

Testing Bidirectional Relationships between Saving Participation and Financial Inclusion in East Africa: Evidence from Propensity Score Matching

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Abstract

Financial inclusion is commonly expected to promote saving, while saving itself may deepen subsequent engagement with credit and digital financial services. Yet these relationships are potentially endogenous because individuals self-select into saving, borrowing, account ownership, internet use and digital payments. This article tests whether the relationships between saving participation and selected financial-access variables exhibit statistically supported bidirectional effects after matching on observed characteristics in Uganda, Kenya and Tanzania. Using World Bank Global Findex 2021 micro-data, the study applies Propensity Score Matching (PSM) in both directions for borrowing behaviour, account ownership, internet access and digital payment use. The Average Treatment Effect on the Treated (ATT) is estimated after balancing observable socioeconomic characteristics. The findings provide limited support for generalized bidirectional effects under the maintained PSM assumptions.

In Uganda, borrowing is the only selected financial variable with a significant post-matching effect on saving, increasing saving participation by 41.0 percentage points (ATT = 0.410, $p < 0.01$); saving does not significantly affect the corresponding financial outcomes. Kenya exhibits the strongest post-matching linkages, but they operate across different dimensions rather than reciprocally within the same pair: saving is associated with a matched increase in borrowing by 26.4 percentage points ($p < 0.10$) and internet access by 35.2 percentage points ($p < 0.01$), while digital payment use is associated with a matched increase in saving by 51.8 percentage points ($p < 0.01$). Account ownership is insignificant in both directions. In Tanzania, none of the selected financial and digital variables retains a statistically significant relationship with saving after matching in either direction.

The results show that strong pre-matching associations should not be interpreted as reciprocal relationships. Financial inclusion–saving linkages in East Africa are country-specific, pathway-specific and predominantly unidirectional. Policy should therefore prioritize the financial channels that demonstrate statistically supported post-matching effects in each national context rather than assume that expanding financial access automatically generates saving or that saving uniformly deepens financial inclusion.

1. Introduction

Uganda, Kenya and Tanzania have experienced substantial expansion in formal financial access, mobile money, digital payments and internet connectivity. Nevertheless, saving participation remains uneven. This coexistence of expanding financial infrastructure and limited saving raises an important question: does financial inclusion independently affect individuals' saving after observable selection is addressed, or are savers simply more likely to become financially and digitally included?

The distinction matters because saving and financial inclusion are jointly determined behaviours. Individuals who borrow, use digital payments or access the internet may possess higher income, stronger labour-market attachment, greater financial capability or other characteristics that also make them more likely to save. Conversely, savers may be more attractive to lenders, more financially engaged and more likely to adopt digital services. Conventional one-way regressions can therefore confuse selection and simultaneity with causal effects.

This article isolates the second objective of the underlying doctoral study: to estimate the bidirectional conditional treatment effects of financial access, borrowing behaviour and digital connectivity on individual saving participation in Uganda, Kenya and Tanzania. The empirical strategy explicitly estimates each relationship in both directions using Propensity Score Matching (PSM). The analysis asks whether borrowing, account ownership, internet access and digital payment use affect saving after matching, and whether saving in turn affects each of these outcomes.

The principal contribution is empirical and methodological. Rather than presuming mutual reinforcement, the study tests it. The matched estimates show that statistically significant post-matching effects are predominantly country-specific and unidirectional. This finding qualifies a common financial-inclusion narrative: strong observed associations between saving and financial engagement do not necessarily imply that the same relationship survives balancing, nor that it operates reciprocally.

2. Theoretical and Empirical Framework

2.1 Saving, Liquidity and Financial Access

The theoretical foundation of this study integrates the Life-Cycle Hypothesis (LCH), the Permanent Income Hypothesis (PIH), liquidity-constraint arguments, and financial inclusion theory. The LCH conceptualizes saving as an intertemporal allocation decision through which individuals seek to smooth consumption over their lifetime, accumulating resources during periods of relatively high income and drawing them down when income falls or consumption requirements increase (Modigliani & Brumberg, 1954). Similarly, the PIH proposes that consumption and saving decisions depend not only on current income but also on expectations of longer-term or “permanent” income (Friedman, 1957). These perspectives imply that saving behaviour reflects both present economic circumstances and expectations regarding future resources.

However, the assumptions underlying classical intertemporal models may be restrictive in developing economies characterized by irregular earnings, widespread informal employment, incomplete insurance markets and limited access to formal credit. Under such conditions, liquidity constraints become particularly important. Deaton (1991) demonstrates that households facing uncertain income and restricted borrowing opportunities may accumulate precautionary balances to protect consumption against adverse shocks. Consequently, borrowing and saving need not necessarily be substitutes. Access to credit can relax short-term liquidity constraints, allowing individuals to meet consumption or investment needs without completely depleting accumulated savings. Conversely, accumulated savings may improve financial resilience and potentially strengthen an individual's capacity to participate in credit markets (Deaton, 1991; Browning & Lusardi, 1996).

