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Evaluating the influence of Green Growth, Foreign Direct Investment and Financial Development towards Sustainable Environment: Evidence by Green Finance Theory

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Abstract
In today's world, environmental sustainability and sustainable development are critical issues that are emphasized by the urgent need for coherent and practical solutions to the ecological effects of economic activity. Hence, this study examines how Pakistan's carbon emissions are affected by green growth, foreign direct investment, human capital, and financial development between 2004 and 2022. Based on the theory of financial development and green finance, this research utilizes a sound theoretical framework, the Auto-Regressive Distributed Lag (ARDL) model, which helps to explain this problem's short-run and long-run relation. The research conclusions reveal that green growth positively correlates with environmental sustainability by improving green activities and investing in better technology to minimize carbon emissions. At the same time, the study demonstrates that human capital remains a key driver of environmental success. This implies that intensified workforces require higher education and training to adopt and sustain sustainable green practices. On the other hand, FDI has been positive but has a insignificant impact on Pakistan's environment. This evidence highlights legislators' need to associate financial development with economic policy to ensure ecology preservation and continuing economic stability. Pakistan can gain environmental and financial benefits from its sustainable human capital development and integrated investment promotion policies.
Keywords: Green Growth, Foreign Direct Investment, Human Capital, Financial Development Environmental Sustainability

1. Introduction

Global environmental degradation and sustainable development have emerged as the most essential features of the contemporary global economy. There is a need to act to address the negative impact of economic activity on the environment. An economically developed economy can only be well fixed with a sustaining climate on which the economy and societal system rely. Renewable energy resources and green development programmes must be implemented to achieve environmental sustainability and development. Therefore, this article explores green finance theory in the context of Pakistan to understand the shared workings of green growth, FDI, and financial development for sustainable growth and the availability of natural resources.

Environmental sustainability and the concept of green growth are interconnected. Environmental sustainability pursues to ensure that the environment's resources remain preserved for future generations. Green growth is an effective contrivance to minimize greenhouse gas emissions and energy consumption, further contributing to the mitigation of environmental deterioration (Sandberg et al. 2019). In today's digital economy, companies may better respond to environmental changes and gain a competitive edge by incorporating sustainable practices into their strategy (Sajid et al., 2024). This helps to incorporate community development with ecological sustainability (Lin & Ullah, 2023). Sinking carbon emissions and encouraging long-term economic growth are two of the most important goals of green investment and green growth (Hao et al. 2021). FDI impacts the global economy and may impact environmental sustainability, particularly carbon dioxide emissions. As countries join the international market to attract FDI, they require support in balancing the economic growth and protection of the environment (Opoku et al. 2022). Host governments must regulate FDI's influence on CO2 emissions and environmental protection (Lee et al., 2021). Foreign investment and the host country's laws may greatly influence ecological impacts. International investors generally bring best practices and equipment to improve productivity and reduce pollution (Hoa et al., 2023).

Investing in human capital is need of today economy. This investment, depends on the safeguarding of our planet and the mitigation of carbon dioxide emissions, can be a catalyst for more sustainable decisions (Li & Ullah, 2022). Education and training are critical essentials that can foster environmental sustainability. These programs provide people with the understanding and practical experience to attain sustainable behavior in interpersonal and occupational spheres (Bayar et al. 2022; Sadiq et al. 2022). Eventually, prioritizing human capital development within the framework of environmental sustainability can pave the way for a more sustainable society (Adikari et al. 2023). Similarly, there is a positive relationship between financial development and the level of CO2 emissions in any given country (Khan & Ozturk, 2021). In this context, it is essential to examine how financial institutions and policies can either contribute to or relieve the adverse effects of CO2 emissions on the environment (Adebayo et al., 2021). Thus, human capital, improve the financial literacy, which boost the sustainable environment (Saleem et al., 2020).

Our study goes to Pakistan to add to the prior work on green growth, FDI, human capital, and financial development, which can help developing nations enhance their environmental quality. By integrating green finance and economic development theories into a theoretical framework for analysis, this research employs the autoregressive distributive lag model (ARDL) to identify short-run and long-run effects, thus providing insights into theoretical and empirical measurements. Therefore, our results can be helpful in giving practical guidance to stakeholders regarding fiscal and regulatory measures, which would improve economic strategies by making them more resilient through sustainable development practices.

