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Advancing SDG 1 through Sustainable Microfinance Institutions: The Roles of Competition, Double Bottom Line Performance, and Digitalization

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ABSTRACT

Objective: The study examines the financial and social performance of microfinance institutions (MFIs) and assesses whether digitalization and its interaction with institution size are associated with operational self-sufficiency and outreach. **Method:** The analysis uses an unbalanced panel from the MIX Marker database. The descriptive output covers 1999-2019 and contains up to 20,120 institution-year observations. Fixed-effects panel regressions are reported for operational self-sufficiency (OSS) and the number of active borrowers (NAB), with profitability, loan volume, capital adequacy, funding structure, poverty outreach, total assets, and digitalization as explanatory variables. **Result:** Return on assets is positively associated with OSS, while loan volume is strongly associated with NAB. A higher deposit-to-loan ratio is linked to stronger OSS. The share of clients below the poverty line is positively associated with OSS but negatively associated with NAB. The direct digitalization coefficient and the digitalization-total-assets interaction are statistically insignificant in the reported models. **Novelty:** The study separates financial sustainability from social outreach and tests whether digital maturity changes the size-performance relationship in an international MFI panel. The result shows that digital adoption alone does not guarantee stronger double-bottom-line performance.

INTRODUCTION

Microfinance Institutions (MFIs) are financial service providers that distribute financial services to individuals and groups with low-income levels or those experiencing economic disadvantage (Mersland, 2011). MFIs are established to address the financial needs of underserved markets that have not been adequately reached by conventional banking institutions (Vanroose & D'Espallier, 2013). The performance of microfinance institutions generally aims to achieve positive social impacts while maintaining sound financial performance, which is commonly referred to as the double bottom line mandate (Morduch, 1999).

Microfinance institutions (MFIs) face a double-bottom-line challenge, where they must provide financial services to poor communities while simultaneously maintaining financial sustainability. Financial intermediation focuses on providing financial services to disadvantaged individuals through loans, savings, insurance, and fund transfers with expected financial returns. Meanwhile, social intermediation emphasizes capacity building and improving the skills of poor communities, including knowledge, confidence, entrepreneurial capabilities, and access to information technology. The objective of social intermediation is to prepare disadvantaged groups to effectively utilize formal financial services (Morduch, 1999).