This complementarity is particularly relevant in East African economies, where individuals frequently combine formal and informal mechanisms for managing liquidity. Borrowing may finance investment, emergencies or temporary consumption shortfalls, while saving provides a buffer against future income shocks. The theoretical relationship between borrowing and saving is therefore ambiguous *ex ante*: borrowing may crowd out saving when debt repayment reduces disposable resources, but it may complement saving where credit enables households to preserve precautionary balances or undertake income-generating investments.

Financial inclusion theory extends these intertemporal perspectives by emphasizing the role of financial infrastructure, accessibility, transaction costs and institutional participation in shaping financial behaviour. Financial inclusion encompasses not simply ownership of a financial account but the ability to access and effectively use appropriate financial services, including payments, savings and credit (Demirgüç-Kunt et al., 2022). Formal accounts can provide secure mechanisms for storing resources, while digital payments and internet connectivity can reduce transaction and information costs associated with financial participation. The Global Findex framework similarly distinguishes between financial access and financial use, an important distinction because account ownership does not necessarily imply active saving or meaningful financial engagement (Demirgüç-Kunt et al., 2022).

Digital financial technologies potentially strengthen the saving mechanism through several channels. First, digital payments can reduce the physical and monetary costs associated with depositing and transferring funds. Second, mobile and internet-based platforms can increase the frequency with which individuals interact with financial institutions. Third, digital transaction histories may facilitate access to additional financial services, including credit and savings products. Nevertheless, access to digital financial infrastructure does not automatically generate saving. Individuals may use mobile money and digital accounts predominantly for transfers, payments and consumption, while insufficient or volatile income may prevent the accumulation of positive balances.

The relationship may also operate in the opposite direction. Individuals who save may subsequently demand safer storage facilities, transactional accounts, digital payment services, financial information and credit. Saving may therefore function not only as an outcome of financial inclusion, but also as a potential mechanism through which individuals deepen their participation in financial and digital systems. This generates the possibility of reciprocal relationships between saving and financial inclusion.

The conceptual framework therefore allows the relationship to operate in both directions: financial inclusion may influence saving participation ($FI_i \rightarrow S_i$), while saving participation may influence financial inclusion ($S_i \rightarrow FI_i$). Here, S_i denotes saving participation for individual i , and FI_i denotes the relevant financial-inclusion dimension—borrowing, account ownership, internet access or digital-payment use.

Theoretical plausibility, however, does not establish empirical bidirectionality. Strict bidirectionality requires statistically significant matched effects in both directions for the same treatment–outcome pair. This distinction is important because saving and financial-service use are jointly selected behaviours.

Accordingly, this article does not presume that financial inclusion and saving are mutually reinforcing. Instead, it empirically tests whether each relationship persists after observable differences between treated and untreated individuals have been balanced.

2.2 Empirical Evidence and Research Gap

A growing empirical literature demonstrates that financial innovation can influence household risk management, consumption smoothing and financial participation. Mobile money has received particular attention because it reduces the costs associated with transferring and storing money and facilitates financial transactions across geographic distances. Using evidence from Kenya, Jack and Suri (2014) show that mobile money reduced transaction costs and strengthened households' capacity to share risks. Suri and Jack (2016)

subsequently demonstrated significant longer-term welfare effects associated with access to mobile money, including improvements in household economic outcomes.

Digital connectivity may reinforce these mechanisms by reducing information barriers and providing access to internet-based banking, mobile applications and financial information. Thaariq et al. (2021), for example, provide evidence that internet access can influence household saving behaviour, suggesting that digital connectivity may affect financial decisions beyond its direct communication benefits. Such findings imply that internet access can operate as part of the infrastructure through which individuals acquire financial information and participate in increasingly digitalized financial markets.

Nevertheless, the empirical relationship between digital finance and saving is not necessarily uniform across institutional settings. Digital platforms may increase transactional activity without increasing accumulated savings. Consequently, observed differences in saving between digital-finance users and non-users may reflect underlying differences in income, employment, education, financial capability or other socioeconomic characteristics rather than an independent causal effect of digital access.

The relationship between borrowing and saving is similarly ambiguous. Traditional models may suggest substitution because borrowing increases future repayment obligations and can reduce disposable income available for saving. However, under liquidity constraints and income uncertainty, borrowing can complement precautionary saving by financing temporary expenditure requirements without forcing households to liquidate existing balances (Deaton, 1991). The direction and magnitude of the relationship therefore depend on the purpose of credit, household liquidity conditions and the broader financial environment.

