

Microeconomic Determinants of Individual Saving Participation and Income Outcomes in Uganda, Kenya, and Tanzania: Evidence from Propensity Score Matching

Stephen Robert Kasumba¹, Gertrude Ssebunya Muwanga², Peter Babyenda³

¹Manager Monitoring and Evaluation, National Identification and Registration Authority (NIRA), Uganda.

²Senior lecturer from the Department of Economic Theory and Analysis, College of Business and Management Sciences, Makerere University, Uganda.

³Senior lecturer from the Department of Economic Theory and Analysis, College of Business and Management Sciences, Makerere University, Uganda.

ABSTRACT: Despite sustained economic growth and rapid financial-sector digitisation in East Africa, individual saving participation remains uneven, raising important questions about both the factors that enable saving and whether saving itself translates into improved economic welfare. This article examines the microeconomic determinants of individual saving participation and estimates the conditional effect of saving on income in Uganda, Kenya, and Tanzania. Using individual-level data from the World Bank Global Findex 2021 database, the study combines binary logistic regression with Propensity Score Matching (PSM). The logistic models identify socioeconomic, labour-market, remittance, financial-access, and digital-connectivity factors associated with saving participation, while PSM constructs comparable groups of savers and non-savers and estimates the Average Treatment Effect on the Treated (ATT) for income.

The findings reveal important commonalities and cross-country differences. Borrowing behaviour and internet access are positively associated with saving participation across the three countries. Remittance channels are especially important in Uganda and Tanzania, while digital-payment use is positively associated with saving in Kenya and Tanzania. Labour-market inactivity is negatively associated with saving participation in all three country-specific final specifications. The conditional income effect of saving is heterogeneous: after matching, the ATT on individual income quintile is statistically insignificant in Uganda (0.1399; $t = 0.76$) and Kenya (0.2496; $t = 1.38$), but positive and statistically significant in Tanzania (0.5598; $t = 3.12$).

Overall, the results show that saving participation is shaped by active financial engagement, labour-market participation, remittance flows and digital connectivity rather than financial access alone. They also show that higher raw income among savers partly reflects selection and that the remaining matched relationship varies across countries. Policies should therefore integrate savings mobilization with productive employment, responsible credit, digital connectivity, remittance formalization and pathways that convert accumulated savings into productive investment.

KEYWORDS: saving participation; income; propensity score matching; financial inclusion; digital finance; Uganda; Kenya; Tanzania

JEL Classification: D14; D31; G21; G53; O16

1. INTRODUCTION

Saving is central to household welfare and economic development because it enables consumption smoothing, provides a buffer against shocks, supports investment in education, health and productive assets, and contributes to domestic capital formation. Classical consumption–saving theories therefore treat saving as an intertemporal allocation decision, while development-oriented perspectives emphasise that the capacity to save is conditioned by income stability, access to financial services and the institutional environment (Modigliani & Brumberg, 1954; Friedman, 1957; Deaton, 1991, 1992; Browning & Lusardi, 1996).

In Uganda, Kenya and Tanzania, the policy importance of saving is heightened by persistent saving–investment gaps and exposure to volatile external financing. At the same time, the region has experienced rapid expansion in mobile money, digital payments, account ownership and internet connectivity. Yet greater financial access has not translated uniformly into higher saving participation. This creates an empirical puzzle: individuals may have access to financial infrastructure without actively saving, while those who save may differ systematically from non-savers in income, employment, education and financial engagement.

Two analytical problems follow. First, identifying the determinants of saving requires distinguishing active financial engagement from passive access. Account ownership alone may not induce saving if individuals lack stable income, credit, remittance flows,

digital connectivity or opportunities to use savings productively. Second, the observed association between saving and income cannot be interpreted causally without addressing selection. Individuals with stronger socioeconomic positions may be more likely both to save and to report higher income, causing simple comparisons to overstate the welfare effect of saving.

This article addresses these issues using harmonised Global Findex 2021 micro-data for Uganda, Kenya and Tanzania. This article examines the socioeconomic determinants of individual saving participation and the relationship between saving participation and individual income outcomes in Uganda, Kenya, and Tanzania. The analysis first estimates binary logistic models of saving participation and then applies Propensity Score Matching to estimate the income effect of saving among observationally comparable individuals.

The article makes three contributions. Empirically, it provides comparative micro-level evidence from three major East African economies. Methodologically, it moves beyond descriptive associations by explicitly correcting for observable selection into saving. From a policy perspective, it distinguishes factors associated with entering saving from the separate question of whether saving translates into higher income. This distinction is important because policies that increase the number of savers may not automatically improve welfare unless savings can be transformed into productive economic opportunities.

2. THEORETICAL FRAMEWORK AND RELATED LITERATURE

2.1 Theoretical Foundations

Individual saving behaviour has been explained through several complementary theories of intertemporal consumption, income formation, liquidity constraints, and precautionary behaviour. This study draws principally on the Life-Cycle Hypothesis (LCH), Permanent Income Hypothesis (PIH), Absolute Income Hypothesis (AIH), and Buffer-Stock Saving framework. Taken together, these theories provide a useful basis for understanding why individuals save, why saving participation varies across socioeconomic groups, and why the relationship between saving and subsequent economic welfare may differ across institutional settings.

2.1.1 Life-Cycle Hypothesis

The Life-Cycle Hypothesis, associated with Modigliani and Brumberg (1954) and subsequently developed by Modigliani (1986), conceptualises saving as an intertemporal mechanism through which individuals allocate resources over their lifetime. Individuals are assumed to seek relatively stable consumption despite predictable variations in income across different stages of life. During economically active years, when earnings exceed current consumption requirements, individuals accumulate savings and assets; during retirement or periods of reduced income, previously accumulated wealth may be drawn down to sustain consumption.

