Paradigms: A Research Journal of Commerce, Economics, and Social Sciences
Print ISSN 1996-2800, Online ISSN 2410-0854
2017, Vol. 11, No. 2 Page 158-164
Doi: 10.24312/paradigms110205

Urbanization and Environmental Kuznets Curve in Pakistan: A Cointegration Analysis

Dr. Fareed Shareef
fareedsharif76@gmail.com
Associate Professor of Economics
Government Emerson College, Multan
Dr. Muhammad Ramzan Sheikh
ramzansheikh@bzu.edu.pk
Associate Professor of Economics
Bahauddin Zakariya University Multan
Muhammad Jahangir
mjahangir.eco@gmail.com
Visiting Lecturer in Economics
BahauddinZakariya University Multan (Layyah Campus)

ABSTRACT

Urbanization-growth-environment nexus has been on the forefront of discussion among researchers for the couple of decades. The increased economic activity and urbanization lead to resource depletion, environmental degradation and have serious consequences for sustainable development in developing economies like Pakistan. The present study endeavors to analyze the impact of urbanization on environmental quality in Pakistan by using inverted U-shape and N-shape environmental curves. Applying johansen-Jusilius technique, the study confirms existence of environmental Kuznets curve in Pakistan. The GDP growth shows positive and significant effect on CO2 emissions in Pakistan. The coefficient of FDI confirms pollution heaven hypothesis which invokes stringent environmental policy implications by government to ensure sustainable growth and environment. Similarly trade openness captures technique effect hypothesis which suggest that with increased growth the production processes become environmental friendly as awareness among the people sets in.

Key Words: Urbanization, Environmental Kuznets Curve, CO2 Emissions.

INTRODUCTION

The most unprecedented challenge faced by the mankind in the world is environmental degradation and global warming. Burning of fossil fuels along with human induced greenhouse gases has intensified the environmental conditions and caused an increase in global temperature (World Bank, 2010). Since the start of process of industrialization, the average temperature on this globe has increased by 1 degree Celsius. If the change in the climate persists with current pace average global temperature would increase by 5^{o}C as compared to that of preindustrial times by the end of this century. The developing and poor economies are more exposed to climatic and environmental hazards. Environmental degradation has disproportionate consequences on developing world (World Bank, 2010; Stern, 2007).

The South Asia is one of the most densely populated areas of the world, characterized with largely depleted natural resources (World Bank, 2010). Pakistan is the second largest country of this region with 188 million populations and population density of 236 persons/ km^2. Increased carbon dioxide emissions and nitrogen oxide emission has deteriorated air quality rapidly. Almost all of the sectors of Pakistan economy are affected by the changes in environmental quality and climatic conditions (Pakistan Economic Survey, 2013-14).

Urbanization is the part of growth process which is measured as the proportion of urban population in the total population. In particular its current annual growth rate, Asia's urban population is twice predictable, in less than 25 years. Urbanization has profound impact on the environment and the process of economic development. Like other developing economies Pakistan on the globe has experienced a rapid urbanization in the process of modernization and development. Several studies have demonstrated significant nexus between urbanization and economic growth (Alam, 2011; Shahbaz, 2011). On the other hand, urbanization has its consequences regarding sustainable development of the economy (Gade, 2013).

Therefore, not only in Pakistan, but also globally the process of urbanization is accelerating. In addition, approximately 60 % of the population expected to be living in the world's urban sector in 2030 went down in developed economies, there are about 6 billion people this number will continue to increase each year from rural to urban areas and is expected to move in the future (Pakistan Economic Survey, 2013-14).

Keeping in view the above mentioned scenario, the present study would be important in policy and decision making to comprehend the determinants of air pollution in Pakistan. It would help in developing effective environmental policies

palliating the effects of human activities and would help in curtailing CO_2 without compromising economic growth in the economy.the major objective and contribution of the study is to verify the existence of environmental Kuznets curve and N-type relationship between growth-urbanization and environmental nexus in Pakistan.

The organization of the paper is as follows. The first section contains introduction which is succeeded by the review of literature in the second section. The third section entails model specification whereas variables and data sources are followed by it. Results and causality tests are described in section 5 and 6 respectively. Finally conclusion is given in the last section of this study.

LITERATURE REVIEW

Environment-growth nexus has remained a burning issue during the last couple of decades. Most of the theoretical and empirical studies argued an inverted U-shaped association between economic progress and pollutions. An inverted U-shaped association between economic growth and pollutions is known as environmental Kuznets curve theory (Grossman and Krueger, 1995). The Environmental Kuznets Curve hypothesis has been tested in many empirical studies. Grossman and Krueger (1995) concluded that economic growth, in initial stages lead to environmental degradation and after maximum level of economic growth it improves the environmental conditions. Some other studies such as Cole (2005); Heil & Selden (2001) explored an inverted-U shaped CO_2 function.

