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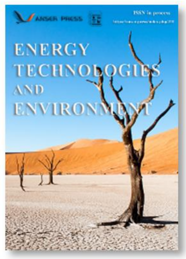

Analyzing the Effects of Renewable and Non-renewable Energy Consumption on the Environment and Economic Growth: Panel Data from South Asian Countries

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ABSTRACT

The primary goal of this research is to examine how different types of energy are used in South Asian countries and how they affect the environment and economic growth. From 1990 through 2021, this research employed Panel Data from multiple sources covering the South Asian countries of Pakistan, India, Bangladesh, Sri Lanka, Nepal, Bhutan, Maldives, and Afghanistan. The results are determined by using the Fixed Effect Regression (FEM) technique in both models. Several significant findings are supported by the data. First, while using renewable energy flattens carbon dioxide effusion, using non-renewable energy sources increases it. CO2 emissions are affected negatively by gross domestic product but positively by gross domestic product square. These results provide credence to the idea that South Asian countries do experience an Environment Kuznets Curve. Furthermore, foreign direct investment has a beneficial effect on CO2 emissions, lending credence to the Pollution Haven Hypothesis. Model 2 instead finds that both renewable and non-renewable energy consumption contributes to economic expansion. Gross Fixed Capital Formation and foreign direct investment also contribute to economic growth in this area. Finally, Inflation retards economic expansion.

KEYWORDS

Renewable Energy; Non-Renewable Energy; Fixed Effect; Economic Growth; South Asia

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1. Introduction

All over the last twenty years and so on, there has been a significant and persistent concern regarding the escalating challenges of climate change and environmental alteration. The Intergovernmental Panel on Climate Change (IPCC) published the first formal declaration that "the evidence shows a noticeable human contribution to global warming" in the year 1995. This declaration was issued by the IPCC. Unfortunately, this line of thinking resulted in several questionable assumptions, and as a consequence, the verdicts were considered to be inconclusive (Sahoo and Sahoo, 2020). The IPCC found in 2014 that rising quantities of greenhouse gases (GHG) and human interests both contribute to global warming. According to scientists, the primary reasons for the rise in GHG emissions are the increased demand for power and the expansion of industrial activities. Every policymaker and observer has been intently monitoring the correlation between power work, greenhouse gas emissions, and economic development as it has evolved into a significant global issue. This has been the case as the issue has been more widespread. After that, as a result of the significance of attaining sustainable economic growth, governments pledged to slowly reduce ecological degradation along with the most recent scientific understanding and to work towards sustainable growth and efficiency (COP, 2016).

According to Boluk and Mert (2014) and Shayanmehr et al. (2020a), current changes in the climate and worldwide heating, both because of rising levels of carbon dioxide (CO2) concentrations, prefer a risk to the continued survival of the ecosystem. According to the Joint Research Centre (JRC) of the European Commission (Olivier et al., 2012; Shayanmehr et al., 2020b), the combustion of residual gases is responsible for approximately 90 percent of all CO2 emissions that are produced on a global scale. with growing worries about a rise in CO2 levels and changes in the climate, the Consumption of natural gas is still necessary for the expansion of a country's Gross Domestic Product, (Pirlogea and Cicea, 2012). The widespread consensus is that using renewable energy sources can help strike a balance between environmental preservation and economic growth. As a consequence of this, the expansion of dynamic renewable resources is of significance to a great number of countries. It has been observed that encouraging the utilization of renewable energy sources is an efficient technique for reducing carbon emissions and achieving goals related to long-term stability (Lee, 2019).

The problem of climate change, which is caused by emissions of greenhouse gases, is not exclusive to industrialized nations. There are reports that India and China, two countries that are still developing economically were accountable for 62 percent of the world's CO_2 releases in 2011. It is essential to establish if or to what extent reducing CO_2 emissions by decreasing the use of fossil fuels will be detrimental to the economic growth of any nation, but this is especially important for emergent nations with low carbon efficiency (Ito, 2017). Even though many empirical studies on the subject of economic connection development and energy feasting have been done (for example, Akinlo, 2008; Asafu-Adjaye, 2000; Eggoh et al., 2011; Joyeux and Ripple, 2011; Lee, 2005; Mahadevan and Asafu-Adjaye, 2007; Ouedraogo, 2013), The correlation that exists between CO_2 emissions, the utilization of renewable energy sources, and the usage of non-renewable energy sources has gotten very little attention. For instance, one could argue that there is a two-dimensional causal relationship between the consumption of energy and the release of CO_2 by using piece information from six Central American countries during the years 1971 and 2004: (2009). Utilizing panel data for 11 members of the Commonwealth of Independent States from 1992 to 2004, They contend that there exists a direct relationship between energy usage and economic growth. The data was used to support their argument. A causal association between emissions and energy use was discovered by the authors Apergis and Payne (2010a). Apergis and Payne (2010b) performed an analysis using data collected from 13 countries in Eurasia between the years 1992 and 2007 to demonstrate that the deployment of sustainable energy sources and financial evolution are related in a bidirectional way.

