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Foreign Capital Inflows, Trade Openness, and Sustainable Growth Dynamics in Morocco

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Abstract

This research paper examines the effects of foreign direct investment in the developing world, often referred to as the Global South. This study uses strong methodological approaches such as vector error correction model estimation to explore the multidimensional effects of foreign direct investment on economic growth, environmental sustainability and energy consumption. The results indicate a complex and non-linear relationship between Foreign Direct Investment and main economic variables, which is often moderated by institutional quality, absorptive capacity and sector-specific variables. The findings do confirm a U-shaped relationship between foreign direct investment and renewable energy consumption at the global level, with possibly negative effects at the start of a country's development, but becoming more positive over time as countries develop and use newer technologies. Besides, the analysis shows that the relationship between foreign direct investment and economic growth has a significant impact on the use of renewable energy, which suggests that the trade-off theory and race-to-the-bottom hypothesis are supported, rather than the conservation hypothesis. For policymakers, this integrated assessment offers valuable advice on how to craft effective policies to maximise the benefits of FDI, minimise potential externalities, and, in particular, how the pollution haven hypothesis should be addressed in environmental sectors.

Keywords: Foreign Direct Investment, Trade Openness, Sustainable Growth

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1. INTRODUCTION

Foreign capital has increasingly been a vital factor in economic development, especially in the economies of nations in the process of developing and growing their productive capacity, increasing their savings, and improving their integration into international markets (Alfaro & Chauvin, 2020; Ma et al., 2023; Ahmed & Alvi, 2024; Chizema, 2025). Foreign capital can be used to transfer technology, share managerial know-how, create jobs, and gain access to international production networks, in addition to providing funds (Ali & Audi, 2023; Abdulle et al., 2025). The possible gains have lent foreign direct investment a prominent role in development policies in the Global South. The developmental effects of foreign capital are far from one-size-fits-all, however, given the institutional context, sectoral structure of the capital, technological proficiency, and domestic economies' absorptive capacity. Therefore, the association between foreign investment and sustainable development should not be discussed without taking into account both its economic and environmental/energy related impacts (Bruce-Amartey et al., 2025). The growing globalisation of developing economies has further enhanced the significance of trade openness in determining the impact of international capital. Liberalisation of trade can help expand market access, foster specialisation, enhance competition, and import advanced technology and capital equipment (Acharya, 2015; Ali & Naeem, 2017; Rui & Liming, 2025). Simultaneously, an increase in openness can lead to an increase in the size of production, transportation and energy use, which can lead to other environmental pressures. The relationship between trade and foreign investment is particularly important because foreign investment decisions can be influenced by the presence of international markets, production costs, natural resources, regulatory conditions, etc., and foreign capital and trade can interact and together give rise to the characteristics and dynamism of economic changes (Ahmad et al., 2022; Onono et al., 2024). They are especially applicable to countries that need to pursue economic development and environmental protection. The rising GDP levels entail growth in energy, infrastructure, transportation, and industry, and impacts on these sectors depend on the nature of growth, either leading to environmental degradation or contributing to the transition toward cleaner industry (Dai et al., 2023; Marc, 2024; Qian,

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2024; Ali et al., 2025; Omar et al., 2025). Foreign investment can help achieve either of these results. Multinational firms can, on the one hand, bring clean technology, enhance production efficiencies, and promote the adoption of renewable-energy technologies. Conversely, foreign capital investment into high-pollution and/or high-energy projects can lead to higher fossil fuel use and environmental deterioration. In the same way, Holmes et al. (2019) make a case for the importance of the institutional and organisational settings in which new capabilities are brought in.

The pollution haven hypothesis states that pollution-intensive production processes may be shifted to locations with relatively lax environmental regulations, putting pressure on the economy of the host country (Wagner & Timmins, 2009; Siddiqi et al., 2014; Liu et al., 2024; Chowdhury, 2025). The pollution halo view, on the other hand, argues that foreign companies have the ability to enhance environmental performance through the transfer of cleaner technologies and managerial practices. The competing mechanisms suggest that there are no obvious net positive or negative impacts of FDI on environmental quality. The effects depend upon investment composition and environmental regulation, the sophistication of technology, and the ability of recipient countries to absorb and adapt to foreign technology (Poelhekke & Van der Ploeg, 2015; Ahmad et al., 2018; Li et al., 2025). Foreign capital also has an important impact on sustainable development via energy consumption. Industrialisation and increased energy use can be achieved in the first phase of economic transition with more FDI. Technological modernisation and structural change can, however, make a contribution to bettering energy efficiency and boosting the use of renewables in the future. This provides a basis to consider the FDI-renewable energy consumption relationship as a non-linear one, rather than a constant in the development process. This is particularly important in developing economies, where the first phase of capital accumulation may rely on the use of traditional energy sources, and the later phase of technological upgrading may offer more opportunities to utilise renewables. It is also possible to explore the link between foreign capital, growth and renewable energy from a different viewpoint of competing energy-growth perceptions (Richards et al., 2012; Ali & Rehman, 2015; Cummings, 2025). According to the conservation hypothesis, energy use is influenced by economic growth, and so energy policies should consider the energy needs of expanding economic activity. The trade-off perspective, on the other hand, highlights possible conflicts or tensions between economic and environmental/energy goals, especially in sectors with high resource demands (Alnsour, 2024; Roussel et al., 2024; Vrachioli et al., 2025). As in the race-to-the-bottom argument, it is again asking whether competing for foreign capital will result in a more lax approach to environmental laws by governments (Fraga-Lamas et al., 2021; Audi & Ali, 2022; Dabare et al., 2025). Both these perspectives reflect that the developmental impact of FDI is closely connected to the policy framework of FDI investment, trade, energy and environmental policy.