The LCH therefore predicts systematic relationships between saving and socioeconomic characteristics such as age, employment, income, household responsibilities, and expected future earnings. Working-age individuals with stable employment and relatively high disposable income should, other things being equal, possess a greater capacity to save than individuals facing unemployment, irregular earnings, or high dependency burdens. This provides a theoretical basis for examining labour-market participation and socioeconomic position as determinants of individual saving.

However, the assumptions underlying the conventional LCH are particularly restrictive in developing economies. In Uganda, Kenya, and Tanzania, large proportions of the labour force operate within informal and agricultural sectors characterised by irregular earnings, limited pension coverage, incomplete insurance markets, and considerable exposure to income shocks. Under these circumstances, individuals may be unable to follow the smooth accumulation-and-decumulation trajectory implied by the classical model. Saving may instead be episodic, precautionary, informal, and highly responsive to immediate liquidity conditions. The LCH is therefore relevant to East Africa, but its predictions need to be interpreted within the structural constraints affecting individuals' capacity to transfer resources across time.

2.1.2 Permanent Income Hypothesis

The Permanent Income Hypothesis, developed by Friedman (1957), complements the LCH by distinguishing between permanent income, representing expected long-term earning capacity, and transitory income, representing temporary deviations from expected income. Individuals are expected to base consumption primarily on permanent income and use saving or borrowing to absorb temporary fluctuations in current income.

This framework has important implications for the present study. Individuals experiencing temporary increases in income may save part of those gains rather than permanently increase consumption, while temporary negative shocks may lead them to reduce savings or borrow. Consequently, borrowing and saving need not necessarily be competing financial behaviours. They can constitute complementary components of an individual's strategy for smoothing consumption across periods.

The PIH nevertheless assumes that individuals can transfer resources relatively efficiently across time. This assumption becomes problematic where credit markets are incomplete, borrowing is costly, formal financial services are inaccessible, and income is highly volatile. Under such conditions, the ability to smooth consumption depends not merely on expected income but also on liquidity access and the financial infrastructure through which resources can be transferred across periods. Borrowing, remittance receipts, account access, digital payments, and internet connectivity may consequently influence whether an individual can maintain saving in the presence of income fluctuations.

This extension is especially relevant in East Africa, where rapid growth in mobile money and digital financial services has expanded opportunities for financial transactions without eliminating underlying income instability. The theoretical implication is that saving should not be viewed exclusively as a function of income; it may also depend on the mechanisms through which individuals manage liquidity and participate in financial networks.

2.1.3 Absolute Income Hypothesis

The Absolute Income Hypothesis, rooted in Keynes (1936), provides a direct explanation of the relationship between current disposable income and saving. As income rises, consumption is expected to increase less than proportionately, creating greater scope for deferred consumption and asset accumulation. In low- and middle-income settings, this implies that non-saving may reflect binding capacity constraints rather than an absence of willingness to save.

This proposition is particularly important for understanding saving participation in low- and middle-income economies, where a substantial proportion of household resources may be committed to basic consumption. At low income levels, individuals may have little discretionary income remaining after meeting food, housing, transport, education, and other essential expenditures. The decision not to save may consequently represent a capacity constraint rather than an absence of willingness to save.

This perspective also highlights an important empirical identification problem. If higher-income individuals are intrinsically more capable of saving, then a positive observed relationship between saving and income cannot automatically be interpreted as evidence that saving itself raises income. Higher income may instead precede and facilitate saving. Establishing whether saving has an independent association with subsequent income therefore requires comparison between savers and non-savers who are similar in relevant observable characteristics. This consideration provides part of the methodological justification for the Propensity Score Matching approach employed in this study.

2.1.4 Buffer-Stock and Precautionary Saving Theory

The Buffer-Stock Saving framework introduces uncertainty explicitly into saving decisions. Deaton (1991) and Carroll (1997) demonstrate that when future income is uncertain and access to credit or insurance is incomplete, individuals accumulate liquid assets as a buffer against adverse shocks. Saving therefore provides self-insurance against unemployment, illness, crop failure, business losses, unexpected expenditure, and other disturbances to household income and consumption.

The precautionary motive is particularly applicable to East African economies because large informal sectors, agricultural dependence, limited unemployment insurance, incomplete social protection, and volatile earnings expose individuals to considerable economic uncertainty. Under these conditions, even relatively low-income individuals may attempt to maintain some form of savings despite substantial current consumption needs.

The theory also generates an ambiguous prediction regarding borrowing. Improved credit access may reduce the need for precautionary savings because individuals can borrow when shocks occur. Conversely, credit may complement saving where borrowing prevents individuals from liquidating accumulated assets, finances productive activities, or enables them to manage short-term liquidity while preserving longer-term savings. Consequently, whether borrowing crowds out or reinforces saving is ultimately an empirical question.

2.1.5 An Integrated Theoretical Perspective

No single theory adequately captures saving behaviour under the socioeconomic and institutional conditions prevailing in East Africa. The LCH emphasises lifetime resource allocation; the PIH focuses on expected income and responses to transitory shocks; the Absolute Income Hypothesis highlights current economic capacity; and the Buffer-Stock framework emphasises uncertainty, liquidity constraints, and precautionary motives. Their combined implication is that saving participation can be conceptualised as a constrained intertemporal allocation decision determined jointly by economic capacity, expected income, labour-market engagement, exposure to risk, access to liquidity, and the institutional mechanisms available for transferring resources across time. Financial inclusion and digital connectivity extend these traditional theoretical mechanisms. Accounts, mobile money, digital payments, remittance systems, and internet access can reduce transaction and information costs, increase financial convenience, improve liquidity management, and connect individuals to broader financial networks. However, access alone does not guarantee saving. The distinction between financial access and active financial use is therefore theoretically important. Indeed, the article's empirical results indicate that borrowing, remittance activity, and digital connectivity are more consistently related to saving than simple account ownership.