Considering what has been done so far, the study goal is to conduct research on proxies that affect carbon discharges, in particular the utilization of renewable and non-renewable sources of energy, and to determine the respective contributions of each to environmental pollution in Asia's developing countries. In this particular study, the quantile regression technique was used. This technique has several advantages, including a lack of sensitivity to data that is either very old or very far away, and it also can provide a more accurate estimate of the variable by taking into account its unusual distribution. The selection of this particular group of developing nations was based on the fact that they are responsible for a higher level of pollution than other countries throughout the world, which are primarily responsible for damaging the environment due to their usage of fossil fuels. In addition, two-thirds of all fatalities that occur around the world take place in Asian countries, mostly as a result of air pollution caused by emissions of carbon dioxide. As a result, research has been conducted to determine how the usage of energy, both renewable and non-renewable, affects economic expansion and the environment in a select number of growing Asian nations. Following an introduction to the subject matter of the literature in Part 2, a discussion of the methodology of the study is presented in Part 3, the findings of the research are presented in Part 4, and a conclusion and some recommendations are presented in Part 5.

Taking into account the aforementioned, the primary aim is to analyze the elements disturbing carbon dioxide releases (CO_2), particularly the usage of both green and fossil-fueled energy, and to determine the relative contributions of each to environmental degradation and economic expansion in emerging South Asia nations. Panel Data was used in this study, which offers benefits including a lack of sensitivity to distant or out-of-date data and the potential for a more precise estimate of the variable depending on the atypical distribution. This particular set of developing nations was chosen because they produce more pollutants than other nations in the globe, which mostly use fossil fuels and harm the environment. Additionally, two-thirds of all fatalities worldwide occur in South Asian nations, primarily as a result of air pollution from carbon dioxide emissions. This study will aid in the explanation to policymakers of the causal link between economic factors and how an increase or drop in one indicator might impact another.

2. Literature Reviews

In their study, Sargolzaie and Ghasemi (2022) investigate how the usage of energy, both renewable and nonrenewable, contributes to the production of carbon dioxide in the Asian region. The study included data from 1965 through 2019 in its analysis, and it was conducted using the panel data technique. According to the findings, the usage of non-renewable energy sources increases the emissions of CO_2, whereas the utilization of renewable energy sources results in a minimized release of carbon dioxide. The robust random effect (RE) approach and Hausman-Taylor Regression are utilized in the study supervised by Dahri et al. (2021) to evaluate the consequences of transitioning from non-renewable to renewable sources of energy in 25 developing nations in Asia (HTR). According to these data, there is a direct correlation between rising economic activity and increased energy use. Vinh Vo and colleagues (2020) researched to examine how renewable energy sources influence economic growth. The study utilized data from the years 1990 to 2018. Methodologies such as heterogeneous non-causality, totally modified ordinary least squares (FMOLS), and dynamic ordinary least squares are utilized in this study. The findings indicate that economic expansion is driven by a combination of factors, including capital, labor, non-renewable energy sources, and renewable energy sources.

Belaid and Zrelli (2019), noticed and analyzed the relation among GDP, carbon releases, and the usage of renewable and non-renewable forms of electricity. Between the years 1980 and 2014, they made use of 9 different Mediterranean countries. Using the "PMG" and "ARDL" panel econometric methodologies, as well as discrepancy and cross-sectioned dependence, we will investigate log and short-run dynamic correlations. The results provide empirical evidence in favor of the panel's conclusion that there is a short-run direct cause-effect link among GDP, renewable power consumption, CO_2 emissions and non-renewable electrical power usage, GDP, and renewable energy use. Furthermore, these results are consistent with the panel's assertion that there is a link between non-renewable energy use, GDP, and renewable electricity usage. In the long run, data suggest that there is a two-way causal relationship between the use of non-renewable sources of electricity and the discharge of carbon dioxide. Mahalik et al. (2018) examined the connection between the growth of the economy and the use of energy. They investigate the most recent data that was acquired through the use of the Quantile-on-Quantile Method. These data show that economic expansion and energy usage are positively connected, which is not surprising given the huge differences in economic conditions that exist among countries. Lei and Fan, 2017. In Beijing, academics examined the relationships between transport, economic growth, and environmental deterioration using time series data for econometric analysis spanning the years 1995 to 2014. The findings indicated that growth in economic activity is helped by increases in both CO_2 emissions and transportation-related emissions.

