



Foreign Direct Investment, Economic Growth, and Environmental Sustainability in Pakistan: an Empirical Investigation of Dynamic Relationships

Agha Jan Hamraz¹, Syed Ahmed Shahab Tariq², Samar Ali³

¹ Institute of Management Sciences (Imsciences) Peshawar, Pakistan.

Email: jaghao52@gmail.com

² Assistant Professor (Economics), Government Degree Sci/ Com College Gulshan e Iqbal bl. 7.

Email: tariqshahabaerc@gmail.com

³ Assistant Professor, Shah Abdul Latif University Ghotki campus.

Email: samar.ghanghro@gmail.com

ARTICLE INFO

Submission:

September 01, 2026

Revised:

September 22, 2026

Accepted:

October 09, 2026

Available Online:

October 20, 2026

Keywords:

Foreign Direct Investment,
Economic Growth,
Environmental Sustainability,
CO₂ Emissions, ARDL Model,
Time-Series Analysis, Pakistan.

Corresponding author:

Samar Ali

Email:

samar.ghanghro@gmail.com

ABSTRACT

This study examined the relationships among foreign direct investment (FDI), economic growth, and environmental sustainability in Pakistan using annual time-series data for 1990–2024. A quantitative longitudinal research design was employed, incorporating descriptive statistics, Pearson correlation analysis, Augmented Dickey–Fuller unit-root testing, autoregressive distributed lag (ARDL) estimation, bounds testing, and diagnostic procedures. FDI was measured as net inflows relative to GDP, economic growth was represented by annual real GDP growth, and environmental pressure was assessed using CO₂ emissions excluding land use, land-use change, and forestry per capita. The correlation analysis revealed statistically non-significant relationships between FDI and economic growth ($r = 0.060$, $p = 0.732$), FDI and CO₂ emissions ($r = 0.121$, $p = 0.490$), and economic growth and CO₂ emissions ($r = -0.076$, $p = 0.664$). The estimated ARDL model indicated substantial persistence in CO₂ emissions, whereas the individual FDI and economic-growth coefficients were statistically non-significant. The bounds-testing result ($F = 1.7557$) did not establish a long-run equilibrium relationship within the CO₂-dependent specification. Diagnostic testing identified heteroskedasticity, for which robust statistical inference was employed. The findings indicate that the hypothesized relationships were not statistically supported within the selected specifications and highlight the importance of considering economic structure, investment characteristics, and environmental conditions when evaluating sustainable development in Pakistan.

Introduction

Foreign direct investment (FDI) is considered to be an important source of external funds for developing economies and is capable of contributing to capital formation, technology development, industrial development and international trade. FDI typically comes with a long-term commitment to foreign enterprises, and can involve transfers of new management skills, new production processes, and access to foreign markets. These advantages can be especially significant in underdeveloped economies, where the domestic savings, investment funds and technological potential are not enough to fulfil the development needs. But the impact of FDI on the economy is hinged on the nature of the investment, the institutional setting in the host country, and the capacity of the host country to acquire the foreign knowledge and technology. FDI is partly shaped by the human capital available in the recipient country (Rauf et al., 2023), and FDI has to be backed by the development of domestic financial markets to increase returns to the domestic economy (Hunjra et al., 2024).

Economic growth is the ability of an economy to produce more goods and services over time that is generally linked to improved income, employment, productive potential and living standard and is measured by the rise in an economy's real GDP. However, economic growth can drive up energy use, industrial pollution, traffic and burden on natural resources. Owing to these environmental impacts, environmental sustainability is becoming an important concern in the current economic research, especially in developing countries which are aiming at a combination of industrialization and environmental protection. Bello et al. (2026) spoke about the possible shift in the interdependency between economic development and environmental degradation in various growth phases, and Chipalkatti et al. (2021) critically analyzed the environmental Kuznets curve and the implications of its relationship with various stages of economic growth. So, while it is important to consider volume growth when measuring economic performance, it is also necessary to consider the impact of the growth on the environment. The relationship between FDI, economic growth and environmental sustainability is particularly relevant for developing countries as the foreign investment can impact on the productive activity and the environment.

Modern technologies and cleaner production processes could lead to better utilization of resources, while investments in energy-using industries can increase pollution and carbon emissions. Likewise, economic growth can enhance the economic, financial and technological resources required for environmental protection, but may also increase energy requirements and industrial activity. As such, the environmental impacts of foreign investment will depend on the composition of industries, environmental laws and policies, the sources of energy used and the technologies utilized by foreign investors. Siripi et al. (2024) explored the complicated relationship between foreign investment and environmental consequences and showed the need to take environmental impacts of international capital flows into account when assessing their economic benefits. These interconnections offer a foundation to examine the dynamic relationships between FDI, economic growth and environmental sustainability in Pakistan.

Theoretical Relationship Between FDI and Economic Growth

Neoclassical growth theory and endogenous growth theory can be used to explain the relationship between FDI and economic growth. In a neoclassical view, foreign investment can lead to an increase in the stock of capital, an expansion of productive capacity and a support of higher output through providing resources for new enterprise creation or modernization. Investment without technological progress and productivity growth, however, may be constrained in the long run as the result of capital accumulation. The endogenous growth theory is a more comprehensive theory that highlights the role of knowledge transfers, human capital formation, innovation and technological spillovers in explaining continued economic growth.

Foreign-owned enterprises can play a role in these processes, by bringing more innovative production processes, training the workforce in their skills, and providing opportunities for domestic businesses to learn from foreign business practices. Mahembe et al. (2014) found that the growth-enhancing impact of FDI is influenced by the human capital of the host economy, meaning that there are different economic conditions under which FDI is stimulating growth.

The effects of FDI on economic growth can also be realized in terms of job creation, export expansion, competition and linkages with the international production networks. Foreign companies can establish employment and stimulate indirect economic activities in the domestic market by providing services to local suppliers and service providers as well as through other industries. The presence of these in international markets can be a motivation for businesses in the country to enhance the quality of their products, production efficiency, and managerial performance. However, these benefits are not guaranteed. The impact of foreign firms on the host economy may be limited when they have weak linkages with local suppliers, are highly dependent on imported inputs or focus on low value-added activities. Iamsiraroj et al. (2015) noted that the channels of FDI's impact on economic growth of developing countries must be taken into account. Almfraji et al. (2014) have likewise shown that the internal financial system could reap or lose the benefits of foreign investment in terms of its contribution to economic performance.

The relationship between foreign direct investment and economic growth may involve reciprocal economic influences, although the existence and direction of such relationships require appropriate empirical testing. Foreign investors may be interested in investing in countries that show signs of economic growth and development, as they may see potential in the expanding market and the improving infrastructure. However, FDI can also help facilitate growth in the future through higher levels of productive investment, enhanced technology and export capacity. This two-way relationship does not imply that a positive relationship between FDI and economic growth automatically implies that foreign investment leads to economic growth. The relationship may be stronger or weaker depending on the economic policies and financial conditions, institutional quality, and composition of foreign investment. Therefore, an empirical study should take into account the short run adjustments and the long run relationships and not only the association in the present time period. This method is of special importance for Pakistan, where the investment flows and economic performances can fluctuate in response to local or global economic and political conditions (Mwakabungu et al., 2023).

