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Nexus of Renewable Energy Consumption, Economic Growth, Population Growth, FDI, and Environmental Degradation in South Asian Countries: New Evidence from Driscoll-Kraay Standard Error Approach

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ABSTRACT

Environmental degradation is the most prominent area nowadays, especially in developing counties where high renewable energy consumption and population growth deteriorate the atmosphere of the country. Thus, the current study investigates the nexus among renewable energy consumption, economic growth (EG), population growth, foreign direct investment (FDI), and environmental degradation in South Asian countries. The covariance matrix estimators that are developed by "Driscoll and Kraay" are used in this study. The primary property of this estimator is that it does not account for the cross-sectional dependence; thus, it provides substantial, robust outcomes among the cross-sectional units while in the presence of cross-sectional dependence. The data was collected from the World Development Indicators (WDI) from 2001 to 2019. The findings exposed that positive nexus among the population growth, FDI, and environmental degradation while renewable energy consumption and EG has negative nexus with environmental degradation and also not supported the EKC hypothesis in South Asian countries. These findings suggested that the regulators should develop policies that reduce environmental degradation in the presence of high EG, energy consumption, FDI, and population growth.

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1. Introduction

Currently, carbon emissions (CO_2) and high renewable energy consumption (REC) are the prominent factors of environmental degradation (ED), especially in developing countries of the globe. In addition, globalization also affects human beings socially, politically, and economically around the globe. It promotes the relationships among the different economies to expand the trading and investment flows to attain high EG by using the high amount of energy that has adverse effects on the atmosphere (Chien, Sadiq, Nawaz, et al., 2021a; Waqih, Bhutto, Ghumro, Kumar, & Salam, 2019). A study conducted by Shahbaz, Mahalik, Shah, and Sato (2016) argued that the globalization process is growing between different countries, indorsing competition among underdeveloped and developed countries. Thus, the economies around the globe are now involved in competition and globalization, which is why economies are closely connected with each other socially, politically, and economically. Currently, the focus of developing countries is on improving EG with the help of a high level of economic activities to eradicate poverty in the country. They are espousing the differentiation strategies to gain the competitive advantages that help them expand trade and EG. In addition, the urbanization and industrialization process can also eradicate poverty in the country (Zhuang et al., 2021). Without these processes, reducing poverty is a difficult task both locally and globally (Schandl et al., 2016). Poverty elimination is the primary task of almost all of the developing countries around the globe, and to achieve this task, countries need to increase the economic activities and trade that enhance the EG and REC, resultantly increase the CO_2 (Baloch et al., 2021; Nawaz, Seshadri, et al., 2021). Hence, globalization, competition, and poverty elimination goals have badly affected environmental quality, such as reducing minerals and global warming (Chien, Kamran, et al., 2021; Shahbaz, Khan, Ali, & Bhattacharya, 2017).

In developing countries, population growth is increasing dramatically, increasing the need for products and services. Increasing population is one of the prominent factors of poverty around the globe, and developing countries are poorly affected due to the poverty that results from the high population (Chien, Pantamee, et al., 2021; Sabir, Qayyum, & Majeed, 2020; Yang & Shafiq, 2020). The requirement of products and services due to population growth and elimination of poverty is increasing that needs to consume a high level of energy to EG. Hence, the high population is one of the vital factors of high REC that severely affected the country's atmosphere. Moreover, these factors move the economies from the agriculture sector towards the industrial sector, increasing REC and carbon emissions (Chien, Hsu, Zhang, Vu, & Nawaz, 2021; Chien, Sadiq, Kamran, et al., 2021; Jun et al., 2021). In addition, the financial sector also plays a vital role in the EG in both developed and developing countries. A well-developed finance system boosts the stock market, attracts investors, and enhances economic activities (Chien, Sadiq, Nawaz, et al., 2021b; Hussain, Mosa, & Omran, 2017). Moreover, a well-managed financial system also attracts FDI and boost the economy of the country that needs more energy resources, resultantly damaged the environment of the country (Li et al., 2021; Mohsin, Kamran, Nawaz, Hussain, & Dahri, 2021; Muhammad, Khan, Khan, & Khan, 2021; Shafiq, Hua, Bhatti, & Gillani, 2021).

