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Is Green Always Beneficial? Assessing the True Impact of Greenfield Investments on Green Economy---Evidence from Selected Asean Countries

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Abstract

This study examines the impact of greenfield investments on the green economy across the ASEAN region based on a dataset from 2003 to 2020 Specifically, the analysis focuses on the relationship between greenfield investments and various economic indicators through models incorporating the Green Economy Index, which is constructed via Principal Component Analysis (PCA) from variables including GDP, GDP growth, and the Sustainable Development Index. The findings indicate that greenfield investments consistently correlate negatively with the green economy, suggesting that these investments may not inherently support sustainable economic outcomes in their current form. The study recommends that future policies in the ASEAN region should promote sustainability criteria for greenfield investments and encourage practices that integrate economic growth with environmental sustainability.

Keywords: Green Economy, Greenfield Investment, Principal Component Analysis, Asean.

Introduction

The concept of the “green economy” represents a transformative approach that combines environmental sustainability with economic growth. This concept is becoming increasingly important as global stakeholders seek sustainable development models that do not sacrifice environmental health in order to achieve economic progress. The “green economy” framework advocates the development of policies to ensure efficient use of resources, reduce pollution, and mitigate climate change while promoting economic prosperity and social equity (Kwilinski et al., 2023; Liu & Dong, 2021). This model is particularly relevant in regions such as

the Association of Southeast Asian Nations (ASEAN). ASEAN consists of diverse economies at different stages of development, each facing unique sustainability challenges.

The concept of “green economy” has gained significant attention globally as countries and regions seek sustainable development models that balance economic growth and environmental protection. The ASEAN region consists of diverse economies with varying levels of development, providing a unique environment for the exploration and implementation of green economy principles.

The transformative influence of foreign direct investments (FDIs) on host countries' economies, particularly in the ASEAN region, has garnered significant academic interest over the years (ASEAN Investment Report, 2023). Within this context, greenfield investments—a subtype of FDIs where a parent company builds its operations in a foreign country from the ground up—represent a crucial dynamic in understanding economic and environmental development. This study focuses on the impact of greenfield investment on the green economy across five selected ASEAN countries: Singapore, Indonesia, the Philippines, Malaysia, and Thailand. The green economy is a pivotal metric that gauges a country’s performance in fostering economic growth while ensuring environmental sustainability.

Greenfield investments, which entail the establishment of entirely new operations in a foreign country, can have mix effects on the green economy in the ASEAN region (Ashraf et al., 2021; Emodi et al., 2022; Raza et al., 2021). Positively, they introduce advanced technologies and practices, create sustainable infrastructure, boost renewable energy, and contribute to economic diversification and job creation (Amendolagine et al., 2021; Herzer & Schmelmer, 2022). However, these investments can also lead to environmental degradation, involve resource-intensive processes, suffer from insufficient regulatory enforcement, negatively impact social and community structures, and sometimes prioritize short-term profits over long-term sustainability (Bakar et al., 2019; Castellani et al., 2022). Balancing these impacts requires robust regulatory frameworks, community involvement in decision-making, and a commitment to sustainability from both investors and governments to ensure that the benefits are maximized while the negative effects are minimized. Therefore, this is a topic worth being explored.

Despite the critical importance of this relationship, there is a scarcity of research exploring the specific effects of greenfield investments on the green economy in these nations. This gap in the literature is particularly significant considering the diverse economic landscapes and environmental policies within the ASEAN region. The ASEAN region faces unique environmental challenges, including deforestation, air pollution, and biodiversity loss, compounded by rapid economic growth and urbanization (Nasir et al., 2019). For example, Singapore, as known for its advanced urban sustainability initiatives, it heavily invests in green buildings, water recycling, and sustainable urban transport. The city-state leads in integrating technology with environmental policy, aiming to become a "smart" and "green" city. Moreover, Indonesia and the Philippines both face severe challenges due to deforestation and reliance on coal for energy. However, Indonesia has ambitious plans to increase its renewable energy capacity, while the Philippines has been promoting geothermal and solar energy. Therefore, the study aims to explore the effect of greenfield investment on the green economy, assessing how these investments influence the sustainability metrics within the

index. To provide a comprehensive measure of sustainable economic practices, this study utilized the Principal Component Analysis (PCA) method to construct a novel green economy index that incorporates both economic factors and sustainable development indicators. This innovative approach allows for a deeper understanding of the diverse economic landscapes and environmental policies within the ASEAN region.

