

GREEN INVESTMENT, DIGITAL TECHNOLOGY AND DIGITAL FINANCE CAPABILITY ON FINANCIAL SUSTAINABILITY

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Abstract

This study aims to examine the role of Digital Finance Capability (DFC) in moderating the influence of green investment and digital technology on the financial sustainability of MSMEs. MSMEs, which play an important role in the Indonesian economy, often face obstacles in accessing technology and financing that can support financial sustainability. The method used in this study is a quantitative approach with a survey of MSMEs that have utilized digital technology and green investment. Primary data will be collected through a questionnaire distributed to MSME actors. The analysis technique used is Structural Equation Modeling (SEM) to test the relationship between the variables studied. The results of the study show that green investment does not have a significant effect on financial sustainability, while digital technology and digital finance capabilities have an effect on financial sustainability. Digital finance capabilities cannot moderate the influence of green investment and digital technology on financial sustainability.

Keywords: *Green investment; technology; digital finance capability; sustainability; SDGs; MSMEs*

INTRODUCTION

Micro, Small, and Medium Enterprises (MSMEs) in Indonesia play a vital role in the economy, accounting for around 61% of the Gross Domestic Product (GDP) and absorbing 97% of the national workforce. However, despite their large contribution, MSMEs often face challenges in accessing financing that supports the growth and sustainability of MSMEs. One potential solution is through digital finance, which can provide more inclusive and efficient access to financing (Du et al., 2024). However, the adoption of digital technology among Indonesian MSMEs is still limited. Data shows that less than 20% of MSMEs in Indonesia have adopted information technology digitally, while in other ASEAN countries such as Thailand and Vietnam, this figure reaches 71% and 43% respectively. This shows that there is a gap in the adoption of digital technology that can affect the operational effectiveness and access of MSMEs to digital financial services. On the other hand, green investment is becoming increasingly important in supporting economic sustainability (Zaid et al., 2025a). MSMEs in Indonesia contribute significantly to greenhouse gas emissions, with an estimated 216 million tons of CO₂ in 2023. The transformation towards green MSMEs is a strategic step to support Indonesia's Net Zero Emission (NZE) target by 2060 or sooner.

However, despite the importance of green investment, the adoption of green practices among MSMEs is still low. A study shows that positive financial behavior is associated with better green investment decisions by MSME owners. This indicates the need to increase financial literacy and understanding of green investment among MSME actors (Ding et al., 2023). This research aims to explore the role of digital finance capability in moderating the influence of green investment and digital technology on the financial sustainability of MSMEs. Using a quantitative approach, this study will analyze data from MSMEs in Indonesia to understand the relationship between these variables. Although digital finance can open up great opportunities for MSMEs, its implementation and application in the MSME sector in Indonesia still has many challenges. Existing quantitative data shows that most MSMEs in Indonesia still do not utilize digital technology optimally. According to the Bank Indonesia 2023 report, around 80% of MSMEs in Indonesia have not used digital payment systems regularly, and only 45% have used digital technology in product marketing and sales.

On the other hand, although the concept of green investment is gaining global attention, most MSMEs do not have the knowledge or access to engage in sustainable investment (Ganlin et al., 2021a). The Global Sustainable Investment Alliance (GSIA) in 2022 reported that green investment in Southeast Asia is still very limited, especially in the MSME sector, which is a market segment with great potential. Therefore, there is a large gap in terms of integrating green investment and digital technology in supporting the financial sustainability of MSMEs (Chen et al., 2024). The problems that will be studied in this study are: 1) How does green investment affect the financial sustainability of MSMEs? 2) How does digital technology affect the financial sustainability of MSMEs? 3) How do green investments and digital technology affect the financial sustainability of MSMEs? 4) How does digital finance capability affect the financial sustainability of MSMEs? 5) How does digital finance capability moderate the influence between green investment and digital technology on the financial sustainability of MSMEs? By paying attention to these facts, this study aims to explore the role of digital finance capability in moderating the influence of green investment and digital technology on the financial sustainability of MSMEs. This research will provide insights into how MSMEs can optimize digital technology and green investment to support MSME financial sustainability, as well as how digital finance capabilities can accelerate the process.