Several of the theoretical and empirical studies (Masih & Masih, 1996; Kraft & Kraft, 1978; Narayan & Singh, 2007; Jalil & Mahmud, 2009) consider energy consumption as another important determinant of carbon emission along with the growth. Suri and Chapman (1998) analyzed that the Environment Kuznets Curve (EKC) inverted-U shaped gave the information about the source of various environment problems. The researchers collected the time series data and pooled cross country that covered the time period of 1971-1990. The study was focused on the economic enlargement, trade openness and energy consumption through the information of EKC. The study suggested that industrial nations should decrease their energy consumption through importing manufactured goods. The researchers concluded that the exporting nations would contributeto the upward slope of EKC and import industrialized nations would contribute to downward slope of EKC.

The above cited literature is evident that most of the studies focused on the growth-environment nexus. The most of the studies explored the existence of EKC hypothesis and these studies are cross-country studies. A few studies analyzed EKC hypothesis by using country-specific data. The developing economies which are highly vulnerable to climate change effect and a pollution emission is a growing challenge as well. Pakistan is one of the developing countries of the world. Pakistan economy has experienced high rates of urbanization during the last few decades. This urbanization might have its environmental consequences. So this study is an attempt to explore the impact of urbanization in the framework of EKC hypothesis and/or N-shaped or Inverted N-shaped association between economic growth and carbon emission in Pakistan. Table 1 enlists all the studies on the topic.

Table1

Summary of Review of Assorted Studies

Reference	Region & Data	Dep. Variable	Explanatory Variables	Main Results
Stern (2007)	OECD and Non-OECD Panel Data	SO2 per capita	Per capita GNP Per capita GNP^2	[+] [-]
Cole (2005)	OECD countries 1980-97	CO2 emissions per capita	Per capita GDP Per capita GDP^2 Per capita GDP^3 Trade Density Dirty Exports Dirty Imports	[-] [-] [-]
Chen (2007)	China Provincial Data Fixed effect Model	CO2 emissions per capita	Per capita GDP Per capita GDP^2 Per capita GDP^3 Industrial share in GDP Exports Population FDI	[-] [+] [-] [+] [+] [-]
Jalil& Mahmud (2009)	China Time Series [1975-2005] ARDL	CO2 emissions per capita	Energy Consumption Per capita Income Per capita Income^2 Trade Openness	[+] [+] [-] [-]
Shahbaz (2011)	Time Series data [1972-2009] ARDL and ECM	CO2 emissions per capita	Real GDP Per CapitaReal GDP Per Capita^2Energy Consumption Per Capita, Trade Share Of GDP	[+] [-] [+] [+]
Anees and Ahmed (2011)	Time series JJ-Cointegration (1971 -2007)	CO2 emissions	Gross Domestic Product (GDP) Gross Domestic Product ^2 Energy Trade Industrial Growth Agriculture Urbanization	[+] [-] [+] [+] [+] [+] [+]
Ahmad & Long (2012)	Pakistan Time Series [1971-2008] ARDL Method	CO2 Emission	Per capita Income Per capita Income^2 Per capita Income^3 Energy consumption Trade openness Population Growth	[+] [-] [+] [+] [+]
Grossman and Krueger (1995)	European countries	CO2,water,soil pollution	GDP Per capita Income Per capita Income^2	[-] [+] [-]
Heil and Selden (2001)	High income countries	Co2	GDP, Population growth , oil prices	[+] [+] [+]

Masih and Masih(1996)	Six Asian countries	Index of Energy consumption	GDP CPI	[+] [-]
Kraft and Kraft(1978)	OECD & Non OECD countries	Energy consumption	GDP	[+]
Narayan and Singh(2007)	FIJI& ARDL Technique	Electricity consumption	GDP Labor force	[+] [+]
Suri&Chapman (1998)	Developed countries	Commercial EC	GDP Exports Industrialization	[+] [+] [+]

Source: Authors' Compilation

Model Specification

To check Environment Kuznets Curve hypothesis, we add a square term of GDP growth rate along with economic determinants of urbanization in the modal. We add Cube of GDP to capture effect of inverted-N shaped relationship. The model to be estimated for the assessment of role and impact of urbanization and growth on environmental quality is in following equation.

$$CO_{2,t} = f(GDP_t, DUPD_t, ENR_t, FDI_t, TROP_t) \quad (1)$$

Growth rate for investigation of environment-growth nexus in the framework of inverted-U, N-shaped and

$$CO_{2,t} = \gamma_o + \gamma_1(\text{GDP}) + \gamma_2(GDP_t)^2 + \gamma_3(GDP_t)^3 + \gamma_4(DUPD_t) + \gamma_5(ENR_t) + \gamma_6(FDI_t) + \gamma_7(TROP_t) + \varepsilon_t \quad (2)$$

