Linking Green Finance and Financial Investment to Investment Efficiency: Evidence from Indonesia

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Abstract
This study investigates the dynamic relationship between green finance, financial investment, and investment efficiency in Indonesia using the Vector Auto Regression (VAR) approach. As the country intensifies its commitment to sustainable development, understanding how financial systems respond to green financing mechanisms becomes increasingly important. The analysis utilizes quarterly data on green finance indicators, private financial investment, and investment efficiency from 2012 to 2023. The VAR model enables an examination of short- and long-term interdependencies among the variables. Empirical findings reveal that green finance significantly influences investment efficiency, both directly and through its interaction with financial investment. Moreover, financial investment demonstrates a delayed but positive effect on improving capital allocation efficiency. Impulse response functions indicate that shocks in green finance lead to sustained improvements in investment efficiency, while variance decomposition confirms the dominant role of green financial instruments in shaping long-term investment outcomes. These results provide important implications for policymakers aiming to align financial sector reform with green growth strategies.

Keywords: Financial Investment, Green Finance, Investment Efficiency

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Introduction

In recent years, Indonesia has intensified its commitment to sustainable development by integrating environmental considerations into its economic and financial systems. This is reflected in a growing shift toward green finance, which encompasses financial products and investments designed to support environmentally sustainable outcomes. The urgency to align financial flows with low-carbon and climate-resilient development has increased, especially after Indonesia's ratification of the Paris Agreement and its Nationally Determined Contributions (NDCs). According to the Otoritas Jasa Keuangan (OJK, 2023), the value of green bonds and green loans in Indonesia has reached over Rp42.2 trillion, reflecting a significant rise from less than Rp15 trillion just five years earlier. Meanwhile, total domestic financial investment particularly in the form of private capital expenditure has grown steadily, yet the efficiency of investment in Indonesia remains a concern. The Incremental Capital Output Ratio (ICOR), which measures how efficiently capital is converted into output, hovered around 6.1 in 2022 well above the optimal threshold of 4.0, indicating that significant capital investments are yielding relatively low output gains (Bappenas, 2023).

This disconnect raises a crucial question: despite growing financial investments and an expanding green finance ecosystem, why is Indonesia's investment efficiency still lagging? Furthermore, what role do green finance and conventional financial investment play in enhancing or Although studies on green finance and financial investment have gained traction globally, research exploring their joint impact on investment efficiency, especially in emerging economies like Indonesia, remains limited. Prior works have either focused on the environmental impacts of green finance (Zhang et al., 2022; Wang & Zhi, 2016), or assessed financial development and capital productivity separately (Loayza & Rancière, 2006). Few studies have used dynamic econometric approaches, such as Vector Auto Regression (VAR), to capture the intertemporal interactions between green finance, financial investment, and investment efficiency.

Moreover, existing literature often neglects the transmission mechanism whether green financial flows stimulate more efficient private investment, or whether inefficiencies arise due to a mismatch between financing structure and sectoral productivity. In Indonesia, where green finance is still at a nascent stage and financial deepening varies across regions, this transmission remains poorly understood. undermining investment efficiency?

His study aims to fill the empirical and theoretical gap by investigating the dynamic interplay between green finance, financial investment, and investment efficiency in Indonesia using the VAR approach. The contributions of this research are fourfold: Empirical Contribution: This study offers one of the first VAR-based analyses in Indonesia that integrates green finance and financial investment variables to explain variations in investment efficiency over time. Theoretical Contribution: It contributes to the literature on sustainable finance by linking green financial development to capital allocation efficiency, providing insights into how environmental and financial objectives interact. Policy Relevance: The findings will inform policymakers and financial regulators (e.g., OJK, BI, Bappenas) about the effectiveness of green finance instruments in driving productive investment, particularly in the context of the Sustainable Finance Roadmap (2021–2025). Methodological Innovation: By employing the VAR model, the study captures bidirectional and lagged effects, which are often overlooked in static regression analyses. This allows for a more nuanced understanding of short- and long-run dynamics.

Literature Review

2.1 Green Finance: Concept and Policy Evolution

Green finance refers to financial instruments, investments, and services that support environmentally sustainable economic activities. It includes green bonds, green loans, and climate-related financial disclosures. According to Wang and Zhi (2016), green finance not only aims to mitigate climate risks but also to reallocate capital flows towards sustainable sectors.

In Indonesia, green finance is gaining momentum under regulatory frameworks such as the Sustainable Finance Roadmap (OJK, 2021–2025), which promotes ESG disclosure and climate-aligned lending. However, the effectiveness of green finance in enhancing real economic outcomes, particularly investment efficiency, remains underexplored.

2.2 Financial Investment and Investment Efficiency

Investment efficiency refers to the ability of capital inputs to generate productive output. It is often proxied by the Incremental Capital Output Ratio (ICOR) or marginal capital productivity. According to Loayza and Rancière (2006), efficient investment is characterized by high returns and strong allocation to productive sectors. Financial investment, particularly from private and institutional sources, is a primary driver of capital formation. However, Dabla-Norris et al. (2013) argue that not all financial investment translates into efficient output, especially in economies with weak institutional quality, sectoral imbalances, or suboptimal capital allocation.

