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ORIGINAL ARTICLE

Not all that glitters is gold: Financial access, microfinance, and female unemployment in sub-Saharan Africa

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Abstract

The present study assesses the relevance of microfinance institutions (MFIs) in the effect of financial access on gender economic inclusion in 44 countries in sub-Saharan Africa (SSA) for the period 2004–2018. The adopted empirical strategy is interactive quantile regressions that are tailored to account for both simultaneity and unobserved heterogeneity. Two MFI dynamics are employed: MFIs per 1,000 km^2 and MFIs per 100,000 adults. Financial access is measured in terms of female bank account ownership while gender inclusion is measured in terms of reducing female unemployment. We find that MFIs per 1,000 km^2 must reach thresholds of between 2.328 and 2.490 at the 90th quantile of the female unemployment distribution in order for female bank account ownership to reduce female unemployment. The partial validity of the tested hypothesis is clarified and we note a few policy implications.

KEYWORDS

Africa, female bank account ownership, female economic integration, formal economic sector, gender, gender equality, inclusive development, inclusivity, microfinance, quantile regressions, SDG5, sub-Saharan Africa, sustainable development, unemployment

The main research question in this study is focused on assessing how microfinance institutions (MFIs) moderate the effect of female bank account ownership on female unemployment in sub-Saharan Africa (SSA). The foundational elements of the present research are based on three underlying motivations, notably: (i) the importance of increasing the involvement of the female gender in the formal economic sector; (ii) the relevance of MFIs in driving gender-inclusive development outcomes; and (iii) corresponding gaps in the gender inclusion literature.

First, in accordance with the scholarly and policy literature (Ngono, 2021; Woldemichael, 2020), female labor force participation in SSA is substantially low compared to other regions and continents in the world.

According to the narrative, policies designed to improve female labor participation should be tailored toward prioritizing the participation of the female gender in the labor market. Inter alia, women participate in taking care of the elderly and children, which are constraints that reduce their participation in the labor market and hence they become less relevant and represented in the formal economic sector.

Second, MFIs have been established to provide enabling conditions for female economic integration, especially within the remit of providing women with the relevant financial opportunities for self-employment by means of doing business as well as through other avenues by which females could be more integrated into the formal economic sector (Asongu, 2024; Assairh et al., 2020; Fox & Van Droogenbroeck, 2017; Gasperin et al., 2019; Kendall et al., 2012; Maldonado & González-Vega, 2008; Ngono, 2021; Obadha et al., 2019; Swapna, 2017; Tariq, 2019). Furthermore, in accordance with the attendant scholarly and policy literature (Tchamyou, Erreygers, et al., 2019; UNCD, 2022), beyond the remit of gender equality, financial access has been documented to be fundamental in the achievement of other poverty- and inequality-oriented sustainable development goals (SDGs). On the basis of the underlying insights, it is thus not surprising that MFIs are considered within this study as moderating variables in the nexus between financial access (i.e., in terms of female bank account ownership) and female unemployment. The positioning of the study is also premised on filling a gap in the literature.

Third, to the best of our knowledge, the literature on enhanced female economic participation has fundamentally been oriented toward, inter alia, boosting inclusive education possibilities for females (Elu, 2018); engaging more females in both formal and informal economic prospects that are relevant for promoting gender inclusion (Uduji & Okolo-Obasi, 2018, 2019, 2020); connecting the underpinnings of mobile money, the female doing of business and microfinance (Ngono, 2021); understanding the nexus between gender inclusion and political inclusion (Bezinna et al., 2022); gender considerations in environmental sustainability (Asongu et al., 2022); how mobile phone externalities provide financial access avenues for entrepreneurial and household improvements (Kim, 2022); and linkages between funding opportunities for females, mobile phones, and information technology as posited by Osabuohien and Karakara (2018) and Mndolwa and Alhassan (2020).

The remainder of the research is organized in the following manner. The theoretical underpinnings and hypothesis development are covered in the Theoretical underpinnings and hypothesis development section while the Data and Methodology section discusses the data and methodology. The Empirical analysis section presents the empirical findings while the study is concluded in the Concluding implications and future research directions section with implications and future research directions.

THEORETICAL UNDERPINNINGS AND HYPOTHESIS DEVELOPMENT

This section provides the theoretical underpinnings on the nexus between the main channel (i.e., female bank account ownership) and female unemployment on the one hand and, on the other, provides an intuition for the relevance of MFIs in moderating the effect female of bank account ownership on female unemployment. The section is covered in three main strands to articulate: (i) the theoretical underpinnings on the nexus between financial access and gender-inclusive development outcomes; (ii) contextualization of the theoretical underpinnings to be consistent with the problem statement; and (iii) the testable hypothesis.

First, the theoretical nexus between financial access and inclusive development outcomes is fundamentally based on the relevance of financial access in providing opportunities via which those who are excluded in society are availed with the resources with which to engage in activities that improve their transition from one social stratum to another—generally, a social transition from poverty to favorable living conditions. This study borrows from the literature on the linkage between financial access and inclusive development for the underlying theoretical underpinnings (Tchamyou, Erreygers, et al., 2019). It is important to note that while Tchamyou, Erreygers, et al. (2019) focus on the nexus between financial access and inclusive development within the remit of reducing income inequality, the focus of the present study is on how financial dynamics (i.e., bank account ownership and MFIs) interact to influence female unemployment, which is a dimension of inclusive development. Hence, while the study borrows from Tchamyou, Erreygers, et al. (2019) in terms of theoretical underpinnings, the contextualization is different. According to Tchamyou, Erreygers, et al. (2019), the nexus between financial access and inclusive development can be understood in terms of the intensive and extensive margin theories, which are discussed in detail in what follows.