Where:

CO_2 = *Environmental degradation measured by CO_2 emissions (metric tons per capita)*
GDP = *Annual GDP growth rate*
GDP^2 = *Square of annual GDP growth rate*
GDP^3 = *Cube of GDP growth rate*
DUPD = *Urbanization measured by the change in urban population density*
ENR = *Road sector diesel fuel consumption per capita (kg of oil equivalent)*
FDI = *Foreign direct investment as percentage of GDP*
TROP = *Trade openness measured by ratio of sum of exports plus imports to GDP*
ε_t= *error term*

Table 2

Explanatory variables and their expected signs

Independent Variables	Expected Sign
GDP growth rate	+
Square of GDP growth rate	-
Cube of GDP growth rate	+
Urbanization	+
Road sector diesel fuel consumption per capita	+
Foreign direct investment	+
Trade openness	-

By using the equation (2) following results are expected:

- If $\gamma_1 = \gamma_2 = \gamma_3 = 0$ it implies that there is no association between carbon emission and GDP growth.
- If $\gamma_1 > 0$ and $\gamma_2 = \gamma_3 = 0$ it implies that there is linear association between GDP growth and carbon emission.
- If $\gamma_1 < 0$ and $\gamma_2 = \gamma_3 = 0$ it implies that there is monotonically increasing association between GDP growth and carbon emission.
- If $\gamma_1 > 0$, $\gamma_2 < 0$ and $\gamma_3 = 0$ it means that the association between GDP growth and carbon emission is inverted-U shaped.
- If $\gamma_1 < 0$, $\gamma_2 > 0$ and $\gamma_3 = 0$ it means that there is U-shaped association between economic growth and carbon emission.
- If $\gamma_1 > 0$, $\gamma_2 < 0$ and $\gamma_3 > 0$ it implies that there is an N-shaped relation between GDP growth and carbon emission.
- If $\gamma_1 < 0$, $\gamma_2 > 0$ and $\gamma_3 < 0$ it means there is an inverted N-shaped association between GDP growth and carbon emission.
- If $\gamma_4 > 0$ it confirms that urbanization degrades environmental quality in Pakistan.
- If $\gamma_5 > 0$ it implies that there is positive association between energy consumption and carbon emission.
- If $\gamma_6 > 0$ then it means FDI increases carbon emission and it is confirmation of the Pollution Heaven Hypothesis (PHH).
- If $\gamma_6 < 0$ then FDI has positive impact on environmental quality in Pakistan.
- $\gamma_7 > 0$ or $\gamma_7 < 0$ the trade openness has positive or negative impact on environmental quality in Pakistan.

Annual time series data for the period of 1972-2015 have been used for the analysis. All the data were collected from World Bank (WDI, 2014).

Table 3

Description of Variables

Variables	Proxy	Abbreviation	Description
Air Pollution	CO2	CO_2	(CO_2) (metric tons per capita), road sector diesel fuel consumption per capita (kg of oil equivalent),
Economic growth	GDP growth rate	GDP	GDP is the market value of a country's production of goods and services within a year.
Urbanization	Urban population density	DUPD	It is the total number of people living in urban areas as the percentage of total population.
Industrialization	Energy consumption per capita	ENR	Road sector diesel fuel consumption per capita (kg of oil equivalent) is the variable of energy consumption.
modernization	Foreign direct investment	FDI	Foreign direct investment is taken as percentage of GDP.
Globalization	Trade openness	TROP	It is calculated by the sum of exports and imports as percentage of GDP

RESULTS AND DISCUSSIONS

The present study is the investigation of the impact of urbanization on environmental quality in the framework of environmental curve: inverted U-shaped and/or N-shaped association between growth and carbon emissions in Pakistan. Pakistan's economy over the years, has experienced higher levels of urbanization. The reliance of economic growth has shifted from agriculture sector to industrial and service sector. The industrial and service sectors are concentrated in the urban areas of the economy. So during the growth process of the economy the influx of population coupled with the increasing trends of urbanization may have environmental consequences.

Most of the time series are non-stationary at levels so it is a prerequisite to pretest the order of integration of the variables to avoid spurious regression. The most commonly used Augmented Dickey Fuller test (Dickey-Fuller, 1979) unit root tests would be used for assessment of the order of integration of the time series.The results of ADF testare shown in Table 4.The ADF unit root test is applied on each of the time series variables with constant, and with constant and deterministic trends. The results of the stationary tests reveal that all the variables are stationary at the first difference. This means that it is appropriate to apply Johansen Jusilious (JJ) co-integration technique for estimation of the long run relationship between the variables under study. So the study proceeds with JJ technique.