The significance of this study lies in its comprehensive analysis of the impact of greenfield investments on the green economy in the ASEAN region, which is characterized by rapid economic growth as well as its significant environmental vulnerability. By adopting principal component analysis (PCA) to develop a new green economy index, this study provides a powerful tool for measuring how greenfield investments affect sustainability in different economic and environmental contexts. By exploring the economic and environmental impacts of greenfield investments, this study enables policymakers with the knowledge to draft more effective regulations and policies that encourage sustainable investment practices while ensuring environmental protection.

The structure of this paper is outlined as follows: Section 2 presents a review of the relevant literature. Section 3 details the methodology employed in our analysis. Section 4 presents the empirical results. Finally, Section 5 offers conclusions.

Literature Review

According to the Pollution Haven Hypothesis (hereafter PHH), companies relocate their operations to countries with lax environmental regulations, potentially increasing pollution and environmental degradation in host countries. Conversely, the Porter Hypothesis suggests that stringent environmental regulations can encourage innovations that may lead to better environmental outcomes and competitive advantages. Ecological modernization theory (EMT) further supports this by arguing that advancements in technology and governance can enable economic growth alongside environmental improvements. These theories provide contrasting perspectives on the potential environmental impacts of investments like greenfield projects.

The impact of greenfield investments on the environment is a critical area of study, given that these projects involve the establishment of new operations and facilities from the ground up in the host country. The literature reveals mixed outcomes: on one hand, greenfield investments can introduce state-of-the-art technologies and environmentally friendly practices that align with sustainable development goals (Amendolagine et al., 2021; Castellani et al., 2022; Khan et al., 2022). These investments can lead to improvements in energy efficiency, pollution reduction, and overall environmental management within developing regions (Yahya & Rafiq, 2020). On the other hand, the literature also highlights significant risks associated with greenfield investments, particularly in cases where they are implemented without adequate environmental safeguards. Such investments can lead to deforestation, water contamination, and increased carbon emissions, especially if they are focused on resource-intensive industries such as mining or heavy manufacturing (Jorgenson et al., 2009). The disparity in environmental outcomes largely depends on the regulatory environment of the host country and the commitment of the investing entities to sustain able practices. Khan et al (2022) demonstrates that innovations, effective green policies, government efficacy, and the consumption of renewable energy all contribute significantly to this type of economic

growth. Furthermore, the authors emphasize that the successful implementation of green innovations necessitates greenfield investments. Doytch & Ashraf (2022) highlights the environmental impact of greenfield Investment (GFDI) on different nations, revealing distinct patterns between developed and developing countries. Overall, GFDI tends to have a more detrimental effect on ecosystems compared to cross-border Mergers and Acquisitions (M&A). In developing countries, the environmental burden of GFDI contributes to their roles within global supply chains, particularly in activities that lead to increased exporting, thus bearing a significant ecological cost. Yahya & Rafiq (2020) shows that for greenfield investments, the findings demonstrate a generally positive influence on renewable energy consumption in both global and low-risk country panels. In high-risk countries, however, greenfield investment has a negative impact on renewable energy usage. Additionally, the study finds that government effectiveness plays a significant role in enhancing the positive relationship between greenfield investment and renewable energy consumption in global and low-risk environments. In contrast, in high-risk countries, effective government weakens the negative association between greenfield investment and renewable energy consumption. Zeraibi et al. (2023) found that within the BRICS nations, greenfield investment results in a reduction of renewable energy consumption and an escalation in the carbon footprint.

