



Financial Inclusion and the Welfare of Smallholder Farmers in Songwe Region, Tanzania

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Abstract

This study examined how financial inclusion is associated with the welfare of smallholder farmers in Songwe Region, Tanzania, whether reported farm income accounts for the association, and if differs by gender, education and asset wealth. A cross-sectional survey of 420 farmers in nine wards of four districts was carried out in May and June 2025. A Composite Financial Inclusion Index (CFII) and a Welfare Index (food security, housing, electricity, living standard) were built by principal component analysis. Estimation used ordinary least squares with robust standard errors, bootstrap mediation and interaction models. A higher CFII was associated with higher welfare after controlling for personal and household characteristics, asset wealth and district ($b = .096, p < .001$), in all 14 specifications examined. Reported farm income did not mediate the association (indirect effect .003, 95% CI $[-.004, .011]$). It was stronger among farmers with no formal education and in the lowest asset tercile, and, though not significantly, among women ($p = .067$). Scores were bunched near the maximum among better-off farmers, and the difference by asset wealth was not significant when asset items that overlap with the welfare indicators were left out. Cross-sectional associations cannot show cause. Income was recorded in three bands, and the welfare index is only moderately coherent (Kaiser-Meyer-Olkin = .58). Programmes may do most for the least educated and least wealthy farmers and should track food security, housing and living standards, not income alone. Evaluations should test this. Generally, financial inclusion is positively associated with smallholder welfare. The evidence shows association, not effect, and does not support an income pathway

Introduction

Financial inclusion (FI) is widely promoted by governments, development agencies, and multilateral institutions as a lever against rural poverty, on the premise that access to savings, credit, insurance, and digital payments allows households to smooth consumption, manage risk, and invest productively (Demirgüç-Kunt et al., 2018, 2019; Adegbite & Machethe, 2020). In Tanzania, this premise has motivated sustained financial-sector reform since 1991, expanding formal financial infrastructure to over 61 banks and five mobile money providers (Bank of Tanzania [BOT], 2018; Mpogole et al., 2020), and formal financial inclusion that reached 76% of adults in 2023, up from 65% in 2017 (Financial-Sector Deepening Trust Tanzania [FSDT], 2023). Yet whether this expansion is linked to better welfare for smallholder farmers rather than simply increased account ownership is a separate



empirical question, and one that has received comparatively little rigorous attention at the micro level in Tanzania.

Three specific gaps motivate this study. First, much of the existing evidence on FI and welfare comes from cross-country panel studies (Park & Mercado, 2021; Tsouli, 2022) that cannot speak to the mechanisms operating within a specific rural economy. Second, where household-level welfare studies exist for Sub-Saharan Africa (Mhlanga et al., 2020, in Zimbabwe; Munyegera & Matsumoto, 2016, in Uganda), few examine whether the link between inclusion and welfare runs through income or through non-income channels such as consumption smoothing, a distinction that matters for how financial inclusion programmes are designed. Third, differences by gender have been examined elsewhere in Africa (Dupas & Robinson, 2013; Suri & Jack, 2016), but few studies that report differences by education or asset wealth among smallholder farmers, and none for Tanzanian smallholders.

Theoretical Review

Two frameworks guide this study. The Sustainable Livelihoods Framework starts from the idea that people make a living by combining assets and activities (Chambers & Conway, 1992) and groups assets into human, natural, physical, social and financial capital (Department for International Development [DFID], 1999). Financial inclusion adds to a household's financial capital, and the framework suggests that its link with welfare may run through several routes, not only income, and may depend on the household's other assets. Vulnerable Group Theory argues that groups facing structural barriers, such as women and the poor, are more likely to be excluded from finance and may gain from it differently (Ozili, 2020). Together the two frameworks motivate the tests of income as a possible channel and of differences by gender, education and asset wealth.

Empirical Review

Studies from Africa report positive links between financial inclusion and household welfare. Mhlanga et al. (2020) used simple regression on survey data from smallholder farmers in Zimbabwe and reported a strong impact of financial inclusion on poverty reduction. Munyegera and Matsumoto (2016), using panel data from rural Uganda, found that households adopting mobile money had higher per capita consumption and linked this to greater receipt of remittances. Suri and Jack (2016) found that access to the M-PESA mobile money system in Kenya raised per capita consumption and lifted about 2% of Kenyan households out of poverty, with larger impacts for female-headed households, which they linked to greater financial resilience, saving and a move out of agriculture into business.

Experimental evidence is more mixed. Dupas and Robinson (2013) randomly offered savings accounts to market vendors, who were mostly women, and to bicycle-taxi drivers in rural Kenya. Market women used the accounts, saved more and increased their business investment and private expenditure, but bicycle-taxi drivers showed no impact. Banerjee et al. (2015), in a randomised evaluation of group microcredit in Hyderabad, India, found no significant increase in consumption and no significant changes in health, education or women's empowerment. Most of these studies concern a single product such as mobile money, savings or credit, not a multidimensional measure of inclusion, and few report whether income explains the welfare difference.