The extensive margin theory is apparent when financial access is offered beyond the remit of traditional beneficiaries of the underlying financial access opportunity, such that those who did not previously have access to this service are provided with more avenues with which to improve socioeconomic activities. This is the case when a fraction of the population is excluded from financial services, such as women (Ngono, 2021). Hence, the use of female ownership of bank accounts as the main channel by which female unemployment concerns can be addressed, as conceived within the remit of this study, is consistent with this stream of the theoretical underpinnings or the extensive margin theory. Moreover, such is also in accordance with the literature on the relevance of financial access in socioeconomic and inclusive

development outcomes (Beck et al., 2007; Tchamyou & Asongu, 2017).

The intensive margin theory, on the other hand, pertains to the perspective that existing beneficiaries of financial access opportunities are offered more avenues through which to fund projects that can enable them to improve their standards of living. It follows that the intensive margin theory exclusively focuses on those who are already financially included. In other words, this stream of theory speaks to those whose existing financial inclusion standards are being enhanced. This stream of studies is also supported by the literature on the nexus between financial access and socioeconomic development outcomes (Bae et al., 2012; Batabyal & Chowdhury, 2015; Chipote et al., 2014; Chiwira et al., 2016; Odhiambo, 2014; Tchamyou, 2020). Regardless of the theoretical stream, both theoretical perspectives agree with the intuition that MFIs are instruments by which female financial access can be promoted, especially through the mechanism of female bank account ownership. This takes us to the second strand of contextualization.

Second, in terms of contextualizing the attendant theoretical underpinnings, as we have already highlighted, MFIs constitute instruments through which financial inclusion can be promoted, especially through financial access in terms of the ownership of bank accounts. This is the case when women are promoted to benefit from financial access with the help of MFIs.

In this strand, we support this contextualization with the relevant references to further articulate how the theoretical underpinnings are consistent with the positioning of this study as is discussed in the subsequent paragraph. It follows from this emphasis that the employment of MFIs as instruments through which financial access is promoted is consistent with both the intensive and extensive margin theories (Gasperin et al., 2019; Ngono, 2021). Accordingly, it has been established by Assairh et al. (2020) that MFIs promote the involvement of women in economic activities, notably, by providing the relevant funding for starting businesses and doing business as well as engagement in other activities that are conducive to the empowerment of the female gender in the economic sector. According to Maldonado and González-Vega (2008), female economic empowerment can be enhanced by MFIs, notably via mechanisms such as, inter alia, the management of risks, income effect, and the household impact. Moreover, as shown by Swapna (2017), female economic empowerment such as employment is promoted by MFIs, a position that is consistent with Tariq (2019). Beyond these considerations of mechanisms, the attendant literature is consistent with the position that various financial access dynamics are linked to MFIs, inter alia, microcredit, and microinsurance services (Ackerly, 1995; Basu, 2006; Brana, 2013; Fox & Van Droogenbroeck, 2017; Goetz & Gupta, 1996; Kendall et al., 2012; Morduch, 1999; Obadha et al., 2019).

Third, with respect to the positioning of the present study, in accordance with the considered empirical and theoretical literature noted earlier, it is not surprising that MFIs can be considered as an instrument by which financial access can be promoted for female employment. The translation of this positioning is seen as MFIs moderating the effect of financial access on female unemployment. The narrative in this section can be summarized in the following argument: MFIs can moderate the effect of financial access on female unemployment. This engenders the following testable hypothesis.

> **Hypothesis 1.** Microfinance institutions moderate financial access in terms of the female ownership of bank accounts for inclusive economic participation by reducing female unemployment.

The claim on which the research question articulated earlier is based is encapsulated in this testable hypothesis. In the testable hypothesis, the ownership of bank accounts is considered as a channel by which female unemployment can be reduced while MFIs are understood as a moderating variable. It is also relevant to note that the theoretical underpinnings in this section have been contextualized to the positioning of the study. Hence, whether the corresponding testable hypothesis withstands empirical scrutiny is a matter of empirical validity.

DATA AND METHODOLOGY

Data

This study is focused on 44 nations in SSA with data spanning from 2014 to 2018. The data is shared by Ngono (2021), the study that is closest to the present exposition. Three main data sources are relevant to the inquiry: (i) the World Development Indicators of the World Bank (2020a), (ii) the Financial Access Survey (IMF, 2020); and (iii) the Gender and Parity Statistics for Men and Women of the World Bank (2020b). It is important to clarify that while all the variables are from Ngono (2021), we felt it appropriate to additionally mention them here.

Before delving more into the specifics of the variables employed, we should underline that the same justifications on data availability constraints pertaining to Ngono (2021) also apply to the present study even though it clearly departs from the former study in terms of positioning. While Ngono (2021) focused on how three main mechanisms (MFIs, mobile money innovations, and banking access) influence female employment, we consider here how MFIs moderate the effect

of financial access on female unemployment. The outcome variable of the underlying study is used in the present exposition only as a control variable, while the mechanism of bank accounts—which is used as a control variable in Ngono (2021)—is employed in this study as one of the independent variables of interest or the main channel. Moreover, another distinguishing feature is that Ngono's study is based on a linear additive model focusing on the generalized method of moments while the present exposition is engaged within an interactive quantile regressions framework.

In light of the above and in accordance with the motivation in the introduction and theoretical exposition in the Theoretical underpinnings and hypothesis development section, the outcome variable is the female unemployment rate while the two main independent variables of interest are: (i) MFI dynamics that are employed as the policy or moderating variables (i.e., MFIs per 1,000 km^2 and MFIs per 100,000 adults) and (ii) female ownership of bank accounts. The choice of these variables is consistent with the financial access and MFI literature discussed in the Theoretical underpinnings and hypothesis development section.

In an effort to take on board concerns related to variable omission bias, some variables are involved in the conditioning information set or set of control variables, notably: trade openness, female fertility rate, female self-employment, time taken for a woman to set up a business, the cost it takes for a woman to set up a business, and the procedures a woman has to go through to start a business. The choice of elements in the conditioning information set accords with studies on gender inclusion and inclusive economic development, notably: Duflo (2012), Tchamyou, Asongu, et al. (2019), Ofori et al. (2021), Ngono (2021), Tchamyou (2021), and Asongu (2024).

