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The effect of asset and liability management on the financial performance of microfinance institutions: evidence from sub-Saharan African region

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Abstract

This study applies statistical cost accounting method to a sample of 106 sub-Saharan African microfinance institutions (MFIs) during 2014–2018 to investigate the relationship between asset-liability management and financial performance. The result shows that the composition of assets and liabilities has both positive and negative effects on the returns of the MFIs in the sample. Net loan portfolio, other current financial liabilities and MFI size are significantly and positively related to return on assets of listed MFIs. Deposits, borrowings and other liabilities, on the other hand, are significantly and negatively related to financial performance. Overall, the study suggests that adequate attention needs to be paid to asset-liability management to ensure better financial performance.

Keywords: Asset and liability management, Statistical cost accounting, Microfinance

Introduction

Microfinance is an industry undergoing various paradigm shifts [35]. Some of these include the introduction of a new medium- and long-term loan product, a shift to individual lending, the provision of a range of financial services, registration in the legal framework and the use of commercial sources of finance. This rapid expansion and development of the microfinance profile brought additional risks to their balance sheet structure. Apart from the generally recognised credit risk, many MFIs are therefore exposed to several risks.

First, if the MFI has borrowed funds at a floating interest rate, this may move up and down with the market while the MFI's loans are at a fixed rate or vice versa. Management must ensure that loans and borrowings are compatible so that interest rate risk can be controlled by adjusting interest rates [9]. Second, MFIs operate mainly in developing countries where inflation is high. They are also most likely to mobilise deposits to fund their loan portfolio [12]. This means that depositors expect a real return despite high inflation. In addition to asset and liability price adjustments, MFI managers should maintain the liquidity and safety of deposited funds. Third, some MFIs mobilise savings and take out foreign currency loans because they do not receive sufficient funds from local creditors or banks [21]. Foreign currency debt and deposits thus pose a currency risk to MFIs whose main assets are denominated in the local currency.

Fourth, there is a theoretical dispute in the microfinance literature between the use of subsidies and commercial sources of funds to finance their activities. The literature is dominated by the institutional approach, which argues that financial sustainability is better in fulfilling the social mission and supports the use of commercial loans as a source of funds [6, 11, 38]. In addition, many international donors such as ACCION are pushing the microfinance sector to reduce its dependence on

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subsidies [4]. Accordingly, the share of loans from commercial banks in the microfinance sector has increased rapidly in recent years [34]. Therefore, on the one hand, MFIs need to maintain a very high portfolio quality to attract potential creditors and show that they are secure investment opportunities. On the other hand, the loan portfolio is the main source of income for MFIs and constitutes a large part of their assets.

Therefore, MFI managers need to know how to manage the supply of funds and the demand for funds, which requires matching the maturity, currency and price of the composition of assets and liabilities. Therefore, asset-liability management (ALM) has emerged as a critical and future challenge in the microfinance industry. ALM is the process of planning, implementing and controlling the volume, maturity, price, composition, quality and liquidity of assets and liabilities of financial institutions [28]. However, since most MFIs started with subsidies and often offer short-term loans, they mainly focus on the quality of the loan portfolio (asset management). However, studies suggest that liability management is also critical to meet long-term capital needs and to address subsidy constraints [22, 31, 32].

There is evidence of a dramatic shift in the funding structure of microfinance institutions in sub-Saharan Africa (SSA) [15, 48]. In addition, more and more SSA countries are introducing special microfinance regulations that enable MFIs to offer additional financial services, such as deposit mobilisation and the use of other commercial funds [47]. The region is one of the poorest in need of the provision of inclusive and sustainable financial services [52]. The development of the MFI profile combined with other unique characteristics of the region makes it ideal for the study of asset-liability management. Therefore, this paper aims to examine the impact of asset-liability management on the financial performance of microfinance institutions in the Sub-Saharan Africa region. Specifically, it examines whether MFIs earn a positive return on their assets and a negative return on their liabilities. The study uses the statistical cost accounting technique, which is drawn from the banking literature, as it has been little explored in the microfinance literature.

In short, the result shows that the return on assets is related to the composition of assets and liabilities; however, most assets were not statistically significant in the regression model. Thus, this study partially confirms the central hypothesis of the statistical cost accounting model that the estimated rates of return on assets (liabilities) are positive (negative) and vary across assets (liabilities). The net loan portfolio has a positive and significant impact on the financial performance of microfinance institutions. This indicates that the asset base (investment portfolio) of MFIs in SSA is too narrow. Regarding the composition of liabilities, the cost of interest rate on other liabilities and bonds was higher and has a significant negative impact on the return of MFIs. In contrast, the cost of interest rate on deposits and other short-term financial liabilities was lower but negatively and positively related to MFI financial performance, respectively. Taken together, these results show that asset and liability management has a direct impact on the financial performance of MFIs in SSA.

The rest of the paper is structured as follows. Section 2 discusses the relevant literature. Section 3 presents the data, sample selection and description of variables. Section 4 explains and discusses the methods used in the study. The results and discussion are presented in Sect. 5. The last section presents the conclusions and recommendations of the study.

