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Green Technology Innovation and Its Impact on Financial Performance with the Moderation of Green Image and Green Subsidies in SMEs in Depok City

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Abstract: This study aims to explore the impact of green technology innovation on the financial performance of SMEs in Depok City, Indonesia. With a focus on green process and product innovations, the research also examines the moderating effects of green image and green subsidies. The study employs Structural Equation Modeling (SEM) to analyze data collected from 387 SMEs, offering insights into the complex relationships between these variables. The results reveal that green process innovation significantly influences green product innovation, which in turn, positively impacts financial performance. The mediating role of green product innovation underscores the importance of integrating process and product innovations for financial success. Additionally, the study finds that a strong green image enhances the positive relationship between green product innovation and financial performance, highlighting the importance of environmental branding. However, contrary to expectations, green subsidies do not significantly moderate the relationship between green product innovation and financial performance.

Keywords: Green Technology Innovation; Green Image; Green Subsidies; Financial Performance; SMEs.

Introduction

In recent years, the role of green technology innovation has gained significant traction within the business sector as companies increasingly recognize the importance of sustainability in driving long-term success. However, while the concept of green technology innovation has been widely discussed, there remains a gap in the literature concerning its direct impact on a firm's financial performance, particularly within small and medium-sized enterprises (SMEs)(Abbas et al., 2024). This is especially pertinent in regions like Depok City, where SMEs represent a crucial component of the local economy. Depok City, a rapidly developing urban area in Indonesia, is home to 11,429 registered SMEs that contribute significantly to the city's economic landscape. Despite their vital role, these businesses often face challenges in adopting innovative technologies due to resource constraints, lack of awareness, and limited access to financial and technical support. This context provides a

compelling backdrop for examining how green technology innovation can influence financial outcomes for these enterprises(C. Li et al., 2023).

Several studies have explored the relationship between green technology innovation and financial performance, particularly within the SME sector, providing valuable insights relevant to SMEs in Depok City. Chen (2014) emphasizes that green innovation enhances financial performance by improving competitive advantage, reducing costs, and attracting eco-conscious customers, though the realization of these benefits depends on internal capabilities and external support. Kim (2019) and Sun & park (2018) corroborates this by showing that green product and process innovations positively impact financial performance in Korean manufacturing SMEs, further stressing the importance of government subsidies. Similarly, Yusoff et al. (2018) and Singh et al (2020) find that sustainability practices, including green innovation, lead to better financial outcomes for Malaysian SMEs, but highlight the need for stronger government incentives. Zhang et al. (2019) in China and Sari et al. (2021) in Indonesia both point out that while green innovation can drive financial gains, success is often contingent on overcoming barriers like limited access to finance and developing a strong green image. Xie et al. (2020) add that environmental dynamism can moderate the relationship between green innovation and financial performance, with firms in rapidly changing markets better positioned to benefit from green technologies. Collectively, these studies underscore the complex interplay between green innovation, financial performance, and contextual factors, providing a robust foundation for examining these dynamics in the context of Depok City's SMEs(Chang et al., 2023).

This study addresses these gaps by investigating the impact of green process and product innovations on the financial performance of SMEs in Depok City. By employing structural equation modeling (SEM) and using data collected from a sample of 387 SMEs, this research delves into the intricate relationships between green technology innovations, a firm's green image, and financial outcomes. Additionally, the study explores the moderating effects of green image and green subsidies, offering insights that could guide both managers and policymakers in fostering a more sustainable and financially viable business environment in Depok City.

Research Method

Research Design

The study employs a qualitative research approach to explore the impact of green technology innovation on the financial performance of SMEs (UMKM) in Depok City. Given the exploratory nature of the study, the use of Structural Equation Modeling (SEM) is appropriate for understanding complex relationships between variables.

Population, Sample, Sampling

The population of the study consists of all SMEs registered in Depok City. As of the latest data, there are 11,429 registered SMEs. A random sampling technique is used to select SMEs from the population, ensuring that the sample is representative of the diverse range

of businesses in Depok City. The study uses Slovin's formula to determine the sample size. With a 95% confidence level and a margin of error of 5%, the calculated sample size is 387 SMEs.

Data Collection

The primary data is collected through a structured questionnaire distributed to the selected sample of SMEs. The questionnaire is designed to capture information on green process innovation, green product innovation, green image, green subsidies, and financial performance(Sahoo et al., 2023).

Data Analysis

The exogenous variable in this research is Green technology innovation which consists of Green process innovation and Green product innovation, Green product innovation as a mediating variable, and Green image and Green subsidies as moderator variables. Meanwhile, the endogenous variable in this research is financial performance. To determine the effect of exogenous variables on endogenous variables, as well as mediating and moderating variables on endogenous variables, the variance-based Structural Equation Model (SEM) statistical analysis technique was used with the partial least squares (PLS) method. The analysis stage carried out in this research includes analyzing the path diagram for the interaction model, evaluating the outer model, evaluating the inner model, and evaluating the model(Shan et al., 2021).

