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Exploring the link between Industrial Development and CO2 Emission in Selected Developing Countries

Allah Ditta [1], Rizwan Ahmed Satti[2], Rashid Ahmad[3], Muhammad Ali Awan[4]

[1]Associate Professor, Department of Economics, Govt. Graduate College Township, Lahore, Pakistan.
Email: ad.tahir77@gmail.com
[2] Lecturer, Department of Economics, Allama Iqbal Open University, Islamabad, Pakistan.
Email: rizwan.ahmed@aiou.edu.pk
[3] Assistant Professor, School of Economics, Bahauddin Zakariya University, Multan, Pakistan.
Email: rashidahmad@bzu.edu.pk
[4] Senior Economist, Economic Studies Division- NESPAK, Lahore, Pakistan. Email: ali.awan@nespak.com.pk

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ABSTRACT

This study examines both the short-run and long-run effects of population, industrial value added, nuclear energy, and energy intensity on carbon emissions in selected developing countries over the period 1990-2024, employing the Panel ARDL bounds testing approach. The analysis uses yearly balanced panel data, with unit root properties tested through the Im-Pesaran-Shin method. The findings indicate that technological advancements in industrialization contribute to a reduction in CO_2 emissions in the long run. Nuclear energy shows a positive relationship with emissions in both the short and long run, likely due to the generation of radioactive waste, while energy intensity is positively and significantly associated with CO_2 emissions in both time frames. Diagnostics from the panel ARDL confirm the robustness of the model, and both CUSUM and CUSUM-squared tests indicate no structural breaks during the study period. Overall, the study suggests that adopting modern, environmentally friendly technologies can help lower CO_2 emissions in these developing countries, and it emphasizes the importance of addressing environmental degradation at an early stage in the short run.

Corresponding Author's Email: ad.tahir77@gmail.com

1. Introduction

Climatic variation is now becoming a major global distress. The sharp rise in harmful gases like carbon dioxide (CO_2), sulfur dioxide (SO_2), and nitrogen oxides (NO_x) is making the situation increasingly concerning. Climatic change has caused by an increase in Green House Gases (GHGs) due to burning of fossil fuels and other social and economic activities. Considerable conversion has practiced due to economics, geopolitics and production distribution globally. Due to many causes, developing nations like Brazil, Russia, India and China have attained imperative part in the production of goods and services internationally, like to draw higher capital, major destination of foreign Direct Investment, large consumer market and its larger population link. Wilson and Purushothaman (2006) symbolize Brazil, Russia, India, and China as an economic Mass. This report also highlights the position of South Africa globally. Although, it does not hold the features of developing countries due to its geography and population but due to its big consumer market and abundance of natural resources. Martinho (2014) considered these growing economies such as the Brazil, Russia, India, China, and South Africa has an eminent position in the world economy. These countries are seen as capacities of prospect, for industry and for employment. Annual growth rate of GDP 6.5%, that intense economic growth has also initiated a numerous environmental harms, precisely carbon dioxide (CO2) emissions in selected developing economies. Internationally Brazil, Russia, India, and China were listed with the UNFCCC then put cautious struggles to decrease their intensity of emissions its GDP in 2020. CO2 emissions in the Brazil, Russia, India, and China counted to approximately 4,901 million tonnes (Mt) in 1990 and 14,322 Mt in 2018, more than rise in threefold time (formerly British Petroleum statistics). CO2 emissions have triggered severe economic degradation and environmental destruction due to global warming and environment transformation. Therefore, it is important to identify the sources of CO_2 emissions in these countries to ensure that their economic growth remains sustainable.