The purpose of this study is therefore to examine how the level of financial inclusion is associated with the welfare of smallholder farmers in Songwe Region, Tanzania. Specifically, it (i) estimates the association between a composite financial inclusion index and a welfare index, (ii) tests whether reported farm income accounts for that association, and (iii) examines whether the association differs



by gender, education and asset wealth. The study uses cross-sectional data, so it reports associations and does not claim to estimate causal effects.

Methods

Research design

The study used a quantitative, cross-sectional survey. This design suits the purpose because the aim is to estimate the association between inclusion and welfare across many farmers at one point in time and to see for whom it is stronger. An experimental design would need random or otherwise independent variation in access to finance, which was not available, and a qualitative design would not give estimates that can be compared across farmers. A longitudinal design could separate cause from consequence better, but was not used here, so the findings are reported as associations.

Data and instrument

The data are primary, quantitative data collected between 27 May and 4 June 2025 with a structured questionnaire administered on KoboCollect. The financial inclusion questions were yes/no items on access, usage, quality and digital services. Welfare was recorded through questions on food security, housing and utilities, and living standards. Age, years of farming, household size and farm income were recorded in bands. Data were collected from 420 smallholder farmers in nine wards of four districts: Mbozi (210 farmers in Igamba, Ihanda, Kilimampimbi and Ukwile wards), Ileje (90 in Chitete and Mbebe), Momba (90 in Ndalambo and Nkangamo) and Songwe (30 in Mwambani). Each ward contributed 30 or 60 farmers. Because quotas were fixed by ward and no weights were applied, the results describe the surveyed farmers and should not be read as regional estimates.

Conceptual framework

Figure 1 shows the constructs and the relationships examined. Financial inclusion is measured by the CFII and its four dimensions. Welfare is measured by an index of four indicators. Reported farm income is tested as a channel linking the two, and gender, education and asset wealth are tested as characteristics that may change the strength of the association. Personal, household and district characteristics are controlled. The arrows show associations to be tested, not established causal effects.

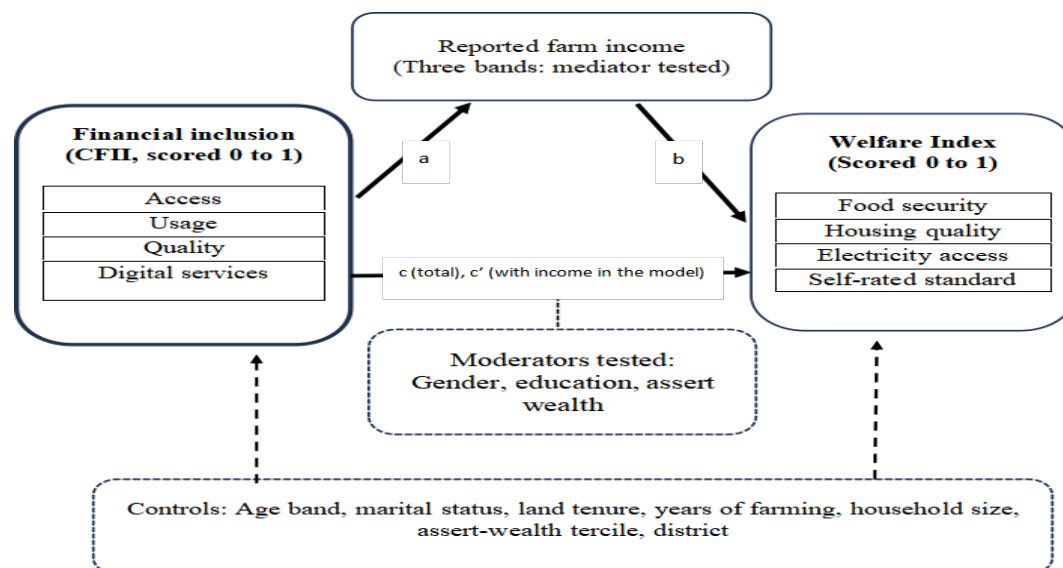


Figure 1: Associations examined in a cross-sectional survey of 420 smallholder farmers, Songwe Region

CFII = Composite Financial Inclusion Index. Numbers in brackets are the numbers of indicators in each dimension. Arrows show associations examined in cross-sectional data, not established causal effects.

Financial inclusion index

The Composite Financial Inclusion Index (CFII) combines 38 distinct yes/no indicators in four dimensions. Access (8 indicators) covers, for example, being able to save, deposit and receive payments through a bank, having a bank nearby, and access to mobile money and insurance. Usage (10) covers holding bank and mobile money accounts, having secured a loan, and using accounts for saving, deposits and payments. Quality (12) covers, for example, trust in banks, clear disclosure of fees, loan terms that suit the farmer, and respectful and tailored service. Digital services (9) cover regular use of digital financial tools, digital payments and loans, and internet and SIM banking. One indicator (receiving digital payments) belongs to both the usage and the digital dimension.