Likewise, account ownership represents financial infrastructure rather than necessarily active financial behaviour. An individual may possess an account but use it infrequently or primarily for receiving wages, government transfers or remittances. The Global Findex evidence emphasizes substantial differences between account ownership and the actual use of accounts for saving, borrowing and digital transactions (Demirgüç-Kunt et al., 2022). Consequently, account ownership should not automatically be interpreted as evidence that financial inclusion causes saving.

Evidence from Sub-Saharan Africa further shows that financial inclusion is systematically associated with socioeconomic characteristics rather than randomly distributed across populations. Using Global Findex data for 31 Sub-Saharan African countries, Asuming et al. (2019) identify age, education, gender, wealth and macro-financial conditions as important correlates of financial inclusion. This heterogeneity strengthens the case for addressing observable selection when estimating the relationship between financial inclusion and saving.

East African experimental evidence also cautions against equating financial access with active saving. In Kenya, reducing savings constraints through access to formal accounts increased saving and productive investment for some groups, while commitment and safe-storage mechanisms also affected saving behaviour (Dupas & Robinson, 2013a, 2013b). In Uganda and two other country settings, however, expanding access to basic bank accounts generated limited average effects because sustained account use remained low, illustrating that access alone need not translate into saving or welfare gains (Dupas et al., 2018).

More broadly, Aron (2018) concludes that the evidence linking mobile money to improved risk sharing is comparatively strong, whereas evidence that mobile money consistently promotes saving and welfare is more

mixed. These findings reinforce the distinction between access, use and behavioural outcomes and motivate the present study's matched comparison of financially included and otherwise similar non-included individuals.

Three related gaps emerge from this literature. First, much of the existing empirical literature examines financial inclusion and saving in a single direction, typically estimating whether financial access or digital-finance participation predicts saving. Such approaches provide limited evidence about whether saving itself subsequently promotes financial engagement.

Second, conventional regression estimates may be affected by non-random selection. Individuals who borrow, own accounts, use the internet or make digital payments may systematically differ from non-users in observable socioeconomic characteristics that also influence saving. Simple comparisons between users and non-users can therefore attribute to financial inclusion effects that actually arise from differences in individual characteristics.

Third, relatively limited comparative evidence simultaneously applies a consistent matched identification framework to multiple East African countries. Differences in financial-system development, digital-finance penetration and socioeconomic structures mean that relationships identified in one country cannot automatically be generalized to neighbouring economies.

This study addresses these gaps by using a harmonized empirical framework to estimate the financial inclusion–saving relationship separately for Uganda, Kenya and Tanzania and, critically, by reversing the treatment and outcome for each financial dimension. Four treatment–outcome pairs are investigated: borrowing and saving, account ownership and saving, internet access and saving, and digital-payment use and saving. This structure permits direct testing of reciprocal effects rather than inferring bidirectionality from a statistically significant association in only one direction.

3. Data and Econometric Strategy

3.1 Data and Variables

The analysis uses nationally representative individual-level data from the World Bank Global Findex 2021 database. The dataset provides harmonized indicators of saving participation, borrowing, account ownership, internet access, digital payment use and socioeconomic characteristics, allowing comparable treatment definitions across the three countries.

The analysis focuses on four binary financial-inclusion dimensions borrowing behaviour, account ownership, internet access and digital-payment use and a binary indicator of saving participation. Each financial variable is alternately specified as the treatment with saving as the outcome, after which saving is specified as the treatment and the financial variable becomes the outcome. This symmetric design permits direct testing of reciprocal pathways using harmonized definitions across the three countries.

3.2 Bidirectional Treatment–Outcome Framework

Table 1
Bidirectional treatment–outcome framework.

Direction	Treatment	Outcome	Interpretation
Financial → Saving	Borrowing	Saving participation	Does credit engagement increase saving?
Saving → Financial	Saving participation	Borrowing	Does saving increase subsequent credit engagement?
Financial → Saving	Account ownership	Saving participation	Does formal account access increase saving?
Saving → Financial	Saving participation	Account ownership	Does saving deepen formal account access?
Digital → Saving	Internet access	Saving participation	Does digital connectivity increase saving?
Saving → Digital	Saving participation	Internet access	Does saving increase digital engagement?
Digital → Saving	Digital payment use	Saving participation	Do digital transactions increase saving?
Saving → Digital	Saving participation	Digital payment use	Does saving increase digital payment use?

3.3 Propensity Score Matching and Identification Strategy

Because saving participation and engagement with financial services are not randomly assigned, simple comparisons between participants and non-participants may produce biased estimates if the two groups differ systematically in observed socioeconomic, demographic, and financial characteristics. Propensity Score Matching (PSM) is therefore employed to reduce observable selection bias by constructing comparison groups that are similar with respect to observed covariates (Rosenbaum & Rubin, 1983; Caliendo & Kopeinig, 2008; Stuart, 2010).