The financial development (FD), EG leads the countries towards the high REC, which is the primary reason for high carbon emissions. Figure 1 given below highlighted the CO_2 per capita and energy consumption (EC) of the world. Increasing trends have been observed in both energy consumption and CO_2 of the world. The energy consumption was only 48 gigajoules per capita in 1965 and after continues increased and reached 73 gigajoules per capita in 2010. On the other hand, carbon emissions were only 48 metric tons per person in 1965 and after continues increased and reached 64 metric tons per person in 2010. Figure 1 regarding world per capita EC and CO_2 are given below:

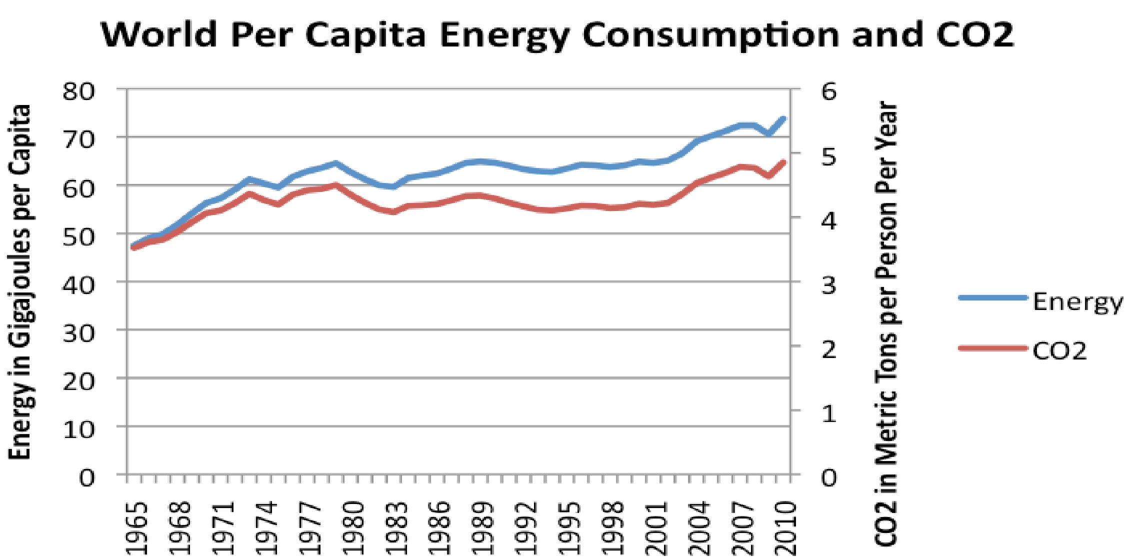

Figure 1: ***World per Capita EC and CO_2***

Specifically, the CO_2 regarding all the continents are also mentioned below in Figure 2. The statistics show that Asia is at the top regarding the carbon emissions in the world, with 16gigaton CO_2 in 2017 that was only 1gigaton in 1960. In addition, other continents are below 7gigaton carbon emission in 2017 such as North America has 6.5gigaton, Europe has 6gigaton, the Middle East has 3gigaton while South America and Africa have 2gigaton and Oceania has only 1gigaton. Figure 2 given below mentioned the carbon emissions of all the continents.