The index was built in two stages by principal component analysis on correlation matrices (Cámara & Tuesta, 2014). In stage one, the indicators of each dimension were standardised, weighted by the loadings of the first principal component, summed, and rescaled to run from 0 to 1. In stage two, the four-dimension scores were combined in the same way, and the result was rescaled to give the CFII from 0 (least-included) to 1 (most included). No other weights were applied. The weight of each indicator (its coefficient in the first component), its loading and the share of farmers answering yes are listed in Appendix Table A1. In stage one, the first component explained 58.9% to 68.4% of the variance of its indicators (Kaiser-Meyer-Olkin, KMO = .88 to .94; Kaiser, 1974), and the internal consistency of each dimension was high (Kuder-Richardson 20 = .91 to .96; Kuder & Richardson, 1937). In stage two, the first component explained 89.3% of the variance (eigenvalue = 3.57), and all four dimensions loaded between .91 and .96.

Fifty-two respondents left at least one of the 38 indicators blank (33 of them only one). Their answers on the remaining indicators were less often "yes" (30.6% of answered indicators, against 36.8% for the



other farmers), and blanks were in Ileje (22 of 90 farmers, against 23 of 210 in Mbozi), so dropping them would remove many of the least-included farmers. Blank answers were therefore set to the most common answer for that indicator, which keeps all 420 farmers in the analysis. Most farmers answered “no” to 31 of the 38 indicators, so this rule set 120 of the 130 blank answers to “no” and 10 to “yes”. It therefore moves these farmers toward lower, not higher, inclusion: their mean CFII is .270 under this rule, .267 if every blank is set to “no” and .336 if every blank is set to “yes” (Appendix Table A3). The CFII built from complete cases only is used as a robustness check.

Welfare index

Welfare was measured with four indicators, each scored from 0 to 1 with higher values meaning better welfare. Food security is the average of three items: no worry about having enough food in the past 7 days, no shortage of food in the past 12 months, and three or more meals a day. Where an item was blank (8 farmers for the 12-month item), the average of the answered items was used. Housing quality is the average of four items: finished floor, durable roof, durable walls (baked bricks, concrete or stones), and toilet facility (none, unimproved pit latrine, or improved). Farmers who left the toilet question blank (14) were scored 0 on that item. Electricity access is scored 1 if the household reports a main source of electricity (grid or solar) and 0 otherwise, including when the question was left blank (44 farmers). Self-rated living standard is the respondent’s description of the household’s current circumstances (rich, comfortable, can manage to get by, never have quite enough, or poor), reversed so that higher means better. The four indicators were combined by principal component analysis on their correlation matrix, and the first component was rescaled to run from 0 to 1 to give the Welfare Index. Whether a single index is justified was judged from the correlations, eigenvalues (Kaiser, 1960), a parallel analysis (Horn, 1965), loadings and sampling adequacy reported in the Results, and each indicator was also analysed separately. The simple average of the four indicators was used as an alternative score.

Other variables

Controls were gender (female or male, as reported by the respondent), age band, education (none, primary, secondary or higher), marital status, land tenure (owner, or renter or both), years of farming, household size band, asset wealth tercile and district. Asset wealth is the first principal component of 35 yes/no indicators of household and productive assets (Filmer & Pritchett, 2001), divided into three equal groups. Asset wealth is treated as a characteristic that exists before the welfare outcome: it enters as a control and as the grouping variable in the tests of differences, and it is not tested as a channel. Six of the 35 asset items (owned houses, refrigerator, television, DVD player, electric fan and satellite dish) concern the dwelling or electric appliances and overlap in content with housing quality and electricity access, so an asset index without them is used as a check. Reported farm income, the mediator, was recorded in three bands (up to 2 million, 2 to 10 million and 10 to 20 million TZS) and entered as a score from 1 to 3.

Estimation

The association between CFII and welfare was estimated by ordinary least squares in three models: CFII alone (Model 1), with personal and household controls (Model 2), and with district added (Model 3). The welfare index was built for all 420 farmers; two farmers did not report an income band, so every regression, including those that do not use income, is estimated on the same 418 farmers (Tables 2 and 3). Mediation followed the regression steps of Baron and Kenny (1986) on the same 418 farmers and with the same controls throughout, so that the total association (c), the association with the mediator included (c’) and the indirect association ($a \times b$) are consistent by construction. The 95% confidence interval of the indirect association comes from 5,000 bootstrap resamples (Hayes, 2018). Differences by group were tested by adding interactions between CFII and gender, education or asset



wealth tercile, with the main effects always in the model, and by reporting the association (slope) in each group with its confidence interval. Fourteen alternative specifications were also estimated (Appendix Table A2); none was set in advance. They include a CFII built from complete cases, an equal-weight CFII, log (CFII + 0.01), dropping Songwe, alternative welfare scores, no asset controls, ward-clustered standard errors, each CFII dimension alone, and an ordered logit model of welfare in terciles (low, middle, high). Heteroscedasticity-robust standard errors were used throughout (White, 1980). Further checks examined the treatment of blank indicators, the simple average welfare score, an asset index without the overlapping items and the share of farmers at the top of the food and housing scales (Appendix Tables A3 and A4). Analyses were carried out in Python using the pandas, NumPy, SciPy and statsmodels packages (Seabold & Perktold, 2010).