The study's subsequent portions follow this structure: A thorough literature review analyzes earlier studies in the paper's second part. Third part shows the research methodology and econometric model. The fourth slot presents empirical results. In contrast, the fifth part concludes with policy recommendations.

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2. Literature review

To evaluate the environmental effect of FDI, green growth, and financial development green finance and financial development theory, are essential. To balance economic growth with environmental sustainability, green growth promotes investments and technology that reduce ecological dangers and scarcities (Hao et al., 2021). Green finance plays the role of sustainable energy infrastructure projects that aim to improve the environment (Ansari et al., 2024). Finance can be directed to green project using green bonds and sustainable investment funds is beneficial in order to retain ecological balance. Among all these proposed investment types, there are potential positive effects on the emissions and renewable energy consumption (Sharma et al., 2021). However, FDI may augment environmental degradation or protect it, depending on the investing corporations' ecological standards and the host nation's legal structure (Boateng et al., 2024). Explaining the financial development theory it established that enhancing networks and structures of financial institutions are pivotal to economic development together with the stewardship of the environment through the provision of financial instruments and green markets for investment (Sajid et al. 2023). Yi et al. (2023) found that FDI with robust financial markets may help green development towards environmental sustainability.

2.1. Green Growth and Environmental Sustainability

Lin & Ullah, (2023) explored the significance of innovation and green development in improving Pakistan's environmental sustainability. According to findings, developing countries like Pakistan, which confront massive environmental challenges, must incorporate ecologically sustainable practices into their economic growth strategies. Environmental levies, renewable energy, and human capital affect green development and carbon reduction in G7 nations, according to Hao et al., (2021). Findings suggest a clear framework linking environmental charges and other fiscal policies with renewable energy and human capital development. Studies demonstrate that environmental taxes encourage firms and people to decrease their carbon footprint and invest in renewable energy sources to deliver clean energy. Pérez-Suárez & López-Menéndez, (2015) assumes a comprehensive evaluation of the accuracy of EKC and Logistic Growth Models in predicting future CO_2 emissions. The literature suggests that Logistic Growth Models can predict the point at which CO_2 emissions will level off as economies change, despite EKC's inverted U-shaped relationship between income levels and environmental degradation, which implies that economic growth initially escalates emissions before declining. Yu et al., (2023) examine how well environmental taxes stimulate green growth and sustainability in China. The findings shows that ecological taxes help enterprises and individuals become more eco-friendly. Levies that reduce pollution and encourage green technology investments assimilate economic activity with environmental protection goals.

H1: Green growth has a positive influence on environmental sustainability.

2.2. Foreign Direct Investment and Environmental Sustainability

FDI greatly aids the growth and development of host nations' economies. However, a contentious issue in recent years has been the effect of FDI on environmental sustainability. Consequently FDI increase the levels of production and consumption, which lead to environmental demolition. On the other hand, FDI promoters highlight the possibility of cleaner manufacturing processes and knowledge transfer as aspects that might enhance ecological sustainability. Bokpin, (2017) explores the detrimental effects of FDI inflows on Africa's ecosystems from 1990 to 2013, and found that FDI increase the carbon emissions. Without good governance and institutions to limit their impact, FDI significantly accelerates environmental damage. The study highlights the importance of good governance and high-quality institutions in reducing the negative effects of FDI on the environment. The influence of FDI on environmental pollution in China is investigated by Haibo et al. (2019). The findings highlights the importance of FDI, which may boost economies but also threaten ecosystems. According to the study's findings, successful regulations and frameworks are necessary to lessen the adverse effects of FDI on China's environment. Le et al., (2022) show that FDI has a mixed influence on pollution and economic development, with some scenarios showing positive impacts and others revealing negative concerns. This highlights the complex connection between FDI and environmental quality, implying that even if FDI may have favorable economic effects, it can also lead to more significant environmental deterioration if robust environmental regulations and investments in green technology are not implemented.

H2: FDI has a positive influence on environmental sustainability.