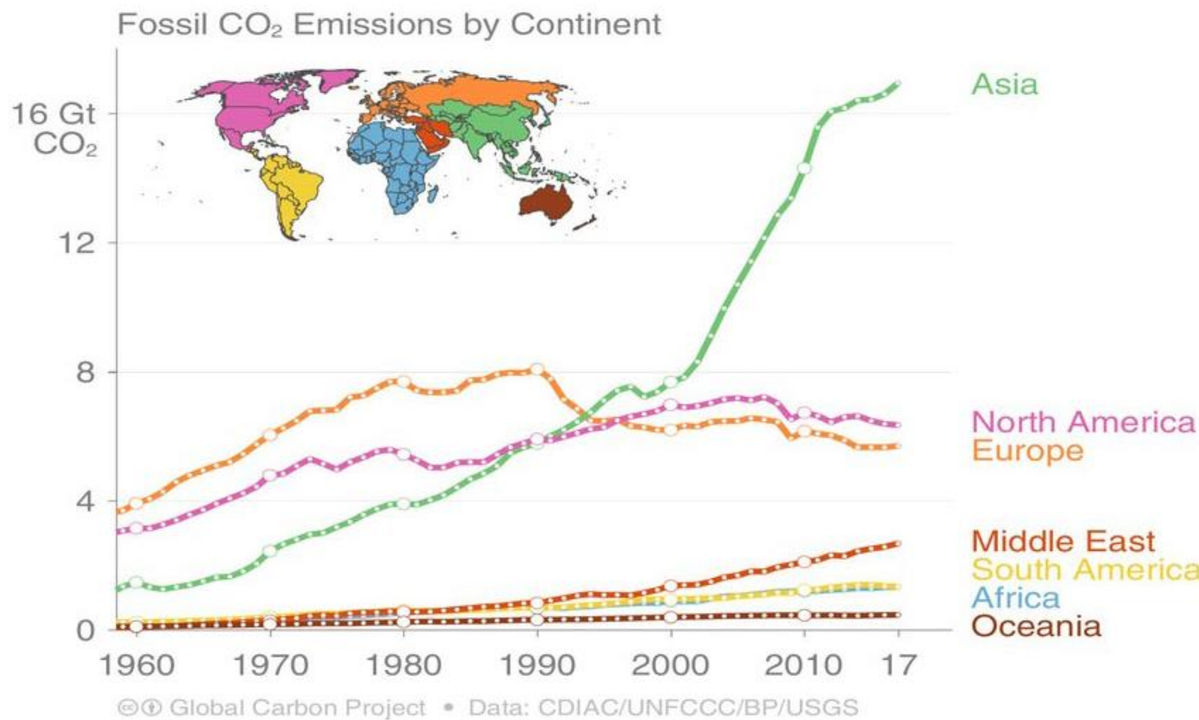

Figure 2: ***Carbon Emissions by Continent***

Thus, the above scenario indicated that Asian countries have more population than the other continents, and excessive needs of products require high REC, resulting in high carbon emissions. More specifically, South Asian countries such as Pakistan, India, Srilanka, Afghanistan, Bangladesh, Bhutan, Maldives, and Nepal have more populated countries than other countries in Asia and have FDI and EG that enhance the use of renewable energy consequently it may damage the atmosphere. Hence, this study considers South Asian countries and examines the effects of REC, EG, population growth, and FDI on environmental degradation.

The remaining sections are as follows: Section two comprises the literature review about the variables and their relationships, while section three comprises the research methods, data, and measurements of variables. The fourth section of the study comprises the study's findings, while the last section deals with discussions and conclusions of the study along with limitations and recommendations.

2. Literature Review

Over the past three decades, the significant growth of the economy has been experienced due to massive REC around the globe. The growing demand for EG and energy with the increase in population leads to atmosphere degradation (Bhatti & Fazal, 2020; Nawaz, Hussain, et al., 2021; Shair, Shaorong, Kamran, Hussain, & Nawaz, 2021; Sun et al., 2020). In addition, Hanif (2018) established nexus among the EG, REC, and CO_2 and elucidated that the EG goals has been achieved with immense REC that persuades the carbon emissions, which was the primary cause of atmosphere degradation. Later on, a study conducted by Emir and Bekun (2019) claimed that it is very difficult to attain the development of the economy without global emissions and climate change. Thus, several studies have discussed the nexus between the environmental quality and the EG in the existence of the "Environmental Kuznets Curve (EKC)" hypothesis. Moreover, this hypothesis postulates that in the early stages, growth in the economy increases the CO_2, however later on, with the increase in EG, the goals of per-capita income threshold has been achieved while further growth in the economy begins to alleviate the CO_2 consequently U-shaped nexus occurs among the CO_2 and EG. In addition, Grossman and Krueger (1991) firstly introduced the inverted U-shaped nexus among CO_2 (environmental quality) and EG. Later on, several researchers have used the EKC hypothesis by including various variables such as EC, urbanization, CO_2, globalization, and EG in different countries.

For instance, a study conducted by Shahbaz, Solarin, Sbia, and Bibi (2015) investigated the effects of EG and EC on the ED in Tunisia by using the ARDL and VECM approach from 1971 to 2010. They exposed that EG needs high energy usage that leads the economy towards the carbon emissions that severely affect the atmosphere. In addition, inverted U-shaped nexus also occurs among the EG and CO_2. Moreover, Pao and Tsai (2010) conducted the study on the nexus between the EG, usage of energy, and CO_2 emissions in BRICS nations. They found that EG and usage of high energy are the major elements of CO_2 emissions, while CO_2 emissions begin to reduce after attain the threshold level of EG that validate the EKC nexus (Nawaz, Ahmadk, Hussain, & Bhatti, 2020). However, Jaunky (2011) investigated the nexus among the income and CO_2 emissions in thirty-six high-income countries for the year 1980 to 2005 by employing VECM and GMM approaches and exposed the validation of EKC in various countries such as the UK, Oman, Malaysia, Greece, and Portugal. In conflict to studies mentioned above, a study undertaken by Saboori and Sulaiman (2013) inspected the nexus among the energy consumption and CO_2 emissions during 1980 to 2009 and found validation of EKC by using disaggregated energy but on the other hand no indication was found regarding EKC among the development of economy and CO_2 emissions per capita by employing the aggregated energy (Fazal, Gillani, Amjad, & Haider, 2020).

