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Credit expansion and financial sustainability of microfinance institutions: A generalized method of moments panel data analysis

Tilahun Aemiro Tehulu^{1*}

Abstract: This study examines the nexus between credit expansion and the financial sustainability of microfinance institutions (MFIs) in Sub-Saharan Africa (SSA). The study also examines the interaction effects of credit expansion and interest rate/portfolio quality on MFI sustainability. The study relies on panel dataset of 136 MFIs across 31 SSA countries covering the year 2004 to 2018 and applies the Arellano-Bover/Blundell-Bond two-step Generalized Method of Moments (GMM) Windmeijer bias-corrected standard errors to analyze the data. The results establish that credit expansion matters in MFI financial sustainability. Specifically, the study uncovers that while the size of the loan portfolio and loan intensity are positively associated with MFI sustainability, the economic significance of loan intensity is higher. On the other hand, the other credit expansion proxy “credit growth” does not predict the sustainability of MFIs. The results also reveal that the loan intensity and portfolio at risk have interaction effects on MFI sustainability. However, the study fails to support an asymmetric effect of credit expansion on financial sustainability depending on the interest rate charged on loans. The study uses three proxies for credit expansion and gives useful insights for policymakers and/or MFI managers that loan intensity should be the main target of MFIs if the goal is to attain financial self-sufficiency. The study also examines the interaction effects of credit expansion and interest rate/portfolio quality on MFI sustainability and sheds light on what is expected from MFI managers to expand credit access to the poor without compromising sustainability.

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1. Introduction

The 2030 Sustainable Development Goals (SDGs) identifies poverty eradication as the first core goal and crucial condition for sustainable development. In developing economies, microfinance institutions (MFIs) are commonly considered as instruments for sustainable development. This role, however, can be ensured only if the MFIs can attain financial sustainability and outreach (Abu Wadi et al., 2021). Financial sustainability and social mission are the twin goals of microfinance institutions (Hermes & Hudon, 2018). Financial sustainability refers to the financial self-sufficiency of MFIs and reducing dependence on donor funds. On the other hand, social mission focuses on social outreach or social sustainability. In recent years, beyond financial sustainability and social outreach, empirical studies have also paid attention to environmental sustainability (Allet & Hudon, 2015; Mia et al., 2018), analyzing the role of MFIs in the green environment. Nevertheless, it can be argued that financially sustainable MFIs are essential to attain social outreach and green environment as the MFIs will fail to continue to exist as a going concern and will no longer help the poor and/or the planet if they are not financial self-sufficient.

Proponents of financial self-sufficiency argue that MFIs need to implement market-based principles to achieve financial sustainability and sustainable poverty alleviation. Githaiga (2022) also states that financial sustainability is a vital ingredient for MFIs' competitiveness and long-term survival. Consequently, numerous studies have examined the determinants of the financial sustainability of MFIs. Nevertheless, those prior empirical studies have focused on investigating mainly the relationship between outreach (Abu Wadi et al., 2021; Chikalipah, 2020; Quayes, 2012), women borrowers (Abdullah & Quayes, 2016), financing structure (Kar, 2012), profit/regulation status (Hartarska & Nadolnyak, 2007; Louis & Baesens, 2013; Nyanzu et al., 2019) or life cycle (Bayai & Ikhide, 2016) and the financial sustainability of MFIs. Empirical research that examines the link between credit expansion and financial sustainability is missing. The credit growth of MFIs in Sub-Saharan Africa (SSA) is rapid (Tehulu, 2021). However, this fast credit expansion might not contribute to sustainable poverty alleviation unless the credit supply enhances the financial sustainability of MFIs. Consequently, this study examines the nexus between credit expansion and the financial sustainability of MFIs in SSA.

Theoretically, the loan portfolio is considered to be the highest earning asset in the asset composition of MFIs and hence, might contribute to the financial sustainability of MFIs. However, given that the portfolio at risk and portfolio yield have significant variability among MFIs (See, Section 4.1), we may expect that the relevant variables that matter in the financial sustainability of MFIs might be the portfolio at risk and/or portfolio yield and not the credit expansion as the loans are less likely to contribute to MFI sustainability if a higher proportion of the loan portfolio becomes uncollectible and/or if MFI managers that grant more loans charge lower financial revenues on loans. MFIs in SSA are also unprofitable (Tehulu, 2021). One main reason for profitability problems of African MFIs is that the MFIs earn low financial revenues which do not cover the high operating expenses in the region (Lafourcade et al., 2005). Hence, unless MFIs charge market-based interest rate on loans in order to compensate for the high screening, monitoring and enforcement (Hartarska & Nadolnyak, 2007) and other operating costs of MFIs, the increase in loan portfolio per se might not lead to improved financial sustainability. Additionally, the loan portfolio might not improve financial sustainability if most of the loans are also not repaid (i.e. if default rate is high).

Accordingly, the paper addresses two main objectives. The study examines the effect of credit expansion on financial sustainability. To this end, we use three proxies for credit expansion namely

credit growth, loan size and loan intensity as the results might be sensitive to the definition of our main predictor variable. Given that the credit growth rate might not reflect the size of the loan portfolio, it might be less important in predicting financial sustainability. Hence, in an alternative model, we use the loan size (natural logarithm of loan portfolio) to measure credit expansion. On the other hand, higher gross loan portfolio relative to MFI size might reflect higher productivity and MFI's preference for high earning assets instead of liquid assets in its asset composition. Therefore, the loan intensity (measured by the gross loan portfolio to total asset ratio) might be best predictor of financial sustainability. Hence, we also use the loan intensity as a measure of credit expansion. The study also investigates the interaction effects of credit expansion and interest rate/portfolio quality on financial sustainability. We postulate that loan supply could contribute more to the financial sustainability of MFIs if the MFIs charge higher interest rate on loan portfolio to cover their operating and other costs. We also hypothesize that loan supply might interact with portfolio quality to influence financial sustainability as the loans become less profitable if a higher percentage of the loan portfolio turns out uncollectable.