Let D_i denote the treatment status of individual i , where $D_i = 1$ indicates exposure to the treatment and $D_i = 0$ otherwise, and let X_i denote a vector of observed pre-treatment covariates. The propensity score is defined as the conditional probability of receiving treatment:

$$p(X_i) = \Pr(D_i = 1 | X_i).$$

Individuals in the treatment group are matched with observationally comparable individuals in the control group on the basis of their estimated propensity scores. Nearest-neighbour matching is used as the principal matching procedure. The primary estimand is the Average Treatment Effect on the Treated (ATT), expressed as:

$$ATT = E[Y_i(1) - Y_i(0) | D_i = 1],$$

where $Y_i(1)$ represents the potential outcome for a treated individual under treatment and $Y_i(0)$ represents the counterfactual outcome that the same individual would have experienced in the absence of treatment.

Identification of the ATT rests principally on the Conditional Independence Assumption (CIA) and the common-support or overlap condition. The CIA requires that, conditional on the observed covariates, treatment assignment is independent of potential outcomes:

$$(Y_i(1), Y_i(0)) \perp D_i | X_i.$$

The overlap condition requires that individuals with comparable observed characteristics have a positive probability of appearing in either the treatment or control group:

$$0 < \Pr(D_i = 1 | X_i) < 1.$$

The adequacy of the matching procedure is evaluated using covariate-balance and common-support diagnostics. Covariate balance is assessed using standardized mean differences (SMDs), variance ratios, and graphical inspection of propensity-score distributions. Absolute SMDs below 0.10 are treated as evidence of satisfactory balance, while values below 0.05 indicate particularly close post-matching comparability between treatment and control groups (Austin, 2009; Stuart, 2010). Variance ratios approaching unity provide additional evidence of similarity in covariate dispersion. Common support is assessed by examining the degree of overlap in the propensity-score distributions of treated and control observations. Adequate overlap indicates that treated individuals have sufficiently comparable controls and reduces reliance on extrapolation beyond the observed data.

These diagnostics are evaluated before and after matching to determine whether PSM materially improves comparability between the treatment and control groups. A reduction in SMDs, variance ratios moving closer to unity, improved propensity-score overlap, and a reduction in the explanatory power of the treatment-assignment model after matching are interpreted as evidence that observable selection differences have been substantially reduced.

Importantly, the Global Findex 2021 data are cross-sectional. PSM can therefore improve comparability and reduce selection bias arising from observed characteristics, but it cannot eliminate bias attributable to unobserved heterogeneity or establish temporal ordering. Accordingly, the estimated ATTs are interpreted as conditional treatment effects under the assumptions of selection on observables and adequate common support, rather than as definitive evidence of experimental or temporal causality (Rosenbaum & Rubin, 1983; Imbens & Rubin, 2015). This qualification is particularly important when interpreting the estimated directional relationships between saving participation and borrowing, account ownership, internet access, and digital-payment use.

The propensity-score models use the harmonized baseline covariates available across the three Global Findex country samples: age, education level, employment status, income quartile, urban/rural residence and remittance status. Treatment and outcome indicators are not included as balancing covariates in the same treatment-assignment model. Propensity scores are estimated separately for each country and for each treatment direction, after which treated observations are matched to observationally similar controls using nearest-neighbour matching on the estimated propensity score and restricting comparisons to the region of common support. The same decision rule is then applied consistently across the country-specific specifications.

3.4 Bidirectional Estimation and Decision Rule

PSM is estimated in both directions for each pair. In the financial-inclusion-to-saving specification, borrowing, account ownership, internet access or digital-payment use is the treatment and saving participation is the outcome. In the reverse specification, saving becomes the treatment and the corresponding financial indicator becomes the outcome. Strict bidirectionality is concluded only when statistically significant matched ATT estimates occur in both directions for the same pair. A significant ATT in only one direction is classified as a unidirectional matched pathway; an insignificant matched ATT is treated as no statistically supported treatment effect under the maintained PSM assumptions.

