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EXPLORING THE IMPACT OF CLIMATE CHANGE ON FDI: EVIDENCE FROM MOROCCO

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Abstract

Climate change has become a central global concern with repercussions across multiple sectors, including economic development. In the Moroccan context, where attracting Foreign Direct Investment (FDI) is pivotal for growth, understanding the relationship between climate change and FDI is of paramount importance. This study employs the Autoregressive Distributed Lag (ADRL) model to scrutinize this intricate nexus and examines the mediating roles of Information and Communication Technology (ICT) and Renewable Energy Potential. Our research reveals that climate change exerts a discernible negative impact on FDI inflows in Morocco. Furthermore, we find that ICT serves as a significant mediator, enhancing Morocco's adaptive capacity in response to climate challenges and attracting FDI. Renewable Energy Potential, also emerges as a compelling mediator, as investors increasingly seek sustainable ventures in a changing climate. These findings hold substantial policy implications for Morocco and nations with similar aspirations for economic growth and sustainability. Policymakers should consider climate resilience strategies alongside investment promotion efforts. The study underscores the importance of accounting for climate change in investment decision-making processes and emphasizes the instrumental role of technology and renewable energy in bolstering FDI. This research contributes significantly to the fields of applied economics, climate change mitigation, and sustainable development by offering actionable insights into navigating the challenges of climate change while fostering FDI. As the world grapples with climate-related economic risks, this study provides a roadmap for nations like Morocco to pursue a resilient and prosperous future.

Keywords: Climate change, FDI, ICT, Renewable Energy Potential

INTRODUCTION

Climate change has emerged as one of the most significant global challenges of the 21st century, with far-reaching implications for various aspects of society, including the economy. As the world grapples with the consequences of a changing climate, it has become increasingly imperative to understand how climate change influences economic dynamics, especially within the context of emerging economies. This study delves into the complex interplay between climate change, Foreign Direct Investment (FDI), and several mediator and control variables within the unique setting of Morocco. Climate change, characterized by rising global temperatures, shifts in precipitation patterns, and an increase in extreme weather events, presents a multifaceted challenge to nations across the globe. It has profound implications for economic stability and development, making it a crucial variable to consider in the context of FDI. Changes in climate can impact sectors vital to a nation's economic growth, such as agriculture, and infrastructure resilience, thereby influencing investment decisions.

Foreign Direct Investment (FDI) is a pivotal driver of economic growth in many countries, including Morocco. FDI represents investments made by foreign entities in domestic enterprises, bringing with it capital, technology, and market access. Morocco, with its strategic location, stable political environment, and diverse economic sectors, has actively sought to attract FDI to foster economic development. However, the relationship between climate change and FDI in Morocco has not been explored comprehensively.

Two crucial mediator variables warrant attention in this study. Firstly, Information and Communication Technology (ICT) can play a pivotal role in mitigating the impacts of climate change. It can enhance disaster preparedness, facilitate efficient resource allocation, and promote sustainable practices—all factors that may influence FDI decisions. Secondly, Morocco's significant renewable energy potential is an attractive prospect for investors seeking sustainable ventures in response to climate change concerns. Exploring how these variables mediate the relationship between climate change and FDI is a central focus of this research. Recognizing the multifaceted nature of FDI determinants, this study incorporates a wide array of control variables. These encompass factors ranging from urbanization and human capital to political stability, healthcare, transportation infrastructure quality, agricultural growth, trade, economic growth, inflation and exchange rates. By controlling for these variables, we aim to isolate the specific impact of climate change on FDI while considering the broader economic and socio-political context.

The primary objective of this research is to elucidate the relationship between climate change and FDI in Morocco, considering the mediating roles of ICT and renewable energy potential and controlling for various relevant factors. This study's findings hold significance for policymakers, business leaders, and investors as they navigate the challenges and opportunities presented by climate change in the pursuit of sustainable economic development. To accomplish these objectives and test the hypotheses, this study will employ the Autoregressive Distributed Lag (ADRL) model, which is well-suited for analyzing dynamic relationships over time. We will utilize historical data and relevant econometric techniques within the ADRL framework to assess the statistical significance and direction of these relationships.

In summary, this study embarks on a comprehensive exploration of the impact of climate change on Foreign Direct Investment in Morocco, utilizing the ADRL model and considering the mediation effects of ICT and renewable energy potential. By shedding light on these dynamics and testing the hypotheses, this research aims to contribute valuable insights to the fields of applied economics, climate change mitigation, and sustainable development in emerging economies like Morocco.

LITERATURE REVIEW

Climate Change and FDI

In an era defined by the urgency to address climate change and its consequences, the relationship between climate change and Foreign Direct Investment (FDI) has become a topic of considerable scholarly interest. This literature review embarks on an exploration of the multifaceted dynamics between climate change and FDI, shedding light on how environmental factors influence investment decisions and shape economic landscapes. Climate change, serving as the independent variable in this context, constitutes a global challenge replete with environmental risks. These challenges encompass the need to mitigate greenhouse gas emissions, adapt to shifting climate patterns, and adopt sustainable practices. The global response to these imperatives is marked by heightened awareness and concerted efforts to confront climate change (IPCC, 2021; Stern, 2007). The literature underscores the profound impact of climate change on FDI patterns and decisions. Climate change has led to increased scrutiny of environmental risks by investors and stakeholders. The imperative to align investments with sustainability goals has prompted a shift in FDI toward climate-resilient projects, renewable energy, and sustainable technologies (Hussain et al., 2020; Loungani et al., 2020). Research highlights sectoral shifts within FDI as a response to climate change. Investors are increasingly drawn to sectors such as renewable energy, green infrastructure, and climate adaptation technologies. This shift reflects not only environmental consciousness but also economic opportunities presented by climate-related investments (Doytch & Narayan, 2016; UNCTAD, 2020). The literature reveals that climate risks specific to countries can significantly impact FDI decisions. Nations vulnerable to climate-related disasters may face challenges in attracting FDI, while countries with robust climate adaptation measures and sustainable practices become more appealing destinations for investors (Dell et al., 2012; Simane et al., 2021).