FDI, Economic Growth, and Environmental Sustainability in Pakistan

The study of foreign investment, economic performance and environmental sustainability has a very special setting in the case of Pakistan. The country is an economy which needs a significant amount of funding for the development of industrial output, modernization of infrastructure, energy supply and creation of jobs. Financial resources, advanced technologies and international business connections are potential benefits of FDI to these objectives. The contribution of these benefits to sustainable development, however, relies on the sectors where investment occurs, on the productivity of foreign funded activities and on the ability of domestic institutions to create productive investment. Technological constraints, economic risk and structural imperfections could have an impact on the degree of foreign investment resulting in economic growth. Thus, the impact of FDI in Pakistan should be assessed in terms of its contribution towards economic development as well as the general conditions that affect the effectiveness of FDI (Mohsin et al., 2022).

Environmental issues of FDI are also significant due to the expansion of industries and economic development in Pakistan may lead to the increased electricity, fuel, transportation and other energy consumptions. Economy may lead to increased CO₂ emissions and environmental pressures if fossil fuels are key to adding more production. On the other hand, foreign investment may contribute to environmental improvement by bringing in technologies, production processes and equipment that are less polluting and more energy-efficient, and therefore lowering pollution production levels per unit of investment. The environmental impact can thus vary depending on the sector where the investment takes place, the type of energy employed, and the strength of environmental policies. Munir et al. (2020) have expounded that the environmental impacts can vary over the course of economic growth, while Faheem et al. (2024) emphasized the need to investigate the environmental repercussions of foreign investment in the context of industrial and regulatory conditions. The above views suggest empirical study of the impact of FDI on Pakistan's environmental sustainability should be done instead of assuming the impact to be positive or negative. These variables also have crucial implications for development priorities in Pakistan.

Economic expansion policies are policies that have the potential to bring foreign investment, and their long-term impact depends partly on whether foreign investment provides an increase in productive capacity at a relatively low cost of the environment. Likewise, economic growth can offer resources to protect the environment, but only if policies and cleaner technologies are put in place. Thus, the economic and environmental performances of Pakistan should be analyzed in a single framework taking into account the possible linkages among investment, output and environment pressures. Zubedi et al. (2022) also pointed out that the correlation between economic development and environmental quality is not straightforward and is not necessarily a linear improvement of environmental quality as income increases. Discussing these relationships together can help determine if foreign investment and economic development go hand in hand with environmental pressures, or can environmental performance standards be satisfied along with the economic advantages (Kanwal et al., 2023).

Short-Run and Long-Run Dynamics Among the Study Variables

The relation between FDI, economic growth and sustainability of the environment might not be the same in the short term as in the long term. In the short run, the foreign investment can affect the economic activities in terms of investment expenditure, business expansion, employment, and industrial production. But this influence can be time-delayed due to project implementation time, economic uncertainties and new enterprises taking time to become productive. Environmental effects can also manifest themselves at varying rates as production and energy usage both rise and fall, and cleaner technologies or efficiencies might not be widespread until after the impacts of production increases have taken effect. So, a sudden rise in FDI inflow does not necessarily result in a corresponding rise in the economic performance or environmental quality. Saleem et al. (2020) examined the short-run and long-run relationships among foreign direct investment, trade openness, and economic growth. In the long run, FDI could have an impact on economic growth by encouraging the accumulation of capital, technological advancement, productivity growth, and the growth of local industries.

The impacts on the environment could be linked to the promotion of cleaner technologies and better use of resources, or to dependence on carbon intensive production through investment. Growth can also impact the ability of businesses and government to invest in environmental management, energy infrastructure and pollution control. Such processes can create patterns of relationships that are not observed in the short-run, and may also have adjustment times before the full impacts are felt. The relevant literature on the environmental Kuznets curve (EKC) is relevant as it discusses the possibility of a rise in environmental degradation at early stages of development followed by a decline at later stages. But this trajectory is not the only one that may be expected, and is influenced by the economy, technology and environmental policy.

It is also important to recognize that the variables may affect each other, over time. Economic activity can be stimulated by FDI, and economic growth can lead to further foreign investment, given the increased expectations of returns and market opportunities. Meanwhile, environmental laws and fluctuations in energy prices could impact investment decisions, and development of industries could impact environmental conditions. These potential interdependencies highlight the importance of examining temporal associations among the variables without assuming that the observed relationships establish causal direction. The empirical method, which differentiates short-term movements from long-term relationships, can be more thorough than analysis of simple correlations. For Pakistan, this kind of investigation can provide the insight to find out if the relationships are stable in time or conditionally stable with the changing economic and environmental conditions. The evidence produced can help to inform a better evaluation of the relationship between investment-driven development and an environment-friendly development (Arnberg et al., 2012).

Macroeconomic and Environmental Implications of FDI and Economic Growth

The impact of FDI on economic and environmental performance must be related to the broader macroeconomics. The effects of foreign capital inflows might be influenced by the degree of openness to trade, domestic investment, the structure of the financial sector, energy structure, technological capacity, and environmental policy. For instance, efficient financial institutions can help allocate resources to productive use, and domestic infrastructure and supplier networks will enhance linkages between foreign companies and local companies. The effects of trade integration can be trade access enhancing and facilitate technological transfer, but can also have environmental implications depending on the nature of the industry and its energy intensity. Abdouli et al. (2017) underlined the role of financial market development for the growth impact of FDI, and Saini et al. (2019) underscored the role of absorptive capacity of domestic financial markets. The above arguments point to the need to evaluate foreign investment within the context of the economic environment that influences the realization of its benefits. When assessing the economic growth and environmental sustainability nexus, the energy footprint and the nature of industrial activity is of special significance. Rising output in a growth economy can lead to higher carbon emissions as they rely on energy-intensive manufacturing, transportation, and fossil-fuel-based electricity generation. On the other hand, the environmental cost of economic activity can be lowered by improvements in energy efficiency, the use of renewable energy and cleaner energy production. Foreign investment can have both positive and negative effects on the two outcomes, depending on the technologies, industries and business practices that they bring in. Thus, sustainability in the environment needs to be addressed with respect not only to the size of economic activity but also to the resource use and emissions during the production process.

Willy (2018) pointed out the role of the environmental features of foreign investment, warned that environmental issues would not be automatically solved by economic development. It is crucial for Pakistan to learn about these aspects to formulate policy recommendations that promote sustainable investments and mitigate environmental pressures. An integrated analysis of FDI, economic growth and environmental sustainability can give evidence on whether a change in foreign investment is correlated with an improvement in economic performance or a change in carbon emissions or both. It can also be useful to paint a picture of whether or not over time, economic growth is accompanied by increasing environmental stress. The present study thus explores the dynamic linkages between FDI, economic growth and environmental sustainability in Pakistan and its short-run and long-run interactions. The study aims to contribute evidence to the investment policy, economic planning and environmental management context by examining these variables in a common empirical context. It is a broader vision to facilitate a more balanced attitude towards the economic development of Pakistan and the consideration of environmental consequences of investment and development.

Research Objectives

- To examine the relationship between foreign direct investment and economic growth in Pakistan.
- To investigate the relationship between foreign direct investment and environmental sustainability in Pakistan.
- To analyse the relationship between economic growth and environmental sustainability in Pakistan.
- To examine short-run dynamic associations and assess the existence of a long-run equilibrium relationship among foreign direct investment, economic growth, and environmental sustainability in Pakistan.

Research Questions

Q1: What is the relationship between foreign direct investment and economic growth in Pakistan?

Q2: What is the relationship between foreign direct investment and environmental sustainability in Pakistan?

Q3: What is the relationship between economic growth and environmental sustainability in Pakistan?

Q4: What are the short-run and long-run relationships among foreign direct investment, economic growth, and environmental sustainability in Pakistan?