Table 4

Unit Root Test Results

Variable	With Intercept	With Intercept and Trend	None	
CO_2	-1.7960	-1.2775	4.7102	I(1)
GDP	-2.5250	-2.6903	-1.5001	I(1)
DUPD	-0.7135	-3.0180	2.4220	I(1)
ENR	-3.6367	0.2343	2.0826	I(1)
FDI	-1.7858	-2.8954	5.2350	I(1)
TROP	-2.8961	-3.3269	-1.0873	I(1)
		Critical Value		
1%level	-3.6156	-4.2119	-2.61	
5%level	-2.9411	-3.5298	-1.94	

Source: Authors' calculations*(**) indicate significance at 0.01(0.05) level.

Co-integration Analysis: Johansen's Approach

As co integration analysis is more sensitive to lag length prior to co integration analysis optimum lag length is selected by using Akaike Information Criteria (AIC). AIC is more suitable to select optimum lag length (Lütkepohl, 1991). The AIC criteria confirmed lag 2 to be optimum lag length to trace out long co integrating vectors in carbon emission model. The results of the Johansen's co integration are summarized in Table 5.

The Johansen co integration analysis reveals that there is a long run equilibrium relationship between carbon emission and its correlates. The trace statistics tests the null hypothesis of R or less than R co integrating vectors against the alternative hypothesis of more than R co integrating vectors. Whereas, Max-Eigen statistics tests the null hypothesis of R co integrating vectors against the R + 1 co-integrating equations. The trace test statistics rejected the null hypotheses of $R \leq 0$, $R \leq 1$, $R \leq 2$, $R \leq 3$ and $R \leq 4$ against the alternative hypotheses of $R > 0$, $R > 1$, $R > 2$, $R > 3$ and $R > 4$ co integrating equations, respectively, at 5 percent level of significance. The Trace statistic is unable to reject the null hypothesis of $R \leq 5$ the alternative of $R = 5$.

The max-Eigen statistics also rejected the null hypotheses of $R = 0$, $R = 1$, $R = 2$, $R = 3$ and $R = 4$ against the alternative hypotheses of $R > 0$, $R > 1$, $R > 2$, $R > 3$ and $R > 4$, respectively, at 5 percent significance level. But max-Eigen statistics cannot reject the null hypothesis of $R = 5$ against the alternative of $R > 5$. Both of the test statistics; Trace and Max-Eigen statistics confirm long run co integrating association among carbon emission, economic growth, urbanization, energy consumption, foreign direct investment and trade openness in Pakistan over the sample period.

Table 5

Johansen's Co integration Analysis Results

Null Hypothesis	Alternative Hypothesis	Eigen value	Trace Statistic	Critical Value	Prob
$R \leq 0$	$R > 0$	0.99	510.938*	187.47	0.00
$R \leq 1$	$R > 1$	0.95	331.379*	150.55	0.00
$R \leq 2$	$R > 2$	0.88	220.826*	117.70	0.00
$R \leq 3$	$R > 3$	0.83	142.377*	88.80	0.00
$R \leq 4$	$R > 4$	0.67	76.719*	63.87	0.00
$R \leq 5$	$R > 5$	0.38	36.4507	42.91	0.19
$R \leq 6$	$R > 6$	0.27	19.0962	25.87	0.27
$R \leq 7$	$R > 7$	0.18	7.4984	12.51	0.29
Unrestricted Co integration Rank Test (Maximum Eigen value)					
Null Hypothesis	**Alternative Hypothesis**	**Eigen value**	**Max-Eigen Statistic**	**Critical Value**	**Prob**
$R = 0$	$R > 0$	0.99	179.55*	56.70	0.00
$R = 1$	$R > 1$	0.95	110.55*	50.59	0.00
$R = 2$	$R > 2$	0.88	78.44*	44.49	0.00
$R = 3$	$R > 3$	0.83	65.65*	38.33	0.00
$R = 4$	$R > 4$	0.67	40.26*	32.11	0.00
$R = 5$	$R > 5$	0.38	17.35	25.82	0.42
$R = 6$	$R > 6$	0.27	11.59	19.38	0.45
$R = 7$	$R > 7$	0.18	7.49	12.51	0.29

Source: Authors' calculations

* denotes rejection of the hypothesis at the 0.05 level

@MacKinnon-Haug-Michelis (1999) p-values

Trace and Max-Eigen Statistics indicate 5 co integrating equations at the 0.05 level.