The study uses a panel dataset of 136 MFIs in 31 SSA countries during 2004 to 2018 to examine the nexus between credit expansion and the financial sustainability of MFIs. We apply the Arellano-Bover/Blundell-Bond two-step Generalized Method of Moments (GMM) Windmeijer bias-corrected standard errors to analyze the data. The study contributes to the literature by providing new empirical evidence that credit expansion contributes to the financial sustainability of MFIs in SSA. The study uses three proxies for credit expansion and gives useful insights for policymakers and/or MFI managers that loan intensity should be the main target of MFIs if the goal is to attain financial self-sufficiency. The study also examines the interaction effects of credit expansion and interest rate/portfolio quality on MFI sustainability and sheds light on what is expected from MFI managers to expand credit access to the poor without compromising sustainability.

The remaining parts of this paper proceed as follows: Section 2 discusses the state of current knowledge on what drives MFI sustainability along with our hypotheses. Section 3 describes our data, variables and modeling. Section 4 presents and discusses the descriptive statistics and econometric results. Finally, Section 5 winds up the study with the conclusions and research implications.

2. Literature review and hypotheses

The world's ambition to eradicate poverty and the widely held belief that MFIs should be financially self-sufficient to attain sustainable poverty alleviation have resulted in a body of empirical literature on what drives the financial sustainability of MFIs. Nevertheless, this research area is still among the virgin areas in microfinance studies (Githaiga, 2022). The literature identifies that several MFI-specific factors might determine the financial sustainability of MFIs. Operating inefficiency is one of the potential determinants of MFI financial sustainability. Given that operating costs are one of the main expenses of financial institutions, a higher operating expenses could lead to lower profitability, *ceteris paribus*. Consistent with this, several empirical studies have documented a negative relationship between MFI inefficiency and financial sustainability (Bayai & Ikhida, 2016; Nwachukwu, 2014; Tehulu, 2013). However, we could also expect a positive relationship between the two if the MFIs are incurring higher operating costs in the form of higher salary (as incentives) because they are more profitable. Notwithstanding this, we hypothesize a negative association of MFI inefficiency with the financial sustainability of MFIs as it seems more plausible that operating inefficiency could increase total expenses of the MFIs and lead to lower financial sustainability.

The rate of interest charged on loans could also affect the sustainability of MFIs. MFIs that are able to generate higher financial revenues on loan portfolios might ensure better financial sustainability. However, Bayai and Ikhida (2016) showed that real yields are negatively related with financial sustainability contrary to theoretical expectations suggesting that high interest rate might reduce MFI sustainability as it might lead to higher defaults since clients face difficulties to repay the loans. Similarly, Nwachukwu (2014) uncovered that MFIs that charge "extremely" high

interest rate have lower financial sustainability. Hence, MFI interest rate could be expected to have a positive association with the financial sustainability but to a limit. If interest rate charged on loans becomes higher than that limit, it could negatively affect MFI sustainability (Naz et al., 2019) as the higher interest rate leads to lower borrower's ability to repay the debt. Thus, the expected relationship between the two is inconclusive.

The literature also reveals the research debate on whether MFIs focusing on social mission, especially to poorer borrowers, compromise their financial sustainability. Given small loan sizes (higher depth of outreach) could increase administrative costs of MFIs, we may expect the loan size to be positively associated with financial sustainability. However, it is also argued that the lending models of the microfinance industry have resulted in low monitoring and administrative costs and low default rate. Hence, a negative relationship between the two could also be expected. In this respect, the empirical evidence on depth of outreach and MFI financial sustainability nexus is also mixed. While Nwachukwu (2014) revealed a trade-off between social mission (depth of outreach) and sustainability, Quayes (2012) showed that a higher depth of outreach could rather improve the financial sustainability of MFIs. On the other hand, Abu Wadi et al. (2021) documented that the effect of outreach measures (breadth and depth of outreach) on financial sustainability is positive but not statistically significant, which in fact also suggests the dearth of trade-off between outreach and sustainability. Thus, our a priori expectation is indeterminate.

Another measure of the success of MFIs in attaining their social mission is the breadth of outreach represented by the number of active borrowers. In the microfinance industry, the productivity of loan officers is commonly measured by the number of active borrowers divided by the number of loan officers. Consequently, higher breadth of outreach might imply higher productivity (efficiency) of MFIs and hence, we can expect breadth of outreach to be positively related with financial sustainability. The number of active borrowers could also represent the size of MFIs as large MFIs have higher breadth of outreach. Big MFIs enjoy economy of scale in comparison to small MFIs (Beccalli et al., 2015) and could be expected to be more financially sustainable than small ones. Accordingly, our a priori expectation of the effect of breadth of outreach on MFI sustainability is positive. Our review also shows that portfolio risk could drive MFI sustainability. A higher portfolio risk could imply higher loan loss provision which reduces the financial sustainability of MFIs. The higher loan defaults also suggest that the money is not available to be lent again which leads to lower interest income and hence, lower financial sustainability. In this regard, prior empirical studies have also revealed that credit risk impacts the financial sustainability of MFIs negatively (Abu Wadi et al., 2021; Nwachukwu, 2014; Tehulu, 2013). However, Bayai and Ikhida (2016) revealed that the effect of portfolio at risk on MFI sustainability is negative as expected, but not statistically significant in explaining financial sustainability. Notwithstanding this, we expect a negative relationship between risk and MFI sustainability.

