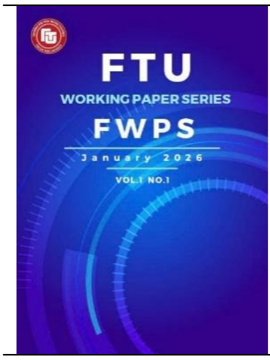

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ĐÁNH GIÁ TÁC ĐỘNG CỦA ĐẦU TƯ TRỰC TIẾP NƯỚC NGOÀI ĐẾN TĂNG TRƯỞNG XANH TẠI CÁC QUỐC GIA ĐANG PHÁT TRIỂN ĐÔNG NAM Á

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Tóm tắt

Trong thời đại mà phát triển kinh tế không thể tách rời trách nhiệm với môi trường, tăng trưởng xanh không chỉ là xu hướng mà còn là yêu cầu sống còn cho tương lai bền vững. Bài nghiên cứu này đánh giá tác động của dòng vốn đầu tư trực tiếp nước ngoài (FDI) đến tăng trưởng xanh tại các quốc gia đang phát triển ở Đông Nam Á giai đoạn 2010–2023, thông qua mô hình dữ liệu bảng, đồng thời phân tích vai trò của các yếu tố kinh tế vĩ mô khác. Từ kết quả nghiên cứu, bài viết đề xuất một số khuyến nghị chính sách nhằm nâng cao hiệu quả thu hút và sử dụng FDI, hướng tới tăng trưởng bền vững.

Từ khóa: FDI, tăng trưởng xanh, quốc gia đang phát triển, Đông Nam Á

ASSESSING THE IMPACT OF FOREIGN DIRECT INVESTMENT ON GREEN GROWTH IN DEVELOPING SOUTHEAST ASIAN COUNTRIES

Abstract

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In an era where economic development cannot be separated from environmental responsibility, green growth is not only a trend but also a vital requirement for a sustainable future. This paper assesses the impact of foreign direct investment (FDI) flows on green growth in developing countries in Southeast Asia during the period 2010–2023, through a panel data model, and analyzes the role of other macroeconomic factors. Based on the research results, the paper proposes a number of policy recommendations to improve the efficiency of attracting and using FDI, towards sustainable growth.

Keywords: FDI, green growth, developing countries, Southeast Asia

1. Introduction

In recent years, fueled by trade liberalization and the momentum of free trade agreements, foreign direct investment (FDI) inflows into the ASEAN region have significantly increased. According to UNCTAD, during the 2000s, total FDI in the region grew at an average of approximately USD 60–70 billion per year, making ASEAN one of the top three global destinations for foreign investment, accounting for 17% of the world's total as of 2023—second only to the United States and the European Union (EU). However, in contrast to these positive signs of economic growth, the environmental situation in the region has worsened over the past decade. There has been a notable increase in transboundary haze pollution, with ASEAN losing around 8,000 square kilometers of forest annually (ASEAN Centre for Biodiversity, 2023). Furthermore, by 2050, plastic waste is projected to exceed the number of marine organisms, posing a severe threat to ecosystems (World Economic Forum, 2016).

This raises the question of whether FDI has a positive or negative impact on the environment in developing Southeast Asian countries. Research on this relationship remains limited and has yet to reach a consensus. Therefore, the research team has chosen the topic ***"Assessing the Impact of Foreign Direct Investment on Green Growth in Developing Southeast Asian Countries"***, with the aim of contributing not only to theoretical understanding but also to practical policy implications.

