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The Impact of Foreign Direct Investment on Climatic Changes in Middle Income Asian Countries

Piyumi Kaushalya Almeda[1], Dr. H. R. Sampath[2]

[1] Student, Sabaragamuwa University of Sri Lanka.

[2]Senior Lecturer, Faculty of Management Studies, Sabaragamuwa University of Sri Lanka.

Abstract

The conceptual and methodological framework of this study is designed to examine the relationships among the key variables influencing climate outcomes in developing regions. The current research investigates how the four factors of Foreign Direct Investment (FDI), Social Globalization, GDP per Capita, and Urban Population affect the Climate Change situation in middle-income Asian countries during the years 2004 to 2023. The study is based on a balanced panel dataset and applies advanced econometric techniques such as panel unit root tests, panel cointegration analysis, and the Autoregressive Distributed Lag (ARDL) model. The estimating methods used include the Mean Group (MG), Pooled Mean Group (PMG), and Dynamic Fixed Effects (DFE). Among the post-estimation tests, the Hausman test indicated that the mean group estimator was the most appropriate, suggesting the presence of long-run heterogeneity among the countries in the sample.

The findings indicate that in the short run, foreign direct investment (FDI) and GDP per capita significantly contribute to CO_2 emissions, highlighting a negative impact on the environment due to economic growth. While social globalization also increases emissions, urbanization has a negative effect, suggesting that well-planned urban environments can reduce emissions. Over time, the influences of FDI and GDP per capita diminish in significance, reflecting a shift towards cleaner production. A negative error correction coefficient indicates a stable long-run equilibrium among the examined variables.

The study finds that middle-income Asian countries are in a transitional stage. In the short term, economic and social forces drive emissions, but in the long term, institutional development and urban efficiency promote sustainability. Policy recommendations include promoting green FDI, strengthening environmental regulations, and encouraging sustainable urban planning to achieve low-carbon economic growth.

Keywords: *Climate Change, Carbon Dioxide Emissions, Foreign Direct Investment (FDI), Social Globalization, GDP per Capita, Urban Population, Middle-Income Asian Countries*

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1. INTRODUCTION

Climate change has become one of the most serious global threats, mainly driven by human activities such as industrial production, energy use, and land-use changes. The continuous rise in greenhouse gas emissions, particularly carbon dioxide (CO_2), has resulted in global warming, extreme weather events, and disruptions to both natural and economic systems. These impacts are more severe in developing countries, where the ability to adapt to climate change varies significantly across different income groups.

Middle-income Asian countries are a major area of concern because they are experiencing rapid economic transformation alongside increasing climate-related challenges. These countries depend heavily on Foreign Direct Investment (FDI) as a key driver of economic growth and technological development. However, the environmental impact of FDI differs based on national conditions. Where environmental regulations are weak, FDI may increase emissions, supporting the Pollution Haven Hypothesis. In contrast, in countries with stronger policies and cleaner technologies, FDI can improve environmental quality in line with the Pollution Halo Hypothesis.

In addition to FDI, socioeconomic factors such as GDP per capita, social globalization, and urbanization also influence climate change. GDP per capita reflects economic development and environmental management capacity, social globalization supports the spread of sustainable ideas, and urbanization increases resource demand and emissions if poorly managed. Therefore, examining the combined impact of FDI and these socio-economic factors on CO_2 emissions in middle-income Asian countries is essential for balancing economic development with long-term environmental sustainability and climate resilience.

Problem Statement

Climate change is a major global challenge that particularly affects middle-income Asian countries due to rapid urbanization, population growth, and rising energy demand. Foreign Direct Investment (FDI) plays a vital role in supporting economic development in these countries by providing capital, advanced technology, and employment opportunities. However, FDI has a dual impact: while it can promote cleaner technologies and sustainable practices, it may also increase environmental degradation when directed toward energy-intensive and environmentally sensitive industries.