Despite the considerable body of literature on the economic and environmental impacts of greenfield investments, there remains a notable gap in research specifically addressing the effects of such investments on the green economy within the ASEAN region. Studies tend to either focus broadly on environmental impacts without distinguishing between different types of economic activities or concentrate on economic outcomes without adequately considering the environmental dimensions. Moreover, the unique environmental, political, and economic contexts of ASEAN countries, which influence the outcomes of greenfield investments, are often underexplored. This gap highlights the need for targeted research that examines how greenfield investments specifically influence the green economy metrics in this region, taking into account the varied sustainability practices and regulatory frameworks across ASEAN countries.

Data and Methodology

The dataset includes annual data spanning from 2003 to 2020, collected from five ASEAN countries. This period was specifically selected due to the start of comprehensive greenfield investment tracking by the United Nations Conference on Trade and Development (UNCTAD) beginning in 2003. This year represents the onset of UNCTAD's consistent and detailed recording of greenfield investment data, making it an ideal baseline for our analysis. Below, we detail the variables included in this dataset and their respective sources.

Dependent Variable

GEI (Green Economy Index)

The Green Economy Index, which is calculated using the Principal Component Analysis (PCA) method. PCA is a statistical technique used to simplify data by reducing the number of variables while preserving important information. It simplifies complexity in high-dimensional data by transforming it into a new coordinate system (Shoaib et al., 2020). In this system, the first axis (principal component) captures the maximum variance in the data, and each succeeding component (independent of the others) captures decreasing amounts of the remaining variance.

The index is derived from a combination of data sources, including the World Development Indicators (WDI), and the calculation is conducted by the author(s). Table 1 below outlines the components of the Green Economy Index. Table 2 presents the descriptive statistics of green economy index from 2003-2020 in selected Asean countries. The descriptive statistics presented in Table 2 for the green economy index from 2003 to 2020 provide a longitudinal snapshot of how this index has evolved over time in the selected ASEAN countries. From 2004 to 2012, the green economy index values were generally negative, indicating poorer green economy performance during these years. Notably, 2004 exhibited the lowest mean value of -2.201, suggesting significant challenges or low emphasis on green economy factors during this period. Starting from 2013, there is a notable shift towards positive values, indicating improvements in green economy performance. This trend becomes more pronounced from 2016 onwards, with each successive year showing an increase in the mean values. By 2020, the index reached its highest mean of 3.114, reflecting substantial progress in green economy metrics over the years.

Table 1
The construction of green economy index

Indicators	Variable	Measurement	Source
Green economy index	Economic benefits	GDP per capita (constant 2015 US$)	WDI
	Economic growth	GDP growth (annual %)	WDI
	Environmental benefit	Sustainable Development Index (SDG index)	The United Nations Sustainable Development Report

Table 2
Descriptive statistics of green economy index from 2003-2020 in selected Asean countries

year	mean	std	min	max
2003	0.054	0.205	-0.196	0.257
2004	-2.201	0.466	-2.735	-1.682
2005	-1.861	0.141	-2.022	-1.691
2006	-1.706	0.182	-1.96	-1.52
2007	-1.5	0.09	-1.62	-1.425
2008	-1.098	0.179	-1.346	-0.928
2009	-0.667	0.184	-0.849	-0.408
2010	-1.207	0.296	-1.659	-0.914
2011	-0.403	0.391	-0.868	0.078
2012	-0.422	0.276	-0.746	0.019
2013	0.054	0.205	-0.196	0.257
2014	0.489	0.265	0.2	0.783
2015	0.846	0.17	0.66	1.031
2016	1.046	0.183	0.893	1.343
2017	1.394	0.089	1.25	1.464
2018	1.79	0.262	1.539	2.224
2019	2.278	0.188	2.158	2.611
2020	3.114	0.477	2.788	3.95

Independent Variable

The main dependent variable in this study is greenfield investment. This variable represents the value of announced greenfield Foreign Direct Investment (FDI) projects by destination. Greenfield investment refers to investment in new physical facilities or expansion of existing facilities. Data for this variable is sourced from the United Nations Conference on Trade and Development (UNCTAD).

