









“How do environmental awareness, IT use, and credit access shape the sustainability of Indonesian MSMES?”

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HOW DO ENVIRONMENTAL AWARENESS, IT USE, AND CREDIT ACCESS SHAPE THE SUSTAINABILITY OF INDONESIAN MSMEs?

Abstract

This study aims to analyze the influence of environmental awareness, information technology (IT) use, and access to credit as moderators on the sustainability of Indonesia's micro, small, and medium enterprises (MSMEs). Data were obtained through a survey of 1,374 MSMEs. Sampling was carried out using purposive sampling techniques, targeting MSMEs that had been established for more than 3 years and had received loans from financial institutions. The analysis used the ordinary least square (OLS) regression method to evaluate the relationship between the independent variables and MSME sustainability. The results show that environmental awareness and IT use significantly positively affect MSME sustainability. Credit access was also found to have a significant and positive effect. However, the interaction between credit access, environmental awareness, and IT use resulted in a small but significantly negative effect. This suggests that an excessive increase in credit access might reduce the positive impact of environmental awareness and IT use on MSME sustainability. Overall, this study confirms the importance of environmental awareness and information technology in improving MSME sustainability and highlights the need for proper management of credit access.

Keywords

MSME sustainability, environmental awareness, IT usage, credit access, environmental responsibility

JEL Classification

Q01, Q56

INTRODUCTION

Micro, small, and medium enterprises (MSMEs) are important in driving economic growth, especially in developing countries, where they contribute significantly to job creation, poverty alleviation, and Gross Domestic Product (GDP). In Indonesia, MSMEs contribute more than 60% of GDP and employ around 97% of the workforce, making them the backbone of the national economy. However, amidst the increasing pressures of globalization, technological advancements, and environmental challenges, the sustainability of MSMEs has become a crucial issue that needs further research.

The concept of sustainability for MSMEs relates to their ability to survive financially and respond to social and environmental issues. As global attention to sustainable development increases, MSMEs are increasingly expected to adopt practices aligned with environmental responsibility. This includes minimizing their ecological impact, improving resource efficiency, and integrating green practices in their business models. However, MSMEs face many challenges adjusting to these demands, especially in developing countries where limited access to resources and technological infrastructure often impede progress.

Moreover, digitalization has emerged as a critical driver of business sustainability. By adopting information technology (IT), MSMEs can improve operational efficiency, expand market reach, and drive innovation. Despite digital technology's transformational potential, MSMEs in many developing countries face significant barriers to its adoption, including limited digital literacy, high costs, and inadequate infrastructure.

In Indonesia, the confluence of environmental concerns, access to finance, and the adoption of digital technology create a complex set of challenges for MSME sustainability. While access to credit is widely recognized as a critical factor in enabling business growth and resilience, many MSMEs still need help securing adequate financing due to structural constraints in the financial sector.

1. LITERATURE REVIEW

This study adopts the triple bottom line (TBL) theory introduced by Elkington and Rowlands (1997), which measures business sustainability using three dimensions: profit, people, and planet (Arowoshegbe & Emmanuel, 2016). Business sustainability is measured financially, and attention needs to be paid to the social and environmental impacts of its operations. In addition, this study also uses legitimacy theory, which is rooted in the social contract between organizations (businesses) and society, where companies need to maintain their sustainability (Dowling & Pfeffer, 1975). Nowadays, more and more people are concerned about the environment, so they choose environmentally friendly products. This can increase the market competitiveness and reputation of SMEs. In addition, currently, the market does not recognize national borders, so SMEs need to be more environmentally conscious to be able to enter some developed countries that are very concerned about the environment.

The triple bottom line (TBL) theory is one of the leading frameworks used to assess the sustainability of MSMEs. This concept states that sustainability should be evaluated based on economic returns and social and environmental impacts (Elkington & Rowlands, 1997). TBL encourages MSMEs to take a holistic approach to their operations by integrating social and environmental responsibility into their business strategy. Environmental awareness is a key driver of sustainable business practices. Many studies have shown that environmental awareness can increase innovation and operational efficiency (Venkatraman & Nayak, 2015). MSMEs with high environmental awareness tend to be

more responsive to environmental regulations and are better able to attract consumers who care about sustainability (Sarango-Lalangui et al., 2023).

This study also adopts the theory of environmental economics, which is concerned with how the economic decisions of individuals, firms, or organizations affect the environment. It focuses on the internalization of environmental externalities often ignored by the market. Negative externalities such as pollution, damage to ecosystems, and overexploitation of natural resources are challenges to sustainable economic development (Baumol & Oates, 1988). As economic actors, MSMEs play an important role in environmental sustainability, especially in the context of increasing awareness of the need for environmentally friendly businesses. Environmental economic theory also highlights the importance of green innovation in supporting economic and environmental sustainability. Green innovation involves the application of new technologies or processes that reduce environmental impacts while improving business efficiency.