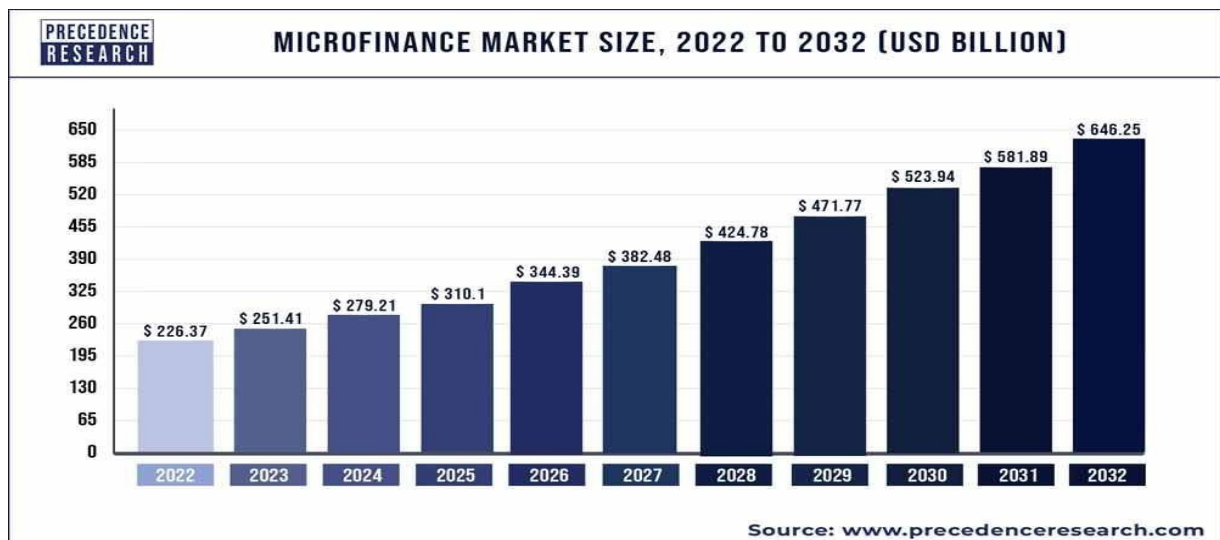


Figure 1. Microfinance market size, 2022 to 2032

Over the past few decades, the microfinance industry in developing countries has experienced rapid growth and gained significant recognition from international organizations, investors, and governments due to its role in poverty reduction, financial inclusion enhancement, and support for small and medium-sized enterprises (Cull et al., 2011). Global microfinance assets increased from USD 4 billion to USD 7 billion between 2006 and 2008, with an annual growth rate of approximately 25% during 2004–2008 (Armendariz et al., 2011). Furthermore, the global microfinance market reached USD 226.37 billion in 2022 and is projected to reach approximately USD 646.25 billion by 2032, representing a compound annual growth rate (CAGR) of 11.06% during the projection period.

The increasing flow of investment into microfinance is partly driven by international recognition that MFIs possess institutional foundations capable of promoting local economic development, creating employment opportunities, and empowering women (Armendariz et al., 2011). Commercialization, accompanied by significant investment inflows, has become a major driver of microfinance evolution and has transformed the sector into a potential business opportunity (Armendariz et al., 2011). The evolution of the microfinance industry has created significant business opportunities and encouraged many institutions to shift their ownership structures from non-profit orientations toward for-profit models (Assefa et al., 2013). Many microfinance institutions were initially established as non-profit organizations with a primary focus on social objectives, such as poverty reduction and financial inclusion. However, over time, MFIs recognized that achieving these objectives sustainably requires sufficient revenue generation to cover operational costs and support institutional growth (Cull et al., 2011).

The rapid development and commercialization of microfinance have intensified competition among MFIs in their efforts to achieve sustainable performance (Hermes et al., 2011). Increased competition can create significant challenges for MFIs and organizations pursuing double-bottom-line objectives because they must simultaneously achieve social and financial goals. Hossain et al. (2020) found that competition may negatively affect the economic sustainability of MFIs because institutions may sacrifice part of their social mission in pursuit of financial returns. Investment in social responsibility activities can influence the image and reputation of

MFIs in attracting customers. However, developing and maintaining social responsibility requires considerable time and financial resources (Abebe, 2020).

To achieve sustainability, MFIs must also improve customer services and operational efficiency while maintaining social and financial performance. Bagdi (2022) stated that digital transformation in the banking sector has created significant changes, including reduced operational costs and increased profitability. Digitalization enables financial institutions to automate internal processes, including transaction processing, risk management, and administrative activities. These improvements contribute to operational efficiency and support long-term financial sustainability.

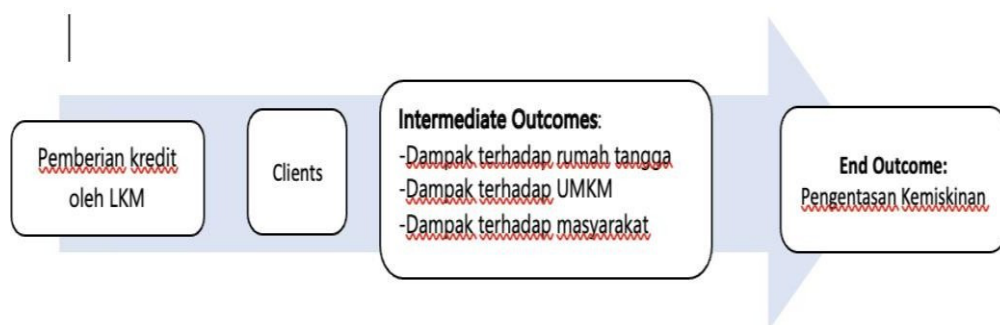
This study aims to investigate the effect of competition and double-bottom-line performance on MFI sustainability by examining digitalization as a moderating variable.

LITERATURE REVIEW

Definition of MFI

Microfinance refers to financial services provided to individuals and communities with limited access to conventional banking services. The concept of microfinance developed from microcredit programs designed to provide financial assistance to poor entrepreneurs who are unable to meet the requirements of traditional bank loans. In developing countries, microfinance enables low-income individuals to develop self-sustaining economic activities that generate income and improve the quality of life for themselves and their families (Roy, 2003).