The urgency of this research is very important in the context of the 2030 Agenda for Sustainable Development Goals (SDGs), especially related to SDG 8 (Decent Work and Economic Growth) and SDG 9 (Industry, Innovation, and Infrastructure). This research will not only provide insights into how digital technology and green investment can be applied in the MSME sector, but will also contribute to SDG 12 (Responsible Consumption and Production) by encouraging MSMEs to switch to more sustainable business practices. In addition, this research is very relevant to ASTA CITA number 2, which includes the creation of innovations and technology applications in improving the accessibility and sustainability of MSMEs. Innovation in digital finance and green technology can be a catalyst for the transformation of the MSME sector, which in turn will support more inclusive and sustainable economic growth.

LITERATURE REVIEW

Research on the role of Digital Finance Capability (DFC) as a moderator between green investment and digital technology on the financial sustainability of MSMEs has developed conceptually and empirically. In general, the literature shows that digital financial literacy, FinTech adoption, digital infrastructure, and financial data management capabilities are important prerequisites for MSMEs to access green financing, improve operational efficiency, and encourage the adoption of green innovations. Digital financial literacy and FinTech together contribute to the implementation of green finance, showing that digital financial capacity can bridge information barriers and increase transparency of sustainable financial transactions for MSMEs. Similar findings at the global level support the idea that FinTech not only improves access to financing, but also facilitates the financing of green projects through alternative financing models such as crowdfunding and digital lending, which in turn strengthens sustainable finance practices in MSMEs.

Various studies also emphasize that DFC plays a conditional moderation factor depending on the institutional context, digital infrastructure, and financial and digital literacy levels. (Serđarušić et al., 2024) found that digital awareness plays a mediator between green finance and FinTech adoption in Croatia, with FinTech adoption contributing to banking sustainability although the direct effects of digital transformation on FinTech adoption are not necessarily significant; These findings indicate that DFC moderation pathways could be indirect pathways through increased digital awareness. FinTech adoption and digital readiness of MSMEs contribute positively to financial performance through direct channels, with supportive regulations strengthening this effect, so that the regulatory framework acts as a context that strengthens the moderating effect of DFC on the financial performance of MSMEs in Indonesia (Moursellas et al., 2024)

The interaction between green investment, digital technology, and DFC is also built through mechanisms to reduce financing barriers and increase trust in digital financial solutions. (Sinaga & Yunanda, 2025) emphasized that FinTech encourages green innovation through access to digital financing, crowdfunding, P2P lending, and the adoption of green technology, all of which are relevant for improving the sustainable financial performance of MSMEs. (Sun & Zhang, 2024) explore digital financial inclusion as a factor driving MSMEs' innovation by reducing financing restrictions and increasing consumption/investment, with these effects being diverse based on the level of digital inclusivity in their region. Meanwhile, (Li & Yang, 2024) confirm that digital finance contributes to the efficiency of the city's green economy through investment support, increased technological innovation, and increased environmental participation, showing how DFC plays a role in channeling financing sources to green initiatives and digital transformation, ultimately influencing sustainable economic performance.

Several studies show that there is a variation in the moderation effect of DFC across countries and sectors, influenced by digital infrastructure, literacy levels, and different regulatory frameworks. The Croatian study shows that green finance increases FinTech adoption and digital transformation, but the direct effects of digital transformation on FinTech adoption are not always significant, so mediation pathways such as digital awareness are key to the context (Serdarusić et al., 2024). Research in Indonesia emphasizes that the effectiveness of DFC moderation is highly dependent on the regulatory environment and the level of technology adoption in certain industrial sectors, so a local context-sensitive empirical framework is needed to validly test DFC moderation (Wulandari et al., 2023a)

METHOD

This research is a type of quantitative research. Quantitative testing is carried out to test field data taken based on theoretical and empirical studies of the relationship between indicators and latent variables (outer model or measurement model), as well as the relationship between variables which ends by testing the research hypothesis (inner model or structural model). Nature of research with explanatory research. Sugiyono (2010) stated that explanatory research is research that intends to explain the position of the variables being studied and the relationship between one variable and another. The location of this research is Medan City. Green investment refers to investments directed at projects or activities that support environmental sustainability, such as renewable energy, efficient management of natural resources, or environmentally friendly technologies. Green investment includes the amount of investment in green projects, the percentage of revenue allocated to green investment and the type of green investment made (Bhatnagar et al., 2024). Digital Technology refers to the use of information and communication technology (ICT)-based tools that support business operations, including e-commerce platforms, inventory management applications, digital payment platforms, and technologies for data analysis. Digital technology includes the use of digital platforms, the implementation of digital systems, the frequency of use of technology for data analysis and financial decision-making (Komariyah, 2024).