The proportion of female borrowers in MFIs could also influence the sustainability of MFIs. Abdullah and Quayes (2016) found that more female participation leads to higher MFI sustainability. Serving women is associated with higher repayment rate and the higher repayment improves the sustainability of microfinance institutions. However, to the extent that proportion of female borrowers influences sustainability through repayment rate, the relevant variable is the portfolio at risk. Another potential determinant of MFI sustainability is capitalization. The empirical findings of Hartarska and Nadolnyak (2007), Nwachukwu (2014), and Abu Wadi et al. (2021) have revealed that MFIs with higher capitalization have better sustainability. On the other hand, the agency theory suggests that debt might be useful in aligning the performance of the management to the best interest of the owners (Bayai & Ikhida, 2016). Kar (2012) has also confirmed that the use of debt by MFIs increases their profitability as it improves cost efficiency. Consequently, the relationship between the two may be positive or negative. Finally, given higher liquid assets (*LIQ*) have lower risks and returns, MFIs that invest a higher proportion of their funds on liquid assets could be expected to have lower financial sustainability than MFIs investing more of their funds in less liquid assets.

While numerous studies have investigated the relationships between financial sustainability and different MFI specific factors as discussed in the preceding paragraphs, empirical research that focuses on the credit expansion and financial sustainability nexus is missing. The new perspectives in our study are as follows: First, we use three proxies for credit expansion namely credit growth, loan size and loan intensity and test which measure should be the target of MFI managers if the goal is to attain financial self-sufficiency as the result might be sensitive to the definition of our main predictor variable. Second, we also examine whether credit expansion interacts with interest rate/portfolio quality to influence the financial sustainability of MFIs. The loan portfolio of MFIs is the highest earning asset in the portfolio of MFIs. Financial institutions including MFIs generate income from interest revenue charged on loans. The higher the credit expansion (micro-credits), the higher could be the financial sustainability of MFIs. Martins et al. (2019) assert that a higher loan intensity in financial institutions implies lower proportion of liquid assets and consequently, a financial institution with higher loan intensity might earn higher profits as long as market-based interest rates are charged on loans.

However, the loan portfolio is less likely to contribute to financial sustainability if the MFIs that grant more loans have higher loan default rate and/or charge lower interest rate on loans. For example, Vithessonthi (2016) documented that while bank credit growth is positively associated with non-performing loans, it has no significant influence on profitability after controlling for non-performing loans and other bank-specific factors. Likewise, if the interest rate charged on loans is low, credit expansion per se could not improve MFI financial sustainability. Notwithstanding this, we expect a positive association of credit expansion with the financial sustainability of MFIs. Hence, our hypothesis could be stated as follows:

Hypothesis (H₁): *Credit expansion has a significant positive effect on the financial sustainability of microfinance institutions.*

MFIs in SSA are unprofitable (Tehulu, 2021). One major reason for unprofitability is that the MFIs charge low financial revenues which do not compensate for the high operating expenses in the region (Lafourcade et al., 2005). Thus, unless MFIs charge market-based interest rate on loans in order to cover the high screening, monitoring and enforcement (Hartarska & Nadolnyak, 2007) and other operating costs of MFIs, the loan portfolio might contribute less to the financial sustainability of MFIs. Accordingly, we hypothesize that if MFIs charge higher interest rate on loans, credit expansion could contribute more to MFI financial sustainability. Additionally, the loan portfolio might contribute less to the financial sustainability of MFIs if a higher percentage of the loans are also not repaid (i.e. if default rate is higher). Hence, we also postulate that credit expansion interacts with portfolio quality to influence financial sustainability as the loans become less profitable if a higher percentage of the loan portfolio turns out uncollectable. Accordingly, this study also tests the following hypotheses:

Hypothesis (H₂): *Credit expansion contributes to the financial sustainability of microfinance institutions more if the interest rate charged on the loan portfolio is higher.*

Hypothesis (H₃): *The effect of credit expansion on financial sustainability is asymmetric depending on the loan portfolio quality of microfinance institutions.*

3. Data, variables and modeling

3.1. Data and variables

The purpose of this study is to examine the link between credit expansion and financial sustainability. To this end, we use panel dataset of 136 MFIs in 31 SSA countries obtained from the MIX Market database that is available under the World Bank data catalogue. The data covers the year

2004 to 2018. Our outcome variable is financial sustainability (FSS). Consistent with previous research (Bayai & Ikhide, 2016; Memon et al., 2022; Quayes, 2012), we use the operational self-sufficiency (OSS) as the proxy variable for financial sustainability of MFIs. OSS measures the ability of a MFI to cover its costs using operating income. It is defined as the ratio of the financial revenue of an MFI as a percentage of its costs, including financial expenses on liabilities, operating expenses and loan loss provisions on gross loan portfolio.

Our main independent variable is credit expansion (CEX). We use three proxies for credit expansion. First, we use the growth rate of gross loan portfolio (CGR) as a measure of credit expansion. However, since CGR is a growth rate, it might not reflect the size of the loan portfolio and might be less important in predicting financial sustainability. Hence, in an alternative regression, we also use the natural logarithm of gross loan portfolio (LNGLP) to measure credit expansion. On the other hand, we argue that higher gross loan portfolio relative to MFI size might reflect higher productivity and the relative importance attached to loan portfolio in comparison to liquid assets in the asset composition of MFIs. Therefore, the loan intensity (measured by the gross loan portfolio to total asset ratio) might be best predictor of financial sustainability. Accordingly, we also use the loan intensity (LOI) as a measure of credit expansion. The use of these three proxies to measure credit expansion is in line with the literature that uses the growth rate of gross loan portfolio (Tehulu, 2021), the logarithm of loans (Olokoyo, 2011) or loans to asset ratio (Hessou & Lai, 2018; Martins et al., 2019) to measure credit supply. We used three proxies of credit expansion because the sensitivity of financial sustainability to credit expansion might vary depending on the proxy for the latter.

