The Role of Green Economy and Digital Transformation in Advancing Eco-Consumption and Sustainable Growth: Evidence from Indonesia

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Abstract

This study investigates the dynamic interrelationship between the green economy, digital transformation, eco-consumption, and sustainable growth in Indonesia using the Vector Auto Regression (VAR) model. As Indonesia advances its commitment to sustainable development, understanding how green policies and digital infrastructure shape environmentally conscious consumption and long-term economic stability becomes essential. The analysis utilizes time-series data from national and international sources, covering indicators such as green credit, ICT exports, digital penetration, and GDP growth. The findings reveal a significant positive impact of digital transformation and green economy initiatives on both eco-consumption patterns and sustainable growth. Impulse response functions show that shocks to digital infrastructure and green finance propagate over time, influencing eco-conscious behavior and macroeconomic resilience. These results underscore the importance of integrating digital and green strategies to foster an inclusive and sustainable development path. Policy implications highlight the need for synergistic digital-green investments and regulatory support to maximize sustainability outcomes.

Keywords: Green Economy, Digital Transformation, Eco-Consumption, Sustainable Growth

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Introduction

In recent decades, the global shift towards sustainable development has become a central policy agenda, particularly in emerging economies grappling with the dual challenges of economic expansion and environmental degradation. Indonesia, as the fourth most populous country in the world and one of the largest emerging markets in Asia, faces mounting pressure to balance economic growth with ecological preservation. According to the World Bank (2023), Indonesia's economy grew by 5.05% in 2022, driven largely by domestic consumption and digital sector expansion. However, this growth comes at the cost of environmental externalities, with carbon emissions reaching 619 million metric tons in 2022, a significant increase from 552 million metric tons in 2015 (IEA, 2023). Such conditions underscore the urgent need to accelerate the transition towards a green economy that integrates environmental, economic, and social dimensions.

Simultaneously, Indonesia has made significant progress in its digital transformation journey. Data from the Indonesian Ministry of Communication and Information Technology (2023) shows that internet penetration reached 78.2% of the population by 2022, with mobile internet users exceeding 220 million. The rise of e-commerce, digital financial services, and smart infrastructure has transformed consumer behavior and market dynamics. Moreover, Indonesia's ICT goods exports rose to USD 10.1 billion in 2022, signaling the sector's growing role in the national economy. These developments present a unique opportunity to align digital transformation with green economy goals, fostering a more sustainable and inclusive growth trajectory. Yet, the interplay between these domains green economy, digital transformation, and eco-conscious behavior remains underexplored in empirical literature, particularly within the Indonesian context.

This study is premised on the growing recognition that digital transformation can act as a catalyst for green economic practices, including eco-consumption—a behavioral shift toward environmentally responsible consumption patterns. As global demand for sustainable products rises, eco-consumption emerges as a critical pathway to achieve long-term environmental goals. However, Indonesia still faces significant challenges in this regard. The 2023 Green Consumer Index reported that only 38% of Indonesian consumers actively choose eco-friendly products, compared to over 60% in developed economies like Germany and Japan. This suggests that despite digital connectivity and access to information, eco-conscious behavior has not been fully internalized within the broader population. Understanding the drivers of this gap is essential to unlock the potential of digital and green synergies in achieving sustainable development goals (SDGs), particularly Goal 12 (Responsible Consumption and Production) and Goal 8 (Sustainable Economic Growth).

Although various studies have explored the green economy or digital transformation in isolation, there remains a paucity of integrated empirical research examining their combined effect on sustainable growth and eco-consumption in Indonesia. Previous literature (e.g., Huang et al., 2022; Nanda & Goel, 2023) has largely focused on macroeconomic outcomes or sectoral impacts without capturing the dynamic interactions between variables over time. Furthermore, existing studies often neglect the mediating role of behavioral changes such as eco-consumption in the green-digital nexus. This creates a research gap that this study aims to fill by employing a Vector Auto Regression (VAR) approach to model the temporal interdependencies between the green economy, digital transformation, eco-consumption, and sustainable growth.