This awareness encourages MSMEs to invest in green innovation, i.e., the application of more environmentally friendly technologies and processes, which are able to reduce negative impacts on the environment while improving operational efficiency (Baumol & Oates, 1988). The use of energy-efficient technologies or better waste management can reduce pollution while reducing operational costs, which in turn increases business competitiveness. Thus, environmental awareness has a positive effect on the sustainability of MSMEs, as the drive to internalize negative externalities through the adoption of green innovations allows

MSMEs to reduce their environmental impact and, at the same time, maintain or even improve their economic performance. This creates a synergy between economic growth and environmental sustainability.

The use of information technology (IT) can also be considered as part of green innovation that contributes to the operational efficiency of MSMEs and reduces energy consumption and pollution (Loebbecke & Picot, 2015). High environmental awareness among MSME entrepreneurs encourages them to invest in green technology and sustainable business practices (Siddik et al., 2023). Sustainability-driven innovation reduces negative environmental impacts and strengthens business competitiveness in the long run (Larios-Francia & Ferasso, 2023). In the context of MSMEs, adopting green technologies can be an important differentiating factor, especially in an increasingly environmentally conscious market. Thus, the environmental awareness of MSME owners and managers plays an important role in driving green innovations that can improve business sustainability. The use of IT enables MSMEs to automate business processes, reduce energy consumption, and monitor and manage resource usage more effectively. For example, through the utilization of digital platforms for data analysis and inventory tracking, MSMEs can optimize their supply chains, reduce wastage, and minimize their environmental impact. In addition to operational efficiency, IT also enables MSMEs to reduce carbon emissions and waste by implementing technology-based energy management systems that can detect and reduce inefficient energy consumption. Thus, IT supports the implementation of green innovations in MSME operations that enable them to contribute to environmental conservation while saving costs.

Adopting digital technology has proven to be a very important factor in supporting the sustainability of MSMEs. Information technology can improve operational efficiency, expand market access, and enable innovation in products and services (Kudyba & Vitaliano, 2003). In addition, MSMEs that adopt digital technology also perform better in terms of productivity and competitiveness (Gawali, 2021). Adopting digital technologies improves internal efficiency and strengthens MSMEs'

external relationships with customers, suppliers, and business partners through better integration into global value chains. Digitalization enables MSMEs to speed up decision-making, improve inventory management, and provide more responsive customer service, all of which contribute to long-term business sustainability (de Pedraza & Katsinis, 2022). Zaki (2019) also found that digital technology drives productivity improvements and creates opportunities for product differentiation and new market penetration, especially in an increasingly digital era of globalization.

Furthermore, adopting digital technologies also enables MSMEs to participate in the platform-based economy, such as e-commerce and fintech, significantly expanding their market access and financial resources (Li et al., 2023). Through digital platforms, MSMEs can access global markets without needing large physical infrastructure, reducing barriers to competing with larger firms. In the context of sustainability, digital technologies also play a role in strengthening green business practices, such as more efficient waste management, monitoring energy use, and reducing carbon footprints (Quttainah & Ayadi, 2024). Despite the importance of IT implementation on the sustainability of MSMEs, the challenges faced in its implementation are diverse. Limited resources, lack of knowledge and skills, and market instability are some of the main barriers often faced by MSMEs (Tambunan, 2011). Loebbecke and Picot (2015) showed that although digital technology offers many benefits, high costs and limited infrastructure often hinder MSMEs from adopting it. In addition, low levels of digital literacy among MSME owners can also limit their ability to utilize technology effectively (Gawali, 2021).

Access to credit is a key factor in the sustainability of MSMEs. Such access plays an important moderating role in strengthening the influence of environmental awareness and IT use on MSME sustainability. In the context of MSMEs, high environmental awareness and IT usage require adequate financial support for the implementation and ongoing maintenance of various green innovations and environmentally friendly technologies. MSMEs often face difficulties obtaining financing from formal financial institu-

tions, limiting their ability to invest in technology and innovation (Beck & Demirci-Kunt, 2006). Ayyagari et al. (2012) show that improved access to credit is associated with better growth and performance for MSMEs, particularly in developing countries. Access to credit supports day-to-day business continuity and enables MSMEs to face long-term financial challenges, such as technological change, increasing production capacity, and managing business risks (Ma et al., 2023). High environmental awareness in MSMEs may encourage them to invest in sustainable business practices, such as the use of environmentally friendly raw materials, implementation of energy-saving technologies, or effective waste management. However, all these initiatives usually require additional capital. With adequate access to credit, environmentally conscious MSMEs can obtain financial support to implement these changes, ultimately improving the sustainability of their operations.

