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Study of the Effect of Green Investment Policy, Technological Innovation, and Sustainable Development on Industrial Competitiveness

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ABSTRACT

This research investigates the intricate relationships among green investment policy, technological innovation, sustainable development, and industrial competitiveness within the context of Indonesia. Employing a quantitative research design, data were collected from a stratified random sample of 110 participants representing diverse industries. Descriptive statistics, correlation analysis, regression analysis, and structural equation modeling were utilized for analysis. The results revealed positive correlations and significant coefficients, indicating the individual and combined contributions of green investment policy, technological innovation, and sustainable development to industrial competitiveness. The findings underscore the importance of a holistic approach to sustainability for enhancing the competitiveness of Indonesian industries.

Keywords: *Green Investment Policy, Technological Innovation, Sustainable Development, Industrial Competitiveness*

1. INTRODUCTION

Indonesia's delicate balance between promoting industrial growth and ensuring ecological sustainability requires a careful examination of the factors affecting competitiveness. The manufacturing industry is a significant contributor to Indonesia's economic development, with a steady growth in GDP over the years [1]. However, there are barriers to export competitiveness, such as product quality, regulations, and marketing, that need to be addressed [2]. The government plays a crucial role in overcoming these barriers and maintaining environmental sustainability [3]. Additionally, the development of the manufacturing industry in Indonesia has increased continuously, even during the COVID-19 pandemic, indicating a good economic condition [4]. Energy conservation policies have been implemented, but their enforcement in the manufacturing industry sector needs improvement to support sustainable development [5]. To achieve sustainable development, it is necessary to enforce environmental laws effectively, improve existing laws, enhance coordination between institutions, and increase public awareness about the importance of the environment [6]–[9].

In recent years, the Indonesian government has demonstrated a noteworthy commitment to promoting green investment policies, technological innovation, and sustainable development as important elements in shaping the direction of its industry [10]–[12]. The government has issued the first sovereign green Sukuk instrument to attract investors for financing green projects, which has shown positive progress and even contributed to dealing with the COVID-19 pandemic [13]. The implementation of sustainable finance principles, such as the green bond regulation, has been regulated to optimize natural resources and achieve a beautiful and sustainable Indonesia [14]. Government policies play a crucial role in shaping the industry, and Indonesia has diverse

industrialization policies that aim to balance economic development with other sectors and increase income per capita [15]. Additionally, empirical investigations have shown that Indonesia can reduce CO2 emissions through economic growth, renewable energy use, technical advancement, and an increase in forest cover, highlighting the importance of policies for achieving environmental sustainability [16]. Furthermore, green innovation practices in small and medium-sized enterprises (SMEs) in Indonesia have been positively influenced by government regulation, human resource management, and green marketing orientation, emphasizing the role of policies in improving green innovation performance [17].

The industrial sector in Indonesia is experiencing rapid development and plays a crucial role in the country's economic growth. It contributes significantly to the formation of a large GDP and has the potential to increase high-added value [1]. However, this growth has also led to environmental challenges, including pollution, climate damage, and depletion of natural resources [3]. The high-tech industry in Indonesia heavily relies on imported components or raw materials, but there is a push for indigenous innovation and sustainable practices in sectors such as electronics, machinery, and transportation [18]. The government has implemented policies to support economic development and address environmental concerns, such as carbon emission disclosure and environmental performance standards [19]. Overall, Indonesia's industrial sector is striving for global competitiveness while recognizing the need to address environmental issues and promote sustainable practices [20].

Growing awareness of the environmental consequences of industrial activities has led to a global shift towards sustainable practices. This shift is particularly important for Indonesia, as choices made in the areas of green investment, technological innovation, and sustainable development will have far-reaching implications for industrial competitiveness in the country. Studies have shown that green process innovation and disclosure of carbon emissions have a positive influence on firm value, indicating that manufacturing companies in Indonesia have been successful in reducing the impact of their activities on the environment [18]. Additionally, environmental performance has been found to have a positive effect on profitability, demonstrating the importance of environmental cost management and compliance with environmental regulations for manufacturing companies in Indonesia [21]. Furthermore, the use of online media has enabled MSMEs in Indonesia to maintain their business during the pandemic, highlighting the role of digital transformation in ensuring sustainable economic growth [22].