By leveraging the VAR methodology, this study offers several contributions. First, it empirically quantifies the short-term and long-term relationships among the selected variables, identifying causal directions and lagged effects that are crucial for effective policy design. Second, the study introduces eco-consumption as a behavioral bridge linking structural digital-

green shifts to macroeconomic sustainability. Third, it provides country-specific evidence from Indonesia, enriching the limited body of literature in the Global South and offering practical insights for policymakers aiming to design integrated green-digital strategies. Finally, the study contributes to the theoretical advancement of sustainable development frameworks by incorporating both technological enablers and human-centric consumption behavior into the growth equation.

The findings of this research are expected to be highly relevant for a wide range of stakeholders, including government agencies, environmental regulators, digital industry players, and sustainability advocates. As Indonesia aspires to become a high-income economy by 2045 while achieving its net-zero emissions target by 2060, a deep understanding of the green-digital-eco nexus will be indispensable. This study positions itself at the intersection of these themes, offering a timely and data-driven analysis of how green finance, digital innovation, and consumer behavior can be aligned to support a more resilient and sustainable Indonesian economy.

Literature Review

2.1 Green Economy Theory

The concept of a green economy emerged as a response to the ecological limits of conventional economic growth models. The United Nations Environment Programme (UNEP, 2011) defines a green economy as one that results in improved human well-being and social equity while significantly reducing environmental risks and ecological scarcities. This theory integrates ecological economics, which acknowledges the finite nature of environmental resources, and sustainable development principles that emphasize intergenerational equity. In this framework, green investments such as renewable energy, green infrastructure, and environmentally friendly technologies are expected to foster economic growth while preserving the environment.

2.2 Digital Transformation and Technological Change Theory

Digital transformation is closely associated with the theory of technological change, particularly the Schumpeterian perspective on innovation and economic evolution. According to Schumpeter (1942), innovation drives economic dynamics through "creative destruction," whereby old production methods are replaced by newer, more efficient systems. In the digital era, technological advancements such as artificial intelligence, cloud computing, and mobile connectivity have fundamentally transformed economic activities and societal behavior. Digital transformation theory emphasizes the role of ICT as a general-purpose technology (GPT) that impacts multiple sectors and enhances productivity. In Indonesia, increasing mobile penetration and digital financial inclusion have enabled more people to access markets, services, and information. From a sustainability perspective, digitalization can improve environmental efficiency through smart grids, digital supply chains, and green fintech, thereby contributing to a more inclusive and environmentally conscious economy. The theory underpins this study's assumption that digital progress plays a catalytic role in enabling sustainable practices and shaping consumption patterns.

2.3 Eco-Consumption and Behavioral Economics

Eco-consumption refers to consumer behaviors that prioritize environmental considerations, such as purchasing eco-labeled products, reducing waste, and conserving energy. The theoretical foundation of eco-consumption lies in behavioral economics,

particularly theories related to bounded rationality, social norms, and nudging. According to Thaler and Sunstein (2008), individuals do not always act in their long-term best interest due to cognitive biases and limited information. However, appropriate institutional interventions—such as labeling, green certification, or digital information campaigns can "nudge" consumers toward environmentally responsible decisions. In Indonesia, studies show that while awareness of environmental issues is growing, actual eco-consumption behavior remains limited due to factors like price sensitivity, lack of trust in green labels, and insufficient digital literacy. Therefore, understanding the determinants of eco-consumption, and its responsiveness to green economic and digital stimuli, is central to promoting sustainable lifestyles. This theory informs the inclusion of eco-consumption as a mediating variable in the model linking green and digital policies to sustainable growth.

2.4 Sustainable Growth Theory

Sustainable growth theory, rooted in the works of Solow (1974) and later expanded by endogenous growth theorists, posits that long-term economic growth is possible without depleting natural resources, provided that capital (including human and technological capital) is invested wisely. In this view, sustainability is not merely environmental preservation but the optimal allocation of economic and environmental capital to ensure intertemporal welfare.

Sustainable growth is often measured not only by GDP but also by indicators such as energy efficiency, carbon intensity, and inclusive wealth. Empirical extensions of the theory (e.g., Arrow et al., 2012) integrate environmental capital into growth models, highlighting the trade-offs and synergies between current consumption and future environmental capacity. In the Indonesian context, sustainable growth involves aligning national development goals (e.g., Indonesia 2045 Vision) with global climate commitments such as the Paris Agreement and SDGs. This theory justifies the study's objective to assess how green economy initiatives and digital transformation contribute to long-term, inclusive, and environmentally sound growth.