Likewise, Furuoka (2015) examined the nexus among the CO_2 emissions and the EG in the existence of EKC and exposed no indication about the EKC among the CO_2 emissions and the development of the economy per capita. In addition, several pieces of literature have recently focused on the EKC hypothesis and the effects of FD by using various econometrics techniques with panel and time-series data. A study by Javid and Sharif (2016) inspected the effects of energy usage, GDP, EG, and FD on the CO_2 emissions in Pakistan from 1972 to 2013 by using the ARDL approach. They uncovered that improvement in the GDP, EG, and FD increase the usage of energy that boost up the carbon emissions however after attain the threshold level, it reduce the carbon emissions that shows validation of EKC hypothesis. Similarly, Solarin, Al-Mulali, Musah, and Ozturk (2017) conducted the study on Ghana for the year 1980 to 2012 by using urban population and found that carbon emissions increases with the increase in urban population. In addition, Tamazian, Chousa, and Vadlamannati (2009) inspected the nexus among the economy, FD, and CO_2 emissions in BRIC countries from 1992 to 2004 and found that development of economy, FD both are the foremost elements of carbon emissions (Noshad, Amjad, Shafiq, & Gillani, 2019). They also exposed that FD reduces the CO_2 emission and stabilized the FD that validates the "EKC hypothesis".

In addition, Pao and Tsai (2011) also exposed the same findings in Brazil from 1980 to 2007 by using various econometrics techniques such as panel unit root and Pedroni co-integration. Similarly, Shahbaz, Solarin, Mahmood, and Arouri (2013) investigated the effects of growth and development of the economy on the CO_2 emissions in South Africa by employing ECM and ARDL approaches from 1965 to 2008. They exposed that the economy's growth boosts the CO2 emissions while FD reduces the CO_2 emissions and testify the "EKC hypothesis". Furthermore, Dogan and Turkekul (2016) examined the nexus between the energy usage, real income, and economic development on the CO_2 emissions in OECD nations from 1975 to 2011 by employing various panel techniques and exposed EKC in OECD nations of the globe. Moreover, Ozturk and Acaravci (2013) exposed the insignificant nexus among the development of Turkey's finance and CO2 emissions from 1960 to 2007 and validated the EKC hypothesis. However, Farhani and Ozturk (2015) discovered the causality nexus between development of finance, urbanization, CO_2 emissions, and usage of energy in the existence of EKC during 1971 to 2012 in Tunisia by using ECM and ARDL approaches and exposed no validation of EKC while all variable has a positive association with CO_2 emissions. In addition, Dogan and Turkekul (2016) exposed the same findings in the USA from 1960 to 2010 by using the ARDL approach, but no effect has been observed in CO_2 emissions due to FD.

However, the literature on the nexus among the economy's growth, population growth, FDI, and usage of renewable energy on the CO2 emissions are inadequate. By reviewing the various studies on economic energy, it is now clear that several studies on the nexus between the development and EG, energy usage, and CO2 emissions. For instance, Shahbaz, Ozturk, Afza, and Ali (2013) explore the effects of economic and energy intensity growth while in the existence of EKC from 1970 to 2010 in Turkey by using the ARDL approach. They found the growth of economy and energy intensity enhanced the CO_2 emissions and validated the EKC. In addition, the same findings have been found by Shahbaz et al. (2017) from 1970 to 2012 in China and found globalization decreased the CO_2 emissions in the existence of EKC. Likewise, Shahbaz, Loganathan, Zeshan, and Zaman (2015) also support EKC by adding energy usage and EG and development in India from 1970 to 2012 by using VECM co-integration approaches. They also exposed that energy usage and EG and development enhance the CO_2 emissions.