4. Results

4.1 Uganda

Table 2
Uganda: Financial-inclusion treatments and saving participation

Variable	Sample	Treated mean	Control mean	ATT / difference	Std. error	t-statistic	p-value	Significance
Borrowed	Unmatched	0.755	0.446	0.309	0.033	9.10	< 0.001	***
	Matched (ATT)	0.755	0.345	0.410	0.142	2.89	0.0039	***
Internet Access	Unmatched	0.819	0.539	0.280	0.028	9.97	< 0.001	***
	Matched (ATT)	0.819	0.748	0.071	0.182	0.39	0.6966	NS
Account Ownership	Unmatched	0.421	0.253	0.168	0.108	1.56	0.1185	NS
	Matched (ATT)	0.421	0.316	0.105	0.245	0.43	0.6676	NS
Digital Payment	Unmatched	0.684	0.421	0.263	0.111	2.37	0.0177	**
	Matched (ATT)	0.684	0.573	0.111	0.276	0.40	0.6890	NS

Table 3
Uganda: Saving participation and financial-inclusion outcomes

Variable	Sample	Treated mean	Control mean	ATT / difference	Std. error	t-statistic	p-value	Significance
Borrowing Behaviour	Unmatched	0.855	0.607	0.248	0.027	9.10	< 0.001	***
	Matched (ATT)	0.855	0.816	0.039	0.157	0.25	0.8020	NS
Internet Access	Unmatched	0.628	0.304	0.324	0.033	9.97	< 0.001	***
	Matched (ATT)	0.628	0.663	-0.035	0.199	-0.18	0.8570	NS
Account Ownership	Unmatched	0.920	0.569	0.351	0.024	14.39	< 0.001	***
	Matched (ATT)	0.920	0.911	0.009	0.142	0.06	0.9510	NS
Digital Payment Usage	Unmatched	0.908	0.534	0.374	0.025	14.90	< 0.001	***
	Matched (ATT)	0.908	0.921	-0.013	0.140	-0.09	0.9290	NS

4.1.1 Interpretation of Uganda Results

In Uganda, borrowing is the only selected financial variable that retains a statistically significant effect on saving after matching. Borrowing increases the probability of saving by 41.0 percentage points (ATT = 0.410, $p < 0.01$). This is a substantial treatment effect and indicates that credit engagement is associated with a higher probability of saving even after balancing observable differences between borrowers and non-borrowers.

The reverse pathway is not significant: saving does not significantly increase borrowing after matching. Internet access, account ownership and digital payment use also fail to produce statistically significant post-matching effects on saving, and saving does not significantly affect these outcomes. Uganda therefore does not exhibit generalized bidirectional effects under the PSM specification. The evidence supports one unidirectional pathway borrowing to saving.

This result is consistent with a liquidity-management interpretation. In a financially constrained setting, access to borrowing may allow individuals to manage shocks or finance activities without depleting accumulated balances. It may also reflect the role of credit as an entry point into more active financial management. The result should not be read as evidence that indiscriminate borrowing raises welfare; the treatment identifies participation in borrowing, not the productivity, price or purpose of the loan.

4.2 Kenya

Table 4
Kenya: Financial-inclusion treatments and saving participation

Variable	Sample	Treated mean	Control mean	ATT / difference	Std. error	t-statistic	p-value	Significance
Borrowing Behaviour	Unmatched	0.711	0.357	0.354	0.029	11.89	< 0.001	***
	Matched (ATT)	0.711	0.682	0.029	0.120	0.24	0.8100	NS
Internet Access	Unmatched	0.847	0.441	0.406	0.036	11.33	< 0.001	***
	Matched (ATT)	0.847	0.797	0.049	0.167	0.30	0.7620	NS
Digital Payment usage	Unmatched	0.592	0.125	0.468	0.125	3.73	0.0002	***
	Matched (ATT)	0.592	0.074	0.518	0.172	3.01	0.0026	***
Account Ownership	Unmatched	0.125	0.232	-0.106	0.107	-0.99	0.3226	NS
	Matched (ATT)	0.125	0.125	0.000	0.154	0.00	1.0000	NS

Table 5
Kenya: Saving participation and financial-inclusion outcomes

Variable	Sample	Treated mean	Control mean	ATT / difference	Std. error	t-statistic	p-value	Significance
Borrowed	Unmatched	0.660	0.304	0.356	0.030	11.94	0.0000	***
	Matched (ATT)	0.660	0.395	0.264	0.141	1.88	0.0601	*
Internet access	Unmatched	0.357	0.073	0.284	0.025	11.36	0.0000	***
	Matched (ATT)	0.357	0.006	0.352	0.066	5.33	< 0.001	***
Account Ownership	Unmatched	0.759	0.373	0.386	0.029	13.30	0.0000	***
	Matched (ATT)	0.759	0.770	-0.011	0.107	-0.11	0.9124	NS
Digital payment	Unmatched	0.755	0.343	0.412	0.029	14.31	0.0000	***
	Matched (ATT)	0.755	0.770	-0.015	0.111	-0.14	0.8887	NS

4.2.1 Interpretation of Kenya Results

Kenya records the strongest and most diverse set of post-matching relationships. Saving participation increases the probability of borrowing by 26.4 percentage points (ATT = 0.264, $p < 0.10$) and increases internet access by 35.2 percentage points (ATT = 0.352, $p < 0.01$). In the opposite broad direction from financial

inclusion to saving digital payment use increases saving participation by 51.8 percentage points (ATT = 0.518, $p < 0.01$).