Long Run Analysis: Co integrating Vector

Now we discuss the marginal impact of GDP growth rate, the square of GDP growth rate, the cube of GDP growth rate, urbanization proxied by the change in urban population density (DUPD), Road sector diesel fuel consumption (ENR), foreign direct investment as percentage of GDP (FDI), trade openness on carbon emission in long run as well as in short run. The short run analysis confirmed the relationship between the variable in Table 6 and the results of long run analysis confirmed the relationship between the variables in Table 7 by using the normalized co integrating coefficients.

Table 6 shows that the impact of GDP growth rate is positive on carbon emissions. The coefficient of GDP shows positive and significant association between GDP growth rate and carbon emission meaning that one percent increase in the GDP growth rate brings 0.6254 metric tons per capitaincrease in the carbon emissions .So, the GDP growth rate is main contributor of pollution emission in Pakistan. The studies (Grossman and Krueger, 1995), Cole (2005), Heil and Selden (2001), Galeottiet al. (2006) and Felman (2015) also found

the positive impact of GDP growth rate on the carbon emission.

Table 6

Normalized Co integrating Coefficients

Variable	Coefficient	Standard Error	t-value
GDP	0.6254*	0.1116	5.6019
(GDP)^2	-0.9109*	0.1163	-7.8355
(GDP)^3	0.3147*	0.0339	9.2793
(DUPD)	0.3806*	0.0376	10.1275
(ENR)	0.0471***	0.0253	1.8646
(FDI)	0.1419*	0.0095	15.0040
(TROP)	-1.5896*	0.0938	-16.9452
Time	0.0032**	0.0008	3.7536

Source: Authors' calculations

, ** and * show significance at 1%, 5% and 10% level.*

The square of GDP growth rate is negative 0.9109 and it is statistically significant. This result confirms that carbon emission increases at early stage of GDP growth rate and then decrease after reaching at maximum level of economic growth. This confirms that there exists the Environment Kuznets Curve for Pakistan. This empirical evidence is in line with the findings of Stern. (2007), Cole and Neumayer (2004), Jalil and Mahmud (2009), Shahbaz (2010), Ahmad and Long (2012), and Ali (2015). The coefficient of the GDP growth rate in cubic form is positive and statistically significant which confirm an N-shaped association between economic growth and carbon emissions in Pakistan.

Another major source of environmental degradation in Pakistan is the urbanization, the share of the urban population to total population. The findings of the study confirm that there is a positive association linking urbanization and carbon emissions. This finding corroborates with the findings of the earlier studies such as Cole and Neumayer (2004), Urdal (2005), Dijkgraaf and Vollebergh (2005), Alamet (2010), and Anees and Ahmad (2011).

The energy consumption is found to have significant and positive association with carbon emissions in Pakistan. The energy consumption is most important contributors to environmental degradation in Pakistan. Carbon emission has increased from industrial sector and power generation that are using natural gas, coal, oil and old tires that are the source of black smoke and pollutions .Carbon emissions have increased due to increasein number of motor vehicles and industrial sectors that are using more natural gas oil and coal Alamet (2010). Most of urban citizens have private motor vehicles or two wheelers. The demand for private motor vehicle has increased owing to growing affordability of people and financing of car loans by banks.

The inefficiency of railway sector is another reason for increasing no of vehicles on road and hence pollution (Pakistan Economic Survey, 2013-14).The industrial sector is the main contributor to these carbon emissions. The use of coal and old tires has increased by 34.3 % in 2012-13 compared with 2001-02 (Pakistan Economic Survey, 2013-14) that increased in the coal, oil and gas consumption and has caused environmental problems in Pakistan economy. The earlier studies of Shahbaz (2010), Ahmad and Long (2012), Boutaba (2013) and Ali (2015) also confirmed this finding.

The impact of foreign direct investment on carbon emission is found to be significant and positive in Pakistan. This means that foreign direct investment on the wheels of the multinational companies shifting their obsolete technologies to developing countries like Pakistan (a pollution heaven hypothesis) that is causing environmental degradation in Pakistan.

The elasticity of trade openness is negative with carbon emission which is in line with the findings of Jalil and Mahmud (2009) in the case of China. The findings of this study confirms the technique effect hypothesis which states that with the increase in the growth via trade openness the country will move towards the adoption of environment friendly technologies in the production processes. Moreover various studies which explain the negative relationship between trade openness and carbon emission such as Cole and Neumayer (2004), Jalil and Mahmud (2009) and Adams and Adger (2013b) are matched by the findings of this study.

Short Run Analysis: Vector Error Correction Model

Vector error correction model is estimated to analyze short-term dynamic environmental degradation and its related factors. If the variables are co- integrated then an error correction model (Granger, 1988) is used to find short run relationship between variables. Error correction model results are listed in Table 7.