Results

Construction of the welfare index

Table 1: Welfare Index: Correlations Between Indicators, Component Loadings and Eigenvalues

Indicator	Food security	Housing quality	Electricity access	Self-rated living standard	PC1 loading	PC2 loading
Correlations and loadings						
Food security	1				.68	-.06
Housing quality	.25	1			.76	.07
Electricity access	.29	.35	1		.70	-.47
Self-rated living standard	.13	.21	-.02	1	.36	.89
Components						
	Eigenvalue	Variance (%)	Cumulative (%)			
PC1	1.66	41.4	41.4			
PC2	1.02	25.4	66.8			
PC3	0.76	18.9	85.7			
PC4	0.57	14.3	100.0			

Note. $n = 420$. PC = principal component. Correlations are Pearson coefficients. Kaiser–Meyer–Olkin = .58; Bartlett’s test of sphericity $\chi^2 (6) = 132.7$, $p < .001$. Each indicator is scored from 0 to 1, higher meaning better.

Table 1 shows how the four welfare indicators relate to each other. Food security, housing quality and electricity access are positively correlated with one another ($r = .25$ to $.35$). Self-rated living standard is only weakly related to them ($r = .13$ with food security, $.21$ with housing and $-.02$ with electricity). The first component has an eigenvalue of 1.66, above the Kaiser criterion of 1, and explains 41.4% of the variance. Food security, housing quality and electricity access load strongly on it ($.68$ to $.76$), but self-rated living standard loads weakly ($.36$). The second component has an eigenvalue of 1.02, only just above 1, and is almost entirely the self-rated living standard (loading $.89$). The first component therefore describes mainly material conditions, and self-rated living standard behaves as a separate dimension. By the Kaiser criterion two components would be kept, but a parallel analysis with 2,000 random permutations of the data (Horn, 1965) gave 95th-percentile eigenvalues of 1.18 for the first component and 1.07 for the second, so only the first exceeds what chance would produce. One component is therefore retained, and self-rated living standard is also analysed alone (Table 2) and left out of an alternative index (Appendix Table A2). Sampling adequacy is mediocre (KMO = .58, just under the .60 commonly taken as a minimum), although Bartlett’s test shows that the indicators are correlated ($\chi^2 (6) = 132.7$, $p < .001$). The Welfare Index is therefore used as a summary of material



welfare that is only moderately coherent, and each indicator is also analysed separately. The index correlates .98 with a simple average of the four indicators, and results for the simple average are reported alongside (Appendix Tables A2 and A4). Many farmers score high: 53.6% have the maximum food security score and 65.0% the maximum housing score, which limits how much better-off farmers can rise. Maximum scores are more common among better-off groups: 58% of farmers with secondary education or more scored the maximum on both food security and housing, against 32% of those with no formal education, and 61% in the highest asset tercile against 29% in the lowest (Appendix Table A4).

Financial inclusion and welfare

Table 2: Association Between the Financial Inclusion Index and Welfare

	Index, Model 1	Index, Model 2	Index, Model 3	Food security	Housing quality	Electricity access	Self-rated living standard
CFII, <i>b</i> (SE)	.242 (.023)	.122 (.025)	.096 (.027)	.137 (.049)	.054 (.025)	.034 (.037)	.101 (.039)
95% CI	[.198,.287]	[.072,.172]	[.043,.149]	[.041,.233]	[.005,.104]	[-.039,.107]	[.025,.176]
<i>p</i>	< .001	< .001	< .001	.005	.032	.364	.009
Personal and household controls	No	Yes	Yes	Yes	Yes	Yes	Yes
District	No	No	Yes	Yes	Yes	Yes	Yes
<i>R</i> ²	.184	.311	.329	.163	.225	.273	.326
<i>n</i>	418	418	418	418	418	418	418

Note. Ordinary least squares; dependent variables scored 0 to 1. The first three columns use the Welfare Index; the last four use the single indicators with the Model 3 specification. *b* = unstandardised coefficient (change in welfare score per unit of CFII); *SE* = heteroscedasticity-robust standard error (HC1); CI = confidence interval. Controls: gender, age band, education, marital status, land tenure, years of farming, household size band and asset wealth tercile.