Figure 1

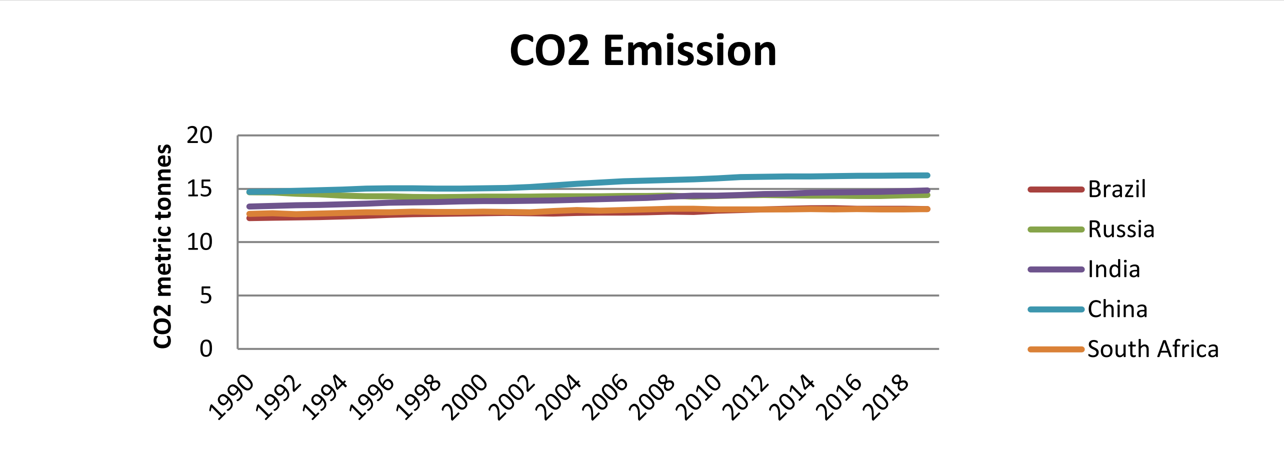


Figure 1 is showing positive upward slope curve of Carbon dioxide emissions in Brazil, Russia, India, and China. Furthermore, China's CO2 emissions are greater from rest of the countries. In this study industrial growth is used as a proxy for economic development. The relationship is examined through the lens of the environmental industrial Kuznets curve, which illustrates how environmental degradation initially rises with increased income driven by industrialization. However, once a certain level of development is reached, environmental conditions tend to improve. Nuclear energy can make a substantial impact on the climate variation. Nuclear power plants (NPPs) produce less GHG emissions or air pollutants throughout their procedure. Besides, nuclear power raises energy supply security and industrial growth consistently. The fundamental consequence of the progress and environmental quality has been generally observe by different investigators as the environmental Kuznets curve (EKC) internationally, locally or country wide. As Grossman and Krueger (1991)firstly introduced the EKC hypothesize by utilizing several variables of the environment. Thus, the purpose of this research is to observe the industrial kuznet curve in selected developing economies by utilizing unit root test and Panel studies. The Panel data analysis will be piloted to reduce the complications of endogeneity, heteroscedasticity and non stationarity in the regression models. After introduction of the study is planned as, Literature review is sighted in section II, Methodology in sect. III, Estimation technique in sect. IV, Empirical results in sect. V and conclusion of the study in sect. VI have been explained(Ragmoun, 2023; Ragmoun & Ben-Salha, 2024).

2. Literature Review

Using a panel data approach, Vijayakumar, Sridharan and Rao (2010) investigated the factors that influence foreign direct investment (FDI) inflows into developing nations from 1975 to 2007. They found that labor costs, market size, currency value, infrastructure, and gross capital formation were the most important factors that would influence FDI inflows into these nations. Trade openness is not a major element in the influx of foreign direct investment (FDI) into emerging nations; instead, the inflation rate and industrial production serve as indicators of economic soundness and growth prediction, respectively. The first study to look at nuclear energy's function in the EKC framework for CO2 emissions was Hiroki et al. (2010). Naudé (2014) found de-industrialization in three countries like (Brazil, Russia and South Africa) during the time span of 1980-2010. They found that China's manufacturing sector play an important and significant role in aggregate development expansion and Study also concluded that for getting technological advancement China's industrial strategy reinforced investment domestically and foreign investment. In China FDI preferred the manufacturing sector and manufactured exports and investment are more important than FDI after 1995. Chkili and Nguyen (2014) used a regime-switching model to explore the vibrant associations among the rate of exchange and stock market proceeds for the BRICS countries. The univariate investigation directs that stock returns for developing countries rendering two dissimilar regimes: a less and a with more volatility regime. Cowan et al. (2014) tested the connecting association amongst economic growth, electricity consumption and emission of CO2 as dependent variable in the developing countries during 1990-2010 by using panel causality analysis. A panel causality interpretation is used for heterogeneity and dependency across countries. The observed outcomes keep evidence for Russia as two way association and the preservation theory for South Africa. Though, an impartiality assumption exists for Brazil, India and China, representing not only electricity consumption or nor economic growth is subtle for themselves. Different outcomes for the developing countries suggest that uniform strategies cannot be employed for each country of developing.