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Middle-income Asian economies possess moderate adaptive capacity to climate change but remain vulnerable to rising temperatures, extreme weather, and urban environmental risks. The environmental effects of FDI differ across countries depending on income levels, social factors, urbanization, and economic structures. Previous empirical studies on the FDI–climate relationship in these economies provide mixed results, demonstrating both positive and negative environmental outcomes, which reveals a clear gap and uncertainty in existing research.

Therefore, examining the relationship between FDI and climate change is critical for designing policies that attract environmentally responsible investments while supporting sustainable economic growth and strengthening climate resilience in middle-income Asian countries.

Hypotheses

Main Hypothesis

This is the primary expected relationship you are testing in your research. It explains how your main independent variables are believed to affect your dependent variable. (C., 2021)

$H0_1$: There is no significant impact of Foreign Direct Investment (FDI) inflows on CO_2 emissions in middle-income Asian countries.

$H1_1$: There is a significant impact of Foreign Direct Investment (FDI) inflows on CO_2 emissions in middle-income Asian countries.

Research Objective

The purpose of the study is to assess the influence of Foreign Direct Investment (FDI) on climate change in middle-income Asian nations while particularly focusing on the interaction among economic, social, and environmental factors that contribute to and determine climate resilience and sustainability.

2. METHODOLOGY

This chapter details the methodology for analyzing the impact of Foreign Direct Investment (FDI) on climate change in middle-income Asian countries. It outlines the research design, population sampling, data collection methods, and analytical techniques employed. The study utilizes a

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quantitative approach with panel data sourced from entities like the World Bank and UNCTAD, covering 2004–2023. It focuses on both short-run and long-run relationships using econometric procedures, including descriptive and correlation analyses, unit root testing, and ARDL estimators. Diagnostic tests ensure model accuracy and reliability, providing a robust framework for testing the research hypotheses.

Research Approach

This study utilizes a quantitative approach to investigate the influence of Foreign Direct Investment (FDI) on climate change in middle-income Asian countries. It employs measurable secondary data from the World Bank, UNCTAD, and the KOF Globalization Index to statistically analyze the relationships between variables. Econometric techniques, particularly ARDL estimators, are used to assess both short and long-term effects of FDI on climate change. This method ensures empirical validity, reduces researcher bias, and allows for broader applicability of the findings.

Research Design

This study adopts a quantitative, explanatory research design to examine the impact of Foreign Direct Investment (FDI) on climate change in middle-income Asian countries. It uses secondary panel data from reliable international sources to ensure cross-country comparability. CO_2 emissions serve as the dependent variable, with FDI inflows as the main independent variable, while GDP per capita, social globalization, and urban population are included as control variables. The design enables a systematic analysis of the relationships between foreign investment, socioeconomic factors, and climate impacts, providing robust empirical evidence relevant to policy and development research.

Population of the Study

This study focuses on middle-income Asian countries as defined by the World Bank's GNI per capita classification, which includes both lower-middle and upper-middle-income economies. These countries represent a transitional stage of development marked by rapid industrialization, urbanization, and rising inflows of Foreign Direct Investment (FDI). They were selected due to their strong economic growth, heavy dependence on foreign capital and technology, and increasing contribution to greenhouse gas emissions.

Middle-income Asian nations also display wide variations in economic structure, globalization, and urbanization, providing a valuable basis for cross-country comparison of FDI's environmental impacts. According to the World Bank's July 2024 classification, Asia contains 24 middle-income countries, which collectively form the target population of this study and represent a critical group striving to balance economic growth with environmental sustainability.

Table: List of Middle-Income Asian Countries

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Armenia	India	Malaysia	Sri Lanka
Bangladesh	Indonesia	Maldives	Tajikistan
Bhutan	Iran	Mongolia	Thailand
Cambodia	Iraq	Nepal	Türkiye
China	Jordan	Pakistan	Uzbekistan
Georgia	Lao PDR	Philippines	Vietnam

Source: Researcher's compilation based on World Bank data

Sample of the Study

Although the study targets all middle-income Asian countries, the final sample was determined based on the availability of consistent secondary data for CO_2 emissions, FDI, social globalization, GDP per capita, and urbanization from 2004 to 2023. Countries with incomplete data were excluded to ensure reliability and validity of the econometric analysis. A purposive sampling method was applied, suitable for panel data studies dependent on data relevance and availability. The final sample therefore consists of representative middle-income Asian countries with similar economic structures, rapid industrialization, substantial FDI inflows, and rising climate challenges, providing a robust basis for analysing the impact of FDI on climate change.

