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Economic Growth, Energy Consumption and Environment Relationship: A Panel Data Analysis of South Asian Countries

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Abstract
This study examines the linkage among CO2 emissions, GDP per capita and renewable energy consumption in South Asian region by applying fixed effect model. The study utilized panel data in case of 8 South Asian countries to check the impact of GDP per capita, renewable energy consumption, population density and foreign direct investment (FDI) on CO2 emissions from 2006 to 2020. The estimated results indicated that with a rise in GDP per capita of South Asian countries, CO2 emissions in the region are increasing. However, we found a non-linear linkage between CO2 emissions and GDP per capita which validates the inverted U-shaped relationship between these variables. Usage of renewable energy is playing its role in mitigating CO2 emissions in South Asia. Population density and FDI are also responsible for polluting the environment by increasing CO2 emissions. It is recommended to policy makers of South-Asian countries to better invest in the renewable energy sources that tend to mitigate the effect of CO2 emissions on environment.
***Keywords*:** CO2 emissions, Renewable Energy Consumption, Environmental Kuznets Curve

1. Introduction

The Organization for Economic Cooperation and Development (OECD), defines environment as, "the environment is the totality of all the external conditions affecting the life, development and survival of organisms" (OECD, 2005). In order to preserve the intimacy of this shared resource, various agreements have been ratified. First, in the queue is the Montreal Protocol (1987) which required the countries to stop producing substances like chlorofluorocarbon (CFCs) that damage ozone layer. This resulted in 99% elimination of these substances. Then in 1992, UN Framework Convention on Climate Change (UNFCCC) established an annual forum Conference of the Parties (COP). This platform proved to be the gateway for Kyoto Protocol (2005) and Paris Agreement (2015). The difference between the Kyoto Protocol and Paris Agreement is that former required developed countries to mitigate emissions by 5% below 1990 levels while the later demands all countries to stop global average temperatures from increasing to 2 degrees Celsius (Maizland, 2022).
South Asia is the region that account for 24.8% share of the total world's population. According to the world bank data India is on top in terms of both population and gross domestic product (GDP) and Bhutan being the last (World Bank Group). Economies of Nepal and Maldives depend largely on tourism and service sector.

Table 1: Comparison of Population and GDP per capita of South Asian countries (2020)

Country Name	GDP per capita (constant 2015 US$)	Total Population
Afghanistan	553.04	38972230
Bangladesh	1593.35	167420951
Bhutan	2878.44	772506
India	1796.49	1396387127
Maldives	7013.57	514438
Nepal	1018.11	29348627
Pakistan	1409.70	227196741
Sri Lanka	4280.85	21919000

Source: Author's creation by WDI (World Development Indicators) World Bank data

According to World Bank, South Asia shares 8% of world's carbon emissions. India is ranked 7th among the world's most affected countries by the global climate risk index 2021. Pakistan and Nepal are placed among the top ten by the long term climate risk index 2000-2019, when annual averages are assessed (Resilience).
While narrating the words of an energy expert Nate Lewis, Friedman writes, "In the year 2000, the world's total average rate of energy usage was roughly 13 trillion watts that is expected to double by 2050 to 26 trillion. In

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order to avoid doubling of CO2, countries like India, China and other developing countries have to cut emissions by 80% to only 2.6 trillion watts" (Friedman, 2008). The Environmental Kuznets Curve (EKC) hypothesis exhibits inverted U-shaped relation between emissions and the economic growth which shows that when economic growth reaches a certain level it tends to decrease the emissions (Stern, 1998).

