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Impact of Environmental Regulation and Sustainable Development on Economic Growth

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ABSTRACT

Access to stable, low-cost, and environmentally friendly power has the potential to raise a country's human development index (HDI). However, there are unforeseen effects to economic growth, such as environmental damage caused by overconsumption of energy. Major changes to the world's ecology have resulted from the growing reliance on non-renewable energy sources. This research delves into the interplay between various energy sources, GDP growth, environmental legislation, sustainable development, and the HDI. The time series data used in this research spans the years 2000–2020. The degree of correlation between two variables may be determined using the Granger causality test. The correlations among the variables, both long-term and short-term, may be determined using the Course Mistake Alteration model. In order to meet the growing need for energy, policymakers should support and promote these renewable liveliness bases as a feasible alternative to traditional energy sources, taking into account the expected results. To reach the goal of reducing carbon emissions by 2030 set by South Asian countries, current environmental laws need to be tightened.

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1. Introduction

The cumulative repercussions of contemporary civilization are causing an increase in environmental concerns. The planet's current condition has impeded human progress. However, people can't live as long as they otherwise would if their surroundings are unhealthy, and problems with the environment have a direct impact on people's happiness. On the other side, supporting a development strategy that results in excessive energy use and pollution is not feasible. As a result, the world is confronted with problems related to the control of different pollutants and changes in the environment. We can no longer afford to ignore long-term sustainable development in favor of GDP. Nowadays, every nation agrees that sustainable development is the best way to preserve the environment while also boosting the economy. In order to address the growing expectations of people throughout the world and find solutions to pressing social problems, sustainable development is essential. It will also help ensure that the economy continues to expand steadily and at a high quality.

A steady supply of energy has historically been associated with economic growth, according to Xiong et al. (2014). Keeping the environment safe and preserving natural resources are huge problems for nations of all economic levels (Ahmad et al., 2018). Countries have been trying to find a way to balance economic growth with environmental protection for a long time. Examining the correlation between energy use and GDP growth could shed light on the relationship between sustainable development and environmental preservation (Javid & Sharif, 2016). Energy consumption is correlated with GDP growth, according to Mirza and Kanwal (2017). Nevertheless, when comparing other countries, statistics, and study methods, the causality of this relationship remains uncertain.

We found that the current literature on the link between renewable energy consumption and economic development lacked comprehensive investigation and assessment. In an effort to fill in some of the blanks, this research looks at how the framework affects carbon emissions, energy consumption, sustainable development, economic growth, and environmental legislation.

In more ways than one, this endeavor adds to what is already known. This study adds significantly to the existing literature by providing the first quantitative analysis of the correlation between renewable energy usage, GDP growth, and human development. It does this by elucidating the obvious link between energy consumption, economic progress, and human advancement. Even though there have been a lot of studies that have tried to look at how different types of energy affect development, none of them have been through enough. Most of the energy that is used on a global scale is generated by humans. There are still many unanswered questions about this matter.

Investigating the link between energy use and the Human Development Index (HDI) may result in potentially life-altering implications. The study's unique contribution to the energy industry is investigating the connection between renewable energy use, economic progress, and the HDI.
No studies have examined how renewable energy use, GDP growth, and HDI in Asian nations relate to one another. We have, therefore, finished our assessment. South Asian nations are particularly susceptible to the effects of the energy crisis due to their low levels of human development and limited access to reliable electricity.

The goal of this research is to fill gaps in our understanding and persuade policymakers in Asian nations of the value of renewable energy sources for advancing human civilization. In panel data analysis, the two-stage least squares (2SLS) algorithm is a typical approach. We examined the layer of static data. The association among the essential components was established by using the regression estimate.

By examining the effects of sustainable development and environmental regulation on economic growth and carbon emission reduction in Asian countries, this study fills a gap in our understanding. It is believed that future research efforts would provide beneficial outcomes for policymaking and decision-making if the current research corpus is enhanced and a framework for sustainable development and economic growth is created. A number of nations and components were considered in this research.