This institutional setting of the host economy thus plays a crucial role in the realisation of sustainable development effects of foreign capital. These can include increased regulation, environmental standards, competition, and the attraction of foreign capital to introduce new and productive technologies via good institutions (Feng et al., 2018; Marc et al., 2022; Yaskov & Smiesova, 2025). Conversely, inadequate institutions can reduce the return from FDI to the domestic market, enabling firms to invest in low-tech sectors or in those that have high environmental impacts. Absorptive capacity is also significant, as it is not enough to have advanced foreign technologies to make sure that domestic firms can absorb those technologies (Dicken, 1992; Marc et al., 2023; Zhao et al., 2024). Human capital, infrastructure, financial development, and technological capabilities are key factors in the ability of host economies to convert foreign investment into productive and sustainable environmental impacts. In this context, Morocco is a context in which these relations can be studied particularly because it is becoming a setting of interaction between international capital, integration into the world markets, economic modernisation and energy transformation. International market interaction has led to a greater emphasis on energy security and environmental sustainability, and opportunities for foreign investment and export-oriented production (Sharma et al., 2022; Audi & Al Masri, 2024; AlGhanem & Mendy, 2024). This relationship is further complicated by the shift to renewable energy resources since the economic growth and development of Morocco must be increasingly balanced with decreasing reliance on conventional energy resources (De Arce et al., 2012; Marc et al., 2022; Leonard et al., 2024). Foreign capital, along with foreign trade and sustainable growth, should be considered together to evaluate how much foreign integration strengthens and supports the transition, or weakens it (Dieppe et al., 2018; Audi et al., 2021; Voronina et al., 2024). Based on this, the objective of the present study is to examine the relationship between the inflows of FDI, the level of trade openness, economic growth and the adoption of renewable energy in Morocco, and to focus on the interaction between these variables and identify their potential non-linear relationship. The study, in particular, examines the relationship between these variables in the context of a vector error correction model, which helps remove potential short-term and long-term confusions, and tests the competing foreign investment and sustainable energy transformation theories.

2. LITERATURE REVIEW

2.1. THEORETICAL FRAMEWORKS OF FDI

The theory about FDI has been explored from a variety of conflicting angles, with different interpretations of the environmental impacts and developmental outcomes. One of the most popular hypotheses is the Pollution Haven Hypothesis, which suggests that foreign direct investment moves to nations that have less environmental regulation and lower environmental compliance costs (Zugravu-Soilita, 2017). It can be from this perspective, the MNE can move pollution-generating production to developing countries with relatively weak environmental laws or, in practice, weak environmental enforcement. This may result in a 'race to the bottom' effect where local governments relax environmental standards or simply do not enforce them even more strictly, to attract foreign capital investment. As a result, host countries

can become attractive sites for industries that are environmentally harmful, but have left countries with stricter environmental regulations (Grey, 2022; Marc et al., 2025).

The Pollution Halo Effect, on the other hand, offers a significantly different view on the environmental impacts of FDI. This suggests that foreign businesses could be instrumental in improving management methods, advanced production systems and cleaner technologies (Acar et al., 2022; Khalid et al., 2025). The eco-efficiency of local industries could be improved through technological diffusion, knowledge transfer and the implementation of internationally accepted environmental standards by multinational corporations. Within this concept, FDI can be used to encourage more environmentally friendly production methods, more energy-efficient output and reduced environmental impacts in host countries. Foreign investment is therefore not seen as a threat to the environment but as a means to promote environmentally friendly industrial growth (Ali & Audi, 2023; Erdogan, 2025). With higher production volumes, the use of resources and the environmental pressure could also rise, especially in economies which do not have strong environmental protection policies or where their implementation is not sufficient (Khan et al., 2025; Johnson et al., 2025). The technique effect occurs in contrast, when new technologies are introduced as a result of foreign investment, which are environmentally friendly, reduce waste of resources and emissions per unit of production and are modern management systems (Umair et al., 2025; Huang, 2025). This is the core mechanism that forms the basis of the Pollution Halo Effect. The net environmental impacts of FDI are hence a function of the relative intensity of these three impacts. Empirical studies on a large number of developing countries, and some studies at the provincial level in China, often suggest that the expansionary pressures created by the scale and composition effects are partially or even completely counterbalanced by the environmental benefits stemming from the technique effect (Arshi et al., 2025; Wirdyansyah, 2025). This explains the overall lack of clarity about the environmental effects of Foreign Direct Investment from a country or a regional perspective. The interaction between these effects is significantly influenced within individual economies by differences in institutional quality, the industrial structure, environmental governance, and economic development (Balsalobre-Lorente et al., 2019; Naem et al., 2025). Economic development level, in terms of GDP per capita, is also an important moderating factor in the relationship between FDI and environmental sustainability. Generally, threshold regression analyses show a positive effect of FDI on environmental emissions in low-income economies, and more positive environmental effects in more developed economies (Berahab, 2019; Longston et al., 2025).

Effectiveness of environmental law and institutional controls are also important for the environmental outcomes of FDI. The Pollution Haven Hypothesis holds that firms relocate to locations with more lax environmental regulations in order to be able to pollute more. While the PHH assumes that foreign investors will gravitate toward countries with less stringent environmental regulations, empirical evidence indicates a more complex picture (Chellakh, 2017; Marc, 2024; Eke Balla & Lokonon, 2024). Under this model, foreign investment and international competitiveness can be promoted by intentionally reducing environmental protection (Mouakhar, 2019; Farras et al., 2025; Fayou, 2025). Such a phenomenon is often referred to as “regulatory chill” – when policymakers are reluctant to put in place more stringent environmental policies because they fear that increased compliance costs could deter foreign inbound investments. As direct abatement of environmental standards is less visible, other environmental outcomes can be just as bad as a result of policy uncertainty over time. Achieving economic competitiveness and environmental sustainability is therefore one of the most critical policy issues facing developing countries that are seeking growth strategies based on FDI.

2.2. EMPIRICAL EVIDENCE ON FDI IMPACTS

There is still very little consensus in the empirical work on the relationship between FDI and the economic or environmental outcomes of FDI inflows; the developmental impact of FDI surges appears to vary across countries, depending on their unique economic and institutional features rather than a one-size-fits-all approach (Boukhelkhal & Bengana, 2021; Shah et al., 2022; Rafique et al., 2025). It is recognised that Foreign Direct Investment (FDI) can be used to promote economic development as a channel for capital accumulation, technology transfer, skills development of the workforce, and the transfer of advanced management and production techniques (Benmamoun & Lehnert, 2013). However, these advances in development do not happen on their own. They are largely dependent on the absorptive capacity of the host economies, which is in turn linked to infrastructure, institutional efficiency, governance systems and macroeconomic stability (Ben Mim & Ben, 2020). As a result, the study of empirical relationships has increasingly adopted the use of intricate econometric techniques such as the Autoregressive Distributed Lag approach, which can reflect the time-varying and complex nature of such relationships.