Table 2 shows that farmers with higher CFII scores have higher welfare scores in every model. The association is .242 index points per unit of CFII with no controls (Model 1), .122 after personal and household characteristics and asset wealth are controlled (Model 2), and .096 after district is added (Model 3). Both scales run from 0 to 1, so a CFII that is 0.1 higher goes with a welfare score about .010 points higher. In standard-deviation terms, a farmer one standard-deviation higher on the CFII has a welfare score about .17 standard deviations higher. The fall from Model 1 to Model 3 shows that much of the raw association reflects differences in education, assets and district between farmers. When each welfare indicator is analysed alone (last four columns), CFII is positively associated with food security (*b* = .137), self-rated living standard (.101) and housing quality (.054), but not with electricity access (.034, *p* = .364).

Income as a possible channel

Panel A of Table 3 tests whether reported farm income carries the association. The total association (*c* = .096) and the association with income in the model (*c'* = .093) are almost the same, and their difference equals the indirect association (*a* × *b* = .003), as it must when all three are estimated on the same farmers. The indirect association is small and its bootstrap confidence interval includes zero [−.004, .011], so about 3% of the total association passes through reported income, and this share cannot be distinguished from zero. Farmers with higher CFII did not report higher income bands (*a* = −.088, 95% CI [−.251, .089]), and income bands were not significantly related to welfare once CFII was controlled (*b* = −.035, 95% CI [−.074, .003]). Using a yes/no indicator of income above 2 million TZS gave the same result (indirect association .003, 95% CI [−.003, .012]). Asset wealth is not tested as a



channel because it is a characteristic that exists before the outcome and is already controlled; the total association without the asset controls is larger (.144; Appendix Table A2). What remains after income and the other controls is an association that this study cannot explain, because the possible channels were not measured.

Table 3: Mediation by Reported Farm Income and Differences by Gender, Education and Asset Wealth

	<i>n</i>	Estimate	95% CI	
Panel A. Reported farm income as mediator				
<i>a</i> : CFII - income band	418	-.088	[-.251, .089]	
<i>b</i> : income band - welfare (CFII held constant)	418	-.035	[-.074, .003]	
<i>c</i> : CFII - welfare, total	418	.096	[.042, .151]	
<i>c'</i> : CFII - welfare, with income in the model	418	.093	[.040, .148]	
<i>a</i> × <i>b</i> : indirect association via income	418	.003	[-.004, .011]	
Share of total passing through income (%)	418	3.2		
Panel B. Association between CFII and welfare, by group				
Gender				
Men	201	.064 (.032)	[.002, .126]	<i>p</i> = .067
Women	217	.149 (.040)	[.070, .228]	
Education				
None	117	.276 (.073)	[.132, .419]	Joint <i>p</i> = .010
Primary	164	.104 (.043)	[.020, .188]	
Secondary or higher	137	.041 (.033)	[-.024, .107]	
Asset wealth tercile				
Lowest	140	.322 (.062)	[.201, .442]	Joint <i>p</i> < .001
Middle	139	.083 (.045)	[-.005, .170]	
Highest	139	.067 (.032)	[.004, .130]	

Panel A: The confidence intervals are percentile intervals from 5,000 bootstrap

resamples; all paths use the same farmers and controls, so $c - c' = a \times b$.

Panel B: Each estimate is the change in welfare score per unit of CFII within the group, from a model with CFII, the group variable, their interaction and the other controls; confidence intervals use robust standard errors. The test of difference is for the interaction terms (joint Wald test where there are three groups).

Differences by gender, education and asset wealth

Panel B of Table 3 shows the association between CFII and welfare within each group. Women's welfare scores rose more with CFII (.149) than men's (.064), but the difference (.085) is not statistically significant ($p = .067$). The association differed by education (joint test $p = .010$). It was largest among farmers with no formal education (.276), smaller among those with primary education (.104), and not significantly different from zero among those with secondary education or more (.041, 95% CI [-.024, .107]). It also differed by asset wealth (joint test $p < .001$): it was largest in the lowest asset tercile (.322) and much smaller in the middle (.083, 95% CI [-.005, .170]) and highest terciles (.067, 95% CI [.004, .130]). On the main index the association is therefore largest among the least educated and the least wealthy farmers, but three checks qualify this. Maximum scores on food security and housing are much more common among better-off farmers, which leaves less room to rise (Appendix Table A4). The differences by education did not appear for self-rated living standard, which has almost no maximum scores (joint $p = .544$), and the difference by asset wealth was not significant for it either ($p = .293$). With an asset index that leaves out the six items overlapping with welfare, the associations were .237 in the lowest, .113 in the middle and .098 in the highest tercile, and the difference was not



significant (joint $p = .269$). This is the opposite of the expectation that education and inclusion strengthen each other, and it does not single out the middle of the wealth distribution.