The use of IT for efficiency and resource management can also be strengthened by access to credit. IT often requires high initial costs for implementation and ongoing system updates. Access to credit can trigger MSMEs to take advantage of more advanced technologies and accelerate the digitization of their business processes. Available credit allows MSMEs to invest in hardware and software that support greener and more efficient operations, ultimately contributing to their sustainability. Limited access to credit hinders the ability of MSMEs to thrive and compete in the global marketplace, especially in the face of rapidly changing technological needs and demands for environmental sustainability (Cull et al., 2006). In addition, Siddik et al. (2023) highlight the important role of financial technology (fintech) in expanding access to credit for MSMEs in developing countries.

Therefore, the study aims to analyze the effect of environmental awareness, information technology (IT) use, and access to credit as moderators on the sustainability of micro, small, and medium enterprises (MSMEs) in Indonesia. This analysis is expected to provide deeper insights into the key factors that influence the sustainability of MSMEs in the context of technological change and environmental sustainability.

2. METHODOLOGY

This study uses primary data obtained through questionnaires distributed to 1,374 MSMEs. Sampling was carried out using purposive sampling techniques, and the MSMEs sampled were established for more than 3 years and had received loans from financial institutions. Data analysis was conducted using the ordinary least squares (OLS) regression method to test the effect of the independent on the dependent variable.

The dependent variable in this study is MSME sustainability, which is measured through organizational, economic, and commercial performance. This sustainability measurement uses a total score index of 15 questions covering these three aspects (Larios-Francia & Ferasso, 2023). The main independent variables are environmental awareness and IT use. Environmental awareness is measured by the total score of respondents' answers to 14 questions about the owner's or manager's views on human relationships with the environment (Blok, Wesselink, et al., 2015; Zhang & Gong, 2023). IT use is measured through four binary indicators: email, websites, online marketing, and online payments (Mushtaq et al., 2022; Trinugroho et al., 2022). This study uses the ease of access to credit as a moderating variable. Access to credit is measured through an index that includes basic financial access (number of loans and accounts) and advanced financial access (proportion of investment and working capital financed by banks and external sources) (Beck & De La Torre, 2007; Claessens, 2006; Mushtaq et al., 2022). Control variables in this study include firm characteristics, such as ownership and exports, and owner characteristics, such as education and gender (Mushtaq et al., 2022; Trinugroho et al., 2022). Owners' education is measured numerically, while gender is assessed with a binary scale (1 for male, 0 for female). The complete research instrument is presented in Table 1.

3. RESULT AND DISCUSSION

The descriptive statistical analysis presented in Table 2 provides an overview of the key variables in this study, namely MSME sustainability, environmental awareness, IT use, and access to credit.

Table 1. Research instrument

Variable	Measurement
MSME Sustainability (MS)	1. Organizational performance has 6 questions. 2. Economic performance has 3 questions. 3. Commercial performance has 6 questions. MSME sustainability index = Total score of 15 MSME sustainability question items
Environmental Awareness (EnA)	Total score of respondents' answers to fourteen categories of questions
IT Use (IU)	Business owners or companies have used the facilities: 1. Email: Binary = 1 if the company uses email to communicate with clients or suppliers, 0 otherwise; 2. Website: Binary = 1 if the company has its own website, 0 otherwise; 3. Online marketing: Binary = 1 if the company offers and promotes products through online platforms, 0 otherwise; 4. Online payment: Binary = 1 if the company accepts online payment platforms from e-wallets, 0 otherwise; IT Use Index = Number of facilities used, index ranges from 0 to 4.
Credit Access (CA)	1. Access to basic finance = sum of loans and accounts. The index value is 0 to 2. 2. Advanced Access to Finance = a. Investment: Proportion of investments financed by banks divided by 100. b. Bank Working Capital; Proportion of working capital financed by the bank divided by 100 c. External Working Capital; Proportion of working capital financed by external sources divided by 100. Access to finance index = Sum of Access to basic finance and Access to advanced finance. The index ranges from 0 to 5
Company Characteristics 1. Ownership 2. Export	1. Binary = 1 if the owners use their own funds to set up the company, 0 otherwise 2. Binary = 1 if the company produces export products.
Owner Characteristics 1. Education (OwnEdu) 2. Gender (OwnGen)	1. The education level of the owner 2. Binary = 1 if male and 0 if female for owners

The average MSME sustainability index, which includes organizational, economic and commercial performance, stands at 12.91 with a standard deviation of 2.10, indicating moderate variation in sustainability performance among MSMEs.

