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Impact of Environment Degradation on Economic Growth in Pakistan: ARDL Approach

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ABSTRACT

We checked impact between environmental quality and economic growth in Pakistan by this study. The time series data has been taken over the period from 1970-2017. For results estimation ARDL Bounds testing Approach has used. The findings reveal that short run Model (ECM) is significant and negative that indicates the slow adjustment speed from previous year to the equilibrium of long run. All the variables in long run are significant. DI, CO_2, N_2O and TO have positive impact to GDP while FDI and LF have negative impact to GDP. That shows DI, CO_2, N_2O and TO increase the GDP while FDI and LF caused the GDP decreased. The positive impact of CO_2 and N_2O on GDP leads to environmental degradation for the case of Pakistan.

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Introduction

Sustainable environmental state and sustainable economic expansion are two aspects of the same coin. In industrial sector rapid production generates economic growth their energy use is rise which caused environmental degradation. Environmental pollution can be decreased by financial developments that elevate economic growth. Although, Frankel and Romer (1999) submitted ripe financial retail can promote foreign direct investment and arouse the percentage to economic growth around developing countries. Financial development provides a passage to advanced environment-friendly technologies (Birdsall & Wheeler, 1993; Frankel and Rose, 2002).

Financial development directly influences to energy consumption then to CO2 emissions Sadorsky, 2010, Tamazian, Chousa, & Vadlamannati (2009). Borrowing cost can be reduced by rapid financial sector, raise asset for energy productive sector, others decreased energy emissions (Tamazian et al. 2009; Tamazian and Rao, 2010; Sadorsky,2010; Shahbaz, 2009; Shahbaz et al. 2010). In particular, least borrows cost to fund environment favorable projects give edge to the national, regional and local governments. Jensen (1996) on contrary describes that industrial growth by financial development increases CO_2 emission. Muhammad Shahbaz et al., 2011.

Research Question

Following the above purposes, following questions are framed. The general research questions are:

1) What is the relationship of Environmental Quality and Economic Growth?
2) What is the impact of CO_2 emission on economic growth?
3) What is the impact of N_2O emission on economic growth?

Research Objective

General Objective

To check the impact between Environment degradation and economic growth in Pakistan.

Specific Objective

To check the short run impact of environment and economic growth.

To check the long run impact of CO_2 emission on economic growth in Pakistan.

To check the long run impact of N_2O emission on economic growth in Pakistan.

Literature Review

Bernard and Mandal (2016) explore trade openness impact on environmental quality. In this study the panel data used for 60 emerging and developing economies. To check relationship between Trade openness and environment for 2002 to 2012 has taken. Employing Environmental Performance Index (EPI) and CO2 emissions are used as environmental quality indicators. The study shows trade openness promotes Environmental Performance Index EPI, whereas it increases CO2 emissions. Trade openness showed no significant to EPI, but increases CO2 emissions. GMM results for EPI shows the political factors enhance environmental quality, though income and population have unfavorable effects. The conclusion of the study supports the controversy over the impact of trade on environmental quality. In emerging Economies to environmental sustainability influence the effectual economic, energy, infrastructural and institutional policies.

Özokcu and Özdemir (2017) describe the EKC, economic growth, energy consumption. The ramification of two models revealed, N-shape and a transformed N-shape relationship to cubic practical frame noticed. Appropriately, outcomes don't bolster the EKC speculation, which infers that ecological debasement can't be unraveled consequently by monetary development.

Saidi, Rahman, and Saadaoui (2017) tries to determine the environmental quality, energy and economic growth relationships. Five OPEC countries (Algeria, Nigeria, Indonesia, Saudi Arabia and Venezuela) obliged panal data for 25 years (1990-2014), to investigate the findings panel unit root tests, panel co integration tests also panel Granger causality tests are used. To conclude long-run two-way relationships exists among GDP and energy consumption for all countries. Reciprocal causal relationships among GDP and CO_2 emissions are also found in these countries not in Algeria where no causality exists. Venezuela existence proved to energy consumption and CO_2 emissions in all countries either unidirectional causality showing from CO_2 to energy consumption is exist.

Tiba and Omri (2017) described the literature to relationships among energy environment and economic growth during the period 1978 to 2014. Concluded which vigor utilization can help monetary development by profitability exceed and may support withal the natural harms from upgrade to poison outflows. This study drops more the

lights on vitality condition development writing by giving a broad posting (1978– 2014) of causal linkages to vitality use factors, condition and monetary development for both individual and aggregate cases. There is a rational agreement for significance of managing as unique relationship, that's by all accounts foundation component in any aspiration systems (vitality, biological and financial aspects).