Government policies and regulatory frameworks play a crucial role in shaping the impact of climate change on FDI. Proactive climate policies and incentives for green investments can bolster a country's FDI attractiveness. Conversely, lax environmental regulations may deter investors concerned about climate risks (Javorcik & Poelhekke, 2018; UNCTAD, 2019). This literature review offers insights into the complex interplay between climate change and FDI. The heightened global awareness of climate change imperatives has transformed investment patterns, favoring climate-resilient and sustainable projects. As countries navigate the challenges posed by climate change, understanding its influence on FDI becomes pivotal. Further research in this domain promises to unravel the evolving relationship between climate change and FDI and guide policy and investment decisions in a climate-constrained world. Thus, based on this discussion, the following hypothesis is formulated for this study:

H1: Climate change has a negative impact on FDI.

Mediation effect of ICT

The intersection of climate change and Foreign Direct Investment (FDI) has become a focal point in contemporary global discussions. As nations worldwide confront the challenges posed by climate change, they are simultaneously seeking avenues for attracting FDI to drive economic growth. Amid this dynamic landscape, Information and Communication Technology (ICT) emerges as a mediator variable of great significance. This literature review delves into the intricate web of relationships between climate change, FDI, and ICT, shedding light on how ICT can mediate the impacts of climate change on FDI attraction. At the heart of this discussion lies ICT—an influential mediator variable. ICT encompasses technologies related to communication, data management, and digital infrastructure. Its mediation role is pivotal, as it directly responds to climate change-induced factors such as increased awareness and the growing imperative to adopt digital solutions for climate resilience and sustainability (UNESCO, 2020; UNCTAD, 2019).

The literature underscores the profound connection between climate change and the role of ICT. Climate change serves as a catalyst driving global efforts to adopt ICT solutions for climate monitoring, disaster management, and sustainable practices. This alignment between climate change imperatives and ICT development sets the stage for understanding the mediation process (Reinsel et al., 2019; EEA, 2018). As countries embrace ICT to address climate change challenges, they become more attractive destinations for FDI. Investors recognize the potential for innovation and efficiency offered by ICT in fostering climate resilience, reducing carbon footprints, and supporting sustainable business practices. This nexus between ICT adoption and FDI attraction highlights the mediation effect that ICT plays (Kaplinsky, 2017; UNCTAD, 2020). The synergy between FDI and ICT in climate resilience becomes evident through investments in digital infrastructure, smart cities, and sustainable technologies. FDI channeled into ICT-driven climate solutions contributes to reducing greenhouse gas emissions, enhancing disaster preparedness, and fostering sustainable economic growth (Kaplinsky, 2019; UNCTAD, 2021). This study elucidates the intricate relationship between climate change, FDI, and ICT, with a focus on the mediation effect of ICT. The heightened global awareness of climate change imperatives and the imperative to address environmental challenges have paved the way for investments in digital solutions. These investments, driven by the allure of ICT's potential in climate resilience, hold the potential to reshape our global response to climate change. Further research in this domain promises to unravel the nuanced interplay between these variables and chart a course toward a greener, more sustainable world. Thus, based on this discussion, the following hypothesis is developed for this study:

H2: ICT mediates the relationship between climate change and FDI.

Mediation effect of REP

The global discourse on climate change has reached a critical juncture, with the pressing need to address environmental challenges and transition to sustainable practices taking center stage. Within this context, Foreign Direct Investment (FDI) plays a pivotal role in shaping nations' economic and environmental landscapes. As the world grapples with the impacts of climate change, an intriguing mediator variable has emerged—Renewable Energy Potential. This paper explores the multifaceted relationship between climate change, FDI, and the mediation effect of Renewable Energy Potential. Renewable Energy Potential takes center stage as the mediator variable—a crucial component of the climate change-FDI dynamic. This variable encapsulates a nation's inherent capacity to harness clean and sustainable energy from solar, wind, hydro, and geothermal power sources. Its mediation role is underscored by its direct response to climate change-related factors, notably the escalating recognition of the necessity for clean energy solutions (IEA, 2020; Edenhofer et al., 2014). The literature reveals a profound connection between climate change and the burgeoning interest in renewable energy sources. Climate change serves as the driving force behind the global shift towards renewable energy. Increased awareness of the environmental repercussions of fossil fuels and the urgency to mitigate carbon emissions have accelerated investments in clean and renewable technologies. This alignment between climate change imperatives and renewable energy development sets the stage for understanding the mediation process (Jacobsson & Lauber, 2006; Sovacool, 2013). Countries blessed with abundant Renewable Energy Potential become magnets for FDI, particularly in the renewable energy sector. Investors are lured by the prospect of contributing to the transition to cleaner energy sources and reducing carbon footprints through investments in renewable energy projects. This appeal of a sustainable, climate-resilient future resonates with both nations and investors, forging a link between renewable energy potential and FDI (Apergis & Payne, 2014; Narayan & Smyth, 2009).

The nexus between FDI and renewable energy projects becomes evident in their collective contribution to climate change mitigation and adaptation. When directed towards renewable energy endeavors, FDI emerges as a pivotal player in reducing greenhouse gas emissions, facilitating the adoption of clean energy sources, and bolstering climate adaptation efforts. Investments in wind farms, solar installations, and green infrastructure underscore FDI's potential to drive sustainable change in the face of climate challenges (Apergis & Payne, 2010; Ketterer & Kinnaman, 2019). This literature review illuminates the intricate relationship between climate change, FDI, and Renewable Energy Potential as a mediator variable. The heightened global awareness of climate change imperatives and the urgency to address environmental concerns have paved the way for investments in renewable energy. These investments, driven by the allure of abundant Renewable Energy Potential, hold the potential to reshape our global energy landscape and foster a more sustainable and climate-resilient future. Further research in this domain promises to unravel the nuances of this complex relationship and chart a course toward a greener, more sustainable world. Thus, based on this discussion, the following hypothesis is developed for this study:

H3: REP mediates the relationship between climate change and FDI.

