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RESEARCH PAPER

Impact of Environmental Degradation, Energy, and FDI on Growth: Panel Analysis of South Asian Economies

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ABSTRACT

Environmental degradation, energy consumption, and FDI exert impetus effects on growth. This study is aimed to explore the impact of environmental degradation, energy, and FDI on growth of South Asia economies. The study has applied one step System Generalized Method of Moment (SGMM) on panel data during the period 2010-2023. Diagnostic tests entail that all the basic assumptions of the Classical Linear Regression Model are satisfied. The result of the Sargon test authenticates that the instruments are good. Findings show the encouraging impact of energy and FDI on growth, whereas, environmental degradation has adverse effect on growth of South Asian economies. The study suggests that South Asian countries should ensure foreign direct investment, increase the usage of advanced technology for energy purposes, as well as, explore the wide-ranging policy implications that would encourage an increase in demand for improved environmental quality which will ultimately, ensure the accelerated economic growth.

Introduction

Environmental degradation increased from 21bn tons in 1990 to 29.4bn in 2008, which was approximately a 40% increase during the said time span across the World (Ghandoor, 2013). During the year 2012, CO_2 emissions in Pakistan were 0.938 metric tons which rose to 0.98 metric tons in 2018, in India, it was 1.906 metric tons which has risen to 1.99 metric tons in 2018, in Bangladesh, it was 0.395 metric tons which have risen to 0.57 metric tons in 2018, in Nepal, it was 0.138 metric tons which have risen to 0.36 metric tons in 2018 and in Sri Lanka, it was 0.630 metric tons which has risen to 0.93 metric tons in 2018 (WDI, 2018). Furthermore, it is claimed that if authorities do not implement necessary measures to reduce CO_2emissions, it will be twice in 2035 (Tiwari, 2011). In such an alarming situation, most of the advanced countries of the world have decided to reduce their CO_2emissions significantly up to 2020 (Kojima and Bacon, 2009).

The fundamental affiliation amid energy consumption and growth has been considered for over eras. In all kingdoms, energy has been one of the substantial aspects of economic development and has played a central role in economic activities. Both, economic growth as well as energy consumption are considered to be equally purposeful, for higher economic growth, intensive energy consumption is required. Similarly, more intensive energy usage requires to an advanced level of growth (Omri and Kahouli, 2013). Ozturk and Acaravci (2010) explored a causal link between energy usage and economic growth and have found two-way causality concerning the energy and growth of Hungary. However, Belloumi (2009) applied VECM and displayed that in

Tunisia, there was a contributing rapport between energy consumption and income during 1971-2004. Hermes and Lensink (2003) stated that foreign direct investment exerts a vital part in promoting growth. If foreign depositors adopt forward-looking technologies for manufacturing development then FDI prevents environmental destruction due to the use of energy-intensive equipment. South Asian countries depend on economically developed countries for financial support in order to achieve economic stability. There is extensive trust that FDI accelerates the production of nations and encourages growth. FDI could not only offer direct investment but also generate helpful externalities through the implementation of external machinery and knowledge. The connection among FDI and CO_2 through energy consumption is discoursed in numerous readings in prevailing literature but the effects are unconvincing. An increase in environmental degradation is a most essential risk of the atmosphere change which has been considered as a most important ongoing concern of emerging and developed economies. The interconnection between ecological impurity, energy use, and economic growth are the issue of extensive hypothetical research during the past few years. The leading object for reading carbon emissions plays a central role in recent discussions on environmental safety. Economic growth has been thoroughly related to energy consumption, meanwhile, higher energy consumption indicates a higher level of growth. Since the last thirty years, impact of environmental degradation, energy usage and FDI on development has become a burning issue for both developing and developed countries of the World and South Asian economies have no exception on this behalf. This research work intends to investigate the effect of environmental destruction, energy consumption, and FDI on economic growth of South Asian economies i.e., Pakistan, Bangladesh Sri Lanka, India and Nepal. This research work may be worth contributing to the literature of economics, as well as, to the researchers, policymakers, and authorities of South Asian economies. The next section of the study provides a review of the literature. Section 3 presents econometric modeling and data sources. Section 4 provides empirical results and interpretations. Section 5 will present the conclusions and policy implications.

Literature Review

Lee (2013) investigated the influences of FDI on clean energy usage, carbon emissions, and growth. The study has used co-integration to observe long-run equilibrium affiliation among these variables, and a fixed effect model to check the extent of FDI through which it helps the other variables. The study considered panel of nineteen countries of G20, since the period 1971 to 2009. The grades specify that FDI is a crucial factor for the economic growth of G20 while it restricts its impacts on environmental degradation in these economies. The study discovers no convincing suggestion of FDI linkage with energy consumption. The study has suggested FDI's possible role in attaining green growth goals.