2. Review of Literature

In this study, Kongbuamai et al. (2021) analyze the BRICS nations' impact on the environment by looking at their GDP growth, use of renewable and nonrenewable energy sources, industrialization, and strict environmental regulations. The findings showed that environmental impact was positively correlated with increases in GDP, renewable energy usage, nonrenewable energy usage, and industrial output, but the ecological footprint was negatively correlated with the strictness of environmental policy in the BRICS countries. Another interesting finding is that there is a negative proportional connection between ecological footprint and renewable energy consumption but a positive inverse association between ecological footprint and economic development.

The impact of a growing economy on the energy use of certain states was examined (Salari et al., 2021). When socioeconomic, legal, and climatic aspects are included in the model, policy assessment is enhanced, and renewable energy is encouraged to be used more widely. The amount of nonrenewable energy consumed and overall energy consumption both lend credence to the feedback idea. Data on energy usage from residential and commercial sectors may further support the expanding allegation.

Acknowledging that the environment can only partly satisfy the expectations of both current and future generations is an essential aspect of sustainable development, as is addressing the needs of people with low incomes. Anand and Sen (2000) state that sustainable development cannot be achieved without intergenerational justice, which is a prerequisite for human growth. Human development could be aided by making better use of monetary resources. Achieving economic sustainability requires sustainable development to reduce income inequality (Brautigam & Knack, 2004). A link between long-term economic growth and ecological protection was shown by Smulders and Gradus (1993).

Sustainable social, economic, and environmental practices are essential, as Sonnenfeld (2008) stresses. Our ecology, institutions, and economy have been impacted by the fast rise of globalization, as pointed out by Azhar et al. (2007). There is a serious and ongoing danger to sustainability from climate change (Guest, 2010). New strategies, policies, and ways of doing things are required to deal with this changing environment (Najam et al., 2007). For policymakers to come up with effective solutions, they must have a solid grasp of sustainable development.

In their study, Cracolici et al. (2010) examined the correlation between economic and non-economic measures of well-being and found that GDP had a positive effect on indicators of labor, capital stock, technological progress, literacy rate, and life expectancy. Gross domestic product (GDP) and pollution also have a positive correlation; specifically, rising GDP is correlated with higher CO_2 emissions. Quality of institutions and economic inequality are other crucial factors.

The substitution of coal for oil in power generation has led to a decline in carbon dioxide emissions in all OECD nations (Acar & Lindmark, 2017). There is an initial phase and a following phase in the research process. The first oil strategy of the OECD was greatly influenced by the ups and downs of OPEC oil prices and concerns about energy security during the Cold War. In the 2010s, several OECD nations passed legislation to safeguard the environment better. During the two stages of economic expansion, coal and petroleum exhibit different behaviors due to the environmental factors outlined before. According to Asumadu-Sarkodie and Owusu (2017), there is a dynamic equilibrium, including pollution, energy consumption, economic development, and industrialization. Economic growth and increased energy use have both contributed to a 20% worsening of environmental conditions, according to the variance decomposition research. To reduce future environmental harm, they suggested that Sierra Leone switch to renewable energy.

Muhammad Mabrouki's (2022) Longitudinal empirical data shows a cointegrating link between educational attainment, population size, life expectancy at birth, economic growth, and gross fixed capital creation. The amount of patents in Scandinavian nations is positively correlated with economic success, according to our empirical investigation. Along these lines, we found that government funding for schools actually slows down economic growth. The triple helix concept may provide light on the path to knowledge-driven sustainable development and innovation. Various fields, including academia, government, and industry, may use this approach as a basis for assessing relationships.

3. Methodology

The WDI was the source for the data used in this research. A substantial dataset pertaining to domestic and international economic activity in South Asian nations is included in this research, which spans two decades, from 2000 to 2022.