Cai, Sam, and Chang (2018) illustrate Nexus to CO_2 emissions, clean energy consumption, economic growth. Here discovers clean intensity usage motivate genuine GDP per capita to Canada, Germany and the US. CO_2 emanations cause clear vitality utilization to Germany. Moreover, discovered critique among pure vitality utilization also carbon dioxide outflows to Germany, and unidirectional causality running from pure vitality utilization CO_2 discharges to US. Our exploration has critical approach suggestions to G7 nations directing morevitality use move to lessen CO_2 emanations.

Armeanu, Vintilă, Andrei, Gherghina, Drăgoi, and Teodor (2018). examined a panel EU-28 country for 1990-2014 on hypothesis (EKC), seeming the primarily energy consumption along selected variables of other country. The conclusion shows the EKC hypothesis for sulfur oxides and of non-methane volatile organic compounds has estimated. The findings from fixed effects methods to Driscoll-Kraay standard errors support, the EKC hypothesis for greenhouse gas, strain of energy consumption, nitrogen oxides, non-methane volatile organic compounds and ammonia emissions..GDP per capita growth to greenhouse gas emissions expose a short-run unidirectional causality by panel vector error correction model, in addition to bidirectional causal link among primary energy consumption and greenhouse gas emissions. Moreover, economic growth and primary energy consumption have no causal link between them, the neo-classical point of view was proved, named the neutrality hypothesis.

Data and Methodology

World development indicators and State Bank of Pakistan are the main sources of data collection. Time period has been taken from 1970-2017. GDP is the dependent variable but the CO_2, N_2O, FDI, DI, TO, LF are the independent variables in this study. Current study approaches various approaches as, unit root test (ADF), ARDL Bounds testing approach for short run and long run, Pairwise Granger Causality Test. Cusum and Cusumsq test. Mathematical model is,

$GDP = f (CO_2, N_2O, FDI, DI, TO, LF)$

The econometric model of the study is below,

$$GDP = \alpha_O+\alpha_1 CO_2 + \alpha_2 N_2O+\alpha_3 FDI+\alpha_4 DI+ \alpha_5 TO+\alpha_6 LF+\varepsilon_O$$

Where:

GDP= Gross Domestic Production

CO_2 = Carbon Dioxide emission

N_2O = Nitrous Dioxide emission

FDI = Foreign Direct Investment

DI = Domestic Investment (Gross fix capital formation)

TO = Trade Openness (Exports of goods and services)

Lf = Labor force

ε_O = Error Term

Results

Descriptive Analysis

Descriptive statistic is used to analyze trends and relationship among dependent and independent variables. That provides average tendencies, distribution of data that helps to expand the span of research that gives better forecasting of future behavior. Forecasted results are useful aid for further analysis and policy implications.

Table Descriptive Statistics of Key Variables (1970-2017)

	GDP	FDI	DI	CO_2	N_2O	LF	TO
Mean	4.745516	2.443395	3.944729	-0.20285	4.34487	39.99801	3.861589
Median	4.748927	2.564765	3.970402	-0.15614	4.370173	33.77	3.956106
Maximum	5.484231	3.74773	4.64543	-0.00391	4.486448	73.23457	4.487128
Minimum	3.801053	-1	2.859293	-0.5106	4.133232	19.61	2.932249
Std. Dev.	0.441302	0.899634	0.438276	0.162238	0.101558	15.47516	0.456408
Skewness	-0.11402	-1.26514	-0.43559	-0.53274	-0.41969	0.623109	-0.39275
Kurtosis	2.263992	5.855214	2.727384	1.93699	2.066432	2.227059	2.052934
Jarque-Bera	1.13795	27.89617	1.597104	4.341675	3.020839	4.211396	2.901696
Probability	0.566105	0.000001	0.44998	0.114082	0.220817	0.121761	0.234371
Sum	218.2937	112.3962	181.4576	-9.33092	199.864	1879.907	177.6331
Sum Sq. Dev.	8.763631	36.42035	8.643854	1.184446	0.464127	11016.1	9.373887
Observations	46	46	46	46	46	46	46