Robustness checks

The positive association held in all 14 specifications, with p below .02 in every case (Appendix Table A2). Where the scale matches the main model, the CFII coefficient ranged from .058 to .144. It was similar when the CFII was built from complete cases (.109) or as an equal-weight index (.105), when Songwe was dropped (.093), when welfare was the average of the four indicators (.081) or left out the self-rated indicator (.094), and with standard errors clustered by ward (.096, $SE = .020$). It was larger without asset controls (.144). Each CFII dimension alone was positively associated with welfare, with quality the strongest (.102) and usage the weakest (.058). The log specification is on a different scale (.043), and in the ordered logit model of welfare terciles the log-odds coefficient was 1.51. Further checks are in Appendix Table A3. Setting blank CFII indicators to “no” gave .097, and setting them to “yes” gave .074 ($p = .009$). Leaving a blank toilet item out of the housing score gave .102. Using asset terciles from an index without the six overlapping items gave .115, and a welfare score built only from food security and self-rated living standard gave .119 (.138 with those asset terciles).

Discussion

This study found that smallholder farmers with higher financial inclusion scores had higher welfare scores after controlling for personal and household characteristics, asset wealth and district ($b = .096$), and the association was positive in all 14 specifications examined. This agrees with Mhlanga et al. (2020), who reported a strong association between financial inclusion and poverty reduction among smallholder farmers in Zimbabwe, and with Munyegera and Matsumoto (2016) and Suri and Jack (2016), who found higher consumption among households with mobile money use or access in Uganda and Kenya. The association here is modest: a farmer one standard-deviation higher on the CFII had a welfare score about .17 standard deviations higher. The studies from Uganda and Kenya used panel data and designs aimed at identifying effects, whereas this study is cross-sectional, so it cannot say whether inclusion raises welfare or whether better-off households are better placed to become included. Not all studies find welfare gains. Banerjee et al. (2015) found no significant increase in consumption from group microcredit in Hyderabad, and Dupas and Robinson (2013) found gains from savings accounts for market women but not for bicycle-taxi drivers. Contrary results such as these suggest that the link between finance and welfare depends on the type of financial service and the type of user, which a single composite index cannot separate.

Reported farm income did not account for the association. The indirect association through income was close to zero (.003, 95% CI $[-.004, .011]$), and income carried only about 3% of the total. This differs from the expectation that finance works mainly by raising income, and from Munyegera and Matsumoto (2016), who traced their consumption result to remittances. It should not be read as showing that income plays no part. Income was recorded in three bands with 80.5% of farmers in the lowest, so it is a weak measure, and the test has little power. Consumption smoothing, saving and changes in occupation, which Suri and Jack (2016) suggested lie behind their results, are possible channels here but were not measured, so what carries the remaining association is unknown.

Women's welfare scores rose more with inclusion than men's (.149 against .064). This is the direction reported by Suri and Jack (2016), who found larger impacts for female-headed households, and by Dupas and Robinson (2013), whose savings-account effects were found among market women. In this study the difference is not statistically significant ($p = .067$), so it should be treated as suggestive only. Gender here is the sex of the respondent, not of the household head, so the comparison with Suri and Jack is not exact.



The association was strongest among farmers with no formal education (.276) and weakest among those with secondary education or more (.041), and strongest in the lowest asset tercile (.322) and weakest in the highest (.067). These patterns do not support the idea that education and financial inclusion complement each other, and they do not support targeting the middle of the wealth distribution. One reading is that farmers with the least education and fewest assets have the most to gain from access to financial services. Another is that welfare scores are bunched near the top of the scale among better-off households, so there is less room to rise. The shares of farmers at the maximum on both food security and housing support this reading in part: they rise from 32% to 58% across education groups and from 29% to 61% across asset terciles (Appendix Table A4). The asset difference may also partly reflect items shared by the asset index and the welfare indicators, since it was not significant with an index that leaves them out. The data cannot tell these readings apart. Grohmann et al. (2018) show that financial literacy is associated with greater inclusion across countries, so education may matter mainly by helping farmers become included, with little further difference in what inclusion adds to welfare. This idea was not tested here.

Limitations

Several limitations apply. First, the results are cross-sectional associations. Households with higher welfare may be better placed to save and borrow, so the link could run from welfare to inclusion, and household characteristics not controlled here, such as market access or entrepreneurial activity, could drive both. Second, the sample comes from nine wards with fixed quotas, and Songwe is represented by one ward, so district results are in effect ward results, standard errors that ignore clustering may be too small, and the findings cannot be generalised to the region. Third, the Welfare Index is only moderately coherent ($KMO = .58$), the self-rated indicator is weakly related to the other three, many farmers score at the top of the food and housing scales, and the indicators were scored by the authors from categorical answers, so other scoring rules could give different results. Fourth, income was recorded in three bands, so the mediation test is weak. Fifth, no data were collected on consumption smoothing, remittances, saving or shocks, so nothing here speaks to whether welfare gains hold up in bad harvest years. Blank answers on the CFII indicators were set to the most common answer, and the asset index shares some content with the housing and electricity indicators; the checks on both are reported in Appendix Table A3, and the difference by asset wealth did not hold when the overlapping items were removed. Finally, many models were estimated and none of the robustness specifications was set in advance, so a few significant results may arise by chance.