3.1 Description of the data source and variables

Changes in	Variable definition	The capacities	Sources
A independent mutable			
The countrywide economy's GDP	The yearly value of goods and services generated inside a nation.	Yearly growth	WDI
Self-determining variables			
CO2 Emissions	Manufacturing cement and burning fossil fuels are two of the most prevalent human-caused activities that release carbon dioxide into the atmosphere.	Metric tons per capita	WDI
Inhabitants development	"Population growth indicates an augmentation of Earth's population." For a very long time, the human population stayed about the same. However, as a result of technological advancements and industrialization, essential services like power, food, water, and healthcare are more available and dependable than in the past.	(Yearly %)	WDI
Social growth directory	The Human Development Index (HDI) considers several indicators, including literacy rate, GDP per capita, and life expectancy. Based on their degree of human development, this index classifies countries into four categories.	Humanoid growth index annual standards	Pakistan cvs
Obvious submissions	Literacy rate, GDP per capita, and life expectancy are among the metrics taken into account by the Human Development Index (HDI). Countries are grouped into four groups according to their level of human development in this index.	Non-residents	WDI

Vitality ingesting	The typical industrial unit of measurement for total energy consumption in processes is kilowatt-hours (kWh). This includes fuels such as petrol, diesel, oil, electricity, and biomass.	% of total final energy consumption	WDI
Regulator variables			
PRICE INCREASES	Inflation, which reduces the value of money, is characterized by universal price increases.	ANNUAL %	WDI
DISTANT STRAIGHT VENTURE (NET INFLOWS)	A country's "foreign direct investment net inflows" are the total amount of money that non-resident investors put into the economy via direct investments. This includes both outbound investments and internal investments, such as loans and retained earnings. After things like loan repayments and capital returns are calculated, this amount is set.	% OF GDP	WDI

Considering the above information, the baseline model can be expressed as. Moreover, for consistency, all factors were employed as log shapes.

$$GDP = f(REC,CO,PPG,PTA,INF,FDI,HDI) \quad 1$$

$$GDP= \lambda_0+\delta_1 REC_{it} + \delta_2 CO_{it} + \delta_3 PPG_{it} + \delta_4 PTA_{it} + \delta_5 INF_{it} + \delta_6 FDI_{it} + \delta_7 HDI_{it} + \mu_{it} \quad 2$$

Due to its prevalence in panel data, cross-sectional dependence is given priority. To examine the interdependencies between provinces on a national and regional scale, we used cross-sectional dependency (CD) analysis, as described by Pesaran (2004). This is important since, later in the research, we will be analyzing the variables' stationarity and long-term correlations.

$$CD = \sqrt{\frac{2l}{n(n-1)}}\left(\sum_{i=1}^{n-1}\sum_{j=i+1}^{n}\kappa_{ij}\right) \quad 3$$

Where l, n and κ_{ij} stand for the time, cross sections, and error term respectively. Pesaran and Yamagata (2015) introduced a test to determine the nature of the panel dataset, mathematically expressed as.

$$\Delta = \sqrt{Sle}\left(\frac{Sle^{-1}h\% - e}{\sqrt{2e}}\right)$$

$$and\,\Delta adj = \sqrt{Sle}\left(\frac{S^{-1}h\% - e}{\sqrt{\frac{2e(M-e-1)}{M+1}}}\right) \quad 4$$

The second-generation unit root test must be performed once the dataset's cointegration has been validated. A cross-sectionally improved DF unit root test and a cross-sectionally augmented IPS (CIPS) were evaluated to accomplish our goal. This battery of tests set out to determine how well the integration order in the

$$CIPS = \frac{1}{S}\sum_{j=1}^{S} m_j(S,M) \quad (5)$$

PSADF

$$\Delta X_{ij} = \varphi_i + \zeta_i X_{i,j-1} + \kappa_i \overline{X}_{j-1} + \sum_{f=0}^{r} \kappa_{if} \overline{X}_{j-1} + \sum_{f=1}^{r} \lambda_{if} \Delta X_{i,j-1} + \mu_{ij} \quad (6)$$

The first step in the research's comprehensive approach is a Pesaran-style examination of cross-sectional dependency. The Fully Modified Ordinary Least Squares (FMOLS) approach is useful when looking for consistent, long-term relationships in panel data. FMOLS is an effective econometric method for reducing the impact of serial correlation and endogeneity on non-stationary time series data. By including lag values of the dependent variable and regressors, FMOLS improves the efficiency and reliability of parameter estimates, providing a strong basis for comprehensive analysis in panel data investigations.