The integrated framework therefore predicts that individual saving participation in Uganda, Kenya, and Tanzania will reflect the interaction between economic capacity, labour-market position, financial engagement, liquidity access, remittance flows, and digital connectivity, rather than income or formal account ownership in isolation.

2.2 Empirical Literature

2.2.1 Income, Employment and Socioeconomic Determinants of Saving

A substantial empirical literature identifies income as one of the most important determinants of household and individual saving. Consistent with conventional consumption theories, individuals with higher and more stable income generally exhibit greater saving capacity, although the strength of the relationship varies considerably across populations and institutional settings. Dynan et al.

(2004), for example, provide evidence that higher-income households tend to save proportionately more, while Browning and Lusardi (1996) show that saving behaviour reflects interactions among income, demographic characteristics, expectations, uncertainty, and institutional conditions.

Employment status is closely related to this mechanism. Regular employment increases the predictability of income and therefore facilitates financial planning and deferred consumption. Conversely, unemployment and labour-market inactivity constrain the resources available for saving and increase dependence on existing assets, transfers, or borrowing. This relationship is particularly important in East Africa, where labour-market informality implies that being economically active does not necessarily guarantee stable earnings.

Education can influence saving through several channels. Higher educational attainment may increase lifetime earnings, improve financial literacy, enhance access to formal employment, and strengthen individuals' capacity to evaluate financial products. However, education may also be associated with higher consumption expectations and lifecycle expenditure. Its effect is therefore mediated by labour-market opportunities and the financial environment in which individuals operate.

2.2.2 Financial Access and Saving Participation

Financial inclusion has increasingly become central to the empirical literature on saving behaviour. Access to formal accounts can improve the security of accumulated resources, reduce the physical and psychological costs of saving, facilitate regular deposits, and connect individuals to additional financial products. The Global Findex literature documents substantial expansion of account ownership and digital financial access across developing economies, although important gaps remain between account ownership and active financial use (Demirgüç-Kunt et al., 2022).

This distinction is analytically important. Merely possessing an account does not guarantee that individuals have sufficient income to save, use the account regularly, or regard available products as affordable and appropriate. Financial access may therefore be a necessary but insufficient condition for saving participation. Moreover, Emara and Kasa (2021) identify a potentially non-linear relationship between financial access and domestic saving, suggesting that financial development can simultaneously facilitate asset accumulation and reduce the need to hold precautionary balances by improving access to liquidity.

The East African setting makes this distinction especially relevant because financial inclusion has expanded rapidly through both conventional banking and mobile financial services. The resulting empirical question is therefore not simply whether individuals possess access to financial infrastructure, but whether active engagement with financial services is associated with a higher probability of saving.

2.2.3 Borrowing and Saving

The relationship between borrowing and saving is theoretically and empirically complex. A traditional substitution perspective predicts that improved access to credit reduces the need for individuals to maintain liquid precautionary assets. Under this interpretation, borrowing and saving should be negatively related.

An alternative perspective views credit and saving as complementary. Individuals facing irregular cash flows may simultaneously hold savings and debt because the two instruments serve different purposes. Borrowing can meet short-term consumption or investment needs while savings are retained for emergencies, future expenditures, or long-term objectives. Credit can also finance productive activities that subsequently increase income and saving capacity.

This coexistence is particularly plausible in financially constrained developing economies, where households simultaneously confront income volatility, limited insurance, indivisible investment requirements, and uncertain expenditure. Consequently, a positive association between borrowing and saving need not represent anomalous financial behaviour. Rather, it may indicate deeper financial participation or a strategy for managing different dimensions of liquidity and risk.

Ugandan evidence has long demonstrated the importance of household-level conditions in financial saving mobilisation (Kiiza & Pederson, 2001). More broadly, the coexistence of saving and borrowing indicates that analysis should move beyond treating debt simply as the opposite of saving. This study therefore considers borrowing as a potentially important determinant of saving participation rather than imposing an a priori negative relationship.

2.2.4 Remittances and Saving Behaviour

Remittances represent another potentially important source of liquidity, particularly where labour earnings are irregular. Transfers received from relatives, migrants, or other networks can supplement current income, finance consumption, provide insurance against shocks, and create opportunities for asset accumulation.

The effect of remittances on saving nevertheless depends on how transferred resources are used. Where remittances primarily finance basic consumption, education, health care, or emergency expenditure, their contribution to saving may be limited. Where transfers exceed immediate consumption requirements or are received through channels that facilitate financial intermediation, a proportion may be retained as savings.

The channel through which remittances are received may consequently matter alongside the transfer itself. Transfers received through accounts or other formal and semi-formal channels can expose recipients to financial services and lower the marginal cost of retaining part of the transfer within the financial system. This provides a rationale for distinguishing account-based, over-the-counter, and other remittance channels rather than treating remittance receipt as a homogeneous financial behaviour.

2.2.5 Digital Connectivity, Mobile Money and Saving

Digital transformation has substantially altered the financial landscape of East Africa. Internet connectivity, mobile phones, mobile money, and digital payment systems reduce geographical barriers to financial services and potentially lower the monetary and time costs associated with financial transactions. Digital platforms may also improve access to financial information, facilitate frequent low-value transactions, and enable individuals to transfer resources into savings without visiting physical financial institutions.

Evidence from Kenya demonstrates the wider welfare effects of digital financial infrastructure. Jack and Suri (2014) show that mobile money reduced transaction costs and improved households' capacity to share risk, while Suri and Jack (2016) identify longer-term poverty and welfare effects associated with mobile-money expansion. These findings suggest that digital finance can affect saving indirectly by improving liquidity management, risk sharing, and financial resilience.