Problem Statement

Foreign direct investment (FDI) is considered an important source of capital, technological advancement, and economic development in developing countries; however, its contribution to economic growth and environmental sustainability remains complex. In Pakistan, attracting foreign investment and achieving sustained economic growth are important development priorities, yet economic expansion may also increase energy consumption, industrial activity, and carbon dioxide emissions. Although FDI can promote growth through capital formation, productivity improvements, and technology transfer, it may also contribute to environmental pressure when investment is concentrated in energy-intensive industries or relies on fossil-fuel-based production. Similarly, economic growth may provide resources for environmental protection, but its environmental consequences depend on energy sources, industrial structure, and the adoption of cleaner technologies (Munir et al., 2020). Despite the importance of these issues, examining FDI, economic growth, and environmental sustainability separately may provide an incomplete understanding of their interconnected dynamics in Pakistan. In particular, the short-run and long-run relationships among these variables require further empirical investigation to establish whether foreign investment and economic expansion are associated with changes in environmental sustainability over time. Therefore, this study investigates the dynamic relationships among FDI, economic growth, and environmental sustainability in Pakistan to provide evidence that may support investment decisions, economic planning, and environmentally sustainable development policies.

Significance of the Study

This study is significant because it examines the interconnected relationships among foreign direct investment (FDI), economic growth, and environmental sustainability in Pakistan. By investigating these variables within a common empirical framework, the study can provide a clearer understanding of whether foreign investment contributes to economic expansion and how it is associated with environmental conditions. The findings may help policymakers develop investment strategies that encourage productive foreign capital while considering environmental protection and the long-term consequences of economic growth. The study may also provide useful insights for government institutions, economic planners, and environmental policymakers seeking to balance industrial development with the reduction of carbon emissions. Furthermore, examining short-run and long-run relationships can help identify whether the effects of FDI and economic growth differ over time, supporting more informed economic and environmental policy decisions. From an academic perspective, this research may contribute to the existing literature on international investment, macroeconomic development, and environmental sustainability in developing economies, particularly Pakistan, and provide a foundation for future research using alternative environmental indicators, economic variables, and econometric approaches.

Literature Review

Theoretical Perspectives on Foreign Investment and Sustainable Development

FDI has been extensively studied as a stimulus to economic development due to its possible contributions in terms of capital, advanced technology, managerial skills, and access to foreign markets. De Mello (1997) analyzed the link between FDI and economic growth in developing countries and pointed out that the accumulation of capital or technological improvements are significant pathways for foreign investment to affect production. The contribution of foreign investment is, however, not determined by the economic conditions of the recipient country, but also depends on its capacity for using foreign resources in productive activities.

This view implies that FDI-development relationships should be looked at in terms of the host country economy and not in isolation of the positive outcomes that are expected to come from FDI investments. Building on the research of Hering (2024), who examined the growth impact of FDI for developing countries, the present paper explores the role of human capital in explaining the impact of foreign investment on development. They found that FDI has the potential to promote economic growth via technological diffusion, especially if the host economy was able to absorb foreign technology. The study was mainly about the economic performance, but the meaning is applicable to environmental sustainability as well, as technology transfer can have an impact on production efficiency and resource utilization.

The technology and production methods brought by foreign multinational enterprises is partly the deciding factor for whether foreign investment is favorable for sustainable development or not. The impact of foreign investment on sustainable development also needs to be considered with regard to environmental outcomes. Johnson (2019) conducted a literature review on FDI and the environment which found that foreign investment can either raise pollution levels (due to the growth of industrial activity) or lower pollution levels (due to more environmentally friendly technologies and production processes used by foreign companies). The conflicting options illustrate that the economic advantages of FDI don't always align with the benefits to the environment. The study of FDI, in conjunction with the study of economic growth and environmental sustainability, might thus allow Pakistan to gain a wider picture of any relationship between foreign investment and economic and environmental balance.

Foreign Investment and the Environmental Consequences of Industrial Activity

Pollution-intensive FDI and technological improvement explain differences in the environmental impact of FDI. According to the pollution haven hypothesis, multinational enterprises might choose countries with less stringent environmental laws for their activities that are damaging the environment. The pollution halo approach, in contrast, suggests that the foreign enterprise can bring in cleaner technology, more efficient production systems and enhanced environmental management practices. In this discussion, Doytch et al. (2016) revisited these conflicting claims and demonstrated that environmental impacts of foreign investment are influenced by the kind of industries where foreign investment is found, the regulatory setting and foreign enterprises' attributes.

The above perspectives offer the basis for studying whether FDI is linked with increase or decrease in the environmental pressure in Pakistan. Bukša et al. (2022) investigated the linkage between economic development and environmental quality and identified some evidence that the linkage can change with different stages of economic development and various environmental indicators. Their work was related to the environmental Kuznets curve literature, which examines whether environmental degradation is initially positively related to income but then turns negative at higher income levels. This can be extended to the FDI and industrial development may have a stimulating impact on the expansion of economic activity, resulting in higher emissions at some point in development. This is likely to change in the future, however, due to technological innovation and more stringent environmental regulations. Stern (2004) examined the literature on the environmental Kuznets curve in detail and warned that given the implications of the EKC literature, it is not a foregone conclusion that economic growth will automatically bring environmental improvement. In his analysis, he pointed out that technological advances, shifts in economic structure, and environmental policies play an important role in the pollution variations. This argument is significant for Pakistan as that boost in production and investment could create environmental stress if the economic activities continue to be reliant on energy sources that are carbon intensive. Thus, the environmental aspects of FDI need to be assessed with economic growth and not considered as a standalone (Fahad et al., 2022).

Economic Growth and Changes in Environmental Quality

Economic growth can boost the living standards, jobs and infrastructure and public services available. However, economic growth can stimulate demand for energy, transportation, industrial raw materials and natural resources. Grossman and Krueger (1995) demonstrated that the relationship between economic development and environmental degradation may be nonlinear. The results indicate that environmental consequences might vary with development stage and pollutant. This gives a theoretical framework with which to explore if there is any link between economic growth and environmental pressure in Pakistan. Other than income growth, however, changes in environmental quality could not be accounted for (Stern, 2004). Better improvements could be made possible through cleaner technologies, moving to less pollutive industries and effective environmental policies (Galeotti, 2007).

Rapid growth in production without an increase in energy efficiency could lead to increased emissions in the economy, while an increase in energy efficiency for production activities could lead to economic growth with relatively small environmental impact. These arguments suggest that the links between eco-sustainability and economic growth should be evaluated on an empirical basis in the context of the economic and energy situation of each country. Where foreign investment helped to expand industry, the relationship between industrial growth and environmental quality was particularly important. The impact of FDI on employment and output could lead to more jobs and a higher standard of living, but it could also lead to adverse environmental effects, depending on the energy sources and technologies that are used in the production of the goods and services. Economic growth with energy intensive activities can lead to an increase in carbon emissions alongside an increase in economic output. On the other hand, technological advancements and 'clean investments' can lead to a decrease in emissions intensity. So an economic growth-environmental sustainability analysis can shed light on whether the economic transformation of Pakistan is driven by environmental pressures or by more environmentally friendly production.

Country-Specific Evidence from Pakistan

The relation between FDI and economic development is significant in the context of Pakistan's economic situation. While not directly on the question of foreign investment and output/output capacity, Ullah et al. (2025) offer more general accounting on potential contributions to output and productivity from foreign investment, findings which also suggest that domestic economic conditions impact the benefits of foreign capital. In the Pakistani context, the impact of FDI could vary from the industries in which the investment is made, local productive capacity, financial conditions, and technological spillovers to the recipient firms. Thus, analysis of the results of country studies is required in addition to the cross-country results. But its emphasis on macroeconomic relationships also underscores the need to consider environmental results in assessing the broader impact of foreign investment and economic growth. The effects of sectoral investments, energy consumption and carbon emissions have also been included in the research on FDI and environment in Pakistan. These studies suggest that the environmental impacts of foreign investment can differ based on the kind of investment activities and the energy needs of the investment activity. The outcomes of the individual studies, however, can vary as a result of variations in data periods, in definition of variables, in econometric technique. Hence, the present study takes into consideration the FDI, economic growth and environmental sustainability as a combined analysis and investigates the relationship of these three in the economic context of Pakistan.