Digital Finance Capability refers to the ability of an MSME to access and utilize digital technology in financial management. DFC covers access to digital financial technology, the ability to access financing through digital platforms, the level of financial digital literacy, and the frequency of use of digital financial applications (Chen et al., 2024; Hu et al., 2023). Financial sustainability refers to the ability of MSMEs to maintain and manage financial resources in the long term, avoid financial crises, and manage risks that may occur. Financial sustainability includes revenue growth, ability to manage cash flow and operating costs, access to financing and long-term financial stability (Ganlin et al., 2021b; Pu et al., 2021). The population in this study is micro, small and medium enterprises. As a general rule the minimum sample count is at least five times more than the number of question items analyzed, the minimum sample size guide in the SEM-PLS analysis is equal to or greater than the condition (Hair et al., 2021). This guideline uses the first rule when estimating parameters using the maximum probability method, the recommended sample size is between 100-200 with a minimum sample of 50. Data collection techniques through surveys, interviews and documentation. Hypothesis test using the Structure Equation Model PLS (SEM-PLS). SEM-PLS modeling consists of a measurement model and a structural model. The structural model is aimed at testing the relationship between exogenous and endogenous constructs. While the measurement model is aimed at testing the relationship between indicators and latent constructs/variables (Ballen, 1989) in the (Ghozali, 2018). SEM in this study was analyzed using SMART-PLS software to test the role of digital finance capability in moderating the influence of green investment and digital technology on the financial sustainability of MSMEs in Medan City.

RESULTS AND DISCUSSION

Outer Model Review (*Measurement Model*)

The outer model consists of *convergent validity*, *discriminant validity*, and *composite reliability*.

Convergent Validity

The convergent validity of the measurement model with reflective indicators can be seen from the correlation between the item/indicator score and the construct score. Individual indicators are considered reliable if they have a correlation value above 0.50. The structural model in this study is shown in the following Figure :

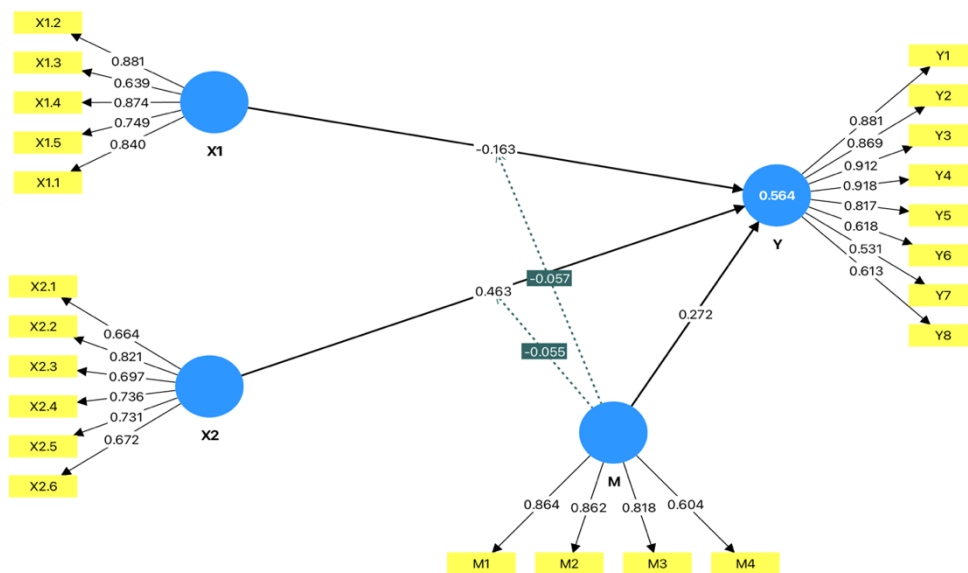


Figure 1 Convergent Validity Test Results

Source : Smart PLS Program Output, 2025

All indicators have a loading factor > 0.50, meaning that all indicators are valid indicators to measure their constructs.

Square Root of Average Variance Extracted (AVE)

The recommended *Average Variance Extracted (AVE)* value is above 0.5 (Mahfud and Ratmono, 2013). If the AVE value is greater than 0.5 then discriminative validity is considered good. The following are the *Average Variance Extracted (AVE)* values in this study:

Table 3 Average Variance Extracted (AVE)

Variabel	Average Variance Extracted (AVE)	Remarks
Investasi Hijau (X1)	0.643	Baik
Teknologi Digital (X2)	0.521	Baik
Keberlanjutan Keuangan (Y)	0.614	Baik
Digital Finance Capability(M)	0.631	Baik

Source: PLS processed data (2025)

Based on Table 3 above, the AVE for each variable in this study is included in the Good category because the AVE value is greater than 0.5.