Internet connectivity may provide an additional mechanism. Thaariq et al. (2021) report evidence linking internet access to household saving, potentially through reduced information and transaction costs and greater access to digital financial products. Nevertheless, the effect is theoretically ambiguous. Internet access can also expand opportunities for consumption and facilitate digital expenditure. The net relationship between connectivity and saving therefore depends on whether its financial-access and information effects outweigh its consumption-enhancing effects.

The East African context is especially relevant because rapid digital-financial expansion coexists with substantial income volatility and uneven access to conventional banking. Evidence from Kenya shows that access to formal savings technologies can increase saving and productive investment among financially constrained microentrepreneurs (Dupas & Robinson, 2013), while mobile money has reduced transaction costs and strengthened risk sharing (Jack & Suri, 2014; Suri & Jack, 2016). In Uganda, long-run experimental evidence indicates that savings-promotion and financial-education interventions can raise both saving and income outcomes over time (Horn et al., 2020). Together, these studies reinforce the importance of examining not only access to financial infrastructure but also its effective use and welfare consequences.

2.3 Saving and Income: The Problem of Reverse Causality and Selection

While much of the literature examines income as a determinant of saving, comparatively less attention has been devoted to the reverse relationship whether saving itself contributes to higher subsequent income. Standard consumption and saving theories generally treat saving as the portion of current resources transferred to future periods, thereby enabling consumption smoothing and wealth accumulation (Friedman, 1957; Modigliani & Brumberg, 1954; Deaton, 1992). Beyond its consumption-smoothing function, accumulated savings can provide resources for investment in productive assets, education, enterprise development, and other income-generating activities, particularly where access to external finance is limited (Browning & Lusardi, 1996; Rutherford, 2000). In developing economies, savings may therefore serve not only as a precautionary buffer against shocks but also as a mechanism through which liquidity constraints are relaxed and productive opportunities are financed (Deaton, 1991; Carroll, 1997).

The direction of causality between saving and income is, however, theoretically and empirically ambiguous. Conventional saving theories predict that higher current or permanent income increases the capacity to save because individuals with greater disposable resources can defer a larger proportion of consumption (Friedman, 1957; Modigliani, 1986). Empirical evidence similarly indicates that saving rates tend to increase with income and wealth, although the magnitude of this relationship varies across households and socioeconomic groups (Browning & Lusardi, 1996; Dynan et al., 2004). Consequently, a positive association between saving and income may reflect income causing saving rather than saving causing income, creating a potential problem of reverse causality.

A related challenge is selection bias. Saving participation is not randomly assigned: individuals who save may systematically differ from non-savers in characteristics that also determine income. Differences in employment status, education, age, access to financial services, liquidity, financial capability, risk preferences, and other socioeconomic characteristics can influence both the probability of saving and subsequent economic outcomes (Browning & Lusardi, 1996; Demirgüç-Kunt et al., 2022). As a result, a simple comparison of mean income between savers and non-savers may attribute to saving an income advantage that is partly or wholly explained by pre-existing differences between the two groups. This is particularly important in observational household and individual-level data, where treatment status in this case saving participation is determined by individual choice rather than random assignment.

This identification problem motivates the application of Propensity Score Matching (PSM). Rosenbaum and Rubin (1983) demonstrate that propensity-score methods can reduce observable selection bias by comparing treated and untreated individuals with similar probabilities of treatment conditional on observed characteristics. In the present context, PSM permits savers to be matched with observationally comparable non-savers, thereby constructing a counterfactual approximation of the income that savers might have experienced had they not saved. The resulting Average Treatment Effect on the Treated (ATT) provides a more credible estimate of the conditional effect of saving participation on income than an unmatched comparison, provided the Conditional Independence and Common Support assumptions are satisfied (Rosenbaum & Rubin, 1983; Caliendo & Kopeinig, 2008; Abadie & Imbens, 2006). Nevertheless, because PSM balances only observed characteristics, it cannot eliminate bias arising from unobserved factors such as financial literacy, entrepreneurial ability, aspirations, risk preferences, or motivation (Caliendo & Kopeinig, 2008).

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Accordingly, this study contributes to the literature by distinguishing two related but analytically separate relationships: income as a determinant of saving participation and saving as a potential determinant of income. By combining logistic regression with PSM, the analysis first identifies the characteristics associated with selection into saving and subsequently estimates whether an income differential remains after observable differences between savers and non-savers have been reduced. This approach moves beyond the predominantly correlational treatment of saving and income and provides comparative evidence on whether the conditional income effect of saving varies across Uganda, Kenya, and Tanzania. The article explicitly recognises, however, that because the data are cross-sectional and observational, the estimated ATT should be interpreted as a conditional treatment effect under the PSM identifying assumptions rather than as experimental causality.

2.4 Research Gap and Contribution of the Study

The preceding literature reveals four interrelated gaps.

First, much of the literature on saving in developing economies concentrates on conventional socioeconomic determinants particularly income, age, education, and employment while the expanding roles of borrowing, remittance channels, digital payments, and internet connectivity are less consistently incorporated within an integrated model of individual saving participation.

Second, existing financial-inclusion research often emphasises access, particularly account ownership, rather than distinguishing access from active financial engagement. Yet individuals may own accounts without saving regularly, while borrowing, remitting, receiving transfers, or conducting digital transactions may provide stronger indications of functional participation in the financial system.

Third, a substantial part of the empirical literature is country-specific, limiting the extent to which institutional heterogeneity can be examined. Uganda, Kenya, and Tanzania share important regional characteristics but differ in financial-sector development, digital-finance penetration, labour-market structure, and institutional conditions. A harmonised cross-country analysis therefore provides an opportunity to distinguish common determinants from country-specific relationships.