The aggregate and disaggregate relationship between India's economic development, CO_2 outputs, and energy consumption (including coal, oil, gas, and electrical energy). Ahmad et al. (2016) used both ARDL and the VECM models to analyze data spanning from 1971 to 2014. Their research reveals that there is a positive association between the use of power strength and CO_2 outputs. Additionally, their research found a reciprocal correlation between CO_2 releases and economic growth. Shafiei and Salim (2014) investigated whether or not there is a correlation between the emission of CO_2 and the depletion of renewable and nonrenewable sources of energy in OECD countries. The STIRPAT model was used to examine the data that was gathered between the years 1980 and 2011. According to their findings, the utilization of non-renewable sources of energy has an effect that is favorable on carbon emissions, whereas the utilization of renewable sources of energy has an unfavorable effect. Alkhathlan and Javid (2013) performed an analysis of the connection between Saudi Arabia's CO_2 accretion, energy usage, and economic growth from 1980 to 2011. They found that the relationship falls somewhere between aggregate and disaggregate levels. According to the findings, carbon dioxide emissions rise along with economic growth and energy consumption, both elements contribute to an elevation in the level of carbon dioxide released into the air.

A study was performed by Solarin et al. (2013) to determine how the utilization of biomass energy influenced CO_2 emissions in 80 different industrialized and developing countries. They used the framework provided by the GMM technique. According to the findings, the exploitation of hydroelectricity did not result in an elevation in CO_2 release, in contrast to the use of fossil fuels and biomass energy. In addition, they find that stable institution quality has the opposite impact of increasing CO_2 discharge, even though real GDP, population, and urbanization are all factors that contribute to a rise in CO_2 release. These findings also reveal that while increased trade openness, foreign direct investment, and financial development all assist developed countries in cutting their emissions, these factors have the opposite effect on developing countries. Alam et al. (2011) analyze the multiple types to analyze the tangential relation that exists among income, energy advantage, and CO_2 emissions. To illustrate India, they chose data spanning the years 1971 and 2006. They establish a strong relation among these two factors, energy usage as well as CO_2 emissions. According to their findings, neither carbon dioxide (CO_2) nor energy use is the primary driver of actual income. Menyah and Wolde-Rufael (2010) performed research to investigate the seemingly unrelated relationships between the growth of the United States, CO_2 emissions, renewable energy, and nuclear energy. In the course of the inquiry, which covered the years 1960 through 2007, we used the test developed by Tado and Yamamoto (1995). The findings illustrate how damaging it is to the environment to rely on resources that do not replenish themselves. The second important conclusion reveals that the usage of renewable energy and CO_2 emissions are only correlated in one direction.

3. Data and Methodological Issues

The present research used Panel Data from 1990 to 2021 and observed the effect of nonrenewable and renewable energy ingesting on the environment and growth of the economy in the instance of a few South Asian nations, including India, Pakistan, Srilanka, Bhutan, Afghanistan, Bangladesh, Nepal, and Maldives. There are various variables in the data. The model of the study can be estimated by the following equation:

$$CO_2 = f(RE, NRE, GDP, GDP2, FDI,) \quad (1)$$

$$GDP = f(RE, NRE, GFCF, INF, FDI,) \quad (2)$$

The econometric model of the study can be estimated by the following equation:

$$CO_2 = \beta_0 + \beta_1 RE_t + \beta_2 NRE_t + \beta_3 GDP_t + \beta_4 GDP_{2t} + \beta_5 FDI_t + €_t \quad (3)$$

$$GDP = \beta_0 + \beta_1 RE_t + \beta_2 NRE_t + \beta_3 GFCF_t + \beta_4 INF_{2t} + \beta_5 FDI_t + €_t \quad (4)$$

3.1. Measurement of Indicators and Data Source

Description of indicators, their abbreviations, and unit of measurement are given below:

Table 1. Summaries of Indicators.