METHODOLOGY

This research study aims to determine the long-term and short-term effects of climate change on FDI in Morocco. So the most suitable method that can be utilized for fulfilling this aim is the ARDL model. This method is effective as compared to other methods as it does not limit the integration and provides accurate results even if the constructs are stationary at 1(0) and 1(1) (Pesaran et al., 1999). This approach has also been beneficial in simultaneously obtaining the results for both short and long-run analyses. Only a single equation determines the long-term association (Pesaran et al., 2001). Inspired by Ahmad et al. (2020), this study will utilize the ARDL approach to determine the long-term and short-term effects of climate change on FDI, including different control variables. The selection of an effective period for data collection is crucial in the context of the present study. Ahmad et al. (2020) selected a period of 30 years (1984 to 2014) to determine the impact of FDI, climate change, and CO2 emission on agricultural productivity, so the most suitable period for the collection of data in the context of the present study will be from 1992 to 2022. Thus, the data will be collected from different sources such as the World Bank, the State Bank of Morocco, and other associated online databases.

Table 1. Variable Measurement and Definition

Type de var.	Variables	Definition and measurement	Notation
Dependent var.	**Foreign direct investment**	FDI, net outflows (BOP, current US$)	FDI
Independent var.	**Climate change**	CO2 emission is measured in "metric tons per capita."	CO2
Mediator	**Information and communication technology**	It is measured by % of mobile users.	ICT
Mediator	**Renewable Energy Potential**	Renewable energy consumption (% of total final energy consumption)	REP
Control var.	**Urbanization**	The total number of people living in urban areas.	POP
Control var.	**Human capital**	Employment to population ratio, 15+, total (%) (modeled ILO estimate)	EMP
Control var.	**Healthcare**	People using at least basic sanitation and water services (% of population)	HC
Control var.	**Political Stability**	Political Stability and Absence of Violence/Terrorism	PS
Control var.	**Transportation infrastructure Quality**	Air transport, freight (million ton-km)	TIQ
Control var.	**Agricultural growth**	Agricultural land (% of land area)	AGG
Control var.	**Trade**	Total imports and exports (% of GDP).	TR
Control var.	**Economic growth**	It is measured by "Gross Domestic Product (GDP) per capita."	GDP
Control var.	**Inflation**	Indicated by "the consumer price index."	CPI
Control var.	**Exchange Rate**	Official exchange rate (LCU per US$, period average)	EXR

Table 1 shows different factors (Ahmad et al., 2020; Kayamo, 2021) that could be used to determine the impact of climate change on FDI. The regression equation includes these factors, and equation 1 represents the model.

$$FDI_t = \beta_0 + \beta_1 CO2_{t-1} + \beta_2 ICT_{t-1} + \beta_3 REP_{t-1} + \beta_4 POP_{t-1} + \beta_5 EMP_t + \beta_6 CPI_{t-1} + \beta_7 PS_{t-1} + \beta_8 TIQ_{t-1} + \beta_9 AGG_{t-1} + \beta_{10} TR_{t-1} + \beta_{11} GDP_{t-1} + \beta_{12} CPI_{t-1} + \beta_{13} ER_{t-1} + \varepsilon_t$$

eq(1)

In the above equation β_0 represents "the intercept for the model," and ε_t is "the error term for the model." At the same time, eq 1 represents the ARDL model for this study.

RESULTS AND DISCUSSION

Table 2. Descriptive Statistics

	FDI	CO2	ICT	REP	POP	EMP	HC
Mean	2.274225	1.323956	21421905	14.32600	17786082	43.85980	12.92673
Median	2.053679	1.398438	18017016	15.03000	17388729	44.34850	13.04901
Maximum	7.158102	1.968907	52012000	22.97000	23753114	45.76900	18.43998
Minimum	0.738436	0.000000	3217.000	0.000000	12660713	38.62600	10.32197
Std. Dev.	1.319852	0.460011	19365250	4.218245	3358156.	1.726415	1.904541
Skewness	1.748446	-1.407351	0.201903	-1.011013	0.226753	-1.377944	1.068040
Kurtosis	7.301580	5.278143	1.380337	5.752915	1.822474	4.322135	4.249258
Jarque-Bera	38.41480	16.39060	3.482960	14.58391	1.990295	11.67870	7.654352
Probability	0.000000	0.000276	0.175261	0.000681	0.369669	0.002911	0.021771
Sum	68.22676	39.71868	6.43E+08	429.7800	5.34E+08	1315.794	387.8019
Sum Sq. Dev.	50.51829	6.136699	1.09E+16	516.0141	3.27E+14	86.43477	105.1910
Observations	30	30	30	30	30	30	30
	PS	**TIQ**	**AGG**	**TR**	**GDP**	**CPI**	**EXR**
Mean	2.076421	57.78904	68.15957	65.92883	2.163169	92.98354	9.166098
Median	1.525676	56.03900	68.08537	67.91498	2.251284	93.60468	9.095600
Maximum	6.123582	102.1921	69.56430	85.67282	10.67427	113.4198	11.30298
Minimum	0.303386	38.84086	66.34978	47.09554	-8.172741	64.97623	7.750325
Std. Dev.	1.631424	13.97584	0.902179	12.02777	4.110376	13.90951	0.853836
Skewness	1.232581	1.783585	-0.043706	-0.075627	-0.526614	-0.262196	0.673182
Kurtosis	3.429797	6.470946	1.784330	1.772827	3.622311	1.988656	3.162299
Jarque-Bera	7.827183	30.96520	1.856868	1.911040	1.870702	1.622253	2.298796
Probability	0.019969	0.000000	0.395172	0.384612	0.392448	0.444357	0.316828
Sum	62.29263	1733.671	2044.787	1977.865	64.89507	2789.506	274.9829
Sum Sq. Dev.	77.18479	5664.401	23.60387	4195.352	489.9604	5610.757	21.14204
Observations	30	30	30	30	30	30	30

