PalArch's Journal of Archaeology of Egypt / Egyptology

ASYMMETRIC IMPACT OF FOREIGN INVESTMENT, ECONOMIC GROWTH, ENERGY CONSUMPTION ON ENVIRONMENTAL QUALITY IN PAKISTAN: APPLYING NOVEL NARDL APPROACH

Dr. Hina Ali[1], Fatima Zahra[2], Dr. Muhammad Ramzan Sheikh[3], Shaneela Altaf[4]

[1]Assistant Professor, Department of Economics, The Women University Multan, Pakistan.

[2]Ms. Scholar, Department of Economics, The Women University Multan, Pakistan.

[3]Associate Professor of Economics, School of Economics, Bahauddin Zakariya University Multan, Pakistan.

[4]PhD Scholar of Economics, School of Economics, Bahauddin Zakariya University Multan, Pakistan.

Dr. Hina Ali , Fatima Zahra , Dr. Muhammad Ramzan Sheikh , Shaneela Altaf , Asymmetric Impact Of Foreign Investment, Economic Growth, Energy Consumption On Environmental Quality In Pakistan: Applying Novel Nardl Approach , Palarch's Journal Of Archaeology Of Egypt/Egyptology 18(8). ISSN 1567-214x.

Keyword: Foreign investment, EKZ Curve, PHH hypothesis, NARDL approach, Pakistan.

ABSTRACT:

In the last three decades, environmental policymakers and environmental economists are trying to check the interconnection between economic growth, foreign investment with environmental quality, and still this matter on the world hot roundtable debate. This paper aims to analyze the asymmetric impact of foreign investment, economic growth, energy consumption on Pakistan's economy. This study used a time series dataset period from 1990 end 2020 by employing a novel approach nonlinear autoregressive distribution (NARDL) approach. The result of the NARDL approach documented that energy, GDP square have a positive impact on carbon emission in both short and long-run period, while GDP per capita and natural resource rents has negative

effects on environment pollution (CO2 Emission). In this study, we test two environmental theories such as environmental Kuznets curve and pollution heaven hypothesis validation. The statistical result shows the validation of the pollution haven hypothesis and indicates invalid environmental quality in the Pakistan economy.

INTRODUCTION:

Energy is a vital factor of production that plays a vital role in accelerating human activity, business development, industrial production, and the country's economic growth. Without energy planning, every sector of economics is unable to take any action. Energy has played a significant role as the engine of the economy as well as the production process, respectively. The energy supply chain is uncertain and also, we cannot ignore the significant role of this pillar indicator of the economy (Abbas, Xu and Sun 2021). In several previous kinds of literature, they predict that non-renewable sources produce carbon emission that is the cause of greenhouse gases, environmental degradation, climate change. Environmental degradation and climate change are a big threat for the human race because their consequences will damage human activity and life. Many scholars used many different methods, empirical tools, theoretical tools, proxies, and different econometrics approaches in different countries. The outcome of all literature cannot generalize from one study to other studies and some contradictory (Muhammad et al., 2021; Rehman et al., 2021; Murshed et al., 2021; Muhammad and Khan 2021).

Moreover, classical and neo-economists ignored the importance of energy because they consider two factors of production: labor and capital; furthermore, it is a significant factor in our daily activity, business development, social welfare, and economic performance (Zhang and Zhang 2021). Many environmentalists, economists, and policymakers claim that energy is the main contributor to increasing carbon emission, which is the main source of two world problems: environmental degradation and climate change. However, policy energy conservation suggested making strategy and policy to reduce the carbon emission level from earth because earth is a global village. Carbon emissions create a big threat in increasing world temperature that is the main threat in melting glaciers and raise the water level of the sea and many more, it is an eyewitness. Since the industrial great revolution, human activities result is significant, but these activities are also the main source of carbon emission that cause environmental degradation. Uncertain resource energy demand increases, and it contributed 70% in increasing carbon emission in the world. Policymakers and economists suggested that energy resource use decreases and maximize the benefits from it.