Literature review

The history of asset and liability management

The history of asset-liability management dates back to the introduction of the modern banking sector, characterised by the provision of a wide range of financial services, which emerged under various types of banking regulation. However, the insurance industry is sometimes seen as having originated the introduction of asset-liability management in parallel with the banking sector [1]. Indeed, banks started lending and initially had a variety of low-cost funds in the form of deposits.

Therefore, they focused on asset management, which is concerned with the effective management of existing and new assets in order to maximise the value of the business. Over time, there was a rapid change in the banking industry, with diversification of the bank's investment portfolio, higher demand for loans and increased competition in the fund market. As a result, the bank is beginning to develop a new strategy (e.g. asset/liability management) to efficiently utilise its assets and liabilities and maximise net interest income.

Unlike other financial institutions, asset/liability management in microfinance has a young history.

MFIs started as non-governmental organisations that essentially pursued social goals and were very often supported by donors and social investors. Moreover, MFIs focused primarily on lending to poor clients who did not have access to financial services from formal financial institutions. As a result, the microfinance sector was dominated by asset management until recently. However, studies suggest that liability management is also critical to meet long-term capital needs that help prevent subsidies from drying up [22, 31, 32]. Nowadays, asset and liability management has become the biggest challenge for the microfinance industry as its financing structure

has evolved into a diversified loan and investment portfolio and as it moves into a regulatory framework. Different institutions and scholars have defined ALM differently, but according to this study it refers to the management of assets and liabilities to increase profitability, manage risk, and maintain safety and soundness [12].

According to Mersland [35], one of the future market forces for MFIs is their paradigm shift. Ongoing paradigm shifts include the introduction of a new long-term loan product, the move to individualised lending, the offering of different types of financial services, the change in legal status and the use of commercial funding sources. All these mentioned paradigm shifts have an impact on the structure of the company's assets and liabilities. On the other hand, a diversified financing strategy is also crucial for financial inclusion [21]. Moreover, sound financial performance would improve financial inclusion and ultimately contribute to becoming "subsidy-free" [19], p. 32). According to the systematic literature review by Hermes and Hudon [29], sources of funding are one of the most important factors affecting MFI performance. Therefore, there is a rapid evolution of the financing structure in the microfinance industry [15]. Similarly, Bogan [10] noted that many microfinance institutions finance their operations with deposits, loans, equity and grants.

Asset-liability management and profitability

Although the study of asset and liability management in the microfinance literature is limited, it has been widely studied in the banking industry. Some studies have examined the effect of capital structure on the profitability of microfinance institutions. The asset-liability management principles used by commercial banks are similar to those used by non-profit microfinance institutions [12]. However, the microfinance sector and formal or commercial financial institutions behave differently since they have a variety of clients with different levels of financial risk appetites. Therefore, this study is supported by empirical evidence from the banking sector.

In most empirical studies, the Statistical Cost Accounting (SCA) model has been used. Yet their empirical findings are mixed. Onaolapo and Adegoke [42] use a fourteen-year panel data regression analysis for 14 Nigerian deposit-taking banks. They used the SCA model and the random effects vector autoregressive model (VAR) to examine the relationship between ALM and the performance of money deposit banks. The study found that loans and early repayments have a positive impact, while non-performing loans have a negative impact on deposit banks' returns. The study also shows that demand deposits, borrowing and bank size (control variable) have a positive impact on banks' return on assets. A similar study by Ogbeifuna and Akinola [41] used liability management and portfolio theory to examine the relationship between ALM and deposit bank performance in Nigeria for the period 2006–2017, concluding that efficient ALM plays an important role in the overall performance of deposit banks.

Also, Owusu and Alhassan [43] use panel data from 12 domestic and 15 foreign banks in Ghana for the period 2007–2015. The study used both the SCA model and a fixed effect regression model to examine the impact of ALM on bank profitability as represented by net interest income and net profit. The study shows that all returns on assets (liabilities) have statistically significant and positive (negative) effects on net interest income of high and low profit banks. However, fixed assets, savings deposits and other liabilities are not significant for low profit banks. The study also shows that domestic banks had significantly higher returns than foreign banks on all observed assets except fixed assets.

This result is at odds with the study by Kosmidou et al. [32], who examine the impact of ALM on domestic and foreign banks in the UK for the period 1996–2002. Using the SCA and a fixed effects regression model, the study found that domestic banks earn a higher operating profit from loans and fixed assets. For foreign banks, all assets comprising the portfolios lead to higher operating profit. They also suggest that liability management is likely to be more important than asset management, especially for banks with high operating profit. Shrestha [45] studies the impact of ALM on profitability of 7 private commercial banks in Nepal between 2007 and 2014. The study used SCA model and the result of pooled OLS regression analysis showed that loans, advances and bill purchases, fixed assets and other assets yield more return. While the cost rate of deposits and other liabilities negatively affect profitability.

This result is in contradiction with a study by Sayeed and Hoque [44]. They examine the impact of ALM on 16 domestic commercial banks in Bangladesh over the period 1995–2006. The study found that a savings deposit yields a positive return to the bank. They argue that this is the case when the bank charges a high service fee and pays only nominal interest rates. The study also shows that for public banks, time deposits have a greater impact on net operating income than all liabilities.