Gokmenoglu and Taspinar (2015) analyzed the connection between CO2 emission, consumption of energy, economic growth, and FDI in Turkey over the period 1974 to 2010. Long-run association amongst environmental degradation, energy, growth, and FDI was discovered by applying the bond test. The ECM suggested that CO_2 emission join to long-run equilibrium level 0f 49.2% quickness of amendment each year with the involvement of energy consumptions, CO2 emission, growth, and foreign direct investment and completed with Environmental Kuznets curve. The consequence displays that by implying the Toda-Yamamoto causality test CO2 emission, energy, and FDI have a two-way causality association, but there were one-way causality relations

from growth. Investigators' findings provided evidence of the validity of environmental degradation has been hypothesized for the EKC in Turkey.

Bakhsh et al. (2016) found the impact of FDI on CO2 emission and growth. Annual data was used to find the elements of FDI inflows in Pakistan during the period of 1980-2014 by using 3SLS. To discover the connection among the variables the simultaneous equation model was used. Results from procedure and arrangement showed that an increase in economic growth indicated the extra pollution emission. The capital accumulation effect presented the positive effect of foreign direct investment on growth while pollution had a negative influence on growth in Pakistan. FDI also had a positive relation with pollution. Investigator offered policy implications to control pollution mostly linked with foreign direct investment in Pakistan.

Darwin et al. (2022) have explored linkages amid energy, foreign direct investment, and growth for 21 developing economies in Asian region by applying the dynamic Generalized Method of Moment (GMM) on panel data during 2005 to 2019. Findings of the study indicated that FDI and energy were positively raising the growth. Poverty and interest rates were reducing the economic growth of selected under developed economies of Asian region. The study has suggested the policy recommendations to increase the economic growth of Asian developing countries.

Many studies have evaluated the association among energy consumption and growth and presented contradictory findings regarding the association among these variables (Al-mulali and Sab, 2012; Apergis and Payne, 2009). Acharyya (2009) investigated the two vital benefits and costs of foreign direct investment from the Indian perspective GDP growth and environmental degradation. Pao and Tsai (2010) reported the influence of both growth and financial development on environmental degradation. Omri and Kahouli (2013) analyzed the nexus between FDI, energy and growth by using the forceful panel data of simultaneous equations for a worldwide panel containing 65 economies during the period 1990-2011. Darwin et al. (2022) estimated the dynamic associations among energy, foreign direct investment, and growth of 21 under developed economies in Asian Region. Many studies have explored the association between environment, energy, and growth (Haseeb et al., 2018; Khan et al., 2021; Nasreen et al., 2017; Omri, 2013; Rehman and Ahmed, 2019; Salahuddin and Gow, 2014; Saidi and Hammami, 2015). Khan et al. (2021) have also estimated the influence of environmental degradation and energy consumption on growth in Pakistan. Findings derived from these studies are found to be heterogeneous across the countries as well as across the various regions of the World. The heterogeneity of the findings across these studies entails that it is not possible to draw a definitive conclusion regarding the effect of energy and environmental degradation on growth. It is evident from the literature that only a few empirical studies (Lee, 2013; Gokmenoglu and Taspinar, 2015; and Muhammad and Khan, 2019) have examined the association between growth, CO2 emissions, energy, foreign direct investment and economic growth. None of the earlier studies has applied a step System Generalized Method of Moment (SGMM) to explore the impact of environmental degradation, FDI, and energy consumption on economic growth in South Asian economies. This research intends to fill this gap and would be worth contributing to the literature on economics.

Material and Methods

The study has collected the required data from World Development Indicator (2023), and United Nations Conference on Trade and Development (2023). Panel data is

considered to be appropriate because we use data from five South Asian countries. The time limit covers a period of 14 years starting from 2010-2023.

Model Specification

This research work intends to find the impact of environmental degradation, energy, and FDI on growth in South Asia, therefore, the following model is specified:

$$GR = f\ (ENV, EC, FDI)\quad (1)$$

Construction of the econometrics model will be the transformation of model (1) which is as under:

$$GR = \beta_0 + \beta_1\ ENV + \beta_2\ EC + \beta_3\ FDI + \varepsilon_1 \quad\quad\quad (2)$$

Where β_0 represents the intercept terms of the models, and β_1, β_2, β_3, indicate the coefficients of the models, and ε_1 show the stochastic disturbance terms.

Table 1
Measurement of Variables

Variables	Full Name	Measurement	Source of Data
GR	Economic Growth	GDP per capita annual %	WDI
EC	Energy consumption	kg of oil equivalent	WDI
ENV	Environmental degradation	CO_2 emission per capita Metric tons	WDI
FDI	Foreign direct investment	FDI millions of dollars	UNCTAD

Source: World Development Indicator (2023)**.** UNCTAD (2023),

Results and Discussion

Econometric analysis is based on non-stationarity of the data because in the panel data we cannot check the stationarity. Robust least square and Hausman test are employed for this determination.