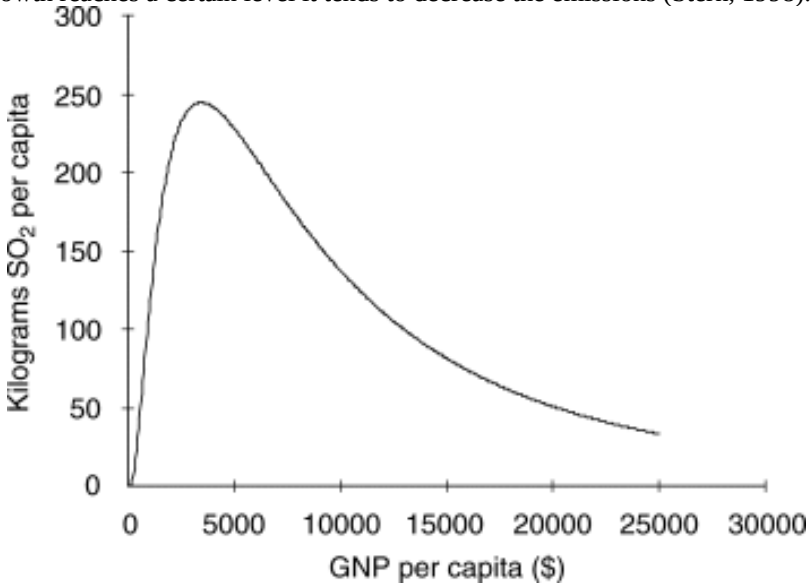


Figure 1: Sulphur Emissions representing Environmental Kuznets Curve
Source: (Stern, 1998)

Various studies have been conducted using the EKC phenomenon. We will be looking at validation of EKC in South Asian context including control variables like foreign direct investment (FDI), population etc.

2. Literature Review

This study shows the review of literature representing how GDP per capita, FDI, renewable energy usage and population density are related to environment through their impact on CO2 emissions.

Pao et al., (2010) found multivariate granger causation between FDI, GDP, energy use and carbon emissions. This research demonstrated that in long-run equilibrium, FDI is inelastic while CO2 emissions function as elastic energy consumption. The results were in line with the EKC. Panel data of the BRICs from 1980 to 2007 were used in this study. In this work, panel cointegration was used. The findings demonstrated a strong bidirectional causal linkage between carbon emissions and energy utilization. Use of energy and carbon emissions has a clear causal relationship.

Hatzigeorgiou (2011) investigated the linkage between Greece's GDP, energy intensity and carbon emissions for years 1977 to 2007. By using multivariate Vector Error Correction Modeling, he employed Granger causality tests and Johansen cointegration tests. The outcomes showed both one-way and two-way causal relationships between the chosen time series. The study's conclusions have substantial policy ramifications for Greece because it seems highly improbable that CO2 emissions and economic development would be uncoupled.

Wang (2012) examined a nonlinear relation linking oil-related carbon emissions and economic expansion. His research examined panel data from 98 nations from 1971 to 2007. The findings showed that, in the group of low economic growth, economic expansion had a effect on oil-related carbon emissions. Oil related carbon emissions and Economic growth are correlated in regime of medium economic growth, but not significantly so in regime of high economic growth.

Ozcan (2013) utilized panel data from twelve Middle Eastern nations from 1990 to 2008 to analyze the connection between CO2 emissions, use of energy and economic growth in MENA region. This study tested the EKC and the findings indicated that there was evidence favourable to the U-shaped curve in case of five Middle Eastern countries, the inverted U-shaped curve was only recognized for 3 Middle Eastern countries. For the other 4 countries, it also appeared that there were no relationships between income and carbon emissions.

Al-Mulali (2014) looks into how nuclear energy usage affected GDP growth and CO2 emissions from 1990 to 2010. Thirty major nuclear energy consumers were chosen as the study's study countries. The study's findings showed that while nuclear energy use does not have long-term impact on carbon emissions, it positively affects GDP growth. As per the findings of Granger causality test, using nuclear energy results in short-term beneficial effect on GDP growth and carbon emissions. This study's results indicated that nuclear energy usage significantly contributes to GDP development in the nations that were studied while having no impact on carbon emissions. Conversely, immediate effect of fossil fuel energy utilization on CO2 emissions and GDP growth is positive.

Moutinho and Robaina (2016) analyzed short-term and long-term impact of real income and the proportion of sources of renewable energy used in producing the electricity on carbon emissions. For the years 1991 to 2010, the study investigated twenty OECD member nations in Europe. Findings support EKC and further show that the renewable energy may have a significant contribution to the disparity in emissions-income relationships among European nations.

Cherni and Jouini (2017) investigated the linkage among economic growth, carbon emissions and usage of renewable energy in Tunisia. Their study estimated their findings using an ARDL model. For the Tunisian economy, the Granger causality test was employed to find out short-run and long-run causality between variables. Findings showed long-term stability in GDP, carbon emissions and usage of renewable energy. Granger causality test found a bidirectional causal linkage between carbon emissions and GDP as well as between the use of renewable energy and GDP. Carbon emissions and the usage of renewable energy sources were unrelated.