Zakarya et al. (2015) examined CO2 emissions in developing countries by means of panel model for the span of 1990-2012. Dependent variable is CO2 emission and independent variables are energy consumption total, net inflows FDI, and GDP per capita. The conclusion specifies that economic development is directly exaggerated by FDI and leaves no direct influence on CO2 emissions in developing countries. It is suggested that there may extensive preparation to increase energy efficacy, advancement of renewable energy means and new machineries must introduce for low-carbon energy. Lin, Omoju and Okonkwo (2015) examined the impact of industrialization on CO_2 emissions from 1980 to 2011. Their analysis indicates that industrial value added is significantly and negatively associated with CO_2 emissions, suggesting that industrialization does not contribute to higher carbon emissions in Nigeria.Chang et al. (2015) measured environmental Kuznets curves for G7 countries and developing countries to inquire energy efficiency. The central outcomes of the study is that G7 countries are in low carbon economies before 2005 than developing countries and has better opportunity for making better its carbonization value conversely the developing that has an opportunities for improving its carbonization value afterwards 2005 throughout the whole period, study made three models and all three environmental Kuznets curves are not an inverted U-shaped but U shape Hypothesis developed. Sinha and Sen (2016) applied a technique of generalized method of moments (GMM) to inspect the fundamental relationship for developing countries between economic growth, trade volume, CO2 emission and human development. Study demonstrate bidirectional causality between dependent and independent variables like CO2 emission and economic growth and it shows there is one way relationship towards economic development from trade dimensions.

Zaman et al. (2016) created link between four stakes of economic progress or green growth, environment, energy, health and wealth in developing countries for the time period of 1975-2013 by using Panel FMOLS and DOLS technique. The literature used three variables of environmental like agricultural techniques, CO2 emission, and population, for energy three variable as nuclear energy consumption, electricity production, two variables for health proxies infant mortality rate and fertility rate and economic growth represented by GDP Per Capita. Energy variable significantly affect economic growth. It is suggested that health expenditure should increase for green growth. Banday and Ismail (2017) checked the prons and cones of tourism on economic evolution and for environment in developing countries by using panel studies for the time span of 1995 to 2013. The result confirms that tourism increases economic progression in case of developing countries and has a direct and significant influence on economic development. The study determines that growth in tourism makes undesirable externalities like pollution, so government should take measures in order to get benefit from in developing states.

Al-Jafari (2018) investigated the dynamic forces of economic growth in developing nations and proved positive association among foreign direct investment and economic growth in the long-run. Hanif (2018) explored the consequences of energy consumption in the form of (fossil Fuels, solid fuels) on health of human being in sub Saharan Africa for the time period of 1995 to 2015 by using GMM for a penal of 34 countries. Mortality rate and tuberculosis are dependent variables while independent variables are outdoor energy consumption habit, indoor energy consumption habit, renewable energy consumption, real per capita gross domestic production, urban population and environmental degradation. The results indicate that the use of fossil and solid fuels contributes to higher mortality and tuberculosis rates in Sub-Saharan Africa. These fuels negatively affect life expectancy by increasing overall mortality, whereas renewable energy and economic growth help lower the incidence of tuberculosis and reduce mortality levels in the region. Dong et al. (2018) analyzed how per-capita CO_2 emissions relate to economic growth, renewable energy utilization, and natural gas consumption in developing countries over the period 1985–2016, applying the Environmental Kuznets Curve (EKC) approach. Panel co integration technique has been used by using the augmented mean group (AMG) estimator, so the findings proved EKC concept for the developing countries strongly. Study suggested that cumulative natural gas and renewable energy consumption depresses CO2 emissions. Sinha and Sen (2016) explored how corruption within the public sector affects carbon emissions, considering the moderating role of energy use. Their study confirmed the validity of the Environmental Kuznets Curve (EKC) for BRICS and Next-11 economies over the period 1990 to 2017. They concluded that corruption worsens environmental quality by weakening the positive impact of renewable energy consumption and intensifying the harmful effects of fossil fuel use.