2.3. Human Capital and Environmental Sustainability

Both human capital and environmental sustainability are important factors that will regulate Earth's fate in the future. A highly educated and capable labor force to generate technical innovation that may resolve environmental problems. Liu et al.,(2022) shown that nations with greater levels of human capital often display superior environmental performance. This is because educated people are more motivated to embrace sustainable practices and make valuable contributions to the advancement of green technology. Rehman et al., (2023) shown that human capital is critical in encouraging more sustainable buying habits. When people are informed and educated, they are better able to make consumption decisions. Organizations can minimize its environmental impact and promote more accountable conduct by increasing funding for environmental education and creating a sustainable culture (Ansari et al. 2021; Haseeb et al. 2023). Adikari et al. (2023) found that educating human capital via awareness and education initiatives positively affects environmental sustainability. The authors state that people with a better understanding of environmental concerns are more tending to make well-informed decisions that are good for the planet. According to a study by Li et al. (2022) investment in human capital is a critical approach for attaining long-term ecological sustainability objectives. In addition, Saqib et al., (2022) claim that environmental sustainability, education programs can influence students' actions and perspectives. Due to this mental change, people may start incorporating more sustainable habits into their everyday lives, such as recycling more, using less energy, and giving money to green causes. Therefore, there may be a significant reduction in carbon emissions, maintenance of natural resource integrity, and safeguarding of biodiversity as a magnitude of the environmental effect.

H3: Human Capital has a positive influence on environmental sustainability.

2.4. Financial Development and Environmental Sustainability

Rani et al., (2023) demonstrate that nations with advanced monetary systems are more able to channel their resources effectively toward green activities. Financial services and products may also help people and companies live more sustainably by giving them

the tools to change their consumption and production habits. Financially stable nations are more likely to have the means and processes to enforce and monitor ecological legislation (Ali et al., 2023) . This may drive people and companies to follow rules meant to safeguard the environment and make sure they pay for what they do. Investment in environmentally friendly sectors and technology may encourage economic expansion and new employment possibilities when a robust financial infrastructure is in place (Alhassan et al., 2022). Attaining environmental sustainability objectives and leaving the world in better shape for generations to come ultimately requires prioritizing financial development. Khan et al., (2022) indicated that nations with robust financial systems had an easier time lowering their greenhouse gas emissions and moving to a low-carbon economy. This emphasizes the significance of financial growth in propelling environmental improvement. Baajike et al., (2022) study also showed that investing in green technology and sectors positively affects the economy and the environment. The results show that emphasizing financial development to achieve sustainability objectives might have a good effect. Furthermore, Ruza & Caro-Carretero, (2022) discovered that nations that have developed green finance channels, including sustainable investment funds and green bonds, were able to garner more significant funding for eco-friendly initiatives. This has the dual benefit of bolstering economic resilience and stability while cutting carbon emissions. Thus, it is evident that to achieve sustainability goals in the long run, it is essential to cultivate a solid financial structure that backs green efforts. A faster, more sustainable, and economically prosperous future is possible for nations if environmental factors are included in budgetary decisions.
H4: Financial Development has a positive effect on environmental sustainability.

3. Data Descriptions and Research Methodology

This study employs the autoregressive distributive lag (ARDL) model to examine the data obtained from Pakistan from 2004 to 2022. The dependent variable in this study is carbon dioxide emissions. Green growth is measured with production-based CO2 intensity, CO2 per capita, FDI is measured by net inflows, human capital is measured by the human capital index, and financial development, is assessed with the proportion of GDP to domestic lending to the private sector. Information on financial development, human capital, FDI, and environmental sustainability are all obtained from the WDI. While working with OECD database statistics on green growth, several extrapolations and assertions have been made to provide a complete and continuous data set throughout the research carried out in this work to overcome the gaps in the data (Rubin, 1976). To enhance the credibility and accuracy of our dataset we are employing some imputation techniques for fill the missing values (Ali et al. 2021; Mir et al. 2020; Sajid et al. 2023, 2024). Figure 1 displays the conceptual model of our study.

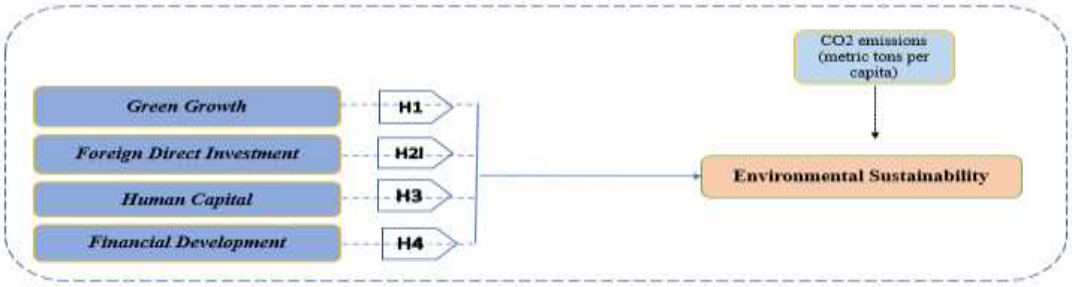

Figure 1: Conceptual Model

Green growth, foreign direct investment, human capital and financial development are main explanatory variables of this study. Descriptions and the data sources related to study variables are presented in Table 1.