Chaabouni and Saidi (2017) examined 51 economies for the relation between carbon emissions, health expenditures and economic growth. They separated the nations into Low income, lower and upper middle income and middle income groupings. The study's chosen time frame ranged from 1995 to 2013. The generalized method of moments (GMM) and dynamic simultaneous equation models were used to check this linkage. Main findings demonstrated a connection between carbon emissions, GDP growth and health spending. In all groupings of nations, there was evidence of a causal relationship between GDP growth and health spending as well as between GDP and carbon emissions.

Mekayilovet al., (2018) found the connection between economic expansion and carbon emissions. It is one of the topics in environmental economics that is most explored. When emissions rise slowly than GDP, there is a relative decoupling; when emissions even fall in relation to the rate of economic expansion, there is an absolute decoupling. The key finding was that every country they looked at had positive income elasticity of carbon emissions for a longer time period from 1861 to 2015. For the 4 situations, the income elasticity is greater than one. It is an appeal to policymakers to come up with ways to reduce pollution levels while preserving economic growth.

Kang et al., (2019) used a three-variable VAR model with a time-varying parametric method. For the years 1965 to 2015, they looked into the linkage between GDP growth, energy usage from non-renewable and renewable sources and CO2 emissions. They discovered that the type of energy used at different points in time affects how GDP reacts to CO2 emissions.

Ardakani and Seyedaliakbar (2019) investigated EKC by looking into the linkage among energy use, carbon emissions and economic growth. Middle East and North Africa region's seven oil-rich countries were the focus of this study's panel data analysis from 1995 to 2014. For carbon dioxide, they used multivariate regression and a quadratic model formulation. The findings showed that GDP significantly improves environmental quality.

Saidi and Omri (2020) investigated long-run and short-run effects of nuclear and renewable energy use on CO2 emissions. Over years 1990–2018, 15 OECD nations were selected. The fully modified OLS (FMOLS) and vector error correction model (VECM) were used for estimation. According to FMOLS findings, while investments in nuclear and renewable energy reduce CO2 emissions, they do the opposite in South Korea and the Netherlands. Additionally, the VECM method's findings show that long-term CO2 emissions are decreased by renewable and nuclear energy sources. According to the analysis, the best method to lower CO2 emissions is to strive for a balance between nuclear and renewable energy sources.

Njoh (2021) utilized a general linear model to assess secondary data. It was investigated how the utilization of renewable energy affected carbon emissions among African nations. Four control variables, Gross Domestic Product (GDP) and Gross National Product (GNP) per capita, level of urbanization and usage of renewable energy were included. The linkage between carbon emissions and energy use was found to be negative.

Kim et al., (2020) found the linkage among total energy carbon emissions, total biomass energy usage and GDP in United States in time frame 1973 to 2016. They made use of the auto regressive distributed lag (ARDL) model and directed acyclic graph (DAG) approaches. Additionally, their work examined if the EKC existed. The study's findings showed that using biomass energy decreased US energy CO2 emissions. They advised continuing to use biomass as a source of energy to cut CO2 emissions.

Mendonca et al., (2020) examined 50 major economies in the world had an increase in CO2 emissions as a result of economic and population expansion. Hierarchical regression modeling was used for the years from 1990 till 2015. They examined the effects of GDP, production of renewable energies and population expansion on CO2 emissions. According to their research, rising CO2 emissions due to GDP and population expansion have a bad impact on the environment. However, producing renewable energy is a strategy which reduces carbon emissions.

Zubair et al., (2020) analyzed long-run relationships among trade integration, income, capital, GDP and FDI inflows. The ARDL model was used to make analysis from 1980-2018. Carbon dioxide emissions were decreased in Nigeria as FDI inflows, GDP, and capital increased. The Granger causality demonstrates a uni-way causation from capital to carbon emissions and a two-way causality between FDI inflows and CO2 emissions.

Nigeria's government should keep enhancing the incentives it offers to local and foreign businesspeople as part of its efforts to promote climate-friendly policies.