In the other scenario, foreign investment is the macroeconomic driver of the economic growth of a country. Now a day it is the cause of foreign investment war example is USA-China foreign investment War. Foreign investment inflow cause of economic growth and also increase the living stander of our life. In the environmental scenario, foreign investment is the second source of increasing industrial output, and this output causes environmental degradation (Ongan, Isik, and Ozdemir 2021). Many scholars test two approaches in the foreign investment scenario. First is the pollution heaven hypothesis that implies that when the foreign investment will increase, then carbon emission will increase positively, and second foreign investment negative impact on carbon emission means the foreign investment will cause carbon emission. Many policymakers of different countries and environmental economists have tested these two approaches on different individuals or groups of countries. The outcome of all studies cannot generalize to each other.

In policy scenarios, environmental policymakers and economists have tried to test the nexuses between carbon emission, economic growth, energy consumption, and foreign investment. In this way, this interrelation of these all-factors hot debate is remaining on the roundtable of policymakers and scholars. However, we are trying to fill the gap to test the impact of energy consumption, foreign investment, natural resource rents and economic growth on carbon emission cause of Pakistan-Pakistan is an emerging developing country. Another contribution of this study is to test novel econometrics approaches such as the nonlinear ARDL approach.
The series structure of this paper is the following; after the first introductory section, the second section of this paper briefly reviews the previous literature and provides a summary of this section. The third section presented data and methodology and the fourth section is the result of analysis with brief interpretation. The last section is the conclusion of the study.

REVIEW OF PREVIOUS STUDIES:

The causation of carbon dioxide and foreign investment between 15 and 28 years has been explained by Hoffmann et al (2005). For an estimate, Granger Causality was applied. The study collected panel data. Variables were gathered from foreign direct investment and carbon dioxide. 112 countries were classified into three groups; 37 low-income nations were in the first group. The second group consisted of 50 countries with moderate incomes and the third group comprised 25 counties with high incomes. The results reveal that carbon dioxide has little causation in middle- and high-income nations towards foreign direct capital investment. Significant causality from direct foreign investment to carbon dioxide has been discovered in middle-income nations. There was high pollution in low-income countries.
During the period 1993 to 2004 Tamazian and Rao (2010) stated the environmental degradation consequences of economic, institutional, and financial development for 24 transitional economies. Model of decreased shape standard has been used. A hypothesis for a GMM estimate was constructed for the environmental Kuznets curve (EKC). Environmental degradation was the explicit variable. The explanatory variables have been considered CO2/capita, per capita GDP, FDI, price liberalization, financial liberalization, open trade, gas consumption, and coal use. This concluded that open commerce and financial development have a good impact on the degradation of the environment. However, FDI has an adverse impact on CO2 emissions. Economic development also has adverse effects on the destruction of the environment. The link between foreign direct investment and pollution was expressed between 1990 and 2000 by Aliyu (2005). The RCM was utilized to estimate the fixed effect and random effect model. Fourteen poor nations received FDI input data (Argentina, Armenia, Brazil, Chile, Colombia, Indonesia, Kazakhstan, Mexico, Pakistan, Paraguay, Poland, Slovenia, Trinidad, Thailand, and Tobago). Eleven advanced countries have employed FDI outflows (Canada, Danish, Finnish, German, Island, Italy, Japan, Sweden, Switzerland, and the United Kingdom). The projected variable and FDI influx, FDI outflow, taxes, and GDP used CO2 emission fossil fuels. It was concluded that FDI has a favorable impact on pollution and energy utilization of the environment.
Bhat (2018) explained the impact on the economic growth and carbon emissions of energy use and renewable energy. The STIRPAT model was applied to the context. For BRICS states, panel data was used between 1992 and 2012. There was the usage of variables such as population, CO2 emissions, GDP, income per capita, capital, labor, consumption of renewable, non-renewable energy. For long-term relationship estimation, Pooled Mean Group and Panel Generalized Moments Method (GMM) approaches have been utilized. Results demonstrated a beneficial impact on economic growth for non-renewable energy and renewables. But statistically