Table: List of Sample Countries

Armenia	Georgia	Jordan	Philippines
Bangladesh	India	Malaysia	Sri Lanka
Cambodia	Indonesia	Nepal	Tajikistan
China	Iraq	Pakistan	Vietnam

Source: Researcher's compilation based on data availability.

Data Collection

Table: Definition, Proxies, Data Sources & Theoretical Foundations of Variables

Variable	**Definition**	**Proxy**	**Data Collection Source**	**Literature**

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Climatic changes	Long-term changes in the general weather patterns of the Earth or a specific region, including changes in temperature, precipitation, wind, and other climatic factors over time	Co2 Emission (Metric tons % GDP)	WDI	Pollution Halo Hypothesis & Pollution Heven Hypothesis
Foreign Direct Investment	either harm or help the environment depending on regulations and sector.	FDI (% of GDP)	World Bank, WDI, UNCTAD	Pollution Haven Hypothesis, Pollution Halo Hypothesis & Ecologically Unequal Exchange Theory
Social Globalization	The transnational spread of ideas, information, lifestyles, and cultural practices through media, migration, and digital networks.	KOF Social Globalization Index (flows of people, information, and cultural proximity)	KOF Swiss Economic Institute	Cultural Diffusion Theory, World Society Theory & Treadmill of Production Theory
Urban population	The proportion of population living in urban areas	Urban population (% of total population)	World Bank WDI	Ecological Modernization Theory & Urban Environmental Transition
GDP per capita	Economic output per person, measuring standard of living	GDP per capita (current US$)	World Bank WDI	Environmental Kuznets Curve & Decoupling Theory

Source: Author's Compilation using WDI, UNCTAD, and KOF Data.

Data Analysis Techniques

This study employs panel data analysis using STATA to examine the impact of Foreign Direct Investment (FDI) on climate change in middle-income Asian countries from 2004 to 2023. Descriptive statistics, correlation analysis, and the Variance Inflation Factor (VIF) were used to assess data characteristics and multicollinearity. Cross-sectional dependency was tested using the Breusch–Pagan LM and Pesaran CD tests, while stationarity was examined through the CIPS panel unit root test.

The Panel ARDL approach was applied to estimate both short-run and long-run relationships using the PMG, MG, and DFE estimators, with the Hausman test selecting the most suitable model. Long-run and short-run effects were analyzed through coefficient estimates, and the Error Correction Term

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confirmed long-run equilibrium. Diagnostic tests ensured model reliability and validity, providing robust evidence on the impact of FDI on CO_2 emissions.

Conceptual Framework

Foreign Direct Investment (FDI) in middle-income Asian countries is examined in relation to climate change, considering social globalization, GDP per capita, and urbanization as control variables. This framework aims to clarify the interaction of economic and social factors crucial for regulating climate in the region.