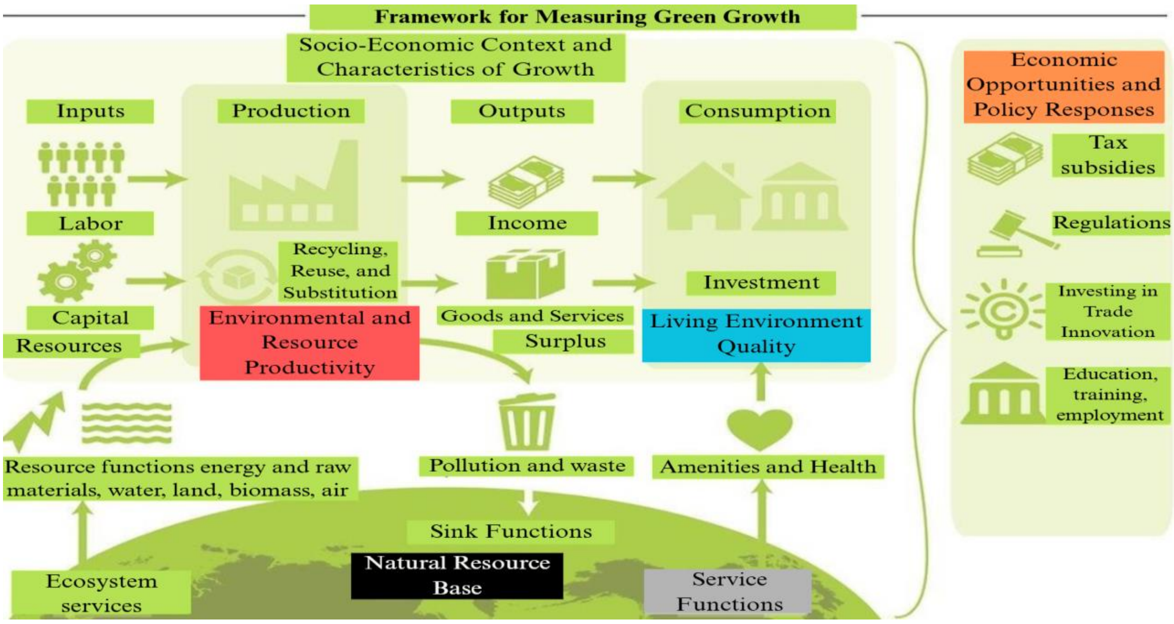
2. Theoretical framework

2.1 Overview of Foreign Direct Investment (FDI)

Foreign Direct Investment (FDI) is a form of long-term investment in which a foreign investor establishes or acquires a business entity abroad with significant control, typically defined by the IMF as holding at least 10% of the equity. According to the WTO, FDI differs from portfolio investment as the investor directly participates in management through a parent–subsidiary relationship. FDI contributes to economic growth by transferring capital, technology, and managerial expertise, thereby promoting international integration and sustainable development. It usually involves long-term commitments such as factory construction, infrastructure investment, and technology transfer, which enhance the host country's technical and managerial capacity without increasing public debt.

2.2 Overview of green growth

Green growth is an economic model that aligns development with environmental protection and sustainable resource use. It promotes clean technologies, green industries, and an effective transition to a green economy. The World Bank (2012) defines it as growth that enhances resource efficiency, reduces pollution, and builds resilience to natural disasters, while the OECD (2014) emphasizes its role in fostering innovation and conserving natural resources for sustainable development. Since the 1990s, the OECD has developed and updated green growth indicators, most recently in 2017, to guide policy and adapt to national contexts.



Source: Center for Science and Technology Information and Statistics

Fig 1. Framework for Measuring Green Growth

The OECD's green growth monitoring framework consists of four main indicator groups: (1) resource and energy productivity, (2) natural asset base, (3) environmental quality of life and economic opportunities, and (4) socio-economic context. These indicators are designed to track progress in reducing carbon emissions, improving resource efficiency, maintaining natural capital, and enhancing quality of life.

2.3 Theoretical perspectives on the impact of foreign direct investment on green growth

The **Environmental Demand Theory** (or Green Demand Hypothesis) suggests that multinational corporations (MNCs) face pressure from consumers and investors to meet high environmental standards. When investing in developing countries, they often adopt cleaner technologies to maintain reputation and comply with global supply chain requirements.

The **Technology Spillover Theory** views FDI as an important channel for transferring green technologies, as foreign firms introduce advanced solutions in renewable energy, resource efficiency, and waste management.