Research on the relationship between energy consumption, economic growth, and environmental degradation began receiving significant attention in the early 1990s. Yorucu and Ertac Varoglu (2020) examined the long-run linkages among CO_2 emissions, economic growth, and industrial output for 23 small island nations from 1977 to 2017 using FMOLS and DOLS panel estimation methods. Their FMOLS results indicated a strong long-term association between industrial activity, economic expansion, and carbon emissions. The DOLS findings further showed that industrialization plays a key role in driving CO_2 emissions, while the vector error correction model revealed that carbon emissions are a significant factor in the short run.He et al. (2020) applied the Bootstrap ARDL test to examine the relationship between FDI and CO_2 emissions in BRICS countries. In the case of Brazil, evidence indicated a long-term cointegration among CO_2 emissions, FDI, and trade. For Russia and India, a causal link was found between FDI and trade. Additionally, Russian trade and FDI were significantly associated with CO_2 emissions, and both FDI and CO_2 emissions were connected to trade. In terms of short-term causality, CO_2 emissions demonstrated a causal relationship with trade, whereas the connection between FDI and CO_2 emissions appeared weak. Overall, trade showed a positive association with FDI.

Ditta, Bashir, et al. (2023) investigate that how labor, energy consumption, and income levels affect environmental deterioration uses ARDL approach during time period 1995 to 2021. The findings of the study show that, over the long term, greater energy consumption is linked to improved environmental quality. Economic growth is found to reduce carbon emissions in the long run, whereas in the short run it contributes to higher emissions among the developed countries. The results further indicate that carbon emissions rise initially as energy consumption grows, but after reaching a certain threshold, they begin to decline. Ditta, Hashmi, et al. (2023) examine how climate change affects food security in a group of developing nations. Their findings show that positive link between climate and food security in the long run. This improvement is attributed to longer growing seasons and the fertilization effect caused by higher temperatures and elevated CO_2 levels. The aim of Developing countries is to achieve industrialization and sustainable development. However, there are few empirical studies that examined the impact of industrialization-led economic transformation on carbon emissions in developing countries. This is the focus of this study. The paper investigates the impact of industrial value-added on CO_2 emissions in selected developing nations. This literature will try to fill this gap by including Industrialization, Nuclear energy and Energy intensity which may provide guidelines for practitioners and policymakers.

3. Data sources and Research Methodology

This study utilizes annual balanced panel data from 1990 to 2023 for the selected developing countries Brazil, Russia, India, China, and South Africa. The dependent variable is CO_2 emissions (measured in metric tons), while the independent variables include total population, industrial value added (used as a proxy for economic growth), nuclear energy consumption (as an alternative energy source, measured as a percentage of total energy use), and energy intensity level of primary energy (measured in MJ per $2011 PPP GDP). All data for CO_2 emissions, population, industrial value added, nuclear energy, and energy intensity are obtained from the World Development Indicators (WDI) database. Where necessary missing values were estimated using forward and backward interpolation techniques to ensure a complete dataset. Present study used IPAT identity that is mathematical terminology to show environmental degradation (Chertow, 2000; Haberl et al., 2011).

$$\text{Impact} = \text{Population} \times \text{Affluence} \times \text{Technology} \tag{1}$$

The above stated IPAT equation narrates an environmental impact like CO2 or any other harmful gases are the product of total population, "affluence" that is stated as economic growth and T is for technology i.e emission per unit of GDP. Current study uses Panel ARDL for analysis to check possible cross-section dependence across selected developing countries. Due to globalization more economic and financial incorporations creates sensitivity among the region of a country. This cross-sectional dependency may play a significant part in identifying relations among the developing countries. The panel data study is assembled as cross section with time series data that break its time series nature of the association for CO2 emission and some selected factors for developing countries. Industrialization and technology are two main aspect of CO2 EKC.

4. Model Specification

EKC proposition is that there is a nonlinear quadratic association among income and environmental degradation. Some other variables other than income can also include avoiding biasness that effect environment also. The research will pay special consideration to the impact of population, industrial growth, nuclear energy and energy intensity on CO2 emission or try to hypothesize Industrial EKC in case of selected developing countries. Earlier studies such as Mehmood, Hunjra and Chani (2019) and Lin, Omoju and Okonkwo (2015) also take industrial production and energy consumption take into account in their studies for the cases of the EKCs in selected developing nations.Dong et al. (2017) and Hanif et al. (2019) identified an inverted U-shaped relationship for CO_2 emissions using panel data analysis. The environmental destruction resulted from economic activities can be improved by using modern technology.