Based on this context, the main objective of this study is to unravel the multifaceted relationship between green investment policy, technological innovation, sustainable development, and their collective impact on industrial competitiveness in Indonesia. This research aims to achieve the following: a. Assess the impact of green investment policies on industrial competitiveness in Indonesia: Understand the extent to which government initiatives and policies that promote environmentally friendly practices contribute to industrial competitiveness. b. Analyze the role of technological innovation in shaping industrial competitiveness: Examine the influence of technological progress, research and development initiatives, and the innovation ecosystem on the competitive performance of Indonesian industries. c. Investigate the relationship between sustainable development practices and industrial competitiveness: Uncover how businesses aligned with sustainable development goals improve their long-term competitiveness in an evolving economic landscape.

2. LITERATURE REVIEW

2.1 Green Investment Policy and Industrial Competitiveness

Green investment policies have been found to positively impact industrial competitiveness, leading to cost reductions and a competitive edge in environmentally-conscious markets [23], [24]. Government spending on green initiatives, tax incentives for sustainable practices, and stringent environmental regulations are key components influencing industry behavior [25]. Industries adhering to green policies can experience cost reductions through energy efficiency measures, which can improve their competitiveness [26]. Additionally, these industries can gain a competitive edge in environmentally-conscious markets by meeting the growing demand for sustainable products and services [27]. Overall, embracing environmentally conscious policies can have positive impacts on industrial sectors, promoting both economic growth and sustainability.

2.2 Technological Innovation and Industrial Competitiveness

Investment in research and development (R&D) is consistently correlated with technological innovation, industrial advancement, and competitiveness [28], [29]. Studies have shown that higher R&D investments can lead to a greater ability to innovate and promote human development in a country [30]. Additionally, R&D investment and invention patents have been found to increase the revenue, profit, and overall value of companies in the capital market, particularly in the new generation of the information technology industry [31]. Private enterprises, in particular, have shown significant increases in value through R&D investment and the promotion of scientific research achievements into production capacity [32]. These findings suggest that investment in R&D and technological innovation is crucial for driving economic growth, improving company performance, and fostering competitiveness in the global market.

2.3 Sustainable Development and Industrial Competitiveness

The integration of sustainable development practices into business strategies has become a crucial factor in industrial competitiveness. Industries that prioritize sustainable development not only contribute to community well-being but also attract socially conscious consumers and establish robust supply chains. This study emphasizes the intrinsic link between sustainable practices and long-term industrial competitiveness [33]. By incorporating sustainable development goals into their strategies, companies can create resilient business models that consider environmental, social, and economic dimensions [34], [35]. This approach allows businesses to adapt to changing market demands, address social and biological issues, and contribute to the achievement of the United Nations' Sustainable Development Goals (SDGs) [36]. By embracing sustainable practices, companies can not only enhance their competitiveness but also contribute to a more sustainable future for all.

Gaps in the Literature

While existing literature provides valuable insights, critical gaps persist. The dearth of studies exploring the combined impact of green policies, technological innovation, and sustainable development on industrial competitiveness in Indonesia

limits our understanding of the holistic dynamics at play. Additionally, empirical evidence specific to the Indonesian context is sparse, necessitating research that accounts for the nuances of the local industrial landscape and policy frameworks.

3. METHODS

This research adopts a quantitative research design to systematically investigate the relationships among green investment policy, technological innovation, sustainable development, and industrial competitiveness in Indonesia. A cross-sectional approach will be employed, and data will be collected at a single point in time, allowing for an analysis of existing relationships and trends within the given context. The data for this study will be sourced from various channels, including government reports, industry publications, and academic research. Primary data will be gathered through structured surveys distributed to a stratified random sample of 110 participants from diverse industries in Indonesia. The survey instrument will be designed to capture information on green investment practices, technological innovation efforts, sustainable development initiatives, and indicators of industrial competitiveness. A stratified random sampling technique will be utilized to ensure representation from different industries in Indonesia. Industries will be categorized based on sectors such as manufacturing, services, and technology. Within each stratum, a random sample of companies will be selected to participate in the survey, aiming for a total sample size of 110 respondents.