Conclusion

Smallholder farmers in Songwe Region who scored higher on a composite measure of financial inclusion also had higher welfare scores, after accounting for personal and household characteristics, asset wealth and district. The association was small to moderate, appeared in every specification tried, was not explained by reported farm income, and was largest among farmers with no formal education and, on the main index, among those with the fewest assets. Because the data are cross-sectional, these findings describe association and do not show that inclusion raises welfare.

If the association reflects real benefits, three implications follow, and each should be tested in programme evaluations. First, extending inclusion to farmers with no formal education and low asset wealth is worth piloting, because the association with welfare was largest among the least educated farmers and, on the main index, among those with the fewest assets. Second, because reported income did not carry the association, programmes should not be judged only by income gains, and should also track food security, housing and farmers' own assessment of their living standard. Third, gender-responsive design deserves attention, given the larger but not statistically significant association for women.



Further studies should use panel data or a credible identification strategy, for example variation in access created by the expansion of agent networks or a randomised rollout, to test whether inclusion changes welfare. They should measure the possible channels directly (consumption, remittances, saving, shocks and coping), record income or consumption as continuous values, use probability sampling across more wards and districts with a larger sample in Songwe, and validate the welfare index against a standard measure such as consumption expenditure. The area still has room for more examination, especially for smallholder farmers in Tanzania.

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Appendix

Table A1: Weights and Loadings in the Construction of the Composite Financial Inclusion Index

Indicator	Yes (%)	Loading	Weight	Relative weight (%)
Access (stage one: eigenvalue 5.12, 64.0% of variance)				
Can access a bank account to save	29.9	.91	.40	14.6
Can make deposits into a bank account	28.9	.94	.41	15.1
Can make payments through a bank	26.1	.93	.41	14.9
Can receive payments into a bank account	22.6	.92	.41	14.7
Can access insurance services	22.1	.88	.39	14.2
Bank or access point within reasonable distance	45.2	.55	.24	8.8
Has access to mobile money services	75.4	.44	.19	7.1
Borrowing history is in the reference bureau	19.3	.66	.29	10.6
Usage (stage one: eigenvalue 6.84, 68.4% of variance)				
Has a bank account	32.2	.88	.34	10.8
Has a mobile money account for business	40.5	.78	.30	9.6
Has secured a loan from a provider	41.1	.75	.28	9.1
Uses bank account to save	26.9	.93	.35	11.3
Uses bank account to make deposits	25.7	.93	.35	11.4
Uses a bank to make payments	24.3	.91	.35	11.2
Receives payments into a bank account	21.4	.90	.34	11.0
Uses mobile money for transactions	67.2	.50	.19	6.1
Receives payments through mobile apps, QR codes or point-of-sale devices (also in Digital)	14.9	.78	.30	9.5
Uses nearby ATMs	19.3	.82	.31	10.0
Quality (stage one: eigenvalue 8.16, 68.0% of variance)				
Trusts and relies on the formal banking system	38.6	.73	.26	7.4
Providers clearly disclose services and fees	31.2	.85	.30	8.6
Given clear information on rights and responsibilities	35.0	.89	.31	9.0
Loan products meet needs	33.5	.89	.31	9.0
Loan terms and conditions are suitable	35.3	.88	.31	8.9
Services are tailored to needs	36.1	.88	.31	8.9
Equal access without discrimination	63.2	.69	.24	7.0
Services received respectfully	58.6	.72	.25	7.3
Providers offer a variety of services	38.8	.88	.31	9.0
Can choose between providers	38.3	.86	.30	8.8
Can switch providers easily	35.2	.87	.31	8.9
Can read and explain services and products	48.2	.71	.25	7.2
Digital (stage one: eigenvalue 5.30, 58.9% of variance)				
Regularly uses mobile banking or digital financial tools	53.3	.64	.28	9.4
Receives payments through mobile apps, QR codes or point-of-sale devices (also in Usage)	14.9	.76	.33	11.0
Understands digital payment methods	59.5	.65	.28	9.5
Comfortable making business payments digitally	51.2	.69	.30	10.0
Uses digital loan platforms	26.0	.81	.35	11.7
Has access to digital loan platforms	22.1	.84	.37	12.3
Uses internet banking	20.4	.85	.37	12.4
Uses SIM banking	22.7	.86	.37	12.5
Considers financial technologies safe and secure	37.5	.77	.34	11.3
Stage two: dimension scores (eigenvalue 3.57, 89.3% of variance)				
Access		.94	.50	25.0
Usage		.96	.51	25.4
Quality		.91	.48	24.2



Indicator	Yes (%)	Loading	Weight	Relative weight (%)
Digital services		.96	.51	25.4

Note. Loading = correlation of the indicator with the first principal component of its dimension (stage one) or of the dimension score with the first component of the four dimension scores (stage two). Weight = coefficient of the standardised indicator (or standardised dimension score) in the first component, as used to build the score. Relative weight = weight as a percentage of the sum of the weights within the dimension (equal weights would be 12.5% for Access, 10.0% for Usage, 8.3% for Quality, 11.1% for Digital services and 25.0% for each dimension in stage two). Yes (%) = share answering yes among the farmers who answered the indicator (blank answers excluded). Receiving digital payments belongs to both Usage and Digital services. Indicator wording is abbreviated.