Discriminant Validity

The testing of discriminatory validity in this study was carried out using the Fornell-Larcker approach. In discriminant validity testing, the square root value of AVE of a latent variable is compared to the correlation value between that latent variable and other latent variables. The results of the discriminatory validity test in this study are as follows:

Table 4
Discriminatory Validity Testing

Indikator	M	X1	X2	Y
M1	0,864	0,581	0,814	0,785
M2	0,862	0,575	0,716	0,524
M3	0,818	0,440	0,583	0,493
M4	0,604	0,337	0,418	0,237
X1.1	0,394	0,840	0,563	0,338
X1.2	0,393	0,881	0,602	0,328
X1.3	0,707	0,639	0,682	0,494
X1.4	0,400	0,874	0,596	0,327
X1.5	0,462	0,749	0,680	0,370
X2.1	0,390	0,529	0,664	0,312
X2.2	0,851	0,586	0,821	0,786
X2.3	0,739	0,612	0,697	0,505
X2.4	0,481	0,665	0,736	0,390
X2.5	0,445	0,565	0,731	0,342
X2.6	0,410	0,597	0,672	0,319
Y1	0,717	0,446	0,651	0,881
Y2	0,655	0,432	0,604	0,869
Y3	0,680	0,490	0,663	0,912
Y4	0,648	0,461	0,644	0,918
Y5	0,547	0,436	0,538	0,817
Y6	0,327	0,224	0,339	0,618
Y7	0,232	0,096	0,199	0,531
Y8	0,390	0,276	0,440	0,613

Source: PLS Processed Data (2025)

From Table 4, it can be seen that the results of the *cross loading* test show that all indicators on variable Y have a higher loading value in their respective constructs compared to other constructs. This shows that the indicators meet the criteria of discriminant validity, where each indicator is more correlated with the latent variable it has than with the other latent variables. These results strengthen the reliability of the measurement model used in this study.

Composite reliability dan Convergent Validity

Measurement assessment is as important and absolutely necessary as conducting thorough testing for the reliability and validity of the scale used to measure latent constructs and their manifest variables. The composite reliability and Alpha Cronbach values for the constructed studied, have been calculated using SmartPLS software as follows:

Table 5 Reliability Testing by Cronbach's Alpha (CA)

Construct	Cronbach's Alpha	Composite Reliability	Remarks
Green Investments (X1)	0.859	0,858	Reliabel
Digital Technology (X2)	0.829	0,902	Reliabel
Financial sustainability (Y)	0.909	0,943	Reliabel
Digital Finance Capability (M)	0.813	0,908	Reliabel

Source: PLS processed data (2025)

The results of the construct reliability test showed that the entire construct obtained *Cronbach's Alpha* and *Composite Reliability* (CR) values of more than 0.70, This indicates a good and reliable level of reliability for the inner measurement of the model.

Structural Model Analysis (Inner Model)

Model R Square

The results of the R Square test in this study are shown in Table 6 below:

Table 6. R-Square

	R Square	R Square Adjusted
KK	0.564	0.553

Source: PLS processed data (2025)

Based on Table 6, it can be seen that the value of the determination coefficient for the latent variable of financial sustainability (Y) is 0.553, which means that green investment and digital technology are able to explain its influence on financial sustainability by 55.3% and is moderate.

Hypothesis Testing (Inner Model)

From the results of the outer model test, it shows that it has met the requirements for validity and reliability. In addition, the internal model examination, which includes the significance test of direct effect and moderation (indirect effect). The inner model in this study is shown in the path diagram as follows:

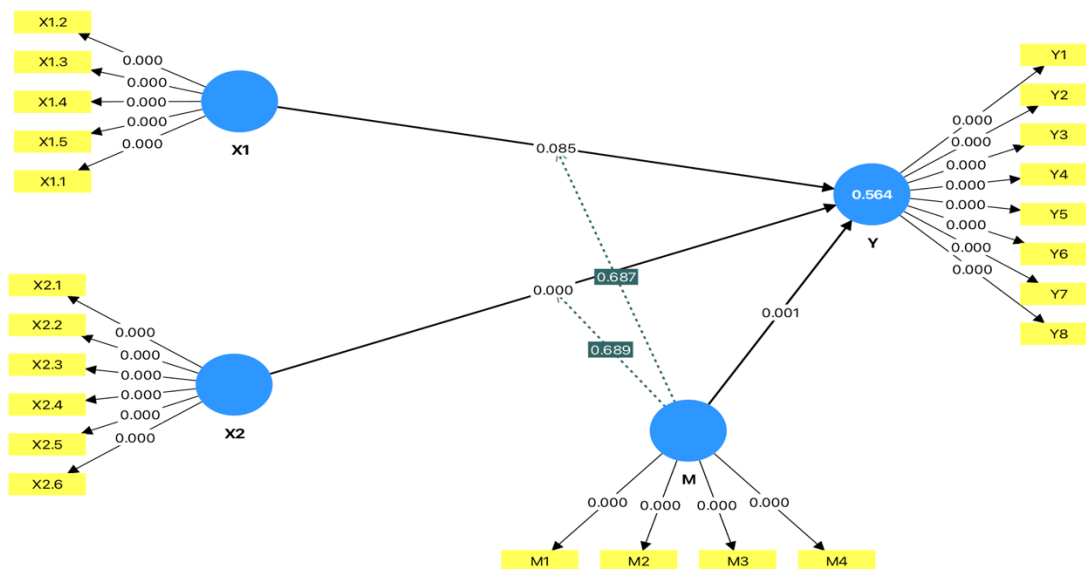


Figure 2 PLS Structural Model Results

Based on the results above, it can be seen that green investment has no effect on financial sustainability with a significant level of $0.085 > 0.05$. Digital technology has an effect on financial sustainability with a significant level of $0.000 < 0.05$. Digital finance capability affects financial sustainability with a significant level of $0.001 < 0.05$. Meanwhile, digital finance capabilities cannot moderate the influence of green investment and digital technology on the financial sustainability of MSMEs.

Discussion

The Effect of Green Investment on Financial Sustainability

Green investment is expected to make a significant contribution to the financial sustainability of Micro, Small, and Medium Enterprises (MSMEs). However, a number of studies show that such investments do not always have a positive impact. (Bhatnagar et al., 2024; Prihastiwi et al., 2023) argue that although the MSME industry has a crucial role in achieving the Sustainable Development Goals (SDGs), MSMEs often face various challenges that hinder the implementation of sustainable green practices, including limited capital and lack of knowledge in financial management. Despite relying on sustainability efforts, many MSMEs are hampered in the application of financial technology and adequate financial literacy, which has more effect on financial performance than green

investment directly. Furthermore, low financial literacy among MSME actors in villages can result in poor financial management, which in turn affects business sustainability. Socialization activities for financial recording applications are used as one of the programs to increase this understanding (Pu et al., 2021). Another factor that contributes to the unsuccess of green investments is the measures chosen to implement green practices themselves. Financial literacy is important as a foundation for achieving MSME sustainability, showing that the tendency of MSMEs to pay more attention to financial management training can determine business sustainability compared to focusing on green investment alone. This research supports the argument that while green investing has the potential to provide long-term benefits, in reality, many factors such as financial limitations and low understanding of financial management are more urgent to address. Therefore, a more holistic approach that combines increased financial literacy and the implementation of a better management system is key to achieving true financial sustainability for MSMEs, rather than just focusing on green investments. This points to the need to rethink the strategies chosen in supporting the financial sustainability of MSMEs, where green investment can be considered as one of the various strategies needed, but not the only solution that must be prioritized.

The influence of digital technology on financial sustainability

Digitalization plays an important role in improving the financial sustainability of Micro, Small, and Medium Enterprises (MSMEs). Through the adoption of digital technology, MSMEs can improve financial management, expand market reach, and improve operational efficiency. (Zaid et al., 2025b) show that the use of financial technology (fintech) provides better access for MSMEs to get the financing needed for business growth and development. Furthermore, (Wulandari et al., 2023b) revealed that a high level of financial literacy, which can be obtained through the implementation of digital systems, contributes positively to the sustainability of MSMEs in Balusu District, proving that mastery of digital technology can strengthen the financial position of small businesses. On the other hand, the use of digital platforms brings with it other benefits, such as reduced marketing costs and increased efficiency in stock management and payments. The use of mobile-based financial recording applications, for example, not only simplifies administrative tasks, but also gives MSMEs the ability to monitor financial conditions in real-time, creating much-needed transparency in business. Thus, the application of digital technology is crucial in increasing the accountability and accuracy of financial statements which ultimately supports the financial sustainability of MSMEs in this increasingly digital era. This shows that by making optimal use of digital technology, MSMEs can adapt to market changes and significantly increase financial sustainability.