Microfinance includes various financial services, such as credit, savings, insurance, and other financial products, which are specifically designed for poor entrepreneurs and small business owners who lack collateral and are unable to access formal banking services (Chirkos, 2014). Therefore, microfinance represents an approach to financial inclusion based on the understanding that low-income communities can improve their economic conditions when provided with appropriate financial access (Chirkos, 2014).



Besides providing financial services to low-income communities, MFIs also play an important role in empowering women, particularly in rural areas. Responsible microfinance initiatives have demonstrated significant potential in improving the social and economic conditions of disadvantaged rural women by increasing access to financial resources, enhancing entrepreneurial capacity, and strengthening economic independence (Roy, 2003).

Double bottom line microfinance

The assessment of Microfinance Institution (MFI) performance is generally conducted by considering two main dimensions: outreach and sustainability (Wijesiri et al., 2015). Outreach refers to the ability of MFIs to provide financial services to disadvantaged

communities, while sustainability refers to the institution's ability to maintain financial viability over the long term.

MFIs pursuing double-bottom-line objectives must achieve both social and financial performance simultaneously. This creates a strategic challenge because MFIs need to balance their social mission of serving poor communities with the necessity of maintaining financial sustainability (Morduch, 1999). MFIs seeking to achieve double-bottom-line objectives face decisions regarding their capital structure, particularly the balance between debt and equity financing. The optimal combination of financing sources influences whether MFIs prioritize social performance, financial performance, or attempt to achieve both objectives simultaneously. The trade-off perspective suggests that an optimal capital structure can be achieved by balancing the benefits of debt financing with the associated costs compared with equity financing.

Competition theory

Kar (2016) argues that competition levels influence the productive efficiency of financial services, as well as the quality, diversity, and innovation of financial products. Furthermore, Hermes et al. (2011) explain that competition affects the financial stability and operational performance of financial institutions. Competition within the microfinance sector is considered important because it can increase household access to financial services, improve consumer welfare, and contribute to economic development. Increased competition may encourage MFIs to reduce operational costs, improve service quality, and offer more affordable financial products (Assefa et al., 2013). Moreover, competition can stimulate technological advancement and encourage financial institutions to adopt innovative policies aimed at strengthening market competitiveness and improving institutional stability. Hermes et al. (2011) found that competition may contribute positively to MFI efficiency by encouraging better management practices and operational improvements.

Digitization theory

Digital channels have evolved beyond simple communication platforms and have become essential mechanisms for delivering financial and banking services. Digitalization has transformed transaction methods and enhanced customer experiences through improved accessibility, convenience, and service personalization (Nylén & Holmström, 2015). Digital transformation has become an important strategy across various industries, including banking and financial services. Porter and Heppelmann (2015) explain that digital technologies enable organizations to create new value, improve operational management, develop personalized services, and establish new business models.

The digital transformation of banking began with the emergence of internet technologies, which enabled banks to provide web-based banking applications such as internet banking (Gu et al., 2009). Subsequently, banking services continued to evolve through the introduction of Automated Teller Machines (ATMs), internet banking platforms, and expanded electronic banking channels (Gu et al., 2009). Harahap et al. (2020) explain that digital banking has continued to develop through the implementation of omnichannel strategies and mobile banking services. Although customers often perceive digital banking through mobile applications, true digital transformation involves broader organizational changes, including operational processes, technology infrastructure, and service innovation. Currently, financial institutions continue to enhance digital services as part of the digitalization era by

strengthening competitive advantages and improving customer accessibility. Digital banking innovations, such as cardless cash withdrawal and mobile-based financial services, demonstrate the continuous development of digital transformation in the financial sector (Harahap et al., 2020).

Previous research

Hossain et al. (2020) analyzed the relationship between competition and the performance of microfinance institutions (MFIs). While classical economic theory suggests that competition improves efficiency and provides benefits for customers and firms, this assumption may not always apply to socially oriented institutions such as MFIs. Using a cross-country dataset consisting of 4,576 MFIs, including 1,139 MFIs operating across 59 countries during 2005–2014, the study found that competition has adverse effects on the economic sustainability of MFIs.

Haji Mohammad (2015) conducted research aimed at presenting an alternative banking system through the optimization of cash waqf concepts and their management within the framework of waqf banks. The study demonstrated that cash waqf could support waqf bank operations and contribute to improving the effectiveness of waqf institutions in delivering public goods to disadvantaged communities. The findings suggest that the implementation of waqf-based financial systems can be considered in various countries.