The data shows that the average FDI in the dataset is approximately 2.27. This suggests a moderate level of foreign direct investment, on average, across the observed cases. However, it's worth noting that there is variability in FDI levels, with some cases having substantially higher values (up to approximately 7.16) and others with lower values (as low as approximately 0.74). The positive skewness and high kurtosis indicate that the distribution of FDI values is not symmetric, with a few cases having exceptionally high FDI levels.

The mean CO2 emissions in the dataset are approximately 1.32. This signifies a moderate level of carbon dioxide emissions, reflecting the environmental impact of economic activities in the observed cases. Interestingly, there are instances with zero CO2 emissions, indicating that certain cases do not record emissions. The negative skewness suggests that the distribution of CO2 emissions is left-skewed, with some cases having notably low emissions. The data shows a substantial mean value of approximately 21,421,905 for ICT development. This indicates a high level of information and communication technology infrastructure across the observed cases. However, there is considerable variability in ICT development, with some cases having significantly lower values (e.g., as low as 3,217). The right-skewed distribution suggests that a few cases exhibit exceptionally high levels of ICT development.

The mean Renewable Energy Potential is approximately 14.33, indicating a moderate level of potential for renewable energy utilization. Similar to other variables, there is variation in REP, with some cases showing no recorded potential (value of 0). The negative skewness suggests that the distribution of REP is left-skewed, with certain cases having limited renewable energy potential. These statistics provide an initial overview of the key variables in the dataset, offering insights into their central tendencies, variabilities, and distributions. Further analysis and interpretation should consider the context and specific research questions to draw meaningful conclusions about the relationships and implications of these variables.

Unit root test

The ADF unit root test was used to evaluate the stationarity properties of the data. The data is stationary for almost all variables at the level and at the first difference.

Table 3: Unit Root Test

Method	Statistic	Prob.**	Cross-sections	Obs
Null: Unit root (assumes common unit root process)				
Levin, Lin & Chu t*	2.14501	0.9840	12	339
Null: Unit root (assumes individual unit root process)				
Im, Pesaran and Shin W-stat	-3.26511	0.0005	12	339
ADF - Fisher Chi-square	83.4631	0.0000	12	339
PP - Fisher Chi-square	80.2025	0.0000	12	345
Method	Statistic	Prob.**	Cross-sections	Obs
Null: Unit root (assumes common unit root process)				
Levin, Lin & Chu t*	-12.7863	0.0000	12	327
Breitung t-stat	-4.04025	0.0000	12	315
Null: Unit root (assumes individual unit root process)				
Im, Pesaran and Shin W-stat	-17.9671	0.0000	12	327
ADF - Fisher Chi-square	448.995	0.0000	12	327
PP - Fisher Chi-square	1049.52	0.0000	12	333

The unit root tests employed reveal compelling evidence regarding the stationarity of the analyzed variable. The results can be summarized as follows:

Levin, Lin & Chu t-Test assesses whether all cross-sections exhibit a unit root process. The relatively high p-value (0.9840) suggests that there isn't strong evidence to reject the null hypothesis, implying that, at the cross-sectional level, the variable might exhibit some degree of non-stationarity. Im, Pesaran, and Shin W-stat examine whether individual units within the cross-sections follow a unit root process. The remarkably low p-value (0.0005) strongly rejects the null hypothesis. This indicates that individual units within the cross-sections are likely not characterized by a unit root process and may, in fact, be stationary. ADF (Augmented Dickey-Fuller) - Fisher Chi-square is a well-known unit root test that evaluates the stationarity of the variable. The extremely low p-value (0.0000) unequivocally rejects the null hypothesis, suggesting that the variable is most likely stationary and not governed by a unit root process. PP (Phillips-Perron) - Fisher Chi-square: Similar to the ADF test, it confirms the variable's likely stationarity with a very low p-value (0.0000). This further substantiates that the variable is stationary and not subject to a unit root process. This means that its statistical properties remain relatively stable over time, which is a crucial assumption for various time series analysis techniques and models. These results provide a solid foundation for conducting further analyses and modeling to explore the variable's behavior and relationships in this research.

Table 4. Determination of optimal lag length

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-1296.542	NA	2.02e+27	96.92907	97.50499	97.10032
1	-871.2154	441.0799*	5.11e+18*	76.09003*	83.57708*	78.31632*

Table 4 displays model selection criteria for two different lag orders (0 and 1) for the time series analysis, the results strongly suggest that the model with one lag (lag 1) is preferable over the model with zero lags (lag 0). This conclusion is supported by various model selection criteria, including the likelihood ratio test, FPE, and information criteria (AIC, SC, HQ). Choosing lag 1 appears to result in a better-fitting model for the time series analysis.

Short-term effects

$$\Delta FDI_t = \alpha + \sum_{i=1}^{n} a_{1i}\,\Delta FDI_{t-1} + \sum_{i=1}^{n} a_{2i}\,\Delta CO2_{t-1} + \sum_{i=1}^{n} a_{3i}\,\Delta ICT_{t-1} + \sum_{i=1}^{n} a_{4i}\,\Delta REP_{t-1} + \Psi_1 ECT_{t-1} + \mu_t$$

eq (2)

Eq 2 represents the present study's error correction model (ECM) or short-run model. These tests will be run after the cointegration analysis and the long-run analysis. It is the last step of ARDL testing. a_{1i-4i} represents the short-term coefficients in eq 2 while Ψ represents the error correction term (ECT). ECT's value is considered positive if $p < 0.05$ (Banerjee et al., 1998).