Table 2: Literature Review Summary

Authors	Countries	Time Period	Method and Techniques	Findings
Pao et al., (2010)	BRICs	1980-2007	Panel cointegration	Environmental Kuznets Curve (EKC)
Hatzigeorgiou (2011)	Greece	1977-2007	Granger causality	Uni and bi-directional causalities among GDP, Energy Intensity and CO2 emissions
Wang (2012)	Ninety eight countries	1971-2007	Panel cointegration and threshold effect	EKC hypothesis cannot hold.
Ozcan (2013)	Twelve Middle East countries	1990-2008	FMOLS method	EKC recognized in 3 countries
Al-Mulali (2014)	Thirty countries which consume nuclear energy	1990-2010	Granger causality and Pedroni cointegration	Nuclear energy usage is positively related to GDP in long run
Moutinho and Robaina (2016)	Twenty OECD countries	1991-2010	Innovative Accounting and Cointegration	Environmental Kuznets Curve (EKC)
Cherni and Jouini (2017)	Tunisia	1990-2015	ARDL	GDP increased the carbon emissions.
Chaabouni and Saidi (2017)	Fifty one countries	1995-2013	DSEM and GMM	Carbon emissions and GDP per capita has Bidirectional causality
Mekayilovet al., (2018)	Twelve European countries	1861-2015	Time varying coefficients cointegration	Positive income elasticity of carbon emissions
Kang et al., (2019)	India	1965-2015	VAR model	Economic growth cause carbon emissions
Ardakaniand Seyedaliakbar (2019)	Seven oil rich countries	1995-2014	Multivariate regression	GDP square help the environment
Saidi and Omri (2020)	Fifteen OECD countries	1990-2018	VECM and FMOLS	CO2 emissions decrease by using renewable and nuclear energy
Kim et al., (2020)	United States	1973-2016	DAG and ARDL	Environmental Kuznets Curve (EKC)
Mendonca et al., (2020)	Fifty biggest world economies	1990-2015	Hierarchical regression modeling	CO2 emissions are increased due to GDP and Population. Renewable energy reduces CO2 emissions.
Zubair et al., (2020)	Nigeria	1980-2018	ARDL	Increase in GDP, capital and FDI reduced CO2 emissions
Pejovic et al., (2021)	Twenty seven countries	2008-2018	PVAR and GMM	In long run, GDP is reducing carbon emissions
Shahnazi and Shabani (2021)	European Union countries	2000-2017	spatial unique board information model	CO2 outflows of a nation were connected with those of its neighbors.
Aslam et al., (2021)	China	1962-2018	ARDL	Environmental Kuznets Curve (EKC)
Malik et al., (2021)	Twenty three African countries	2007-2015	GMM	production capabilities are increasing PM2.5 emissions
Amin et al., (2021)	Pakistan	1970-2015	Nonlinear ARDL	GDP increase CO2 emissions

Source: Author's creation by doing literature review

Pejovic et al., (2021) examined the linkage among energy use, economic expansion and CO2 emissions. Twenty seven European Union nations as well as the Western Balkans were included covering time from 2008 to 2018. Estimations were conducted using GMM and the panel vector autoregressive approach (PVAR). According to

estimated results, changes in GDP account for the majority of variations in CO2 emissions, making it possible to reduce CO2 emissions over the long term by consistently raising GDP. Growing the amount of renewable energy consumed can directly decrease carbon emissions, which will have positive environmental impact. The research's conclusions could be very important for people in charge of directing environmental policy, controlling energy policy and directing economic growth.

Shahnazi and Shabani (2021) examined how spatially distributed carbon emissions are in the nations of the European Union (EU). From 2000 to 2017, they applied a spatially unique board information model. Results demonstrated the linkage between a country's carbon emissions and those of its neighbours. A U-shaped relation between economic freedom and CO2 emissions was also discovered.

Aslam et al., (2021) looked into the connections between China's population density, industrialization, trade openness and economic growth. For the years 1962 to 2018, they applied an ARDL model. The investigation revealed that the EKC existed.

After reviewing significant amount of literature on the subject matter, It is observed that CO2 emissions increase with a rise in gross domestic product (GDP) and population. It is so because whenever the GDP per capita of a country rises, it is associated with increase in production volume. However we observed in many studies that after achieving a specific level of GDP per capita, countries promote usage of renewable energy and try their best to decrease carbon emissions. This effort of policy makers is reflected in literature by validating the existence of EKC in various studies. The renewable energy consumption is found decreasing CO2 emissions in prior literature.