These effects do not constitute strict bidirectionality for the same variable pairs. Borrowing does not significantly increase saving after matching even though saving increases borrowing. Internet access does not significantly increase saving even though saving increases internet access. Digital payment use increases saving, but saving does not significantly increase digital payment use. Account ownership is insignificant in both directions.

Kenya therefore illustrates an interconnected financial ecosystem in which post-matching effects operate through different channels. Digital transactions appear to be an important gateway into saving, whereas saving itself is associated with deeper subsequent engagement in borrowing and internet access. The magnitude of the digital-payment effect is particularly notable and is consistent with Kenya's highly developed digital financial infrastructure.

4.3 Tanzania

Table 6
Tanzania: Financial-inclusion treatments and saving participation

Variable	Sample	Treated mean	Control mean	ATT / difference	Std. error	t-statistic	p-value
Borrowed	Unmatched	0.797	0.477	0.319***	0.032	10.12	0.000
	Matched (ATT)	0.797	0.600	0.197	0.125	1.57	0.117
Internet Access	Unmatched	0.818	0.634	0.184***	0.028	6.56	0.000
	Matched (ATT)	0.818	0.902	-0.083	0.154	-0.54	0.589
Account Ownership	Unmatched	0.536	0.416	0.119	0.098	1.21	0.225
	Matched (ATT)	0.536	0.785	-0.250	0.197	-1.27	0.203
Digital Payments	Unmatched	0.772	0.536	0.236**	0.087	2.73	0.006
	Matched (ATT)	0.772	0.739	0.032	0.212	0.15	0.881
Notes: *** $p < 0.01$; ** $p < 0.05$; * $p < 0.10$. NCE denotes no statistically significant matched treatment effect.							

Table 7
Tanzania: Saving participation and financial-inclusion outcomes

Variable	Sample	Treated mean	Control mean	ATT / difference	Std. error	t-statistic	p-value
Borrowing Behaviour	Unmatched	0.838	0.545	0.293***	0.029	10.12	0.000
	Matched (ATT)	0.838	0.668	0.169	0.157	1.08	0.280
Internet Access	Unmatched	0.524	0.297	0.226***	0.034	6.56	0.000
	Matched (ATT)	0.524	0.714	-0.190	0.185	-1.03	0.304
Account Ownership	Unmatched	0.803	0.401	0.402***	0.030	13.32	0.000
	Matched (ATT)	0.803	0.822	-0.020	0.139	-0.14	0.890
Digital Payments	Unmatched	0.782	0.355	0.427***	0.031	13.96	0.000
	Matched (ATT)	0.782	0.791	-0.010	0.139	-0.07	0.945

4.3.1 Interpretation of Tanzania Results

In Tanzania, none of the selected financial or digital variables has a statistically significant post-matching effect on saving, and saving does not significantly affect borrowing, internet access, account ownership or digital payment use. This contrasts with strong pre-matching associations between financial engagement and saving.

The disappearance of significance after matching indicates that observable socioeconomic differences explain a substantial share of the raw relationships. Individuals who borrow, use digital services or hold accounts may also possess characteristics that independently increase their propensity to save. Once comparable groups are constructed, the selected financial variables do not exhibit independent treatment effects under the matched specification.

The Tanzanian result is therefore substantively important rather than a null finding to be minimized. It demonstrates why policy conclusions should not be based solely on descriptive or regression associations when participation in financial services is strongly selected.

4.4 Cross-Country Synthesis

Taken together, the matched estimates reject a uniform reciprocal model. Uganda provides evidence of a borrowing-to-saving pathway; Kenya provides three significant but non-reciprocal pathways; and Tanzania provides no statistically significant matched pathway. The contrast between unmatched and matched estimates underscores the importance of addressing observable selection before interpreting financial-inclusion associations as independent treatment effects.

Table 8
Cross-country summary of statistically supported matched treatment effects

Treatment → Outcome	Uganda	Kenya	Tanzania	Interpretation
Borrowing → Saving	0.410***	NCE	NCE	Uganda only
Saving → Borrowing	NCE	0.264*	NCE	Kenya only
Internet → Saving	NCE	NCE	NCE	No significant matched effect
Saving → Internet	NCE	0.352***	NCE	Kenya only
Account ownership → Saving	NCE	NCE	NCE	No significant matched effect
Saving → Account ownership	NCE	NCE	NCE	No significant matched effect
Digital payments → Saving	NCE	0.518***	NCE	Kenya only
Saving → Digital payments	NCE	NCE	NCE	No significant matched effect
Notes: NCE = no statistically significant matched treatment effect. *** $p < 0.01$; ** $p < 0.05$; * $p < 0.10$; NS = not statistically significant.				