Conversely, the **Pollution Haven Hypothesis** warns that FDI may exacerbate environmental degradation if developing countries lower regulatory standards to attract capital. In such cases, FDI shifts pollution-intensive activities to these economies, undermining sustainable development goals.

3. Literature review

In the context of globalization and climate change, the relationship between foreign direct investment (FDI) and green growth has received increasing scholarly attention, particularly in developing economies. Green growth, which combines economic development with environmental protection and resource efficiency, has become a key policy objective in Southeast Asia. Understanding how FDI influences this process is crucial for designing strategies that maximize its developmental benefits while minimizing environmental risks.

Empirical evidence on the FDI–green growth nexus remains inconclusive. Several studies emphasize the positive role of FDI in promoting green growth through technology transfer, improved productivity, and stricter environmental standards. Zarsky and Gallagher (2003) highlight that multinational corporations often introduce advanced technologies and stronger environmental practices, generating positive spillovers. Similarly, Zhang (2020) and Nguyen and Vo (2021) demonstrate that technology-intensive FDI projects tend to comply with international environmental and ESG standards, thereby enhancing sustainability and institutional quality.

However, other research provides contrasting evidence. The *pollution haven* hypothesis (Cole & Elliott, 2005) suggests that investors may relocate pollution-intensive industries to countries with weaker environmental regulations. Eskeland and Harrison (2003) further argue that FDI is not always environmentally friendly, especially in resource-extractive sectors. Le (2020) and Rahman et al. (2022) also find that weak environmental monitoring in Southeast Asia contributes to deforestation and pollution. Consequently, the environmental impact of FDI largely depends on the institutional quality and governance capacity of host countries.

Despite these insights, several research gaps remain. Most prior studies examine FDI's relationship with economic growth or environmental outcomes separately, while few provide an integrated quantitative analysis encompassing economic, environmental, and resource-efficiency dimensions. Moreover, although Southeast Asia is both a major FDI recipient and a region facing acute ecological challenges, existing literature primarily focuses on single-country cases (e.g., Indonesia, Malaysia), offering limited regional perspectives that reflect institutional and policy heterogeneity. Finally, the concept and measurement of green growth remain inconsistent, as the use of diverse indicators—such as CO_2 emissions, energy efficiency, and composite green economy indexes—hinders comparability and leads to fragmented empirical findings.

4. Research methods and data

4.1 Estimation model

Based on an extended Solow growth model and the Cobb-Douglas production function, with environmental factors taken into account—as well as drawing on the studies of Cole et al. (2008), Tamazian et al. (2009), and Wang et al. (2021)—the research team proposes the following general model:

$$GGI = f(FDI, GDPG, ANE, POPG, TRADE, EU, CO2PC) \quad (1)$$

In this model, the **dependent variable** is the Green Growth Index (GGI); the **independent variable** is Foreign Direct Investment (FDI); and the **control variables** include: economic growth (GDPG), the share of alternative and nuclear energy (ANE), population growth (POPG), trade openness (TRADE), energy use (EU), and per capita CO_2 emissions (CO2PC).

To assess the impact of foreign direct investment on green growth in developing Southeast Asian countries during the period 2010–2023, the research team constructs a sample regression model (SRF) in the following form:

$$GGI = \beta_0 + \beta_1 FDI_{it} + \beta_2 GDPG_{it} + \beta_3 ANE_{it} + \beta_4 POPG_{it} + \beta_5 TRADE_{it} + \beta_6 EU_{it} + \beta_7 CO2PC_{it} + u_{it}$$

Where:

β_0: Intercept coefficient

β_{it}: Slope coefficients (i = 1, 2, 3, ..., 7)

u_{it}: Overall random error term corresponding to observation *i*, representing other factors that affect GGI but are not included in the model.

4.2 Research data

To study the impact of foreign direct investment on green growth in developing Southeast Asian countries during the period 2010–2023, the research team collected data from two reputable sources: the **World Bank** and the **Global Green Growth Institute (GGGI)**.