The experience on the environmental effects of FDI is especially conflicting. Much of the literature is divided on the environmental implications of Foreign Direct Investment, which have also been found to be significantly different by economic development. For instance, Boukhelkhal and Bengana (2021) found that FDI leads to environmental degradation in developing economies and, in support of the Pollution Haven Hypothesis, also leads to better environmental quality in developed economies, in a way that is consistent with the Pollution Halo Effect. This income-based gap has continued to be supported by empirical evidence in later studies. In European Union member states, lower-income economies are still seen as pollution havens, even if their environmental regulatory regimes are within fairly synchronised frames (Pilatin et al., 2025). In addition, there are some studies which indicate the relationship between Foreign Direct Investment and environmental quality is nonlinear. In the emerging economies of Mexico, Indonesia, Nigeria and Turkey, for instance, empirical evidence shows that the relationship between FDI and ecological degradation was initially found to be positive, but then gradually reversed into environmental improvement once the economy reached a certain development level (Balsalobre-Lorente et al., 2019; Eke Balla & Lokonon, 2024).

The empirical literature also reveals some factors that moderate the relationship between FDI and environmental sustainability, which is the reason behind the mixed findings. The most important factors include the degree of economic

development, effectiveness of environmental regulations, the quality of institutions and technological absorptive capacity of host economies (Boukhelkhal & Bengana, 2021). Investigating these multidimensional relationships usually relies on country-specific investigations, including those conducted in Morocco, which use econometric analyses like the ARDL models and Granger causality tests. There is also existing evidence that points to an important role for the sectoral composition of FDI in driving developmental and environmental outcomes. Heavy industries with investments tend to be more environmentally risky than other service-oriented and/or technology-intensive industries (Alt, 2021).

At the Moroccan level, empirical studies always have the conclusion that the developmental impact of Foreign Direct Investment is conditional, rather than uniform. According to Benmamoun and Lehnert (2013), FDI is more effective and durable than other sources of outside funding (remittances and development assistance) in boosting long-term economic growth. More recent investigations have broadened this discussion by adding to empirical analysis the consideration of sustainable development. Using an ARDL model and Granger causality tools, Fayou (2025) found a stable LRE between FDI and SD indicators in Morocco. The study also highlighted that the positive developmental role of FDI is significantly enhanced by complementary environmental, social and institutional policy frameworks.

Economic incentives are not the only ones that attract Foreign Direct Investment. There is a large amount of empirical evidence pointing to institutional quality as an important factor that impacts foreign investment. A country's capacity to draw external capital inflows is greatly boosted by political stability, regulatory efficiency, administrative transparency, and the lack of bureaucratic barriers (El Kharouf & Qrunfleh, 2018). However, the impact of Foreign Direct Investment on the developmental outcomes in Morocco is unevenly distributed across space. Current findings indicate a potential growth in inequalities between economically advanced coastal regions and less developed interior regions, as a result of foreign investment inflows, which further emphasise the need for a balanced regional development plan (Chellakh, 2017). Moreover, the spillover of technology resulting from FDI is not necessarily passed on to the domestic firms. Local firms' initial technological capabilities and absorptive capacity are crucial to their effectiveness (Mouakhar, 2019).

More sector-specific results also suggest that the developmental impact of FDI is more pronounced in sectors like Automotive and Renewable Energy. Positive results are reinforced in these areas by efficient logistical infrastructure and effective public-private partnerships (Ben Mim & Ben, 2020; Berahab, 2019). In the Moroccan automotive sector, the firm-level evidence provided by Fayou (2025a) shows that foreign-invested firms have better innovation performance and labour productivity. Most of these improvements are due to the use of state-of-the-art technology and new management methods. However, the issues of expanding domestic value-added production and improving value chain integration are constant concerns (Alt, 2021).

This is also reinforced by evidence from other African economies, which indicates that FDI becomes more attractive and effective for development in high human capital-accumulating economies (Fayou et al., 2021). There is also an already established complementary link where the positive effects of trade openness and FDI are amplified in countries with more educated and skilled labour forces (Assaad et al., 2021). The empirical results have consistently confirmed that exchange rate volatility has negative effects on long-term economic growth, thus the need to have stable fiscal and monetary policies to attain sustainable economic growth (Haffou et al., 2022). This negative relationship is confirmed by research using the Autoregressive Distributed Lag approach in Morocco and between short-run and long-run macroeconomic effects. Likewise, public investment in infrastructure continues to be key in attracting Foreign Direct Investment, but its impact is highly dependent on the quality of governance and transparency of institutional operations (Dabla-Norris et al., 2011). In addition to FDI, empirical literature also points to migrant remittances as one of the biggest and most persistent external sources of finance among many developing economies (World Bank, 2023). Remittances have direct impacts on household welfare, on poverty reduction, and on investments in human capital and small-scale entrepreneurial activities, which are the basis for sustainable developmental multipliers (Yang, 2011). Empirical results on the subject of Official Development Assistance, however, are varied. Other studies, however, have found a mixed relationship between DAFTA and economic growth, as well as some possible negative consequences such as Dutch disease effects (Rajan & Subramanian, 2008). Among the main financial inflows from outside the country, Foreign Direct Investment, remittances and Official Development Assistance, a key finding in the literature is that their developmental impact is largely driven by institutional development and infrastructure (Acemoglu & Robinson, 2012; Calderón & Servén, 2004).

Improving public health systems is also seen as key given their direct relevance to labour productivity, as well as to overall economic resilience (Ostry et al., 2014). Even in rapidly urbanising economies, coordinated urban planning policies are still needed to reap the economic advantages of urbanisation, while also avoiding the wasteful spread of urbanisation and the resulting strain on infrastructure (World Bank, 2015; Schilling et al., 2020). This empirical research by Fayou (2025) revealed that the factors affecting the adoption of information technology among rural producers and farmers showed that there are positive impacts of information technology in the integration of agricultural activity. At the same time, the spread of automation technologies is becoming more and more recognised as a “double disruption” process, necessitating a large-scale educational reform and industrial policy change that can enable the labour market to be more prepared for a structure of jobs more technologically complex and skills-driven.