With respect to signs that are anticipated from the control variables, trade openness and female self-employment are expected to reduce female unemployment while the female fertility rate in light of Ngono (2021) should have the opposite effect. Moreover, given that the three remaining control variables are constraints upon females starting and doing business, these are expected to positively influence the outcome variable. These underlying expected signs are valid under the condition that concerns pertaining to multicollinearity are not apparent, not least because when variables that are highly correlated are entered into the same specification, only some of them can emerge from the regression output with the expected signs. It is therefore because the underlying concern of multicollinearity is overlooked in interactive regressions that net effects and/or thresholds (i.e., involving both the unconditional and conditional effects of the main channel) are computed to assess the overall or total effect of the main channel, contingent on the moderating variable (Tchamyou, 2019).

Table A1 discloses the definitions of variables and their corresponding sources while the summary statistics are provided in Table B1. Accordingly, the summary statistics are used to compute net effects, especially as they pertain to assessing if the assessed hypothesis withstands empirical scrutiny. It is important to note that, to avoid concerns underlying interactive regressions as documented in Brambor et al. (2006), net effects should be computed to fully appreciate the relevance of MFIs in complementing the effect of female bank account ownership on female unemployment. To this end, the mean values and corresponding ranges of the variables disclosed in the summary statistics are worthwhile for the computation of such net effects. The Appendix section is completed with insights into paired correlations that are provided in Table C1.

Methodology

The present exposition departs from the literature that has examined nexuses based on mean values of female economic inclusion (Ngono, 2021) and so we adopt an estimation technique that assesses the considered nexuses throughout the conditional distribution of the female economic inclusion outcome variable. The motivation for examining the attendant linkages throughout the conditional distribution of the outcome variable is to provide room for more policy implications. Contrary to the underlying female economic inclusion studies in which common policy implications emerge from the findings based on an estimation technique premised on mean values of the outcome variables, we argue here that initial, intermediate, and high initial levels of the outcome variable are taken into account to make room for more policy implications. In essence, the corresponding argument is that common policies based on estimations that are founded on the mean value of the outcome variable are unlikely to succeed unless these are based on the initial values of the outcome variable and tailored differently across countries with differing initial levels of the outcome variable. Given the underlying insights, the present exposition is consistent with studies that are focused on assessing the linkages throughout the conditional distribution of the outcome variable by adopting the quantile regressions (QR) strategy (Asongu, 2024; Billger & Goel, 2009).

As documented in Asongu (2017) and in non-contemporary literature (Koenker & Hallock, 2001; Koenker & Bassett, 1978), relative to ordinary least squares (OLS) regressions in which it is supposed that error terms are distributed normally, such an assumption is not relevant to the QR approach. This is because the nexuses are investigated throughout the conditional distribution of the female economic inclusion variables. Still, in line with the corresponding literature, in the QR approach, the θ^{th} quantile estimator linked to female

unemployment is derived by engaging the optimization disclosed in Equation (1), which is presented in the absence of subscripts to enhance readability.

$$\min_{\beta \in R^k} \left[\sum_{i \in \{i: yi \geq xi'\beta\}} \theta |yi - xi'\beta| + \sum_{i \in \{i: yi < xi'\beta\}} (1-\theta) |yi - xi'\beta| \right], \quad (1)$$

where $\theta \in (0, 1)$. Compared to the OLS technique, which is essentially based on reducing the total sum of squared residuals, in relation to the QR analytical strategy, the estimation process is consistent with the maximization of the corresponding absolute deviations. The attendant process involves maximizing the related absolute deviations of the corresponding quantiles. For the sake of illustration, the 75th quantile (i.e., related to $\theta = 0.75$) is obtained by weighing the residuals approximately. The attendant quantile of female unemployment or yi given xi is:

$$Qy(\theta/xi) = xi'\beta\theta, \quad (2)$$

where the comparative θth quantile parameters that are connected to unique slopes are assessed within the remit of the conditional distribution of female unemployment. The corresponding estimation is orthogonal to $E(y/x) = xi'\beta$ in the OLS slope that is characterized by an evaluation of parameters exclusively at the conditional mean of the outcome variable or female unemployment. Relative to the process of estimation in Equation (2), the dependent variable yi is the female unemployment rate while xi contains a constant term: *women ownership of bank accounts like men, MFIs, trade openness, female self-employment, female fertility rate, the cost it takes for a woman to set up a business, the procedures a woman has to go through to start a business*, and *the time for women to set up a business*.

It is important to note that the relevance of the quantile regressions approach is apparent from the heterogeneous effects in the linkages that are examined. Hence, if the estimated linkages are only significant in some quantiles, it justifies the choice of the quantile regression estimation technique as an analytical strategy, not least because the responsiveness of female unemployment to the channel (i.e., bank account), and corresponding moderators (i.e., MFIs dynamics) is contingent on initial levels of female unemployment. Hence, when the heterogeneous effects are apparent from the perspective that the investigated nexuses are only significant for some quantiles, net effects and attendant thresholds are only computed for the relevant or corresponding quantiles.

EMPIRICAL ANALYSIS

Presentation of results

The empirical results are presented in Table 1, which entails two main panels: the left hand side shows regressions related to MFIs per 1,000 km^2 and the right hand side reflects estimations focused on MFIs per 100,000 adults. Building on the narrative in the methodology section, especially as it relates to the choice of the estimation approach, the choice of the QR strategy is justified given that, compared to the corresponding OLS estimates, the QR estimates are distinct in terms of both significance and magnitude of significance, especially in light of the independent variables of interest.

From the two panels in Table 1, the findings in relation to the tested hypothesis are exclusively valid in the top or 90th quantiles of the conditional distribution of the outcome variable. It follows that the tested hypothesis is only partially valid, especially in light of corresponding MFIs at which the overall effect of bank account ownership by females on female unemployment is negative. The partial validity of the tested hypothesis is discussed in more depth shortly, especially regarding computed net effects and thresholds as well as the corresponding discussion with respect to literature in the Robustness checks: Accountingfor simultaneity and the unobservedheterogeneity section.