As one of the control variables, the model includes a measure of depth of outreach to determine if MFIs focusing on social mission, especially to poorer borrowers, compromise their financial sustainability. Depth of outreach (LSI) is represented by average loan size divided by the gross national income per capita given to poor borrowers. Since our dataset comprises data from 31 different SSA countries, this proxy is used instead of the average loan size per borrower to normalize for differences in national income across countries, which is in line with the literature (Abdullah & Quayes, 2016; Githaiga, 2022). Smaller average loan size could reflect poorer customers served by MFIs. We also include another measure of MFI social impact known as the breadth of outreach (NAB) measured by the natural logarithm of number of active borrowers (Githaiga, 2022; Tehulu, 2013) to test if serving larger of number of borrowers enhances financial sustainability. We also include operating inefficiency (OPI) because MFIs with higher operating expense are expected to have a lower financial sustainability (Naz et al., 2019; Tehulu, 2013). OPI is measured as operating expenses/total assets ratio. An increase in the operating expense to total asset ratio indicates higher inefficiency of MFIs.

Our model also includes MFI interest rate measured by the portfolio yield (PYI). The portfolio yield (PYI) is the financial revenues from loans scaled by average gross loan portfolio and captures the ability of MFIs to generate revenues from interest, fees and commissions on the gross loan portfolio. We can argue that the interest rate charged by MFIs could contribute to their sustainability if the interest rate is significantly higher than the costs on debts. Consequently, our model also controls for the financial expense of MFIs measured as the financial expense to asset ratio. The portfolio risk (PAR) of MFIs is also one of the potential determinants of MFI sustainability (Abu Wadi et al., 2021; Naz et al., 2019). It is represented by the portfolio at risk greater than 30 days. We use the total equity capital to total asset ratio to measure capitalization (CAR). Finally, our model also controls for the liquidity (LIQ) of MFIs. Liquidity is measured as the nonearning liquid assets to total asset ratio as this measure is the main liquidity indicator in the context of the microfinance sector.

3.2. Modeling financial sustainability

This study models sustainability as a function of different MFI specific factors where one of the MFI specific factors is credit expansion. Consequently, our econometric model (*Equation.1*) has the following form:

$$FSS_{i,c,t} = \beta_0 + \beta_1 FSS_{i,c,t-1} + \beta_2 CEX_{i,c,t} + \beta_3 LSI_{i,c,t} + \beta_4 NAB_{i,c,t} + \beta_5 OPI_{i,c,t} + \beta_6 PYI_{i,c,t} + \beta_7 PAR_{i,c,t} + \beta_8 CAR_{i,c,t} + \beta_9 LIQ_{i,c,t} + \beta_{10} FEA_{i,c,t} + (\eta_i + \varepsilon_{i,c,t}) \quad (1)$$

Where *FSS* is our outcome variable (financial sustainability) and *CEX* denotes our main variable (credit expansion). We use three proxies for credit expansion viz. credit growth rate (*CGR*), loan size (*LNGLP*) and loan intensity (*LOI*). Others as described below:

LSI = Depth of outreach measured as average loan size divided by the gross national income per capita

NAB = The natural logarithm of number of active borrowers, a measure of breadth of outreach

OPI = Operating inefficiency (operating expense to asset ratio)

PYI = MFI interest rate represented by the portfolio yield

PAR = Portfolio at risk greater than 30 days

CAR = Capitalization measured as capital to total asset ratio

LIQ = Liquid assets to total asset ratio which captures the liquidity of MFIs

FEA = Financial expense to asset ratio, a measure of the magnitude of costs on financial obligations of MFIs including interest costs on deposits

$\beta_1, \beta_2, \dots, \beta_{10}$ = Parameter estimates

β_0 = The constant of the model

$(\eta_i + \varepsilon_{i,c,t})$ = Error term that also contains the unobserved individual fixed effects

To test the existence of interaction effects of credit expansion and interest rate/risk on financial sustainability, we expand Eq. 1 by including two interaction variables. One is *CEXT*PYIT* which represents interaction effect of credit expansion (*CEXT*) and interest rate (*PYIT*). The second is *CEXT*PART* which captures interaction effect of credit expansion (*CEXT*) and portfolio risk (*PART*). Before creating the interaction terms, we have transformed the main variables (credit expansion proxies, interest rate and portfolio at risk) using mean centering to allow a meaningful interpretation of these main variables since they are continuous variables. The transformation is made as follows (Equation. 2):

$$Y_{i,c,t} = X_{i,c,t} - \frac{\sum_{i=1}^n X_{i,c,t}}{n} \quad (2)$$

Where $Y_{i,c,t}$ is the transformed main variable of MFI *i* in country *c* at time *t*; $X_{i,c,t}$ is the non-transformed main variable and the deduction is simply the mean value of the non-transformed observations

Therefore, our model for the interaction effects has the following form (Equation. 3):

$$FSS_{i,c,t} = \beta_0 + \beta_1 FSS_{i,c,t-1} + \beta_2 CEXT_{i,c,t} + \beta_3 LSI_{i,c,t} + \beta_4 NAB_{i,c,t} + \beta_5 OPI_{i,c,t} + \beta_6 PYIT_{i,c,t} + \beta_7 PART_{i,c,t} + \beta_8 CAR_{i,c,t} + \beta_9 LIQ_{i,c,t} + \beta_{10} FEA_{i,c,t} + \beta_{11} CEXT * PYIT_{i,c,t} + \beta_{12} CEXT * PART_{i,c,t} + (\eta_i + \varepsilon_{i,c,t}) \quad (3)$$

3.3. Estimation technique

Following the prior empirical research (e.g., Githaiga, 2022), the article applies the two-step system Generalized Method of Moments (GMM) Windmeijer bias-corrected standard errors in estimating model parameters. The Arellano-Bover/Blundell-Bond two-step GMM is preferred as it allows to obtain an unbiased estimates in case there are unobserved individual fixed effects. The GMM estimator also addresses endogeneity problem, which likely exists in panel data estimation. Additionally, it helps to avoid reverse causality or potential simultaneity among variables. The two-step system GMM is also more efficient than the difference GMM. However, two conditions must be fulfilled for the GMM estimation results to be valid. First, the over-identifying restrictions must be valid (i.e. The instruments must be uncorrelated with the residuals). Second, there should be no second-order serial correlation among the residuals. The results in Tables 2 and 3 confirm that the instruments are uncorrelated with the residuals (i.e. the over-identifying restrictions are valid) at 1 percent level as reflected by the Sargan test results. The results also confirm that there is no second-order autocorrelation in the residuals in all GMM models at 1 percent level. Moreover, the Wald test reveals that the explanatory power of our econometric models is high ($\text{Prob} > \chi^2 = 0.0000$ in all models).