3. Theoretical Framework

At an initial stage of any study, it is the core responsibility of the author(s) to develop the theoretical framework which serves the purpose of linking the variables analyzed by the research work. This study looked into if EKC existed in South Asia. This study tried to determine the relationship between CO2 emissions, usage of renewable energy and GDP per capita.

3.1. CO2 Emissions and Gross Domestic Product (GDP)

The linkage between GDP per capita and carbon emissions is not new to the world. It is a well know fact, that nothing comes free in this modern world. If a country is willing to achieve enormous economic progress, one of the most likely costs is environmental degradation through CO2 emissions. Same is the case in this study. It is so, because most of the time when developing economies tries to gain economic expansion, it happens at the cost of degrading the environment.

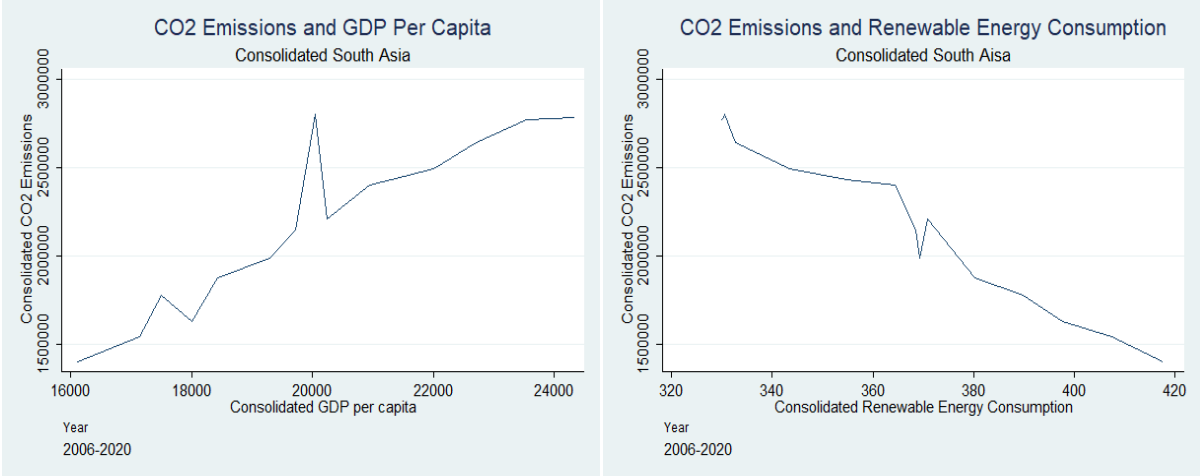
3.2. Renewable Energy Consumption and Economic Growth

It is a predominant fact that growing economies are using energy resources to maintain their production volume. Without consumption of energy it is not possibly for an economy to enhance its economic conditions. With the induction of renewable energy, way to the economic expansion has become relatively unproblematic because using renewable energy is responsible for reducing CO2 emissions. Environmentally friendly strategies to improve the environment should continually be sought for by policymakers. (Mustafa et al., 2021).

3.3. CO2 Emissions and Renewable Energy Consumption

A key contributor to rising CO2 emissions in an economy is energy use. However, using renewable energy has a distinct effect. Carbon emissions can be decreased by the increasing the usage of renewable energy. Wind, solar, tidal, biomass, hydro, and geothermal energy are all examples of renewable energy sources. These are the forms of energy which can help an economy's policy makers to mitigate CO2 emissions in the country. The usage of renewable energy is negatively related to CO2 emissions in South Asia.

Figure 2: CO2 Emissions linked with GDP Per Capita and Renewable Energy Consumption in South Asia



Source: Author's creation by consolidating WDI data of 8 South Asian countries

4. Data Sources and Methodology

4.1. Data Sources

This study analyzed the impact of GDP per capita and renewable energy consumption on CO2 emissions in 8 South-Asian economies. This study analyzed panel data for 8 South Asian economies (Afghanistan, Bangladesh, Bhutan, India, Maldives, Nepal, Pakistan and Sri Lanka) for years from 2006 to 2020. The data on variables (CO2 emissions, GDP per capita, FDI, Renewable energy consumption and Population density) analyzed in this study was taken from World Development Indicators (WDI) World Bank.