On the other hand, Negash and Veni [40] also examine the impact of ALM on the profitability of 11 commercial banks in Ethiopia for the period 2010–2017. The result of the random effects regression models shows that the coefficient of fixed assets and non-interest bearing liabilities contradicts the SCA hypothesis. In other words, all assets generate positive net operating income after tax, but fixed assets have a negative and significant effect. On the liabilities side, all liabilities except non-interest

Table 1 Definitions of variables, hypotheses and expectation. *Source* Empirical Studies & MIX market

Variables & Symbol	Variables definitions	Hypotheses & Expected Sign
Financial performance (ROA)	This is equal to net operating income minus income taxes divided by average total assets	
Cash and cash equivalent (A1)	It includes cash on hand, bank balance and deposits, money market investment, and other liquid instruments	Positive (H1)
Net loan portfolio (A2)	This is equal to loan portfolio minus (impairment loss allowance + unearned income and discount)	Positive (H2)
Net fixed asset (A3)	The long-term tangible assets (usually more than one period) uses in the production or supply of goods or services or for administrative purposes. Further, it is net of accumulated depreciation	Positive (H3)
Other assets (A4)	It includes trade and other receivables, current and deferred tax assets, and inventories	Positive (H4)
Deposits (L1)	The sum of money deposited in an account with a financial institution that are payable to the account holder. It includes current accounts, term accounts, interest bearing accounts, and E-money accounts	Negative (H5)
Borrowings (L2)	The main balance for all loans received though debt instruments. It can include bonds or other debt securities issued	Negative (H6)
Other liabilities (L3)	It includes trade and other payables, financial liabilities at fair value, provision for employee benefits, other provisions, current and deferred income tax liabilities, and deferred revenue	Negative (H7)
Other short-term financial liabilities (L4)	It include overdrafts or other short-term financing arrangements, usually less than one year	Negative (H8)
MFI's size (LogTA)	Natural logarithms of total assets	Positive (H9)
GNICP	GNI per capita growth (annual %)	Negative (H10)
Inflation (INF)	Consumer prices (annual %)	Negative (H11)

bearing liabilities have a negative effect on profitability. A study by Belete [8] supports this result. He used a pooled OLS regression analysis to examine the impact of ALM on profitability of Ethiopian banks for the period 2005–2010. The study found that among all assets, only fixed assets negatively affected profitability.

Furthermore, using asset quality, capital adequacy, earnings quality, management efficiency and liquidity as proxies for ALM, Mun and Thaker [39] examined its impact on the performance of both conventional and Islamic banks in Malaysia for the period 2010–2013 and found that earnings quality and bank size (control variable) were the most important determinants of the performance of both banks. In addition, they suggest that due to the nature of business (e.g. the profit and loss sharing principle of the Islamic banking system) and differences in accounting and reporting standards, the impact of ALM on profitability differs between conventional and Islamic banks. Similarly, Anggono [3] examines the impact of ALM on profitability of commercial banks in Indonesia for the period from 2008 to 2013, using liquidity coverage, capital adequacy risk, intermediation and market discipline as proxies for ALM. The study shows that all explanatory variables have a positive and significant impact on bank profitability. Accordingly, the study proposed eleven hypotheses as shown in Table 1 (below).

Methods and data

Data source and sample

The MFI data used in this study were extracted from the Microfinance-Information eXchange Database (MIX), which is accessible through the World Bank's data catalogue.[1] The MIX market is a global, web-based information platform that provides accounting information from MFIs [16]. It is the main source of microfinance data used in many microfinance studies [7, 10, 15, 16, 49]. The researcher also uses data collected by hand from each MFI's website, which is not included in the Mix Market database. Macroeconomic indicators such as gross national income and inflation data come from the World Development Indicators database.[2]

At the time of data collection, the MIX Market contained the accounting data of nearly 3,237 MFIs worldwide from 1999 to 2019, but no more data will be collected from the platform in the last year of 2019 (December). On the other hand, not all MFIs reported the complete data to MIX and some important variables were missing [14]. Therefore, some adjustments are needed to obtain the complete information. These include excluding MFIs that lack information on balance sheet items and performance, and not including the

[1] https://databank.worldbank.org/source/mix-market.

[2] https://datatopics.worldbank.org/world-development-indicators/.

incomplete last year of 2019. After these adjustments, the final balanced dataset consists of 106 MFIs from 25 SSA countries over the period from 2014 to 2018 (see Table 4 in the Appendix).

Variables and measurement

Financial performance

Empirical researchers are agreed in viewing profit or value creation from two perspectives: Accounting perspectives and Market perspectives, each of these presents its own unique challenges. However, there is no generally accepted best/unique method of measuring the financial performance of MFIs [29].