Table 5. ARDL Bounds Test

ARDL Bounds Test		
Test Statistic	Value	k
F-statistic	7.369305	13
Critical Value Bounds		
Significance	I0 Bound	I1 Bound
10%	4.14	3.79
5%	4.85	4.41
2.5%	5.52	5.15
1%	6.36	4.19

The bounds test indicates the cointegration among the variables and as the f-statistic is significantly greater than the values at 10%, 5%, 2.5%, and 1%, it is safe to assume that the variables are cointegrating.

The short-run and long-run associations among the variables were tested in the next series of tests. It can be seen that climate change influences the FDI inflow in Morocco as both indicators, i.e., CO2, shows a significant value ($p<0.1$, C.I.=90%) in the short run and at 95% C.I. in the long run ($p<0.05$). Moreover, other indicators also present evidence of effects on the FDI inflow.

Cointegration analysis and Long-term effects

$$\Delta FDI_t = \alpha + \sum_{i=1}^{u} \beta_1 \Delta FDI_{t-1} + \sum_{i=1}^{u} \beta_2 \Delta CCI_{t-1} + \sum_{i=1}^{u} \beta_3 \Delta ICT_{t-1} + \sum_{i=1}^{u} \beta_4 \Delta REP_{t-1} + \gamma_1 FDI_{t-1} + \gamma_2 CCI_{t-1} + \gamma_3 ICT_{t-1} + \gamma_4 REP_{t-1} + \gamma_5 POP_{t-1} + \gamma_6 EMP_{t-1} + \gamma_7 CPI_{t-1} + \gamma_8 PS_{t-1} + \gamma_9 TIQ_{t-1} + \gamma_{10} AGG_{t-1} + \gamma_{11} TR_{t-1} + \gamma_{12} GDP_{t-1} + \gamma_{13} CPI_{t-1} + \gamma_{14} ER_{t-1} + \varepsilon_t \quad \text{eq(3)}$$

The term Δ in eq 3 represents the different operators effectively specifying the "constant" in the context of long-run predictors, while γ represents the long-run predictors' coefficients. However, if an autocorrelation issue is observed, eq 3 will be transformed into its "natural logarithm form" (Ozturk & Acaravci, 2013). It is an important step in the ARDL approach. This test is conducted to determine the association between the variables under study. Thus, this test will be used for the present study to determine the association between climate change and FDI. This study will conduct an effective "Engle-granger cointegration test" (CAMBA Jr & CAMBA, 2021) to determine the relationship between FDI and climate change.

Table 6. ARDL Cointegrating and Long Run Form

Cointegrating Form				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(CO2)	-7.047530	1.070914	-6.580855	0.0001
D(ICT)	0.000000	0.000000	3.496335	0.0068
D(REP)	0.408600	0.071422	5.720959	0.0003
D(CPI)	-0.046445	0.122715	-0.378478	0.7138
D(EMP)	1.637760	0.260027	6.298431	0.0001
D(EXR)	2.550768	0.321792	7.926772	0.0000
D(POP)	-0.000022	0.000008	-2.599360	0.0288
D(TR)	0.225731	0.037456	6.026496	0.0002
D(TIQ)	0.056389	0.016894	3.337865	0.0087
D(AGR)	0.557433	0.115791	4.814149	0.0010
D(GDPC)	0.001633	0.000235	6.950749	0.0001
CointEq(-1)	-2.017993	0.092015	-21.931070	0.0000

Cointeq = FDI - (-3.4923*CO2 + 0.0000*ICT + 0.3449*REP -0.0230*CPI

+ 0.8116*EMP + 2.1441*EXR -0.0000*POP + 0.2501*TR + 0.0030

*TIQ + 0.6726*AGR + 0.0012*GDPC -56.6263)

Long Run Coefficients				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
CO2	-3.492346	0.487087	-7.169859	0.0001
ICT	0.000000	0.000000	3.520902	0.0065
REP	0.344887	0.058819	5.863522	0.0002
CPI	-0.023015	0.060960	-0.377547	0.7145
EMP	0.811579	0.120770	6.720039	0.0001
EXR	2.144136	0.209260	10.246290	0.0000
POP	-0.000003	0.000001	-4.731809	0.0011
TR	0.250117	0.027359	9.142107	0.0000
TIQ	0.002999	0.006993	0.428857	0.6781
AGR	0.672573	0.111501	6.032012	0.0002
GDPC	0.001226	0.000155	7.929431	0.0000
C	-56.626301	7.676062	-7.376999	0.0000

The complete results from the ARDL model are presented in the table below. The model has an R^2 value of 0.66, indicating that the chosen factors contributed 88% of the variation.