Indicators	Description	Units
CO_2	Carbon Dioxide Emission	Thousand Ton (kt)
RE	Renewable Energy	% of Total Consumption
NRE	Non-Renewable Energy	% of Total Consumption
GDP	Gross Domestic Product	Annual Growth
GDP^2	Square of Gross Domestic Product	Annual Growth
FDI	Foreign Direct Investment	Inflow, % of GDP
GFCF	Gross Fixed Capital Formation	% of GDP
INF	Inflation Rate	Annual Change

In Table 1, CO_2 represents the Environment, GDP is Gross Domestic Product, GDP2 is Gross Domestic Product Square NRE is nonrenewable energy and RE is renewable energy utilized according to the theory of EKC (Environment Kuznets Curve). FDI represents the Foreign Direct Investment. This variable is supported by the Pollution Halo and Haven Hypothesis. The estimated model of the study is guided by the Literature Reviews, the Theory of EKC (Environmental Kuznets Curve), and the hypothesis of Contamination Halo and Haven.

4. Results & Discussions

This part will present the empirical results of the analysis of data. The goal of our study is to look at the use of nonrenewable and renewable energy and the growth of the economy in South Asian nations. This study used Panel Data from 1990 to 2021. These countries were Bangladesh, Nepal, Afghanistan, Pakistan, India, Sri Lanka, Bhutan and Maldives. These numbers came from several different data stores. A method called Fixed Effect Regression (FEM) is used on both models to figure out the results of the study. Several important conclusions can be drawn from the data. First of all, when non-renewable energy sources are used, CO_2 emissions go up, but when green energy sources are used, CO_2 emissions go down. CO_2 emissions go down when the GDP goes up, but they go up when the GDP^2 goes up. These results are more proof that the Environment Kuznets Curve (EKC) exists in South Asian countries. The hypothesis of Pollution Halo is also more likely to be true because foreign direct investment has a bad impact on CO2 Emissions. The results are more proof that the hypothesis of Pollution Haven is true. In Model 2, however, both the use of nonrenewable and renewable energy adds to the growth of the economy. FDI (Foreign direct investment) and the creation of gross capital formation both help to grow the economy in this area. As a final thing to think about, inflation hurts the growth of the economy.

4.1. Descriptive Statistics

Table 2 shows the description of Descriptive Statistics of the indicators. In the first row mean value of dependent indicator CO2 (4.097936), and independent indicators RE (54.55419), NRE (35.16488), GFCF (26.81672), FDI (1.595600), GDP (5.120581), INF (7.045959), and GDP2 (51.37779).

Table 2. Descriptive Statistics.

	LCO2	RE	NRE	GDP	GDP2	GFCF	INF	FDI
Mean	4.097936	54.55419	35.16488	5.120581	51.37779	26.81672	7.045959	1.595600
Median	4.095091	54.17197	44.62939	5.310789	29.91442	25.04067	6.691213	0.801695
Maximum	6.391353	95.91994	83.38750	41.74510	1742.653	69.57143	22.56450	17.13262
Minimum	1.924279	0.364065	0.001440	-33.49280	0.014434	3.246968	-1.685412	-0.675563
Std. Dev.	1.199903	28.89093	29.05320	5.026953	145.3430	11.60640	4.124287	2.553087
Skewness	0.185383	-0.400928	-0.053036	-0.395822	9.277180	1.318098	0.793886	3.278972
Kurtosis	2.080183	2.277003	1.346461	31.67600	97.51014	5.370789	4.357983	15.19725
Jarque-Bera	9.179619	10.87984	25.62414	7680.770	86580.01	117.3216	40.74129	1789.942
Probability	0.010155	0.004340	0.000003	0.000000	0.000000	0.000000	0.000000	0.000000
Sum	917.9376	12220.14	7876.933	1147.010	11508.62	6006.945	1578.295	357.4145
Sum Sq. Dev.	321.0682	186135.0	188231.8	5635.267	4710784.	30040.02	3793.173	1453.570
Observations	248	248	248	248	248	248	248	248

Table 2's second-to-last row contains the skewness values. An unbalanced and asymmetrical deviation from the mean of a data distribution is called skewness in statistics. Assuming that the mode, median, and mean are all equal and that the data is skewed, we can argue that the distribution is skewed. When the data follows a normal distribution and the bell curve is entirely symmetrical, the median and mean values are identical. RE, NRE, and GDP are negatively skewed in this case. Since the means of all other variables are larger than the medians, we may say that they are positively skewed. This includes CO2, GFCF, INF, GDP2, and FDI.