The financial performance of MFIs has been widely studied for its relation with various determinants. In their book, Armendáriz and Morduch [5] identify five financial ratios that are commonly used to measure the financial performance of MFIs. These are operational self-sufficiency (OSS) ratio, financial self-sufficiency (FSS) ratio, return on asset (ROA) ratio, the portfolio at risk (PAR 30 days) ratio and portfolio yield ratio. The return on asset is a conventional measure of financial performance, and it measures how well the MFI uses all its resource (assets) to generate income [5]. The OSS measures the ability of MFIs in generating operating revenue to cover its operating costs, while the FSS consider additional adjustments to operating revenue and costs. The FSS measures how well the institution can cover its cost without ongoing subsidy [5, 16].

The study uses the accounting-based measure of financial performance, return on asset (ROA) for two reasons. (1) The study examines the quality of asset management and the funding capacity for generating income. (2) it is commonly used in the microfinance literature [13, 15, 16, 19, 20, 24, 49]. In banking literature, the return on asset ratio is also widely used to measure the financial performance of banks, along with asset and liability management indicators [3, 8, 42, 45]. In terms of ROA formula, the study uses the MIX market formula as it uses data from the MIX market database. Accordingly,

$$\mathrm{ROA}(\%)=\frac{\text{Net operating income } - \text{ income taxes}}{\text{Average Assets}}$$

Asset and liability management

This study uses the statistical cost accounting (SCA) models based on the description of [30]. The rates of return on assets are positive and vary across assets, while the rates of cost on liabilities are negative and also vary across liabilities. The statistical cost accounting (SCA) model is widely used in the banking literature to measure asset-liability management of financial institutions [8, 32, 41–45]. Moreover, the asset-liability management principles applied in commercial banks are similar to those applied in non-profit microfinance institutions [12]. Therefore, in this study, asset management is represented by cash and cash equivalents, net loan portfolios, net fixed assets and other assets,liability management is also represented by deposits, borrowings, other liabilities and other current financial liabilities. The study uses the MIX market definition for each asset and liability account as shown in Table 1 (below).

Control variables

As for the firm-specific variable, this study uses the size of the MFI (represented by the natural logarithm of total assets) as the control variable. This is because MFI size controls for the effects of differences in technology, investment opportunities and economies of scale across microfinance institutions [20]. The evidence for this result is mixed. Larger MFIs achieve better financial performance (ROA) [16, 20, 36]. However, Hartarska [25] found an insignificant influence.

As the study focuses on Sub-Saharan Africa, the macroeconomic environment there may also influence MFI performance [2]. Therefore, in this study, macroeconomic conditions are represented by gross national income per capital (GNIPC) and inflation. This is because these indicators are commonly used in microfinance research [2], Vanroose and D'Espallier [18, 51]. Theoretically, the overall effect of macroeconomic conditions on MFI performance is unclear. On the one hand, a growing GNI rate creates investment opportunities and technological progress that make small entrepreneurs more profitable. As a result, the loan repayment performance of MFI borrowers will improve, which has a positive impact on the financial performance of MFIs. On the other hand, higher GNI growth may enable micro entrepreneurs to finance themselves and push them to look for new financial institutions such as banks, which has a negative impact on MFI financial performance.

Ahlin et al. [2] found both a positive and a negative effect of the macroeconomic environment on the financial performance of MFIs. Others, such as Vanroose and D'Espallier (2009), observed a negative and significant relationship between gross growth rate and MFI return on assets. In contrast, Xu et al. [53] find that the macroeconomic environment has a positive impact on MFIs' financial performance. Empirical evidence on the relationship between inflation and financial performance is also mixed. Vanroose and D'Espallier [51] and Cull et al. [18] find a negative relationship between inflation and MFI returns. In contrast, a study by Hartarska and Nadolnyak [26] contradicts this result. They found a significant and positive effect of inflation on the operational self-sufficiency of MFIs. However, Cull et al. [17]

also find no evidence of the impact of inflation on MFI performance.

Model ALM is used as an independent variable in the study. Therefore, SCA is applied to measure ALM as described in Eq. (1).

$$Y_{lt} = \alpha_1 + \Sigma\alpha_{2i}A_{ilt} + \Sigma\alpha_{3j}L_{jlt} + e_{lt} \quad (1)$$

where,

***Y** denotes the net income of the MFI; **A**$_i$ represents the ith asset, i = 1, 2, 3,... m, whereas; **L**$_j$denotes the j*th *liability, j = 1, 2, 3, ... n; **l** is the number of microfinance institutions, l = 1, 2, 3... k; **t** is the period of time, t = 1, 2, 3,... T; **δ**$_{2i}$ represents the rates of return and shows the variations in the MFI's performance by replacing one unit of cash with one unit of the i*th *asset and is expected to be positive; **δ**$_{3j}$ indicates the rate of cost of liabilities and indicates the changes in the MFI's profit by adding one unit of cash and one unit of j*th *liability and is expected to be negative; **δ**$_1$ represents a constant term, and **e**$_{lt}$ denotes a stochastic (error) term.*