4. Empirical results and discussions

4.1. Descriptive statistics

The descriptive statistical results (Table 1) show that MFIs in SSA have on average an operational self-sufficiency (OSS) ratio of 107 percent and a standard deviation of 33 percent. The minimum OSS is 2 percent which is substantially lower than the mean OSS. An important empirical question is, therefore, what determines the variations in MFI financial sustainability. In this regard, we find that the mean values of credit expansion proxies viz. credit growth, gross loan portfolio (GLP) and loan intensity are 38 percent, \$5,067,509 and 67 percent, respectively, while the minimum and maximum values are negative 95 percent and 1,061 percent, \$19,984 and \$3,417,790,067 and 6 percent and 2,742 percent, respectively, suggesting that there is significant variability in the credit expansion observations among MFIs in SSA. Consequently, in the subsequent section, we discuss whether the variations in the credit expansion proxies explain the variations in the financial sustainability of MFIs in SSA. We also discuss which proxy of credit expansion should be the target of MFI managers if the goal is to attain financial self-sufficiency.

Table 1 also reveals that there are significant differences in the depth and breadth of outreach among MFIs in SSA as reflected by the minimum and maximum values. The mean values of capitalization and liquidity are 34 percent and 21 percent while their standard deviations are 41 percent and 19 percent, respectively. Hence, these variables are also potential factors that could determine MFI sustainability. The mean values of operating inefficiency and financial expense are 22 percent and 3 percent of total assets, respectively, while the mean value of portfolio at risk is 8 percent of the loan portfolio. This suggests that operating inefficiency and portfolio at risk could also be the major obstacles in the financial sustainability of MFIs in comparison to financial expenses. The maximum and minimum values (105 percent Vs 2 percent) for operating inefficiency suggests that some MFIs are highly inefficient in comparison to other MFIs. The portfolio at risk has a standard deviation of 10 percent and minimum and maximum values of zero and 97 percent suggesting that the proportion of loan defaults significantly differ from MFIs to MFIs.

The financial revenues charged on loans (referred to as portfolio yield or interest rate) has a mean and standard deviation of 37 percent and 22 percent, respectively. The standard deviation of portfolio yield and its minimum and maximum values (2 percent and 188 percent) show that the variation in portfolio yield among MFIs in SSA is considerably high. Given the significant variability in portfolio at risk and portfolio yield, the relevant variables that matter in the financial sustainability of MFIs might be the portfolio at risk and/or portfolio yield and not the credit expansion as the loans are less likely to contribute to MFI sustainability if a higher proportion of the loan portfolio becomes uncollectible and/or if MFI managers that grant more loans charge lower financial revenues on loans. Therefore, in Section 4.2, we also discuss what matters (credit

Table 1. Descriptive statistics

Variables	Measure	Obs.	Mean	Std. Dev.	Min.	Max.
Financial Sustainability	The ratio of the financial revenue of an MFI as a percentage of its costs, including financial expenses on liabilities, operating expenses and loan loss provisions on gross loan portfolio	1226	1.065994	0.3278956	0.0225	3.5562
Credit Growth	The growth rate of gross loan portfolio	1135	0.3765545	0.7572647	−0.9474	10.6053
Gross Loan Portfolio Size	The natural logarithm of gross loan portfolio	1309	15.43836	1.946015	9.902687	21.95226
Loan Intensity	It is measured by the gross loan portfolio to total asset ratio	1264	0.6731131	0.7837307	0.0612	27.4167
Depth of Outreach	Average loan size divided by the gross national income per capita	1207	1.223798	2.313842	0.013	31.8915
Breadth of Outreach	The natural logarithm of number of active borrowers	1221	9.553375	1.628958	4.276666	13.68033
Operating Inefficiency	Operating expenses to total assets ratio	1150	0.2176144	0.1539422	0.0185	1.0527
Interest Rate	The financial revenues from loans scaled by average gross loan portfolio	1007	0.3738515	0.2196397	0.0152	1.8836
Portfolio at Risk	It is represented by the portfolio at risk greater than 30 days.	1031	0.0824762	0.1016014	0	0.97
Capitalisation	Total equity capital to total asset ratio	1271	0.3350419	0.4061091	−1.5337	1.0000
Liquidity	The nonearning liquid assets to total asset ratio	1040	0.2135976	0.1904877	0.0001	0.7909
Financial Expense	The financial expense to asset ratio	1140	0.0300988	0.0296007	0	0.1952

expansion or portfolio at risk and/or portfolio yield or all the three?) in MFI sustainability. Moreover, we deliberate on whether credit expansion and portfolio at risk/portfolio yield have interaction effects on the financial sustainability of MFIs.