$$\mathrm{CO2} = f(\mathrm{IND}, IND^2, \emptyset) \qquad (2$$

In Equation 2 $\emptyset$ indicates an indefinite factor (as Nuclear energy, Energy Intensity or population) and their prospective impact on carbon releases. To assess this relationship an econometric model has been devised as in equation 3.

$$CO2_{it} = \beta_0 + \beta_1 \mathrm{IND}_{it} + \beta_2 \mathrm{IND}^2{}_{it} + \beta_3 \emptyset_{it} + \mu_{it} \qquad (3$$

In the current literature it is assumed that industrialization, nuclear energy, energy intensity and population are considered to be dynamic variables that possibly will bring changes into carbon emissions in the developing countries. We use log-linear description already followed by Cameron (1994); Ehrlich (1996). Above description of variables is written in logarithmic form, an extended form of EKC hypothesis is as follows in equation 4

$$lnCO2_{it} = \beta_0 + \beta_1 \mathrm{lnPOP}_{it} + \beta_2 \mathrm{lnIND}_{it} + \beta_3 \mathrm{IND}^2{}_{it} + \beta_4 NUC_{it} + \beta_5 lnENI_{it} + \mu_{it} \qquad (4$$

In the above equation, (CO_2) represents carbon dioxide emissions, while (POP) denotes the total population. (IND) and (IND^2) refer to industrial value-added production and its squared term, respectively. Additionally, (NUC) stands for nuclear energy, and (ENI) indicates energy intensity. The subscripts 'i' and 't' correspond to cross-sectional units (states) and time periods, respectively. Equation (4) will be used to discover the long-run connection among the explained and explanatory variables.

Table 1: Variance of Inflation Factor

	lco2m	Lpop	Lindc	lindc2	Lnuc	Lengi
lco2m	-					
Lpop	1.521089	-				
Lindc	1.003909	1.630021	-			
lindc2	1.004482	1.613733	5000.25	-		
Lnuc	1.02397	1.021902	1.000013	1.000017	-	
Lengi	1.541529	1.491626	1.015438	1.016525	1.000014	-

Source: author's own calculation

Table 2: Pairwise correlation of coefficient

	lco2m	**Lpop**	**Lindc**	**lindc2**	**Lnuc**	**Lengi**
lco2m	1					
Lpop	-0.5853	1				

	0					
Lindc	0.0624	0.6217	1			
	0.4482	0				
lindc2	0.0668	0.6167	0.9999	1		
	0.4165	0	0			
Lnuc	0.1530	-0.1464	-0.0036	0.0041	1	
	0.0616	0.0739	0.9649	0.9606		
Lengi	0.5927	-0.5741	0.1233	0.1275	0.0037	1
	0	0	0.1327	0.1199	0.9643	

Source: author’s own calculation

Table 3: Cross section dependence test

Test	Statistic	Prob.
Breusch-Pagan LM	11.6271	0.3108
Pesaran scaled LM	--0.7542	0.4507
Bias-corrected scaled LM	--0.8435	0.3990
Pesaran CD	--0.9977	0.3184

Source: author’s own calculation

Table 1 presents the values of variance of inflation factors. All values are less than three reflecting no multicollinearity between independent variables. The pair-wise correlations among variables are also used to ascertain the rigorousness of multicollinearity in addition to VIF in table 2. Findings of Pair-wise correlation of coefficient demonstrate the situation that there is a weak multicollinearity in the explanatory variables. Table 3 outcomes indicate that there is no presence of cross sectional dependency. It means the panel unit root tests are suitable to further estimation.

Table 4: Unit Root Analysis

Pesaran,s CIPS Panel Unit Root Test					
	At Level	**Lag Length**	**At First difference**	**Lag Length**	**Decision**
LCO2	-0.0801 (0.4681)	1	-9.6414 (0.0000)	1	I(1)
LPOP	-8.3163 (0.0000)	1	-3.4195 (0.0003)	1	I(0)
LINDC	0.2293 (0.5907)	1	-4.4384 (0.0000)	1	I(1)
LINDC2	0.3446 (0.6348)	1	-4.3823 (0.0000)	1	I(1)
LNUC	0.6207 (0.7326)	1	-2.2531 (0.0121)	1	I(1)
LENI	-0.0202 (0.4919)	1	-4.2005 (0.0000)	1	I(1)

Source: author’s own calculation

Table 4 results of unit root tests show the mix order of integration. To show the long run equilibrium relationships this study utilized co-integration tests. The bounds test verifies the existence of a cointegration relationship, supporting the use of the ARDL estimation method for the variables carbon emissions, population, industrial value added, nuclear energy, and energy intensity. As presented in Table 5, the results indicate that both the F-statistic and W-statistic exceed the upper critical bounds at the 5% and 1% significance levels, respectively, suggesting a co-integrating relationship among the variables.