4. Results and Discussion

The aim of descriptive analysis is to highlight the essential features of a dataset. It is esteemed for its capacity to provide critical insights, including measures of central tendency that highlight departures from the mean and quantify data dispersion. Measures of central tendency include mean, minimum, and maximum, while skewness and kurtosis evaluate data dispersion. The findings of this descriptive analysis are shown in Table 1.

Table 1: Descriptive Statistics

variable	mean	Std. Dev.	Min	Max	skewness	kurtosis
lngdp	22.417	1.116	11.3	25.615	0.7532	0.0021
lnrec	2.242	1.367	.139	2.536	0.0011	0.0121
lnco2	-0.523	0.95	-2.923	1.477	0.1387	0.2297
lnppg	0.34	0.554	-2.162	2.12	0.0110	0.0217
lnpta	5.241	2.416	0.10	10.242	0.6546	0.6692
lninf	1.547	0.675	-1.291	3.63	0.2001	0.2001
lnfdi	0.007	1.229	-4.537	2.541	0.1791	0.0294
lnhdi	-0.563	0.24	-.744	-.714	0.5846	0.5230

The descriptive statistics table summarises the dataset's log-transformed variables, drawing attention to their distribution, variability, and central tendency. The standard deviations (Std. Dev.) show how dispersed the values are around the means, whereas the mean values show how each variable is distributed throughout the whole. The variable lngdp shows a lot of variation in GDP statistics, with a mean of 24.417 and a standard deviation of 2.116. Examples of data distribution properties shown by skewness and kurtosis values include lngdp's positive skew (0.7532), indicating a more prominent right tail, and lnhdi's moderate skewness (0.5846). The kurtosis values tend to be close to zero, which means that the distributions of most variables are normal or nearly so, with the exception of lnco2 and lnpta, which exhibit small deviations. The data shows that these economic indicators vary from one set of numbers to another, with lyric showing a limited range (0.139 to 2.536) and Anita (0.10 to 10.242) defining their respective ranges.

Table 2: Pairwise correlations

variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
(1) lngdp	1.001							
(2) lnrec	0.254*	1.010						
	(0.002)							
(3) lnco2	0.003	-0.326*	1.010					
	(0.984)	(0.001)						
(4) lnppg	-0.192*	-0.527*	0.272	1.002				
	(0.011)	(0.001)	(0.354)					
(5) lnpta	0.953*	-0.537*	0.546*	0.550*	1.010			
	(0.011)	(0.011)	(0.011)	(0.001)				
(6) lninf	0.233	0.221*	-0.192*	-0.135	-0.242	1.002		
	(0.084)	(0.012)	(0.023)	(0.072)	(0.677)			
(7) lnfdi	-0.223	-0.622*	0.621*	0.252*	0.522*	-0.119	1.001	
	(0.119)	(0.001)	(0.001)	(0.001)	(0.001)	(0.811)		
(8) lnhdi	0.003	0.493*	0.311	-0.826*	-0.241	0.063	0.383	1.001
	(0.986)	(0.052)	(0.081)	(0.000)	(0.632)	(0.800)	(0.115)	