Table 1: Variable, descriptions, and data sources

Variable	Notations	Descriptions	Source
Environmental Sustainability	CO2	CO2 emissions per person in metric tons	WDI
Green growth	GRN	CO2 intensity based on production and CO2 per capita connected to energy	OECD
Foreign Direct Investment	FDI	Foreign direct investment net inflows	WDI
Human Capital	HCP	Human Capital Index	WDI
Financial Development	FD	The proportion of GDP attributed to domestic private sector credit.	WDI

3.1. Econometric Strategy

Carbon emission (CO2) is the dependent variable in this study. Financial development, human capital, green growth, and foreign direct investment are the main explanatory variables. To ensure the comparability of outcomes, all the data were transformed in to natural log. To find out the co integration among variables and short run and long run results, we employ linear ARDL model. ARDL model is relevant in econometric examination due to its flexibility and robustness. This flexibility is critical as it allows the ARDL model to estimate stationarity of the data at level I (0) and at first difference I (1). Secondly, the ARDL method is more beneficial when the sample size of the study is small. It stretches and refines the econometric models by offering a fine-grained consideration of the short-run and long-run structural relations (Tanveer et al., 2021; Mahmood et al., 2020; Ur Rahman et al., 2019).

3.2. ARDL Co-integration Bound Testing Approach

ARDL co-integration bounds testing approach identifies the co-integration among the study variables in short and long run. At first, it provides co-integration estimates based on current and lagged data that may span over the years. Second, this work is productive in investigations with small datasets. Thirdly, its flexibility allows the application of first-order integrated datasets,

stationary datasets, or a combination of both. ARDL framework simplifies both interpretation and estimation by incorporating them into a single, principled equation. It also allows for the consistent estimation of long- and short-run effects while addressing issues of endogeneity and autocorrelation. Based on the exploration of (Sajid et al. 2023; Tanveer et al. 2021), the ARDL equation (3) is presented.

3.3. Models Specification

Our study explore the connection among CO2 emission, green growth, foreign direct investment, human capital and financial development in Pakistan. The model is as follows:

CO2 = f (GRN, FDI, HCP, FD) (1)

In Equation 1, CO2 indicates carbon emission, GRN expresses Green growth, FDI represents foreign direct investment, HCP indicates human capital index, and FD represents financial development.

$$\Delta CO2_t = \omega_o + \sum_{i=1}^{l} \omega_{1i} \Delta GRN_{t-1} + \sum_{i=0}^{p} \omega_{2i} \Delta FDI_{t-i} + \sum_{i=0}^{q} \omega_{3i} \Delta HCP_{t-i} + \sum_{i=0}^{r} \omega_{4i} FD_{t-i} + \\ + \lambda_1 GRN_{t-1} + \lambda_2 FDI_{t-1} + \lambda_3 HCP_{t-1} + \lambda_4 FD_{t-1} + \mu_t \quad (2)$$

CO2 indicates carbon emission as the dependent variable. GRN displays green growth, FDI presents the foreign direct investment, HCP demonstrates human capital, and FD represents financial development in Equation 2. Additionally, the symbol Δ indicates the variables' short-term dynamics, while the symbol λ indicates the long-term link between the model's exogenous and endogenous variables.

$$\Delta CO2_t = \omega_o + \sum_{i=1}^{l} \omega_1 \Delta GRN_{t-i} + \sum_{i=0}^{p} \omega_2 \Delta FDI_{t-i} + \sum_{i=0}^{q} \omega_3 \Delta HCP_{t-i} + \sum_{i=0}^{r} \omega_4 \Delta FD_{t-i} + \eta ECT - 1 + vt_t \quad (3)$$

The error correction term (ECT), which is crucial in measuring the rate at which variables return to equilibrium after a deviation, is defined by equation 3 in our study. In essence, the ECT provides a precise schedule for the predicted restoration of equilibrium by quantifying the proportion of disequilibrium that is rectified each year. Our econometric model's forecast accuracy is increased by using the ECT because it takes into consideration the variables' immediate and delayed reactions to changes in their environment.