Environmental awareness has an average score of 11.98 with a standard deviation of 1.97, indicating a generally high level of environmental awareness among MSME owners or managers. On the IT use variable, which is measured based on the use of email, websites, online marketing, and online payments, the average score reached 3.52 with a standard deviation of 0.93. The minimum score of 0.00 and a maximum score of 4.00 indicate that while many MSMEs have utilized IT, some still have not

fully engaged in digital technology. Meanwhile, the access to credit variable has an average of 1.06 with a standard deviation of 1.08, meaning most MSMEs have access to basic banking services. However, some are still limited in their access to more advanced or complex credit.

Table 3 shows that environmental awareness, IT use, and access to credit significantly influence the sustainability of MSMEs, while some control variables have varying effects. Green awareness has a significant positive coefficient in all models. In Model (1), the coefficient of 0.0137 with a very high *t*-statistic (265.18) indicates that increased environmental awareness among MSME owners significantly improves MSME sustainability. This

Table 2. Descriptive statistics

Variable	Obs.	Mean	Std	Min	Max
MSME Sustainability	1,374	12.90830	2.09783	5.00	15.00
Environmental Awareness	1,374	11.98035	1.96704	5.00	14.00
IT Use	1,374	3.51747	0.92591	0.00	4.00
Credit Access	1,374	1.05677	1.07666	0.00	5.00
Ownership	1,374	0.95852	0.19948	0.00	1.00
Export	1,374	0.12009	0.32518	0.00	1.00
Owner Education	1,374	2.70524	1.01469	1.00	5.00
Owner Gender	1,374	0.63537	0.48150	0.00	1.00

is consistent across all models, meaning that environmental awareness is an important factor in supporting sustainability performance.

Table 3. Testing factors affecting the sustainability of MSME (robust)

Variable	MSME Sustainability		
	(1)	(2)	(3)
Environmental Awareness	0.0137*** (265.18)	0.0139*** (165.97)	0.0137*** (264.05)
IT Use	0.241*** (31.14)	0.238*** (30.60)	0.274*** (22.63)
Credit Access		0.0916*** (2.95)	0.101*** (3.48)
EnACA (EnAxCA)		-0.000104*** (-3.00)	
IUCA (IUxCA)			-0.0216*** (-3.54)
Ownership	-0.0879*** (-3.64)	-0.0928*** (-3.83)	-0.0875*** (-3.62)
Export	0.000873 (0.06)	0.00122 (0.08)	0.000667 (0.04)
Owner Education	-0.00717 (-1.40)	-0.00594 (-1.14)	-0.00504 (-0.96)
Owner Gender	0.00513 (0.51)	0.00454 (0.45)	0.00374 (0.37)
_cons	-3.799*** (-77.88)	-3.952*** (-56.00)	-3.968*** (-58.23)
N	1374	1374	1374
F	19413.70	16261.82	16304.38
Prob > F	0.0000	0.0000	0.0000
R-squared	0.9929	0.9930	0.9930
Root MSE	0.17581	0.17536	0.17513

Note: ***, **and * denote statistically significant variables at 1%, 5% and 10% levels, respectively; *t*-statistics are in parentheses.

In line with the triple bottom line theory introduced by Elkington and Rowlands (1997), this study shows that MSMEs that have a high level of environmental awareness are more likely to survive in the face of economic challenges and increasingly stringent regulations related to environmental issues. This study also reinforces the concept of corporate social responsibility (CSR), where companies, including MSMEs, are expected to not only focus on short-term profits but also consider the social and environmental impacts of their operations. CSR, as a form of environmental awareness, can serve as a tool to improve corporate reputation and consumer confidence, which in turn improves business performance and sustainability (Mehnaz et al., 2024).

The findings confirm that environmental awareness has a significant positive influence on MSME

sustainability. This is in line with previous research showing that environmental awareness can improve overall business performance (Blok, Gremmen, et al., 2015; Ullah et al., 2023). Owners or managers who are more aware of the importance of environmental sustainability tend to make more sustainable business decisions, such as reducing energy use, improving resource efficiency, and implementing better waste management policies. This helps protect the environment and improves the company's image in the eyes of consumers who are increasingly concerned about sustainability (Larios-Francia & Ferasso, 2023).

Increased environmental awareness among MSME players can also contribute to business sustainability in the long run, as environmentally friendly businesses are increasingly valued in the global marketplace. In addition, environmentally conscious MSMEs can attract more customers, increase consumer loyalty, and minimize future regulatory risks, all of which can contribute to improved financial and commercial performance. In line with these findings, several studies have also shown that high environmental awareness can increase product innovation, especially related to green and eco-friendly products, which can expand the market for MSMEs (Mushtaq et al., 2022). However, successful implementation of green policies also depends on support from the government and access to green technologies. MSMEs may not be motivated to adopt sustainable business practices without adequate incentives, such as tax breaks or subsidies (Claessens, 2006). Therefore, collaboration between the private sector and the government is essential to encourage the implementation of sustainability policies among MSMEs.