Thus, previous literature examined the nexus between usage of energy, EG and development, and CO_2 emissions in the context of panel countries as well as an individual country, In addition, numerous literature has been seen on the link among the globalization and ED in various countries however less attention has been paid on the nexus between REC, EG, population growth, FDI, and ED. Furthermore, previous studies used the VECM, IPS, GMM, ARDL, and LLC approaches, which shows less attention has been paid to the robust standard error technique that fixes the effects of "heterogeneity" and "cross-sectional dependence". Thus, this study examines the nexus between the REC, EG, population growth, FDI, and ED by employing the "Driscoll and Kraay Standard Error" technique.

3. Research Methods

The prime aim is to investigate the nexus among REC, EG, population growth, FDI, and ED in South Asian countries such as India, Afghanistan, Bhutan, Bangladesh, Maldives, Pakistan, Nepal, and Sri Lanka. The data was collected from the WDI from 2001 to 2019. The covariance matrix estimators developed by "Driscoll and Kraay Standard Error" are used in this study. Thus the current study develops the following equation:

$$CO2_{it} = \alpha_0 + \beta_1 REC_{it} + \beta_2 GDP_{it} + \beta_3 GDP2_{it} + \beta_4 PG_{it} + \beta_5 FDI_{it} + e_{it} \quad \textbf{(1)}$$

Where
i = Country
t = time period
CO_2 = Carbon emissions
REC = Renewable Energy Consumption
GDP = Gross Domestic Product
PG = Population Growth
FDI = Foreign Direct Investment

The first assumption is multicollinearity, which means no highly correlation among the constructs and calculated by using the following equations:

$$R^2_Y \Longrightarrow Y_{it} = \alpha_0 + \beta_2 X_{2it} + \beta_3 X_{3it} + \beta_4 X_{4it} + \beta_5 X_{5it} + e_{it} \quad \textbf{(2)}$$

$$j = R^2_{REC}, R^2_{GDP}, R^2_{GDP2,} R^2_{PG,} R^2_{FDI} \quad \textbf{(3)}$$

$$Tolrance = 1 - R^2_j \qquad VIF = \frac{1}{Tolerance} \quad \textbf{(4)}$$

The second assumption related to normality is checked by using the Skewness and kurtosis and the estimation equations are given below:

Skewness: $\sum Ni = 1(Yi - \bar{Y})3/Ns3$ **(5)**

Kurtosis: $\sum Ni = 1(Yi - \bar{Y})4/Ns4$ **(6)**

The third and fourth assumptions related to heteroscedasticity and autocorrelation were also verified before the regression analysis using the Breusch-Pagan and Wooldridge test. The results are given in the results section.

The present article examines the suitable model with the help of the Hausman test. If the probability value of the Hausman test is less than 0.05, then the random model is suitable, and vice versa. The present study results have executed the fixed effect model (FEM) because it is appropriate for the study, and the FEM equation is given as under:

$$Y_{it} = \beta_{1i} + \beta_2 X_{2it} + \beta_3 X_{3it} + \beta_4 X_{4it} + \beta_5 X_{5it} + u_{it} \quad \textbf{(7)}$$

In the equation as mentioned above, subscript (i) shows the individual country while subscript (t) shows the time-variant. As mentioned above, FEM is appropriate, and by using current study variables, the FEM equation is developed as under:

$$CO2_{it} = \beta_{1i} + \beta_2 REC_{it} + \beta_3 GDP_{it} + \beta_4 GDP2_{it} + \beta_5 FDI_{it} + \beta_6 PG_{it} + u_{it} \quad \textbf{(8)}$$

Finally, the relationships among variables are also checked with the help of robust standard error because it adjusts the model's heterogeneity issues. Thus the equation for robust standard error with the help of current research variables is as under:

$$CO2_{it} = \beta_1 REC_{it} + \beta_2 GDP_{it} + \beta_3 GDP2_{it} + \beta_4 FDI_{it} + \beta_5 PG_{it} + \varepsilon_{it} \quad \textbf{(9)}$$

3.1. Data

The data of South Asian counties were extracted from the database such as "World Development Indicator" of World Bank. The data include the ED that is measured by "Carbon dioxide damages (% of GNI)" while REC is measured by the "percentage of total energy consumption." In addition, EG is measured by the GDP growth (annual %) while the annual percentage growth in population measures population growth, and FDI is measured by the net inflow of FDI (percentage of GDP). Table 1 shows the measurements of the constructs.