4.5 Diagnostics and Sensitivity Analysis

4.5.1 Covariate Balance and Common Support

The PSM diagnostics indicate substantial improvement in observable comparability after matching. In Uganda, pre-matching standardized mean differences (SMDs) of approximately 22–30% fell below 5% after matching. In Kenya, post-matching SMDs were generally below 5% and the treatment-assignment pseudo- R^2 declined markedly. Tanzania likewise recorded substantial reductions in SMDs and pseudo- R^2 . Propensity-score distributions showed improved treated-control overlap in all three countries, supporting the common-support requirement. These diagnostics support the adequacy of matching on observed covariates, while they do not rule out unobserved confounding.

Table 9
Summary of covariate-balance and common-support diagnostics

Country	Pre-match imbalance	Post-match balance	Pseudo- R^2 after matching	Common support / overlap
Uganda	SMDs approx. 22–30%	SMDs < 5%	Reduced	Substantially improved overlap
Kenya	Observable imbalance present	SMDs generally < 5%	Marked decline	Substantially improved overlap
Tanzania	Observable imbalance present	SMDs substantially reduced	Marked decline	Substantially improved overlap
Note: SMD = standardized mean difference. The table reports only diagnostic magnitudes supported by the underlying analysis; exact specification-level balance statistics should be supplied in an online appendix where required by the target journal.				

4.5.2 Multicollinearity and Hidden-Bias Sensitivity

Table 10
Variance Inflation Factor (VIF)
diagnostics for baseline covariates

Variable	VIF	1/VIF
Borrowing (yes)	2.45	0.408
Internet access	2.12	0.472
Account ownership	3.18	0.314
Digital payments	2.76	0.362
Remittances	1.89	0.529
Employment status	2.67	0.375
Income (quartiles)	3.54	0.282
Education level	2.31	0.433
Age	1.76	0.568
Residence (urban)	2.08	0.481
Mean VIF	2.48	

Table 11
Rosenbaum bounds sensitivity analysis for the
Uganda Borrowing → Saving ATT (ATT =
0.410)

Gamma(Γ)	Q_mh+	Q_mh-	p-value+
1.0	2.85	2.85	0.004
1.1	2.41	3.29	0.008
1.2	2.05	3.68	0.015
1.3	1.72	4.01	0.042
1.4	1.39	4.32	0.083
1.5	1.12	4.58	0.131
1.6	0.89	4.81	0.187
1.7	0.71	5.02	0.238
1.8	0.55	5.19	0.291
1.9	0.41	5.34	0.341
2.0	0.29	5.47	0.387

Table 11 applies specifically to the statistically significant Uganda borrowing → saving estimate (ATT = 0.410; $p = 0.0039$). At $\Gamma = 1.0$, the upper-bound p-value is 0.004; statistical significance remains below 5% through $\Gamma = 1.3$ ($p = 0.042$) but is lost at $\Gamma = 1.4$ ($p = 0.083$). Thus, the Uganda estimate is moderately sensitive to hidden bias: an

unobserved factor that changed the odds of borrowing by roughly 40% between otherwise comparable matched individuals could overturn conventional statistical significance. This sensitivity result reinforces the article's cautious interpretation of PSM estimates as conditional treatment effects under selection on observables.

5. Discussion

The results refine the conceptual relationship between financial inclusion and saving. Financial inclusion is multidimensional, and its components do not operate symmetrically. Credit, accounts, internet connectivity and digital payments provide different economic functions; consequently, it is unsurprising that their treatment effects differ by country and direction. Uganda's borrowing-to-saving pathway suggests complementarity between liquidity access and saving accumulation. The absence of a significant reverse matched effect indicates that saving by itself does not necessarily deepen formal credit engagement after observable differences are controlled for. This cautions against assuming a self-reinforcing savings–credit cycle.

Kenya provides the clearest evidence that the direction of the statistically supported relationship depends on the financial channel. Digital payments facilitate saving, potentially by lowering transaction costs and integrating routine financial flows with digital stores of value. At the same time, savers are more likely to borrow and access the internet after matching, suggesting that saving may be part of a broader progression into financial and digital engagement. Yet the lack of same-pair reciprocity remains crucial: interconnectedness is not equivalent to bidirectionality.

Tanzania shows that strong financial inclusion–saving correlations may largely reflect selection. This finding is especially important for programme evaluation. An intervention that increases account ownership or digital access cannot be assumed to increase saving merely because users of those services save more in raw data. Credible impact evaluation must establish whether outcomes differ among comparable individuals.