Table 3 also shows that the IT use variable has a significant positive effect on the sustainability of MSMEs in all three models. In Model (1), the coefficient of 0.241 with a *t*-statistic of 31.14 indicates that the utilization of information technology significantly increases the sustainability of MSMEs. In Model (3), the coefficient increases slightly to 0.274, indicating that increased use of IT further strengthens MSME sustainability. These findings indicate the important role of information technology in strengthening the competitiveness, innovation, and sustainability of small and medium enterprises in the current digital era.

Information technology adoption in the context of small and medium-sized businesses can be explained through the technology-organization-environment framework (TOE) theory developed by Tornatzky and Fleischer in 1990 (Baker, 2012). TOE theory explains that technology adoption is influenced by three main dimensions: technology, organization, and external environment. In the context of MSMEs, information technology, such as the use of email, websites, online marketing, and digital payments, can be considered as technological factors that can accelerate the digital transformation process of enterprises and support sustainability. From a technological perspective, IT adoption enables MSMEs to access tools and platforms that can improve operational efficiency and expand market access. Technologies like e-commerce and digital payments allow MSMEs to reach a wider range of consumers and improve transaction efficiency. IT can also assist firms in optimizing resource management, improving internal and external communication, and speeding up the decision-making process. Meanwhile, external pressures such as consumer demand, industry competition, and government policies regarding digitalization encourage MSMEs to adopt information technology to maintain their competitiveness (Mushtaq et al., 2022).

The research results are also consistent with the literature, which states that IT adoption plays an important role in driving innovation and competitive advantage (Brynjolfsson & Hitt, 2020). Adopting information technology can increase productivity by enabling process automation, accelerating information access, and improving decision-making. The use of IT by MSMEs in online marketing and digital transactions can enable firms to more quickly adapt to changing markets and consumer needs. Information technology also enables MSMEs to manage supply chains more efficiently and minimize operational costs.

This paper also shows that MSMEs that use information technology are more likely to survive in an increasingly competitive business environment. With the adoption of technology, MSMEs can access market information more quickly and efficiently, improve the process of product and service innovation, and expand their market share to a wider geographical area. These innovations

enable MSMEs to deliver products that are more relevant to consumer needs, improving their competitiveness and sustainability (Trinugroho et al., 2022). In addition, the use of digital payment technologies such as e-wallets and online payment platforms is increasingly important in supporting the sustainability of MSMEs. The convenience and security offered by digital payment technologies can increase consumer confidence and facilitate faster and more efficient transactions. This is especially relevant in the COVID-19 pandemic, where there is accelerated digitization and increased use of cashless transactions. In the long run, the use of these technologies can help MSMEs improve their competitiveness in an increasingly digitized market (Fauzi & Sheng, 2022).

The credit access variable also shows a significant positive effect in Model (2) and Model (3), with coefficients of 0.0916 and 0.101, respectively. This suggests that easy access to credit significantly contributes to the sustainability of MSMEs, especially in improving economic and commercial performance. Access to credit has a direct impact on the ability of MSMEs to increase productivity. MSMEs can invest in fixed assets, such as more efficient machinery and technology, which can increase production capacity and reduce operating costs. Credit also enables MSMEs to expand the scale of their operations, for example, through the addition of labor or the development of new products that are more innovative and competitive. This study supports the literature, showing that credit is a key factor in the growth and development of MSMEs. MSMEs with access to external financial resources, especially credit, tend to have faster growth rates than those relying solely on internal capital (Beck et al., 2006). Credit allows MSMEs to invest in risky but potentially high-return projects, which in turn supports sustainable business growth.

Table 3 also shows the test results of the interaction between environmental awareness and credit access (EnACA), which show a small significant negative effect, with a coefficient of -0.000104 in Model (3). Although this significance is high, its impact on MSME sustainability is small. This suggests that excessively increasing credit access may not necessarily positively impact MSMEs that already have high environmental awareness. This

finding is in line with the resource-based view (RBV) theory, which emphasizes that a firm's ability to utilize scarce and valuable resources will determine its advantage in the long run (Barney, 1991). In this study, access to credit is one of the important resources for MSMEs, especially in supporting operational and investment activities. However, when MSMEs have a high level of environmental awareness, too much credit access may not be in line with their need to adopt more sustainable business practices. This is because environmentally conscious MSMEs tend to focus more on resource efficiency and green innovation rather than simply raising capital through loans.