The kurtosis values are displayed in the table after the skewness numbers. Kurtosis is a statistical measure of how flat or peaky a data set is in comparison to a normal distribution. In a normal distribution, the kurtosis value is 3. A very peaked distribution, called a Leptokurtic distribution, is indicated by a kurtosis value higher than 3. If the kurtosis value is less than 3, it indicates that the data is flat and the probability distribution is Platykurtic. We found that FDI, GDP2, GFCF, and INF all had kurtosis values higher than 3, indicating that they are Leptokurtic platykurtic variables, among others, in our descriptive statistics analysis. All three of these variables-CO2, RE, and NRE-are platykurtic.

4.2. Analysis of Multicollinearity

"Multicollinearity is meant the existence of a perfect or exact linear relationship among some or all explanatory variables of a regression model." The issue of multicollinearity among the variables is commonly identified by the PairWise Correlation Matrix.

This table shows the Pair-Wise correlation. The multicollinearity does not exist.

4.3. Analysis of Autocorrelation

"The problem of Autocorrelation arises when consecutive error terms are correlated with each other." The unruly Auto association is tackled by the Serial Correlation Breusch-Godfrey LM test.

Table 3. Results of PairWise Correlation Matrix.

Variables	LCO_2	RE	NRE	GDP	GDP^2	FDI	GFCF	INF
LCO_2	1							
RE	-0.0048	1						
NRE	-0.0741	-0.0023	1					
GDP	-0.0909	0.1115	0.2441	1				
GDP^2	0.2141	-0.1596	0.5376	0.5405	1			
FDI	0.0241	-0.5136	-0.7571	-0.1952	-0.1583	1		
GFCF	0.6147	-0.4546	-0.2872	0.0383	0.3103	0.5672	1	
INF	-0.7523	-0.5440	-0.3680	0.0383	0.5672	0.2602	0.2300	1

Table 4. Serial Correlation Breusch-Godfrey LM Test.

Model 1			
F-Statistics	0.069864	Prob. F(2,715)	0.9657
Model 2			
F-Statistic	0.129531	Prob. F(2,175)	0.8786

The findings show that the probability values of Model 1 (0.9657) and Model 2 (0.8786) are insignificant, which means Autocorrelation does not exist.

4.4. Analysis of Heteroskedasticity

"Heteroskedasticity is a situation where the variance of the residuals is unequal over a range of measured values."

Table 5. Heteroskedasticity Breusch-Pagan-Godfrey Test.

Model 1			
F-Statistics	2.200031	Prob. F(817)	0.4363
Model 2			
F-statistic	0.033056	Prob. F(2,175)	0.9675

The findings show that the probability values of Model 1 (0.4363) and Model 2 (0.9675) are insignificant, which means there is no Heteroskedasticity.

4.5. Analysis of the Hausman Test

The test is used to see whether the random effect approach or the fixed effect approach is best suited. The random effect approach is more effective if the probability value is greater than 5%, while the Fixed effect method is more efficient if the probability value is less than 5%.

As the Hausman test probability value is less than 5%, the study uses the Fixed effect technique, which is quite effective.

4.6. Analysis of Redundant Test

To check the effect of common effect and random effect we apply a redundant fixed effect test and according to the results it shows a fixed effect will be applied.

Table 6. Hausman Test.

Model 1			
Effects Test	Statistic	d.f.	Prob.
Cross-section F	5.138406	(5,167)	0.0002
Cross-section Chi-square	25.757893	5	0.0001
Model 2			
Effects Test	Statistic	d.f.	Prob.
Cross-section F	2.741968	(5,167)	0.0208
Cross-section Chi-square	14.201789	5	0.0144

Table 7. Redundant Test.

Model 1			
Test Summary	Chi-Sq. Statistic	Chi-Sq. d.f.	Prob.
Period Random	11.717204	7	0.0103
Model 2			
Test Summary	Chi-Sq. Statistic	Chi-Sq. d.f.	Prob.
Period Random	23.763627	7	0.0013

To check the outcome of common effect and random effect we apply a redundant fixed effect test and according to the results it shows a fixed effect will be applied.