4. Results

4.1. Descriptive Statistics and Correlation Matrix

Table 2 comprehensively summarizes the descriptive statistics and relationships between the variables. Various descriptive metrics are discussed, including probability values, skewness, maximum, minimum, mean, and median. Notably, green growth has the lowest mean value and foreign direct investment (FDI) the greatest. According to the Jarque-Bera statistics, all of the numbers fit within a normal distribution.

Table 2: Descriptive statistics and correlation matrix

	CO2	GRG	FDI	HCP	FD
Mean	0.768	0.708	21.489	3.421	19.472
Median	0.757	0.700	21.512	3.500	16.632
Maximum	0.918	0.850	22.444	3.500	28.734
Minimum	0.693	0.650	20.571	3.000	14.682
Std. Dev.	0.061	0.054	0.482	0.187	5.171
Skewness	0.856	1.050	0.359	- 1.876	0.719
Kurtosis	3.043	3.557	3.036	4.521	1.808
Jarque-Bera	2.320	3.734	0.410	12.980	2.762
Probability	0.314	0.155	0.815	0.002	0.251
CO2	1.000				
GRG	0.985	1.000			
FDI	0.336	0.393	1.000		
HCP	0.094	0.150	0.070	1.000	
FD	- 0.372	- 0.259	0.493	- 0.032	1.000

4.2. Unit root test

The Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) tests were used to assess the existence of unit roots and verify the suitability of the ARDL methodology. According to Ouattara (2004), the ARDL model is appropriate for variables that are stationary at level I (0) and 1st difference I (1), but it does not accommodate variables stable at the 2nd difference I (2).

4.3. ARDL bound test results

Integrating the bound test and F-statistic values in Table 4 shows a substantial long-term association among the variables evaluated in Equation (3). Notably, particularly when constant factors are taken into account, the F-statistic values are above the upper critical limitations, as described by Narayan, (2005).

Table 3: Unit Root Estimates

Variables	Levels		First difference		Decision
	ADF	PP	ADF	PP	
CO2	-1.706	-1.841	-2.913*	-3.009***	I (1)
GRG	-1.676	-1.839	-3.014*	-3.114***	I (1)
FDI	-5.252	-2.423	-3.822***	-3.342***	I (1)
HCP	-3.266	-3.172	-5.000**	-9.735***	I (1)
FD	-1.082	-1.103	-3.372***	-3.175***	I (1)

Note: The significance values directed single steric, double steric, and triple steric for 10%, 5%, and 1%, respectively.

Table 4: Bounds Test Estimation

F-Statistic	k	Range	Critical Values	
			I (0) bound	I (1) bound
10.5648	4	10%	2.450	3.520
		5%	2.860	4.010
		1%	3.740	5.060

4.4. Long and Short-Run Statistics

By applying the bounds test for cointegration, we can confirm the presence of a long-term relationship among the variables listed in Table 4. Utilizing the ARDL approach, we can assess both symmetric (linear) relationships and the dynamics of how these relationships evolve over the short and long-term. Green growth significantly improves environmental sustainability, as shown in Table 5. A more sustainable environment may be fostered via green growth efforts, as seen by this considerable association. More specifically, green growth-oriented programs are crucial in encouraging the use of renewable energy sources, which are vital in reducing carbon emissions and the impacts of climate change. Our findings support the observations made in prior research (Sandberg et al., 2019; Yu et al., 2023). Similarly, our research findings indicate that enhancing environmental sustainability in Pakistan depends heavily on human capital. These values are evident in the influence of adopting and implementing advanced technologies and eco-sustainability, which are more relevant in protecting the environment. Human capital development provides an informed and ethical workforce capable of identifying and managing environmental issues and optimizing resource use. This progress contributes to a more vital ecosystem and Pakistan's goals for developing robust solutions to handle adverse environmental conditions. Our findings are consistent with previous studies of .Yao et al., (2020) and Rehman et al., (2023). In light of the above, our findings indicate that FDI does not have a long-run or short-run impact on Pakistan's measure of environmental sustainability. This conclusion suggests that at the current stage of its development, the country is not actively using FDI to contribute to the country's sustainable development and improve the existing indicators in the sphere of environmental protection. This implies that the approach to steering FDI towards environmental industries requires strategic modification. More specifically, Pakistan benefits from the favorable policies that can be implemented for foreign investment in green technology and infrastructure sustainability. Policies that regulate foreign investments' environmental impacts may also ensure that these contributions are better aligned with sustainability principles. In return, Pakistan may turn these investments into an excellent tool for building a more sustainable environment by developing a legal framework to ensure the proper utilization of FDI. Our findings are in line of Yi et al., (2023). In addition, our findings confirm that by attaining financial development, Pakistan has significantly enhanced its environmental sustainability levels. Through this connection, we can better understand the notions of economic development and its role in the overall progression of nations regarding sustainable practices. On the same note, effective financial management in a particular economy can ensure adequate capital that can be used to fund innovative efforts that focus on managing resource pollution and resource management. Consequently, as reflected by the alignment of economic growth with environmental concerns, Pakistan's financial structure is working towards creating a better environment. This synergy is crucial to keeping the country on a sustainable development track in the long run and protecting Pakistan's overall ecology and economy. Our these findings are consistent with (Adebayo et al., 2021; M. Khan & Ozturk, 2021; Sharma et al., 2021).