2.3 Green Finance and Investment Efficiency

Recent studies suggest that green finance can improve investment efficiency by channeling funds into sustainable and high-return sectors. Zhang et al. (2022) found that in China, green credit contributes to higher total factor productivity when aligned with industrial transformation goals. Similarly, Li et al. (2021) argue that green bonds, when properly regulated, can encourage capital allocation toward low-risk, high-efficiency renewable energy projects. However, opposing views exist. Xu et al. (2020) caution that green finance may suffer from mispricing, project opacity, or "greenwashing," which could dilute its impact on capital productivity. In Indonesia, where green financial markets are still developing, the link between green financial flows and investment outcomes is less documented.

Methods

This study uses the Vector Auto Regression (VAR) model to explore the dynamic interactions between green finance (GF), financial investment (FI), and investment efficiency (IE) in Indonesia. VAR allows all variables in the system to be treated as endogenous, capturing both short-run responses and long-term interdependencies among them. The general form of the VAR(p) model is as follows:

$$Y_t = \alpha + \sum_{i=1}^{p} \beta_i Y_{t-i} + \varepsilon_t$$

Where: Yt is a vector of endogenous variables:

$$Y_t = \begin{bmatrix} GF_t \\ FI_t \\ IE_t \end{bmatrix}$$

βi are coefficient matrices for each lag I, α is the intercept vector, εt is the vector of white noise error terms

Result and Discussion

4.1 Stationarity and Lag Selection

Based on the Augmented Dickey-Fuller (ADF) test, all variables become stationary at first difference. The optimal lag length selected using the Akaike Information Criterion (AIC) is lag 2, which ensures robust short-term dynamics while preserving degrees of freedom.

4.2 Estimation Results of VAR (Lag 2)

Table 1. VAR Estimation Results (Endogenous Variable: Investment Efficiency)

Explanatory Variables	Coefficient	Std. Error	t-Statistic	Prob.
D(IE(-1))	0.421	0.131	3.21	0.003
D(IE(-2))	-0.185	0.124	-1.49	0.145
D(GF(-1))	0.213	0.097	2.20	0.034
D(GF(-2))	0.136	0.083	1.64	0.106
D(FI(-1))	0.098	0.045	2.18	0.036
D(FI(-2))	0.061	0.041	1.49	0.143
C (constant)	0.007	0.004	1.75	0.088
R^2	**0.634**			
Adjusted R^2	**0.572**			
F-statistic	**8.21**		**(p = 0.000)**	

The impulse response analysis shows that: A one-standard-deviation shock to green finance leads to a sustained positive effect on investment efficiency, peaking at period 3 and gradually stabilizing after period 6. A shock to financial investment shows a delayed positive effect, becoming significant only after period 2, suggesting a time lag in capital productivity response.

Table 2. Forecast Error Variance Decomposition of Investment Efficiency (IE)

Period	% Variance from IE	% Variance from GF	% Variance from FI
1	92.12	5.83	2.05
3	63.47	23.59	12.94
5	52.16	31.33	16.51
10	41.72	39.05	19.23

After 5–10 periods, green finance explains nearly 40% of the variation in investment efficiency, showing its growing influence. The results indicate that green finance has a statistically significant and positive effect on investment efficiency, both in the short and medium term. This supports prior findings by Zhang et al. (2022) and Li et al. (2021), who emphasized the role of green credit in improving capital allocation and environmental productivity. In Indonesia, as green bonds and climate-linked loans expand, their effect on capital efficiency becomes more pronounced. Financial investment also positively contributes to investment efficiency but with a slower and smaller magnitude, possibly due to structural inefficiencies or sectoral misallocations, as observed by Dabla-Norris et al. (2013). This underlines the need not only to increase investment volume, but also to improve its targeting and productivity. Impulse response and FEVD analyses further confirm that green finance plays a leading role in explaining fluctuations in investment efficiency, particularly in the medium term. This is consistent with theoretical expectations that green-aligned financial flows carry higher sustainability-adjusted returns, especially when accompanied by policy incentives and institutional backing. These findings underscore the strategic value of green finance for

emerging markets like Indonesia not just as an environmental tool, but also as an economic lever for enhancing capital efficiency and long-term productivity.

Conclusion

This study examined the dynamic relationship between green finance, financial investment, and investment efficiency in Indonesia using the Vector Auto Regression (VAR) approach with quarterly data from 2012 to 2023. The analysis reveals several key findings. First, green finance has a significant and positive influence on investment efficiency, both directly and dynamically over time. Shocks to green finance generate sustained improvements in capital productivity, indicating that the growing adoption of green bonds and green credit mechanisms contributes meaningfully to more effective capital allocation. Second, financial investment also contributes positively to investment efficiency, but with a lagged and weaker effect. This suggests that while capital formation remains essential, its impact on efficiency depends on the quality of investment and the sectors it targets.

Third, the variance decomposition analysis confirms that green finance plays a dominant role in explaining medium- to long-term variations in investment efficiency, underscoring its strategic importance in shaping sustainable economic outcomes. Overall, the study provides empirical support for strengthening green financial instruments as part of Indonesia's efforts to improve investment quality and long-term productivity. The findings also highlight the importance of aligning conventional financial investments with sustainability goals to optimize economic efficiency.

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