4.2. Methodology

In the model being estimated, CO2 emissions in South Asia depend on GDP per capita, usage of renewable energy, population density and FDI. This empirical model is based on the theoretical linkage between the CO2 emissions and regressors.

$$lnEM_{it} = \beta_1 + \beta_2 \ln GDP_{it} + \beta_3 \ln GDP_{it}^{\ 2} + \beta_4 \ln FDI_{it} + \beta_5 \ln REC_{it} + \beta_6 POP_{it} + \delta_i + \varepsilon_{it}$$

This model serves the purpose of investigating the validity of EKC in South-Asian countries.

Table 3: Definition of Variables

Variable	Description	Measurement	Source
EM	CO2 emissions	CO2 emissions (kt)	WDI
GDP	GDP per capita	constant 2015 US$	WDI
FDI	Foreign direct investment	net inflows (% of GDP)	WDI
REC	Renewable energy consumption	% of total final energy consumption	WDI
POP	Population density	people per sq. km of land area	WDI

Source: Compiled by author

4.3. Method of Estimation

4.3.1. Hausman Specification Test

After data collection the next main objective of a researcher is to adopt a correct method of estimation so that research question could be answered properly. This study applied Hausman specification test to select the appropriate panel data estimation method. The empirical values of Hausman test suggested the authors to apply fixed effect model of panel data estimation.

4.3.2. Fixed Effects Model

Fixed effects model means the model parameters are fixed and they are not random quantities. It is different from random effects model where some or all parameters are random variables. A fixed effects model means a regression model having fixed group means. We know that the data can be grouped according to several observed factors and group means could be modeled as random or fixed effects for each grouping. In our selected model (fixed effect model) the mean of each group is a fixed quantity which is group specific.

5. Results and their Interpretation

Table 4 displays the descriptive statistics for the variables investigated in this study. The mean values, standard deviation and minimum / maximum values of the variables used in this research are mentioned below.

Table 4: Descriptive Statistics of South-Asian Countries

Variable	Mean	Std. Dev.	Min	Max
lnEM	9.752	2.514	5.704	14.716
lnGDP	7.43	.855	5.869	9.23
$lnGDP^2$	55.934	13.12	34.439	85.19
lnFDI	0.086	1.25	-4.837	2.841
lnREC	3.384	1.282	0.095	4.526
POP	482.29	499.208	17.247	1801.807

Source: Author's creation

This study applied Hausman specification test to select the appropriate panel data estimation technique. This test determines whether the variance between the coefficient estimates produced using the fixed effect approach and the random effect method is statistically significant. According to the null hypothesis, fixed effect estimates are inefficient while random effect estimates are accurate and reliable. Hausman test has a Wald test form. It is often reported with k-1 degrees of freedom in Chi^2 form. Here k represents number of regressors in model. For our panel data estimation, the Hausman test directs our choice of either a random effect model or a fixed effect model.

Table 5: Hausman Specification Test

	Coef.
Chi^2 test value	17.043
Prob. Value	0.004

Source: Estimation by author

It is observed that probability value of the Hausman test is less than 5%, we cannot accept the null hypothesis of using random effect model. It means this study accept the alternative hypothesis of using fixed effect model.

Table 6: Determination of CO2 Emissions by Fixed Effect Model

lnEM	Coef.	St.Err.	t-value	p-value	[95% Conf	Interval]	Sig
lnGDP	4.775	1.206	3.960	0.000	2.384	7.165	***
$lnGDP^2$	-0.237	0.079	-3.010	0.003	-0.393	-0.081	***
lnFDI	0.021	0.022	0.950	0.342	-0.023	0.066	
lnREC	-0.588	0.207	-2.850	0.005	-0.997	-0.178	***
POP	0.001	0.000	4.270	0.000	0.000	0.001	***
Constant	-10.862	5.067	-2.140	0.034	-20.911	-0.814	**
R-squared	0.799						
F-test	82.843		Prob > F		0.000		

Source: Estimation by author, *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

According to Table 6, which is in line with earlier studies, CO2 emissions are significantly increasing due to GDP per capita. (Cherni and Jouini, 2017; Moutinho and Robaina, 2016; Pao et al., 2010). It demonstrates that as South Asian economies grow, CO2 emissions rise and the environment continues to deteriorate. GDP per capita and CO2 emissions are positively linked. This is true because in order to manufacture more things, a nation often faces rise in carbon emissions. A nation's carbon emissions increase along with the level of production (Ali et al., 2022; Ali & Audi, 2017).