Source: Software EViews 9

Table 4.1 reported the descriptive statistics of all variables which employed in the study. This descriptive analysis based on 46 observations, which are enough to represent distribution of the data. Mean is center value of the data. Central tendencies of the data are measured by the mean and median both. Median expresses the midpoint of analyzed data. For gross domestic index (GDP) mean is 4.745516 while median is 4.748927 and largest value of data gross domestic product (GDP) is 5.484231. Minimum data value of gross domestic product (GDP) is 3.801053. The standard deviation points out the spread out of employed data while higher value of standard deviation showed greater spread. The value of standard deviation is purposed table 0.441302. Symmetrical trend of data is measured by value of skewness. The skewness value for gross domestic product (GDP) is -0.11402. It showed that negatively skewed. The value of kurtosis for gross domestic product (GDP) is 2.263992 its positive which showed employed data is not normally distributed. Goodness of fit checked by the Jarque-Bera test. Jarque-Bera test based on OLS residuals of OLS. Jarque-Bera test for gross domestic product (GDP) has 1.13795 values which is greater than 0.5 and forecast that data is not normally distributed. If probability of data is less then o.o5 means rejected null hypotheses. P. value of gross domestic product (GDP) is 0.566105

The second variable of the table is (FDI) foreign direct investment. Mean and median of FDI is 2.443395 and 2.564765 respectively. The maximum and minimum value of FDI is 3.74773 and -1 respectively. The standard deviation of data is 0.899634 respectively. Skewness value is -1.26514 and value of kurtosis is 5.855214 which showed FDI is normally distributed, because Jarque-Bera is 27.89617 and p. value less than 0.05.

The third variable of the table is (DI) domestic investment. Mean and median of DI is 3.944729 and 3.970402 respectively. The maximum and minimum value of DI is 4.64543 and 2.859293 respectively. The standard deviation of data is 0.438276 respectively. The skewness value is 0.43559 and value of kurtosis is 2.727384. Jarque-Bera is 1.597104 and p. value 0.44998.

The fourth variable of the table is (CO_2) Carbon Dioxide emission. Mean and median of CO_2 is 0.20285 and -0.15614 respectively. The maximum and minimum value of CO_2 is -0.00391 and -0.5106 respectively. The standard deviation of data is 0.162238 respectively. The skewness value is -0.53274 and value of kurtosis is 1.93699. Jarque-Bera is 4.341675 and p. value 0.114082. The fifth variable of the table is (N_2O) Nitrous Oxide. Mean and median of N_2O is 4.34487 and4.370173 respectively. The maximum and minimum value of N_2O is 4.486448 and 4.133232 respectively. The standard deviation of data is 0.101558 respectively. The skewness value is -0.419685 and value of kurtosis is 2.066432. Jarque-Bera is 3.020839 and p. value 0.220817. The sixth variable of the table is (LF) Labor Force. Mean and median of LF is 39.99801 and 33.77 respectively. The maximum and minimum value of LF is 73.23457 and 19.61 respectively. The standard deviation of data is 15.47516 respectively. The skewness value is -0.623109 and value of kurtosis is 2.227059. Jarque-Bera is 4.211396 and p value 0.121761. The seventh variable of the table is (TO) Trade Openness. Mean and median of TO is 3.944729 and 3.956106 respectively. The maximum and minimum value of TO is 4.487128 and 2.932249 respectively. The standard deviation of data is 0.456408 respectively. The skewness value is -0.39275 and value of kurtosis is 2.052934. Jarque-Bera is 2.901696 and p. value 0.234371.

Unit Root Test

		Level		First Difference	
Variables		t-statistics	Probability	t-statistics	Probability
GDP	ADF	-0.57394	0.8661	-9.02158	0.000
FDI	ADF	-1.94068	0.3113	-14.1083	0.000
DI	ADF	-1.26718	0.6366	-7.00643	0.000
CO_2	ADF	-2.54302	0.1124	-6.81457	0.000
N_2O	ADF	-1.65247	0.448	-5.4192	0.000
TO	ADF	-1.67029	0.4391	-6.97291	0.000
LF	ADF	-4.53446	0.0007	-	-

Source: Software EViews 9

To check the stationary of the variables we used unit root test. First, we check the GDP at level its probability value is not stationary at level then we checked GDP at first difference its probability value is stationary at first difference.

Secondly, we checked the FDI stationarity, it is also stationary at first difference. Thirdly we checked the stationarity of DI, it is also stationary at first difference. At fourth we checked the stationarity of CO_2 it is also stationary at first difference. At fifth we checked the stationarity of N_2O it is also stationary at first difference. At sixth we checked the stationarity of TO, it is also stationary at first difference. Then we checked the stationarity of Pop it is stationary at the level.