** Shows significance at $p<0.05$*

It turns out that pairwise correlation analysis reveals a bunch of major correlations. With a positive connection of 0.255 with lnrec and 0.954 with lnpta, GDP drives economic activity and primary energy use. An imbalance between economic expansion and carbon emissions is indicated by the negative correlation between lnrec and lnco2 (-0.524), while the negative correlations between lnppg and lnrec (-0.507) and lnpta (-0.737) imply that increased primary energy production per capita may lead to reduced economic activity and energy consumption. Coefficients of association between lninf and lnrec (0.201) and lnco2 (-0.194) demonstrate the intricate interplay between economic and environmental factors. The economic activity (lyric) is negatively impacted by life (-0.621 coefficient). Since lnhdi is positively associated with lnrec (0.494) and lnco2 (0.411), it follows that augmented human development promotes economic activity and increases carbon emissions. The links in the dataset are better understood because of these results, which provide light on economic, environmental, and developmental processes.

When doing regression analysis on panel data, the Variance Inflation Factor (VIF) is used for evaluation. If there is multicollinearity among the independent variables, it will look at how much a strong correlation with other variables increases the variance of the regression coefficients that were calculated. For both time-series and cross-sectional data, the Variance Inflation Factor (VIF) must be used in panel data analysis. The stability of the model, correct estimates, and trustworthy interpretation of the effects of variables are all guaranteed by its capacity to identify and relieve multicollinearity. We can see the results of the VIF in Table 3.

Table 3: Variance Inflation Factor

	VIF	1/VIF
Fdi	2.267	0.505
co2	2.258	0.563
Rec	1.281	0.575
ppg	1.227	0.754
Pta	1.273	0.752

Hdi	1.269	0.735
Inf	1.238	0.763
Mean VIF	1.531.	

The variables in the regression model exhibit varying degrees of multicollinearity, as shown by the VIF analysis. With VIF values of 2.267 and 2.258, respectively, FDI and CO2 exhibit a significant level of multicollinearity. A VIF of 1.481 indicates that the economic activity variable does not exhibit significant multicollinearity. The VIF values for PPG, PTA, HDI, and INF range from 1.269 to 1.227, indicating a substantial decrease in multicollinearity. With a mean VIF of 1.531 across all variables, we can see that multicollinearity is moderate. The inverse of VIF, shown as 1/VIF, suggests that non-collinearity-related factors account for a significant portion of the variability in the regression coefficient estimate.

To determine whether heteroskedasticity exists, the Breusch-Pagan test looks at the relationship between the independent variables and the squared residuals. To guarantee that parameter estimations and hypothesis testing are accurate and reliable, this is a crucial step. Autocorrelation and serial correlation in residuals, especially in panel or time-series datasets, are the targets of the Wooldridge test. The best modeling approaches can be identified only when autocorrelation has been identified. You may learn a lot about the complicated impacts of variables in various contexts by assessing slope heterogeneity, which entails looking at whether the relationship between the independent and dependent variables changes among different groups. The findings of the diagnostic tests, which include an exhaustive investigation of potential concerns, are shown in Table 4.

Table 4: Diagnostic Test

Test for heteroskedasticity		
chi2(1) = 4.58		
Prob > chi2 = 0.2364		
Examination for autocorrelation		
H_0: no chief order autocorrelation		
F(1,7) = 8827.287		
Prob > F = 0.0001		
Slope heterogeneity		
H_0: slope coefficients are homogenous		
	Delta	p-value
	6.346	0.001
Adj.	8.134	0.001

Significant insights into the regression model are provided by the diagnostic tests described in Table 4. To disprove the constant variance null hypothesis, we may use the heteroskedasticity test, which looks at the fitted values of lngdp to see whether the error components are normally distributed. Heteroskedasticity is present in the model, as this indicates. Substantial evidence is shown against the null hypothesis of no first-order autocorrelation by the statistical test employed to measure autocorrelation. The residuals exhibit autocorrelation, as seen below.