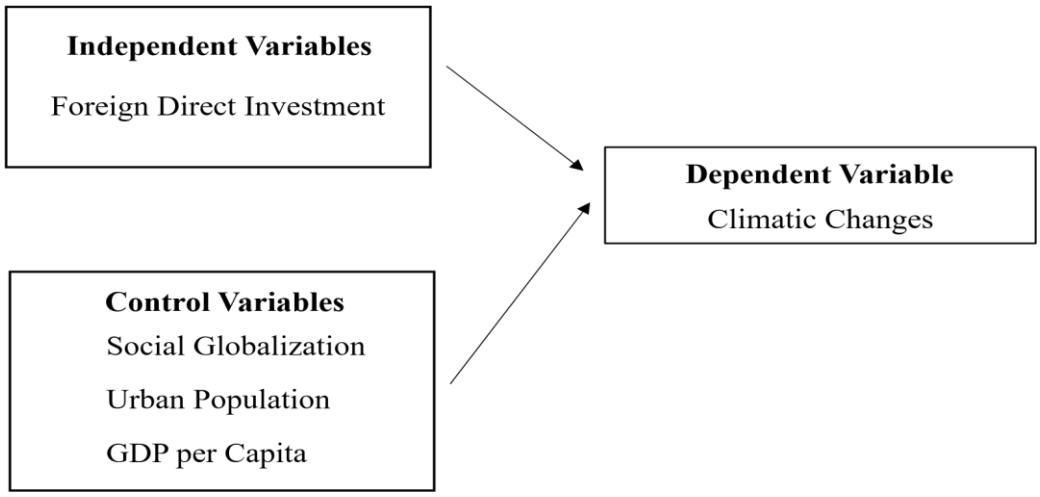

Figure: Conceptual Framework, Source: Compiled by the Author

General Model

This study occupied following general model to showcase the impact of FDI on Climatic changes.

$$CC_{it} = f(FDI)$$

Equation 3. 1

Specific Model

This study used the following specific model to demonstrate the impact of foreign direct investment and other control variables on climate change.

$$CC_{it} = \beta_0 + \beta_1 FDI_{it} + \beta_2 SG_{it} + \beta_3 URB_{it} + \beta_4 GDPpc_{it} + \varepsilon$$

Equation 3. 2

Where,

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CC	=	Climatic Changes
FDI	=	Foreign Direct Investment
SG	=	Social Globalization
URB	=	Urban Population
GDPpc	=	GDP per Capita
e	=	Error Term

DATA ANALYSIS AND DISCUSSION

This chapter presents and analyzes empirical findings on the impact of Foreign Direct Investment (FDI) on climate change in middle-income Asian countries from 2004 to 2023. It interprets results from econometric models that assess short-run and long-run effects of FDI on CO_2 emissions, accounting for social globalization, GDP per capita, and urban population influences. The analysis includes descriptive statistics, correlation analysis, and panel diagnostic tests, followed by results from the Autoregressive Distributed Lag (ARDL) model using various estimation techniques. The chapter concludes with a discussion of the empirical results in relation to existing theories, examining whether FDI contributes to climate improvement or environmental stress, laying the groundwork for conclusions and policy recommendations in Chapter Five.

Data analysis

The chapter analyzes the relationship between Foreign Direct Investment (FDI) and climate change, indicated by CO_2 emissions, in middle-income Asian countries from 2004 to 2023. It includes descriptive statistics and graphical trends, followed by panel diagnostic tests for econometric suitability. Using the Panel ARDL model, the study estimates the short-run and long-run effects of FDI, social globalization, GDP per capita, and urban population on CO_2 emissions, explaining their contributions to climate change in the selected regions.

Descriptive Analysis

Descriptive statistics were employed to analyze data from 16 middle-income Asian countries over a 20-year study period (2004–2023), yielding 320 observations. Key findings include a mean GDP per capita of 7.82, suggesting economic progress, and a mean CO_2 emissions value of 18.13, indicating ongoing climatic contributions. Foreign Direct Investment (FDI) averaged 3.73 but varied significantly, with the highest standard deviation of 5.54, reflecting inconsistencies across nations. Social globalization averaged 52.54, revealing moderate

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global integration, while the urban population percentage averaged 47.63. The data illustrates persistent positive values for emissions and highlights the dynamic interaction between economic growth, social connectivity, and foreign investment, influencing climate outcomes throughout the study period.

Table: Descriptive Statistics

Variable	Observation	Mean	Standard deviation	Min	Max
co2 emi	320	18.133	2.105	14.608	23.200
fdi	320	3.733	5.537	-37.173	43.912
sg	320	52.542	13.026	23.489	83.391
urb	320	47.634	20.716	14.841	92.02
Gdp pc	320	7.819	0.795	5.633	9.446

Source: Compiled by the author based on STATA output

Correlation Analysis

To see if the variables Foreign Direct Investment (FDI), social globalization (SG), climatic changes (CO_2 emissions), population (PO), and GDP per capita (CA) were related statistically, correlation analysis was applied.