Control variables

The control variables incorporated into the analysis encompass a diverse range of factors influencing the dynamics of the green economy. Beginning with "**lnTrade**," representing trade openness as the natural logarithm of the sum of imports and exports of goods and services relative to GDP, it offers insight into a nation's level of international trade engagement. "**lnUrb**," reflecting urbanization through the natural logarithm of urban population as a percentage of the total population, sheds light on the pace and extent of urban development within a country. "**lnPpl**," capturing population growth as an annual percentage, highlights demographic trends crucial for understanding economic and environmental pressures. Lastly, "**LnHucap**," denoting human capital development as the natural logarithm of gross school enrollment at the primary level, underscores the significance of education in fostering sustainable economic growth and societal well-being. The source for the control variables provided in the merged paragraph is primarily the World Development Indicators (WDI). Table 3 shows the the descriptive statistics of all the variables used in this study.

Table 3
Descriptive statistics of the variables

Variable	SD	Mean	Min	Max
gei	1.499	0	-2.735	3.950
greenfield	1.087	8.586	4.637	10.06
lntrade	0.724	4.770	3.496	6.081
lnurb	0.321	4.082	3.554	4.605
lnppl	0.623	0.223	-2.424	1.672
lnhucap	0.065	4.614	4.436	4.728

Table 3 reveal diverse ranges and distributions across variables. The green economy index (gei) is normalized with a mean of zero and shows a broad range, suggesting varied economic conditions. Trade and urbanization show consistent values with moderate spreads, indicating stability in these areas across observations. Human capital is remarkably uniform as indicated by its very low standard deviation. In contrast, the population shows significant variability, potentially reflecting varying demographic trends.

Empirical Results
Green economy index based on PCA method among selected Asean countries.

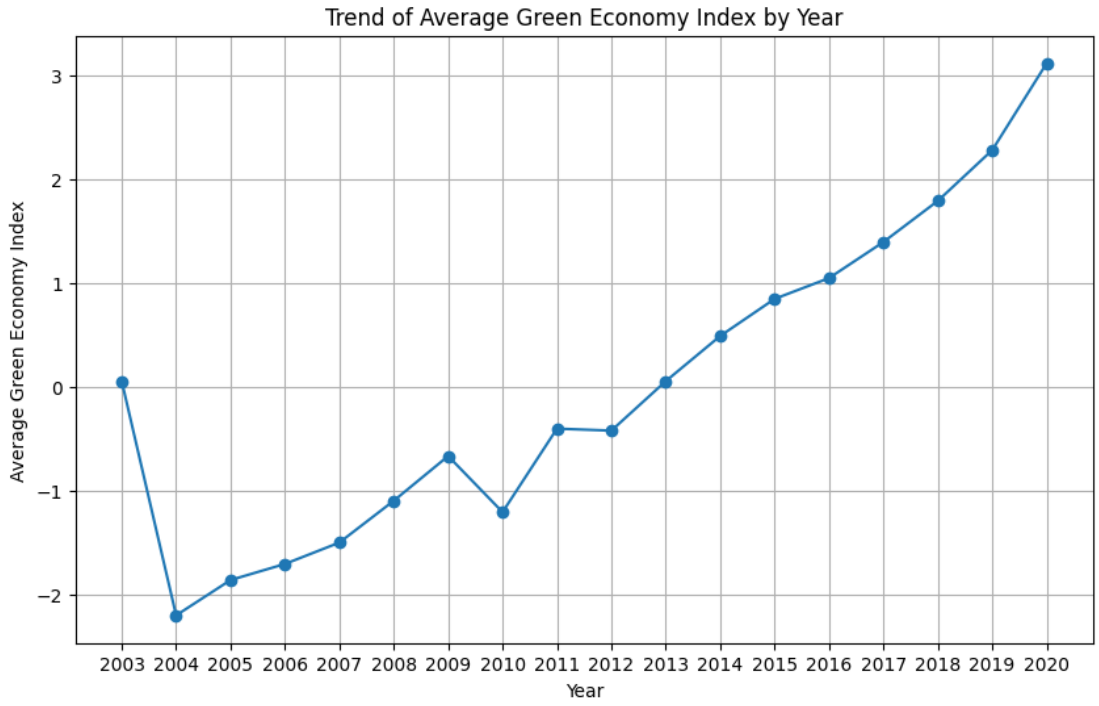

Figure 1 Average Green Economy Index for the selected ASEAN countries from 2003 to 2020