To examine the testable/investigated hypothesis—and hence the importance of MFIs in complementing financial access in terms of female bank account ownership for inclusive economic participation—the study is consistent with the literature in computing the net effect of bank account ownership on female unemployment, contingent on MFIs (Asongu, 2024). To illustrate this computational perspective, in the last column of the 90th quantile of the left hand side of Table 1, the corresponding net effect of bank accounts or financial access on female unemployment is 9.512 = ([−13.758 × 1.799] + [34.263]). In the attendant computation, 34.263 is the unconditional impact of bank account ownership or financial access on female unemployment, 1.799 is the mean or average value of MFIs per 1,000 km^2 while −13.758 is the interactive or conditional effect of financial access or bank account ownership on female unemployment.[1]

In the same vein, in the 90th quantile of the right hand side, the net effect of financial access on female unemployment, contingent on MFIs per 100,000 adults, is 0.488 = ([1.871 × 4.189] + [−7.349]). In the corresponding computation, −7.349 is the unconditional

[1]The unconditional impact is the impact not involving the interactive term. The impact involving the interactive term is the conditional or interactive impact.

TABLE 1 Female unemployment, microfinance institutions, and bank accounts.

	Dependent variable: Female unemployment Microfinance institutions per 1,000 km^2						Microfinance institutions per 100,000 adults					
	OLS	**Q.10**	**Q.25**	**Q.50**	**Q.75**	**Q.90**	**OLS**	**Q.10**	**Q.25**	**Q.50**	**Q.75**	**Q.90**
Constant	**37.121*****	**13.230****	14.932	23.763	35.250	**23.072*****	**28.031*****	−1.097	0.328	2.889	**75.014*****	**71.782*****
	(0.000)	**(0.027)**	(0.220)	(0.405)	(0.146)	**(0.004)**	**(0.000)**	(0.718)	(0.962)	(0.926)	**(0.000)**	**(0.000)**
Nmfi1	0.304	−3.596	−0.913	0.342	11.773	**12.762*****	---	---	---	---	---	---
	(0.789)	(0.159)	(0.861)	(0.978)	(0.259)	**(0.000)**						
Nmfi2	---	---	---	---	---	---	0.065	**0.929****	0.936	0.517	−2.229	**−2.230*****
							(0.911)	**(0.020)**	(0.291)	(0.897)	(0.369)	**(0.001)**
BkAcct	**7.309*****	−7.159	−0.550	5.267	31.741	**34.263*****	1.843	4.428	5.258	5.285	−8.329	**−7.349***
	(0.001)	(0.159)	(0.961)	(0.841)	(0.156)	**(0.000)**	(0.611)	(0.113)	(0.401)	(0.852)	(0.634)	**(0.096)**
BkAcct × Nmfi1	−1.741	3.294	0.266	−1.628	−12.656	**−13.758*****	---	---	---	---	---	
	(0.111)	(0.197)	(0.959)	(0.894)	(0.225)	**(0.000)**						
BkAcct × Nmfi2	---	---	---	---	---	---	0.308	**−0.739***	−0.792	−0.641	1.976	**1.871*****
							(0.593)	**(0.063)**	(0.373)	(0.873)	(0.427)	**(0.003)**
FSEmpl	**−0.536*****	**−0.150*****	**−0.156***	**−0.330***	**−0.629*****	**−0.543*****	**−0.730*****	**−0.208*****	**−0.203*****	−0.194	**−0.748*****	**−0.708*****
	(0.000)	**(0.000)**	**(0.060)**	**(0.089)**	**(0.000)**	**(0.000)**	**(0.000)**	**(0.000)**	**(0.000)**	(0.419)	**(0.000)**	**(0.000)**
Fertility	**3.087****	**2.351*****	1.377	2.342	0.934	**1.439****	**7.314*****	**3.333*****	**3.042*****	3.219	**2.517***	**2.482*****
	(0.033)	**(0.000)**	(0.132)	(0.274)	(0.606)	**(0.016)**	**(0.000)**	**(0.000)**	**(0.000)**	(0.185)	**(0.094)**	**(0.000)**
Trade	−0.041	**0.032*****	0.020	0.0001	−0.050	**−0.059*****	0.004	**0.039*****	**0.037*****	0.021	−0.012	**−0.019****
	(0.109)	**(0.001)**	(0.304)	(0.997)	(0.203)	**(0.000)**	(0.863)	**(0.000)**	**(0.002)**	(0.676)	(0.697)	**(0.019)**
CostBusiness	−0.022	−0.007	−0.008	−0.005	**−0.033***	**−0.054*****	**−0.049*****	**−0.019*****	**−0.016*****	−0.026	**−0.034****	**−0.038*****
	(0.125)	(0.112)	(0.383)	(0.974)	**(0.088)**	**(0.000)**	**(0.001)**	**(0.000)**	**(0.005)**	(0.306)	**(0.031)**	**(0.000)**
TimeBusiness	−0.029	**0.035*****	**0.054****	0.007	0.027	**0.058*****	−0.023	**0.053*****	**0.068*****	0.080	0.047	**0.041*****
	(0.398)	**(0.006)**	**(0.040)**	(0.908)	(0.598)	**(0.001)**	(0.531)	**(0.000)**	**(0.000)**	(0.279)	(0.299)	**(0.000)**
Startupprocd	0.193	**−0.457*****	**−0.596*****	−0.443	0.106	**0.277****	**0.810****	**−0.275*****	**−0.394*****	−0.393	0.078	**0.152****
	(0.451)	**(0.000)**	**(0.001)**	(0.255)	(0.747)	**(0.011)**	**(0.013)**	**(0.000)**	**(0.000)**	(0.394)	(0.782)	**(0.035)**
Net effects	na	na	Na	na	na	9.512	na	na	na	na	Na	0.488
Nmf threshold	na	na	Na	na	na	2.490	na	na	na	na	Na	nsa