Table 7

Vector Error Correction Estimates

Variable	Coefficient	Std. Error	t-Statistic	Prob.
Constant	0.0616*	0.0148	4.1716	0.0009
D(CO_2(-1)	-0.6367**	0.2603	-2.4456	0.0283
D(CO_2(-2)	0.0221	0.2091	0.1055	0.9175
D(GDP(-1)	0.0422	0.1530	0.2755	0.7869
D(GDP(-2)	-0.0385	0.1029	-0.3739	0.7141
D(GDP(-1))^2)	0.0548	0.1758	0.3115	0.7600
D(GDP(-2))^2)	0.0828	0.1159	0.7145	0.4867
D (GDP(-1))^3)	-0.0324	0.0542	-0.5972	0.5599
D (GDP(-2))^3)	-0.0263	0.0345	-0.7628	0.4582
D (DUPD(-1)	0.4268	0.2970	1.4368	0.1727
D (DUPD(-2)	-0.7518***	0.4218	-1.7826	0.0963
D(ENR(-1)	-0.0683	0.0986	-0.6924	0.5000
D(ENR(-2	0.0974	0.1262	0.7720	0.4529
D(FDI(-1)	-0.0202	0.0142	-1.4275	0.1754
D(FDI(-2)	-0.0273**	0.0117	-2.3428	0.0344
D(TROP(-1)	0.2806***	0.1328	2.1135	0.0530
D(TROP(-2)	0.3528*	0.1023	3.4481	0.0039
ECT(-1)	-0.4743**	0.1804	-2.6286	0.0198

R^2 = 0.8535, Adjusted R^2 = 0.6339

F-value = 3.8853, Prob(F-value) = 0.0060

Durbin-Watson Stat. = 2.2650

Source: Authors' calculations

, ** and * show significance at 1%, 5% and 10% level.*

Short-term results show that the error correction term is significant at 5% significance level. Coefficient of error correction term is negative and statistically robust. The value -0.4743 which means that in case of disequilibrium in the short run the model will converge to equilibrium after almost five months. In addition, the significance of the error correction term also confirms that economic growth, urbanization, energy consumption, foreign direct investment

and trade openness have some bearings on carbon dioxide emissions in Pakistan.

The coefficient of the GDP is found to be insignificant which means that in short run the GDP has no impact on CO2 emissions which is also obvious theoretically because growth is a long term phenomenon and it can effect environment in the long run. Similarly the coefficient of urbanization with square term appears significantly with negative sign which means that at higher level of growth the environmental pollution falls (EKC hypothesis) and this is also true for urbanization as people become aware environment friendly technologies and better standard of living.

The coefficient of trade openness is found to be significant positive sign which means that trade openness increases CO2 emissions owing to increased production activities and transportation.

The statistical robustness of the estimated model is adjudged by the properties of error term. Jarque-Bera test, Breush-Godfrey Serial Correlation LM test and ARCH hetro-scedasticity test are applied to test the normality, serial correlation and heteroscedasticity of the residuals respectively. The Diagnostic tests results given in the Table 8 are evident that the error term is normally distributed serially uncorrelated and have constant variance.

Table 8

Diagnostic Tests

Tests	JB-Statistic	F-statistic	Obs*R-squared	Decision
Normality Test	1.2807 [0.5270]	-	-	**Normally Distributed**
Breusch-Godfrey Serial Correlation LM Test	-	0.3829 [0.689]	2.1596 [0.3396]	**Serially Uncorrelated**
Heteroskedasticity Test: ARCH	-	0.8307 [0.445]	1.7295 [0.4211]	**Homoskedastic**

Source: Authors' calculations

Note: The values in [ ] are the p-values.

Causality Test

The present study conducted Granger causality test to determine the direction of causality. The result of pair wise granger causality is given in Table 9. The result suggests that there exist unidirectional causality from output to carbon dioxide emission up to three lags. The unidirectional causality observed from foreign direct investment, energy consumption, output and urbanization to trade openness. It means that increased economic activity, urbanization, output and openness can be achieved at the expense of carbon dioxide emission. The study results show that there exist unidirectional causality from carbon dioxide emission to urbanization and foreign direct investment due to lax environmental regulations. Unidirectional causality observed from energy consumption to output, output and trade openness to carbon dioxide emission. All other variables are insignificant at 5 percent significance level. None of the variable showed bidirectional causality.