Beck and De La Torre (2007) and Mushtaq et al. (2022) emphasize the importance of credit access in improving the economic performance of MSMEs, especially in developing countries. Credit enables MSMEs to expand the scale of their operations, increase production capacity, and innovate products and processes. However, this study shows that when credit access is combined with high environmental awareness, the positive effect of credit access is no longer dominant. This may be due to the different priorities between short-term economic profitability and long-term environmental sustainability. Environmentally conscious MSMEs tend to be more cautious in their use of resources and focus on environmentally friendly investments rather than massively scaling up operations that are usually supported by credit.

The small and negative coefficient of interaction between environmental awareness and credit access also suggests the trade-off between sustainability and rapid growth. Aguilera-Caracuel and Ortiz-de-Mandojana (2013) and García-Machado and Martínez-Ávila (2019) suggest a complementary relationship exists between environmental sustainability and economic performance, especially when green innovations are implemented. However, when credit access is too high, MSMEs that are already environmentally oriented may not be able to optimally utilize the credit for green innovation, as growth driven by large capital may not be aligned with environmental sustainability goals. In addition, the literature also suggests that high credit access may increase the risk of unwise financial management, especially if the loans are not utilized efficiently. Claessens (2006) empha-

sizes that excessive access to credit may encourage small firms to take greater risks, which may lead to their inability to meet debt repayment obligations and ultimately threaten the sustainability of the firm.

The interaction results between IT use, and credit access (IUCA) also has a significant negative coefficient of -0.0216 in Model (3). This suggests that the combination of IT use and credit access may have a dampening effect on efficiency or sustainability at some point, even though both variables are individually positive. This finding indicates that while the use of information technology and access to credit individually have a positive impact on the sustainability of MSMEs, the combination of the two variables may have a negative effect on sustainability when used together at a certain level.

This finding can be explained using the technology acceptance model (TAM) theory proposed by Davis (1989). According to TAM, a company's adoption of technology is strongly influenced by its perceived ease of use and usefulness. In this case, the use of IT can improve the operational efficiency of MSMEs, increase market access, and simplify the business transaction process, which ultimately supports business sustainability. However, when IT use is combined with high access to credit, firms may experience difficulties in managing both resources simultaneously. This can happen if increased credit encourages MSMEs to significantly expand their operations without sufficient understanding or capability to optimally utilize IT, resulting in reduced efficiency and focus on sustainability.

This result is also in line with the resource constraint theory, which states that too many resources in the form of credit or technology without the right strategy can lead to inefficiencies in management. Many MSMEs have access to advanced technology but lack the technical capabilities to utilize the technology fully. Mushtaq et al. (2022) mentioned that many MSMEs in developing countries still have limitations in terms of technological and management capacity, so technology adoption without adequate preparation can lead to underutilization, where technology is not used optimally. In addition, the negative effect of the interaction between IT and credit access can also be seen

in the context of organizational overload. When MSMEs gain access to credit, they often tend to focus on improving their physical capacity or expanding their scale through the available capital, such as expanding operations, increasing inventory, or hiring more workers. However, this excessive focus on financial aspects and

physical growth can distract from the efficient utilization of IT sources. As a result, while the use of IT sources individually improves sustainability, the combination with excessive access to credit can lead to imbalances in business strategy and reduce the focus on technological innovation.

CONCLUSION

This study aimed to analyze the influence of environmental awareness, use of information technology (IT), and access to credit as moderators on the sustainability of micro, small, and medium enterprises (MSMEs) in Indonesia. The results show that increased environmental awareness helps improve the sustainability of MSMEs. The findings support the importance of environmental awareness and show that the use of technology can help improve the operations of small and medium-sized enterprises. The high coefficient of IT use indicates that adopting technology can help improve market access and operational efficiency. The results of the study revealed that the increase in credit access without proper management can have detrimental effects on the operations of high environmental awareness firms. The negative effects of credit access and IT use on the operations of small and mid-sized enterprises were identified. This suggests that a more balanced approach is needed to provide technological and financial support to these organizations.

The findings of this study contribute to the growing body of research regarding the sustainability of micro, small and medium-sized enterprises (MSMEs). It also provides valuable lessons that can be applied to the operations of these businesses. For instance, financial institutions and governments should continue supporting programs that promote technology adoption and environmental awareness. The study also highlighted the need for financial institutions and governments to expand the availability of credit to help these businesses sustain their operations. Second, it shows that supporting businesses that have not yet fully embraced digital technology is vital. Providing adequate training to help entrepreneurs use information and communications technologies effectively can significantly enhance their company's competitive advantage and operational effectiveness. Furthermore, the study highlights the importance of combining environmental consciousness with technology and financial resources to create sustainable enterprises.