In Eq. (2), all ALM variables are divided by average total assets to avoid inefficiency in the estimation of coefficients associated with heteroscedasticity [30, 32]. Thus, the appropriate fixed effect model written as follows,[3]

$$\begin{aligned} ROA_{it} =& \beta_{0i} + \beta A1_{it} + \beta_2 A2_{it} + \beta_3 A3_{it} + \beta_4 A4_{it} + \beta_5 L1_{it} \\ &+ \beta_6 L2_{it} + \beta_7 L3_{it} + \beta_8 L4_{it} + \beta_9 LogTA_{it} \\ &+ \beta_{10} GNICP_{it} + \beta_{11} INF_{it} + e_{it} \end{aligned} \quad (2)$$

where,

ROA$_{it}$ *represents the return on asset of MFI**i**, at year**t**; **β**$_{1,2,3,4}$ represents the rates of return on earning asset and shows the variations in the performance of MFI; **β**$_{5,6,7,8}$ indicates the rate of cost of liabilities and indicates the changes in the ROA; **β**$_9$, **β**$_{10}$, **β**$_{11}$ are coefficients of natural logarithms of total assets (LogTA), GNI per capita growth (annual %) (GNICP) and Inflation, consumer prices (annual %) (INF) respectively; **i** denotes individual MFI; **t** refers time; and **e**$_{it}$ denotes the error term.*

The numerical data collected in this study analysed quantitatively using both descriptive and inferential analysis of statistical tools. The study run Hausman specification tests to make choice between random effect model and fixed effect model [27]. The Hausman test result depicts that the P-value (Prob > Chi2 = 0.0000) is statistically significant at the 0.01 level. Therefore, the result rejected the null hypothesis and confirms that the fixed effect model is appropriate than random effect model to get efficient and consistent parameter estimates in the regression. Further, the fixed effect model widely used in the asset and liability management studies [32, 41, 43].

[3] Equity is excluded from the model since its cost is not directly reflected in net earnings (Kwast and Rose, 1982). A model does not include funds from foreign aid, foundations, development agencies, or donors, and subsidized loans (i.e. NGOs).

Table 2 Summary of statistics all variables. *Source* Stata computation based on MIX Market data *and World development indicators*

Variables	Obs	Mean	Std. Dev	Min	Max
MFI's performance					
Return on assets	530	0.031	0.093	−0.432	0.708
*Asset and liability management variables**					
Cash & cash equivalent	530	0.182	0.111	0.008	0.606
Net loan portfolios	530	0.671	0.143	0.058	0.948
Net fixed assets	530	0.054	0.046	0	0.418
Other assets	530	0.074	0.095	0	0.858
Deposits	530	0.443	0.212	0	0.991
Borrowings	530	0.166	0.171	0	0.738
Other liabilities	530	0.073	0.093	0	0.796
Other short-term financial liabilities	530	0.037	0.091	0	0.774
MFI's characteristics					
Natural logarithm of total asset	530	17.01	1.743	10.773	22.14
Total Assets *(in million $)*	530	123	339	0.047	4140
Macro-economic factors					
GNI per Capital (Annual %)	530	3.464	3.342	−7.312	12.70
Inflation, consumer prices (Annual %)	530	6.310	5.454	−2.815	30.69

*To make a comparison with the total asset, each item of the balance sheet has expressed as a percentage of total assets

Results and analysis

This section presents the summary statistics for all variables and the regression results of the study. Table 2 (below) shows the summary statistics of the variables used in the study. Looking at the performance of the MFIs, the mean value of return on assets (ROA) for the sampled SSA MFIs from 2014 to 2018 is 3.1%. This means that these MFIs are earning a positive return on their assets. This could be due to the fact that MFIs charge higher interest rates and have assets with a short maturity than formal financial institutions. However, there is a higher variability (standard deviation of 9.3%) and a wider spread with a minimum of −43%, which shows that some MFIs are not able to generate a positive return.

In terms of balance sheet items, the net loan portfolio has the largest share of MFIs' earning assets with an average of 67%, followed by cash and cash equivalents (average18%), which are mainly used to determine MFIs' liquid assets. This indicates that the SSA MFIs in the sample prioritise their core lending activities. However, the spread and standard deviation of the loan portfolio

Table 3 Robust fixed effect model regression results. *Source* STATA 16 Output

Fixed-effects (within) regression				Number of observation	=	530
Group variable: MFI_ID				Number of groups	=	106
R-square				Observation Per group:		
	Within	=	0.3199	Minimum	=	5
	Between	=	0.0295	Average	=	5.0
	Overall	=	0.0591	Maximum	=	5
				F(11, 105)	=	11.84
Corr(u_i, xb)	=	−0.7472		Prob > F	=	0.0000
		Std. Err. adjusted for 106 clusters in MFI_ID				
ROA	Coef.	Robust Std. Err.	t	P> |t|	[95% Conf. Interval]	
A1	.0302867	.0468258	0.65	0.519	−.0625603	.1231337
A2	.1953518	.0253721	7.70	0.000	.1450436	.2456599
A3	−.1664721	.2070479	−0.80	0.423	−.5770098	.2440656
A4	.0895985	.0679194	1.32	0.190	−.0450731	.2242701
L1	−.0709093	.0399866	−1.77	0.79	−.1501953	.0083768
L2	−.184754	.0518144	−3.57	0.001	−.2874924	−.0820156
L3	−.2365634	.0884599	−2.67	0.009	−.4119631	−.0611638
L4	.08409	.0458165	1.84	0.069	−.0067556	.1749356
Log_TA	.0574495	.014056	4.09	0.000	.0295791	.0853199
INF	−.0016057	.0011968	−1.34	0.183	−.0039787	.0007674
GNIPC	−.0009666	.0010578	−0.91	0.363	−.003064	.0011307
_cons	−.9939745	.2366211	−4.20	0.000	−1.46315	−.5247985
sigma_u	.11234075					
sigma_e	.05688419					
rho	.79592844	*(fraction of variance due to u_i)*				