Table 5: Empirical Results of the bounds test for Cointegration

Equ (1) LogCO2, LogPOP, Log IND, LogINDC2, Log NUC, LogNUC	**Bound Test Value 95% Upper bound**	**90% Upper bound**	**Conclusion**
F Statistics	12.7152 > 4.6942	12.7152 > 3.9274	Cointegration exists
W statistics	76.2912 > 28.165	76.2912 > 23.5645	Cointegration exists

Source: calculated by author

To assess the long term association among the variables, this study applies the autoregressive distributed lag (ARDL) model, which delivers reliable long-run coefficients as well as short-run estimates for each variable.

Table 6: Panel ARDL-based long-run estimation

Variable	Coefficient	t-Statistics	Prob
LPOP	0.3751	1.2721	0.2061
LINDC	-5.6812***	2.8854	0.0047
LINDC2	0.1040***	3.2350	0.0016
LNUC	0.0824***	-7.8813	0.0000
LENGI	0.5300***	8.6831	0.0000
Turning point	27.34 $		

Source: author's own calculation

The results of the study table 6 show that, population is an insignificant cause of high carbon emissions in selected developing countries. These findings are consistent with those reported by Shaari, Abdul Karim and Zainol Abidin (2020). The analysis shows that industrial value added has a significant, negative impact on CO_2 emissions. In particular, a 1% rise in industrial value added is associated with a 5.68% decrease in carbon emissions. Additionally, the squared term of industrial value added shows a positive relationship with CO_2 emissions in selected developing countries. This suggests that a 1% increase in the squared industrial value added corresponds to an approximate 0.10% rise in emissions, holding all other factors constant. Therefore, the industrial environmental Kuznets Curve (EKC) exhibits a U-shaped pattern. These results are consistent with existing literature (Chang et al., 2015; Lin, Omoju, & Okonkwo, 2015; Stefanski, 2017). The results show that nuclear energy usage exerts a clear and positive influence on carbon emissions in Brazil, Russia, India, and China. Specifically, a 1% increase in nuclear energy consumption is linked to a 0.08% rise in CO_2 emissions. These outcomes are consistent with the findings of Lee et al. (2013) as well as Piłatowska, Geise and Włodarczyk (2020). The analysis further demonstrates that energy intensity has a significant, positive effect on carbon emissions, aligning with the evidence reported by Lin, Omoju and Okonkwo (2015); Wang et al. (2017); Xu et al. (2016). Additionally, the table identifies the turning point at which CO_2 emissions begin to shift direction. In the long-run model, the estimated turning point based on industrial value added and its square is approximately USD 27.34. This turning point indicates the level of industrial value added at which CO_2 emissions start to increase, supporting the U-shaped Environmental Kuznets Curve (EKC) hypothesis. Given that the turning point is relatively elevated, it implies that the selected countries may require a significant amount of time to reach this stage. These results are in line with the findings of Orubu and Omotor (2011).

Table 7: Panel ARDL ECM estimates

Variable	Coefficient	t-Statistics	Prob
D(LPOP)	10.6418	0.7851	0.4341
D(LINDC)	-4.6312	-0.4048	0.6864
D(LINDC2)	0.0825	0.3978	0.6916
D(LNUC)	0.1467*	5.0432	0.0000
D(LENGI)	0.0605	0.3083	0.7585
C	44.3900	4.9085	0.0000
EC_{t-1}	-0.6354*	-4.8585	0.0000

Table 8: Results of Diagnostic tests

Test Statistics	LM Version	F Version
Test for Serial Correlation	CHSQ(1) = .07498 [.784]	F(1,15) = .0402 [.844]
Functional Form	CHSQ(1) = .4679E-4[.995]	F(1,15) = .2507E-4[.996]
Normality Test	CHSQ(2) = 1.1126 [.573]	-
Test for Heteroscedasticity	CHSQ(1) = 1.0254 [.311]	F(1,26) = .9884 [.329]