4.7. Analysis of Fixed Effect Regression Analysis

Table 8. Fixed Effect Regression Analysis of Model 1.

Variable	Coefficient	Std. Error	t-Statistic	Prob.
RE	-0.023671	0.031941	0.741083	0.0497
NRE	0.013066	0.017403	0.750781	0.0538
GDP	0.071557	0.024975	2.865110	0.5447
GDP^2	-0.092000	0.048347	1.902915	0.0588
FDI	-0.020889	0.009558	2.185564	0.0302
C	7.608969	1.471117	5.172239	0.0000
LCO_2(-1)	0.821823	0.037108	22.14656	0.0000
R^2	0.972892	F-Statistics	499.4572	
Adjusted R^2	0.970944	Prob (F-Statistics)	0.000000	
Durbin-Watson stat		1.983160		

The value of the coefficient of renewable energy (RE) shown in the table above demonstrates that there is a significantly inverse link between the independent variable renewable energy and the dependent variable carbon emission (RE). According to the collected evidence, the amount of carbon emissions reduced is equal to (-0.023671) units for each unit increase in the amount of renewable energy (RE) (CO_2). There is a significantly positive association between the independent variable nonrenewable energy and the dependent variable carbon emission (NRE), as indicated by the coefficient value of non-renewable energy (NRE) in the table that was presented before. As per empirical research results, the amount of carbon emissions rises by 0.013066 units for every unit the amount of nonrenewable energy (CO_2) rises.

According to the value of the coefficient of GDP in the preceding table, there is a significant impact that is both positive and helpful on carbon emissions. According to the findings of empirical research, there is a correlation between each unit growth in GDP and a drop of 0.071557 units in CO2 emissions. The value of the GDP^2 coefficient in the table that was just presented demonstrates that there is a negative and considerable influence on CO2 emissions. The outcome of empirical research shows that there is a correlation between a unit rise in GDP and a unit decrease in carbon emissions (CO_2) of -0.092000. According to the value of the FDI coefficient, which can be found in the table that is located above, there is a significant and detrimental impact on carbon emission. According to the findings of empirical research, carbon emissions decrease by (-0.020889) units for each unit increase in GDP.

4.8. Analysis of Fixed Effect Regression Analysis

Table 9. Fixed Effect Regression Analysis of Model 2.

Variable	Coefficient	Std. Error	t-Statistic	Prob.
RE	0.005169	0.001648	3.137196	0.0020
NRE	0.001229	0.000480	2.562980	0.0113
GFCF	0.018613	0.000778	-0.787512	0.3321
INF	-0.041559	0.000634	0.880575	0.0798
FDI	0.021699	0.000291	2.405569	0.0172
C	0.537169	0.121924	4.405779	0.0000
LGDP (-1)	0.844254	0.032005	26.37921	0.0000
R^2	0.979189	F-Statistics	654.7995	
Adjusted R^2	0.977694	Prob (F-Statistics)	0.000000	
Durbin-Watson stat		1.860693		

It is notable in the table above that the coefficient value of renewable energy (RE) is positive and has a high positive significance implying that there is a strong and positive correlation between the independent variable Renewable Energy (RE) and the dependent variable (GDP). According to the data that has been collected, there is a gain in GDP of 0.005169 units for every unit that is added to the total amount of renewable energy. The reality shows coefficient value of non-renewable energy in the table above is positive and has a large positive significance indicating that there is a strong and positive correlation between the independent variable (NRE) and the dependent variable (GDP). According to empirical data, a one-unit rise in nonrenewable energy is correlated with a one-unit increase in GDP by 0.001229%.