The results of the unit root test shows that all the variables are stationary at the first difference while the LF is stationary at the level. That's why we go with the ARDL bound test approach to co-integration for time series data.

ARDL Bounds Test

Model	F-statistics		
GDP, FDI, DI, CO_2, N_2O, TO, LF	7.126837		
	Significance	I0 Bound	I1 Bound
	10%	2.12	3.23
	5%	2.45	3.61

	2.50%	2.75	3.99
	1%	3.15	4.43

Source: Software EViews 9

We checked the values of upper and lower bonds at different level of significance. For the model the value of F-statistics is 7.126837. That shows the values of the upper and lower bonds are less than the value of F-statistics. That means we can use the ARDL Bounds test for short run and long run.

ARDL Short Run.

Dependent Variable: D(GDP)

Variable	**Coefficient**	**Std. Error**	**t-Statistic**	**Prob.**
D(GDP(-1), 2)	0.777717	0.249715	3.114419	0.0051
D(GDP(-2), 2)	0.115782	0.086243	1.342498	0.1931
D(FDI, 2)	-0.03147	0.018615	-1.69052	0.105
D(FDI(-1), 2)	0.027034	0.01681	1.608217	0.122
D(DI, 2)	0.432105	0.060589	7.131776	0.000
D(DI(-1), 2)	-0.33996	0.118802	-2.86154	0.0091
D(CO2, 2)	0.092291	0.160711	0.574268	0.5716
D(CO2(-1), 2)	-0.25886	0.138806	-1.86491	0.0756
D(NO, 2)	0.099145	0.102287	0.969284	0.3429
D(LF, 2)	-32.0238	54.93134	-0.58298	0.5658
D(LF(-1), 2)	103.3578	56.54982	1.827729	0.0812
D(TO, 2)	0.189457	0.071497	2.649844	0.0146
CointEq(-1)	-2.57782	0.431571	-5.97311	0.000

Cointeq = D(GDP) - (-0.0249*D(FDI) + 0.4429*D(DI) + 0.2845*D(CO2) + 0.1618*D(NO) -2.5731*D(LF) + 0.1820*D(TO) + 0.0424)

Source: Software EViews 9

The above table estimated the period of the short run parameters for the period of the long run relationship through equation of co integration. The value of coefficient of error correction model is significant and negative. The estimated value of the error correction coefficient is -2.57782 percent. Error correction model indicate the slow adjustment speed from previous year to the equilibrium of long run. That shows 2.5 years are required to remove the error of this model. Also, the results of D(DI) (Domestic Investment) and GDP in the short run are highly significant and positively associated with each other. Here the "D" represents the variable difference and the value of the coefficient is 0.432105. While taking the first difference the value of the coefficient become significantly negative. It shows that 1 percent increase in DI will increase the GDP as 0.432105 percent.

The results of the next independent variable CO_2 show significantly negative relationship to GDP at first difference. The value of the coefficient is -0.25886, that show 1 percent increase in CO2 will decrease GDP as 0.25886 percent.

The next variable LF becomes positive and significant at taking the first difference. The coefficient value is 103.35777. This shows 1 percent increase in LF will increase the GDP as 103.35777 percent. The next independent variable TO (Trade Openness) shows highly significant and positive relationship to GDP. The coefficient value is 0.189457. This shows the 1 percent increase in TO will increase the GDP as 0.189457 percent.

ARDL Cointegrating And Long Run Form

Dependent Variable: D(GDP)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
Constant	0.042414	0.00456	9.302058	0.0000
FDI	-0.02491	0.01099	-2.26664	0.0336
DI	0.442852	0.029931	14.79588	0.0000
CO_2	0.284498	0.092462	3.076917	0.0055
N_2O	0.161811	0.033931	4.76883	0.0001
LF	-2.57315	0.534686	-4.81245	0.0001
TO	0.181984	0.033881	5.371232	0.0000

Source: Software EViews 9

By testing the ARDL co-integrating and long run the FDI has significant and negative impact on GDP. It means that 1 percent increase in FDI will decrease GDP at 0.02 %. If we checked the impact of DI on GDP, then DI has positive and significant impact on GDP. That means if the DI increase 1 percent then GDP will also increase to 44 %. CO2 has significant and positive impact on GDP, it shows when the 1 percent increase in CO_2 then the GDP will also increase to 28 %. N_2O has significant and positive impact on GDP, means 1 percent increase in N_2O will increase 16 % GDP. LF has significant and negative impact on GDP. That means 1 percent increase in LF will decrease GDP to 2.57 %. TO has positive and significant impact to GDP, that means 1 percent increase in TO will increase the GDP to 18 %.