Source: author's own calculation

Table 7 presents the results of the error correction model which is (EC_{t-1}) statistically significant at the 1% level and carries a negative sign. This significance indicates a long-run relationship among the estimated variables in case of selected developing nations. The negative sign reflects a convergence toward equilibrium, suggesting that the model corrects deviations from the long-run path. According to the results, approximately 64% of the short-run disequilibrium is corrected annually, implying a return to equilibrium over time. The convergence coefficient EC_{t-1} quantifies the speed of this adjustment, and in this case, the estimated time to restore equilibrium is around 1.56 years. This confirms the presence of a stable long-term relationship among the variables. Table 8 presents the results of diagnostic tests. These results indicate no issues of serial correlation in the error terms and confirm the normality of residuals, which are distributed with a zero mean and constant variance. Furthermore, no evidence of autoregressive conditional heteroscedasticity (ARCH) is found. Figures 3 and 4 present the outcomes of the Ramsey RESET test for model stability at a 5% significance level. Both the Cumulative Sum of Recursive Residuals (CUSUM) and the CUSUM of Squares stay within their respective critical bounds, indicating that the estimated model remains stable over time.

Figure 3

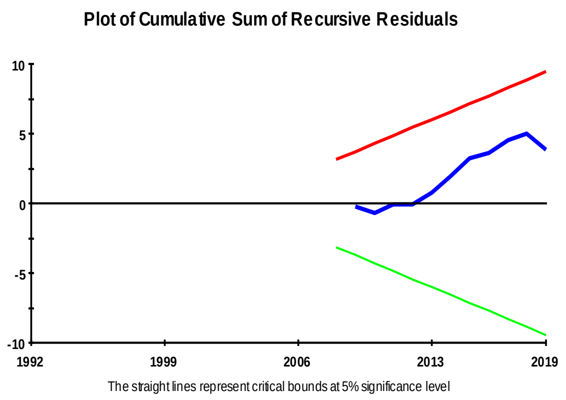
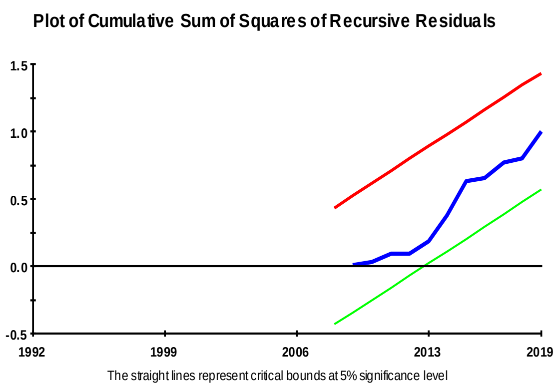


Figure 4



5. Conclusion and Policy Recommendations

This Study observes the effect of environmental degradation by exploring the relationship between industry value added (constant LCU) and carbon emission for the sample period of 1990-2024 by using panel ARDL bound testing method. Industrialization is a mandatory to attain ecological economic growth, creation of jobs and to reduce poverty. Though, there are some apprehensions on the environmental influence of industrialization in context with environmental variation. It also examines effect of industrial value added, population, Nuclear Energy and energy intensity on carbon emission in selected countries. The unit root test results indicate that all variables are non-stationary at their first difference, except for population. The cointegration test reveals the existence of a long-run relationship between CO_2 emissions and nuclear energy, energy intensity, industrialization, and population. In the long run, population is statistically insignificant and does not appear to influence CO_2 emissions, whereas in the short run, the results align with economic theory, showing that an increasing population contributes to higher CO_2 emissions. Increase in industrialization in long run indicates improvement in carbon emission (Co2) due to better utilization of technology. Nuclear energy is also positive but the impression is modest partly because of use of batteries. Enhancement in energy intensity has inhibitive influence on Co2 emission means more use of energy output will be greater. So, Carbon intensity will have progressive influence on Co2 emission. The outcomes of the study also advocate that for the long run, EKC is a U shaped quadratic function hypothesis and in short run it is inverted U shape in selected developing countries. The existence of EKC should be main focus, at initial phase of development and to reach rapidly towards turning point is a solution. So to remove environmental degradation selected developing countries should touch that turning point by putting all their best efforts. These results of study provide guidelines for practitioners and policymakers.

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