Hypotheses

Based on the study's focus on green technology innovation, financial performance, and the moderating effects of green image and green subsidies, the following hypotheses could be formulated:

H1: Green process innovation positively influences green product innovation.

H2: Green process innovation positively influences a firm's financial performance.

H3: Green product innovation mediates the relationship between green process innovation and financial performance.

H4: A firm’s green image positively moderates the relationship between green product innovation and financial performance.

H5: Green subsidies positively moderate the relationship between green product innovation and financial performance(Deng et al., 2022).

Result and Discussion

The study on green technology innovation among SMEs in Depok City offers valuable insights into the interplay between green process innovation, green product innovation, and financial performance, with the moderating roles of green image and green subsidies. The descriptive statistics highlight the varied adoption levels of green technologies across different industries and SME sizes, indicating a growing awareness and implementation of green innovations. Frequency distribution analyses reveal that a significant proportion of SMEs have embraced green process innovations, reflected in the mean values of financial performance indicators. These findings suggest that green process innovations are

positively correlated with enhanced financial outcomes, corroborating previous research. For instance, Xie et al. (2019) found that green process innovation positively influences green product innovation, which in turn, improves financial performance (Liao & Li, 2022).

Through Structural Equation Modeling (SEM), the study confirms the positive impact of green process innovation on green product innovation, suggesting that SMEs focusing on enhancing production processes are also likely to develop greener products. This finding is consistent with existing literature, such as Xie, Huo, and Zou (2019), which underscores the interdependence of process and product innovations in driving financial performance. Furthermore, the SEM analysis supports the mediating role of green product innovation between green process innovation and financial performance, emphasizing that the benefits of process improvements are often channeled through product innovation, directly contributing to financial success (Cai et al., 2020). This mediation effect aligns with research by Aguilera-Caracuel and Ortiz-de-Mandojana (2013), who noted the importance of a holistic approach to green innovation (Pan et al., 2023).

The study also highlights the significance of green image as a moderating factor, demonstrating that SMEs with a strong green image can better leverage green product innovations to achieve financial gains. This finding resonates with the work of Huang and Li (2017), who argued that organizational capability and public perception are critical in realizing the financial benefits of green innovations (Luo et al., 2019). On the contrary, the study finds that green subsidies do not significantly moderate the relationship between green product innovation and financial performance. This contrasts with earlier studies, such as those by Zhang, Xing, and Wang (2020), which emphasized the role of subsidies in overcoming financial constraints for green innovation. The limited impact of subsidies in this study suggests that while they may encourage initial adoption, their effectiveness depends on how well SMEs integrate these innovations into their overall strategy (H. Li et al., 2024).

The regression analysis complements the SEM findings by quantifying the strength of these relationships, with green process innovation showing a strong positive coefficient with green product innovation, and both innovations having significant positive coefficients with financial performance. The moderation analysis reveals that a strong green image substantially increases the impact of green product innovation on financial performance, further supporting the importance of branding in green innovation (Liu et al., 2023).

This study provides robust evidence that green process and product innovations are essential for enhancing the financial performance of SMEs in Depok City. The effectiveness of these innovations is significantly influenced by the firm's green image, while the direct impact of green subsidies on financial performance is limited. These findings suggest that SMEs should prioritize both process and product innovations while cultivating a strong green image to maximize the financial benefits of green technologies. Additionally, policymakers should consider integrating subsidies with strategies that encourage SMEs to develop a strong market presence through green branding and sustainable practices, ensuring long-term financial success (Lee et al., 2023).

Conclusion

This study highlights the significant role of green technology innovation in enhancing the financial performance of SMEs in Depok City. The findings demonstrate that green process innovation positively influences green product innovation, which in turn, improves financial performance. Additionally, green product innovation serves as a mediator between green process innovation and financial performance, indicating the importance of integrating both types of innovation for optimal financial outcomes. The study also reveals that a firm's green image strengthens the relationship between green product innovation and financial performance, underscoring the value of cultivating a strong environmental reputation. However, the anticipated moderating effect of green subsidies on the relationship between green product innovation and financial performance was not supported, suggesting that subsidies alone may not be sufficient to enhance the financial benefits of green innovations. The findings have important implications for both SMEs and policymakers. For SMEs, the study underscores the financial benefits of adopting green technologies and the importance of integrating both process and product innovations. A strong green image can serve as a competitive advantage, attracting customers and enhancing financial performance. For policymakers, the results suggest that while subsidies are important, they should be complemented by other forms of support to maximize the impact of green innovations. The study also calls for a more nuanced approach to policy design, one that considers the specific needs and capabilities of SMEs in different contexts. Overall, this research contributes to a better understanding of the complex dynamics between green technology innovation and financial performance in the SME sector, offering practical insights for both business leaders and policymakers.

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