Additionally, the null hypothesis of constant slope coefficients is rejected when the evaluation of slope heterogeneity is conducted using Blomquist and Westerlund's methods. This discovery strongly supports slope variability. For regression analysis to be robust and reliable, the findings show that

autocorrelation, slope heterogeneity, and heteroskedasticity must be addressed.
In panel data or cross-sectional time-series data, cross-sectional dependency (CD) occurs when there is an unequal distribution of interdependent behaviors across observations within the same entity or period. This indicates that the observations inside a certain cross-sectional unit have interconnected features. Biassed parameter estimates and erroneous conclusions may occur from violations of independence assumptions. The CD test results are in Table 5.

Table 5: Cross Sectional Independence

Variable	Cd test	p-value	average joint T	mean ρ	mean abs(ρ)
Gdp	21.542	0.001	25	0.83	0.82
Rec	18.72	0.001	25	0.79	0.79
co2	11.435	0.001	25	0.85	0.85
Ppg	2.587	0.001	25	0.17	0.38
Pta	1.636	0.009	25	0.12	0.17
Inf	1.289	0.023	25	0.07	0.18
Fdi	1.506	0.013	25	0.12	0.27
Hdi	13.636	0.001	25	0.68	0.68

A number of characteristics' cross-sectional independence are thoroughly examined in Table 5. There is a high level of interdependence among the variables that were considered since the Cd statistical test findings and corresponding p-values disprove the hypothesis of cross-sectional independence on several occasions. Gdp, REC, CO2, PPG, PTA, INF, FDI, and HDI are some of the factors. To address cross-sectional dependency in the evaluation of these variables, a comprehensive study and modification are required in response to the continual rejection of independence. The significant presence of cross-sectional dependency is shown by the averaged joint T values and mean ρ statistics. To acquire relevant statistical findings within the context of the dataset, it is necessary to handle this problem.

Panel seasonal augmented dickey-fuller (PSADF) and cross-sectionally enhanced IPS (CIPS) are two advanced unit root tests developed for panel data analysis. In the IPS (Im, Pesaran, and Shin) test, CIPS uses lag values of the dependent variable for each cross-section to lessen cross-sectional dependency. Assuming a cross-sectional correlation among the units of the panel makes this expansion even more advantageous. The PSADF test improves upon the ADF (Augmented Dickey-Fuller) test by using lagged changes of the dependent variable to account for seasonality in panel data. Improved assessments of stationarity in variables affected by cross-sectional dependency or seasonality among the panel units are the goal of both approaches, which seek to address the shortcomings of classic unit root tests in panel settings.

Table 6: CIPS and PSADF

	CIPS		PSADF	
Variables	Level	1st Difference	level	1st Difference
lngdp	-0.187	-1.325	-0.629	-1.894***
lnrec	-1.782***	-2.758***	1.129	-1.595**
lnco2	-2.755	-2.723***	-1.754	-2.012***
lnppg	-1.866	-1.508***	-1.555	-1.745***
lnpta	-2.686	-1.568 ***	-1.379	-1.932

lninf	-2.895***	-3.563***	-2.157***	-2.287***
lnfdi	-1.569***	-2.543***	-1.284	-3.425***
lnhdi	-1.708***	-2.597***	-2.782***	-1.331**

Note: ***, ** and * stand for the 1%, 5% and 10% significance level.

Table 6 displays the results of the CIPS and PSADF tests, which give important information on the variables in their original and different forms. According to CIPS, there is no statistical stationarity at the level of the economic metrics GDP, CO2, PPG, and PTA. At some point, REC, INF, FDI, and HDI all show the same characteristics. It must be noted, nevertheless, that all variables, with the exception of GDP, first display stagnant behavior. The PSADF framework shows that INF and HDI both have zero means and steady level fluctuation. All components except the PTA show non-stationarity when evaluating the initial discrepancy.

Panel data were used in the research to create random effects regression models, which accounted for unobserved individual-specific effects. These models take into account the fact that every item in the dataset has its own distinct, unobserved properties that impact the dependent variable. By using fixed effects and random effects, respectively, random effects models state that there is no correlation between time-invariant individual-specific effects and unobserved time-varying effects. The model accounts for both within-individual and across-individual variation, making it efficient and adaptive with imbalanced panel data. Generalized Linear Models (GLM) or Restricted Maximum Likelihood (RML) are used to evaluate the variance of individual-specific effects. By looking at how different individuals affect the independent variables, the Hausman test finds the random effects models. Table 5 shows the outcomes of the research that used random effects.