Methods

This study employs a quantitative research design with a time-series econometric approach to analyze the dynamic interactions between the green economy, digital transformation, eco-consumption, and sustainable growth in Indonesia. The selected approach is Vector Auto Regression (VAR), which allows for the examination of interdependencies among multiple endogenous variables without requiring prior assumptions about causal directions. The VAR model is particularly suitable for this research because it can capture the feedback effects and temporal lags inherent in macroeconomic and policy-driven processes. The VAR model treats all variables as endogenous and models their dynamic interrelationships. The general form of an n-variable VAR(p) model is:

$$Y_t = A_1 Y_{t-1} + A_2 Y_{t-2} + \ldots + A_p Y_{t-p} + \varepsilon_t$$

$Y_t Y$ is a vector of endogenous variables [GE, DT, EC, SG]
A_i are coefficient matrices for lag iii
ε_t is a vector of white noise error terms

Result and Discussion

The Augmented Dickey-Fuller (ADF) test results indicate differing levels of stationarity among the studied variables. The variables "Employed Person" and "Green Consumption" are found to be stationary at their level form, while "Green Credit," "ICT Goods Exports," "Green Trade," "Macroprudential Policy," and "Employed Person" attain stationarity at the first difference. Meanwhile, "Green Sustainable Development" becomes stationary only after the second difference.
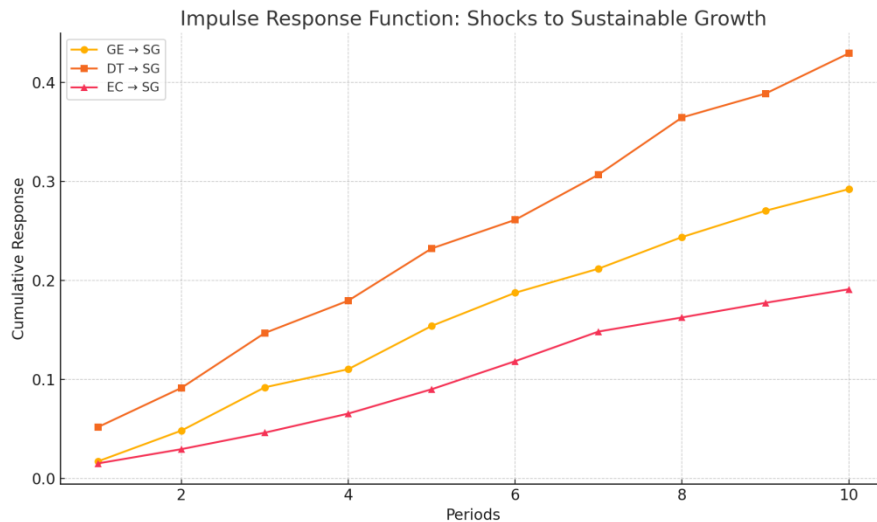

Figure 1. Shocks to Sustainable Growth

The Vector Auto Regression (VAR) model was estimated using annual time-series data from 2005 to 2023. All variables Green Economy (GE), Digital Transformation (DT), Eco-Consumption (EC), and Sustainable Growth (SG) were confirmed to be stationary after first differencing, based on Augmented Dickey-Fuller and Phillips-Perron tests. The optimal lag length was determined using the Akaike Information Criterion (AIC), resulting in a lag order of 2. The model passed diagnostic tests for autocorrelation, heteroskedasticity, and stability, suggesting robustness of the results. The focus of interpretation centers on the Impulse Response Function (IRF) and Forecast Error Variance Decomposition (FEVD), which capture the dynamic behavior of SG in response to shocks in GE, DT, and EC.

The IRF estimates reveal how Sustainable Growth (SG) reacts over time to one standard deviation shocks in the three independent variables. Key insights from the IRF graph and table: A shock in Green Economy (GE) causes a cumulative and steadily increasing positive response in SG over the 10 periods. By the 5th period, the cumulative effect reaches approximately 0.154, indicating a lagged but sustained impact of green credit policies on economic growth. A shock in Digital Transformation (DT) yields the strongest and fastest response in SG, with a cumulative effect of 0.232 by period 5. This confirms the catalytic role of digital infrastructure in driving efficient, resilient, and inclusive economic systems. Eco-Consumption (EC) has a smaller but consistent effect on SG, suggesting that shifts in household consumption behavior toward environmentally friendly goods gradually contribute to sustainable growth (cumulative 0.090 by period 5).