negligible renewable energy consumption was. Additional population and consumption of non-renewable energy have a direct effect on CO2 emissions. The use of renewable energy had negative consequences on the emission of carbon dioxide. The effect of energy consumption, FDI, and urbanization on CO2 emissions in South and South Asia was explained by Behera and Dash (2017). Panel data for 17 countries were used between 1980 and 2012. The panel-data co-integration test was employed by Pedroni. The study was separated into three sample panels based on GDP per capita income. The needed variable is collected from carbon dioxide emissions. Free components were primary energy use, foreign direct investment, and urban expansion. The results show that the deterioration of the environment and CO2 emissions in South and South Asia areas have increased FDI consistency and energy consumption. However, there was a statistically significant association between urban expansion, energy use, CO2 emissions, and foreign direct investment for all revenue levels. In addition, the impact of power consumption on carbon emissions was higher than that of direct foreign investment.
Concerning literature, all these research results in a mixture over time, different instruments of econometrics and countries, and not all are generalized to each other. This subject nevertheless attracts us to study Pakistan. We would like to investigate the notion of pollution in Pakistan. Whether energy and gross production can contribute to pollution in the environment.

DATA AND METHODOLOGY:

In the Pakistan case study, the data of this empirical study is annual time series data and its period range from 1990 end 2020. The 30 years annual data of carbon emission, economic growth, energy consumption, and natural resource rents were collected from a different source of the dataset. Moreover, carbon emission (CO2 Emission) and energy consumption electronic data were collected from the Statistic Review of World Economic (SRWE) database. Economic growth, foreign investment inflow, and natural resource data collected from the world bank electronic database.

Variable Model specification:

Carbon emission = f(energy consumption, foreign investment, economic growth, natural resource rents)………………………………………………………………………….. (1)

Econometrics model:

$\mathrm{CO2\ EMS} = \mathrm{f(ENG\ CMP, GDP,\ GDPSQR, FDI, NF)}$……………………….. (2)

$\mathrm{CO2\ EMS} = \beta_0 + \beta_1 \mathrm{ENG\ CMP} + \beta_2\ \mathrm{GDP} + \beta_3\ \mathrm{FDI} + \beta_4 \mathrm{NRRT} + \beta_5 \mathrm{GDPSQR} + \varepsilon$……………………………………………………………………………….. (3)

$\Delta(\mathrm{CO2})_t = \beta_0 + \beta_1(\mathrm{ENG\ CMP})_t + \beta_2(\mathrm{GDP})_t + \beta_3(\mathrm{FDI\ NF})_t + \beta_4(\mathrm{GDPSQR})_t + \sum_{i=1}^{p} \gamma\, \Delta(\mathrm{CO2})_t + \sum_{i=1}^{p} \omega\, \Delta(\mathrm{ENG\ CMP})_t + \sum_{i=1}^{p} \theta\, \Delta(\mathrm{GDP})_t + \sum_{i=1}^{p} \omega\, \Delta(\mathrm{FDI\ NF})_t + \sum_{i=1}^{p} \beta\, \Delta(\mathrm{GDPSQR})$ ……………………………….. (4)

Above this all-statistical equation presented time series econometrics regression variables model and we will further test this equation in econometrics approaches case. In these questions, CO2 EMS presented to carbon emission that causes of climate change and also climate change. The second variable is ENG CMP elaborates on energy consumption that is the cause of increasing economic growth, foreign investment, and CO2 emission. The third variable is GDP growth per capita that is the most important factor of income and helps to improve the happiness of nations. The fourth variable is, FDI, the foreign investment that is the most pillar factor of one nation's

economy because it causes boosting economic growth, industrial output, and performance. The fifth variable is NRRT that presented to natural resource rents of Pakistan. Further things are $\beta_0, \beta_1, \beta_2, \beta_3, \beta_4, \beta_5$ presented to the coefficient of the variables and variables are given in equations. In equation four Δ , change means when the independent variable changes then how many changes will come independent variables such as CO2 emission.