Short-Run Responses and Long-Run Relationships

The effects of FDI, economic growth, and environmental sustainability may vary over time. In the short term, foreign investment can affect production by creating jobs, purchasing equipment, and establishing new businesses. It can also change energy use and put pressure on the environment. However, improvements in technology and productivity may take more time to appear. Barrero et al. (2017) explained that FDI can influence economic performance in different ways, depending on a country's conditions and stage of development. In the long term, FDI can support economic growth by increasing investment, bringing new technologies, and improving productivity.

At the same time, investment in industries that produce high carbon emissions may increase environmental problems, while clean technologies can help reduce pollution and change the link between economic growth and emissions. Şahin et al. (2015) explained that the connection between income and the environment depends not only on economic growth but also on changes in industrial structure and technology. It is important to differentiate between the short run and long run relationships in order to gauge if the relationship between FDI, growth and environmental sustainability is stable over time. There can also be feedback within the dynamic relationships. Economic growth can help draw foreign investment in by expanding the market size and business opportunities; foreign investment can also shape economic growth by it being invested productively. An economy's investment appeal can also be impacted by environmental factors and regulatory policies. This approach helps researchers' study both short-term changes and long-term connections between FDI, economic growth, and environmental sustainability. In Pakistan, it can help identify whether these factors affect each other in one direction or whether they move towards a stable, long-term balance.

Research Gap

Previous research has examined the relationships among foreign direct investment, economic growth, and environmental quality in Pakistan, including studies employing autoregressive distributed lag models and alternative econometric approaches (Munir & Ameer, 2020; Zubedi et al., 2022; Kanwal et al., 2023). Consequently, the joint examination of these variables cannot independently be considered a novel contribution. However, differences in sample periods, variable definitions, model specifications, and statistical inference warrant further investigation of the empirical robustness of these relationships. The present study examines annual data covering 1990–2024, using CO₂ emissions per capita as an indicator of environmental pressure and incorporating dynamic regression estimates, finite-sample bounds testing, heteroskedasticity-robust inference, and selected stability diagnostics. Its contribution lies in reassessing the statistical evidence for contemporaneous and dynamic associations within this specific empirical framework rather than establishing causal relationships or assuming the existence of long-run equilibrium.

Research Hypotheses

H1: Foreign direct investment has a significant relationship with economic growth in Pakistan.

H2: Foreign direct investment has a significant relationship with environmental sustainability in Pakistan.

H3: Economic growth has a significant relationship with environmental sustainability in Pakistan.

H4: Foreign direct investment, economic growth, and environmental sustainability have significant short-run and long-run relationships in Pakistan.

H5: Foreign direct investment, economic growth, and environmental sustainability exhibit significant adjustment towards long-run equilibrium in Pakistan.

Conceptual Framework

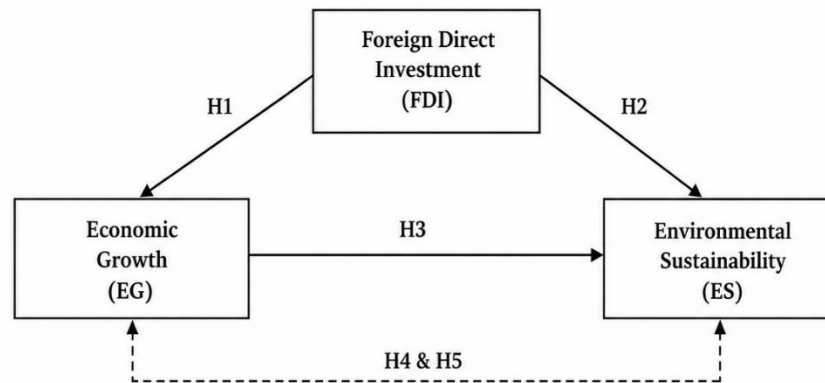


Fig 1: Conceptual Framework

Methodology

Research Design

This study employed a quantitative longitudinal research design to examine the relationships among foreign direct investment (FDI), economic growth, and environmental sustainability in Pakistan. The analysis was based on annual secondary time-series data covering the period 1990–2024. The research framework incorporated descriptive analysis, stationarity assessment, and econometric modelling to investigate the statistical associations and dynamic characteristics of the selected variables. The empirical strategy distinguished between short-run dynamics and potential long-run relationships, taking into account the integration properties of the variables, model specification, and the results of appropriate cointegration tests. Given the observational nature of the data, the analysis focused on statistical relationships without assuming causal effects.

Data Sources and Study Variables

The study utilized annual secondary data for Pakistan covering the period 1990–2024, with the World Bank's World Development Indicators (WDI) serving as the principal data source. Foreign direct investment was measured using net FDI inflows as a percentage of gross domestic product (GDP), while economic growth was represented by the annual percentage growth rate of real GDP. Environmental pressure was measured using carbon dioxide (CO₂) emissions excluding land use, land-use change, and forestry (LULUCF) per capita, expressed in metric tonnes per person. Higher CO₂ emissions per capita indicate greater carbon-related environmental pressure rather than improved environmental sustainability. These variables formed the basis for examining the relationships among foreign investment, economic performance, and environmental conditions. The measurement definitions and temporal coverage were maintained consistently throughout the analysis.

Data Collection and Preparation

Annual observations for foreign direct investment, economic growth, and CO₂ emissions per capita were compiled chronologically for the period 1990–2024. The dataset was examined for missing observations, inconsistencies, and data-entry errors before statistical analysis. Consistent measurement definitions were maintained throughout the study period, and the final dataset comprised 35 annual observations for each variable. The prepared time-series data were subsequently used for descriptive, correlation, and econometric analyses.

Descriptive and Preliminary Analysis

The preliminary analysis examined the distributional and temporal characteristics of foreign direct investment, economic growth, and CO₂ emissions per capita. Descriptive statistics, including the mean, standard deviation, minimum, and maximum values, were used to summarize the observed characteristics of each variable. Time-series plots were employed to examine historical movements, fluctuations, and potential changes in the underlying data patterns. Pearson correlation coefficients were calculated as preliminary measures of linear association, with particular attention to the possibility of spurious relationships arising from non-stationary time-series data. Accordingly, correlation analysis was not interpreted as sufficient evidence of causality, cointegration, or the existence of short-run and long-run relationships.

Unit-Root and Stationarity Tests

The stationarity properties of the selected time-series variables were assessed using the Augmented Dickey–Fuller (ADF) unit-root test, with lag lengths selected according to the Akaike Information Criterion (AIC). Unit-root tests were applied to determine whether the variables were stationary in levels, $I(0)$, or became stationary after first differencing, $I(1)$. Appropriate deterministic components and lag specifications were selected according to the statistical properties of each series. Particular attention was given to the possibility of structural breaks associated with major economic and institutional developments during the study period, as conventional unit-root tests may be sensitive to unaccounted structural changes. The applicability of the ARDL bounds-testing approach was evaluated based on the integration properties and model specification, including the requirement that no variable be integrated of order two, $I(2)$. The interpretation of cointegration results also accounted for the relatively small sample size and the need for appropriate finite-sample critical values.