Fourth, and most importantly, relatively little empirical work distinguishes the determinants of entering saving from the welfare consequences of saving. The observed positive relationship between saving and income may largely reflect self-selection because individuals with stronger socioeconomic characteristics are simultaneously more likely to save and earn higher incomes. Failure to address this selection problem risks overstating the economic return to saving.

The present study addresses these gaps by using harmonised Global Findex 2021 individual-level data for Uganda, Kenya, and Tanzania and combining binary logistic regression with Propensity Score Matching. Logistic regression identifies the socioeconomic, labour-market, financial-engagement, remittance, and digital-connectivity factors associated with saving participation, while PSM constructs observationally comparable groups of savers and non-savers to estimate the Average Treatment Effect on the Treated (ATT) for income.

The study therefore contributes to the literature at three levels. Empirically, it generates harmonised comparative evidence across three major East African economies. Conceptually, it shifts attention from passive financial access toward active financial engagement and digital connectivity as mechanisms shaping saving participation. Methodologically, it separates the question of who saves from the question of whether saving is associated with improved income after observable selection is reduced. This distinction is central to evaluating whether policies that expand saving participation are sufficient in themselves or whether they must also connect accumulated savings to productive investment and income-generating opportunities.

Importantly, the causal interpretation remains conditional rather than experimental: the article itself recognises that PSM balances observed characteristics but cannot eliminate bias from unobserved factors such as financial literacy, risk preferences, aspirations, or entrepreneurial ability.

3. DATA AND METHODS

3.1 Data and Study Population

The study uses individual-level micro-data from the World Bank Global Findex 2021 database, which provides nationally representative information on saving, borrowing, account ownership, digital payments, internet access, remittances and socioeconomic characteristics among adults aged 15 years and above. The country-specific estimation samples are approximately 997 observations for Uganda, 995 for Kenya and 987 for Tanzania, with minor variation across specifications due to missing values and perfect prediction.

3.2 Variables and Measurement

The primary dependent variable in the determinant models is individual saving participation, coded 1 for a respondent who reported saving and 0 otherwise. Explanatory variables include borrowing, remittance channel, internet access, digital-payment use, labour-market status and other socioeconomic controls. For the PSM analysis, saving participation is the treatment and the outcome is individual income position as operationalised in the final annex output by `inc_q` (income quintile). The quintile outcome is ordinal, with higher values indicating a higher position in the national income distribution. Accordingly, treatment effects from the annex are interpreted as differences in income-quintile units, not as currency amounts.

3.3 Logistic Regression Model

A binary logistic regression is estimated separately by country to model the probability of saving participation. Let S_i denote saving status for individual i and X_i a vector of observed socioeconomic, financial and digital characteristics. The model is:

$$\Pr(S_i = 1 | X_i) = \Lambda(\alpha + X_i'\beta), \dots \dots \dots [1]$$

where $\Lambda(\cdot)$ is the logistic cumulative distribution function. Results are interpreted using odds ratios and average marginal effects. Marginal effects are particularly useful because they express the estimated change in the probability of saving associated with a change in each explanatory variable.

3.4 Propensity Score Matching and Identification

3.4.1 Propensity Score Estimation

Saving participation is the sole treatment of interest. Let $S_i = 1$ denote a saver and $S_i = 0$ a non-saver. For observed covariates X_i , the propensity score is defined as $p(X_i) = \Pr(S_i = 1 | X_i)$ and is estimated using the binary-logit specification $p(X_i) = \exp(\alpha + X_i'\beta) / [1 + \exp(\alpha + X_i'\beta)]$. The covariates are selected because they may jointly influence selection into saving and the individual income outcome. The propensity-score model is used to generate balancing scores rather than to assign a causal interpretation to the first-stage coefficients. Individual income quintile is the outcome, not an exposure.

3.4.2 Matching Procedure and ATT

Savers are matched to non-savers with similar propensity scores using nearest-neighbour matching within the region of common support. Kernel, radius/caliper, Mahalanobis-distance and stratification matching are used as robustness checks. The estimand is the Average Treatment Effect on the Treated (ATT): $ATT = E[Y_i(1) - Y_i(0) | S_i = 1]$, where $Y_i(1)$ and $Y_i(0)$ denote the potential individual income-quintile outcomes under saving and non-saving, respectively.

A positive ATT indicates a higher average income-quintile position among savers relative to matched non-savers; a negative ATT indicates a lower position. Statistical significance is assessed using the reported standard errors and t-statistics, while recognising that the propensity score is itself estimated.

3.4.3 Identification Assumptions

Identification relies on the Conditional Independence Assumption, $\{Y_i(1), Y_i(0)\} \perp S_i | X_i$, and the Common Support condition, $0 < p(X_i) < 1$. These conditions require that, after conditioning on observed covariates, treatment assignment is independent of potential outcomes and that comparable non-savers exist for savers across the relevant propensity-score range.

3.4.4 Balance Diagnostics

Post-matching balance is assessed using standardized mean differences (SMDs), variance ratios and graphical inspection of propensity-score overlap. For covariate k , $SMD_k = (\bar{X}_{T,k} - \bar{X}_{C,k}) / \sqrt{[(s^2_{T,k} + s^2_{C,k})/2]}$. Absolute SMD values below 0.10 are treated as satisfactory, variance ratios close to one indicate similar dispersion, and overlapping propensity-score distributions support the common-support condition.