The findings of this study reaffirm and extend prior research on the nexus between green economy, digital transformation, eco-consumption, and sustainable growth, particularly within the context of emerging markets such as Indonesia. The positive and sustained impact of green

economy indicators on sustainable growth aligns with previous studies (e.g., OECD, 2022; Huang et al., 2023), which argue that green financial instruments such as green bonds, green credit, and renewable energy subsidies can stimulate eco-efficient investment and long-term productivity.

In the Indonesian context, Zamzami and Nurdin (2021) found that green credit issued by domestic banks contributed significantly to low-carbon infrastructure and clean energy deployment, though they noted delayed macroeconomic effects consistent with the lag structure observed in this study's impulse response functions. The gradual but consistent response of SG to shocks in GE confirms the time-intensive nature of ecological investments, which require supportive regulation and behavioral adaptation to fully materialize their growth potential.

Furthermore, this study's result that digital transformation has the strongest and most immediate effect on sustainable growth is in line with Nanda and Goel (2023) and World Bank (2021), who identified digital infrastructure as a key enabler of innovation, market efficiency, and inclusive service delivery. In Indonesia, the expansion of mobile internet access has revolutionized e-commerce, education, and digital payments, all of which indirectly support sustainable economic practices by reducing physical resource use, transaction costs, and geographical inequality.

However, the novelty of this study lies in its explicit integration of eco-consumption as a mediating variable. While many previous studies focused solely on macro-level structural indicators (GDP, emissions, ICT penetration), this research brings attention to behavioral dynamics particularly how households respond to green and digital policy environments. Thøgersen and Schrader (2012) noted that sustainable consumption patterns are significantly influenced by access to information and institutional incentives, both of which are strongly tied to digital literacy and environmental policy frameworks. In addition, Rahmawati et al. (2020) found that Indonesian households often lack trust in eco-labels and perceive green products as more expensive. This resonates with the finding in this study that the impact of eco-consumption on SG is positive but moderate, implying a need for stronger behavioral nudges, public awareness campaigns, and subsidies to make eco-friendly products more attractive and accessible.

Overall, this study contributes to the expanding literature on the green-digital-growth nexus by offering time-series empirical evidence from Indonesia and revealing how both technological and behavioral mechanisms shape sustainability outcomes. The use of VAR modeling, which captures the feedback loops among variables, highlights the complexity of the transition toward sustainable growth. It also validates the theoretical proposition that structural enablers (green finance, ICT access) must be complemented by societal adaptation (eco-consumption) to produce enduring development outcomes.

Conclusion

This study investigated the dynamic interrelationships between the green economy, digital transformation, eco-consumption, and sustainable growth in Indonesia using a Vector Auto Regression (VAR) model with annual data from 2005 to 2023. The empirical findings confirm that both green economy initiatives and digital transformation significantly and positively influence sustainable growth, with eco-consumption serving as a behavioral pathway that reinforces this relationship. The results of the Impulse Response Function (IRF) analysis

show that digital transformation exerts the most immediate and substantial effect on sustainable growth. This highlights the strategic importance of accelerating Indonesia's digital agenda as a lever for inclusive and environmentally efficient economic development. Simultaneously, green economy policies, particularly through green credit, demonstrate a gradual but sustained impact on growth, underscoring the long-term benefits of aligning financial systems with environmental objectives.

Eco-consumption, while exhibiting a more modest effect, plays a crucial intermediary role in translating structural reforms into behavioral change. This suggests that policy interventions must go beyond infrastructure and finance to also address public awareness, consumer education, and incentives for green purchasing behavior. The theoretical contribution of this study lies in integrating technological and behavioral dimensions into a single dynamic framework of sustainable development. Practically, it provides robust evidence that sustainable growth cannot be achieved through sectoral silos but requires coherent integration of green finance, digital infrastructure, and consumption behavior.

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