This study used a time series annual dataset of Pakistan's country. In this research, we apply the nonlinear ARDL approach. In the present study, we used a couple of tools to analyze in good and healthy ways. First of all, we check the data behavior with descriptive statistics and a correlation matrix. Second, we test the unit root test using the Augmented Dickey-Fuller Test (ADF Test) and Phillips-Perron Test (PP Test). Third, the most important tools are leg select criteria that guide us further co-integration tools. Fifth, after checking the leg selection criteria, we test the bound test to check the existing short-run and long-run co-integration. Six steps, in this step we test the nonlinear ARDL econometrics approach that shows short and long-run effects and second the last step, is the CUSUM test checking model stability and the last is the nonlinear ARDL multiplier.

EMPIRICAL ANALYSIS AND RESULT:

Descriptive Statistic and Correlation Matrix in Statistical perspective:

The descriptive statistic is most important first step of empirical study.

Table 1: Descriptive Statistic:

	LNCO2	LNENG	LNFDI	LNGDP	LNGDPSQR	LNNRRT
Mean	4.753414	2.595605	-0.107789	6.627096	11.45425	0.393370
Maximum	5.289803	2.799766	1.299735	7.301354	12.71289	1.037306
Minimum	4.057214	2.313855	-0.979421	5.918029	9.233499	-0.246477
Std. Dev.	0.360615	0.144288	0.568765	0.467224	0.881940	0.372664
	1	0.969424761454565 1	0.1320554452199694	0.9647808465326346	0.9074794633035742	0.4475301198392449
		1	0.3004708284361808	0.9197034915439323	0.8422846198279069	0.4559839908511474
			1	0.0446650281237171 4	0.0174759487335458 1	0.2472877429081076
				1	0.8700536773074992	0.4789429253355256
					1	0.5321659602538969
						1

Source: Author Own' EViews 9.0.

In this study we used 31 observation and means, maximum, minimum and standard deviation. We can show the value of all these statistical value of all these variables such as LNCO2 (M = 4.753414, Max=5.289803, Min=4.057214, S. D= 0.360615), LNENG (M=2.595605, Max=2.799766, Min=2.313855, S.D=0.144288), LNFDI (M=-0.107789, Max=1.299735, Min=0.979421, S.D=0.568765), LNGDP (M=6.627096, Max= 7.301354, Min= 5.918029, S.D= 0.467224), GDPSQR (M=11.45425, Max= 12.71289, Min= 9.233499, S.D= 0.881940), LNNRRT (M= 0.393370, Min=1.037306, Max=-0.246477, S.D= 0.372664). Correlation matrix show positive association between all variable with each other.

Table 2: Unit Root Test:

Source: Author Own' EViews 9.0.

Unit root test is the most important part of the time series when research is carried out to test the co-integration. In this subsection of analysis, we can test stationary with famous two tests such ADF and PP test. In our study, all variables stationary on the level and first difference fig two show these all-statistic values. This stationary suggested that we switch to the NARDL approach and then test the lag selection criteria because for NARDL we must know how much maximum lag we can take for the NARDL result process. For lags selection criteria, all test is given below, namely LR, FPE, AIC, SC and HQ. one scholar suggests choosing AIC test for Lag selection criteria. Our analysis AIC test suggests that maximum we can take 2 lags and value is: **"-**10.9395".