ARDL Model Specification and Estimation

The autoregressive distributed lag (ARDL) approach was employed to examine dynamic relationships among foreign direct investment, economic growth, and CO₂ emissions per capita. The principal ARDL (1,1,1) specification included CO₂ emissions per capita as the dependent variable, with foreign direct investment and economic growth as explanatory variables. The model incorporated one lag of the dependent variable and contemporaneous and first-lag observations of both explanatory variables. Additional dynamic regressions were estimated with economic growth as the dependent variable to examine its associations with FDI and CO₂ emissions. Heteroskedasticity-consistent HC3 standard errors were employed for coefficient inference, and joint Wald tests were conducted to assess the significance of contemporaneous and lagged explanatory-variable coefficients. The model specifications were evaluated in relation to the integration properties of the variables and the limited annual sample.

Short-Run and Long-Run Relationship Analysis

Short-run dynamic associations were examined through the estimated contemporaneous and lagged coefficients and their joint statistical significance. The existence of a long-run level relationship was investigated using the ARDL bounds-testing procedure, with finite-sample critical values considered because of the relatively small sample size. The calculated F-statistic was compared with the corresponding lower and upper critical bounds to assess the null hypothesis of no level relationship. Long-run coefficients and error-correction parameters were considered interpretable only when sufficient statistical evidence of cointegration was established. In the absence of cointegration, no long-run equilibrium adjustment was inferred.

Diagnostic and Stability Tests

Diagnostic procedures were conducted to evaluate the statistical adequacy of the estimated ARDL model. The Breusch–Godfrey test was employed to examine residual serial correlation, while the Breusch–Pagan test was used to assess heteroskedasticity. The Ramsey RESET test was applied to investigate potential functional-form misspecification, and the Jarque–Bera test was used to evaluate residual normality. Parameter stability was assessed using the cumulative sum (CUSUM) test, while Chow breakpoint tests were conducted for 2006, 2008, and 2009 to examine potential structural changes. Heteroskedasticity-consistent HC3 standard errors were used for coefficient inference to account for non-constant residual variance.

Statistical Significance

Statistical inference was based on the estimated coefficient signs, magnitudes, and corresponding p-values, using a 5% significance level. The research hypotheses were evaluated using the available correlation estimates, dynamic regression results, joint Wald tests, and ARDL bounds-testing outcomes, as appropriate to the specified relationships. The results were analyzed in terms of the research goals and the existing literature in the field of foreign investment, economic growth and environmental sustainability. The

analysis was observational and secondary time-series data were used so that the results were given as empirical relationships and not as absolute evidence of causation.

Ethical Considerations

This study was based on secondary data retrieved from publicly available databases without engaging in human participant, interviews or personal data. Thus, it is not necessary that the individual participant should give consent. Appropriate mention of the data sources was made in the completed research paper and an analysis and reporting was carried out according to academic research standards.

Results

The empirical analysis investigated the relationships among foreign direct investment (FDI), economic growth, and environmental sustainability in Pakistan using annual time-series data covering 1990–2024. The analysis employed descriptive statistics, Pearson correlation, Augmented Dickey–Fuller (ADF) unit-root testing, autoregressive distributed lag (ARDL) modelling, bounds testing, heteroskedasticity-robust inference, and diagnostic and structural stability tests. The dataset comprised 35 annual observations for each variable. Environmental pressure was measured using CO₂ emissions excluding land use, land-use change, and forestry (LULUCF) per capita.

Descriptive Statistics

Table 1 presents the descriptive statistics for foreign direct investment, economic growth, and CO₂ emissions per capita in Pakistan during the study period.

Table 1; Descriptive Statistics of Study Variables in Pakistan (1990–2024)

Variables	N	Mean	Standard Deviation	Minimum	Maximum
Foreign Direct Investment (% of GDP)	35	0.9218	0.6491	0.3096	3.0357
Economic Growth (Annual GDP Growth, %)	35	3.9746	2.0904	–1.2741	7.8313
CO ₂ Emissions per Capita	35	0.7724	0.1067	0.5651	0.9658

The descriptive statistics indicate that foreign direct investment averaged 0.92% of GDP, with a standard deviation of 0.65. FDI inflows ranged from 0.31% to 3.04% of GDP, reflecting considerable variation in foreign investment throughout the observation period. Economic growth averaged 3.97%, with a standard deviation of 2.09%, indicating fluctuations in Pakistan's annual economic performance. The minimum economic growth rate was –1.27%, while the maximum reached 7.83%. CO₂ emissions per capita averaged 0.77 tonnes, with minimum and maximum values of 0.57 and 0.97 tonnes, respectively. These descriptive results indicate substantial differences in the variability of foreign investment, economic growth, and environmental pressure over the study period.

Time-Series Trends of Foreign Direct Investment, Economic Growth, and CO₂ Emissions

The historical patterns of the study variables were examined to identify major fluctuations and changes during 1990–2024. Foreign direct investment exhibited considerable variation, with a pronounced increase during the mid-2000s followed by a subsequent decline. Economic growth fluctuated across the observation period, reflecting episodes of expansion and contraction. The economic contraction in 2020 coincided with the economic disruption associated with the COVID-19 pandemic. CO₂ emissions per capita generally increased over much of the study period, although temporary reductions were also observed.

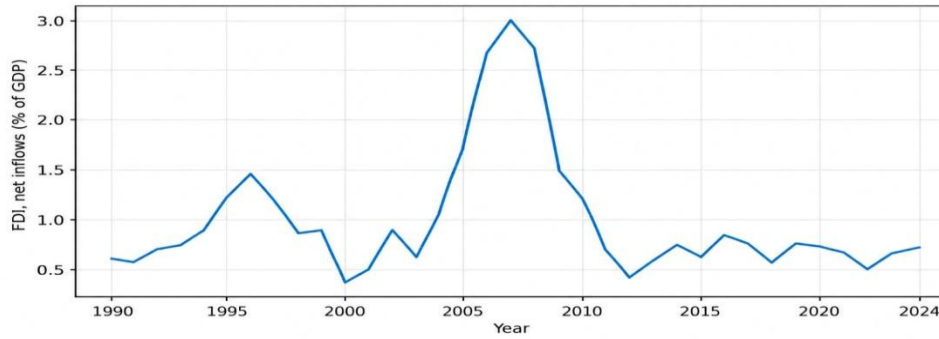


Figure 2. FDI Trend Graph (1990–2024)

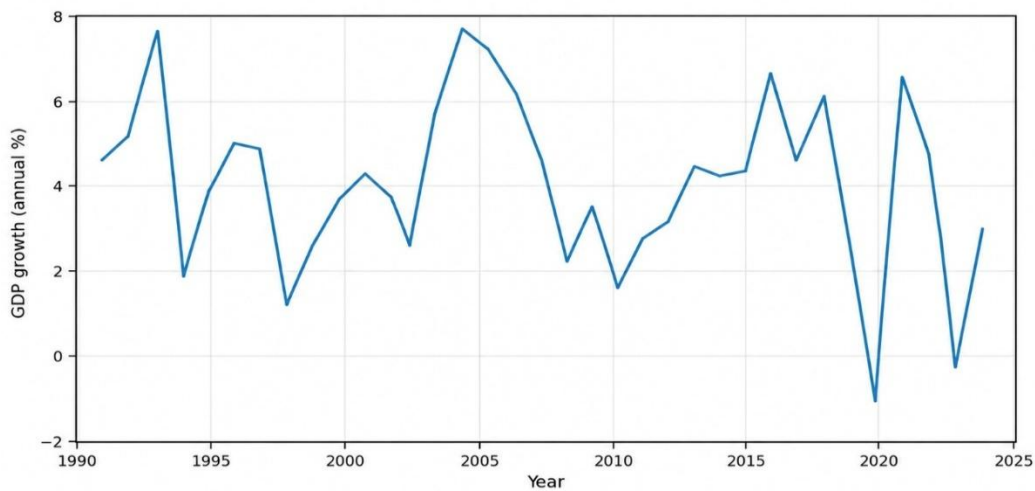


Figure 3. GDP Growth Trend Graph (1990–2024)