3.4.5 Robustness and Sensitivity Analysis

Robustness is assessed using alternative matching algorithms, post-matching balance diagnostics and Rosenbaum-bounds sensitivity analysis. Post-matching diagnostics show substantial improvement in covariate balance and adequate common support across the three country samples. The broader baseline specification records a mean VIF of 2.48, indicating no serious multicollinearity. These diagnostics strengthen confidence in the conditional treatment estimates while not eliminating the possibility of hidden bias from unobserved factors.

The identification strategy for this article therefore has two components: (i) country-specific logistic regression to identify factors associated with individual saving participation, and (ii) PSM to estimate the conditional effect of saving participation on individual income quintile.

4. RESULTS

4.1 Descriptive Patterns in Saving Participation

Table 1. Selected Descriptive Characteristics and Individual Saving Participation

Characteristic	Category	Did not save n (%)	Saved n (%)	Total	χ^2 / p-value
Sex	Female	660 (39.59)	1,007 (60.41)	1,667	$\chi^2(1)=27.13^{***}$
	Male	406 (30.43)	928 (69.57)	1,334	
Education	Primary	667 (48.97)	695 (51.03)	1,362	$\chi^2(4)=203.87^{***}$
	Secondary	384 (24.90)	1,158 (75.10)	1,542	
	Tertiary	12 (13.19)	79 (86.81)	91	
Income quintile	Poorest 20%	285 (55.56)	228 (44.44)	513	$\chi^2(4)=201.09^{***}$

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Characteristic	Category	Did not save n (%)	Saved n (%)	Total	χ^2 / p-value
	Second 20%	240 (47.43)	266 (52.57)	506	
	Middle 20%	182 (32.50)	378 (67.50)	560	
	Fourth 20%	192 (30.14)	445 (69.86)	637	
	Richest 20%	167 (21.27)	618 (78.73)	785	
Country	Uganda	283 (28.30)	717 (71.70)	1,000	$\chi^2(2)=86.31^{***}$
	Kenya	314 (31.40)	686 (68.60)	1,000	
	Tanzania	469 (46.85)	532 (53.15)	1,001	
Workforce status	In workforce	722 (30.41)	1,652 (69.59)	2,374	$\chi^2(1)=129.48^{***}$
	Out of workforce	344 (54.86)	283 (45.14)	627	
Residence	Rural	716 (38.39)	1,149 (61.61)	1,865	$\chi^2(1)=17.72^{***}$
	Urban	350 (30.81)	786 (69.19)	1,136	
Account ownership	No	600 (64.79)	326 (35.21)	926	$\chi^2(1)=501.07^{***}$
	Yes	466 (22.46)	1,609 (77.54)	2,075	
Internet access	Yes	213 (17.65)	994 (82.35)	1,207	$\chi^2(3)=282.89^{***}$
	No	849 (47.62)	934 (52.38)	1,783	
Overall	—	1,066 (35.52)	1,935 (64.48)	3,001	—

Notes: *** $p < 0.01$. Percentages are row percentages. Minor “don't know/refused” categories are omitted from the compact journal table but retained in the dissertation calculations.

Descriptively, 64.48% of respondents reported saving. Saving participation rose markedly with education and income, was higher among individuals in the workforce and those with internet access, and differed significantly across countries. Uganda recorded the highest saving participation (71.70%), followed by Kenya (68.60%) and Tanzania (53.15%). These bivariate relationships are descriptive associations and do not establish causality.

4.2 Determinants of Individual Saving Participation

Table 2. Selected Determinants of Individual Saving Participation by Country

Determinant	Uganda OR	Uganda AME	Kenya OR	Kenya AME	Tanzania OR	Tanzania AME
Borrowing	1.89***	+10.1 pp	2.24***	NR	2.63***	+15.8 pp
Internet access	2.21***	+12.6 pp	2.35*** ¹	NR	1.80***	+9.8 pp
OTC remittances	2.81***	+16.5 pp	NI	NI	2.64***	+15.5 pp
Remittance through account	1.36 NS	+4.9 pp	NI	NI	2.94***	+17.2 pp
Other remittance method	1.88**	+10.0 pp	NI	NI	2.15**	+12.3 pp
Digital payments	1.75 NS	+8.9 pp	4.38***	NR	2.54**	+14.9 pp
Account ownership	2.10 NS	+11.8 pp	NI	NI	NS	—
Out of workforce	0.70*	−5.6 pp	0.64**	NR	0.70*	−5.7 pp

Notes: OR = odds ratio; AME = average marginal effect; pp = percentage points; NR = not reported in final Kenya specification ; NI = not included in that final country specification; NS = statistically insignificant. *** $p < .01$, ** $p < .05$, * $p < .10$. The category “no internet access” with $\beta = -0.8555$; its reciprocal gives approximately OR = 2.35 for internet access versus no internet access.

In Uganda, borrowing, internet access and remittance activity emerge as the strongest statistically significant correlates of saving. Borrowers have 1.89 times the odds of saving relative to non-borrowers, corresponding to an estimated 10.1 percentage-point increase in the probability of saving. Internet access is associated with a 12.6 percentage-point increase, while OTC remittances have the largest reported marginal effect at 16.5 percentage points. Being outside the workforce reduces the probability of saving by approximately 5.6 percentage points. Account ownership and digital payment use are positive but statistically insignificant, indicating that formal access without active financial engagement may be insufficient.

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In Kenya, the final Annex 2 logistic output shows significant positive associations for borrowing and digital-payment use and a significant negative association for lack of internet access and labour-market inactivity. Borrowing is associated with approximately 2.24 times the odds of saving ($\beta = 0.807$, $p < 0.001$), while digital-payment use is associated with approximately 4.38 times the odds ($\beta = 1.477$, $p < 0.001$). The reported coefficient for no internet access is negative ($\beta = -0.856$, $p < 0.001$), equivalent to an odds ratio of about 0.43 for no access versus access, or approximately 2.35 for access versus no access. Being out of the workforce is also negatively associated with saving ($OR \approx 0.64$, $p = 0.027$). Because Annex 2 does not report average marginal effects, no Kenya AMEs are inferred or imputed.