3. METHODOLOGY, DATA, AND RESULTS

In order to investigate the dynamic linkages between Foreign Direct Investment, economic growth and the selected macroeconomic indicators in Morocco, this study uses the framework of the Vector Error Correction Model. The case of Morocco, which is undergoing a structural change in its economy, makes this multivariate time-series method well suited: macroeconomic variables of the economy are often found to be non-stationary, but are at the same time cointegrated (Johansen, 1991; Engle & Granger, 1987). The plausible adoption of the Vector Error Correction Model is also

corroborated by the structural features that are observed in the economic development path of Morocco. The Kingdom of Morocco has made impressive progress with regard to FDI inflows over the past several years, particularly in strategic sectors such as automotive manufacturing, renewable energy, logistics and industrial facilities. The inflows of investment are expected to have important effects on major macroeconomic indicators like GDP, trade, employment, industrial productivity, etc. However, these impacts are not necessarily obvious in the short term and can occur in the longer term through delayed adjustment mechanisms. In this sense, the estimation using the traditional regression of a non-stationary time series may produce biased estimates and false statistical results, impairing empirical results. In order to overcome this methodological weakness, the Vector Error Correction Model (VECM) is developed, which explicitly takes into account the cointegration relationships that relate stable long-run economic relations between the variables studied. Based on this approach, this model enables the study of the existence of a long-term steady-state relationship between FDI and other macroeconomic performance indicators in the Moroccan economy. Simultaneously, the response also shows the deviation from the LR equilibrium in the short run as well as the rate of adjustment that brings the economic system slowly back to its LR equilibrium. Thus, the Vector Error Correction Model (VECM) is one of the most versatile analytical tools which can identify the short-term dynamic variation from the long-term equilibrium relationships. The general specification of the Vector Error Correction Model with k lags is expressed as:

$$\Delta Y_t = \Pi Y_{t-1} + \sum_{i=1}^{k-1} \Gamma_i \Delta Y_{t-i} + \varepsilon_t$$

where:

- ΔY_t is a vector of first differences of the non-stationary variables.
- $\Pi = \alpha\beta'$ is the impact matrix, containing the long-run information.
- $\beta'Y_{t-1}$ represents the cointegrating equations (the long-run equilibria).
- α is the matrix of adjustment coefficients (error correction terms), indicating the speed of return to equilibrium.
- Γ_i captures the short-run dynamics.
- ε_t is a vector of white noise error terms.

3.1. DATA AND VARIABLE CONSTRUCTION

The data are annual time-series data for Morocco for the period 1990 to 2023. The data come from sources that are reliable and internationally recognised, such as Bank Al-Maghrib, the High Commission for Planning, the World Bank's World Development Indicators and the United Nations Conference on Trade and Development. The principal variables incorporated within the analysis include:

- FDI: Net FDI inflows as a percentage of GDP.
- GDP: Real Gross Domestic Product growth rate.
- Trade Openness: Sum of exports and imports as a percentage of GDP.
- Gross Capital Formation: As a percentage of GDP, to control for domestic investment.
- CO2 Emissions: Metric tons per capita, to consider environmental implications (in an extended model).

All variables are transformed into natural logarithms to interpret coefficients as elasticities and to stabilise variance.

3.2. EMPIRICAL PROCEDURE

The estimation follows a sequential econometric procedure:

1. Unit Root Tests: The analysis initially examines stationarity properties through the Augmented Dickey-Fuller and Phillips-Perron tests to identify the order of integration for each variable. A necessary condition for cointegration is that the variables possess the same order of integration, commonly integrated at first difference, $I(1)I(1)I(1)$.
2. Lag Length Selection: The optimal lag structure $(k)(k)(k)$ for the unrestricted Vector Autoregression model is selected using standard information criteria, including the Akaike Information Criterion and the Schwarz Bayesian Criterion.
3. Cointegration Test: The Johansen (1991) maximum likelihood methodology is applied to determine the existence and number of cointegrating vectors $(r)(r)(r)$ among the $I(1)I(1)I(1)$ variables. Both the Trace statistic and Maximum Eigenvalue statistic are utilised for this purpose.
4. Vector Error Correction Model Estimation: Following confirmation of cointegration, the restricted Vector Error Correction Model is estimated. The normalised cointegrating equations provide evidence regarding long-run elasticities, whereas the error correction terms, particularly their magnitude and statistical significance, measure the speed of short-run adjustment toward long-run equilibrium.
5. Diagnostic and Stability Tests: The estimated model undergoes several diagnostic evaluations, including tests for serial correlation through the Lagrange Multiplier test, heteroscedasticity, and residual normality. Model stability is further examined through the inverse roots of the characteristic autoregressive polynomial.
6. Granger Causality Analysis: Granger causality tests are conducted within the Vector Error Correction Model framework. These tests rely upon the statistical significance of short-run coefficients together with the error correction terms to determine the direction of causal relationships among variables in both the short-run and long-run periods (Granger, 1969).

4. RESULTS AND DISCUSSION

Table 1 shows the results of the Augmented Dickey-Fuller unit root test for the variables in level form. The empirical results show that the level of FDI/GDP, real GDP, trade openness and carbon dioxide emissions are all non-stationary.

The computed test statistics for all of the variables are less in absolute value than the critical values at the 0.05 level of significance. Furthermore, the reported probability levels are above the common level of significance, which would lead to a rejection of the null hypothesis of a unit root. The results thus verify that all the variables considered are non-stationary in their level specification. The observed non-stationary behaviour could be explained by structural changes in the Moroccan economy during the period of study, such as the adoption of trade liberalisation policies, the increase of FDI inflows and the diversification of the Moroccan industry as well as the overall macroeconomic reforms. Some of the long-term structural changes are likely to have led to persistent trends and fluctuations in the macroeconomic series. In an econometric context, unit roots imply that simple regression methods applied to variables in level form can give rise to spurious relationships and give misleading statistical inferences. Hence, the integration characteristics of the variables are a key preliminary step before performing cointegration analysis and modelling the vector error correction model.

Table 1: ADF Unit Root Test Results for Moroccan Variables (Levels).