Arping (2019) found that competition may influence banking behavior by encouraging institutions to act more cautiously. As competition intensifies, banks tend to strengthen risk management practices because they face greater pressure to compete for customers and revenue. These precautionary actions may include stricter credit evaluation, enhanced investment risk monitoring, and maintaining higher liquidity levels. Although these measures can reduce default risk and improve stability, excessive caution may also reduce lending activity and potentially affect economic growth.

Research framework

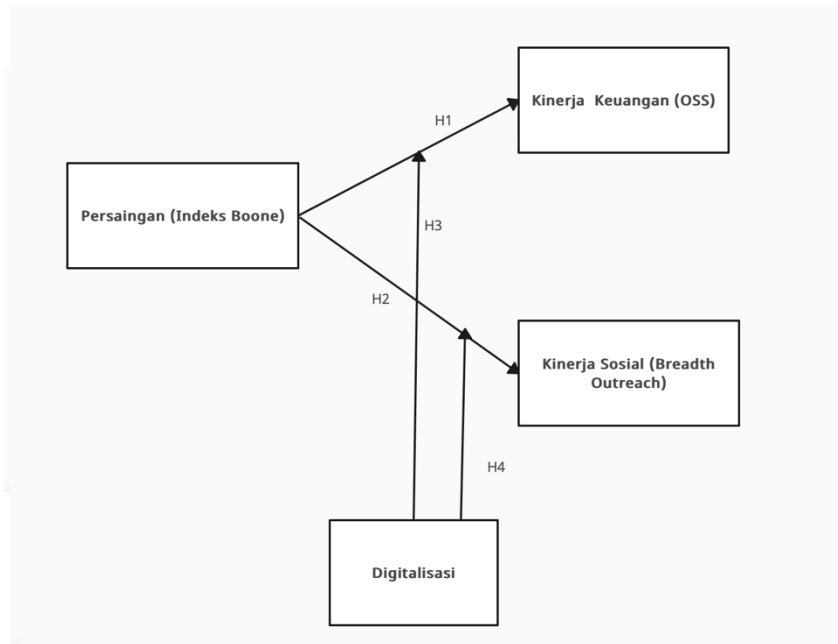


Figure 3. Research framework

RESEARCH METHOD

The data used in this study are MFIs around the world from 2015-2020. This study uses a sample of Microfinance Institutions companies in the world from 2015-2020. This data uses panel data with a total of 41,259 observations. The data source comes from the MIX Market database.

Research model

MFI Sustainability = α + Competition β_1 + Social Performance β_2 + Financial Performance β_3 + Control Variables β_4 + ε

MFI Sustainability = α + Competition β_1 + Competition * Digitalization β_2 + Social Performance β_3 + Social Performance * Digitalization β_4 + Financial Performance β_5 + Financial Performance * Digitalization β_6 + Control Variable β_7 + ε

Operational definition of variables

Dependent variable

The dependent variable in this study is the sustainability of Microfinance Institutions (MFIs). MFI sustainability is assessed based on the double-bottom-line concept, which incorporates two dimensions: financial sustainability (financial performance) and social outreach (social performance). From the existing literature, financial sustainability is commonly measured using Operational Self-Sufficiency (OSS) (Cull et al., 2007; Hossain et al., 2020; Mersland, 2011). OSS indicates whether an MFI is capable of generating sufficient revenue to cover its operational costs. Operational sustainability is achieved when an MFI reaches at least 100% operational self-sufficiency, indicating that its operating income is sufficient to cover operating expenses. A higher OSS value reflects stronger financial health and greater financial sustainability of the MFI.

Social performance is measured through the depth and breadth of client outreach. The breadth of outreach represents the number of clients served by an MFI. In other words, it reflects the extent of financial service coverage based on the number of active borrowers. Previous studies commonly use the logarithm of the Number of Active Borrowers (NAB) as a measurement of outreach breadth (Hossain et al., 2020; Mersland, 2011). A higher number of active borrowers indicates greater outreach and a wider social impact of MFIs. Meanwhile, depth of outreach reflects the ability of MFIs to serve poorer segments of society. This dimension is commonly measured using the logarithm of the Average Loan Balance per Borrower (ALB) (Hossain et al., 2020; Mersland, 2011). An increase in average loan size indicates that MFIs may be reaching relatively wealthier clients because poorer borrowers generally demand smaller loan amounts. Therefore, ALB is considered an important indicator for evaluating whether MFIs effectively serve disadvantaged communities.