Granger Causality Tests

Null Hypothesis	Obser.	F-Statistics	Prob.
FDI does not Granger Cause GDP	44	1.18018	0.318
GDP does Granger Cause FDI		4.94115	0.0122
DI does Granger Cause GDP	44	3.86942	0.0293
GDP does Granger Cause DI		10.3519	0.0002
CO2 does not Granger Cause GDP	44	0.0532	0.9483
GDP does not Granger Cause CO2		0.42378	0.6575
NO does not Granger Cause GDP	44	0.18007	0.8359
GDP does not Granger Cause NO		2.30758	0.1129
LF does Granger Cause GDP	44	8.84179	0.0007
GDP does Granger Cause LF		57.0712	0.0003
TO does not Granger Cause GDP	44	1.42626	0.2525
GDP does Granger Cause TO		3.14476	0.0542
DI does Granger Cause FDI	44	4.56681	0.0165
FDI does not Granger Cause DI		0.7035	0.501
CO2 does Granger Cause FDI	44	15.4329	0.00001
FDI does not Granger Cause CO2		0.2687	0.7658
NO does not Granger Cause FDI	44	1.44723	0.2476
FDI does not Granger Cause NO		2.38233	0.1056
LF does Granger Cause FDI	44	12.6416	0.00006
FDI does not Granger Cause LF		0.73542	0.4858
TO does Granger Cause FDI	44	9.88533	0.0003
FDI does not Granger Cause TO		1.61921	0.2111

CO2 does not Granger Cause DI	44	1.56814	0.2213
DI does not Granger Cause CO2		0.04006	0.9608
NO does not Granger Cause DI	44	0.07912	0.9241
DI does not Granger Cause NO		2.38154	0.1057
LF does Granger Cause DI	44	8.45911	0.0009
DI does Granger Cause LF		17.9433	0.000003
TO does Granger Cause DI	44	4.63669	0.0156
DI does Granger Cause TO		2.90974	0.0664
NO does not Granger Cause CO2	44	0.02073	0.9795
CO2 does Granger Cause NO		3.30222	0.0473
LF does not Granger Cause CO2	44	0.64047	0.5325
CO2 does Granger Cause LF		2.93984	0.0647
TO does not Granger Cause CO2	44	1.78404	0.1814
CO2 does not Granger Cause TO		2.35489	0.1083
LF does Granger Cause NO	44	3.90966	0.0283
NO does Granger Cause LF		6.02469	0.0052
TO does Granger Cause NO	44	4.37448	0.0193
NO does not Granger Cause TO		0.17825	0.8374
TO does not Granger Cause LF	44	1.86122	0.169
LF does not Granger Cause TO		2.07321	0.1394

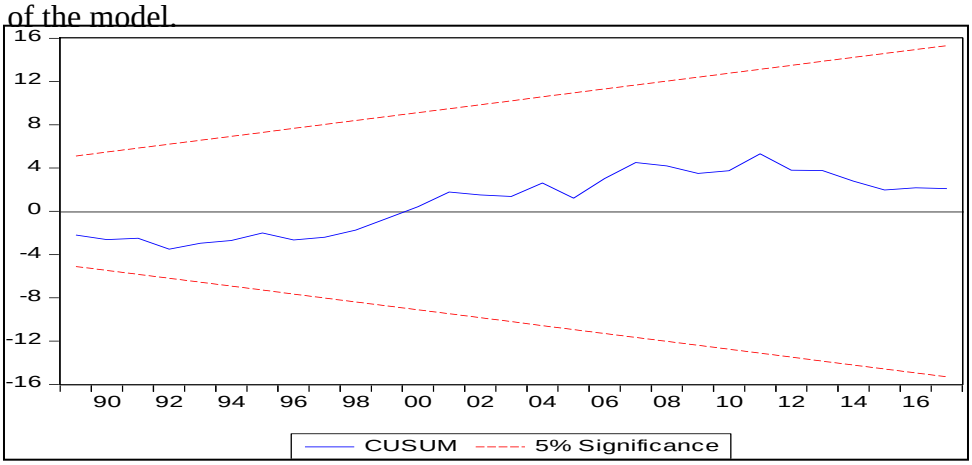
Source: Software EViews 10

Null hypothesis is shown in first column that can be rejected or accepted at different significance level. Whereas second shows the observations third F statistic and fourth column indicate probability value. After observing the P value GDP does Cause to increase FDI and has unidirectional relationship to each other. The GDP and DI do cause positive bidirectional relationship to each other. LF and GDP cause positive bidirectional relationship to each other. GDP does cause to increase TO, having unidirectional relationship. DI does cause to increase FDI and has unidirectional relationship. CO2 does cause to increase FDI having unidirectional relationship. LF does cause