TABLE 1 (Continued)

	Dependent variable: Female unemployment						Microfinance institutions per 100,000 adults					
	Microfinance institutions per 1,000 km^2											
	OLS	Q.10	Q.25	Q.50	Q.75	Q.90	OLS	Q.10	Q.25	Q.50	Q.75	Q.90
R^2/Pseudo R^2	0.688	0.364	0.360	0.357	0.524	0.713	0.622	0.353	0.325	0.279	0.490	0.702
Fisher	**11.54*****						**9.55*****					
Observations	88	88	88	88	88	88	88	88	88	88	88	88

Note: *, **, ***: significance levels of 10%, 5%, and 1%, respectively. OLS: Ordinary Least Squares. R^2 for OLS and Pseudo R^2 for quantile regression. Lower quantiles (e.g., Q 0.1) signify nations where female unemployment is least. FSEmpl: Female Self-Employment. Nmfi1: microfinance institutions per 1,000 km^2. Nmfi2: microfinance institutions per 100,000 adults. SES: Secondary female high school enrollment rate. Trade: trade openness. CostBusiness: The cost it takes for a woman to set up a business. TimeBusiness: The time of women to set up a business. Startupprocd: The procedures a woman has to go through to start a business. Bankaccount: dummy variable that takes the value of 1 if women can open bank accounts like men, 0 otherwise. The mean value of Nmfi1 is 1.799 while the mean value of Nmfi2 is 4.189. na: not applicable because at least one estimated coefficient needed for the computation of net effect is not significant. nsa: not specifically applicable because a positive threshold is apparent. The range of MFIs per 1,000 km^2 (Nmfi1) is 0.020 to 9.282 while the range of MFIs per 100,000 adults (Nmfi2) is 0.244 to 11.532. Bold values represent significant estimated coefficients and the Fisher statistics.

impact of bank account ownership or financial access on female unemployment, 4.189 is the mean or average value of MFIs per 100,000 adults while 1.871 is the interactive or conditional effect of financial access or bank account ownership on female unemployment.

Given the considered hypothesis and on the premise of significant estimated coefficients, it is apparent that the tested hypothesis is exclusively invalid in the 90th quantile where the significant positive net effects are established on the one hand. On the other hand, the tested hypothesis is neither validated nor invalidated for the remaining quantiles in which at least one estimated coefficient is not significant to require the computation of net effects. When corresponding thresholds are not computed, the information criteria for the validity of the tested hypothesis are that: (i) the estimated coefficients corresponding to the independent variables of interest should be significant to engender the computation of net effects; and (ii) when such significance is apparent, the corresponding net effects should be negative.

Most of the significant control variables have the expected signs, in accordance with the narrative on expected signs disclosed above in the data section. Moreover, in interactive regressions, the concern about multicollinearity is overlooked and hence only thresholds and net effects can be interpreted with confidence because they involve both the unconditional and conditional effects of the interacted variables (Brambor et al., 2006). Other variables included in the conditioning information set or control variables are not expected to have the anticipated signs because the concern of multicollinearity—which can affect the expected signs—is not taken into account in the computation of net effects. Accordingly, interpreting control variables distinctly would amount to interpreting the control variables as in linear additive models.

Concerning the heterogeneous effect of MFIs in the 10th quantile on the right hand side of Table 1, it is relevant to note that, MFIs play the role of moderating variables in the estimation exercise. Therefore, when the partial derivative of female unemployment on the main channel or bank account is taken, the unconditional effect of microfinance institutions becomes zero. Hence, the unconditional effect of microfinance institutions is not taken into account in the computation of corresponding net effects and thresholds. This is consistent with documented insights on interactive regressions (Brambor et al., 2006).

To improve policy implications, we performed an extended analysis to identify the MFIs' thresholds at which the positive unconditional effect of bank account on female unemployment changes to negative. In the left hand side of Table 1, the corresponding MFIs threshold is 2.490 (34.263/13.758). Hence, when MFIs per 1,000 km^2 exceed a threshold of 2.490 per 1,000 km^2, the total effect of female bank account

ownership on female unemployment changes from positive to negative. The corresponding threshold has policy relevance because it is situated within the statistical policy range of 0.020 to 9.282 apparent in the summary statistics. The corresponding threshold is not computed in the 90th quantile of the right hand side of Table 1 because a positive threshold is apparent instead.

Robustness checks: Accounting for simultaneity and the unobserved heterogeneity

To further assess if the findings in Table 1 withstand empirical scrutiny, a robustness analysis was performed controlling for more dimensions of endogeneity, notably: (i) simultaneity or reverse causality by lagging the independent variables of interest by 1 year (Mlachila et al., 2017); (ii) the unobserved heterogeneity in terms of time fixed effects (Tchamyou, 2021); and (iii) variable omission bias by controlling for the education variable, which was omitted in the initial regression exercise (Asongu, 2024). Accordingly, the procedure for accounting for endogeneity is adopted because other quantile regression approaches based on fixed effects and generalized quantile regression adopted by Byaro, Kinyondo, et al. (2023), Byaro, Rwezaula, et al. (2023), and Byaro, Mafwolo, et al. (2023) do not yield significant estimated coefficients. Moreover, the adopted approach is consistent with a strand of literature focusing on improving traditional quantile regressions to further account for simultaneity and the unobserved heterogeneity by means of accounting for lagged independent variables and time fixed effects, respectively (Asongu & Eita, 2024).

Following the same elements of style in reporting the findings in Table 1, we establish the following findings from Table 2. First, the net effect is positive in the 90th quantile of the left hand side and negative in the 10th quantile of the right hand side while the corresponding thresholds are 2.328 MFIs per 1,000 km^2 and 1.147 MFIs per 100,000 adults, respectively. It follows that 2.328 MFIs per 1,000 km^2 is needed at the 90th quantile for female ownership of bank accounts to reduce female unemployment while 1.147 MFIs per 100,000 adults is equally essential for bank account ownership by females to reduce female unemployment. Both thresholds are within the statistical ranges of the moderating variables in the summary statistics and thus are policy-relevant. However, when the findings in Table 1 are compared with those of Table 2, it becomes apparent that only the results on the left hand side of both tables in the 90th quantile withstand empirical scrutiny. So, the main conclusion from the findings is that MFIs per 1,000 km^2 must reach thresholds of between 2.328 (i.e., Table 2) and 2.490 (i.e., Table 1) at the 90th quantile of the female unemployment distribution in order for female bank account ownership to reduce female unemployment. The main policy implications of the study will build on this main finding.

