-1)	-0.991551	0.219001	-4.527602(0.0002)
R-Squared	0.998759	R-Bar-Squared	0.998109
S.E. of Regression	0.009179	F-Stat.	1536.782[0.000]
Mean of Dependent Variable	4.946927	S.D. of Dependent Variable	0.211109
Residual Sum of Squares	0.001769	Equation Log-likelihood	115.4294
Akaike Info. Criteria	-6.268447	Schwarz Bayesian Criterion	-5.724263
Hannan-Quinn Criterion	-6.085346	DW statistics	2.298710

After analyzing the long run relations of variables, now it is easy to explore the short-run dynamics by applying the VECM. The short run outcomes of the model are depicted in the table 7. The findings indicate that agricultural growth has inverse and insignificant relation with environmental degradation. The coefficient of energy consumption highlights that consumption of energy and environmental degradation have significant and positive short run relation. Audi and Ali (2016) also prove this type of relation between consumption of energy and environmental degradation in case of Lebanon over the short run. The findings of this study show that an increase of 1 percent in consumption of energy brings (0.969040) percent increase in environmental degradation. The results reveal that globalization has negative and insignificant effect on environmental degradation. The estimates highlight that industrial growth has insignificant impact on environmental degradation. The empirics indicate that population density has insignificant effect on environmental degradation in Pakistan. The significant and negative ECM reveals the adjustment speed towards the long run equilibrium from short run shocks. The empirical findings of ECM indicate that one and half year is needed for long run convergence. Furthermore, the last period variations are rectified by (99.155) percent in the next year in Pakistan. The overall short run results reveal that environmental degradation in Pakistan is not short run phenomena.

Table-8
Diagnostic Test

Test Statistics	F-statistics	Probability Value
LM Test: Breusch-Gogfrey Serial Correlation	0.146420	0.8645
Hetroskedasticity Test: Breusch-Pagan-Godfrey	1.493334	0.2237

Table-8 shows the empirical results of the two diagnostic tests such as LM test and Hetroskedasticity tests. Probability values of both tests are greater than 0.05 which shows that there is no problem of serial correlation and hetroskedasticity.

Figure 1
Plot of Cumulative Sum of Recursive Residuals

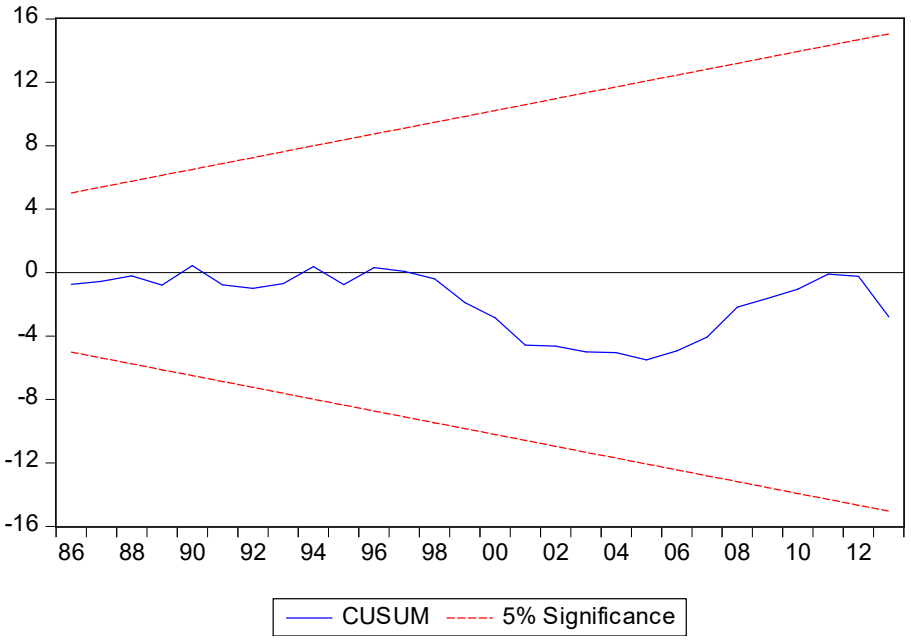
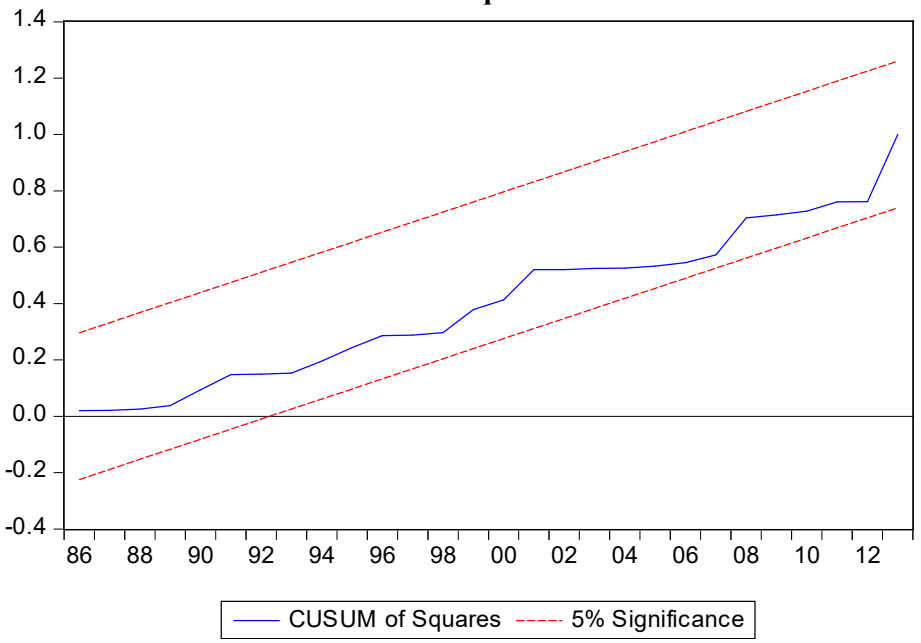