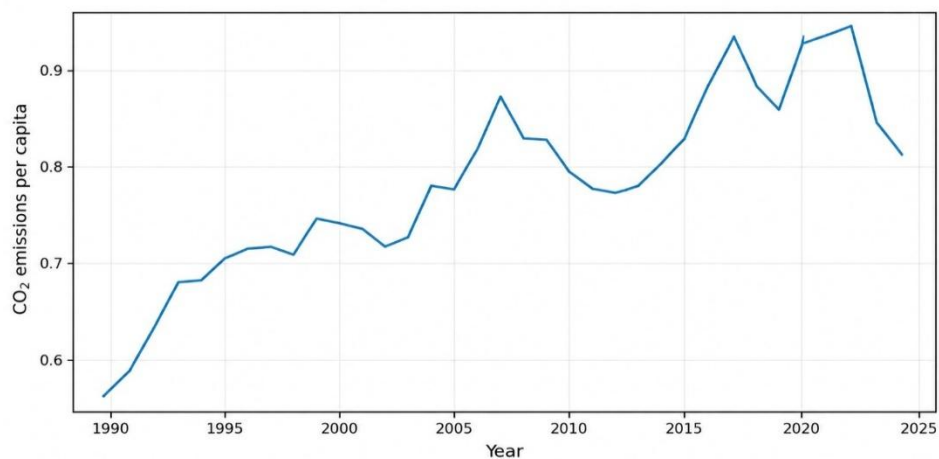


Figure 4. CO₂ Emissions Trend Graph (1990–2024)

These patterns indicate that foreign investment, economic growth, and environmental pressure followed different trajectories. The historical variations provide descriptive context for the subsequent econometric analysis but do not independently establish causal relationships among the variables.

Pearson Correlation Analysis

Pearson correlation analysis was conducted to investigate the preliminary linear relationships among foreign direct investment, economic growth, and CO₂ emissions per capita.

Table 2; Pearson Correlation Analysis Among Study Variables

Variables	Pearson Correlation (r)	p-value
FDI and Economic Growth	0.060	0.732
FDI and CO ₂ Emissions	0.121	0.490
Economic Growth and CO ₂ Emissions	-0.076	0.664

The correlation results indicate a weak positive relationship between FDI and economic growth ($r = 0.060$, $p = 0.732$). However, the relationship was not statistically significant at the 5% level. Similarly, FDI exhibited a weak positive association with CO₂ emissions per capita ($r = 0.121$, $p = 0.490$), indicating insufficient statistical evidence of a significant contemporaneous relationship between foreign investment and environmental pressure. Economic growth demonstrated a weak negative association with CO₂ emissions per capita ($r = -0.076$, $p = 0.664$), which was also statistically non-significant. Overall, none of the three pairwise correlations reached conventional levels of statistical significance. These findings are interpreted as preliminary linear associations rather than evidence of causality, particularly given the time-series characteristics of the variables.

Unit-Root and Stationarity Analysis

The Augmented Dickey-Fuller unit-root test was applied to examine the stationarity properties of the selected variables. The analysis considered level and first-difference specifications, with lag lengths selected using the Akaike Information Criterion.

Table 3; Augmented Dickey-Fuller Unit-Root Test Results

Variables	ADF Statistic at Level	p-value	ADF Statistic at First Difference	p-value
Foreign Direct Investment	-3.1113	0.0257	-3.9098	0.0020
Economic Growth	-3.3838	0.0115	-7.7224	$p < 0.001$
CO ₂ Emissions per Capita	-2.0315	0.2729	-4.8844	$p < 0.001$

The ADF results indicate that foreign direct investment was stationary at level under the intercept-only specification (ADF = -3.1113, $p = 0.0257$). Economic growth was also stationary at level (ADF = -3.3838, $p = 0.0115$). In contrast, CO₂ emissions per capita were non-stationary at level (ADF = -2.0315, $p = 0.2729$) but became stationary after first differencing (ADF = -4.8844, $p < 0.001$). Additional specifications incorporating deterministic trends indicated sensitivity in the stationarity classification of certain variables. Nevertheless, the first-difference results did not indicate integration of order two. These findings supported consideration of the ARDL modelling framework, subject to appropriate specification and inference.

Autoregressive Distributed Lag Model Estimation

An ARDL (1,1,1) model was estimated with CO₂ emissions per capita as the dependent variable and foreign direct investment and economic growth as explanatory variables. The specification incorporated contemporaneous and lagged explanatory variables and one lag of CO₂ emissions. Heteroskedasticity-consistent HC3 standard errors were employed to assess coefficient significance.

Table 4; ARDL Model Estimation with Heteroskedasticity-Robust Inference

Variables	Coefficient	Robust Standard Error	Robust p-value
Constant	0.06181	0.06783	0.3699
CO ₂ Emissions (-1)	0.88861	0.09029	$p < 0.001$
FDI	0.01263	0.02028	0.5386
FDI (-1)	-0.00673	0.02275	0.7695
Economic Growth	0.00484	0.00757	0.5273
Economic Growth (-1)	0.00166	0.00381	0.6656

The ARDL estimates indicate that lagged CO₂ emissions were positively and statistically significantly associated with current emissions ($B = 0.88861$, $p < 0.001$), suggesting substantial persistence in environmental pressure. The contemporaneous coefficient of FDI was positive but statistically non-significant ($B = 0.01263$, $p = 0.5386$), while its lagged coefficient was negative and non-significant ($B = -0.00673$, $p = 0.7695$). Similarly, the contemporaneous coefficient of economic growth was positive but statistically non-significant ($B = 0.00484$, $p = 0.5273$). The lagged economic-growth coefficient was also non-significant ($B = 0.00166$, $p = 0.6656$). The estimated model produced an R^2 of 0.8607 and an adjusted R^2 of 0.8358, indicating that approximately 86.07% of the observed variation in CO₂ emissions was accounted for by the included regressors. This explanatory power was primarily associated with the persistence of the dependent variable and should not be interpreted as evidence of a causal or long-run equilibrium relationship. The heteroskedasticity-robust coefficient estimates therefore did not provide statistically significant evidence of individual contemporaneous or lagged associations between FDI, economic growth, and CO₂ emissions within the specified model.

Dynamic Relationships and Joint Significance Testing

Additional dynamic regressions were estimated to examine the associations involving economic growth as the dependent variable. HC3 heteroskedasticity-robust Wald tests were applied to assess the joint significance of contemporaneous and first-lag coefficients for the specified explanatory variables.

Table 5; Dynamic Regression and Joint Wald Test Results

Dependent Variable	Explanatory Variable	F-Statistic	p-value
Economic Growth	FDI	0.4452	0.6452
Economic Growth	CO ₂ Emissions	0.3902	0.6805
CO ₂ Emissions	FDI	0.2080	0.8135
CO ₂ Emissions	Economic Growth	0.2707	0.7648

The results indicate that the contemporaneous and lagged coefficients of FDI were not jointly significant in the economic-growth equation ($F = 0.4452$, $p = 0.6452$). Similarly, CO₂ emissions did not exhibit statistically significant joint explanatory power in the estimated economic-growth equation ($F = 0.3902$, $p = 0.6805$). In the CO₂ emissions equation, the contemporaneous and lagged coefficients of FDI were jointly non-significant ($F = 0.2080$, $p = 0.8135$). Economic growth also exhibited statistically non-significant joint coefficients ($F = 0.2707$, $p = 0.7648$). These findings provide insufficient evidence of statistically significant dynamic associations under the selected specifications. The joint Wald tests assess the included contemporaneous and lagged coefficients and should not be interpreted as formal evidence of Granger causality or bidirectional causal relationships.