3.1 Variables and Measurements

The research will focus on the following key variables:

1) Green Investment Policy: Measured through indicators such as government spending on green initiatives, tax incentives, and compliance with environmental regulations.
2) Technological Innovation: Assessed by examining research and development (R&D) spending, technology adoption, and the presence of innovation hubs within the surveyed industries.
3) Sustainable Development: Evaluated based on self-reported adherence to sustainable business practices, corporate social responsibility initiatives, and integration with sustainable development goals.
4) Industrial Competitiveness: Measured through market share, profitability, export performance, and other industry-specific indicators provided by the respondents.

3.2 Survey Instrument

The survey questionnaire will consist of a combination of closed-ended and Likert-scale questions. Participants will be asked to rate the extent of their organization's involvement in green practices, technological innovation, and sustainable development. Additionally, they will be queried on their perceptions of how these factors contribute to their industrial competitiveness.

3.3 Data Analysis

Data analysis will be conducted using the Statistical Package for the Social Sciences (SPSS) software. The analysis will encompass several stages:

1) Descriptive Analysis: Descriptive statistics, including means, standard deviations, and frequency distributions, will be used to summarize the main characteristics of the data.
2) Correlation Analysis: Pearson correlation coefficients will be computed to assess the bivariate relationships between pairs of variables, providing insights into the strength and direction of associations.
3) Regression Analysis: Multiple regression analysis will be employed to examine the individual and combined effects of green investment policy, technological

innovation, and sustainable development on industrial competitiveness. This analysis aims to identify the key predictors of industrial competitiveness within the surveyed industries.

4. RESULTS AND DISCUSSION

4.1 Descriptive Statistics

The descriptive statistics for key variables – green investment policy, technological innovation, sustainable development, and industrial competitiveness – are presented in Table 1.

Table 1. Descriptive Statistics

Variable	Mean	Standard Deviation
Green Investment Policy	3.75	0.92
Technological Innovation	4.20	1.05
Sustainable Development	3.98	0.88
Industrial Competitiveness	4.15	0.94

Green Investment Policy (Mean: 3.75, SD: 0.92): The mean score suggests a moderate level of engagement in green investment practices across the surveyed industries. The standard deviation indicates some variability, signifying differing degrees of adherence to green policies among respondents. Technological Innovation (Mean: 4.20, SD: 1.05): The mean score reflects a relatively high level of technological innovation within the industries. The standard deviation indicates a degree of variability, with some industries exhibiting more pronounced innovation efforts than others.

Sustainable Development (Mean: 3.98, SD: 0.88): The mean score indicates a moderate to high commitment to sustainable development practices. The standard deviation suggests variations in the extent to which industries integrate sustainability into their operations. Industrial Competitiveness (Mean: 4.15, SD: 0.94): The mean score signals a generally high level of industrial competitiveness across the surveyed industries. The standard deviation implies some variability, indicating differences in the perceived competitiveness of industries.

4.2 Correlation Analysis

The correlation analysis explores the bivariate relationships between pairs of variables, shedding light on the strength and direction of associations among green investment policy, technological innovation, sustainable development, and industrial competitiveness.

Table 2. Correlation Matrix

	Green Investment Policy	Technological Innovation	Sustainable Development	Industrial Competitiveness
Green Investment Policy	1.00			
Technological Innovation	0.784	1.00		
Sustainable Development	0.655	0.825	1.00	
Industrial Competitiveness	0.728	0.885	0.747	1.000

Green Investment Policy and Technological Innovation (r = 0.784): There is a significant positive association between the two, suggesting that industries that participate in more green investment policies are more likely to be technologically innovative. Sustainable Development and Green Investment Policy (r = 0.655): A positive association suggests that businesses that prioritize green investment policies also frequently incorporate sustainable development principles into their daily operations. Industrial Competitiveness and Green Investment Policy (r=0.728): A robust positive association suggests that businesses that implement green investment policies are more likely to be seen as competitive in the marketplace. Sustainable Development and Technology Innovation (r = 0.825): There is a substantial positive association indicating that industries leading the way in technology innovation are also likely to adopt sustainable development practices. Industrial Competitiveness and Technical Innovation (r = 0.885): A robust positive connection suggests that businesses that embrace technical innovation are typically more competitive in the marketplace. Industry Competitiveness and Sustainable Development (r = 0.747): A positive association suggests that businesses that adopt sustainable development strategies are generally viewed as more dynamic.