Another significant finding from the empirical estimations is the negative relation between CO2 emissions and square of GDP per capita. This suggests that CO2 emissions decrease as the square of per capita GDP increases. This outcome is similar to some previous investigations (Ardakani & Seyedaliakbar, 2019; Aslam et al., 2021; Kim et al., 2020). The outcome demonstrates the existence of EKC in South Asian countries. EKC indicates, a country's CO2 emissions initially climb as its GDP per capita rises, but they later on decline at higher GDP per capita levels. As a result, an inverted U-shaped linkage forms between CO2 emissions and GDP per capita.

FDI is increasing the CO2 emissions in South Asia, however its coefficient is insignificant. This finding represents the Pollution Haven Hypothesis which is also in line with other studies (Marques & Caetano, 2022; Singhania & Saini, 2021; Wang & Luo, 2020; Ali and Audi, 2016). The impact of FDI inflow could vary from country to country. The Pollution Haven Hypothesis indicates degradation of a country's environment due to FDI inflow. It means increase in the FDI results in environmental degradation. This phenomenon exists in the economic literature because of the reason that many other researchers have found developing countries to be Pollution Haven for developed countries (Liu et al., 2022; Ali et al., 2021; Audi et al., 2020).

Consumption of renewable energy is inversely related with CO2 emissions. Therefore, South Asia's CO2 emissions are falling as it uses more renewable energy. This outcome is in line with other studies as well (Mendonca et al., 2020; Njoh, 2021; Saidi & Omri, 2020). This result lends credence to the idea that we can dramatically diminish CO2 emissions by encouraging the usage of renewable energy. In South Asian nations, population density has worsened the environment through raising CO2 emissions. This outcome is similar to earlier studies (Ahmad et al., 2013; Mendonca et al., 2020). This result is consistent with the idea that higher population levels will result in higher CO2 emissions. This is the case because higher population is associated with higher total demand, higher production and ultimately more CO2 emissions.

Value of R-square is showing that the independent variables used in this study explain 79% variations in CO2 emissions in South-Asian countries. It means that the variable selection by this study was good. From the F-test statistic result, it is indicated that the fitted model's overall significance is good. It is observed from the results that both R-square and F-test statistics are validating the goodness of the fitted model. This means that the econometric model, fitted to check EKC in South Asia, is a good fit. The results estimated by this study indicate the existence of EKC in South Asia.

6. Conclusion and Recommendations

This study highlights the crucial contributions that utilization of renewable energy sources and GDP per capita significantly affect the environment by their distinct impact on CO2 emissions. This study looked into the effect of population density, GDP per capita, FDI and renewable energy on CO2 emissions empirically for 8 South Asian countries for years from 2006 to 2020. By utilising the fixed effect approach of panel data estimation, the link between the aforementioned variables was examined. The findings show that in the South Asian region,

CO2 emissions and GDP per capita are significantly positively related. Every time the GDP per capita increases, it becomes the reason of increasing CO2 emissions (Mandonca et al., 2020). The negative significant square of GDP per capita's coefficient in our model, illustrates how this association between CO2 emissions and GDP per capita turns negative at a later stage of economic expansion. This discovery validates that the EKC exists in South Asia. It means with increased income, policy makers invest in renewable energy resources and environment friendly policies which help in reducing CO2 emissions. EKC is validated by the estimated results of this study in case of countries of South Asia (Salariet al., 2020). Utilizing renewable energy is a crucial strategy for halting environmental degradation. This study also discovered a connection between South Asian CO2 emissions and usage of renewable energy. It is evident from the findings that in South Asia the CO2 emissions decrease by utilization of renewable energy (Karaslan et al., 2022). The CO2 emissions are rising due to population growth as well. Population density is degrading the environment. The population significantly effects carbon emissions (Yang et al., 2021). GDP increases FDI (Siddiqui & Iqbal ,2018) and numerous studies from the past have shown that FDI raises carbon emissions (Shahbaz et al., 2019). In addition, this analysis discovered a linkage between FDI and CO2 emissions in 8 countries of South Asia, which was positive but statistically insignificant. To safeguard their environment from the damaging consequences of CO2 emissions, we advise policymakers in South Asian economies to make such policies which increase the usage of renewable energy.

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