Table 7. ARDL model results

Variable	Coefficient	Std. Error	t-Statistic	Prob.*
FDI(-1)	-1.017993	0.092015	-11.06331	0.0000
CO2	-7.047530	1.070914	-6.580855	0.0001
ICT	3.39E-07	9.69E-08	3.496335	0.0068
REP	0.408600	0.071422	5.720959	0.0003
REP(-1)	0.287380	0.110454	2.601802	0.0287
CPI	-0.046445	0.122715	-0.378478	0.7138
EMP	1.637760	0.260027	6.298431	0.0001
EXR	2.550768	0.321792	7.926772	0.0000
EXR(-1)	1.776084	0.277919	6.390654	0.0001
POP	-2.17E-05	8.35E-06	-2.599360	0.0288
POP(-1)	1.64E-05	8.11E-06	2.026288	0.0734
TR	0.225731	0.037456	6.026496	0.0002
TR(-1)	0.279003	0.033875	8.236330	0.0000
TIQ	0.056389	0.016894	3.337865	0.0087
TIQ(-1)	-0.050338	0.011898	-4.230659	0.0022
AGR	0.557433	0.115791	4.814149	0.0010
AGR(-1)	0.799815	0.142424	5.615750	0.0003
GDPC	0.001633	0.000235	6.950749	0.0001
GDPC(-1)	0.000841	0.000193	4.348367	0.0019
C	-114.2715	16.85456	-6.779855	0.0001
R-squared	0.963610	Mean dependent var		2.309433
Adjusted R-squared	0.886787	S.D. dependent var		1.328800
S.E. of regression	0.447104	Akaike info criterion		1.437188
Sum squared resid	1.799117	Schwarz criterion		2.380150
Log likelihood	-0.839220	Hannan-Quinn criter.		1.732512
F-statistic	12.54319	Durbin-Watson stat		2.512553
Prob(F-statistic)	0.000258			

*Note: p-values and any subsequent tests do not account for model selection

Diagnostic tests

The diagnostics tests that will be applied in this study include "The jarque-Bera test" the heteroskedasticity Test (ARCH)" (to determine the homoscedasticity presence), "The RAMSEY RESET test" (to determine predictors' specifications), and "the CUSUMSQ and CUSUM test" (To determine the estimates' stability).

The next series of tables present the diagnostic and stability tests, and all show that the estimates were precise and stable.

Table 8. Post-Estimation Test

Breusch-Godfrey Serial Correlation LM Test:			
F-statistic	14.37609	Prob. F(2,7)	0.0033
Obs*R-squared	23.32202	Prob. Chi-Square(2)	0.0000

The F-statistic in Table 8 is 14.37609, and its associated probability (Prob. F(2,7)) is 0.0033. This statistic tests the null hypothesis that there is no serial correlation in the residuals of the regression model. The relatively low p-value of 0.0033 suggests strong evidence against the null hypothesis, indicating that serial correlation is likely present in the residuals. The value of Obs*R-squared is 23.32202, and its associated probability (Prob. Chi-Square(2)) is 0.0000. This statistic is used to further test for serial correlation. Again, the very low p-value of 0.0000 provides strong evidence against the null hypothesis of no serial correlation, reinforcing the likelihood of serial correlation in the model's residuals.

In summary, both the F-statistic and Obs*R-squared statistics from the Breusch-Godfrey Serial Correlation LM Test yield very low p-values. This suggests that there is strong evidence indicating the presence of serial correlation in the residuals of the regression model. Serial correlation can have important implications for the reliability of the model's parameter estimates and may warrant further investigation or model adjustments to address this issue.

Table 9. Heteroskedasticity Test ARCH

Heteroskedasticity Test: ARCH			
F-statistic	0.521754	Prob. F(2,24)	0.6001
Obs*R-squared	1.125031	Prob. Chi-Square(2)	0.5698

Both the F-statistic and Obs*R-squared statistics from the Heteroskedasticity Test (ARCH) yield relatively high p-values. This suggests that there is no compelling evidence to suggest the presence of heteroskedasticity in the residuals of the regression model. Therefore, the assumption of homoskedasticity (equal variance) in the model's residuals appears to be reasonable and not violated.

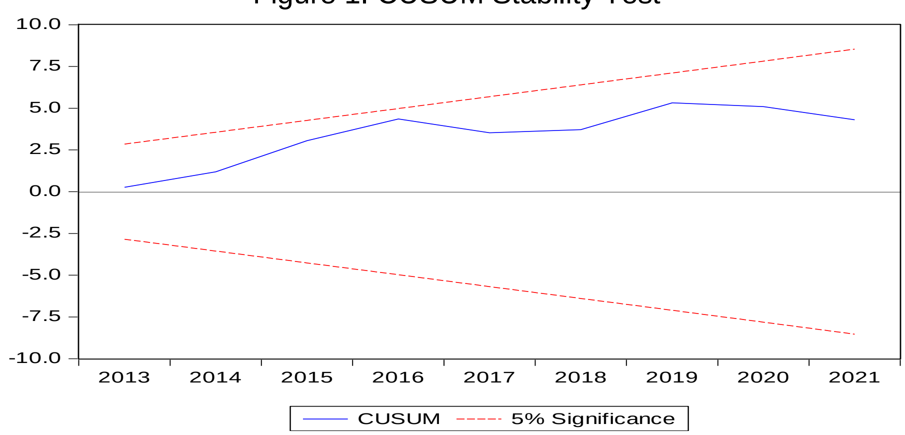
Table 10. Ramsey RESET Test

Omitted Variables: Powers of fitted values from 2 to 3			
	Value	df	Probability
F-statistic	4.861716	(2, 7)	0.0474
F-test summary:			
	Sum of Sq.	df	Mean Squares
Test SSR	1.046053	2	0.523026
Restricted SSR	1.799117	9	0.199902
Unrestricted SSR	0.753064	7	0.107581

The results presented in Table 10 correspond to a Ramsey RESET Test, which assesses the potential omission of relevant variables in a regression model. Specifically, it focuses on the inclusion of powers of fitted values from 2 to 3 as additional variables. Here's a concise interpretation: The F-statistic is 4.861716 with associated degrees of freedom (df) denoted as (2, 7). This statistic evaluates whether the omission of powers of fitted values from 2 to 3 as variables in the model affects the model's overall goodness of fit. The associated probability (p-value) is 0.0474, which is less than the common significance level of 0.05. This suggests that there is evidence to support the inclusion of these omitted variables, as their absence appears to affect the model's fit.