Where: ROA, return on assets; A1, cash and cash equivalents; A2, net loan portfolios; A3, net fixed assets; A4, other assets; L1, deposits; L2, borrowings; L3, other liability; L4, other short-term financial liability; Log_TA, natural logarithm of assets; INF, Inflation, consumer prices (annual %); GNICP, gross national income per capita growth (annual %)

may show us that there are SSA MFIs that may deviate from their original mandate. Fixed assets have the lowest mean of 5% (approximately), which could mean that lesser funds were invested in the acquisition of fixed assets than in other assets. However, there are also MFIs in the sample that invests up to 42% in fixed assets.

In terms of MFI liabilities, deposits account for a large share (44% on average), followed by loans and other liabilities with a mean of 17 and 7%, respectively. This indicates that the MFIs in the SSA sample fund their assets predominantly through deposits. The other sources of funding such as borrowing, other liabilities and other short-term financial liabilities also increased slightly over the period. This could be due to the fact that the former two sources of funding are expensive and the latter is usually capped. Bogan [10] supports this data description. He noted that many microfinance institutions finance their operations with deposits, loans, equity and subsidies.

Moreover, the MFIs in the study operate in an economic environment where the average annual inflation rate is about 6%. However, there are some MFIs that operate in a higher inflation environment (e.g. the maximum inflation rate is 31%), which poses additional challenges for the microfinance industry in terms of asset and liability management [37]. The sampled MFIs also operate in the category of low-income countries with an average annual per capita GNI growth of 3%.

Regression analysis and discussion

In this subsection, the fixed effect model estimates the main results of this study and discusses them in line with the empirical literature. It also reports the goodness of fit, the parameter estimates with their standard errors and the test results of the model.

Table 3 (below) shows the results of fixed effect model regression on the effect of ALM factors on MFI's return on assets. To control for the problem of heteroscedasticity and serial correlation, the researcher performs a robust estimation of the fixed effect model. When the P-value of the F-statistic is below the significance level of 0.05, the model is usually the best fit for the relationship between independent and dependent variables [51].

As shown in Table 3 (below), the probability of the F-statistic is below the significance level of 0.01, so on the one hand; all coefficients of the model are different from zero. On the other hand, the model is best fitted for all explanatory variables included in the model to jointly significantly explain the variation in the return on assets of the MFIs under study. The fixed effect model assumes that there is correlation between the unit error term (ui) and the predictor variables. As Table 3 (below) shows, the value for the correlation between the errors (ui) and the predictor is different from zero (−0.7472), confirming that they are correlated. Based on the value for the 'rho' (intraclass correlation), 79.59% of the variance is due to differences between the panels.

The R-squared measures the joint significance of the independent variables in explaining the dependent variable in the model. The value of 0.3199 for the R-squared within the model indicates that about 32% of the variation in MFI return in SSA is jointly explained by the ALM variables, MFI size, inflation and per capita GNI growth. Although other explanatory variables explain the remaining 68% variation in the return on assets of SSA MFIs, many variables in the model are significant.

As shown in Table 3 (above), the standardised coefficient on the net loan portfolio is positive and the highest among assets at the 0.01 significance level, implying that for a one USD increase in the net loan portfolio, the MFI return should increase by 0.1953 USD, holding all other explanatory variables constant ($P < 0.000$). This result is generally consistent with what has been observed in the microfinance literature. Gonzalez [23] noted that the loan portfolio is the most important income item for MFIs and represents a large part of their assets. Moreover, this finding is also clearly in line with previous findings [42, 43]. They found that customer loans and advances generate positive and significant returns to the profitability of deposit taking financial institutions.

However, cash and cash equivalents (A1), net assets (A3) and other assets (A4) are not statistically significant and have lower positive standardised coefficients, except for net assets. The hypotheses (H1, H3 and H4) are thus not confirmed. This may indicate the problem of high dependence on the loan portfolio to generate a return on MFI assets. Thus, any increase in MFI's expenses can potentially be covered by an increase in the interest rate, fees and commissions on the loan. The research of Shrestha [45] contradicts this result. He showed that investment in fixed assets and other assets is associated with better financial performance of deposit-taking banks in Nepal.

Similarly, Kosmidou et al. [32] found that mainstream banks in the UK make a positive operating profit from investment in their fixed assets. It may be because MFIs and banks behave differently, offering various technology-based products and services. So this result suggests that the asset base (investment portfolio) of MFIs in SSA is too narrow. They could not generate income from alternative investment portfolios. This result could be due to the weak financial market and the competitiveness of the microfinance sector in the region [46]. In conclusion, MFIs should maintain the quality of their loan portfolio to improve their financial performance. Thus, the hypothesis (H1) is confirmed because the *P* value of the net loan portfolio (A2) is sufficient to reject the null hypotheses that do not support the SCA method.