Figure 1 depicts the Average Green Economy Index for the ASEAN region from 2003 to 2020, showing a trend that initially dips to its lowest in 2004 before fluctuating up to 2009, indicating a period of instability or varied economic conditions affecting the green economy. As we know, the devastating tsunami on December 26, 2004, had a significant impact on the economies of several ASEAN nations, potentially causing a shift in focus away from green initiatives to immediate disaster response and recovery efforts. Besides, the effects of the global financial crisis could have led to a reduction in investment in green economy initiatives

in 2010 as governments and businesses might have prioritized economic stability and recovery over environmental concerns. Post-2009, the index demonstrates a gradual and consistent increase, with an accelerated growth observed from 2016 onwards, culminating in the highest index value by 2020. This overall upward trajectory suggests a strengthening commitment to sustainable economic practices within the region, reflecting the implementation of green policies, investments in sustainable technologies, and the impact of international environmental agreements. While the graph provides a positive average trend towards a greener economy in ASEAN, individual country variations and the influence of global events such as economic downturns and commodity price shifts are factors that might underlie this aggregate trend.

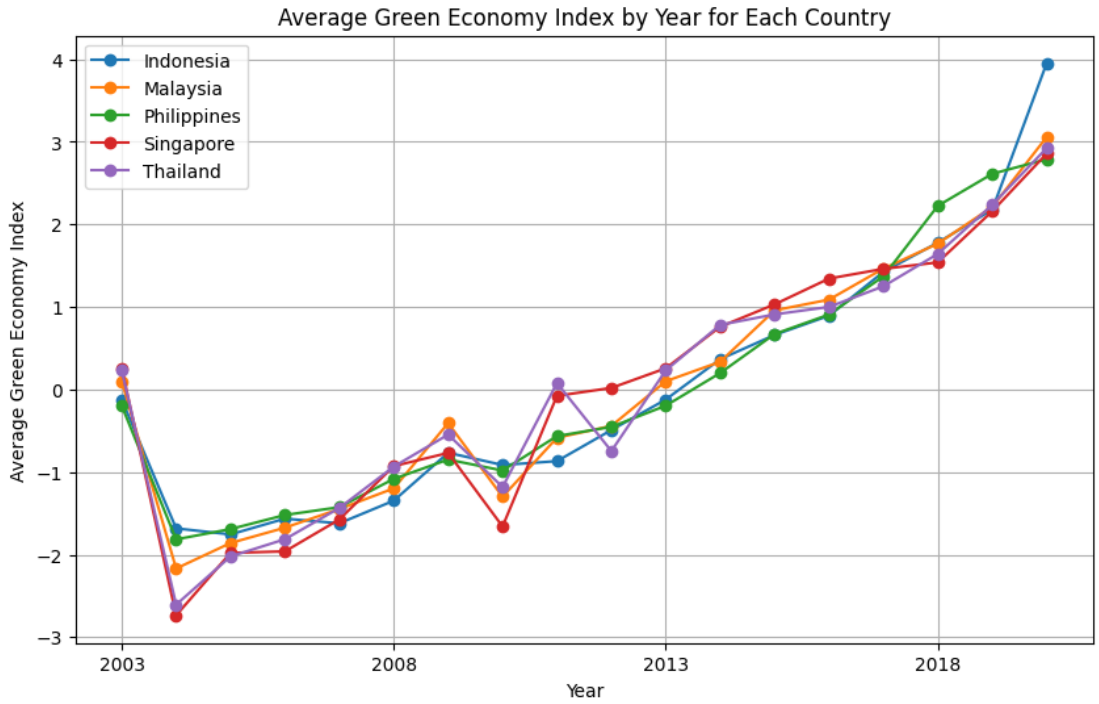

Figure 2 Average Green Economy Index for the selected ASEAN countries by each country from 2003 to 2020