The analysis came up with a finding that FDI was positively correlated, albeit weakly, with both SG (r = 0.259) and PO (r = 0.179). Of the variables considered, SG had the strongest positive correlation with GDP per capita (r = 0.757) and a moderate one with population (r = 0.628).

However, the correlation coefficients were all below the critical limit of 0.80, which implied that there were no multicollinearity and all the considered variables were suitable for inclusion in a regression model.

Table: Correlation Analysis

	co2emi	fdi	sg	urb	Gdp pc
co2emi	1.000				
fdi	-0.242	1.000			

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sg	-0.011	0.259	1.000		
urb	0.086	0.179	0.627	1.000	
Gdp pc	0.295	0.069	0.757	0.675	1.000

Source: Compiled by the author based on STATA output

Serial Correlation

Serial correlation, or autocorrelation, refers to the correlation of error terms in a regression model across time or observations. It is commonly evaluated through the use of tests such as the Durbin–Watson or Breusch–Godfrey tests. In a research project that investigated the effect of Foreign Direct Investment (FDI) on climate change in the Asian region of middleincome countries, the analysis utilized a panel dataset comprising 16 countries over a time span of 20 years. The results showed the lack of significant proof of serial correlation, thus indicating the independent distribution of the residuals. This validates the estimated coefficients and the statistical inferences related to FDI, social globalization, and CO_2 emissions.

Multicollinearity Test (Variance Inflation Factor - VIF)

Multicollinearity is a phenomenon that occurs when there is a strong correlation among the independent variables in a regression model, making it difficult to determine their separate impacts on the dependent variable. The study employed the Variance Inflation Factor (VIF) test to assess multicollinearity between the explanatory factors: Foreign Direct Investment (FDI), Social Globalization (SG), urban Population (PO), and GDP per capita (CA) concerning CO_2 emissions in middle-income Asian countries. The VIF values for all variables were less than 5, thus indicating the absence of multicollinearity and that every variable is playing a unique role in explaining the emissions of CO_2. This not only strengthens the credibility of the regression model but also verifies the separate adverse impacts of FDI and social globalization on CO_2 emissions without distortion from the interplay of variable correlations.

Table: Variance Inflation Factors

Variable	VIF	1/VIF
Gdp pc	2.93	0.342

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sg	2.71	0.368
urb	1.98	0.506
fdi	1.13	0.883
Mean VIF	2.19	

Source: Compiled by the author based on STATA output

Cross Sectional Dependency

The necessity to test for cross-sectional dependency first is dictated by the fact that this bias can, for instance, affect the results of the fixed effects or random effects methods if there are common shocks in the region. A Breusch–Pagan LM value of 1765.670 shows that there is a strong cross-sectional dependence among the countries chosen, which means that the environmental effects in one country are determined by the laws and practices in the adjoining countries as well. The FDI also shows dependency with a Breusch–Pagan LM statistic of 353.269, indicating that foreign investments are affected by regional stability and geopolitical conditions. Furthermore, social globalization shows a very strong interdependence (Breusch-Pagan LM of 1917.057), and urbanization as well, with a BiasCorrected Scaled LM value of 114.146, signifying that practically the same development took place in the different areas. The most potent dependence across the sections is in GDP per capita, which is backed by a Breusch-Pagan LM value of 2067.745, meaning economic growth is influenced by the simultaneous external shocks.

Table: Cross-Sectional Dependency

	co2 emi	fdi	sg	urb	Gdp pc
Breusch pagan lm	1765.7	353.27	1917.06	1894.87	2067.75
Pesaran scaled lm	106.23	15.057	115.999	114.567	125.726
Bias corrected scaled lm	105.81	14.636	115.579	114.146	125.305
Pesaran cd	41.109	5.365	43.469	36.717	45.386

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Source: Compiled by the author based on EViews output

Unit Root Test

The CIPS unit root test was performed to assess the stability and time-series properties of variables in the model, ensuring no uncontrolled trends distort regression results. With all variables having statistically significant CIPS values ($p < 0.05$), stability over time is confirmed, suggesting no long-term drifting patterns. This stability is crucial for validating regression relationships. CO_2 emissions, foreign direct investment, social globalization, urban population, and GDP per capita all exhibit consistent behavior across time, indicating reliable trends in the respective data.