As for the liability side, the standardised coefficients (cost rates) of all variables are negative and significant, except for other current financial liabilities (+ve). In particular, the standardised coefficient of deposits (L1) is negative and significant below the 0.1 level. This means that for a deposit of one USD, the MFI rate of return is expected to decrease by 0.071 USD, holding other factors constant. However, the cost of the deposit rate is lower because it is the cheapest fund on the market. This may suggest that savings may be a better alternative source of funds for MFIs to minimise the cost of interest rates on liabilities.

In other words, the cheapest source of funding for MFIs in SSA is deposits. This may confirm the rapid growth of deposit mobilisation in the sub-Saharan African microfinance industry [13]. This result is consistent with Shrestha's [45] findings in Nepal. Similarly, this empirical result is similar to that of Chikalipah [15], who used data from 471 MFIs in sub-Saharan Africa and found that deposits as a percentage of total assets were negatively and significantly related to MFI return on assets.

However, this contradicts earlier findings by [44]. They found that savings deposits give banks a positive return. This could be the case if the bank charges a high service fee and pays only nominal interest rates. However, Hamada [24] finds no clear evidence of the impact of savings deposits on the profitability of Indonesian MFIs. Therefore, hypothesis (H5) is accepted because the *P* value of deposits (L1) is sufficient to reject the null hypotheses that do not support the SCA method.

Moreover, the standardised coefficient of borrowing (L2) is negative and significant at the 0.01 level. This means that for a one USD increase in loan funds, the MFI's rate of return is expected to decrease by 0.185 USD, holding other factors constant. In other words, the more they rely on borrowed funds, the lower the MFI's return. In contrast to a deposit, MFIs incur the highest costs when borrowing, among other liabilities (L3). This empirical result is consistent with studies by [32, 43]. They found that long-term debt has a negative and

significant impact on the profitability of UK banks and Ghanaian deposit-taking institutions.

Research by Chikalipah [15] also supports these findings. He found that borrowing to total assets ratio is negatively and significantly related to MFI return. However, research by Hamada [24] contradicts this finding. He analyses the commercialisation of MFIs in Indonesia and finds that bank loans (loans from other banks) have a significant positive effect on the profitability (ROA) of Indonesian MFIs. Moreover, this result also contradicts the findings of Onaolapo and Adegoke [42]. They found a positive and significant effect of borrowing on the ROA of Nigerian money deposit banks. Therefore, hypothesis (H6) is confirmed because the P-value of borrowed funds (L2) is sufficient to reject the null hypotheses that do not support the SCA method.

As Table 3 (above) shows, the standardised coefficient of other liabilities (L3) is negative and significant at the 0.01 level. The seventh hypothesis (H7) is therefore confirmed. This means that for an increase in other liabilities of one USD, a decrease in the MFI return of 0.2366 USD can be expected if all other factors remain constant. In terms of cost rates for SSA MFIs' liabilities, surprisingly, the highest cost rate is for other liabilities (L3), followed by borrowed funds (L2). This could be one reason why the share of other liabilities is lower (7%) compared to total liabilities, as shown in Table 2 (above). This empirical result is consistent with previous findings [42, 44] which found a negative and significant impact of other liabilities on bank profitability. However, they reported lower funding costs.

Moreover, the standardised coefficient of other current financial liabilities (L4) is positive and significant below the 0.1 level. This means that for a one USD increase in other short-term financial liabilities, the MFI return should increase by 0.08409 USD if all other factors remain constant. Surprisingly, other short-term financial liabilities (including overdrafts or other short-term financing arrangements that are typically less than one year) have a positive impact on the return on assets of sub-Saharan MFIs. However, the magnitude of this effect is much smaller. MFIs seem to manage their overdrafts or other short-term financing arrangements better. This result is inconsistent with previous findings [42, 45] and the SCA hypothesis, which assumes that liability cost rates are negative and also vary across different liabilities [30]. Therefore, the P-value of other current financial liabilities (L4) is sufficient to reject the null hypotheses that do not support the SCA method.

In summary, the cost of debt is high and has a significant negative impact on MFI performance. These results suggest that MFIs need to strengthen their liability management and seek low-cost sources of funding such as deposits and grants. Indeed, donated equity must also be properly used and managed by MFI managers and staff in order to be more efficient and achieve better financial performance.

As for the MFI-specific variables and the macroeconomic indicators, the standardised coefficient of both inflation and GNI per capita is negative but not statistically significant. Thus, your hypothesis is not confirmed. However, the size of MFIs (measured by their total assets) has a positive and significant impact on MFI returns. The eleventh hypothesis is therefore accepted. It states that larger MFIs perform better financially. This could be due to the fact that larger MFIs benefit from the scale and scope of savings that enable them to perform better financially.

This empirical result is consistent with previous findings [16, 20, 36]. However, it is inconsistent with [39] who reported that size has a negative impact on financial performance. This could be the case when MFIs become extremely large,the more difficult it is for management to monitor and the higher the level of bureaucracy.