Figure 2 shows the Average Green Economy Index from 2003 to 2020 for five ASEAN countries—Indonesia, Malaysia, the Philippines, Singapore, and Thailand—revealing an initial sharp decline in 2004 across the board, followed by a generally positive upward trend indicative of growing commitment to sustainable practices. Each country displays unique fluctuations; Philippines's growth is relatively steady, while Indonesia and Singapore exhibit more volatility, and Malaysia maintains a consistent upward trajectory, reflecting stable policy implementation. Thailand's Index shows a particularly strong increase post-2016, suggesting aggressive green economy measures. The convergence of all countries' indices towards the latter part of the timeline hints at a possible regional policy synergy or shared economic influences driving the green economy. By 2020, all nations are at their peak within this timeframe, suggesting a region-wide emphasis on the green economy's advancement, although the varying paths taken underscore the individual economic, political, and environmental contexts within each nation.

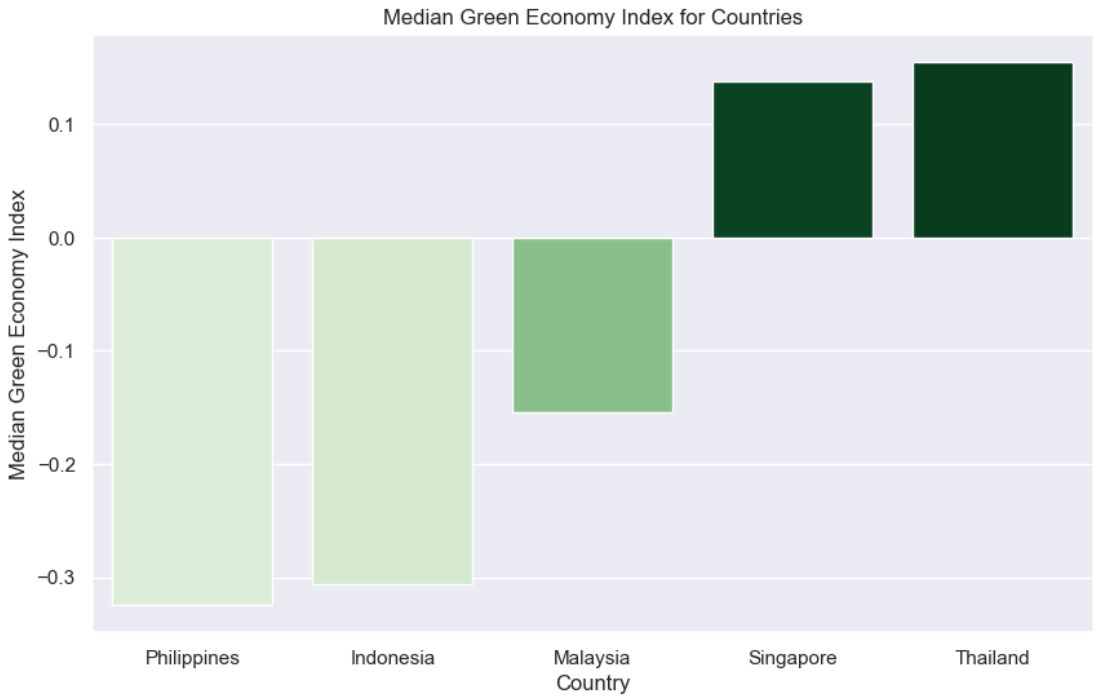

Figure 3 Median Green Economy Index for the selected ASEAN countries from 2003 to 2020

Figure 3, which is the bar chart, illustrates the median Green Economy Index for five ASEAN countries, indicating varied performances in green economic aspects. The use of median values implies these figures represent a central tendency within each country's data, less skewed by outliers, and highlights the diversity in green economy achievements across the region, from areas of potential development to more successful implementations. The Philippines has the lowest median index, marginally below zero, suggesting challenges in advancing its green economy, while Indonesia exhibits a similar but slightly better situation with its median value also under zero. The negative medians suggest that while there may be economic growth, it might not be sustainable, or the size of the economy is not translating effectively into sustainable development. Economic activities in these countries might be impacting the environment negatively, or the gains from growth are not adequately reinvested into sustainable initiatives.