Table 2
Results of Descriptive Statistics

Variable	Observation	Mean	Std. Dev.	Min	Max
GDPPC	70	5.480286	2.007167	0.42	9.14
FDI	70	3.065298	1.00901	0.0045707	4.673043
ENV	70	0.7505857	0.4714737	0.1	1.99
EC	70	2.485743	0.270896	1.999435	2.58459

Descriptive statistics can produce observations, mean, median, maxima, minima, and standard deviation. Descriptive statistics are used for everything from early study and checking the rationality of data to removing education data and creating indicators from a domestic survey, frequencies are used for the initial analysis of a data set.

Table 3
Results of Pair Wise Correlation

	GDPPC	FDI	ENV	EC
GDPPC	1.0000			
FDI	0.3490	1.0000		

ENV	0.2621	0.8444	1.0000	
EC	0.2256	0.1186	0.2790	1.0000

Table 3 indicates the pair-wise correlations matrix of all four variables and presents the summary statistics of the panel data. FDI is positively related to growth and the value of correlation is 0.3490, environmental degradation has positive association with growth and the value of the correlation is 0.2621, and energy is positively related to growth and value of the correlation is 0.2256.

Table 4
Results of Multicollinearity

Variable	VIF	1/VIF
ENV	3.98	0.251389
FDI	3.70	0.270183
EC	1.16	0.863650
Mean	2.95	

Table 4 shows the result of the Variance Inflationary Factor (VIF) test and Tolerance (Tol) test which authenticate that multicollinearity is not found in the model because VIF < 10.

Table 5
Results of Heteroscedasticity

Arellano-Bond AR(1)	…	
Arellano-Bond AR(2)	0.116	No Autocorrelation
Breusch-Pagan	0.8388	No Heteroscedasticity

To check the Heteroscedasticity, Breusch-Pagan, and Arellano-Bond AR(2) tests are applied for the robustness. The results of these tests indicate that there is no Heteroscedasticity in a regression model.

Table 6
Results of One Step System GMM

Sample Size	2010-2023		
Dependent Variable GDPPC			
Independent Variables	Coefficient	P-value	Std. Err
FDI	1.474504	0.004	0.5093471
ENV	-1.851556	0.058	0.9785377
EC	2.018343	0.016	0.8348204
Constant	-2.616934	0.263	2.33761
Wald Chi^2 (3)	824.13		
Prob> Chi^2	0.000		
Sargent Test	0.036		

Discussion

Results given in table 6 indicate that environmental degradation has negative connection with growth which means that higher economic growth can only be achieved at the cost of more environmental deterioration, reflecting the negative range of the environmental Kuznet's curve (EKC) hypothesis in which developing economies can accelerate economic growth by affording the environmental losses. This result is identical to the results derived by many studies e.gAcharyya (2009) for India, Tasi and Pao (2010) for BRICS countries, Al-Mulali and Sab (2012) for MENA countries, Lee (2013) for European countries, Saidi and Hammami (2015) for the panel of 58 countries,

Kasmanand Duman (2015) for European countries, Danlami et al. (2018) for middle-income countries, and Muhammad Khan (2019) for Asian countries, and Khan et al. (2021) for the case of Pakistan, etc. The results also indicate that energy has a positive effect on growth of the selected South Asian nations which entails that accelerated economic growth of South Asian nations depends upon more utilization of the energy resources. This result is identical to the results derived by many studies e.gDanlami et al., 2018; Safdar et al., 2019; Muhammad & Khan, 2019; Khan et al., 2021; and Darwani et al., 2022). FDI has a positive impact on growth which entails that as FDI increases it results in a higher level of economic growth in South Asian countries. This result is matched with the results derived by (Acharyya, 2009; Danlami, 2018; Muhammad & Khan, 2019; and Darwani et al., 2022) which reported the positive impact of FDI on growth.

Conclusion

The study has focused on exploring the effect of environmental degradation, FDI, and energy on the growth of South Asian economies. The study has applied one step System Generalized Method of Moment (SGMM) from 2010 to 2023. The results reveal that FDI and energy consumption have a positive influence on growth of South Asia, indicating that an increase in FDI and energy consumption enhances the economic growth of South Asia. Environmental degradation exerts a negative influence on growth which indicates that a rise in environmental degradation may cause to shrink the level of economic growth in South Asia.

Recommendations

- Firstly, environmental degradation exerts negative effect on growth, so, there is dire need to address this core issue. Therefore, South Asian economies ought to adopt advanced technology and clean energy in order to reduce environmental deprivation.
- Secondly, energy has a positive influence on growth in South Asian economies. So, it is proposed that South Asian economies should make well-organized and active strategies and use advanced energy resources e.g. wind energy, solar energy, and geothermal energy.
- Third, FDI exerts a positive effect on growth, therefore, it may be recommended that South Asian economies have to inspire foreign direct investment to improve the economy as well as to restore the trust of foreign countries in South Asia.

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