ARDL Bounds Testing for Long-Run Relationships

The ARDL bounds-testing procedure was employed to assess the existence of a long-run level relationship among CO₂ emissions, foreign direct investment, and economic growth. Finite-sample critical values were obtained for a model incorporating an unrestricted intercept without a deterministic trend.

Table 6; ARDL Bounds Test Results

Test Components	Values
F-Statistic	1.7557
Significance Level	5%
Lower Bound I(0)	4.2096
Upper Bound I(1)	5.3749

The bounds-testing results produced an F-statistic of 1.7557, which was below the 5% lower-bound critical value of 4.2096. Consequently, the null hypothesis of no level relationship could not be rejected. The findings do not establish a statistically significant long-run equilibrium relationship among CO₂ emissions, foreign direct investment, and economic growth within the estimated CO₂-dependent specification. As cointegration was not supported, long-run equilibrium coefficients and cointegration-based error-correction parameters were not interpreted. Accordingly, the results provide insufficient evidence of adjustment towards a stable long-run equilibrium. These findings are specific to the selected variables, sample period, deterministic components, and model specification and do not establish the absence of long-run relationships under alternative econometric frameworks.

Model Diagnostic and Stability Tests

Diagnostic testing was conducted to examine residual serial correlation, heteroskedasticity, functional-form specification, residual normality, and parameter stability.

Table 7; Diagnostic and Stability Test Results

Diagnostic Tests	Test Statistic	p-value
Breusch–Godfrey Serial Correlation	0.0083	0.9272
Breusch–Pagan Heteroskedasticity	13.0087	0.0233
Ramsey RESET	1.6843	0.2053
Jarque–Bera Normality	5.8661	0.0532
OLS-Residual CUSUM	0.5803	0.8893

The Breusch–Godfrey test indicated no statistically significant evidence of first-order serial correlation ($p = 0.9272$). However, the Breusch–Pagan test identified statistically significant heteroskedasticity ($p = 0.0233$), indicating that the constant residual variance assumption was not satisfied. Accordingly, HC3 heteroskedasticity-consistent standard errors were used to evaluate coefficient significance. The Ramsey RESET test did not provide statistically significant evidence of functional-form misspecification ($F = 1.6843$, $p = 0.2053$). The Jarque–Bera test also failed to reject residual normality at the 5% significance level ($p = 0.0532$).

The OLS-residual CUSUM test did not identify significant parameter instability ($p = 0.8893$). However, this result does not exclude structural changes that may be detected using alternative stability tests or different model specifications.

Structural Break Analysis

Potential structural changes were examined using Chow breakpoint tests for selected years associated with developments during the mid-2000s and the global financial crisis.

Table 8; Chow Structural Break Test Results

Break Year	F-Statistic	p-value
2006	0.4229	0.8558
2008	0.5681	0.7512
2009	0.3948	0.8744

The Chow breakpoint tests did not identify statistically significant changes in the estimated coefficients at the selected break dates. The null hypothesis of coefficient stability could not be rejected for 2006 ($F = 0.4229$, $p = 0.8558$), 2008 ($F = 0.5681$, $p = 0.7512$), or 2009 ($F = 0.3948$, $p = 0.8744$). These results indicate that the estimated model did not exhibit statistically significant coefficient changes at the specified breakpoints. However, the findings do not exclude structural changes at other dates, including disturbances associated with the COVID-19 pandemic and subsequent economic developments. The relatively small annual sample further limits the statistical assessment of recent structural changes.

Discussion

The present study examined the relationships among foreign direct investment (FDI), economic growth, and environmental sustainability in Pakistan using annual time-series data for 1990–2024. The findings revealed weak and statistically non-significant associations among the selected variables. The relationship between FDI and economic growth was positive but non-significant ($r = 0.060$, $p = 0.732$), suggesting insufficient evidence of a significant relationship during the study period. Although foreign investment can contribute to capital accumulation, technological advancement, and productivity improvements, its economic contribution may depend on domestic financial development, institutional conditions, and absorptive capacity (Mahembe & Odhiambo, 2014; Iamsiraroj & Ulubaşoğlu, 2015). The present findings therefore suggest that the anticipated economic benefits of FDI cannot be assumed to occur uniformly across different economic conditions.

The relationship between FDI and CO₂ emissions was also positive but statistically non-significant ($r = 0.121$, $p = 0.490$). Similarly, the ARDL estimates did not establish statistically significant individual associations between FDI and CO₂ emissions. These findings do not provide sufficient evidence supporting either environmentally beneficial or environmentally detrimental effects of foreign investment in Pakistan. Previous research has emphasized that the environmental consequences of FDI may vary according to

industrial composition, technological characteristics, and regulatory conditions (Munir & Ameer, 2020; Rauf et al., 2023). However, these potential mechanisms were not directly examined in the present study.

Economic growth demonstrated a weak negative and statistically non-significant association with CO₂ emissions ($r = -0.076$, $p = 0.664$). This finding indicates insufficient evidence of a significant contemporaneous relationship between annual economic growth and environmental pressure. The Environmental Kuznets Curve literature suggests that environmental degradation may vary across stages of economic development (Stern, 2004). Nevertheless, the present study employed annual GDP growth rather than income levels and squared income terms; therefore, its findings cannot be interpreted as a direct empirical test of the Environmental Kuznets Curve hypothesis.

The ARDL bounds-testing results did not establish cointegration among FDI, economic growth, and CO₂ emissions ($F = 1.7557$). Consequently, the estimated model did not provide sufficient evidence of a stable long-run equilibrium relationship or significant equilibrium adjustment. Diagnostic testing identified heteroskedasticity, which was addressed through robust coefficient inference, while the selected breakpoint tests did not reveal significant coefficient changes at the examined dates. Overall, the findings indicate that the relationships among foreign investment, economic performance, and environmental pressure in Pakistan require consideration of broader economic and institutional conditions. The limited annual sample and exclusion of potentially relevant variables, including energy consumption, trade openness, and financial development, should also be considered when interpreting the results.

Conclusion

This study investigated the relationships among foreign direct investment, economic growth, and environmental sustainability in Pakistan using annual time-series data from 1990 to 2024. The empirical findings revealed weak and statistically non-significant correlations among the selected variables. The estimated ARDL model similarly provided insufficient evidence of statistically significant individual associations between foreign direct investment, economic growth, and CO₂ emissions per capita. The ARDL bounds-testing results did not establish a statistically significant long-run equilibrium relationship among the variables. Consequently, the findings did not support long-run equilibrium adjustment through a cointegration-based error-correction mechanism. Diagnostic testing identified heteroskedasticity, which was addressed using robust statistical inference, while the selected structural-break tests did not indicate significant parameter changes at the examined dates. Overall, the findings suggest that the relationships among foreign investment, economic growth, and environmental pressure in Pakistan cannot be adequately explained through simple direct associations. The results highlight the importance of considering investment composition, energy consumption, technological development, and institutional conditions when examining sustainable economic development. The study contributes empirical evidence concerning these relationships in Pakistan while emphasizing the need for cautious interpretation of statistically non-significant findings and the limitations associated with the selected econometric specifications.