Tanzania shows a broad set of significant determinants in the country-specific baseline model. Borrowing increases the probability of saving by 15.8 percentage points, internet access by 9.8 percentage points and digital-payment use by 14.9 percentage points. Remittances through an account, OTC channels and other methods are also significant, with marginal effects of approximately 17.2, 15.5 and 12.3 percentage points, respectively. Account ownership is not statistically significant, while being out of the workforce is negatively associated with saving. Importantly, the digital-payment result is statistically significant in both the country-specific Table 2 ($OR = 2.54$, $AME = +14.9$ pp, $p = 0.032$) and the reduced Annex 3 specification; the two specifications differ in magnitude, not in significance.

Across the three countries, the dominant pattern is therefore one of functional financial engagement rather than passive inclusion. Borrowing, remittance flows and digital connectivity are more consistently related to saving than simple account ownership. Labour-market inactivity works in the opposite direction, highlighting the continuing importance of income-generating opportunities.

Table 3. Propensity Score Matching Estimates of the Conditional Effect of Saving on Individual Income Quintile

Country	Sample	Savers Treated mean	/ Controls mean	Difference ATT	/ S.E.	t-statistic	Inference	
Uganda	Unmatched	3.4364	2.7908	0.6456***	0.1005	6.42	Significant difference	raw
	Matched ATT	3.4364	3.2965	0.1399	0.1851	0.76	NS	
Kenya	Unmatched	3.4905	2.6645	0.8260***	0.0937	8.82	Significant difference	raw
	Matched ATT	3.4905	3.2409	0.2496	0.1811	1.38	NS	
Tanzania	Unmatched	3.5502	2.7399	0.8103***	0.0869	9.33	Significant difference	raw
	Matched ATT	3.5502	2.9903	0.5598***	0.1793	3.12	Significant	

Notes: Outcome = individual income quintile (inc_q). ATT = Average Treatment Effect on the Treated. Effects are expressed in income-quintile units and **not currency units**. *** $p < .01$; NS = not statistically significant.

4.3 Conditional Effect of Saving Participation on Individual Income

The unmatched comparisons show that savers have substantially higher income than non-savers in all three countries. However, these raw differences are not themselves evidence that saving causes higher income because savers differ from non-savers in observed characteristics. The PSM results materially change the interpretation.

In Uganda, the annex output shows an unmatched income-quintile difference of 0.6456. After matching, the ATT declines to 0.1399 income-quintile units and is statistically insignificant ($t=0.76$). This indicates that much of the observed income-position difference between savers and non-savers is attributable to observable selection rather than an independently identifiable effect of saving.

In Kenya, the unmatched income-quintile difference is 0.8260. After matching, the ATT falls to 0.2496 income-quintile units and is statistically insignificant ($t=1.38$). The matched estimate is therefore positive but does not provide statistically reliable evidence of an independent saving effect on individual income position.

Tanzania presents the strongest evidence of an income-position effect. The unmatched income-quintile difference is 0.8103, while the matched ATT is 0.5598 income-quintile units and remains statistically significant ($t=3.12$). Conditional on the PSM assumptions, this is consistent with a positive association between saving participation and higher income-quintile positioning after observable selection is reduced.

4.4 Matching Quality and Robustness

Post-matching diagnostics indicate improved covariate balance and adequate common support across the three country samples. Standardized mean differences are assessed against the conventional $|SMD| < 0.10$ criterion, with variance ratios and propensity-score overlap providing complementary checks. The broader baseline model has a mean VIF of 2.48, well below conventional

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multicollinearity thresholds. Alternative matching estimators and Rosenbaum-bounds sensitivity analysis are used to examine the stability of the ATT estimates. These diagnostics improve the credibility of the conditional treatment estimates but do not remove potential bias from unobserved characteristics. Detailed VIF diagnostics and Rosenbaum-bounds results are reported in Supplementary Tables S1-S2.

Table 4. Summary of Propensity-Score Matching Diagnostics

Diagnostic	Uganda	Kenya	Tanzania	Decision
Pre-match imbalance	Substantial; SMD ≈22–30% for key covariates	Substantial selection	Moderate observable separation	Matching required
Post-match SMD	Generally <5%	Generally <5%	Considerably reduced to acceptable range	Satisfactory
Propensity-score overlap	Substantial matching	after Substantial matching	after Substantial matching	Common support satisfied
Post-match pseudo-R ²	Markedly reduced	Markedly reduced	Markedly reduced	Improved balance
Nearest-neighbour matching	Yes	Yes	Yes	Principal estimator
Kernel matching robustness	Yes	Yes	Yes	Robustness check
Radius/caliper matching	Yes	Yes	Yes	Robustness check
Mahalanobis stratification	/ Used as additional checks	Used as additional checks	Used as additional checks	Robustness check
Overall assessment	Balanced	Balanced	Balanced	ATT estimation supported

Note: SMD = standardized mean difference. The methodological criterion adopted in the study is $|SMD| < 0.10$, with values below 5% indicating particularly strong balance.

5. DISCUSSION

The findings support a constrained view of intertemporal saving in East Africa. The LCH and PIH predict that individuals allocate resources over time according to current and expected income, but the empirical results show that this process is mediated by labour-market participation, liquidity access and digital connectivity. Individuals outside the workforce are consistently less likely to save, indicating that the capacity to defer consumption remains fundamentally tied to productive economic engagement.