Furthermore, our findings present negative and meaningful ECT, indicating strong evidence supporting the long-run co-integration of the analyzed variables. This negative ECT has implications because it shows the gradual convergence of short-term fluctuations to the long-term equilibrium co-integration relationship since it guarantees stability. More specifically, a negative ECT substantiates the credibility of the model by verifying that the variables will attain equilibrium at a statistically significant rate. Therefore, this shows us how well the models simulate the long-term relationships between the variables and how they go about it, which is essential for making sound conclusions and policy decisions.

Table 5: Long Run Approximations

Variables	Coefficient	Prob
GRN	1.0140***	0.0000
FDI	0.0102	0.9518
HCP	0.0738*	0.0637
FD	0.0339**	0.0332
C	0.2456	0.6193
Short Approximations		
Variables	Coefficient	Prob
D(GRN)	0.9271***	0.0000
D(FDI)	0.0094	0.9518
D(HCP)	0.0675*	0.0639
D(FD)	0.0310**	0.0349
ECT (-1)	-0.9143***	0.0000

4.5. Stability Test

The outcomes of diagnostic test are presented in Table 6. The model has R-squared of 0.992, suggesting a robust model fit with the data. Additional diagnostic tests like the serial correlation test, heteroscedasticity test, and histogram normality test can be performed to further check the model's robustness and normality. These outcomes confirmed that all the data are normally distributed and free from error. Moreover, Figures 2 and 3 show CUSUM and CUSUMSQ diagrams to show the models' stability.

Table 6: Diagnostic Test (ARDL)

R^2	0.992
Adj R^2	0.989
Durbin-Watson	1.499
Jarque Bera Test	0.298
Normality	0.861
LM Test	4.925 (0.0304)
Hetro Test	0.702 (0.632)
Ramsey reset test	1.479 (0.249)
CU-SUM	Stable
CUSUM-Square	Stable