Future Implications

Future research should further investigate the relationships among foreign direct investment, economic growth, and environmental sustainability in Pakistan by incorporating additional macroeconomic and environmental variables, particularly energy consumption, trade openness, financial development, technological innovation, and institutional quality. Extended time-series data and alternative econometric approaches may provide further insights into potential structural changes, nonlinear relationships, and short-run and long-run dynamics.

From a policy perspective, the findings highlight the importance of evaluating foreign investment according to its sectoral composition, technological characteristics, and potential environmental implications. Policies encouraging cleaner production technologies, renewable energy, and energy-efficient industrial development may support sustainable economic objectives, although their effectiveness requires further empirical evaluation. Comparative studies involving other developing economies may also help identify the economic and institutional conditions under which foreign investment contributes to sustainable development.

References

1. Rauf, A., Ali, N., Sadiq, M. N., Abid, S., Kayani, S. A., & Hussain, A. (2023). Foreign direct investment, technological innovations, energy use, economic growth, and environmental sustainability nexus: new perspectives in BRICS economies. *Sustainability*, 15(18), 14013.

2. Hunjra, A. I., Bouri, E., Azam, M., Azam, R. I., & Dai, J. (2024). Economic growth and environmental sustainability in developing economies. *Research in International Business and Finance*, 70, 102341.
3. Bello, M. O., Jimoh, S. O., Ch'ng, K. S., & Oyerinola, D. S. (2026). Environmental sustainability in ASEAN: what roles do energy consumption, economic growth, and foreign direct investment play?. *Environment, Development and Sustainability*, 28(3), 6831-6857.
4. Chipalkatti, N., Le, Q. V., & Rishi, M. (2021). Sustainability and society: do environmental, social, and governance factors matter for foreign direct investment?. *Energies*, 14(19), 6039.
5. Siripi, H., Kuuwill, A., & Tamakloe, M. D. (2024). Economic growth and environmental sustainability: The role of foreign direct investment and technological innovation on carbon emissions in Ghana. *Research in Globalization*, 9, 100260.
6. Mahembe, E., & Odhiambo, N. M. (2014). Foreign direct investment and economic growth: A theoretical framework. *Journal of Governance and Regulation*, 3(2).
7. Iamsiraroj, S., & Ulubaşoğlu, M. A. (2015). Foreign direct investment and economic growth: A real relationship or wishful thinking?. *Economic modelling*, 51, 200-213.
8. Almfraji, M. A., & Almsafir, M. K. (2014). Foreign direct investment and economic growth literature review from 1994 to 2012. *Procedia-Social and Behavioral Sciences*, 129, 206-213.
9. Mwakabungu, B. H. P., & Kauangal, J. (2023). An empirical analysis of the relationship between FDI and economic growth in Tanzania. *Cogent Economics & Finance*, 11(1), 2204606.
10. Mohsin, M., Naseem, S., Sarfraz, M., Zia-UR-Rehman, M., & Baig, S. A. (2022). Does energy use and economic growth allow for environmental sustainability? An empirical analysis of Pakistan. *Environmental Science and Pollution Research*, 29(35), 52873-52884.
11. Munir, K., & Ameer, A. (2020). Nonlinear effect of FDI, economic growth, and industrialization on environmental quality: evidence from Pakistan. *Management of Environmental Quality: An International Journal*, 31(1), 223-234.
12. Faheem, M., Farooq, F., Nousheen, A., & Waheed, A. (2024). Green growth and financial development: A path to environmental sustainability in Pakistan. *Journal of Accounting and Finance in Emerging Economies*, 10(1), 13-22.
13. Zubedi, A., Jianqiu, Z., Ali, Q., Memon, I., & Zubedi, E. (2022). Impact of energy consumption, economic growth, and FDI through environmental Kuznets Curve: Perspective from belt and road initiative and Pakistan. *Mathematical Problems in Engineering*, 2022(1), 3130605.
14. Kanwal, A., Khalid, S., & Alam, M. Z. (2023). Analyzing the asymmetric effects of green finance, financial development and FDI on environment sustainability: New insights from Pakistan based non-linear ARDL approach. *iRASD Journal of Economics*, 5(3), 625-644.
15. Saleem, H., Shabbir, M. S., & Bilal khan, M. (2020). The short-run and long-run dynamics among FDI, trade openness and economic growth: using a bootstrap ARDL test for co-integration in selected South Asian countries. *South Asian Journal of Business Studies*, 9(2), 279-295.
16. Arnberg, S., & Hansen, L. G. (2012). Short-run and long-run dynamics of farm land allocation: panel data evidence from Denmark1. *Agricultural Economics*, 43(2), 179-190.
17. Abdouli, M., & Hammami, S. (2017). The impact of FDI inflows and environmental quality on economic growth: an empirical study for the MENA countries. *Journal of the Knowledge Economy*, 8(1), 254-278.
18. Saini, N., & Sighania, M. (2019). Environmental impact of economic growth, emission and FDI: systematic review of reviews. *Qualitative Research in Financial Markets*, 11(1), 81-134.
19. Willy, R. (2018). The role of economic growth, foreign direct investment in determining environmental degradation: A panel data analysis. *Journal of Energy and Environmental Policy Options*, 1(4), 96-102.

20. de Mello, L. R., Jr. (1997). Foreign direct investment in developing countries and growth: A selective survey. *The Journal of Development Studies*, 34(1), 1-34. <https://doi.org/10.1080/00220389708422501>
21. Hering, L. (2024). Foreign Direct Investment in sub-Saharan Africa: sustainability perspective.
22. Johnson, L. (2019). FDI, international investment agreements and the sustainable development goals. In *Research handbook on foreign direct investment* (pp. 126-148). Edward Elgar Publishing.
23. Doytch, N., & Uctum, M. (2016). Globalization and the environmental impact of sectoral FDI. *Economic Systems*, 40(4), 582-594.
24. Bukša, T., Bukša, J., & Kosovac, I. (2022). Effects of foreign direct investment on the economy and environment. *Journal of process management and new technologies*, 10(3-4), 22-39.
25. Stern, D. I. (2004). The rise and fall of the environmental Kuznets curve. *World Development*, 32(8), 1419-1439. <https://doi.org/10.1016/j.worlddev.2004.03.004>
26. Fahad, S., Bai, D., Liu, L., & Baloch, Z. A. (2022). Heterogeneous impacts of environmental regulation on foreign direct investment: do environmental regulation affect FDI decisions?. *Environmental Science and Pollution Research*, 29(4), 5092-5104.
27. Grossman, G. M., & Krueger, A. B. (1995). Economic growth and the environment. *The Quarterly Journal of Economics*, 110(2), 353-377. <https://doi.org/10.2307/2118443>
28. Galeotti, M. (2007). ECONOMIC GROWTH AND THE QUALITY OF THE ENVIRONMENT: TAKING STOCK: M. GALEOTTI. *Environment, Development and Sustainability*, 9(4), 427-454.
29. Ullah, S., Xiaopeng, D., Anbar, D. R., Amaechi, C. V., & Ashraf, M. W. (2025). Political risk management in international construction: Evidence from Pakistan. *Global Journal of Flexible Systems Management*, 26(4), 839-864.
30. Barrero, J. M., Bloom, N., & Wright, I. (2017). *Short and long run uncertainty* (No. w23676). National Bureau of Economic Research.
31. Şahin, A., Tansel, A., & Berument, M. H. (2015). Output-employment relationship across sectors: A long-versus short-run perspective. *Bulletin of Economic Research*, 67(3), 265-288.



2026 by the authors; Journal of Global Social Transformation (JGST). This is an open access article distributed under the terms and conditions of the Creative Commons Attribution (CC-BY) license (<http://creativecommons.org/licenses/by/4.0/>).