AUTHOR CONTRIBUTIONS

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REFERENCES

- Aguilera-Caracuel, J., & Ortiz-de-Mandojana, N. (2013). Green innovation and financial performance. *Organization & Environment*, 26(4), 365-385. <https://doi.org/10.1177/1086026613507931>
- Arowoshegbe, A. O., & Emmanuel, U. (2016). Sustainability and triple bottom line: An overview of two interrelated concepts. *Igbinedion University Journal of Accounting*, 2, 88-126. Retrieved from <https://redox-college.s3.ap-south-1.amazonaws.com/kmc/2020/May/14/Zakk4pEaS6xYAnk15cFF.pdf>
- Ayyagari, M., Demirguc-kunt, A., & Maksimovic, V. (2012). *Financing of firms in developing countries: Lessons from research* (Policy Research Working Paper Series 6036). The World Bank. Retrieved from <https://ideas.repec.org/p/wbk/wbrwps/6036.html>
- Baker, J. (2012). The technology–organization–environment framework. In Y. K. Dwivedi, M. R. Wade, & S. L. Schneberger (Eds.), *Information Systems Theory* (pp. 231-245). New York: Springer. https://doi.org/10.1007/978-1-4419-6108-2_12
- Barney, J. (1991). Firm resources and sustained competitive advantage. *Journal of Management*, 17(1), 99-120. <https://doi.org/10.1177/014920639101700108>
- Baumol, W. J., & Oates, W. E. (1988). *The theory of environmental policy* (2nd ed.). Cambridge University Press.
- Beck, T., & De La Torre, A. (2007). The basic analytics of access to financial services. *Financial Markets, Institutions and Instruments*, 16(2), 79-117. <https://doi.org/10.1111/j.1468-0416.2007.00120.x>
- Beck, T., & Demirguc-Kunt, A. (2006). Small and medium-size enterprises: Access to finance as a growth constraint. *Journal of Banking & Finance*, 30(11), 2931-2943. <https://doi.org/10.1016/j.jbankfin.2006.05.009>
- Beck, T., Demirguc-Kunt, A., & Maksimovic, V. (2006). Financial and legal constraints to firm growth: Does size matter? *The Journal of Finance*, 60(1), 137-177. <https://doi.org/10.1111/j.1540-6261.2005.00727.x>
- Blok, V., Gremmen, B., & Wesselink, R. (2015). Dealing with the wicked problem of sustainability: The role of individual virtuous competence. *Business & Professional Ethics Journal*, 34(3), 297-327. Retrieved from <http://www.jstor.org/stable/44074859>
- Blok, V., Wesselink, R., Studynka, O., & Kemp, R. (2015). Encouraging sustainability in the workplace: A survey on the pro-environmental behaviour of university employees. *Journal of Cleaner Production*, 106, 55-67. <https://doi.org/10.1016/j.jclepro.2014.07.063>
- Brynjolfsson, E., & Hitt, L. M. (2020). Beyond Computation: Information Technology, Organizational Transformation and Business Performance. *Journal of Economic Perspectives*, 14(4), 23-48. <https://doi.org/10.1257/jep.14.4.23>
- Claessens, S. (2006). Access to financial services: A review of the issues and public policy objectives. *The World Bank Research Observer*, 21(2), 207-240. <https://doi.org/10.1093/wbro/lkl004>
- Cull, R., Davis, L. E., Lamoreaux, N. R., & Rosenthal, J.-L. (2006). Historical financing of small- and medium-size enterprises. *Journal of Banking & Finance*, 30(11), 3017-3042. <https://doi.org/10.1016/j.jbankfin.2006.05.005>
- Davis, F. D. (1989). Perceived usefulness, perceived ease of use, and user acceptance of information technology. *MIS Quarterly*, 13(3), 319-340. Retrieved from <https://psycnet.apa.org/doi/10.2307/249008>
- de Pedraza, P., & Katsinis, A. (2022). *Monitoring SME's performance in Europe – Methodological assessment of the SBA Scoreboard 2021*. Publications Office of the European Union. <https://doi.org/10.2760/029214>
- Dowling, J., & Pfeffer, J. (1975). Organizational legitimacy:

- Social values and organizational behavior. *Pacific Sociological Review*, 18(1), 122-136. <https://doi.org/10.2307/1388226>
18. Elkington, J., & Rowlands, I. H. (1997). Partnerships from cannibals with forks: The triple bottom line of 21st-century business. *Alternatives Journal*, 25(4). <https://doi.org/10.1002/tqem.3310080106>
 19. Fauzi, A. A., & Sheng, M. L. (2022). The digitalization of micro, small, and medium-sized enterprises (MSMEs): An institutional theory perspective. *Journal of Small Business Management*, 60(6), 1288-1313. <https://doi.org/10.1080/00472778.2020.1745536>
 20. García-Machado, J. J., & Martínez-Ávila, M. (2019). Environmental performance and green culture: The mediating effect of green innovation. An application to the automotive industry. *Sustainability*, 11(18), Article 4874. <https://doi.org/10.3390/su11184874>
 21. Gawali, R. B. (2021). How digital transformation can help Indian MSMEs in overcoming constraints and improving performance? – An analysis and way forward. *The Management Accountant Journal*, 56(7), 89-94. <https://doi.org/10.33516/maj.v56i7.89-94p>
 22. Kudyba, S., & Vitaliano, D. (2003). Information technology and corporate profitability: A focus on operating efficiency. *Information Resources Management Journal*, 16(1), 1-13. <https://doi.org/10.4018/irmj.2003010101>
 23. Larios-Francia, R. P., & Ferasso, M. (2023). The relationship between innovation and performance in MSMEs: The case of the wearing apparel sector in emerging countries. *Journal of Open Innovation: Technology, Market, and Complexity*, 9(1), Article 100018. <https://doi.org/10.1016/j.joitmc.2023.100018>
 24. Li, H., Lu, Z., & Yin, Q. (2023). The development of fintech and SME innovation: Empirical evidence from China. *Sustainability*, 15(3), Article 2541. <https://doi.org/10.3390/su15032541>
 25. Loebbecke, C., & Picot, A. (2015). Reflections on societal and business model transformation arising from digitization and big data analytics: A research agenda. *Journal of Strategic Information Systems*, 24(3), 149-157. <https://doi.org/10.1016/j.jsis.2015.08.002>
 26. Ma, C., Cheok, M. Y., & Chok, N. V. (2023). Economic recovery through multisector management resources in small and medium businesses in China. *Resources Policy*, 80, Article 103181. <https://doi.org/10.1016/j.resour-pol.2022.103181>
 27. Mehnaz, J. J., Hussain, A., Warraich, M. A., & Waheed, A. (2024). Impact of perceived CSR practices on customers loyalty: The mediating role of reputation and customer satisfaction. *Corporate Social Responsibility and Environmental Management*, 31(5), 3724-3734. <https://doi.org/10.1002/csr.2762>
 28. Mushtaq, R., Gull, A. A., & Usman, M. (2022). IT adoption, innovation, and SMEs' access to finance. *Telecommunications Policy*, 46(3), Article 102275. <https://doi.org/10.1016/j.telpol.2021.102275>
 29. Quttainah, M. A., & Ayadi, I. (2024). The impact of digital integration on corporate sustainability: Emissions reduction, environmental innovation, and resource efficiency in the European. *Journal of Innovation and Knowledge*, 9(3), 100525. <https://doi.org/10.1016/j.jik.2024.100525>
 30. Sarango-Lalangui, P., Castillo-Vergara, M., Carrasco-Carvajal, O., & Durendez, A. (2023). Impact of environmental sustainability on open innovation in SMEs: An empirical study considering the moderating effect of gender. *Heliyon*, 9(9), Article e20096. <https://doi.org/10.1016/j.heliyon.2023.e20096>
 31. Siddik, A. B., Rahman, M. N., & Yong, L. (2023). Do fintech adoption and financial literacy improve corporate sustainability performance? The mediating role of access to finance. *Journal of Cleaner Production*, 421, Article 137658. <https://doi.org/10.1016/j.jclepro.2023.137658>
 32. Tambunan, T. T. H. (2011). Development of small and medium enterprises in a developing country. *Journal of Enterprising Communities: People and Places in the Global Economy*, 5(1), 68-82. <https://doi.org/10.1108/17506201111119626>
 33. Trinugroho, I., Pamungkas, P., Wiwoho, J., Damayanti, S. M., & Pramono, T. (2022). Adoption of digital technologies for micro and small business in Indonesia. *Finance Research Letters*, 45, Article 102156. <https://doi.org/10.1016/j.frl.2021.102156>
 34. Ullah, R., Ahmad, H., Rehman, F. U., & Fawad, A. (2023). Green innovation and sustainable development goals in SMEs: The moderating role of government incentives. *Journal of Economic and Administrative Sciences*, 39(4), 830-846. <https://doi.org/10.1108/JEAS-07-2021-0122>
 35. Venkatraman, S., & Nayak, R. R. (2015). Corporate sustainability: An IS approach for integrating triple bottom line elements. *Social Responsibility Journal*, 11(3), 482-501. <https://doi.org/10.1108/SRJ-11-2013-0136>
 36. Zaki, M. (2019). Digital transformation: Harnessing digital technologies for the next generation of services. *Journal of Services Marketing*, 33(4), 429-435. <https://doi.org/10.1108/JSM-01-2019-0034>
 37. Zhang, J., & Gong, X. (2023). From clicks to change: The role of Internet use in fostering environmental sustainability awareness. *Journal of Environmental Management*, 348, Article 119275. <https://doi.org/10.1016/j.jenvman.2023.119275>