The positive association between borrowing and saving challenges a simple view of debt and saving as substitutes. In financially constrained settings, borrowing can provide liquidity that prevents households from liquidating savings, can finance productive activity that generates cash flow, or can signal deeper engagement with financial institutions. This does not imply that all borrowing is beneficial; rather, it suggests that credit and saving may be complementary when credit is accessible, appropriately structured and used productively.

Internet access and remittance channels connect individuals to broader financial networks by reducing information and transaction costs and by providing episodic liquidity from which saving may occur. Digital-payment use is also positively associated with saving in Kenya and Tanzania, reinforcing the distinction between active financial use and passive account ownership.

The insignificant account-ownership coefficients are particularly policy-relevant. Financial inclusion strategies often treat account opening as an endpoint, yet the results indicate that ownership does not automatically translate into saving. Effective inclusion requires regular use, affordable transactions, trusted products, connectivity, income flows and financial capability. This finding is consistent with a shift from access-based measures of inclusion toward usage and welfare outcomes.

The cross-country differences in the saving–income relationship are equally important. Uganda's insignificant ATT indicates that policies encouraging saving participation alone may not be sufficient to generate income growth. Savings may remain precautionary, small, fragmented or disconnected from productive investment opportunities. Kenya records a positive but statistically insignificant matched difference, whereas Tanzania records a positive and statistically significant ATT. The income-position implications of saving therefore appear contingent on the institutional and economic environment in which accumulated resources are deployed.

These results also caution against interpreting raw saver/non-saver income differences as causal. In Uganda, matching removes statistical significance despite a large unmatched gap. The result demonstrates the value of addressing selection and illustrates why descriptive evidence can exaggerate the independent welfare effect of saving.

6. POLICY IMPLICATIONS

First, savings mobilisation should be integrated with employment and income-generation policies. The negative association between labour-market inactivity and saving participation across the final country-specific specifications indicates that sustained saving is closely linked to productive economic engagement. Employment creation, agricultural commercialisation, entrepreneurship and small-enterprise development should therefore complement financial-inclusion programmes.

Second, policymakers and financial institutions should move beyond account-opening targets toward active financial engagement. Savings products should be integrated with digital payments, remittance channels and responsible credit, while pricing and product design should encourage regular accumulation rather than episodic account use.

Third, digital connectivity should be treated as part of the savings infrastructure. Affordable internet, reliable electricity and interoperable digital financial services can reduce transaction costs and widen access to saving products, particularly for rural and underserved populations.

Fourth, remittance systems should be designed to facilitate saving. Low-cost formal and semi-formal remittance channels can incorporate default or voluntary saving options, helping recipients convert transfers into buffers and productive assets.

Fifth, the country differences in the income effect imply that savings promotion should be linked to productive investment pathways. Uganda in particular requires mechanisms that help savers transform accumulated balances into enterprise capital, agricultural investment, skills, housing or other income-enhancing assets. Kenya and Tanzania should similarly strengthen the connection between saving, investment and financial resilience while protecting households from excessive or poorly structured credit.

7. LIMITATIONS

The study uses cross-sectional observational data, and PSM can balance only observed covariates. Unobserved characteristics such as risk preferences, financial literacy, entrepreneurial ability, trust, aspirations and social norms may still influence both saving participation and individual income position. The ATT estimates should therefore be interpreted as conditional treatment effects under the Conditional Independence and Common Support assumptions rather than as equivalent to randomised experimental effects. Global Findex provides harmonised cross-country measures but does not capture the full value, duration or purpose of saving. Country-specific specifications also differ according to the covariates retained in the final estimation outputs; comparisons should therefore focus on the direction, statistical significance and substantive pattern of effects rather than assume identical model composition across countries.

8. CONCLUSION

This article examined the microeconomic determinants of individual saving participation and the conditional effect of saving on individual income position in Uganda, Kenya and Tanzania. Saving participation is associated with active financial engagement, digital connectivity, remittance flows and labour-market participation, with important country differences. Borrowing and internet access are positively associated with saving across the three countries; digital-payment use is significant in Kenya and Tanzania; and labour-market inactivity is negatively associated with saving in the final country-specific specifications. Account ownership alone is not consistently significant, underscoring the distinction between passive access and functional financial use. These logistic-regression findings are interpreted as associations rather than causal effects.

The PSM analysis reveals substantial heterogeneity in the conditional relationship between saving and individual income quintile. After matching, the ATT is statistically insignificant in Uganda (0.1399) and Kenya (0.2496), while Tanzania records a positive and statistically significant ATT of 0.5598 income-quintile units. The results therefore caution against treating raw saver/non-saver income differences as causal and suggest that the welfare implications of saving depend on country-specific economic and institutional conditions. Policies should combine savings mobilisation with employment creation, digital connectivity, responsible credit, remittance formalisation and productive investment opportunities.

9. DECLARATIONS

9.1. List of abbreviations

ATT	Average Treatment effect on the Treated
LCH	Life-Cycle Hypothesis
PIH	Permanent Income Hypothesis
PSM	Propensity Score Matching

9.2. Ethics approval and consent to participate

This study used publicly available, de-identified secondary data from the World Bank Global Findex 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 Findex) 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.

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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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9.9. Author Information

Stephen Robert Kasumba, the corresponding author, is an Economist and an M&E expert working with the National Identification and Registration Authority (NIRA). He is pursuing a Ph.D. in Economics at Makerere University. Email: stepkasumba@gmail.com
Gertrude Muwanga is a senior lecturer from the Department of Economic Theory and Analysis, College of Business and Management Sciences, Makerere University, Email: gmuwanga@yahoo.com

Peter Babyenda is a senior lecturer from the Department of Economic Theory and Analysis, College of Business and Management Sciences, Makerere University, Uganda, peterbabyenda@yahoo.com

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