Table A2: Association Between the Financial Inclusion Index and Welfare Under 14 Alternative Specifications

Specification	n	b	SE	p	Note
Primary (Model 3)	418	.096	.027	< .001	
CFII from complete cases only	366	.109	.027	< .001	
CFII as equal-weight index	414	.105	.027	< .001	
log(CFII + .01)	418	.043	.008	< .001	log scale
Excluding Songwe district	388	.093	.029	.001	
Outcome: mean of the four indicators	418	.081	.022	< .001	
Outcome: PCA of three indicators (no subjective)	418	.094	.030	.002	
No asset-wealth controls	418	.144	.025	< .001	
Standard errors clustered by ward (9 clusters)	418	.096	.020	< .001	few clusters
CFII dimension alone: Access	418	.076	.023	.001	
CFII dimension alone: Usage	418	.058	.024	.015	
CFII dimension alone: Quality	418	.102	.023	< .001	
CFII dimension alone: Digital	418	.086	.028	.002	
Ordered logit, welfare in terciles (log-odds)	418	1.510	.408	< .001	log-odds

Note. Ordinary least squares with heteroscedasticity-robust standard errors and the Model 3 controls, except where stated. *b* is the coefficient on CFII (or on the variable named in the row), *SE* its standard error. The log specification, the ordered logit (log-odds; welfare index cut at its 33rd and 67th percentiles) and the dimension-alone rows are on different scales from the main model. Ward-clustered standard errors are based on 9 clusters. All specifications were run after the main analysis and none was set in advance.

Table A3: Additional Checks on Blank Indicators, Welfare Measurement and Asset Overlap

Check	n	b	SE	p
Panel A. Treatment of blank CFII indicators				
Blank indicators set to the most common answer (main)	418	.096	.027	< .001
Blank indicators set to "no"	418	.097	.027	< .001
Blank indicators set to "yes"	418	.074	.028	.009
Complete cases only	366	.109	.027	< .001
Panel B. Welfare measurement				
Welfare Index, blank toilet item left out of the housing score	418	.102	.029	< .001
Mean of food security and self-rated living standard	418	.119	.033	< .001
Panel C. Asset terciles from an index without the six overlapping items				
Welfare Index	418	.115	.027	< .001
Mean of food security and self-rated living standard	418	.138	.032	< .001



Note. Ordinary least squares with heteroscedasticity-robust standard errors and the Model 3 controls. *b* is the coefficient on CFII. Among the 52 farmers with blank CFII indicators the mean CFII is .270 when blanks are set to the most common answer, .267 when set to “no” and .336 when set to “yes”. The six overlapping asset items are owned houses, refrigerator, television, DVD player, electric fan and satellite dish.

Table A4: Association Between CFII and Alternative Welfare Scores, by Group, With Shares at the Maximum Score

Group	n	At maximum on food and housing (%)	Welfare Index	Simple average	Self-rated living standard
Gender					
Men	201	52	.064	.054	.081
Women	217	32	.149	.126	.132
Test of difference			<i>p</i> = .067	<i>p</i> = .058	<i>p</i> = .398
Education					
None	117	32	.276	.213	.165
Primary	164	36	.104	.091	.072
Secondary or higher	137	58	.041	.038	.106
Joint test			<i>p</i> = .010	<i>p</i> = .022	<i>p</i> = .544
Asset wealth tercile					
Lowest	140	29	.322	.252	.195
Middle	139	36	.083	.065	.046
Highest	139	61	.067	.064	.123
Joint test			<i>p</i> < .001	<i>p</i> = .002	<i>p</i> = .293
Asset wealth tercile, index without the six overlapping items					
Lowest	142	34	.237	.193	.128
Middle	137	33	.113	.090	.098
Highest	139	59	.098	.089	.131
Joint test			<i>p</i> = .269	<i>p</i> = .313	<i>p</i> = .860

Note. Entries in the last three columns are the change in the score per unit of CFII within the group, from a model with CFII, the group variable, their interaction and the Model 3 controls. Welfare Index = first principal component of four indicators; simple average = mean of the four indicators; self-rated living standard = single indicator scored 0 to 1. Tests of difference use robust standard errors (joint Wald test for three groups). At maximum on food and housing = share of farmers scoring the maximum on both food security and housing quality.