Table: Unit Root Test

Variable	**CIPS level**	**Statistic**	
co2emi	-8.473	0.000	1st difference
fdi	-3.289	0.000	level
sg	-5.302	0.000	level
urb	-8.526	0.000	2nd difference
Gdp pc	-4.169	0.000	level

Source: Compiled by the author based on EViews output

Model Estimation and Comparison

In order to examine the impact of foreign direct investment (FDI) and other macroeconomic factors on climatic change in middle-income Asian countries, three ARDL-based estimators were applied. those are Pooled Mean Group (PMG), Mean Group (MG) and Dynamic Fixed Effects (DFE). These models differ in how they treat cross-country heterogeneity.

Table: Model Comparison

Dependent variable (co2emi)		**Pooled mean group**	**Mean group**	**Dynamic fixed effect**
Long run				
fdi	coef.	0.004	0.082	0.024

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	std. err.	0.002	0.074	0.008
sg	coef. std. err.	0.038 0.004	-0.011 0.018	0.044 0.013
urb	coef. std. err.	0.042 0.008	0.270 0.252	-0.044 0.017
Gdp pc	coef. std. err.	-0.150 0.040	0.047 0.535	0.632 0.149
Short run				
speed of adjustment		-0.388	-0.656	-0.197
fdi	coef. std. err.	-0.008 0.008	-0.021 0.033	0.001 0.001
sg	coef. std. err.	-0.012 0.006	-0.002 0.008	-0.005 0.005
urb	coef. std. err.	0.751 0.497	1.012 1.639	-0.007 0.034
Gdp pc	coef. std. err.	0.137 0.048	-0.007 0.077	0.087 0.054

Source: Compiled by the author based on STATA output

Long-Run Effect

The long-run effects detail the persistent impact of FDI, social globalization, GDP per capita, and urban population on CO_2 emissions over time, illustrating how these variables influence climate outcomes as countries progress toward long-term equilibrium.

Short-Run Effect

The short-run effects indicate immediate and temporary adjustments in CO_2 emissions due to short-term changes in FDI, social globalization, GDP per capita, and urban population, highlighting fluctuations prior to achieving long-run balance.

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Discussion

Foreign Direct Investment (FDI) and Climate Change

The analysis revealed that FDI had a positive and significant short-run effect on CO_2 emissions, indicating that increased investment inflows initially intensify environmental pressure in middle-income Asian countries. The descriptive results also showed that FDI fluctuated widely (mean = 3.73, SD = 5.54), confirming uneven investment trends across the region. The correlation between FDI and CO_2 emissions was negative (r = –0.243), but regression results showed that in the short term, industrial activities funded by foreign investors still raise emission levels. This supports the Pollution Haven Hypothesis, suggesting that FDI flows into energy-intensive industries. However, the long-run coefficient was insignificant, meaning that as economies mature, technology transfer and policy improvements may reduce the negative environmental effects of FDI, gradually reflecting the Pollution Halo Hypothesis.

GDP per Capita and Climate Change

GDP per capita showed a positive short-run effect on CO_2 emissions, confirming that economic growth remains dependent on carbon-based production. The descriptive mean (7.82) and low variability (SD = 0.79) indicate steady income growth across countries. The positive correlation (r = 0.296) and significant short-run regression coefficient highlight that increasing income levels raise energy use and emissions. However, the long-run impact became insignificant, implying that some countries may be moving toward the turning point of the Environmental Kuznets Curve (EKC), where higher income supports investment in cleaner technologies and improved efficiency.