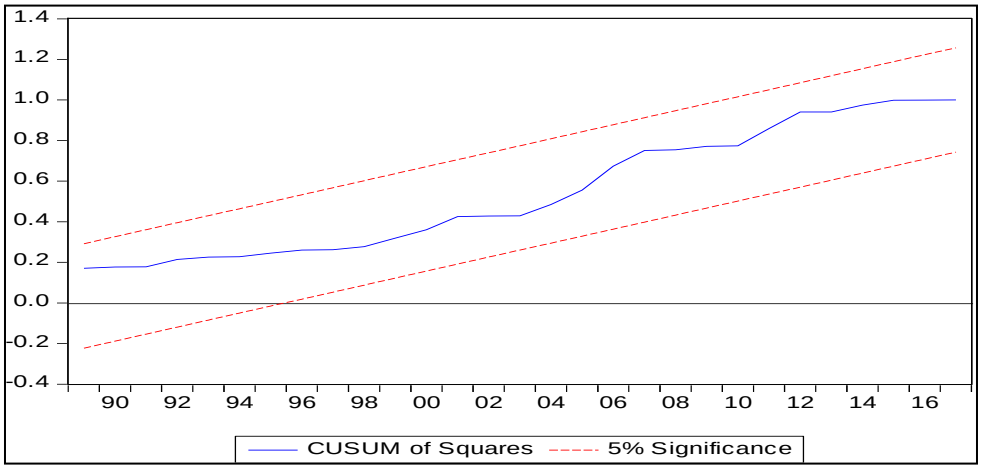
to increase FDI it is unidirectional relationship. TO does caused to increased FDI, it is unidirectional relationship. LF does cause to increase DI, has a uni directional relationship. DI does cause to increase LF, it is a unidirectional relationship. TO and DI does cause to increase each other in bidirectional relationship. CO2 does cause to increased N2O, it is unidirectional relationship. CO_2 does cause to increase LF, it is a unidirectional relationship. LF and N_2O do caused to increase each other, it has a bidirectional relationship. TO does cause to increase N_2O, it has a unidirectional relationship.

4.9 Cumulative Sum Test.

Cumulative sum test helps to show if coefficients of regression are changing systematically. Cumulative sum of recursive residuals (CUSUM) and cumulative sum of squares of recursive residuals (CUSUMSQ) test is used to check the stability of the model.



CUSUM plots remains within the bounds 5% level of significance and remains closer to the standard line that means the model that we used is structurally stable.



CUSUMSQ plots remains within the bounds 5% level of significance and that means the model that we used is structurally stable.

Conclusion

The key objective of the study is to check the impact of the environmental degradation on the economic growth of the Pakistan apply the Auto Regressive Distributed Lag (ARDL) method for the duration of the 1970-2017. World development indicators and State Bank of Pakistan are the main sources of data collection. GDP is the dependent variable but the CO_2, N_2O, FDI, DI, TO, LF are the independent variables in this study. Current study applies various approaches as, unit root test (ADF), ARDL Bounds testing approach for short run and long run, Pairwise Granger Causality Test. Cusum and Cusumsq test. The study concluded that GDP and CO_2 have significant but negative impact on GDP in short run relationship, Nasir and Rehman (2011) supports that Carbon emission and income has unidirectional relationship in short run relationship while GDP and CO_2 have positive bidirectional relationship to each other respectively in long run relationship Shahbaz, Islam and Butt (2011) also supports conclusion of the study that long run financial acceleration will reduce the CO_2 emission. The CO_2 Emission increases which caused the environment degradation in Pakistan. In developing countries, the environment Kuznets curve theory supports but in this analysis in case study of Pakistan from the period of 1970-2017 the GDP increased but the environment is degraded as well, to improve our environment we should have to used better advanced technology for GDP generate.

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