Second, it is also apparent from Table 2 that, at the 90th quantiles, the coefficient size of the bank account variable is quite large. This is not a major issue because, in interactive regressions, the size of coefficients from the interactive constituents does not matter because the estimated coefficients are not interpreted as in linear additive models. When the thresholds are computed, irrespective of the magnitude of the corresponding unconditional and conditional effects, the thresholds have to be within statistical range to make economic sense and have policy implications. In other words, irrespective of the magnitude of estimated coefficients, when the threshold is computed by dividing the unconditional impact by the conditional effect, the effect of coefficient size disappears (Odhiambo, 2020, 2022). This is why the threshold is situated between the minimum and the maximum values of the moderating variable apparent in the summary statistics.

Clarifying the partial validity hypothesis and nexus with the literature

The discussion in this section follows two main strands: (i) clarification of the partial validity of the tested hypothesis in light of intuition and stylized facts; and (ii) the use of the gender inclusion literature to complement our clarifications.

On the first front, the partial validity of the tested hypothesis can be traceable to inter alia: (i) low penetration of female bank accounts, especially as this pertains to the ownership of bank accounts by males employed in the formal economic sector; and (ii) reduced relevance of MFIs in being connected with formal banking establishments and promoting the involvement of women in the formal economic sector. This second point is worth emphasizing. As apparent in Appendix Table D1 from Asongu and Acha-Anyi (2017) on the formal, semi-formal, and informal financial sectors, MFIs are contextualized as in the semi-formal financial sector. Hence, the absence of a significant nexus between the attendant semi-formal financial sector on the one hand and, on the other, the lack of a substantial linkage between formal financial institutions, such as banks and MFIs, can explain the insignificance of the findings.

Second, the partial validity of the tested hypothesis can also be clarified in light of the existing literature. This is so especially given that, at times, financial inclusion policies such as female bank account ownership and MFI-driven gender-inclusive measures can instead worsen the economic involvement of women in

TABLE 2 Female unemployment, microfinance institutions, and bank accounts (IVQR with year fixed effects plus education variable).

	Dependent variable: Female unemployment Microfinance institutions per 1,000 km^2						Microfinance institutions per 100,000 adults					
	OLS	**Q.10**	**Q.25**	**Q.50**	**Q.75**	**Q.90**	**OLS**	**Q.10**	**Q.25**	**Q.50**	**Q.75**	**Q.90**
Constant	**−1975.4****	**−518.985**	−817.59	−1251.43	**−1343.28****	−486.46	**−994.23**	563.30	1098.39	−925.15	**−1170.0****	**−1634.3*****
	(0.031)	**(0.196)**	(0.414)	(0.141)	**(0.026)**	(0.248)	**(0.333)**	(0.198)	(0.341)	(0.307)	**(0.045)**	**(0.009)**
Nmfi1 (−1)	−0.7503	−2.264	−0.322	−1.268	4.150	**20.718*****	---	---	---	---	---	---
	(0.888)	(0.565)	(0.974)	(0.879)	(0.473)	**(0.000)**						
Nmfi2 (−1)	---	---	---	---	---	---	2.211	**2.437***	2.479	0.207	−0.020	−0.970
							(0.368)	**(0.060)**	(0.461)	(0.937)	(0.990)	(0.579)
BkAcct (−1)	2.896	−3.735	2.071	5.322	12.556	**50.994*****	10.500	**15.184***	14.155	2.065	2.557	−3.549
	(0.810)	(0.657)	(0.922)	(0.764)	(0.311)	**(0.000)**	(0.428)	**(0.071)**	(0.517)	(0.904)	(0.813)	(0.755)
BkAcct × Nmfi1(−1)	0.074	1.952	−0.208	0.388	−4.218	**−21.897*****	---	---	---	---	---	
	(0.989)	(0.623)	(0.983)	(0.963)	(0.470)	**(0.000)**						
BkAcct × Nmfi2 (−1)	---	---	---	---	---	---	−1.090	**−2.123***	−1.693	0.321	0.270	1.142
							(0.572)	**(0.089)**	(0.602)	(0.899)	(0.866)	(0.500)
SES(−1)	−0.049	0.026	0.031	0.127	0.041	0.226***	−0.226	0.025	0.044	−0.024	−0.012	**−0.032**
	(0.747)	(0.640)	(0.826)	(0.287)	(0.619)	(0.000)	(0.173)	(0.654)	(0.766)	(0.836)	(0.868)	**(0.676)**
FSEmpl(−1)	**−0.625****	−0.053	−0.340	**−0.914*****	**−1.014*****	**−0.689*****	**−1.006*****	**−0.307*****	**−1.038*****	−1.136***	**−1.099*****	**−1.036*****
	(0.013)	(0.528)	(0.113)	**(0.000)**	**(0.000)**	**(0.000)**	**(0.001)**	**(0.003)**	**(0.000)**	(0.000)	**(0.000)**	**(0.000)**
Fertility(−1)	**7.917****	**3.049****	4.230	**11.309*****	11.476***	**4.784*****	6.359	**2.749***	**8.037****	9.654***	**11.811*****	**11.232*****
	(0.010)	**(0.029)**	(0.217)	**(0.000)**	**(0.000)**	**(0.000)**	(0.119)	**(0.054)**	**(0.034)**	(0.002)	**(0.000)**	**(0.000)**
Trade (−1)	−0.078	0.005	0.023	−0.013	0.001	−0.023	−0.009	**0.074*****	0.099	0.032	0.0004	−0.013
	(0.298)	(0.813)	(0.704)	(0.799)	(0.977)	(0.375)	(0.878)	**(0.009)**	(0.174)	(0.572)	(0.991)	(0.717)
CostBusiness (−1)	−0.007	−0.001	0.011	0.002	−0.001	−0.006	**−0.023****	**−0.005**	−0.029	−0.0008	−0.005	−0.004
	(0.493)	(0.867)	(0.508)	(0.886)	(0.884)	(0.345)	**(0.049)**	**(0.486)**	(0.125)	(0.957)	(0.590)	(0.661)
TimeBusiness (−1)	0.086	0.009	0.178	0.076	0.134	**0.182*****	**0.218***	**0.161****	0.219	0.208	0.095	0.110
	(0.597)	(0.881)	(0.262)	(0.566)	(0.148)	**(0.008)**	**(0.097)**	**(0.021)**	(0.222)	(0.141)	(0.284)	(0.237)
Startupprocd (−1)	0.502	−0.248	−0.848	0.104	0.181	**−0.510***	0.511	**−0.804*****	−0.290	−0.041	0.377	0.343
	(0.500)	(0.380)	(0.234)	(0.860)	(0.660)	**(0.091)**	(0.337)	**(0.006)**	(0.696)	(0.944)	(0.309)	(0.378)