However, average loan balance alone may not provide a consistent measurement across countries because it is strongly influenced by differences in economic conditions. Therefore, a more standardized measurement is applied by calculating the average loan balance per borrower relative to Gross National Income (GNI) per capita. Since the social impact of microfinance is difficult to measure directly, NAB and ALB relative to GNI per capita (ALB_GNI) are widely used indicators for assessing the social performance of MFIs (Hossain et al., 2020; Mersland, 2011).

Independent variables in the study include competition

The independent variable in this study is competition among MFIs. To measure the level of competition among MFIs worldwide, this study uses the Boone Indicator. The Boone Indicator measures competition by examining the relationship between efficiency and firm performance in terms of profitability and market share.

The Boone model explains that increased competition leads to a stronger relationship between efficiency and market outcomes, where efficient firms gain greater market shares or higher profits compared with inefficient firms. The indicator is based on the assumption that competition reallocates market share from inefficient firms toward more efficient firms.

The Boone Indicator is interpreted based on its coefficient value, where a more negative coefficient represents a higher level of competition. As competition increases, efficient firms experience stronger improvements in performance, while inefficient firms lose market advantages. Therefore, competition creates incentives for firms to improve operational efficiency and enhance competitiveness.

The Boone model provides several advantages compared with traditional competition measurements. First, it assumes that products are close substitutes and that entry barriers are relatively low, making it more effective than concentration-based measures. Second, the Boone Indicator allows competition to be measured within specific product markets and across different categories of financial institutions (Boone, 2008).

Moderating variable

The moderating variable used in this study is digitalization. Indicators to measure digitalization include;

- ATMs to branches
- Merchant POS to branches
- Percentage of total transactions at agents, number

- Percentage of total transactions at merchant POS, number
- Percentage of total transactions at ATMs, number
- Percentage of total transactions by internet, number
- Percentage of total transactions by mobile banking, number
- Percentage of total transactions at roving staff, number
- Percentage of total transactions at agents, value
- Percentage of total transactions at merchant POS, value
- Percentage of total transactions by internet, value
- Percentage of total transactions by mobile banking, value
- Percentage of total transactions at roving staff, value
- Percentage of total transactions at sub-branches, value
- Percentage of total transactions at ATMs, value
- Percentage of total transactions at ADCs, value

Control variables

- GDP
- Inflation
- NPL
- MFI director education level
- Number of workers
- MFI age

Data analysis technique

The data analysis technique used is panel data regression. Panel data analysis is a statistical method used to analyze data collected from a series of individuals or observation units that are observed repeatedly in several time periods. Some panel data tests are Pooled OLS (Ordinary Least Squares), Fixed Effect Model, and Random Effect Model.

RESULTS AND DISCUSSION

Results

Table 1. Statistic descriptive

Variable	Obs	Mean	Std. dev.	Min	Max
MFI	20.120	1451.547	866.0388	1	2994
Tahun	20.120	2009.537	4.608605	1999	2019
oss	17.762	1.165424	1.052976	-47.8453	81.2188
roa	15.179	0.0049612	0.1616932	-7.4637	2.0892
nab	18.339	77396.3	414393.9	0	8934874
lnNLO	14.226	9.249867	2.091774	0.6931472	19.9932
ln _{ta}	19.047	15.52853	2.287137	0	28.99582
car	18.928	0.3389672	1.203942	-18.3526	156.0655
lndeposit	9.057	14.91535	2.806489	1.791759	24.08925
clientsbel~e	1.066	2.279568	55.23661	0	1799.26
dig	20.120	0.6281276	15.30878	0	20

The OSS (Operational Self-Sufficiency) variable as a proxy for financial performance has a mean value of 1.165. This indicates that the microfinance institutions measured by

this OSS variable can generate operational revenues that are 16.5% higher than their operational costs. A mean value above 1 shows that, on average, these microfinance institutions are quite efficient in their operations and can cover their costs with the income they generate.

The Active Borrowers (NAB) variable, as a proxy for social performance, has a mean value of 77,369.6. This means that the average number of active borrowers in the microfinance institutions studied is around 77,370 people. This indicates that these institutions, in terms of their social performance, are able to reach and serve an average of over 77,000 active borrowers, reflecting a significant social impact and the broad reach of their services in supporting financial inclusion.