Malaysia's median is near zero, denoting a balanced mix of positive and negative green economic factors. This balance may reflect targeted efforts to incorporate sustainable practices within economic growth strategies. Singapore and Thailand stand out positively, with Singapore showing a median above zero, reflective of favorable green economic conditions, and Thailand leading with the highest median, signifying a strong green economy performance. A higher median indicates that Singapore, despite its limited size and natural resources, is effectively integrating economic growth with sustainable development, likely due to significant investments in technology, efficient urban planning, and strong environmental governance. The highest median implies that Thailand's GDP size and growth, along with sustainability efforts, are well-aligned. This could be due to successful policies that have integrated economic development with environmental sustainability, possibly in areas like renewable energy, green tourism, and sustainable agriculture.

4.2 The regression results of the effect of greenfield investment on green economy.

Table 4

Effect of greenfield investment on green economy.

	(1) M1	(2) M2	(3) M3	(4) M4	(5) M5
greenfield	-0.167*	-0.162*	-0.174**	-0.174*	-0.144*
	(-1.93)	(-1.79)	(-2.00)	(-1.96)	(-1.87)
lntrade		0.356	0.395	0.389	0.341
		(0.81)	(0.88)	(0.87)	(0.88)
lnurb			-0.503	-0.500	-0.890
			(-0.69)	(-0.68)	(-1.22)
lnppl				0.00978	-0.0423
				(0.14)	(-0.70)
lnhucap					-2.082**
					(-2.43)
_cons	1.437*	-0.303	1.666	1.674	12.86**
	(1.92)	(-0.12)	(0.47)	(0.47)	(2.09)
Country_FE	Yes	Yes	Yes	Yes	Yes
Year_FE	Yes	Yes	Yes	Yes	Yes
N	90	90	90	90	90
r2_a	0.971	0.971	0.971	0.970	0.974

t statistics in parentheses

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Further, this study explores the effect of greenfield investment on the green economy. For the robustness, the regression adds the control variables one by one. Table 4 suggests that greenfield investments have a consistently negative relationship with the green economy across all model variations, as indicated by the statistically significant negative coefficients in each model. This relationship persists even when controlling for trade, urbanization, population, and human capital, and remains robust across various specifications that include country and year fixed effects to control for unobserved heterogeneity. The negative coefficients of greenfield investment could imply that such investments might not always align with the principles of the green economy, which typically emphasize sustainable environmental practices. It's possible that greenfield investments in the Asean regions are directed towards industries or projects that do not prioritize sustainability, or they could be indicative of a broader trend where economic expansion through greenfield investment is not coupled with environmental considerations. Trade, while positively related to the green economy, does not show statistical significance, indicating that its impact is less clear from this analysis. Interestingly, human capital has a significant negative impact on the green economy in the most comprehensive model (M5), suggesting that the way human capital is being leveraged in these investments might not support green economy outcomes.

The high adjusted R-squared values suggest the models explain a significant portion of the variance in the green economy index, which strengthens the case that the observed relationships are not due to random chance. However, interpretation of these relationships should be cautious, as regression analysis can reveal correlation but not causation, and other unmeasured factors may be at play. Moreover, the significance of the constant term in models M1 and M5 suggests that other unobserved or omitted variables may also be influencing the green economy. The results imply that policymakers and investors might need to scrutinize the nature of greenfield investments and consider integrating more stringent sustainability criteria to ensure that such investments contribute positively to the green economy. This could include investing in green technologies, renewable energy, or sustainable infrastructure that supports long-term environmental goals.