4.3 Regression Analysis

The multiple regression analysis delves into the individual contributions of green investment policy, technological innovation, and sustainable development to the prediction of industrial competitiveness.

Table 3. Regression Analysis Results

	Coefficient	Standard Error	t-Value	p-Value
Green Investment Policy	0.355	0.074	5.007	0.001
Technological Innovation	0.426	0.091	4.676	0.002
Sustainable Development	0.305	0.065	5.204	0.001
Constant	1.256	0.403	3.125	0.005

Green investment policy, technological innovation, and commitment to sustainable development are all positively associated with industrial competitiveness. A one-unit increase in the level of engagement in green investment policy is associated with a 0.355-unit increase in industrial competitiveness. Similarly, a one-unit increase in technological innovation is associated with a 0.426-unit increase in industrial competitiveness. Additionally, a one-unit increase in commitment to sustainable development is associated with a 0.305-unit increase in industrial competitiveness. These findings suggest that policies promoting green investment, technological innovation, and sustainable development can enhance industrial competitiveness. The constant term represents the baseline level of competitiveness when all independent variables are zero.

Discussion

Implications for Green Policies

Green investment policies have a positive correlation and regression coefficients that highlight their role in enhancing industrial competitiveness [37]. Industries that actively engage in green practices, supported by these policies, are more likely to thrive in the competitive landscape [24]. Technological innovation plays a crucial role in this context. The results of various studies indicate that increasing research and development (R&D) expenditures and green finance investment positively impact industrial structure and development [27]. Additionally, technological progress has a significant long-term effect on green industrial development [23]. Therefore, insights into technological innovation are essential for understanding the relationship between green investment policies and industrial competitiveness [38].

Insights into Technological Innovation

Technological innovation plays a pivotal role in driving industrial competitiveness [39]–[43]. There is a strong correlation and positive coefficient between technological innovation and corporate competitiveness. Industries that are at the forefront of technological advancements are well-positioned for success. Technological innovation has a significant and positive impact on a firm's performance. It helps companies improve their competitive positions in the marketplace. Technological innovation also leads to gaining a competitive advantage in the marketplace. Moreover, technological innovation has a significant and positive influence on competitive advantage in the telecommunication industry. Technologically innovative firms are more likely to produce better products and services, acquire more customers, and earn a competitive advantage.

Sustainable Development and its Competitive Edge

Sustainable development has the potential to contribute to industrial competitiveness, as businesses that align with sustainable practices can gain a competitive edge [44]. By fulfilling social and environmental responsibilities, these businesses not only meet the expectations of stakeholders but also differentiate themselves in the market [24]. The positive correlation and coefficient between sustainable development and industrial competitiveness highlight the benefits of integrating sustainability into business strategies [45]. This alignment allows companies to address the pressures imposed by environmental constituents, such as resource limitations and competitive entities [5]. Moreover, sustainable practices can enhance a company's reputation, attract environmentally conscious consumers, and improve brand value, all of which contribute to its competitive advantage [46]. Therefore, businesses that prioritize sustainability not only contribute to a more sustainable future but also position themselves for long-term success in the marketplace.

Limitations and Recommendations for Future Research

While the study provides valuable insights, limitations such as the cross-sectional nature of the data and potential response bias should be acknowledged. Future research could adopt a longitudinal design for a more in-depth analysis of the dynamics over time. Additionally, qualitative research may complement the quantitative findings, offering a richer understanding of industry practices.

CONCLUSION

In conclusion, this study contributes empirical insights into the dynamics shaping industrial competitiveness in Indonesia. The positive correlations and coefficients highlight the significant roles of green investment policy, technological innovation, and sustainable development in fostering competitiveness. Industries engaging in sustainable practices, supported by government policies and technological advancements, are better positioned to thrive in the global marketplace. The research suggests that a synergistic integration of these factors offers a robust pathway for achieving sustainable industrial development. As Indonesia continues its trajectory of economic growth, policymakers and industry leaders can leverage these findings to formulate informed strategies that balance economic progress with environmental responsibility.

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