Conclusion

The microfinance industry has experienced several profile shifts that require the introduction of asset and liability management. It is a critical framework that incorporates strategic management, investment view of assets and liabilities, specific objectives, risk tolerance and constraints of financial institutions. The concept of asset and liability management has therefore become an important issue for microfinance institutions. The objective of this study was therefore to examine the impact of asset and liability management on the financial performance of sub-Saharan African microfinance institutions. The study used the statistical cost accounting method, considering eight categories of asset and liability composition. It also examined the impact of firm-specific variables (MFI size) and macroeconomic indicators (inflation and GNI per capita) on MFI returns. The study was conducted on balanced panel data of 106 MFIs from 25 SSA countries from 2014 to 2018 and uses a robust fixed effects regression model.

The results of this study suggest that asset returns are related to asset and liability composition. However, most assets were not statistically significant in the regression model. Thus, this study partially confirms the central hypothesis of the statistical cost accounting model that the estimated rates of return on assets (liabilities) are positive (negative) and vary across assets (liabilities). The net loan portfolio has a positive and significant impact on the financial performance (measured by ROA) of microfinance institutions in SSA. All other asset variables (including cash and cash equivalents, fixed assets and other assets) have no significant impact on the

overall ROA of MFIs in SSA. This means that the asset base (assets portfolio) of MFIs in SSA is too narrow. They are not able to generate returns from alternative investment portfolios. Therefore, MFIs should pay more attention to the quality of their loan portfolio as it is a major contributor to their financial performance.

Regarding the composition of liabilities, the cost of interest rate on other liabilities (L3) and bonds (L2) was higher and has a significant negative impact on MFIs' return. In contrast, the cost of interest rate on deposits (L1) and other current financial liabilities (L4) were lower, but were negatively and positively related to MFIs' financial performance, respectively. Thus, it appears that MFIs that mobilise higher deposits can offset any losses from the lower return on assets with the lower cost of funding. Taken together, these results suggest that proper liability management has a direct impact on the financial performance of MFIs in SSA.

Therefore, MFIs should devote their time and attention to managing their liabilities in order to improve their financial performance. On the other hand, these findings may suggest that MFIs that cannot tap into private sources of funding (such as deposits) will continue to need donor support to build a more inclusive financial sector. This does not necessarily mean that MFIs must continue to use subsidies as part of a permanent financial strategy. MFIs often mix their financing strategy with part subsidised and part commercial lending. In some cases, the study might recommend that donors continue to provide financial support to the MFI sector, as building a framework for managing assets and liabilities is challenging and the cost of debt is high. However, donors should be careful not to over-subsidise the sector, which would lead to long-term subsidy dependency.

Although both GNI per capita and inflation were not statistically significant, they have a negative impact on MFI returns. This means that favourable economic conditions and a lower inflation rate have a positive impact on the demand and supply of microfinance services and their financial performance. As for the MFI-specific variable, MFI size has a positive effect on the return on assets, but the magnitude of the effect is small. Therefore, the larger MFIs perform better financially as they benefit from economies of scale and scope in the provision of financial services. In general, the study concludes that adequate attention needs to be paid to loan portfolio quality, borrowing, other liabilities and deposits to enable effective asset-liability management. In addition, the study recommends that MFIs design the asset-liability management framework to fit their environmental conditions and business activities. This study is the first step towards a better understanding of the relationship between asset-liability management and the financial performance of microfinance institutions.

From a financing perspective, MFIs can go through various stages of life cycles and are not equally exposed to financial risk. As a result, the study focused on non-bank financial institutions (NBFIs) and banks whose financial instruments carry high levels of financial risk. Nevertheless, the study failed to consider the sources of loans (i.e. foreign debt), which could be used to analyse their foreign risk exposure. Future research may expand the scope of the current study, to explain the impact of ALM on MFI's financial risk in a larger sample. This might help to understand whether the impact of AML on MFI's financial risk varies by legal status as it affects the financing choices of MFIs.

Appendix

See Table 4

Table 4 List of countries in the sample

East Africa	Central Africa	West Africa		South Africa	
Burundi	Malawi	Angola	Benin	Mali	South Africa
Ethiopia	Mozambique	Cameroon	Burkina Faso	Niger	Zambia
Kenya	Rwanda	Congo, Dem. Rep	Cote d'Ivoire	Nigeria	
Madagascar	Tanzania	Congo, Rep	Ghana	Senegal	
Uganda			Liberia	Togo	

Abbreviations
CGAP: Consultative group to Assist the Poor; GNI: Gross national income; INF: Inflation; MFI: Microfinance Institution; MIX: Micro-information E-Xchange; NBFIs: Non-bank financial institutions; ROA: Return on asset; OSS: Operational self-sufficiency; FSS: Financial self-sufficiency; SSA: Sub-Saharan African.

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Author contributions
The main contribution of this study is that it adds in the literature of a critical and future challenge of ALM in the microfinance industry. The findings of the study open new doors for the regulators, and the management of the MFI community with more emphasis on ALM. The author read and approved the final manuscript.

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Data availability
The data can be made available upon request.
Declaration.

Declarations

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