Furthermore, for the digitalization variable as a moderation variable, the average value is 0.628, which means that based on the digital interval value, overall, banks in Indonesia are still at the multichannel integration stage (digitalization 3.0). The minimum value is 0, indicating that there are still banks with digitalization at the e-banking stage (digitalization 1.0). The maximum value for the digitalization variable is 20, showing that there are also banks in Indonesia that have reached the internet of everything stage (digitalization 4.0).

The independent variable used next is bank size, projected by total assets. MFIs have an average total asset value of 113,000,000, with a minimum value of 494,606 and a maximum value of 1,730,000,000. The vast difference between the maximum and minimum values indicates that banks in Indonesia are divided into groups of large-scale banks with significant assets and small-scale banks with fewer assets.

Table 2. Impact of competition on financial performance (OSS) and social performance (NAB)

	(1) OSS	(2) NAB
ROA	2.049*** (17.08)	17595.4 (0.37)
NLO	8.35e-08 (1.91)	0.662*** (41.95)
CAR	-0.0146 (-0.55)	-3617.5 (-0.34)
depositstoloans	0.225*** (5.29)	-6046.9 (-0.36)
clientsbelowpovertyline	0.000309** (2.73)	-255.6*** (-5.92)
assets	-2.33e-12 (-0.05)	
DIG	-0.000194 (-0.24)	95.26 (0.29)
_cons	1.063*** (68.40)	52707.9*** (8.45)

The regression results show that Return on Assets (ROA) has a positive and significant impact on operational self-sufficiency (OSS) with a coefficient of 2.049 and a significance level of $p < 0.001$. This means that every increase in ROA will enhance the operational self-sufficiency of MFIs. However, ROA does not have a significant impact

on social performance (NAB), even though its effect is positive. This indicates that profitability does not directly affect the social outreach of MFIs.

The number of loans (NLO) has a positive impact on OSS, but it is not statistically significant with a coefficient of 8.35e-08. Conversely, NLO has a positive and significant impact on NAB with a coefficient of 0.662 and a significance level of $p < 0.001$. This shows that an increase in the number of loans can improve the social performance of MFIs by expanding their outreach. However, its effect on operational self-sufficiency is not very strong.

The capital adequacy ratio (CAR) has a negative impact on both OSS and NAB, but it is not statistically significant. This indicates that CAR does not play a significant role in determining the operational self-sufficiency or social performance of MFIs. In other words, the level of capital adequacy does not sufficiently influence the operational efficiency or the ability of MFIs to achieve their social goals.

The savings-to-loans ratio has a positive and significant impact on OSS with a coefficient of 0.225 and a significance level of $p < 0.001$, but it has a negative impact on NAB although not statistically significant. This indicates that the savings-to-loans ratio helps improve operational self-sufficiency by enhancing liquidity. However, this ratio does not directly affect the social outreach of MFIs.

The number of clients below the poverty line has a positive and significant impact on OSS with a coefficient of 0.000309 and a significance level of $p < 0.01$, and a negative and significant impact on NAB with a coefficient of -255.6 and a significance level of $p < 0.001$. This indicates that serving poorer clients can improve operational self-sufficiency, but at the same time, it may reduce social outreach because it may be more challenging to achieve large scale with poorer clients.

Digitalization (DIG) has a negative impact on OSS and a positive impact on NAB, but both are not statistically significant. This indicates that the implementation of digital technology has not had a significant impact on the operational self-sufficiency or social performance of MFIs. Although digitalization has the potential to increase efficiency and outreach, its implementation may not yet be optimal or may require more time to show tangible results.

Table 3. Regression analysis results (interaction with digitalization variable)

	(1) OSS	(2) NAB
DIGTA	3.07e-13 (0.08)	-8.08e-11 (-0.01)
DIG	-0.000228 (-0.25)	95.28 (0.29)
ROA	2.049*** (17.07)	17603.5 (0.37)
NLO	8.23e-08* (2.09)	0.662*** (41.92)
CAR	-0.0148 (-0.56)	-3619.1 (-0.34)
depositstoloans	0.224*** (5.31)	-6047.1 (-0.36)
clientsbelowpovertyline	0.000307** (2.86)	-255.6*** (-5.92)
_cons	1.063*** (68.25)	52709.0*** (8.44)
N	913	914

Discussion

The interaction effect between digitalization and total assets influences the financial and social performance of MFIs. This study aligns with the research on the role of digital transformation in bank efficiency in Vietnam. Their findings indicate that total assets and the interaction between digitalization and total assets affect the performance of banks in Vietnam. A similar study on the role of digitalization in bank efficiency in Russia. Banks with the largest assets and high digital maturity have a competitive market advantage. In contrast, smaller banks are not significantly affected by online presence, online sales, or active online promotion and communication with customers. This could be due to the inadequate involvement of small banks in the digitalization process because of limited available resources, a small client database, narrow specialization in certain operations, and heterogeneous competition in the Russian banking sector.