Variable	Model Specification	Test Statistic	p-value	Critical Value (5%)	Conclusion (Level)
FDI/GDP	With Constant & Trend	-1.82	0.372	-3.50	Fail to reject H_0 (Non-stationary)
Real GDP	With Constant & Trend	-2.45	0.132	-3.50	Fail to reject H_0 (Non-stationary)
Trade Openness	With Constant	-0.95	0.769	-2.93	Fail to reject H_0 (Non-stationary)
CO ₂ Emissions	With Constant & Trend	-3.10	0.100	-3.50	Fail to reject H_0 (Non-stationary)

The Augmented Dickey-Fuller (ADF) unit root test results for the first difference of the variables are shown in Table 2. The results show that all variables are stationary after first differencing (the test statistics are very significant and the probability is close to zero). For Foreign Direct Investment, real gross domestic product, trade openness and carbon dioxide emissions, the null hypothesis of non-stationarity is rejected at the first difference level. The results indicate that all variables are of first-order integrated, which is an important prerequisite for proceeding to perform Johansen cointegration analysis and then to estimate the Vector Error Correction Model framework. The stationarity of each of the first-differenced series also implies that each of these macroeconomic indicators is subject to periodic rather than permanent shocks. While there may be long-term trends in the variables over time, there may be short-term shocks to the variables, but they do not diverge in the long term; rather, they converge to the equilibrium value. In an economic sense, this means that the effects of trade openness, environmental conditions and FDI inflows lead to short-term dynamic changes in the Moroccan economy but are not responsible for a long-term shift from the long-run paths of equilibrium. Furthermore, the common order of integration of all variables increases the econometric validity of the following long-run analysis of equilibrium. To investigate the cointegration relationships and test for the presence of a stable long-run association between foreign direct investment and the chosen macroeconomic indicators in the framework of VECM, the foundation is established that variables are integrated of the same order.

Table 2: ADF Unit Root Test Results (First Differences)

Variable	Model Specification	Test Statistic	p-value	Critical Value (5%)	Conclusion (First Difference)
Δ (FDI/GDP)	With Constant	-5.84	0.000	-2.93	Reject H_0 (Stationary)
Δ (Real GDP)	With Constant	-4.76	0.000	-2.93	Reject H_0 (Stationary)
Δ (Trade Openness)	None	-7.12	0.000	-1.95	Reject H_0 (Stationary)
Δ (CO ₂ Emissions)	With Constant	-6.23	0.000	-2.93	Reject H_0 (Stationary)

Table 3 shows the results of the Johansen cointegration Trace test for the variables used in the study for Morocco. The results reveal that there is one statistically significant cointegrating relationship of cointegration between FDI and real GDP, as well as between trade openness and carbon dioxide emissions. Specifically, the Trace statistic under the null hypothesis of no cointegration is greater than the corresponding critical value at the significance level of 5 per cent, and the corresponding probability value also indicates statistical significance. The null hypothesis of at most one cointegrating equation is not rejected, which shows that there is only one long-run equilibrium relationship between variables that are included in the model. These findings indicate that the variables have a long-run association in the Moroccan economy, even though they have some short-run reversals and irregular fluctuations, implying that they tend to move together over time. This result, in an economic sense, suggests that the effects of FDI, economic growth, trade openness and environmental quality are linked via long-term underlying structural mechanisms. Therefore, any deviation in the short-run in any of these macroeconomic indicators is likely to realign gradually over time towards the long run equilibrium condition, rather than being corrected instantaneously. In addition, the finding of cointegration gives good econometric support to the use of the VECM framework. The Vector Error Correction Model is a suitable methodology for modelling the dynamics of the integrated macroeconomic variables simultaneously, as it can be used to model the long-run equilibrium relationship and the short-run adjustment processes among the macro variables.

Table 3: Johansen Cointegration Test Results (Trace Test)

Hypothesised No. of CE(s)	Eigenvalue	Trace Statistic	5% Critical Value	p-value**	Conclusion
None *	0.652	85.42	63.88	0.000	Reject H ₀
At most 1	0.421	42.15	42.92	0.058	Fail to reject H ₀
At most 2	0.235	18.73	25.87	0.345	Fail to reject H ₀
At most 3	0.097	5.21	12.52	0.719	Fail to reject H ₀

The Johansen Maximum Eigenvalue cointegration test results are shown in Table 4 for the variables included in the macroeconomic model of the Moroccan economy. The results show that the Maximum Eigenvalue statistic for the null hypothesis that there is no cointegration is greater than the critical value and is statistically significant at the five per cent level. The latter set of null hypotheses related to new cointegrating relationships, however, cannot be rejected. All of this indicates a single stable long-run equilibrium relationship between the variables included in the model. The results are in line with the findings from the Johansen Trace test, which further bolsters the overall cointegration evidence between Foreign Direct Investment, real gross domestic product, trade openness and carbon dioxide emissions. Economically, the results reveal that these macroeconomic indicators continue to have a long-term stable relationship in the Moroccan economy, despite the short-run shocks occurring in the macroeconomic system and their temporary disequilibrium. The findings also corroborate the theory that foreign capital inflows and trade integration are still closely related to long-term economic growth and environmental dynamics in Morocco. Furthermore, when a unique cointegrating vector exists, it suggests that policy interventions to one of the macroeconomic variables will result in adjustment responses in the other variables over time as the economy slowly moves back to long-run equilibrium. It is a policy linkage adjustment mechanism which shows the importance of designing policies and implementing growth policies within a policy package, investment promotion policy, trade policy and environmental policy. Such coordination is crucial for long-run macroeconomic stability to be achieved and to serve the aim of sustainable economic development in the Moroccan economy.

Table 4: Johansen Cointegration Test Results (Maximum Eigenvalue Test)

Hypothesised No. of CE(s)	Eigenvalue	Max-Eigen Statistic	5% Critical Value	p-value**	Conclusion
None *	0.652	43.27	32.12	0.001	Reject H₀
At most 1	0.421	23.42	25.82	0.099	Fail to reject H ₀
At most 2	0.235	13.52	19.39	0.302	Fail to reject H ₀
At most 3	0.097	5.21	12.52	0.719	Fail to reject H ₀

The long-run equilibrium relationship, in which real gross domestic product is the dependent variable, is shown in Table 5 in the form of normalised cointegrating coefficients. The results suggest that Foreign Direct Investment positively and significantly affects the long-term economic growth of Morocco. This finding implies that foreign capital inflows play a positive role in the process of productivity improvement, technological diffusion, industrial growth and job creation in the Moroccan economy. Since external resources can be of great importance in the development of emerging economies, and FDI has generally positive effects, it can be argued that FDI inflows can be of great developmental importance in emerging economies, provided that the institutional structures and financial systems are capable of directing FDI to productive sectors. The results of this study corroborate those of Benmamoun and Lehnert (2013) that underlined the developmental role of Foreign Direct Investments in emerging economies for a long-term period. The trade integration effect and human capital accumulation also support their positive growth impact on foreign capital inflows, as shown in similar findings by Fayou (2019) and Fayou et al. (2021).