Table 7: Random Effect

GDP	Coefficient	Std. Err.	z	p>z
REC	-0.039197	0.0054152	-5.24	0.001
CO2	-0.526027	0.162934	-1.12	0.022
PPG	-0.62966	0.2329626	-2.57	0.001
PTA	0.0011376	0.0001129	11.63	0.001
INF	0.24385	0.149954	2.74	0.278
FDI	-0.444535	0.1624154	-1.94	0.001
HDI	0.7812777	0.7446099	1.25	0.292

Table 7 displays the results of the Random Effects model, which shed light on the relationships between various variables and GDP. Correlations between GDP and REC, CO2, PPG, PTA, and FDI are statistically significant, and their p-values are as low as they go. There may be strong relationships between a number of variables that have a major impact on gross domestic product (GDP), such as increased economic activity, lower carbon emissions, decreased primary energy production per capita, increased primary energy consumption overall, and reduced FDI. At the standard level of significance, the research found no statistically significant relationship between INF and GDP. Similarly, there is no statistically significant correlation between HDI and GDP. These results provide light on the complex interrelationships that influence GDP in the context of the random effects model.

Cointegrated time series, which indicate variables with a common stochastic trend, are analyzed using the econometric approach known as Fully Modified Ordinary Least Squares (FMOLS). When assessing long-term interactions, FMOLS is especially useful for reducing biases and endogeneity problems. A key feature of the FMOLS approach is the use of lags in the dependent variable's values and other relevant factors to alter the ordinary least squares (OLS) estimate significantly. To deal with heteroscedasticity in the error term, this method employs weighted least squares. This approach uses statistical inference based on asymptotic theory.

Table 8: FMOLS

lngdp	Coefficient	Std. err.	z	p>z
rec	-0.06922	0.023428	-20.13	0.001
Co2	-2.44455	0.214484	-11.5	0.001
PPG	-2.16519	0.114613	-21.52	0.001
PTA	9.15E-15	7.68E-16	11.79	0.001
INF	0.219215	0.114925	2.55	0.011
FDI	-0.27291	0.124337	-1.29	0.197
HDI	-3.33375	0.541475	-6.15	0.001
linear	-0.15392	0.012596	-13.5	0.001
_cons	32.45436	0.655965	49.58	0.001

Several parameters and lngdp are shown to be significantly related to the regression findings. Increased economic activity, decreased CO2 emissions, decreased PPG, and PTA are among the other variables that correlate significantly with GDP fluctuations. Strong coefficients corroborate the associations. Statistical evidence shows that INF and GDP are positively correlated. Still, a skeptic may claim that FDI doesn't really affect GDP much. Higher levels of human development are correlated with lower levels of GDP, as seen by the negative link between the HDI and GDP. The whole model is significantly affected by the addition of a linear trend variable, which represents a huge and statistically significant decrease over time. The intercept term, which represents the predicted GDP in the absence of any predictors, is statistically very significant. By illuminating the nuanced interplay between economic, environmental, and developmental factors, the results shed light on the intricate processes impacting GDP.

Empirical data derived from regression analysis provide light on the many mechanisms impacting GDP. The complex interplay between GDP and other factors, such as environmental, developmental, and economic concerns, is elucidated in this research. When it comes to GDP, the REC variable is key. In the South Asian setting, a negative coefficient suggests that there is an adverse link between growing REC and GDP. Contrary to the commonly held view that increased economic output always results in increased resource consumption, this study's findings point to the prospect of a more sustainable or energy-efficient economic model. The study's findings are in agreement with (Suwandi, 2022), (Assi et al., 2021) and (Zhu et al., 2022).