Table 1
Measurements of Variables

S#	Variables	Measurements
01	Carbon Emission	Carbon dioxide damages (% of GNI)
02	Renewable Energy Consumption	Percentage of total energy consumption
03	Foreign Direct Investment	The net inflow of FDI (percentage of GDP)
04	Economic Growth	GDP growth (annual %)
05	Population Growth	Population growth (annual %)

4. Findings

The finding section includes all assumptions regarding the "Ordinary Least Square (OLS)" regression, such as multicollinearity, serial correlation, homoscedasticity, and normality. The multicollinearity assumption is verified by the "Variance Inflation Factor (VIF)" and correlation matrix.

The findings of VIF shown that the "multicollinearity assumption" is valid because VIF is less than five and tolerance values are less than 0.10, which means variables are not highly correlated with each other. Table 2 mentioned below shown the VIF of the study.

Table 2
Variance Inflation Factor

	VIF	1/VIF
FDI	2.616	0.382
GDP	2.414	0.414
PG	2.039	0.491
REC	1.887	0.530
Mean VIF	2.239	.

The second way to verify the "multicollinearity assumption" of the data is the correlation matrix. According to the statistics, there is no issue with the "multicollinearity assumption" because the values are less than 0.90. Correlation matrix shows in Table 3.

Table 3
Correlation Matrix

Variables	CO_2	REC	PG	FDI	GDP	GDP^2
CO_2	1.000					
REC	-0.591	1.000				
PG	0.256	-0.517	1.000			
FDI	0.706	-0.539	0.453	1.000		
GDP	0.814	-0.442	-0.014	0.635	1.000	

The second assumption of normality is verified with the help of "Skewness and Kurtosis test". The results have been indicated that the probability values are less than 0.05 that means data is nor normal, which rejects the null hypothesis that data is normally distributed. However, normality does not affect the results when the data is large (more than 100 observations) (Gujarati & Porter, 2011). Table 4 given below shown the "Skewness and Kurtosis test".

Table 4
Skewness and Kurtosis Tests

Variable	Obs	Pr(Skewness)	Pr(Kurtosis)	adj_chi2(2)	Prob>chi2
CO2	152	0	0.002	32.62	0
REC	152	0.137	0.039	6.2	0.045
GDP	152	0.001	0.936	9.18	0.01
PG	152	0.002	0.158	10.25	0.006
FDI	152	0	0	.	0

The Breusch-Pagan test checks the third assumption of homoscedasticity. The test has shown that the data has a heteroscedasticity issue because the probability value is greater than 0.05 that rejects the null hypothesis of homoscedasticity, whereas the Wooldridge test checks the fourth assumption of serial correlation. The test has shown that the data have a "serial correlation issue" because the probability value is greater than 0.05 that rejects the "null hypothesis" of no serial correlation.

Table 5
Fixed Effect Model

CO2	Beta.	S.E	t-value	p-value	L.L.	U.L.	Sig
REC	-0.011	0.002	-6.03	0.000	-0.014	-0.007	***
GDP	-2.947	0.681	-4.33	0.000	-4.293	-1.602	***
GDP^2	0.611	0.110	5.55	0.000	0.393	0.829	***
PG	0.089	0.027	3.30	0.001	0.036	0.142	***
FDI	0.016	0.008	1.99	0.048	0.000	0.033	**
Constant	4.420	1.101	4.01	0.000	2.242	6.597	***
R-squared		0.786	Prob > F				0.000

**** p<.01, ** p<.05, * p<.1*

Table 5 and Table 6 provided the results of "fixed effect and random effect models." In both models, REC and GDP have significant negative nexus with carbon emissions, while population growth and FDI have significant positive nexus with CO_2 of the Asian countries in the world. The purpose of including these models is to check that which of them is appropriate. For this purpose, the Hausman test is applied to the results.

Table 6
Random Effect Model

CO2	Beta.	S.E.	t-value	p-value	L.L.	U.L.	Sig
REC	-0.010	0.002	-5.98	0.000	-0.013	-0.007	***
GDP	-2.939	0.678	-4.34	0.000	-4.268	-1.611	***
GDP^2	0.612	0.110	5.57	0.000	0.397	0.827	***
PG	0.086	0.027	3.21	0.001	0.033	0.138	***
FDI	0.016	0.008	1.94	0.042	0.000	0.032	*
Constant	4.359	1.104	3.95	0.000	2.195	6.522	***
Overall r-squared		0.692	Prob > chi2			0.000	
**** p<.01, ** p<.05, * p<.1*							

Table 7 given below highlighted the Hausman test to check which model is appropriate among the fixed and random effect models. The probability value is higher than 0.05 that reject the null hypothesis and accept that the FEM is appropriate.