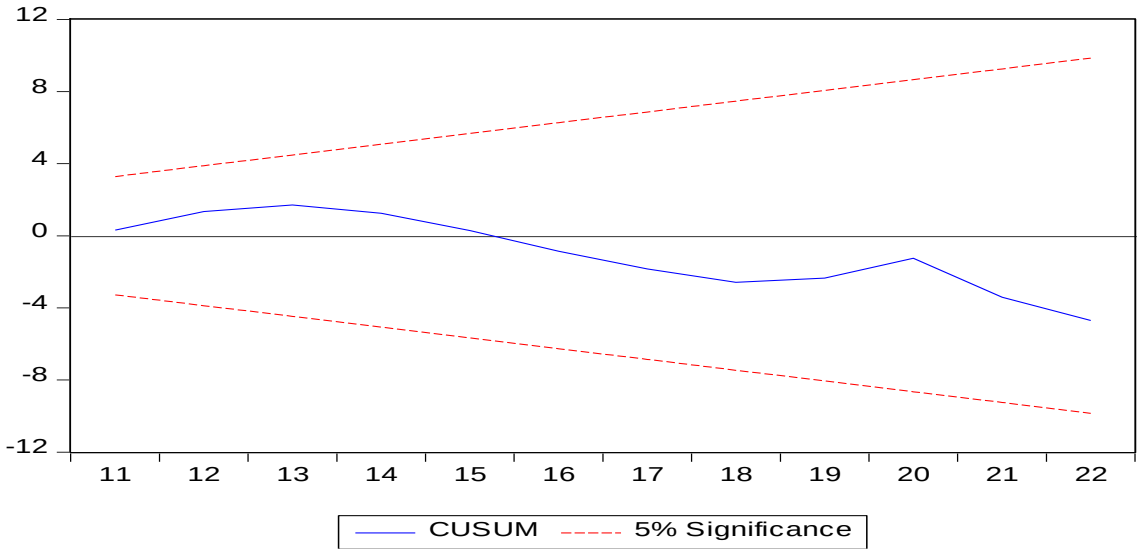

Figure 2: CUSUM

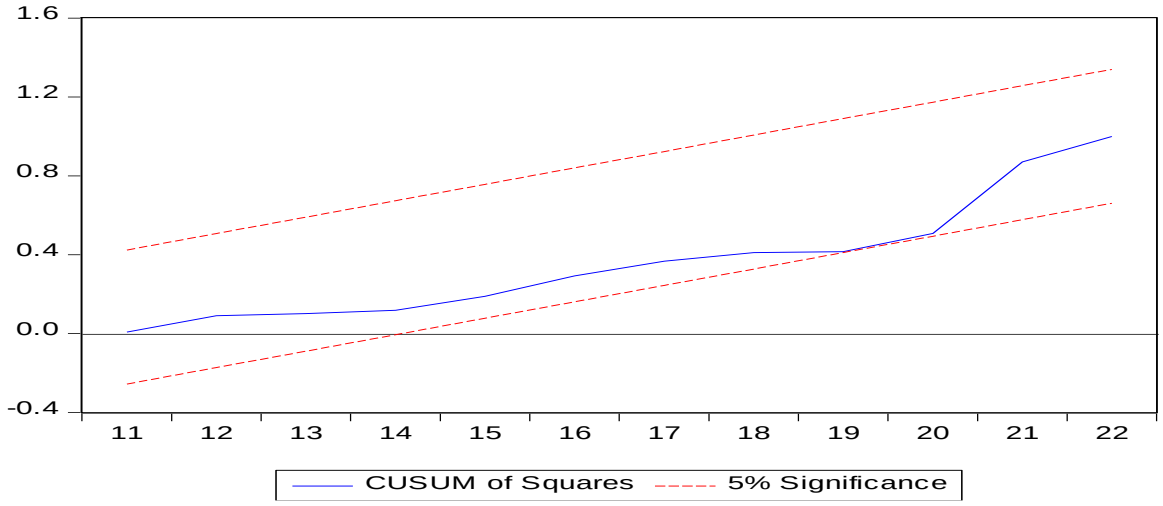

Figure 3: CUSUMSQ

5. Concluding remarks and Policy Implications

The findings of this study highlight that green growth, human capital and financial development are essential to achieve the environmental sustainability in Pakistan. In this study, the cointegration results are obtained by employing the bound test of cointegration and the autoregressive distributed lag (ARDL) model to identify the long-run relations of these variables. The development of green growth initiatives positively impacts environmental sustainability, highlighting the importance of using renewable energy and decreasing carbon footprint. Human capital also contributes to improving ecological management since better education and training are required to produce skilled and creative workers who can utilize new approaches to environmental management. The findings also indicate that FDI has not significantly contributed to the ecological sustainability in Pakistan. This means that FDI is not directed toward achieving sustainable development goals in Pakistan.

Consequently, we see that it is necessary to assume the strategic changes in the investment policies are further directed at funding the projects, positively affecting the state of the environment. It is argued that policymakers need and require a multifaceted plan to address these issues. First, increasing sustainable attitudes can stimulate green growth with awareness campaigns and incentives, which would help encourage different renewable power projects. Second, to establish an adequate marketplace of sustainability skills, it is imperative to invest in human capital, focusing on incorporating environmental literacy at various levels. To stimulate more FDI for investment in green infrastructure and technologies and to enhance environmental standards that investors are expected to adhere to and meet, the legal regimes governing FDI should also be revised. Green bonds and other sustainable means and instruments should encourage the financial sector to financially support projects and activities that are friendly to the natural environment. All these measures must be incorporated in a broad strategy implying the juxtaposition of current economic activities and the proposed environmental goals. This strategy should entail periodic policy reviews and environmental performance standards to ensure flexibility and adaptation to new ecological opportunities and threats. Pakistan needs to implement these policies to guarantee the stability and sustainability of economic development and enhance environmental sustainability.

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