Conclusion

This study reveals a complex relationship between greenfield investments and the green economy within the ASEAN region. Our analysis, utilizing a robust regression framework incorporating the Green Economy Index constructed from GDP, GDP growth, and the Sustainable Development Index, has demonstrated that greenfield investments are not inherently beneficial to the green economy. Instead, they often correlate negatively across various models and specifications. The findings suggest that despite the general assumption that investments in new, greenfield projects would drive sustainable development, the reality in ASEAN paints a different picture. These investments, in their current implementation, may not always align with environmental sustainability goals. The consistently negative impact across different countries within the region underscores the need for a critical reassessment of how these investments are planned and executed.

Policy Implications

The study's results highlight a negative impact of greenfield investments on the green economy in the ASEAN region, suggest a need for strategic policy interventions. Policymakers should consider instituting sustainable investment criteria that mandate compliance with environmental standards for all new greenfield projects. Such criteria can guide investments towards enhancing the green economy, particularly by focusing on renewable energy and sustainable infrastructure. The introduction of a green certification program can also serve as an incentive, offering recognition and potential tax benefits to investments that meet green economy standards. Moreover, integrating environmental impact assessments into the early stages of greenfield investment planning can help ensure that these projects align with regional sustainability goals.

Additionally, fostering public-private partnerships geared towards sustainability can drive innovation and efficient resource use, while capacity-building initiatives can educate stakeholders about sustainable development practices. ASEAN collaboration is crucial for harmonizing policies and sharing best practices that promote green investments. A robust monitoring framework for environmental impacts, along with transparent reporting, would aid in holding investors accountable and informing policy refinements. Financial sector support through instruments like green bonds and sustainability-linked loans can provide the necessary capital flows to green projects. Inclusive policy development, which involves local communities and civil society, will balance economic, environmental, and social objectives, paving the way for a sustainable and prosperous future for the region.

Limitations and Future Study

The study, while shedding light on the relationship between greenfield investments and the green economy in the ASEAN region, is not without limitations that could be addressed in future research. A key limitation lies in the use of the Green Economy Index, which, although comprehensive, may not capture all the sustainability and environmental impacts. The index is obtained from aggregate economic data and may overlook micro-level effects that greenfield investments have on local communities and ecosystems. Additionally, the study's reliance on regression models that establish correlation but not causation leaves room for further exploration into the direct causal mechanisms at play.

Moreover, the fixed effects approach controls for unobserved heterogeneity across countries and years but may omit variables specific to certain regions or sectors within countries that could influence the green economy. The study's scope is also limited by the available data, which might not reflect recent policy changes or the latest economic conditions. Furthermore, the study assumes that all greenfield investments are homogeneous in nature, which might not be the case as they can vary widely in terms of scale, sector, and sustainability.

Future research should aim to overcome these limitations by employing longitudinal case studies or qualitative methods that can provide deeper insights into the local environmental and social impacts of greenfield investments. Additionally, utilizing methods that can establish causal inferences, such as instrumental variables or randomized controlled trials, could substantiate the findings. Expanding the range of variables to include more granular data on greenfield investments, such as sector-specific impacts, and incorporating newer data to capture the effects of recent environmental policies, could also provide a more detailed picture.

Future studies could also compare the impacts of greenfield investments with those of brownfield investments to understand their relative contributions to the green economy. Moreover, research can delve into the role of technology and innovation in mediating the relationship between greenfield investments and sustainable economic outcomes. Investigating the effectiveness of specific policy interventions aimed at aligning greenfield investments with green economy objectives can further inform policymakers. Lastly, the adoption of an interdisciplinary approach, integrating insights from economics, environmental science, and social studies, can enrich the understanding of the complex interplay between investment activities and sustainable.

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Author contributions

WS: conceptualization, validation, investigation, writing-original draft, and visualization. WL: writing review and editing, conceptualization, and validation. SM and YT: analysis, corrections, and revisions. All authors contributed to the article and approved the submitted version.

Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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Data availability Statement

Data available on request from the authors.

Ethical statements

Ethical approval

This article does not contain any studies with human participants performed by any of the authors.

Informed consent

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