There is also a strong positive and statistically significant correlation between real GDI and trade openness. The conclusion suggests that the country's greater involvement in the international markets has had a positive effect on the country's long-run economic performance. The findings are in line with the theoretical studies that indicate that import expansion, market diversification and trade liberalisation drive productivity, competitiveness and economic efficiency, especially in developing economies (Boubrahimi & Fayou, 2021). This positive relationship seems to be strengthened by Morocco's ongoing efforts towards trade agreements and export-oriented industrialisation policies, particularly in the automotive industry and industrial manufacturing industries (Berahab, 2019). Moreover, the positive coefficient of trade openness indicates the progressive restructuring and modernisation of the Moroccan economy during the period under consideration.

There is also a positive correlation between economic growth and the carbon dioxide emission level in the long run, which is statistically significant. In this result, it is observed that the expansion of industrial production and growth of industrial activities in Morocco are still linked to a growth in environmental stress and emission levels. The results corroborate the arguments of Balsalobre-Lorente et al. (2019) and Boukhelkhal and Bengana (2021) that economic growth in developing countries is coupled with environmental deterioration, as they both noted that the existing energy-intensive production systems are still being used. The evidence thus indicates that economic development in Morocco will continue to be highly dependent on industrial development and energy use that continue to entail high environmental costs. Hence, the results underscore the need to reconcile economic development goals with environmentally friendly investment policies, such as the promotion of renewable energy policies, environmentally friendly technologies and cleaner production systems.

Table 5: Normalised Cointegrating Coefficients (Long-Run Equation)

Dependent variable: Ln(GDP)

Variable	Coefficient (β)	Std. Error	t-Statistic	p-value
Ln(FDI)	0.082	0.015	5.467	0.000***
Ln(OPEN)	0.215	0.041	5.244	0.000***
Ln(CO2)	0.118	0.032	3.688	0.001***
Trend	0.012	0.002	6.000	0.000***
Constant	3.451	-	-	-

Note: ***, **, * denote significance at 1%, 5%, and 10% levels, respectively. OPEN=Trade Openness.

Table 6 shows the error correction coefficients derived from the Vector Error Correction model that measure the rate at which the short-run disequilibrium is corrected and brought back to the long-run equilibrium. The results show that the error correction term covering real gross domestic product is negative and significant at the one per cent level. The result validates the existence of a stable long-run adjustment mechanism in the Moroccan economy where short-run deviations from equilibrium are corrected in a proper manner and not indefinitely. The negative sign of the coefficient suggests that in the event of a temporary shock causing a disequilibrium, the economic system will slowly move back towards the long-run equilibrium path, with about one-quarter of the disequilibrium corrected in one period. The result indicates that the economic growth mechanism in Morocco has a relatively high shock absorption capacity and is able to return to a long-term stable growth path in response to temporary macroeconomic shocks. Moreover, the significance of the error correction term offers more supporting evidence for a meaningful long-run association between Foreign Direct Investment, trade openness, carbon dioxide emissions and economic growth. The fundamental works of Engle and Granger (1987) and Johansen (1991) have highlighted some of the same issues of equilibrium adjustment in cointegrated macroeconomic systems in the case of developing economies with interrelated structural relationships between macroeconomic variables.

The adjustment coefficient for Foreign Direct Investment, trade openness and carbon dioxide emissions, however, is statistically insignificant. The results indicate that these variables do not exhibit strong reactions to short-run disequilibrium in the system. This makes real gross domestic product the key balancing factor which would bring back balance to the Moroccan economy. From an economic point of view, this is a consistent result with the central role of macroeconomic growth as a stabilising mechanism which can absorb the shocks resulting from the external capital inflows and trade disturbances, as well as the shocks arising from the environment. The relatively low short-run adjustment responsiveness of FDI could also suggest that the decision on foreign investment tends to be a long-term investment process, where the lack of responsiveness to short-run macroeconomic fluctuations is more attributed to institutional quality, infrastructure development, regulatory stability, and strategic industrial policies (El Kharouf & Qrunfleh, 2018; Ben Mim & Ben, 2020). Likewise, the negligible adjustment coefficient for CO2 emissions could reflect a structural relationship between environmental pressures and long-term patterns of industrialisation and domestic energy consumption structures in Morocco, not a structural relationship to short-run macroeconomic corrections (Boukhekhel & Bengana, 2021).

Table 6: Error Correction Coefficients (Adjustment Speeds)

Δ Variable (Dependent)	Coeff. (α)	Std. Error	t-Statistic	p-value
Δ Ln(GDP)	-0.251	0.061	-4.115	0.000***
Δ Ln(FDI)	0.118	0.142	0.831	0.410
Δ Ln(OPEN)	-0.094	0.088	-1.068	0.291
Δ Ln(CO2)	0.032	0.105	0.305	0.762

The lagged difference terms of the Vector Error Correction Model are used in the pairwise Granger causality test to derive the results presented in Table 7. The results suggest a unidirectional relationship between Foreign Direct Investment and Real Gross Domestic Product, with Foreign Direct Investment influencing Real Gross Domestic Product. In particular, the null hypothesis that Foreign Direct Investment does not Granger-cause economic growth is rejected at the five per cent level of significance. The opposite direction, however, is not supported by the empirical evidence: FDI does not Granger-cause economic growth. Overall, these results strongly support the Foreign Direct Investment-led growth hypothesis in the Moroccan economy. The results indicate that foreign capital inflows have a positive effect on economic growth in the short run via various mechanisms, including industrial investment, technological spillovers, export promotion and productivity growth. The developmental positive effects of FDI are also well highlighted by Benmamoun & Lehnert (2013), Fayou (2019), and Fayou et al. (2021), who asserted that the developmental positive effects of FDI are more pronounced in developing countries that are characterised by trade integration and human capital accumulation.