(Continues)

TABLE 2 (Continued)

	Dependent variable: Female unemployment						Microfinance institutions per 100,000 adults					
	Microfinance institutions per 1,000 km^2											
	OLS	Q.10	Q.25	Q.50	Q.75	Q.90	OLS	Q.10	Q.25	Q.50	Q.75	Q.90
Time effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Net effects	na	na	Na	na	na	11.601	na	−6.456	na	na	Na	na
Thresholds	na	na	Na	na	na	2.328	na	1.147	na	na	Na	na
R^2/Pseudo R^2	0.862	0.4327	0.496	0.628	0.792	0.873	0.888	0.403	0.453	0.626	0.806	0.872
Fisher	**18.57*** **						**32.06*** **					
Observations	50	50	50	50	50	50	50	50	50	50	50	50

Note: *, **, ***: significance levels of 10%, 5%, and 1%, respectively. OLS: Ordinary Least Squares. R^2 for OLS and Pseudo R^2 for quantile regression. Lower quantiles (e.g., Q 0.1) signify nations where female unemployment is least. FSEmpl: Female Self-Employment. Nmfi1: microfinance institutions per 1,000 km^2. Nmfi2: microfinance institutions per 100,000 adults. SES: Secondary female high school enrollment rate. Trade: trade openness. CostBusiness: The cost it takes for a woman to set up a business. TimeBusiness: The time of women to set up a business. Startupprocd: The procedures a woman has to go through to start a business. Bankaccount: dummy variable that takes the value of 1 if women can open bank accounts like men, 0 otherwise. The mean value of Nmfi1 is 1.799 while the mean value of Nmfi2 is 4.189. na: not applicable because at least one estimated coefficient needed for the computation of net effect is not significant. The range of MFIs per 1,000 km^2 (Nmfi1) is 0.020 to 9.282 while the range of MFIs per 100,000 adults (Nmfi2) is 0.244 to 11.532. Bold values respresent significant estimated coefficients and the Fisher statistics.

the formal economic sector (see Cheah et al., 2021; Chen et al., 2021). Accordingly, it has been established in the literature that women could be less socio-economically included (Molinier & Quan, 2019) because, compared to men, they are more likely to adopt traditional modes of transactions (Cheah et al., 2021), especially as they relate to more use of transitional financial modes of transactions that are more connected to the informal financial sector (Demirgüç-Kunt et al., 2018). As substantiated by Demirgüç-Kunt et al. (2018) and Kofman and Payne (2021), married women could be controlled by husbands who limit their access to less informal modes of transaction while unmarried women may simply prefer to remain in the informal financial status quo. Conversely, the invalidity of the tested hypothesis is not consistent with the documented studies in the Theoretical underpinnings and hypothesis development section employed to formulate the testable hypothesis as well as studies on women using more contemporary and modern modes of transactions to improve their wellbeing, employment opportunities, and socio-economic avenues (Loko & Yang, 2022; Moufakkir & Mohammed, 2020; Sahay et al., 2020; Sioson & Kim, 2019; Suri & Jack, 2016; Yeyouomo & Asongu, 2023).

CONCLUDING IMPLICATIONS AND FUTURE RESEARCH DIRECTIONS

The present study assesses the relevance of MFIs in the effect of financial access on gender economic inclusion in 44 countries in SSA for the period 2004 to 2018. Financial access is measured in terms of female ownership of bank accounts while gender inclusion is measured in terms of reducing female unemployment. The hypothesis that financial access by means of female bank account ownership is moderated with MFIs to reduce female unemployment is consistently valid exclusively at the 90th quantile of the female unemployment distribution. MFIs per 1,000 km^2 must reach thresholds of between 2.328 and 2.490 at the 90th quantile of female unemployment distribution in order for female bank account ownership to reduce female unemployment. Given the partial validity of the tested hypothesis, we now note a few policy implications.

The partial validity of the tested hypothesis suggests that policy makers should tailor their policies toward two goals. The first concerns increasing the penetration of female bank account ownership so that more women looking for jobs in the formal economic sector should be in possession of a bank account, like their male counterparts. Second, policy makers should concentrate on improving the connection between MFIs (which are in the semi-formal financial sector) and the banking sector (which is in the formal economic

sector) as well as the nexus between MFIs and formal employment opportunities for women. A third policy implication relates to putting in place measures that fight the stigma against women in the formal economic sector, such that their involvement in mining, construction, factories, and transportation, should be prioritized and coordinated by both financial access and MFI policies focused on the promotion of more formal female economic participation. In summary, gender-sensitive programs should be promoted by policy makers and policy makers should also enforce the implementation of labor laws on antidiscrimination.