Variable	ADF test		PP test	
	At Level	At 1st Difference	At Level	At 1st Difference
LNCO2	-0.0674 (0.9425)	-4.6848 (0.0011)	-0.2997 (0.9136)	-1.7983 (0.0690)
LNENG	-1.2910(0.9701)	-5.9373 (0.000)	-1.2642(0.6327)	-6.5735 (0.0000)
LNFDI	-2.9324 (0.0538)	-3.585(0.0125)	-1.8220 (0.3631)	-3.4508(0.0171)
LNGDP	-0.3119 (0.9117)	-5.3212 (0.0002)	-0.3119 (0.9117)	-5.3212 (0.0002)
LNGDPSQR	0.5796 (0.9867)	-4.0687 (0.0041)	3.4173 (1.0000)	-2.5729 (0.0120)
LNNRRT	-0.7340 (0.3900)	-4.2772 (0.0119)	-1.7433 (0.4001)	-4.4955(0.0013)

Table 3: Lags Selection Condition:

Lag	LogL	LR	FPE	AIC	SC	HQ
0	44.60553	NA	2.81e-09	-2.662451	-2.379562	-2.573853
1	194.6902	227.7147*	1.14e-12	-10.53036	-8.550138*	-9.910179*
* 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			

Source: Author Own' EViews 9.0.

For Further Process, we can test the bound test. It is the most important test for ARDL and NARDL approach because its condition is that the F-statistic value will greater than up bound and lower bound because long-run co-integration existing. In our NARDL case study, the F-Statistic value is greater from the upper and lower bound test, suggesting that in long-run co-integration existing.

Table 4: NARDL Approach' Bond Test

Test Statistic	Value	
F-statistic	12.06457	
Significance	I(0) bound	I(1) bound
1%	2.96	4.26
5%	2.32	3.5
10%	2.03	3.13

Source: Author Own' EViews 9.0.

Table 5: NARDL Estimation Long Run result

Variables	Coefficient	P-Value
LNENERGY	0.489067	0.1001
LNFDI_POS	0.114353	0.0079
LNFDI_NEG	-0.013626	0.4019
LNGDP	-0.015480	0.8502
LNGDPSQR	0.074445	0.0001
LNNRRT	-0.071599	0.0029

Source: Author Own' Eviews 9.0.

The long term results shows that long run energy consumption has an insignificant positive impact on carbon emission and in the short run, it has a low significant impact on environmental quality. In the short and long run, GDP has a negative impact on environmental pollution because countries use green technology to reduce pollution in the environment. GDP square has a positive and significant impact on environmental pollution. Natural resource rent has a significant and positive impact on co2 emission and negative in the short-run period.

Table 6: NARDL Estimation Short Run result

D(LNCO2(-1))	0.338433	0.1112
D(LNENERGY)	0.294966	0.0959
D(LNFDI_POS)	0.039175	0.1296

D(LNFDI_POS(-1))	-0.076355	0.0274
D(LNFDI_NEG)	-0.014346	0.4353
D(LNGDP)	-0.016298	0.8528
D(LNGDPSQR)	0.033896	0.1608
D(LNNRRT)	0.003678	0.9011
D(LNNRRT(-1))	0.052946	0.1105
CointEq(-1)	-1.052858	0.0003
R-squared	0.998049	
Adjusted R-squared	0.995948	
F-statistic	475.0065	
Durbin-Watson	1.958066	
Prob(F-statistic)	0.000000	

Source: Author Own' Eviews 9.0.

The short-term results show that the FDI rises and the FDI declines are good. For example, FDI rises in expected elasticity (decrease), for example in CO2 emissions of a factor 0.039175 (-0.014346) indicate that 1 percent of FDI expansion (contraction) is predicted as a statistical reduction of CO2 emissions of a factor of 0.039175 Percent (-0.014346 percent). That means that the inflow of Pakistan's FDI has a harmful influence on the environment, whereas a drop in the FDI has an adverse effect, which means a drop in the FDI has an enhanced environmental quality. In addition, the Wald test shows that the short-term and long-term reinforced symmetry hypotheses are unrejected, meaning the symmetric effects in FDI changes in the short-term and longer-term.

Stability Test (NARDL CUSUM and CUSUM of Square 5%):

CUSUM and CUSUMSQ check the stability of the NARDL model. The cumulative and cumulative sum of these tests and the essential 5% lines are summarized.