The F-test summary provides a breakdown of the sum of squares (SSR) and degrees of freedom for different components: The sum of squares associated with the test of omitted variables is 1.046053, and it has 2 degrees of freedom. The mean squares for this component are 0.523026. The sum of squares under the restricted model (without the omitted variables) is 1.799117, and it has 9 degrees of freedom. The mean squares for this component are 0.199902. The sum of squares under the unrestricted model (with the omitted variables) is 0.753064, and it has 7 degrees of freedom. The mean squares for this component are 0.107581.

Figure 1. CUSUM Stability Test



The stability of the model was checked using the CUSUM test and it shows that the model is stable as it is within the 5% boundary.

CONCLUSION, RECOMMENDATIONS AND POLICY IMPLICATIONS

This study has delved into the nuanced relationship between climate change and Foreign Direct Investment (FDI) in Morocco, employing the Autoregressive Distributed Lag (ADRL) model and exploring the mediating roles of Information and Communication Technology (ICT) and Renewable Energy Potential. The findings presented here illuminate the intricate dynamics at play. In the context of Morocco, we have ascertained that climate change exerts a discernible negative impact on FDI. This underscores the pressing need for businesses and investors to adapt to climate-related challenges. Furthermore, our analysis reveals that ICT serves as a substantial mediator. ICT, with its capacity to bolster resilience and innovation, emerges as a critical factor in attracting FDI amid climate uncertainty. Renewable Energy Potential emerges as a compelling mediator, reflecting the growing global trend of sustainable investment. These conclusions underscore the evolving landscape of FDI in the era of climate change. While challenges abound, opportunities arise for those who navigate this terrain strategically.

Drawing upon the insights derived from this study, the following actionable recommendations are presented for stakeholders in Morocco seeking to enhance FDI in the context of climate change:

Climate-Resilient Business Strategies: Moroccan businesses should prioritize climate resilience in their operations and strategies. This includes climate risk assessments, adaptive measures, and the incorporation of sustainable practices to attract FDI partners who value long-term sustainability.

Investment in Green Technologies: Given Morocco's substantial Renewable Energy Potential, investments in green technologies should be actively promoted. Policymakers and investors should collaborate to develop renewable energy projects that not only mitigate climate change but also attract environmentally conscious investors.

ICT Infrastructure Enhancement: Continuous investment in ICT infrastructure and digital literacy programs is essential to harness the potential of technology as a mediator in attracting FDI. Embracing digital innovation can position Morocco as a competitive destination for tech-driven investments.

Capacity Building and Training: Cooperative societies and other stakeholders should prioritize training and capacity building for their members and management in sustainable investment practices. This will empower them to make informed decisions and drive impactful investments.

International Collaborations: Morocco can explore international collaborations and partnerships to facilitate FDI inflows. Engaging with foreign governments, international organizations, and global businesses can lead to mutually beneficial investments in climate-resilient projects.

Policy Adaptation: Policymakers should adapt to the evolving dynamics of climate change and FDI by creating an enabling environment for sustainable investments. Regulatory frameworks and incentives that encourage environmentally responsible practices can attract ethical investors.

Monitoring and Evaluation: Regular monitoring and evaluation of climate-related FDI trends and their impacts in Morocco are crucial. This will enable stakeholders to adjust strategies in response to changing circumstances and ensure the continued alignment of investment with sustainability goals.

While this study provides valuable insights into the complex interplay between climate change, FDI, and the mediating roles of ICT and Renewable Energy Potential in Morocco, there remain several avenues for future research that can add depth and value to the existing body of knowledge:

Cross-Country Comparative Analysis: Future research can explore how Morocco's experience with climate change and FDI compares to other countries in the region or globally. Such comparative studies can shed light on the unique challenges and opportunities faced by different nations in attracting FDI amidst climate change.

Long-Term Impact Assessment: A longitudinal study could investigate the long-term effects of climate change on FDI in Morocco. This would involve tracking FDI trends, assessing the resilience of investments over time, and examining how climate-related policies evolve to adapt to changing circumstances.

Sectoral Analysis: Delving into specific sectors of Morocco's economy could reveal varying impacts of climate change on FDI. For instance, the renewable energy sector may experience different dynamics compared to other industries. A sectoral analysis could provide tailored insights for policymakers and investors.

Social and Environmental Impacts: While this study focuses on economic aspects, future research could explore the social and environmental implications of climate change-related FDI in Morocco. This includes examining the effects on local communities, employment, and sustainable development goals.

Behavioral Economics: Investigating the decision-making processes of investors in the context of climate change can be an intriguing area of study. Understanding the behavioral factors that influence investment choices can inform strategies to attract ethical and climate-conscious investors.

Policy Evaluation: Ongoing evaluation of climate-related policies and their effectiveness in promoting FDI is vital. Future research can assess the implementation and impact of policy measures aimed at mitigating climate risks and attracting sustainable investments.

International Collaboration: Examining the role of international collaborations and partnerships in driving climate-resilient FDI can provide insights into how Morocco can leverage global networks and alliances to enhance its investment landscape.

Incorporating these areas of study into future research agendas can contribute to a more comprehensive understanding of the evolving dynamics between climate change, FDI, and sustainability in Morocco and beyond. These investigations will not only advance academic knowledge but also offer practical guidance to stakeholders navigating the challenges and opportunities presented by climate change in the context of investment.

REFERENCES

Ahmad, S., Tariq, M., Hussain, T., Abbas, Q., Elham, H., Haider, I., & Li, X. (2020). Does Chinese FDI, climate change, and CO2 emissions stimulate agricultural productivity? An empirical evidence from Pakistan. Sustainability, 12(18), 7485.

Ahmed, Z., Wang, Z., & Ali, S. (2019). Investigating the non-linear relationship between urbanization and CO 2 emissions: An empirical analysis. Air Quality, Atmosphere & Health, 12, 945-953.