4.2. Econometric results

The econometric results are summarized in Table 2. The results show that from the three credit expansion proxies, the loan intensity is the strongest predictor of financial sustainability. A 10 percent increase in loan intensity measured by the gross loan portfolio to total asset ratio leads to a 3.1 percent increase in financial sustainability. The result is statistically significant at 1 percent level. Given the high variability in loan intensity (standard deviation of 78.37 percent) among MFIs in SSA, the potential for further improvement in financial sustainability of MFIs is significant. The second proxy of credit expansion namely the credit growth rate is not associated with MFI sustainability. This proxy is a growth rate and changes in credit growth rate might not reflect the changes in the absolute gross loan portfolio (GLP) as MFIs with small GLP in the previous year are likely to have higher credit growth rate in the current year while MFIs with large GLP in the preceding year are likely to have lower credit growth rate in the current year since the previous year GLP is the denominator in the calculation of credit growth. While the effect of the size of the gross loan portfolio (the third proxy) on financial sustainability is positive and significant at 5 percent level, its economic significance is marginal. The gross loan portfolio has to increase by 100 percent in order to raise financial sustainability by about 6.68 percent.

Table 2. Credit expansion and MFI financial sustainability (GMM Results)

Variables	Model 1 ^a	Model 2 ^a	Model 3 ^b	Model 4 ^b	Model 5 ^c	Model 6 ^c
Financial Sustainability (Lag)	0.0890797 (0.1234714)	0.0991533 (0.1406942)	0.1117543 (0.1203447)	0.1407944 (0.1243104)	0.10482 (0.1113669)	0.1082747 (0.1170068)
Credit Expansion ((CGR)	0.0118625 (0.0164717)	0.0114414 (0.0171137)				
Credit Expansion (LNGLP)			0.029219 (0.0463752)	0.0668802** (0.0292079)		
Credit Expansion (LOI)					0.3108929*** (0.0876649)	0.3150492*** (0.0861968)
Depth of Outreach	-0.0104221 (0.02731)	-0.0070995 (0.0230326)	-0.0200721 (0.0329379)	-0.0389536 (0.039219)	-0.0158061 (0.032081)	-0.0176488 (0.0344134)
Breadth of Outreach	0.0731349** (0.0302137)	0.0748388*** (0.029)	0.0520234 (0.0496616)	N/A (N/A)	0.0462436* (0.0247285)	0.0459925* (0.0260931)
Operating Inefficiency	-1.251805*** (0.247902)	-1.250049*** (0.2358548)	-1.227668*** (0.281334)	-1.182965*** (0.247625)	-1.373577*** (0.3875154)	-1.406293*** (0.3727498)
Interest Rate	0.7274992*** (0.2192417)	0.7354698*** (0.1949367)	0.7423819*** (0.2588293)	0.7103201*** (0.1914805)	0.7723847*** (0.1785296)	0.7946772*** (0.1725433)
Portfolio at Risk	-0.2707787 (0.1809537)	-0.3193072** (0.1559327)	-0.3212479 (0.2030199)	-0.3722071* (0.2048002)	-0.2305766 (0.1509128)	-0.275011* (0.1506735)
Capitalisation	0.0462339 (0.0994642)	N/A (N/A)	0.0362657 (0.1148699)	0.0772893 (0.1126574)	0.0635551 (0.1015904)	N/A (N/A)
Liquidity	-0.0428632 (0.1289312)	-0.045117 (0.1447684)	-0.0523273 (0.129937)	-0.0392538 (0.0977417)	-0.2677675*** (0.1019857)	-0.2713482*** (0.1006828)
Financial Expense	-0.5697244 (1.000148)	-0.6436016 (1.04546)	-0.7361677 (0.9308289)	-0.6497281 (1.002757)	-1.279524 (0.9713053)	-1.29845 (1.160159)
Constant	0.3017523 (0.4089369)	0.2856551 (0.3860824)	0.0514577 (0.5284712)	-0.0455912 (0.5834855)	0.4323718 (.2693336)	0.4548815 (0.3047057)
Wald Test	chi2(10) = 39.87 Prob>chi2 = 0.0000	chi2(9) = 44.54 Prob>chi2 = 0.0000	chi2(10) = 38.30 Prob>chi2 = 0.0000	chi2(9) = 54.44 Prob>chi2 = 0.0000	chi2(10) = 60.51 Prob>chi2 = 0.0000	chi2(9) = 55.24 Prob>chi2 = 0.0000
Sargan Test ^d	Prob>chi2 = 0.9981	Prob>chi2 = 0.9985	Prob>chi2 = 0.9968	Prob>chi2 = 0.9964	Prob>chi2 = 0.9999	Prob>chi2 = 0.9998

(Continued)

Table 2. (Continued)

Variables	Model 1 ^a	Model 2 ^a	Model 3 ^b	Model 4 ^b	Model 5 ^c	Model 6 ^c
AR(1) ^e	Prob > z = 0.0428	Prob > z = 0.0565	Prob > z = 0.0289	Prob > z = 0.0260	Prob > z = 0.0197	Prob > z = 0.0224
AR(2) ^e	Prob > z = 0.7745	Prob > z = 0.8197	Prob > z = 0.8473	Prob > z = 0.9616	Prob > z = 0.7105	Prob > z = 0.7559
Observations	727	727	727	727	727	727
No. of groups	136	136	136	136	136	136
No. of instruments	114	113	114	113	114	113

^a The growth rate of gross loan portfolio (CGR) is the proxy for credit expansion. ^b The natural logarithm of gross loan portfolio (LNGLP) is the proxy for credit expansion. ^c The gross loan portfolio to total asset ratio (LOI) is the proxy for credit expansion. ^d Sargan test of over-identifying restrictions where H0: over-identifying restrictions are valid. ^e Arellano-Bond test for zero autocorrelation in first-differenced errors where H0: no autocorrelation. *** show significance at 1 percent level; ** indicate significance at 5 percent level and * reflect significance at 10 percent level. The values in parentheses are WC-Robust standard errors