The fact that there is a positive and considerable strong effect on GDP is indicated by the magnitude of the coefficient of GFCF in the table that was just presented. According to the findings of empirical research, there is a correlation between an increase in GFCF and a rise in GDP of 0.018613 units for every unit increase in GFCF. The fact that the value of the coefficient of INF is negative in the table that was just presented suggests that there is a substantial negative impact on GDP. The empirical evidence suggests that a loss in GDP of (-0.041559) units occurs whenever there is a unit increase in the INF. The fact shows that the FDI coefficient value is positive in the table that was just presented suggests that there is a high and positive effect on GDP. According to the findings of empirical research, there is a correlation between an increase in FDI levels and a rise in GDP levels of 0.021699 units. As per the outcome of the study, Renewable Energy reduced the level of CO_2 emission and Non-Renewable promoted it. These findings are consistent with Sargolzaie and Ghasemi (2022), and Dahri et al. (2021). The outcome also highlights that, GDP positive and GDP^2 negative effect on CO_2 Emission. These findings offer supporting evidence for the presence of the Environment Kuznets Curve in South Asian nations. These results are in line with, Isik et al (2021), In addition, the fact that Foreign Direct Investment (FDI) hurts Co2 Emission lends credence to the corporeality of the Pollution Halo Hypothesis. This finding provides further evidence in favour of the Pollution Halo Hypothesis. These outcomes are consistent with Balsalobre-Lorente et al (2019), and Mert & Caglar (2020). Kisswani & Zaitouni (2021). In the second model of our research, Renewable Energy and Non-Renewable encourage Economic Growth in South Asian nations. These findings are in line with, Ivanovski et al (2021), Rahman, &

Velayutham, (2020). Adams, et al (2018), GFCF and FDI also promote the Growth of the economy in South Asian countries. These findings are in line with, Rahman, & Velayutham, (2020). While Inflation is negative and FDI positive impact on the Growth of the economy in South Asian countries. These results are in line with, Opeyemi, A. F. (2020).

5. Conclusion

The study's overarching goal is to examine how different energy sources, renewable and non-renewable, affect South Asian countries' environmental and economic growth rates. This study utilized the Panel Data of South Asian nations throughout the time frame of 1990 to 2021, including Bangladesh, Pakistan, India, Nepal, Sri Lanka, Maldives, Afghanistan, and Bhutan. These data were acquired from a variety of data repositories. The outcomes of the study are determined by applying a method called Fixed Effect Regression (FEM) to both models. Empirical results show several significant findings. First of all, carbon dioxide emissions go up when we use non-renewable energy sources and down when we use renewable energy. Emissions of carbon dioxide are positively correlated with GDP^2 but negatively correlated with GDP. These results provide more proof that South Asian countries are located on the Environment Kuznets Curve (EKC). On top of that, the Pollution Halo Hypothesis is supported by the fact that FDI reduces CO2 emissions. The results of this study lend credence to the Pollution Haven Hypothesis. Nevertheless, in Model 2, the usage of non-renewable energy and renewable energy contributes to the expansion of the economy. Gains in gross fixed capital formation (GFCF) and FDI (foreign direct investment) help propel economic growth in this area. Finally, it's important to remember that inflation stunts economic growth. Nonlinearities and the impact of different renewable sources were not examined in this study. Further, this research can be extended by increasing the number of countries and variables by comparing the economic growth of different countries using the subgroups of Renewable energy resources.

6. Policy Recommendations

The findings of this study have been used to inform some policy recommendations that are presented below.

A better energy mix, with more low-carbon technology and less fossil fuels, is something that policymakers should work towards. Furthermore, policymakers should push for the widespread use of renewable energy and urge municipalities to switch to green power. Furthermore, carbon taxes should be used to encourage businesses to use energy-efficient technologies.

According to the findings, GDP has a noteworthy and positive influence on emissions of CO2, while GDP2 has a notable and negative effect. Put another way, this finding lends credence to Kuznets's theory. The U-shaped relationship between economic expansion and CO2 pollution is Kuznets's hypothesis. Based on the results, policymakers should encourage companies to utilize low-carbon, high-efficiency technologies. Additionally, FDI has a large and negative effect on CO2 emissions. Foreign direct investment reduces emissions, to rephrase the question. Therefore, getting ready for the flood of foreign money is a good idea.

The paper states that using non-renewable energy sources significantly reduces CO2 emissions. Reduced carbon dioxide emissions are a major side effect of switching to renewable energy sources. So, whereas growing Asian nations see a decrease in CO2 emissions from Renewable energy use, emerging Asian nations see an increase in Non-renewable energy use.

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Conflict of interest

All the authors claim that the manuscript is completely original. The authors also declare no conflict of interest.

Authors contributions

Muhammad Ali Husnain: Writing Original Draft, Literature Reviewing, and Editing Data Analysis and interpretations; Ping Guo: Supervision; Guoqin Pan: Conceptualization, Data Curation, Methodology, Visualization; Muhammad Kamran Bhatti: Data Analysis and Interpretations; Rabia Islam: Revising the Draft & and Editing.

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