Social Globalization and Climate Change

Social globalization showed a positive correlation with GDP per capita (r = 0.757) and a positive short-run effect on CO_2 emissions, meaning that greater connectivity, global lifestyles, and digital expansion increase consumption and energy demand. The descriptive mean (52.54) reflects moderate integration with global networks. In the short term, globalization increases environmental pressure through higher material demand and mobility. However, in the long run, its impact was insignificant, suggesting that as social globalization advances, knowledge diffusion and global awareness may help promote environmental sustainability.

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Urban Population and Climate Change

Urbanization demonstrated a negative and significant relationship with CO_2 emissions in both the short and long run. The mean urban population (47.63%) shows that nearly half of the people in these countries live in cities. The correlation between urbanization and emissions was weakly positive (r = 0.086), but model estimation indicated that structured urban growth actually reduces per-capita emissions. This implies that improved public transport, compact housing, and better access to modern technology in urban areas enhance energy efficiency. The result supports the Ecological Modernization Theory, showing that sustainable urban development contributes positively to climate stability.

Final Model

This section presents the final long-run and short-run models derived from the Mean Group (MG) estimator. The MG model was selected as the most appropriate estimator because the Hausman test comparing MG and PMG produced a statistically significant result (Prob > chi^2 = 0.0054), rejecting the null hypothesis of homogeneity in long-run coefficients. This confirms that the long-run relationships among the variables differ across countries, and therefore, the MG estimator which allows for heterogeneity in both intercepts and slopes is the most suitable for this study.

Long-run Model

$$\boldsymbol{CO2EMI = 0.082FDI - 0.011SG + 0.270URB + 0.047GDP_{PC}}$$

Equation 4.1

The long-run MG results reveal that FDI, urbanization, and GDP per capita have positive associations with CO_2 emissions, whereas social globalization has a negative long-run effect. This implies that foreign investment and economic expansion contribute to environmental degradation over time. The positive coefficient of urbanization indicates that rapid urban expansion still exerts upward pressure on emissions in the long term.

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Short-run Model

$$\Delta CO2EMI = -0.1917(ECM_{t-1}) - 0.021\Delta FDI - 0.002\Delta SG + 1.012\Delta URB - 0.007\Delta GDP_{PC}$$

Equation 4.2

The negative and statistically significant error correction coefficient (–0.1977) indicates that approximately 19.8% of any short-run disequilibrium adjusts toward long-run equilibrium each year. This confirms the existence of a stable long-run relationship among the variables.

In the short run, urbanization shows a positive and significant relationship with CO_2 emissions, implying that rapid city growth temporarily increases pollution levels. FDI, social globalization, and GDP per capita show weak or negative short-run effects, suggesting that their immediate influence on emissions is limited compared to long-term structural impacts.

CONCLUSION AND RECOMMENDATIONS

Conclusion

This chapter presents the conclusion of the study based on the empirical findings discussed in Chapter Four. The study examined the impact of Foreign Direct Investment (FDI) on climatic changes in middle-income Asian countries during 2004–2023. The analysis used panel data representing 16 countries and employed econometric techniques, including descriptive statistics, correlation analysis, panel unit root tests, cross-sectional dependency, multicollinearity testing, and dynamic panel ARDL estimators (PMG, MG, and DFE). The Mean Group (MG) estimator was chosen to be the most appropriate model. This chapter provides an overview of the most significant findings, conclusions, policy recommendations, theoretical and practical implications, limitations and future research directions.

Implication

The study finds that Foreign Direct Investment (FDI) increases CO_2 emissions in the short run, mainly through investment in manufacturing, construction, and energy-intensive sectors, thereby supporting the Pollution Haven Hypothesis. However, in the long run, the impact of FDI becomes statistically insignificant, suggesting that cleaner technologies and stronger environmental regulations help reduce its environmental effects, consistent with the Pollution Halo Hypothesis. GDP per capita and social globalization are identified as key drivers of rising emissions in the short term due to fossil-fuel–based consumption patterns. In contrast, urbanization reduces emissions in both the short and long run, supporting the Ecological Modernization Theory by indicating improved energy efficiency. Overall, middle-income Asian economies appear to be in a transition phase where current economic growth

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worsens environmental quality, but future improvements through technology and institutions remain promising.

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