Table 9

Pairwise Granger Causality Tests

Null Hypothesis:	Obs	F-Statistic	Prob.
(GDP) does not Granger Cause (CO22)	43	4.201	0.023
(CO22) does not Granger Cause (GDP)		1.793	0.182
(GDP)^2 does not Granger Cause (CO22)	43	4.988	0.012
(CO22) does not Granger Cause (GDP)^2		1.317	0.281
(GDP)^3 does not Granger Cause (CO22)	43	5.287	0.010
(CO22) does not Granger Cause (GDP)^3		1.247	0.300
(DUPD) does not Granger Cause (CO22)	43	0.777	0.468
(CO22) does not Granger Cause (DUPD)		3.794	0.033
(ENR) does not Granger Cause (CO22)	43	0.714	0.496
(CO22) does not Granger Cause (ENR)		0.578	0.566
(FDI) does not Granger Cause (CO22)	43	0.037	0.963
(CO22) does not Granger Cause (FDI)		3.889	0.030
(TROP) does not Granger Cause (CO22)	43	4.371	0.020
(CO22) does not Granger Cause (TROP)		2.432	0.103
(GDP)^2 does not Granger Cause (GDP)	43	0.390	0.679
(GDP) does not Granger Cause (GDP)^2		0.611	0.548
(GDP)^3 does not Granger Cause (GDP)	43	0.556	0.578
(GDP) does not Granger Cause (GDP)^3		0.838	0.441
(DUPD) does not Granger Cause (GDP)	43	2.068	0.143
(GDP) does not Granger Cause (DUPD)		0.519	0.599
(ENR) does not Granger Cause (GDP)	43	3.068	0.06
(GDP) does not Granger Cause (ENR)		0.030	0.969
(FDI) does not Granger Cause (GDP)	43	2.410	0.105
(GDP) does not Granger Cause (FDI)		0.859	0.432
(TROP) does not Granger Cause (GDP)	43	0.726	0.491
(GDP) does not Granger Cause (TROP)		3.366	0.046
(GDP)^3 does not Granger Cause (GDP)^2	43	0.569	0.571
(GDP)^2 does not Granger Cause (GDP)^3		0.610	0.548
(DUPD) does not Granger Cause (GDP)^2	43	1.648	0.208
(GDP)^2 does not Granger Cause (DUPD)		0.794	0.460
(ENR) does not Granger Cause (GDP)^2	43	1.806	0.180
(GDP)^2 does not Granger Cause (ENR)		0.039	0.961
(FDI) does not Granger Cause (GDP)^2	43	2.395	0.106
(GDP)^2 does not Granger Cause (FDI)		0.439	0.648
(TROP) does not Granger Cause (GDP)^2	43	0.691	0.507
(GDP)^2 does not Granger Cause (TROP)		2.898	0.069
(DUPD) does not Granger Cause (GDP)^3	43	1.369	0.268
(GDP)^3 does not Granger Cause (DUPD)		1.216	0.309
(ENR) does not Granger Cause (GDP)^3	43	1.092	0.347
(GDP)^3 does not Granger Cause (ENR)		0.079	0.924
(FDI) does not Granger Cause (GDP)^3	43	2.268	0.119
(GDP)^3 does not Granger Cause (FDI)		0.235	0.791
(TROP) does not Granger Cause (GDP)^3	43	0.865	0.43
(GDP)^3 does not Granger Cause (TROP)		2.218	0.124
(ENR) does not Granger Cause (DUPD)	43	0.522	0.597
(DUPD) does not Granger Cause (ENR)		0.563	0.575
(FDI) does not Granger Cause (DUPD)	43	2.451	0.102
(DUPD) does not Granger Cause (FDI)		0.394	0.677
(TROP) does not Granger Cause (DUPD)	43	0.047	0.953
(DUPD) does not Granger Cause (TROP)		4.063	0.026
(FDI) does not Granger Cause (ENR)	43	0.345	0.710
(ENR) does not Granger Cause (FDI)		2.95	0.066
(TROP) does not Granger Cause (ENR)	43	1.476	0.243
(ENR) does not Granger Cause (TROP)		4.284	0.022
(TROP) does not Granger Cause (FDI)	43	2.605	0.089
(FDI) does not Granger Cause (TROP)		3.379	0.046

Source: Authors' calculations

CONCLUSIONS

The present study endeavored to explore the effect of urbanization, economic growth, energy consumption, FDI and trade openness on the carbon emission in Pakistan economy for the period of 1972-2015. The study used Johansen co integration test for estimating the relationship between variables which confirmed the existence of co integrating association among carbon emission and it covariates. It implies that economic growth, urbanization, energy consumption, FDI, and trade openness affect carbon emission in long run. The error correction term in the ECM model has the correct sign and is statistically significant at 5 percent level confirming the long run causality running from economic growth, urbanization, and FDI and trade openness. The results are statistically robust as adjudged by coefficient

of determination, JB-test, serial correlation LM test and heteroscedasticity ARCH test.

The findings of the study verified the existence of the environmental Kuznets curve and N-type relationship between environment degradation, economic growth and urbanization in Pakistan. As far as FDI and trade openness is concerned the policy of the government should be to adopt stringent environmental regulations to avoid the transfer of obsolete technologies and environmentally hazardous goods (pollution heaven hypothesis) from developed countries to developing countries like Pakistan.