The Influence of Digital Finance Capability on Financial Sustainability

Digital financial capabilities are increasingly recognized as an important factor that improves the financial sustainability of Micro, Small, and Medium Enterprises (MSMEs). These capabilities enable businesses to leverage a wide range of digital tools and platforms that facilitate financial management, thereby improving operational efficiency and expanding access to funding sources. For example, argue that digital inclusive finance plays a crucial role in helping SMEs overcome financing challenges, which is important to encourage green innovation and sustainable practices within these companies. In addition, (Serdarušić et al., 2024) explore how access to sustainable finance solutions, driven by digital innovation, can significantly improve the growth and sustainability of SMEs, especially in integrating environmental, social, and governance (ESG) principles into operations. In addition, (Chen et al., 2024) highlight that the digital transformation of businesses among MSMEs has received a positive response, showing that products marketed on digital platforms are more likely to attract customers, which in turn encourages financial sustainability. This transition is not only beneficial for sales but also important for building agility and resilience in market changes. Furthermore, research by (Alqatan et al., 2024) underscores the importance of embracing digital tools to improve innovation, sustainability, and overall performance among MSMEs, thus confirming the direct relationship between digital financial capabilities and financial resilience in the modern economy. Overall, it is evident that improving digital financial literacy and capabilities is essential for MSMEs to ensure long-term financial sustainability in an increasingly digital world.

Digital Finance capability does not moderate the influence of green investment and digital technology

The role of digital finance capabilities in moderating the relationship between green investing and overall business financial sustainability is a nuanced subject. While digital finance has the potential to improve financial management and accessibility, evidence suggests that digital finance does not necessarily moderate the impact of green investing and direct adoption of digital technologies. (Zhang et al., 2023) suggest that while the efficiency of

urban economies can be supported by digital financial solutions, the integration of environmental factors does not guarantee better outcomes in sustainability without a fundamental commitment to green practices. Similarly, findings by (Fan et al., 2022) reveal that innovative financial instruments for green investments can benefit from digital technologies, but the effectiveness of such technologies depends on the level of financial literacy and operational readiness that exists within the company. This means that the presence of digital financial capabilities alone does not bridge the gap between the theoretical benefits of green investing and its practical outcomes, as the capacity to effectively utilize these tools remains an important factor. In this regard, (Li & Yang, 2024) emphasizes that while digital innovation promotes financial efficiency, it does not inherently ensure sustainable practices unless accompanied by strategic investments in green technologies and initiatives. Thus, while digital financial capabilities can improve operational efficiency, it does not act as a moderator in the relationship between green investments and financial sustainability, highlighting the importance of an integrated approach that considers financial and environmental variables

CONCLUSION

This study aims to explore the role of digital financial capabilities (DFC) in moderating the influence of green investment and digital technology on the financial sustainability of MSMEs in Indonesia. The results of the study show that although green investment should be able to make a significant contribution to the financial sustainability of MSMEs, in reality green investment does not have a significant influence. This is due to limited financial resources and low financial literacy owned by MSME actors, which hinders the positive impact of green investment. On the contrary, digital technology has been proven to have a significant positive influence on the financial sustainability of MSMEs. By adopting digital technology, MSMEs can improve financial management, expand market access, and improve operational efficiency, ultimately contributing to long-term financial stability. In addition, digital finance capabilities (DFCs) also have a positive influence on financial sustainability, as they allow MSMEs to access and utilize digital financial platforms and tools effectively to manage finances and obtain funding more easily. However, digital financial capabilities are not able to moderate the relationship between green investment and digital technology towards financial sustainability. This shows that while digital finance can improve operational efficiency, it is not enough to address the problems that exist in implementing green investments. As such, MSMEs need to adopt a more holistic approach that includes improving financial literacy, implementing green practices, and better management systems to achieve more optimal sustainability. Policymakers must also focus on improving financial literacy and creating an environment that supports the adoption of digital technology, so that the potential of MSMEs in the digital and green economy can be maximized.

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