Our findings establish that the increase in the size of the loan portfolio per se has less contribution to the financial sustainability of MFIs unless there is an improvement in the loan intensity (measured by the gross loan portfolio to asset ratio). In other words, the proportion of the loan portfolio in the asset composition of MFIs is a superior predictor of MFI sustainability compared to other proxies of credit expansion. The higher loan intensity implies higher gross loan portfolio given the same MFI size, which in turn indicates higher productivity since the loan portfolio is the main output of MFIs. This higher productivity leads to better financial sustainability. A higher loan intensity also suggests that a greater proportion of the total asset of a MFI is invested in loan portfolio rather than in liquid assets. The loan portfolio is the highest earning asset in the asset composition of MFIs; whereas, liquid assets like cash are non-earning assets and other liquid assets like short-term investments in securities provide lower income. This may also explain the positive association of loan intensity with the financial sustainability of MFIs. The results are consistent with the findings of Martins et al. (2019) who found that banks with higher loan intensity earn higher profits. Our findings suggest that policymakers and MFI managers should focus on the loan intensity of MFIs instead of other proxies of credit expansion namely credit growth rate and the size of the gross loan portfolio if the goal is to attain financial sustainability.

Our results also reveal that the loan intensity and portfolio at risk have interaction effects on the financial sustainability of MFIs (Table 3). As expected, we find that the higher the portfolio at risk, the lower is the contribution of credit expansion to the financial sustainability of MFIs. Our results show that if the portfolio at risk is higher by 10 percent holding loan intensity constant at mean values, then the contribution of credit supply (loan intensity) to MFI sustainability will be lower by 6.22 percent ($-0.9234018 \times 0.6731131 \times 10$). Conversely, if we are able to reduce portfolio at risk by 10 percent holding loan intensity constant, this same level of loan intensity could improve the financial sustainability of MFIs by 6.22 percent higher. Given the significant negative interaction coefficient (-0.9234018), our findings establish that credit expansion per se could not improve MFI sustainability unless MFI managers are able to limit portfolio at risk. Hence, the portfolio at risk is the major impediment in the effort to improve financial sustainability through the expansion of credits. In light of the positive association of interest rates with the financial sustainability of MFIs as documented in our study and discussed in subsequent paragraphs, our findings suggest that MFI managers who are unable to limit the portfolio at risk can alternatively increase interest rate on loans to make up the diminishing financial sustainability due to the rising loan defaults if the MFIs have to expand credit access to the poor without compromising financial sustainability.

Furthermore, the study uncovers that the main effects are also significant. That is, the portfolio at risk also has a negative direct effect on MFI sustainability while the interest rate charged on loans has a positive direct effect on financial sustainability. These results are in line with the literature which documents that the portfolio at risk is negatively associated with MFI sustainability (Abu Wadi et al., 2021; Nwachukwu, 2014) and MFI interest rate contributes to MFI performance positively (Dang et al., 2022). An increase in portfolio at risk implies higher loan defaults which leads to higher loan loss provision and lower amount of cash flow to be lent again and these in turn reduce the sustainability of MFIs; whereas, an increase in interest rate indicates higher financial revenue charged on loans that contributes to MFI sustainability positively. However, the study fails to support an interaction effect of credit expansion and interest rate on the sustainability of MFIs. As to our control variables, the results show that the depth and breadth of outreach of MFIs are not detrimental to their financial sustainability which refutes the trade-off theory. More specifically, we find that the depth of outreach does not have a significant impact on MFI sustainability. Besides, the study provides evidence of complementarity between financial sustainability and breadth of outreach, which is in line with the findings of Githaiga (2022).

We also uncover that operating inefficiency is the most detrimental factor in the sustainability of MFIs. In all models (Tables 2 and 3), the results are statistically significant at 1 percent level. The effect of operating inefficiency has the highest economic significance. A 10 percent increase in operating inefficiency leads to a 11.8 percent to 14.1 percent reduction in financial sustainability

Table 3. Interaction Effects of Credit Expansion and Interest Rate/Risk on Sustainability (GMM Results)			
Variables	Model 1 ^a	Model 2 ^b	Model 3 ^c
Financial Sustainability (Lag)	0.101661	0.1453071	0.0950662
	(0.1353256)	(0.1348499)	(0.096112)
Credit Expansion (CGR)	0.0067998		
	(0.0188884)		
Credit Expansion (LNGLP)		0.0645719*	
		(.034581)	
Credit Expansion (LOI)			0.2778399***
			(0.11214)
Depth of Outreach	0.0037284	-0.0345098	-0.0289189
	(0.0399647)	(0.0357945)	(0.0319523)
Breadth of Outreach	0.0801632***	N/A	0.0371595
	(0.0291543)	(N/A)	(0.0263823)
Operating Inefficiency	-1.209116***	-1.179984***	-1.406677***
	(0.2540655)	(0.290402)	(0.3191428)
Interest Rate (Mean centered)	0.7062669***	0.6872069***	0.7978988***
	(0.1989429)	(0.2004181)	(0.163219)
Portfolio at Risk (Mean centered)	-0.2912596	-0.4446501*	-0.353137**
	(0.2217818)	(0.2507883)	(0.1447603)
Capitalisation	N/A	0.0745371	N/A
	(N/A)	(0.1107717)	(N/A)

(Continued)

Table 3. (Continued)