Previous literature has highlighted the role of bank size as a determinant of bank profitability and its interaction with information technology. In this context, that larger banks are more likely to adopt financial technology than smaller ones. Additionally, larger banks are safer, more established, and more profitable than smaller ones, primarily due to economies of scale. The above impact is more likely to enhance the financial technology of larger banks. That large and small banks might exhibit different business models. Indeed, larger banks can be more diversified than smaller ones, and they have economies of scale in monitoring borrowers, while smaller banks are more focused on intermediation activities. The Society for Worldwide Interbank Financial Telecommunication (SWIFT) stated that the adoption of digital innovations has a significant impact on long-term profitability and that this influence is more significant for smaller banks than larger ones.

Banks with large asset ownership are known to have larger IT teams and more expertise in IT. Unlike smaller banks, larger banks can gather substantial capital needed to invest in digital projects. Moreover, size makes it easier to manage risky fintech projects because larger banks can spread business risks through the launch of various innovative projects. Furthermore, larger banks are more likely to have the specific assets required for the commercial success of digital projects. One such asset is marketing. The larger the bank, the more economies of scale can enhance its ability to adopt fintech and improve its operational efficiency. These results can also be explained by the greater importance of fintech cost-saving effects in larger banks since the number of managers, employees, and branches is greater.

CONCLUSION

Fundamental Finding: The reported evidence shows that MFI financial sustainability and social outreach respond to different institutional factors. ROA and the deposit-to-loan ratio are positively associated with OSS, while loan volume is strongly associated with the number of activity borrows. The poverty-outreach measure is positively associated with OSS but negatively associated with borrower scale. Digitalization and its interaction with total assets are statistically insignificant in the reported models. **Implication:** MFI managers should assess digital investments though measurable operational and client outcomes rather than channel availability. Policy makers should avoid treating digital adoption as a substitute for sound funding, portfolio management, client protection, and outreach strategy. Financial and social performance require separate targets and monitoring systems. **Limitation:** The source manuscript contains inconsistent sample descriptions, expensive missing data, a digitalization

statistic requiring verification, and regression tables that omit the Boone competition coefficient. The reported models also do not show the treatment of country effects, time effects, serial correlations, heteroskedasticity, or endogeneity. **Future Research:** Future studies should use validated digital-use measures, lagged effects, country and year controls, robust or clustered standard errors, alternative outreach measures, and endogeneity-sensitive estimators. The final model should report the competition coefficient and test whether competition interacts with digitalization, institutional size, and regulatory status.

AUTHOR CONTRIBUTIONS

Djoko Karyono contributed to the conceptualization, development of the research framework, formulation of research objectives, methodology design, and manuscript preparation. **Djoko Suhardjanto** contributed to the theoretical framework, literature review, research methodology refinement, and validation of the research model. **Irwan Trinugroho** contributed to data analysis, interpretation of empirical findings, methodological evaluation, and critical revision of the manuscript. **Izza Mafruhah** contributed to data collection, literature analysis, discussion development, and manuscript editing. All authors contributed to reviewing and revising the manuscript and approved the final version of this submission.

CONFLICT OF INTEREST STATEMENT

The authors confirm that there are no conflicts of interest, either financial or personal, that may have influenced the content or outcome of this study.

ETHICAL COMPLIANCE STATEMENT

This manuscript complies with research and publication ethics. The authors affirm that the work is original, conducted with academic integrity, and free from any unethical practices, including plagiarism.

STATEMENT ON THE USE OF AI OR DIGITAL TOOLS IN WRITING

The authors declare that artificial intelligence (AI)-based tools were used only to support language refinement, proofreading, and manuscript organization. The research framework, data collection, analysis, interpretation, and conclusions were developed by the authors. The authors remain fully responsible for the originality, accuracy, and integrity of the manuscript.

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