REFERENCES

Adams, H. & Adger, W. N. (2013b). The contribution of ecosystem services to place utility as a determinant of migration decision-making. *Environmental Research Letters*, 8(1), 015006.

Ahmad, K., Shahbaz, M., Qazi, Q, A and Long (2014). Linkage between deforestation, energy, and growth for Environmental degradation in Pakistan. *Ipag Business School*, 6(3), 1-19.

Alam.Shaista, Rehman. Shafiqur, Butt. Mohammad, S. (2010). Trade liberalization, environment degradation and sustainable development in Pakistan. *European Journal of Social Sciences*, 19(1), 84-96.

Alam, M. Jahangir, Begun, I., Buysse, J., Rahman, S., & Yuylenbroeck, G. (2011). Dynamic Modeling of Cuasal Reltaionship between Energy Consumption, CO2 Emissions and Economic Growth in India. *Renewable and Sustainable Energy Reviews, 15(1)*, 3243-3251.

Anees and Ahmad (2011).Industrial Development, Agricultural Growth, Urbanization and Environmental Kuznets Curve in Pakistan. *Munich Personal RePEc Archive*. 33469.

Chen, W. (2007). Economic growth and environment in china; an empirical test of the Environmental Kuznets Curve using provincial panel data. *Munich Personal RePEc Archive*. 33470

Cole, M. A. (2005). Re-examining the Pollution-Income Relationship: A Random Coefficients Approach. *Economics Bulletin*, 14(1), 1-7.

Cole, M. A., and Neumayer, E. (2004).Examining the impact of demographic factors on air pollution. *Pollution and Development Review*, 26(1), 5-21.

Dijkgraaf, E and Volleberg, H. (2005). A test for parameter homogeneity in CO2 Panel EKC Estimations. *Environmental and Resource Economics*, 32(2), 229-239.

Economic Survey, Pakistan. (2013-14). *Pakistan Economic Survey*. Islamabad: Ministry of Finance, Government of Pakistan.

Felman, S. (2015). Environmental Degradation and Poverty in India. *International Review Spring*, 45(1), 451-455

Gade.A.D, Katti.V.P, Todkar.R.A. (2003). Exploring Nexus between Urbanization Growth and Environment: with Reference to South Asian Countries. *International Journal of Innovative Research in Science Engineering and Technoy*, 2(12), 7809-7816.

Grossman, G., and Krueger, A. (1995).Economic Environment and the Economic Growth. *Quarterly Journal of Economics*, 110(1), 353-377.

Heil, M. T. and Selden, T. M. (2001). Carbon Emissions and Economic Development: Future Trajectories Based on Historical Experience. *Environment and Development Economics*, 6(1), 63-83.

Jalil, A. and Mahmud, S. F. (2009). Environment Kuznets Curve for CO_2 Emissions: A Cointegration Analysis for China. *Energy Policy*, 37(1), 5167-5172.

Kraft, J. and Kraft, A. (1978).On the Relationship between Energy and GNP. *Journal of Energy Development*, 3(1), 401-403.

Lütkepohl, Helmut (1991). *Introduction to Multiple Time Series Analysis*, New York: Springer-Verlag.

Masih, A. M. M., and Masih, R. (1996). Energy Consumption, Real Income and Temporal Causality Results from a Multi-country Study Based on Cointegration and Error Correction Modeling Techniques. *Energy Economics*, 18(1) 165-183.

Narayan, P. K. and Singh, B. (2007).The Electricity Consumption and GDP Nexus for the Fiji Islands. *Energy Economics*, 29(1), 1141-1150.

Suri and Chapman (1998). Analysis of Economic Growth, Trade and Energy: Implications for the Environmental Kuznets Curve. *Ecoical Economics*, 25(1), 195-208.

Shahbaz, M., Lean, H.H., Shabbir, M.S. (2010). Environmental Kuznets Curve and role of energy consumption in Pakistan. Development Research Papers, 10/05, Monish University Australia.

Shahbaz (2011). The environmental cost of skiing in the desert? Evidence from co-integration with unknown structural breaks in USE, Munich Personal Repel Archive. 48007

Stern, D I., (2007).The rise and fall of Environmental Kuznets Curve. World Development report 32(1), 1419-1439.

Suri and Chapman (1998). Analysis of Economic Growth, Trade and Energy: Implications for the Environmental Kuznets Curve. Ecoical Economics, 25(1), 195-208.

Urdal (2005). People vs. Malthus: Population Pressure, Environmental Degradation, and Armed Conflict Revisited. Journal of Peace Research, 42(4), 417–433.

World Bank. (2010). Development and Climate Change, World Development Report. Washington, D. C.: The World Bank.