The table below explains the symbols, descriptions, and expected signs of the variables used in the study:

Table 1. Variable Description and Expected Signs

Symbol	Description	Unit	Expected Sign	Data Source
GGI	Green Growth Index	–	–	Global Green Growth Institute (GGGI)
FDI	Foreign Direct Investment	%	+/-	World Bank
GDPG	GDP Growth Rate	%	+	
ANE	Alternative and Nuclear Energy	%	+	
POPG	Population Growth	%	–	
TRADE	Trade Openness	%	+/-	
EU	Energy Use	kg of oil	–	
CO2PC	CO_2 Emissions Per Capita	tons/person	–	

Source: Compiled by the authors

4.3 Research method

The research employs STATA to estimate the impact of FDI on green growth using the Pooled OLS model. Since the data are panel-based, Fixed Effects (FEM) and Random Effects (REM) models are also applied to control for unobserved spatial and temporal factors. FEM assumes correlation between unobserved effects and independent variables, while REM assumes no such correlation.

After estimating all three models, the Breusch–Pagan and F-tests are used to identify the most suitable one. To ensure robustness, the study tests for multicollinearity, heteroskedasticity, serial correlation, and cross-sectional dependence at the 5% level. If any issues arise, appropriate corrective methods are applied to ensure reliable results.

5. Research results and discussion

5.1 Descriptive statistics

The authors conducted descriptive statistics to understand the basic characteristics of the sample data, such as **mean, standard deviation, maximum value, and minimum value**, as follows:

Table 2. Descriptive Statistics

Variable	Observations	Mean	Standard	Minimum	Maximum

			Error	Value	Value
GGI	112	56.716	4.216	45.880	63.180
FDI	112	4.013	2.871	-1.753	11.243
GDPG	112	4.432	3.403	-9.518	8.862
ANE	112	10.504	13.163	0.000	56.030
POPG	112	1.201	0.439	-0.046	2.048
TRADE	112	101.536	41.456	0.147	186.676
EU	112	85.459	16.561	56.537	135.259
CO2PC	112	4.918	5.901	0.356	22.136

Source: Compiled by the authors

5.2 Correlation among variables

The results in Table 3 indicate that the correlations among the independent variables are mostly below 0.8.This suggests that the issue of perfect multicollinearity can be ruled out and the model is less likely to have multicollinearity issues.

Table 3. Correlation Matrix

	GGI	FDI	GDPG	ANE	POPG	TRADE	EU	CO2PC
GGI	1.0000							
FDI	-0.4861	1.0000						
GDPG	-0.0852	0.3591	1.0000					
ANE	0.3418	0.3418	0.2154	1.0000				
POPG	-0.2794	0.3338	0.2784	0.2672	1.0000			
TRADE	-0.1628	0.1629	0.0406	-0.586	-0.1479	1.0000		
EU	0.1095	-0.0030	-0.2906	-0.2427	-0.0655	0.3810	1.0000	
CO2PC	-0.1187	-0.3000	-0.4991	-0.3987	0.0315	0.2057	0.6309	1.0000

Source: Compiled by the authors

5.3 Research findings

5.3.1. Model Selection Tests

The Breusch–Pagan Lagrange Multiplier (LM) test produced a p-value of 1.000 ($>\alpha$ = 0.05), indicating that the Pooled OLS (POLS) model is preferred over the Random Effects Model (REM). However, the F-test yielded a p-value of 0.000 ($<\alpha$ =0.05), confirming significant individual effects across cross-sectional units. Therefore, the Fixed Effects Model (FEM) was identified as the most appropriate specification for this study.

5.3.2 Diagnostic testing

Diagnostic tests were conducted to ensure model robustness. The Variance Inflation Factor (VIF) values were all below 10 (mean VIF = 1.95), confirming no multicollinearity. The Wald test (p-value = 0.000) indicated heteroskedasticity, while the Wooldridge test (p-value = 0.004) revealed first-order serial correlation. Additionally, the Pesaran CD test (p-value = 0.0368) suggested cross-sectional dependence. To correct these issues, the Driscoll & Kraay robust standard error estimator was applied.