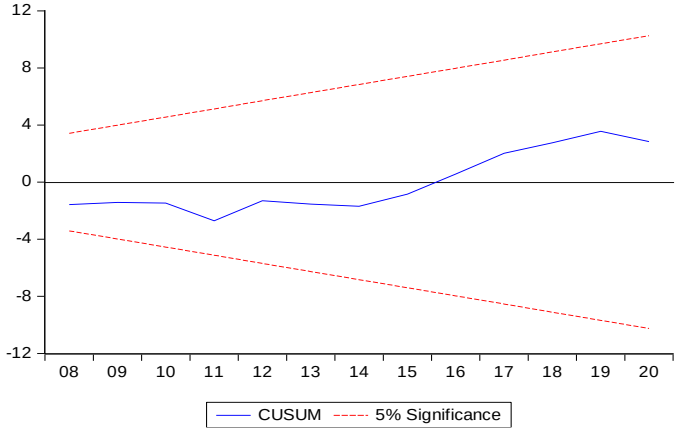

Fig 1: CUSUM (NARDL)

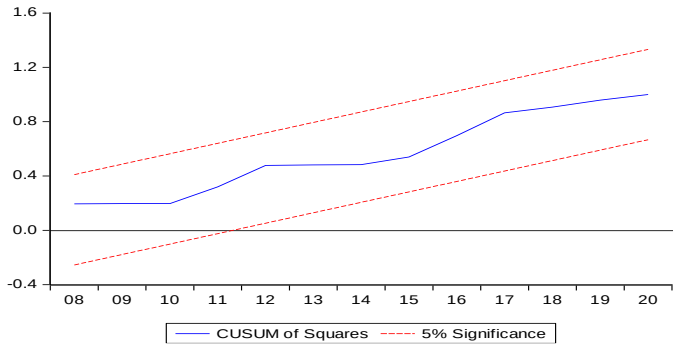

Fig 2: CUSUM of Squares (NARDL)

The cumulative effect of FDI on CO2:

In addition, FDI's dynamic multiplier graph shows the dynamic effects of positive and negative shocks in which CO2 responds fasters to a rise in FDI than the drop in Pakistan's FDI influx. Note: The center-dotted line (asymmetry) curve shows a linear mix of negative and positive dynamic multipliers.

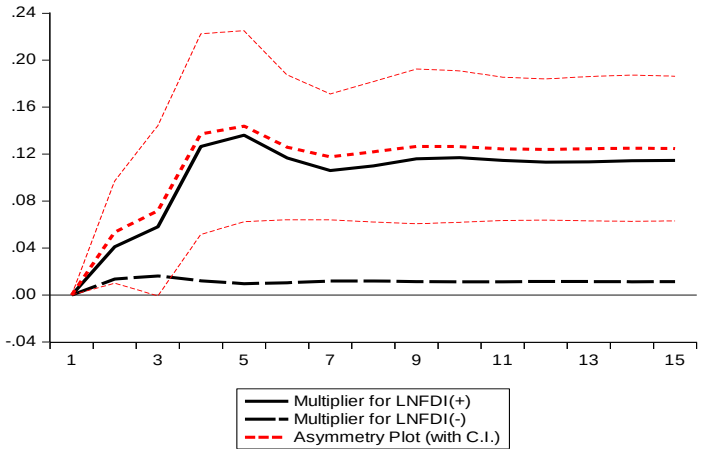

Figure 3: Dynamic Multiplier Graph FDI on CO2 (NARDL)

CONCLUSION:

This article aims to test the asymmetric effect of energy consumption, foreign investment, and GDP per capita on carbon emission. To analyze this interconnection to took the time series annual dataset for this study and employ the Nonlinear ARDL novel econometrics approach. The statistical result indicated that energy consumption has a positive impact on carbon emission. It means energy consumption is the main cause of carbon emission increases in the short and long run. Although several research on the influence of FDI on CO2 emissions has been carried out, most have been reviewed by panels of different nations. Little attention was paid to the control using NARDL model approaches of positive or negative FDI shock. We discovered FDI influencing emissions in Pakistan positively and profoundly. For positive and negative shocks, we employed the NARDL model. For instance, it will not catch negative shocks in FDI if we choose the symmetrical strategy. We are aware that positive shocks affect CO2 emissions positively, profoundly, and significantly. In contrast, FDI's negative impacts on CO2 emissions are negative but minor. These measures are essential since they confirm that any policy to

enhance Pakistan's FDI inflows affects the environment while limiting FDI does not seem to be a way of improving environmental quality. Therefore, politicians need to sustain and not diminish a stable FDI influx. To do that, politicians can formulate a particular policy to promote FDI in the green industry. These findings further imply that policymakers should attentively ensure that the FDI influx across various industries is properly allotted from the political point of view.

As look at the short and long-run period impact of GDP per capita and GDP square on carbon emission (CO2 emission). The result of NARDL indicates that GDP has a negative impact on environmental pollution because countries use green technology to reduce carbon emissions. GDP square has a positive impact on environmental pollution. The result indicates that the Kuznets curve cannot be valid on the Pakistan economy in the short and long run.

REFERENCE:

Abbas, H. S. M., Xu, X., & Sun, C. (2021). Role of foreign direct investment interaction to energy consumption and institutional governance in sustainable GHG emission reduction. Environmental Science and Pollution Research, 1-14.

Aliyu, M. A. (2005). Foreign direct investment and the environment: Pollution haven hypothesis revisited.

Behera, S. R., & Dash, D. P. (2017). The effect of urbanization, energy consumption, and foreign direct investment on the carbon dioxide emission in the SSEA (South and Southeast Asian) region. Renewable and Sustainable Energy Reviews, 70, 96-106.

Bhat, J. A. (2018). Renewable and non-renewable energy consumption—impact on economic growth and CO 2 emissions in five emerging market economies. Environmental Science and Pollution Research, 25(35), 35515-35530.

Hoffmann, R., Lee, C. G., Ramasamy, B., & Yeung, M. (2005). FDI and pollution: a granger causality test using panel data. Journal of International Development: The Journal of the Development Studies Association, 17(3), 311-317.

Muhammad, B., & Khan, S. (2021, May). Understanding the relationship between natural resources, renewable energy consumption, economic factors, globalization and CO2 emissions in developed and developing countries. In Natural Resources Forum (Vol. 45, No. 2, pp. 138-156). Oxford, UK: Blackwell Publishing Ltd.

Muhammad, B., Khan, M. K., Khan, M. I., & Khan, S. (2021). Impact of foreign direct investment, natural resources, renewable energy consumption, and economic growth on environmental degradation: evidence from BRICS, developing, developed and global countries. Environmental Science and Pollution Research, 28(17), 21789-21798.

Murshed, M., Rahman, M. A., Alam, M. S., Ahmad, P., & Dagar, V. (2021). The nexus between environmental regulations, economic growth, and environmental sustainability: linking environmental patents to ecological footprint reduction in South Asia. Environmental Science and Pollution Research, 1-22.

Ongan, S., Isik, C., & Ozdemir, D. (2021). Economic growth and environmental degradation: evidence from the US case environmental Kuznets curve hypothesis with an application of decomposition. Journal of Environmental Economics and Policy, 10(1), 14-21.

Rehman, A., Ma, H., Ozturk, I., Murshed, M., & Dagar, V. (2021). The dynamic impacts of CO2 emissions from different sources on Pakistan’s economic progress: a roadmap to sustainable development. Environment, Development and Sustainability, 1-24.

Tamazian, A., & Rao, B. B. (2010). Do economic, financial and institutional developments matter for environmental degradation? Evidence from transitional economies. Energy Economics, 32(1), 137-145.

Zhang, X., & Zhang, X. (2021). Nexus among economic growth, carbon emissions, and renewable and non-renewable energy in China. Environmental Science and Pollution Research, 1-15.