Liquidity	-0.0344419 (0.109019)	-0.0368292 (0.0963791)	-0.3197697** (0.1389159)
Financial Expense	-0.8489314 (1.025419)	-0.8246856 (1.254871)	-1.099495 (1.026655)
Credit Expansion* Interest Rate	0.0357568 (0.0759062)	0.0034162 (0.1147084)	0.075695 (0.2032986)
Credit Expansion* Portfolio at Risk	0.2179595 (0.2530664)	-0.0545158 (0.2077458)	-0.9234018* (0.4992407)
Constant	0.4648949 (0.3446132)	1.243313*** (0.1936088)	1.048252*** (0.3220328)
Wald Test	chi2(11)= 60.10 Prob>chi2=0.0000	chi2(11)= 57.61 Prob>chi2=0.0000	chi2(11)= 57.98 Prob>chi2=0.0000
Sargan Test ^d	Prob > chi2= 0.9945	Prob>chi2=0.9899	Prob>chi2=0.9999
AR(1) ^e	Prob > z= 0.0536	Prob > z= 0.0299	Prob > z= 0.0135
AR(2) ^e	Prob > z=0.7733	Prob> z= 0.9816	Prob > z= 0.8001
Observations	727	727	727
No. of groups	136	136	136
No. of instruments	115	115	115

^a The mean centered growth rate of gross loan portfolio (GGR) is the proxy for credit expansion. ^b The mean centered natural logarithm of gross loan portfolio (LNLGP) is the proxy for credit expansion. ^c The mean centered gross loan portfolio to total asset ratio (LOI) is the proxy for credit expansion. ^d Sargan test of over-identifying restrictions where H0: over-identifying restrictions are valid. ^e Arellano-Bond test for zero autocorrelation in first-differenced errors where H0: no autocorrelation. *** show significance at 1 percent level; ** indicate significance at 5 percent level and * reflect significance at 10 percent level. The values in parentheses are WC-Robust standard errors

(Tables 2 & 3). The findings of this study supports the literature that documents a negative relationship of MFI inefficiency with their sustainability (Bayai & Ikhide, 2016; Nwachukwu, 2014). Similarly, the results reveal that the liquidity of MFIs has a negative effect on the financial sustainability of the institution. Taking our preferred models (Model 6 in Table 2 and Model 3 in 3), the result is statistically significant at least at 95 percent confidence interval. These findings are in line with theoretical expectations that liquidity is inversely related with profitability as the liquid assets are non-earning assets (eg. cash) or pay little income in comparison to the loan portfolio. Our findings imply that unless MFIs invest a greater proportion of their total assets in loan portfolio, attaining financial self-sufficiency might be difficult. On the other hand, MFIs need also to have adequate liquidity to meet withdrawal and loan demands as well as fulfill regulatory liquidity requirements in the case of regulated MFIs.

Consequently, the results suggest that MFI managers need to determine their asset composition carefully, especially the proportion of the total assets that must be invested in loan portfolio versus in liquid assets. The study establishes the vital role of credit expansion in the asset composition of MFIs if the goal is to attain financial sustainability. However, MFI managers need not also forget making a balance between financial sustainability and liquidity as both profitability problems and liquidity crunch could cause MFI crisis. Regulated MFIs are also subject to liquidity requirements. Consequently, any undue liquidity requirement ratio could also be detrimental to the financial sustainability of MFIs. Hence, policymakers need to determine the optimal regulatory liquidity requirement carefully as high liquidity requirement might lead to poor financial sustainability. Finally, we find that capitalization and the financial expense of MFIs do not have significant effects on the sustainability of MFIs.

5. Conclusions

The credit growth of MFIs in Sub-Saharan Africa (SSA) is rapid. However, this fast credit expansion might not contribute to sustainable poverty alleviation unless the credit supply enhances the financial sustainability of MFIs. Consequently, this study examines the nexus between credit expansion and the financial sustainability of MFIs in SSA. To this end, the study uses a panel dataset of 136 MFIs in 31 SSA countries during 2004 to 2018 and applies the Arellano-Bover /Blundell-Bond two-step Generalized Method of Moments (GMM) Windmeijer bias-corrected standard errors to estimate the parameters. Our results establish that credit expansion matters in MFI financial sustainability. Specifically, the study uncovers that while the size of the loan portfolio and loan intensity are positively associated with MFI sustainability, the economic significance of loan intensity is higher. On the other hand, the other credit expansion proxy “credit growth” does not predict the sustainability of MFIs. The results also reveal that the loan intensity and portfolio at risk have interaction effects on MFI sustainability. Our findings show that credit expansion per se could not improve MFI sustainability unless MFI managers are able to limit portfolio at risk.

Furthermore, we find that the portfolio at risk also has a negative direct effect on MFI sustainability while the interest rate charged on loans has a positive direct effect on financial sustainability. However, the study fails to support an interaction effect of credit expansion and interest rate on the sustainability of MFIs. As to our control variables, the study reveals that the depth and breadth of outreach of MFIs are not detrimental to their financial sustainability which refutes the trade-off theory. The study provides evidence of complementarity between financial sustainability and breadth of outreach while the effect of depth of outreach is insignificant. We also uncover that operating inefficiency and liquidity are negatively associated with financial sustainability and the effect of MFI inefficiency has the highest economic significance in the financial sustainability of MFIs. Nevertheless, capitalization and the financial expense of MFIs do not have significant effects on the sustainability of MFIs.

The study contributes to the literature by providing new empirical evidence that credit expansion contributes to the financial sustainability of MFIs in SSA. The study uses three proxies for credit expansion and gives useful insights for policymakers and/or MFI managers that loan intensity

should be the main target of MFIs if the goal is to attain financial self-sufficiency. The results on the interaction effects of credit expansion and portfolio quality on MFI sustainability also shed light on what is expected from MFI managers to expand credit access to the poor without compromising sustainability. More specifically, given that the portfolio at risk is the major impediment in the effort to improve financial sustainability through the expansion of credits, the study suggests that MFI managers shall design and implement appropriate risk management strategies to limit the portfolio at risk. Alternatively, MFI managers who are unable to limit the portfolio at risk can increase interest rate on loans to make up the diminishing financial sustainability due to the rising loan defaults. Hence, appropriate loan pricing strategies are also vital in the financial sustainability of MFIs given that interest rate charged on loans is also positively associated with the financial sustainability of MFIs.

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