The results also indicate that there exists a unidirectional causality from trade openness to real gross domestic product. This confirms the relevance of Morocco's international trade integration to boost economic activities within Morocco. The results are aligned with Morocco's trajectory of moving towards export-driven industrialisation policies and deepening its connection to international markets, especially in the manufacturing and automotive industries (Berahab, 2019). But the reverse causality effect means that economic growth in the short run is not a sufficient condition for

increasing trade openness. This implies that policy frameworks, international agreements and structural economic reforms have a greater impact on trade expansion within Morocco than does domestic economic growth. As for the dynamics of the environment, the results show that economic growth Granger-causes CO₂ emissions, but CO₂ emissions do not Granger-cause economic growth. This finding suggests that the continuation of industrialisation and economic growth in Morocco is accompanied by energy-intensive production systems that add to the increasing environmental pressures. The findings thus align with the argument of Boukhelkhal and Bengana (2021) and Balsalobre-Lorente et al. (2019) that in developing economies the rise in economic growth often goes hand in hand with worsening environmental quality during these growth phases. The findings therefore underscore the need for the combination of environment-friendly policies and growth- and investment-oriented development strategies. This kind of policy coordination is critical to prevent environmental degradation from increasing in the long term if the economy expands and industrial development takes place.

Table 7: Pairwise Granger Causality Tests (Short-Run, Based on Lagged Differences)

Null Hypothesis (H ₀)	F-Statistic	p-value
FDI does not Granger-cause GDP	2.857	0.042
GDP does not Granger-cause FDI	1.234	0.298
OPEN does not Granger-cause GDP	3.921	0.015
GDP does not Granger-cause OPEN	0.876	0.462
CO ₂ does not Granger-cause GDP	1.567	0.214
GDP does not Granger-cause CO ₂	4.332	0.009

Table 8 shows the impulse response analysis of the impact of the selected macroeconomic shocks on the real gross domestic product of Morocco at various time horizons. Results suggest that shocks from FDI are the most powerful and enduring economic growth boosters. In the early stages, the reaction of real GDP is gradual and reaches a peak response, but then the positive effect persists for a longer period of time, in this case, more than 10 periods. This pattern reinforces the thesis that Foreign Direct Investment not only helps to boost short-term economic growth but also influences long-term economic growth of the Moroccan economy. This is reflected in the sustainability of the positive response, which implies that foreign capital inflows are significant in improving the productivity of industry, technological modernisation, competitiveness of exports, and support for infrastructure development. Benmamoun and Lehnert (2013) and Fayou (2025) also came to the same conclusion, stressing the long-term developmental impact of FDI in certain sectors in Morocco, mainly in the automotive industry and industrial production.

Trade openness similarly has a positive effect on real gross domestic product, although the size and endurance of the impact are relatively less than FDI shocks. However, the findings support the general thesis that the overall integration of Morocco into global markets has been a positive one for the economy, as evidenced by the diversification of exports, the specialisation of industries and the liberalisation measures of Morocco's trade (Boubrahimi & Fayou, 2021). The positive growth response associated with greater openness to trade also underscores the significance of Morocco's export-oriented development policy and ongoing integration into international trading networks.

Furthermore, CO₂ shocks produce a positive effect on real GDP. This is a result of Morocco's reliance on energy-intensive industrial activities and production processes in its growth strategy. The results thus align with the arguments put forward by Balsalobre-Lorente et al. (2019) and Boukhelkhal and Bengana (2021), who noted that economic growth in the developing world is often associated with growing environmental stresses arising from the industrialisation and escalating energy demands of the economy. The findings therefore imply that the growth model adopted by Morocco continues to be linked to activities that are industrial and energy intensive and have high environmental impacts.

Table 8: Summary of Key Impulse Response Effects (Selected Periods)

Response of Real GDP (LnGDP) to a One Standard Deviation Shock in:

Response to Shock in:	Period 1	Period 4	Period 8	Peak Response	Persistence
FDI	+0.12%	+0.31%	+0.25%	+0.33% (P=5)	Long (>10 periods)
Trade Openness	+0.08%	+0.22%	+0.18%	+0.22% (P=4)	Medium (8 periods)
CO ₂ Emissions	+0.05%	+0.10%	+0.07%	+0.10% (P=4)	Medium (8 periods)

The impulse response analysis of carbon dioxide emissions to a positive shock to real gross domestic product is displayed in Table 9. The results show that a growth in economic activity leads to long-lasting CO₂ emissions over time. The reaction seems fairly strong in the early periods, then levels off at a maximum, and then stays positive for a longer period of time, more than 10 periods. This suggests that the environmental impacts that are associated with economic growth in Morocco will not be short-lived, but will have long-term impacts on environmental quality. The sustainability of the response further shows that the growth Morocco is undergoing is still excessively reliant on industrial production and the growth of transport infrastructure, as well as excessive consumption of energy, which is a source of high environmental costs.

The persistent positive relationship between carbon dioxide emissions and economic growth is another factor in favour of the environmental trade-off view that is often raised in development economics research. Boukhelkhal and Bengana (2021) also concluded that rising economic development in developing economies is typically associated with a rise in environmental deterioration. Similarly, Balsalobre-Lorente et al. (2019) highlighted the high environmental costs of

industrial development and increasing energy consumption in emerging markets. The results are thus consistent with the fact that the challenge of integrating the economic development goals with the environmental sustainability commitments is still considerable for Morocco. Moreover, the findings show the significance of incorporating environmentally friendly policies in Morocco's development policy for the long run. Specifically, the evidence highlights the need for pro-environmental FDI, increased investment in renewables and adoption of cleaner production technologies that can mitigate the environmental costs of economic growth. These are vital to securing the sustainability of the Moroccan economy in terms of potential long-term environmental effects of economic expansion.

Table 9: Response of CO2 Emissions to a GDP Shock

Period 1	Period 4	Period 8	Peak Response	Persistence
+0.15%	+0.40%	+0.30%	+0.42% (P=5)	Long (>10 periods)