Across the three countries, account ownership has no significant matched effect in either direction. This reinforces the distinction between access and effective use. An account can provide financial infrastructure without generating saving unless individuals have sufficient income, appropriate products, trust, incentives and reasons to accumulate balances.

6. Policy Implications

Policy should move from generic financial-inclusion targets toward pathway-specific interventions. Uganda's evidence supports closer integration of responsible credit with saving products. Credit products can incorporate structured saving components, but safeguards are required to prevent over-indebtedness and ensure that borrowing supports liquidity management or productive activity.

In Kenya, the strongest actionable pathway is digital payments to saving. Financial institutions and digital platforms can use transaction accounts as gateways to low-cost, automated and goal-based saving products. Because saving also increases borrowing and internet access, consumer protection, digital financial literacy and responsible lending should accompany deeper engagement.

In Tanzania, the absence of significant matched effects implies that expanding financial access alone may be insufficient. Policies should strengthen the socioeconomic foundations that enable individuals to convert

access into saving, including productive employment, income stability, financial capability, affordable connectivity and appropriately designed saving products.

Across all three countries, account-opening targets should not be treated as equivalent to financial inclusion outcomes. Monitoring frameworks should distinguish access, usage, saving accumulation and welfare effects. Evaluation designs should also test identified treatment pathways rather than infer programme impact from cross-sectional differences between users and non-users.

7. Methodological Contribution and Limitations

The principal methodological contribution is the explicit two-direction treatment framework. By reversing treatment and outcome definitions for the same financial dimensions, the study tests rather than assumes reciprocal conditional treatment relationships. This is particularly useful in financial-inclusion research, where saving and financial-service use are jointly selected behaviours.

The analysis nevertheless has limitations. PSM balances observed covariates but cannot eliminate hidden bias from unobserved characteristics such as risk preferences, financial literacy, entrepreneurial ability, trust or aspirations. The Global Findex data are cross-sectional, limiting temporal ordering. Accordingly, the ATT estimates should be interpreted as conditional treatment effects under the maintained matching assumptions, not as definitive evidence of temporal or experimental causality. Future work using longitudinal data, natural experiments or randomized interventions could provide stronger evidence on dynamic feedback mechanisms.

A further reporting lesson arises from the empirical analysis: pre-matching associations and marginal effects must be clearly separated from matched ATT estimates. The matched results show that several relationships that appear strong before matching become statistically insignificant afterward. This distinction is central to the article's contribution.

8. Conclusion

This article tested the bidirectional relationships between saving participation and borrowing behaviour, account ownership, internet access and digital payment use in Uganda, Kenya and Tanzania. The results do not support a general claim that saving and financial inclusion mutually reinforce one another in a reciprocal manner across East Africa.

Instead, the pattern of matched treatment effects is heterogeneous. In Uganda, borrowing increases saving by 41.0 percentage points, with no significant reverse effect. In Kenya, saving increases borrowing by 26.4 percentage points and internet access by 35.2 percentage points, while digital payment use increases saving by 51.8 percentage points. None of these Kenya relationships is reciprocal within the same pair. In Tanzania, no selected financial or digital variable retains a statistically significant matched relationship with saving in either direction.

The broader implication is that financial inclusion should be treated as a set of distinct mechanisms rather than a single state. Strong associations between saving and financial engagement can disappear once selection is addressed. Effective policy therefore requires identifying which financial channel is associated with a

statistically supported treatment effect on which behavioural outcome in each national context and designing interventions around those verified pathways.

Abbreviations

ATT

Average Treatment effect on the Treated

LCH

Life-Cycle Hypothesis

PIH

Permanent Income Hypothesis

PSM

Propensity Score Matching

Declarations

9.2. Ethics approval and consent to participate

This study used publicly available, de-identified secondary data from the World Bank Global Index 2021 database and involved no direct interaction with participants. No new human-subject data were collected by the authors; therefore, separate ethical approval for this secondary analysis was not required.

9.3. Consent for publication

The analysis used de-identified secondary survey data and contains no personally identifiable information. Individual consent for publication was therefore not applicable to this secondary analysis.

9.4. Availability of data and materials

The data employed in this manuscript were sourced from secondary, exclusively quantitative datasets. Specifically, the analysis draws on the Global Financial Inclusion (Global Index) Database 2021, accessible through the World Bank platform, including country-specific data for Uganda, Kenya and Tanzania.

9.5. Competing interests

The authors declare no competing interests in this manuscript.

9.6. Funding

The authors received no specific funding for this work.

9.7. Authors' contributions

S.R.K. conceptualized the study, developed the theoretical and empirical framework, conducted the analysis, and prepared the initial manuscript. G.M. contributed to the conceptual and methodological review, while P.B. reviewed and edited the final manuscript. All authors reviewed and approved the final version.

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