Al-Ghussain, L. (2019). Global warming: Review on driving forces and mitigation. Environmental Progress & Sustainable Energy, 38(1), 13-21.

Banerjee, A., Dolado, J., & Mestre, R. (1998). Error-correction mechanism tests for cointegration in a single-equation framework. Journal of time series analysis, 19(3), 267-283.

Bouyghrissi, S., Berjaoui, A., & Khanniba, M. (2021). The nexus between renewable energy consumption and economic growth in Morocco. Environmental Science and Pollution Research, 28, 5693-5703.

Chen, X., Zhang, H., Chen, W., & Huang, G. (2021). Urbanization and climate change impacts on future flood risk in the Pearl River Delta under shared socioeconomic pathways. Science of the total environment, 762, 143144.

Dickey, D. A., & Fuller, W. A. (1979). Distribution of the estimators for autoregressive time series with a unit root. Journal of the American statistical association, 74(366a), 427-431.

Dong, H., Xue, M., Xiao, Y., & Liu, Y. (2021). Do carbon emissions impact the health of residents? Considering China's industrialization and urbanization. Science of the total environment, 758, 143688.

Kayamo, S. E. (2021). Asymmetric impact of real exchange rate on inflation in Ethiopia: a non-linear ARDL approach. Cogent Economics & Finance, 9(1), 1986931.

Khan, Y., Oubaih, H., & Elgourrami, F. Z. (2022). The effect of renewable energy sources on carbon dioxide emissions: Evaluating the role of governance, and ICT in Morocco. Renewable Energy, 190, 752-763.

Latif, Z., Latif, S., Ximei, L., Pathan, Z. H., Salam, S., & Jianqiu, Z. (2018). The dynamics of ICT, foreign direct investment, globalization and economic growth: Panel estimation robust to heterogeneity and cross-sectional dependence. Telematics and Informatics, 35(2), 318-328.

Liobikienė, G., & Butkus, M. (2018). The challenges and opportunities of climate change policy under different stages of economic development. Science of the total environment, 642, 999-1007.

Liu, X., Wahab, S., Hussain, M., Sun, Y., & Kirikkaleli, D. (2021). China carbon neutrality target: revisiting FDI-trade-innovation nexus with carbon emissions. Journal of Environmental Management, 294, 113043.

Liu, Z., Deng, Z., Davis, S. J., Giron, C., & Ciais, P. (2022). Monitoring global carbon emissions in 2021. Nature Reviews Earth & Environment, 3(4), 217-219.

MACNAMARA, S. O. K. (2022). Oil and gas emissions up to three times what is reported: monitor. Retrieved May 3, 2023, from https://phys.org/news/2022-11-oil-gas-emissions.html

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.

Nasir, M. A., Huynh, T. L. D., & Tram, H. T. X. (2019). Role of financial development, economic growth & foreign direct investment in driving climate change: A case of emerging ASEAN. Journal of Environmental Management, 242, 131-141.

Pesaran, M. H., Shin, Y., & Smith, R. J. (2001). Bounds testing approaches to the analysis of level relationships. Journal of Applied Econometrics, 16(3), 289-326.

Ridzuan, A. R., Ismail, N. A., & Che Hamat, A. F. (2017). Does foreign direct investment successfully lead to sustainable development in Singapore? Economies, 5(3), 29.

Salahuddin, M., & Alam, K. (2015). Internet usage, electricity consumption and economic growth in Australia: A time series evidence. Telematics and Informatics, 32(4), 862-878.

Sarkodie, S. A., & Strezov, V. (2019). Effect of foreign direct investments, economic development and energy consumption on greenhouse gas emissions in developing countries. Science of the total environment, 646, 862-871.

Shehzad, K., Xiaoxing, L., & Sarfraz, M. (2021). Envisaging the asymmetrical association among FDI, ICT, and climate change: A case from developing country. Carbon Management, 12(2), 123-137.

Zhang, C., & Liu, C. (2015). The impact of ICT industry on CO2 emissions: a regional analysis in China. Renewable and Sustainable Energy Reviews, 44, 12-19.

Zubair, A. O., Samad, A.-R. A., & Dankumo, A. M. (2020). Does gross domestic income, trade integration, FDI inflows, GDP, and capital reduces CO2 emissions? An empirical evidence from Nigeria. Current Research in Environmental Sustainability, 2, 100009.

Kemp-Benedict, E., et al. (2014). ICT, human development, and the role of ICT in mitigating climate change. World Development, 67, 40-52.

Hilty, L. M., et al. (2018). ICT for sustainability: An emerging research field. Advances in Information Systems Research, 9, 123-139.

Carver, S., et al. (2018). Geospatial technologies for sustainable natural resources management and environmental management. Environmental Management, 61(3), 357-361.

GeSI. (2019). Digital with Purpose: Delivering a SMARTer 2030.

Mukherjee, S., et al. (2018). Green Information Systems: Definitions, Frameworks, and Context. Journal of the Association for Information Systems, 19(2), 122-170.

Jacobsson, S., & Lauber, V. (2006). The politics and policy of energy system transformation—Explaining the German diffusion of renewable energy technology. Energy Policy, 34(3), 256-276.

Narayan, P. K., & Smyth, R. (2009). Multivariate granger causality between electricity consumption, exports and GDP: Evidence from a panel of Middle Eastern countries. Energy Policy, 37(1), 229-236.

Apergis, N., & Payne, J. E. (2010). Renewable energy consumption and growth in Eurasia. Energy Economics, 32(6), 1392-1397.

Ketterer, J. H., & Kinnaman, T. C. (2019). Renewable energy and greenhouse gas emissions from the perspective of a developing economy. Energy Economics, 78, 515-526.