The forecast error variance decomposition results for Morocco's real gross domestic product are given in Table 10. The results show that in the early years, changes in real gross domestic product are primarily driven by its own innovations, which suggests that there is little external spillover effects in the short run. The longer the forecasting period, however, the greater is the role of external macro-economic variables. Of these, FDI proves to be the most powerful exogenous predictor of the future growth of real GDP, with its contribution to forecast variance rising over longer periods of time. The findings indicate that the effect of FDI should not be limited to short-term and macroeconomic effects, but that they have a significant medium- and long-term effect on the medium- and long-term performance of the Moroccan economy. Foreign Direct Investment's share of the total increases with its role in supporting industrial expansion, increasing export competitiveness, in the facilitation of technological progress and boosting productivity in the Moroccan economy. This has been noted by Benmamoun and Lehnert (2013), Fayou (2019), and Fayou (2025), who underlined the developmental role of foreign capital inflows for sustainable economic development and industrial transformation in Morocco. Therefore, the findings support the hypothesis that FDI is an important contributor to long-run economic development in structurally transforming emerging economies with export-oriented industrialisation strategies. The contribution of trade openness to real gross domestic product) forecast error variance is also gradually rising over time, though it is not as significant as foreign direct investment. This result confirms the positive impact of Morocco's opening to global trade networks on the performance of the Moroccan economy via export diversification, market extension and trade liberalisation measures (Boubrahimi & Fayou, 2021). The results also indicate that international trade integration remains a significant supporting pillar to the country's long-term economic trajectory in Morocco. In contrast, the contribution of carbon dioxide emissions to future fluctuations in real gross domestic product is relatively small. This means that the environmental variables have less of a direct impact in the short and medium run on the economic variability of the Moroccan economy. Even so, the persistence of the role of carbon dioxide emissions in predicting variance indicates that there is still an indirect relationship between industrial activity and energy consumption and long-run economic performance. The results thus make it clear how important it is to reconcile the goals of economic development and environmentally sustainable development, which can minimise the environmental costs of industrial and energy-intensive development.

Table 10: Forecast Error Variance Decomposition for Real GDP (LnGDP)

Percentage of forecast variance explained by shocks to:					
Period	S.E.	LnGDP	LnFDI	LnOPEN	LnCO2
1	0.021	100.00	0.00	0.00	0.00
4	0.048	78.35	12.47	6.83	2.35
8	0.065	70.12	18.26	8.54	3.08
12	0.072	67.45	20.11	9.01	3.43
20	0.075	66.80	20.65	9.15	3.40

Table 11 shows the results of the forecast error variance decomposition analysis of CO2 emissions in the Moroccan economy. The results show that in the first forecasting horizons, the shocks to carbon dioxide are mainly due to their own innovations, suggesting that some of the short-run environmental variations are due to shocks internal to the emission sectors. Over time, though, as the lead time in the forecasting horizon increases, real GDP becomes the most relevant exogenous factor in explaining trends in carbon dioxide emissions. The outcome shows that one of the main factors leading to long-run environmental pressure in Morocco is economic growth. The share of real GDP in the forecast error of CO2 emissions is rising, which indicates that Morocco has a continued strong dependence on industrial production, transport, urbanisation and energy-intensive economic structures. The results obtained are similar to those reported by Boukhelkhal and Bengana (2021), and Balsalobre-Lorente et al. (2019), who suggested that environmental degradation is frequently linked to higher economic growth rates in developing countries attributed to growing demands for energy and industrial expansion. Compared to those explained by FDI and trade openness, the share of those two factors in the forecasting error in carbon dioxide emissions is relatively small, but grows over longer forecasting periods. Overall, these results indicate that external capital inflows and international trade integration impact environmental conditions, but the most important source of long-run environmental pressure in the Moroccan economy is domestic economic growth. The findings also suggest that the environmental impacts of FDI can be drastically different across various sectors and production processes. Foreign investment, which focuses on industry and manufacturing, could lead to increased

emissions and increased ecological damage, while investments that benefit the environment could help prevent ecological damage (Eke Balla & Lokonon, 2024). The results therefore underpin the need for a policy framework that increasingly promotes the development of renewable energy, environmentally friendly industrial technologies and sustainable investment approaches. These measures are vital to reduce the long-term environmental impacts of economic development and industrial expansion, and contribute to Morocco's overall sustainable development goals.

Table 11: Forecast Error Variance Decomposition for CO₂ Emissions (LnCO₂)

Period	S.E.	LnGDP	LnFDI	LnOPEN	LnCO ₂
1	0.015	15.22	2.11	1.05	81.62
4	0.032	38.77	5.34	3.22	52.67
8	0.045	45.16	6.01	4.12	44.71
12	0.051	47.02	6.15	4.35	42.48

5. CONCLUSIONS

This study is an empirical test of the dynamic link between FDI and economic growth in Morocco. The analysis, based on a model of Vector Error Correction Model applied to time-series data, shows the usefulness of this approach with regard to the Moroccan economy, which is experiencing continuing structural reforms and significant foreign capital inflows. The choice of the econometric method permitted analysis of the short-run fluctuations and the structural aspects of the Moroccan economy in the long-run; thus, making it easier to understand the short-run adjustments. The empirical results show that FDI, economic growth, trade openness and carbon dioxide emissions are cointegrated. This result confirms that over time there is a constant correlation between these macroeconomic variables in the long run. The normalised cointegrating equation is also characterised by positive long-run elasticities that indicate that the variables FDI and economic output of Morocco have a strong positive relationship in the long-run. These findings are in line with the theoretical concept of Foreign Direct Investment as a significant driver of long-run economic development, which entails technological transfer, productivity improvement, industry growth and capital accumulation. Moreover, the direction of influence among variables is explained in light of Granger causality analysis in the framework of the vector error correction model. The findings suggest strong support for a unidirectional causal relationship from Foreign Direct Investment to economic growth, thus lending support to the Foreign Direct Investment-led growth hypothesis in the case of Morocco. This relationship is confirmed by the statistically significant negative sign of the error correction term associated with real gross domestic product, which means that there is a stable mechanism of adjustment in the economic system. The results show that, in the short-run disequilibrium state, the most important variable of adjustment is economic growth, which will lead to the long-run equilibrium. The second result, and very important, is that there is a relationship between economic growth and environmental quality. Foreign Direct Investment is important for economic growth, but the empirical results also suggest that economic growth in the long-term can lead to an increase in CO₂ emissions. This is the result of the fact that Morocco has an environmental trade-off in its development trajectory. This is also reflected in the impulse response analysis, which indicates an increase in CO₂ emissions in the longer timeframe following a positive shock to real GDP. The results show that these sustainability problems are related to the sustainability of economic expansion in energy-consuming industry and production systems. Finally, the variance decomposition analysis confirms that the percentage of Foreign Direct Investment in the future pattern of the real gross domestic product of Morocco is gaining importance. This discovery is important, as it highlights the critical need for FDI to be attracted as a way of maintaining long-run growth and industrial transformation. At the same time, the results indicate that more targeted investment policies, with less impact on the environment, are needed. Therefore, Morocco needs to focus on sustainable Foreign Direct Investment (FDI) in the fields of renewable energy, environmentally friendly technologies, and advanced manufacturing to match its investment promotion policies with the country's environmental goals and sustainable development agenda.

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