Table 7
Hausman Test

	Coef.
Chi-square test value	.933
P-value	.968

Table 8 below shows the "Driscoll and Kraay Standard Error" with fixed effect that shows the relationship among the understudy variables. The results indicated that REC and EG negatively influence the carbon emissions in Asian countries because the beta has negative sign "t" values are higher than 1.96 and "p" values are less than 0.05. While findings also highlighted that population growth and FDI positively influence carbon emissions in Asian countries because the beta has positive sign "t" values are higher than 1.96, and "p" values are less than 0.05.

Table 8
Path Analysis (Robust Standard Error)

CO2	Coef.	S.E.	t-values	p-values	L.L	U.L.
REC	-0.011	0.002	-6.190	0.000	-0.014	-0.007
GDP	-2.947	0.736	-4.000	0.001	-4.494	-1.401
GDP^2	0.611	0.123	4.950	0.000	0.352	0.870
PG	0.089	0.017	5.260	0.000	0.053	0.124
FDI	0.016	0.008	2.050	0.055	-0.000	0.033
_cons	4.420	1.165	3.790	0.001	1.972	6.867

5. Discussions

The findings indicated that the high population growth in the Asian countries severely affected the atmosphere due to the high consumption of energy other renewable energy such as oil, coal, petroleum, and gas. High population growth demands extensive goods and services and transportation for survival in life. These demands can be fulfilled by using extensive use of energy that enhances the country's environmental degradation. These findings are matched with the output of Alam, Murad, Noman, and Ozturk (2016), who also found positive nexus between population growth and environmental degradation. Moreover, Riti, Song, Shu, and Kamah (2017) also found that the high population can manage environmental degradation and EG. These findings are matched with the findings of the present research. In addition, FDI in the country also increases with the passage of time in the Asian countries that also enhance the country's production level and the consumption of energy that affected the country's atmosphere. Moreover, FDI brings the opportunity for developing countries to grow in the market; therefore, developing countries engage in extensive production goals that increase the consumption level of the energy, enhancing ED. These findings are matched with the output of Naz et al. (2019), who also found positive nexus between FDI and ED.

Conversely, the paper's outcomes indicated that REC in the Asian countries are not affected the atmosphere because lack of renewable energy usage has been observed in the context of Asian countries compared to non-renewable EC. These outcomes are matched with the Dogan and Seker (2016), results who also exposed negative nexus between the REC and ED. In addition, the findings are also exposed that EG has a negative influence on the atmosphere of the country. In contrast, an increase in EG affected the country's atmosphere and rejected the EKC hypothesis. These outcomes are matched with the Dogan and Turkekul (2016) results that not supported the validity of the "EKC hypothesis" in the USA environment where GDP2 increases environmental degradation. In addition, a study conducted by Özokcu and Özdemir (2017) on EG, energy, and EKC concluded that the findings did not support the "EKC hypothesis" that EG cannot solve EG the ED automatically. Moreover, Wang, Li, and Fang (2018) also found that environmental degradation can only be managed with the efforts of regulatory implemented authorities but not automatically through EG and reject the "EKC hypothesis".

5.1. Conclusion and Implication

Finally, this study concluded that population growth and FDI motivate developing countries to increase the productivity level, enhancing the country's environmental degradation. While REC and EG in the developing countries are not much and also not increase the ED but increase in GDP^2 increase the ED because high EG requires a high production level that increases the EC which affects the atmosphere of the country and also rejects the EKC hypothesis. This study recommended that the regulators develop the regulations regarding energy consumption in high FDI, population growth, and EG. The developing country must control their energy consumption in the situation of high FDI, population growth, and EG and reduce the ED in the country.

5.2. Limitations and Future Directions

Moreover, the current paper has few and considerable limitations that are the directions for this area's future researcher. The paper takes the four predictors (REC, EG, population growth, and FDI) to predict environmental degradation. Many other factors also exist that predict environmental degradation such as non-renewable energy, FD, and urbanization, and future studies may include these factors under their examination. In addition, this study takes the developing countries under examination, and prospective researchers may add developed countries under their investigation.

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