There is notable evidence that carbon emissions and GDP are inversely related. Findings from this study point to the growing significance of environmental sustainability and provide hope for achieving economic growth while reducing environmental damage. This aligns with the practicality of low-carbon and environmentally friendly development projects as tools for boosting the economy. The findings are supported by the (Wang et al., 2022), (Kutlu and Örün, 2022) and (Li et al., 2023).
We need to go towards energy efficiency since the association between PPG and GDP shows it has a negative impact. Energy conservation and efficiency measures are necessary to boost economic development since there is a link between GDP growth and a decline in primary energy production per capita. The relationship between GDP and PTA is positive and statistically significant. An uptick in patents is positively associated with higher rates of economic production. The article draws attention to

the importance of energy in driving economic development, which raises questions about how this expansion can be sustained in the face of global efforts to conserve energy. In support of the results, the (Oyebanji et al., 2022), (Aziz and Khan, 2022) and (Hu et al., 2021).

It is reasonable to assume that rising demand is the engine that propels economic development, given the established association between GDP and inflation. It would seem that higher inflation is a byproduct of more robust economic activity and more consumer spending, which in turn boosts overall economic production. Contrarily, there is a lack of substantial evidence in the present study suggesting that FDI has a substantial impact on GDP. Results like these call for more research into the many factors—including FDI features, sector-specific dynamics, and the macroeconomic climate—that influence the effects of FDI. This finding is in agreement with (Akter, Fouzia.; Smith, 2021), (Salamai et al., 2022) and (Ullah et al., 2020).

Notable is the discovery of an inverse relationship between HDI and GDP. High levels of human development, as measured by better social and human indicators, are inversely correlated with GDP. This claim makes one wonder how countries with high human development indices vary economically and why they place such a premium on factors other than GDP growth. By factoring in a decreasing linear trend over time, the study takes on a more temporal dimension, highlighting the need to consider shifting dynamics when trying to understand economic patterns.

The results of the regression analysis shed light on the intricate web of relationships between GDP and environmental, developmental, and economic factors. Policymakers seeking balanced economic development, environmental preservation, and social progress might take heart from these findings, which deepen our understanding of the elements impacting economic growth. If researchers are serious about promoting sustainable and fair economic development, they need to go further into the discovered subtle connections, analyze the underlying causal mechanisms, and provide policy solutions.

5. Conclusion and Policy Implication

This research investigates the impact of sustainable development and environmental regulation on economic growth in South Asian nations. This part wraps up the topic covered in the previous chapter. The overarching goal of this study is to study how sustainable development and environmental laws have affected GDP growth in Asian countries. Economic development is favorably correlated with environmental legislation. Sustainable development and increased economic growth have an inverse relationship.

There are several policy consequences of this research. The consistent bidirectional relationship between GDP and energy consumption from renewable and nonrenewable sources demonstrates the critical need for an adequate energy supply for Asian nations to achieve substantial economic development. To guarantee an adequate supply of all energy sources in South Asia, the government must adopt strategies for the short-term, medium-term, and long-term.

South Asian countries place equal importance on environmental and economic outlooks. We will keep using the same amount of electricity as before. Although renewable energy helps reduce the issue of increasing CO_2 emissions from traditional power plants, the analysis uses FMOLS, and the unit root test is satisfactory. Energy use eventually leads to less CO2 emissions. Human development index (HDI) data from developed countries shows that faster economic growth is associated with higher HDI values. Alternative energy sources are associated with rising economic levels. Both the immediate and distant effects of switching to renewable energy sources on emissions of carbon dioxide are causal. However, in a developing nation like Pakistan, technical progress may temporarily affect HDI and whatever progress is made. The study lays out several policy implications that arise from the interaction of the components mentioned before. Pakistan needs a reliable energy source to boost its economic development because of the persistent negative association between GDP and energy consumption. This holds for both renewable and nonrenewable sources of energy. To ensure a consistent supply of various energy types, the South Asian government has to implement measures for the short, medium, and long term.

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