5.4 Estimation results

Using the Driscoll & Kraay (1998) method, the research team obtains the final estimation results presented in Table 5.

Table 4. FEM Estimation Results (Driscoll & Kraay Standard Errors)

	FEM	**Driscoll & Kraay**
FDI	0.217*** (3.06)	0.217*** (5.26)
GDPG	-0.0598* (-1.66)	-0.0598** (-2.82)
ANE	0.0555** (2.09)	0.0555 (1.37)
POPG	-1.024** (-2.45)	-1.024*** (-3.58)
TRADE	-0.0178*** (-3.08)	-0.0178*** (-3.53)
EU	-0.0259* (-1.94)	-0.0259 (-1.62)
CO2PC	0.739*** (4.53)	0.739* (2.26)
_cons	57.14*** (43.58)	57.14*** (55.91)
Observations	112	112

Note: Robust standard errors in parentheses.

*, **, *** *indicate statistical significance at the 10%, 5%, and 1% levels, respectively.*

Source: Compiled by the authors

5.5 Discussion of research findings

The estimation results reveal that FDI, GDPG, POPG, and TRADE are statistically significant, while ANE, EU, and CO2PC are not at the 5% level. FDI shows a positive and significant coefficient of 0.217, meaning a 1% increase in FDI raises the Green Growth Index (GGI) by 0.217 units. This result aligns with previous studies (Zarsky & Gallagher, 2003; Zhang, 2020; Tang & Tan, 2015), confirming that FDI promotes green growth through technology transfer, cleaner production, and higher environmental standards adopted by multinational corporations.

Conversely, GDPG has a negative coefficient (-0.06), indicating that faster economic growth reduces green growth in developing Southeast Asian economies. This reflects the early stage of the Environmental Kuznets Curve (Panayotou, 1997; Tamazian & Rao, 2010), where industrialization-driven growth leads to higher emissions and environmental degradation.

POPG also shows a negative effect (-1.024), suggesting that population growth constrains green growth. As population increases, resource demand and pollution rise, causing overexploitation of natural resources (Cole & Neumayer, 2004; Kwilinski et al., 2023). Finally, TRADE has a small but negative coefficient (-0.018), implying that trade expansion may undermine green growth, as developing countries often attract pollution-intensive industries due to lower environmental standards (Cole, 2004; Ejike, 2020).

6. Policy implications

Based on the empirical findings, several policy directions are proposed to enhance the positive and mitigate the negative effects of FDI on green growth in developing Southeast Asian countries. Governments should adopt selective and sustainable FDI attraction strategies that prioritize environmentally friendly sectors such as renewable energy, green transport, and clean production, supported by appropriate incentives and tax policies.

Investment policy reforms are essential, including simplified administrative procedures, improved legal frameworks, and stronger infrastructure in transport, logistics, and clean energy. Parallel efforts should focus on developing human capital and technological capacity to meet the requirements of sustainable industries.

Finally, governments need to strengthen regional integration and investment promotion, enhance transparency, and ensure effective capital management. A balanced approach between economic growth and environmental protection, together with continuous monitoring of ecological impacts, is vital to achieving long-term sustainable development across the region.

7. Conclusion

This study assessed the impact of FDI inflows on green growth in developing Southeast Asian countries during the period from 2010 to 2023. Using the Fixed Effects Model (FEM), the research results indicate a positive relationship between FDI and green growth, consistent with prior theories and studies. This finding highlights the issue of attracting FDI in Southeast Asian developing countries while aligning with environmental protection goals.

The study also emphasizes the necessity of establishing effective FDI attraction and management policies to promote economic growth, reduce emissions, and use resources efficiently. It advocates for institutional reforms and enhanced regional integration to achieve sustainable development.

However, the study does not yet take into account institutional, political, and developmental disparities among countries, which may influence the results. In summary, this research provides important empirical evidence on the role of FDI in green growth and contributes to shaping sustainable development policies for the ASEAN region.

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