The perspective that MFI policy thresholds are relevant in order for female bank account ownership to reduce female unemployment at the 90th quantile of the conditional distribution of female unemployment leads to two main policy implications. First, the relevance of MFIs per 1,000 km in moderating female bank account ownership to reduce female unemployment is most relevant as a policy instrument when existing levels of female unemployment are at their highest. It follows that policy makers who have been considering the policy relevance of MFIs in promoting female financial access to reduce female unemployment from a common perspective *are getting their dynamics wrong*. More appropriate policies should be contingent on existing levels of female unemployment and thus tailored differently across countries with low, intermediate, and high initial levels of female unemployment. Second, while policy makers should ensure that MFIs exceed the established thresholds in order for financial access by females to reduce female unemployment, established MFI thresholds require fewer policy resources. This is essentially because the established MFI thresholds are closer to their minimum ranges in the summary statistics compared to their maximum ranges.

The findings in this study evidently provide space for future areas of research, especially as it relates to understanding why some of the nexuses are not significant in some of the considered quantiles. Moreover, it is also worthwhile to consider other SDGs, not least because the present study largely focuses on the fifth SDG (i.e., SDG5).

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CONFLICT OF INTEREST STATEMENT

The authors declare no conflict of interest.

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APPENDIX A

TABLE A1 Definitions and sources of variables.

Variables	Definitions	Sources
Female Unemployment	Unemployment, female (% of female labor force)	WDI (World Bank)
Microfinance 1	Microfinance institutions per 1,000 km^2	Financial Access Survey (2020)
Microfinance 2	Microfinance institutions per 100,000 adults	Financial Access Survey (2020)
Bank accounts	Dummy variable that takes the value 1 if women can open bank accounts like men, 0 otherwise.	Gender and parity statistics for men and women (2020)
Education	School enrollment, high, female (% gross)	WDI (World Bank)
Female Self-Employment	Self-employed, female (% of female employment)	WDI (World Bank)
Fertility	Fertility rate of women	WDI (World Bank)
Trade	Trade is the sum of exports and imports of goods and services measured as a share of gross domestic product.	WDI (World Bank)
Cost to start business	The cost it takes for a woman to set up a business.	Gender and parity statistics for men and women (2020)
Time to start business	The time it takes for a woman to set up a business.	Gender and parity statistics for men and women (2020)
Start-up procedure	The procedures a woman has to go through to start a business	Gender and parity statistics for men and women (2020)

Abbreviation: WDI, World Development Indicators.

APPENDIX B

TABLE B1 Summary statistics.

	Mean	SD	Min	Max	Obs
Female unemployment	9.206	8.512	0.218	38.265	645
Microfinance 1	1.799	1.877	0.020	9.282	97
Microfinance 2	4.189	3.092	0.244	11.532	97
Bank accounts	0.836	0.370	0.000	1.000	660
Education	43.377	26.076	6.542	112.824	391
Female self-employment	76.840	22.988	11.816	99.081	645
Fertility	4.812	1.220	1.36	7.63	616
Trade	74.769	34.486	19.100	225.023	604
Time to start business	40.416	39.625	4.000	261	635
Cost to start business	108.518	140.472	0.200	1229.100	635
Start-up procedure	9.468	3.089	3.000	18.000	635

Abbreviations: Max, maximum; Min, minimum; SD, standard deviation.

APPENDIX C

TABLE C1 Appendix 3: Correlation matrix (uniform sample size: 50).

	FUmpl	Nmfi1	Nmfi2	Account	SES	FSE	Fertility	Trade	Cost	Time	StartupP
FUmpl	1.000										
Nmfi1	−0.364	1.000									
Nmfi2	−0.155	0.238	1.000								
Account	0.112	0.015	−0.286	1.000							
SES	0.298	0.307	0.121	−0.367	1.000						
FSE	−0.649	−0.177	0.456	0.015	−0.628	1.000					
Fertility	−0.093	−0.483	0.371	0.065	−0.693	0.731	1.000				
Trade	−0.451	−0.200	0.179	0.117	−0.198	0.610	0.206	1.000			
Cost	−0.312	−0.196	0.067	−0.010	−0.448	0.505	0.391	0.159	1.000		
Time	0.391	−0.675	−0.214	−0.021	−0.182	0.073	0.376	0.049	0.475	1.000	
StartupP	0.105	−0.485	−0.411	−0.013	−0.068	0.021	−0.039	0.289	0.472	0.772	1.000

Abbreviations: Account, dummy variable that takes the value 1 if women can open bank accounts like men, 0 otherwise; Cost, the cost it takes for a woman to set up a business; FSE, Female Self Employment; FUmpl, Female Unemployment; Nmfi1, microfinance institutions per 1,000 km^2; Nmfi2, microfinance institutions per 100,000 adults; SES, Education; StartupP, the procedures a woman has to go through to start a business; Time, the time of women to set up a business; Trade, trade openness.

APPENDIX D

TABLE D1 Segments of the financial system by degree of formality in Paper's context.

Paper's context			Tiers	Definitions	Institutions	Principal Clients
Formal financial system	IMF definition of Financial System from International Financial Statistics (IFS)	Formal Financial sector (Deposit Banks)	Formal banks	Licensed by central bank	Commercial and development banks	Large businesses, Government
Semi-formal and informal financial systems		Semi-formal financial sector(Other Financial Institutions)	Specialized non-bank financial institutions		Rural banks, Post banks, Saving and Loan Companies, Deposit taking Micro Finance banks	Large rural enterprises, Salaried Workers, Small and medium enterprises
			Other non-bank financial institutions	Legally registered but not licensed as a financial institution by the central bank and government	Credit Unions, Micro Finance NGOs	Microenter-prises, Entrepre-neurial poor
	Missing component in IFS definition	Informal financial sector	Informal banks	Not legally registered at the national level (though may be linked to a registered association)	Savings collectors, Savings and credit associations, Money lenders	Self-employed poor

Source: Asongu and Acha-Anyi (2017)

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