Figure 2

Plot of Cumulative Sum of Squares of Recursive Residuals



Conclusion and Policy Implications

The long-run findings indicate that agricultural growth has significant and negative effect on environmental-degradation. The results reveal that consumption of energy has significantly positive effect on CO2 emissions. Halicioglu (2009) finds the same type of relation between consumption of energy and environmental degradation. This research reveals that globalization has positive and insignificant effect on CO2-emissions. The outcomes of this study show the negative and significant relation between industrial growth and environmental degradation. The results reveal positive and significant relation between population density and environmental degradation in Pakistan. The long-run results give a better picture of environmental degradation in Pakistan. So conclusions can be drawn as agricultural growth and industrial growth has negative impact on environmental degradation. It shows that an increase in agricultural and industrial growth decrease the environmental degradation in Pakistan which means Pakistan is using traditional and environment friendly methods of producing both in industry and agriculture. The empirics reveal that consumption of energy, globalization and population density are positively related to environmental-degradation in Pakistan, so it is concluded that control these factors for healthy environment. The short run dynamics show that agricultural growth has negative and insignificant effect on environmental degradation whereas consumption of energy has significant and positive effect on environmental degradation, globalization has negative and insignificant effect on environmental degradation, industrial growth has positive and insignificant effect on environmental degradation and population density has insignificant impact on environmental degradation. On the basis of short run outcomes, it is decided that environmental degradation in Pakistan is short run phenomena as compare to existing literature.

On the basis above conclusions, there are some policy suggestions for Pakistan. It must control industrial sector pollution which is the major cause of environmental related problems. Preventive measures including encouraging the use of cleaner fuels and diesel with lower sulfur content should be encouraged in Pakistan. Petrol-based engine should be converted into CNG-based engines to control the air pollution. The system of sanitation should be improved to control urban population. Recently, two key of long-term macro policy measures are

introduced in Vision 2030 and the MTDF 2005-10. These macroeconomic policies treat the environmental issues as basis right of human life. In 2005, a National Environmental Policy of Pakistan was approved by the Federal Government. The strategies and plans of this policy is to provide a proper framework for treating the comprehensive environmental issues. For the success of this policy, there is need to get basic information about environment. For environmental prospects, energy-sector must be focused on promoting energy efficient ways. The government of Pakistan must increase the agricultural growth in positive way to reduce the environmental degradation. There should be a policy to protect environmental quality with a non-polluted agricultural growth. The Government must also increase the industrial growth in efficient manner to control environmental degradation in Pakistan. There should be a proper control on the energy consumption, negative impacts of globalization and population density to overcome the environmental degradation in Pakistan. In the end, considering a long run phenomenon, Pakistan must treat environmental degradation as its primary issue for its coming generations.

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