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FACTORS AFFECTING THE LEVEL OF THE FINANCIAL INCLUSION A COMPARATIVE STUDY OF TANZANIA, KENYA AND UGANDA

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Abstract:

This research examined the comparative characteristics affecting financial inclusion in Tanzania, Kenya, and Uganda. Despite Tanzania's robust economic development, its degree of financial inclusion remains inferior to that of its neighboring nations, Kenya and Uganda. The provision of accessible financial services to underrepresented people is essential for poverty alleviation and economic growth. This study used cross-sectional micro-level data from the Global Findex Database survey waves conducted in 2011, 2014, 2017, and 2021. The Least Absolute Shrinkage and Selection Operator (LASSO) post-selection inference technique was used in the research to address issues arising from highdimensional data and model selection bias. The results indicate that Kenya excels in financial inclusion, propelled by sophisticated digital financial institutions, whilst Tanzania lags behind. The significant primary drivers of financial inclusion were debit card utilization. bank borrowing. and demographic characteristics such as gender and education level while the use of credit cards amongst women had a negative influence on financial inclusion. The research underscores the significance of access to financial services and the contribution of digital finance to improving inclusion. It underscores the need for focused strategies to tackle obstacles such as inadequate infrastructure, insufficient financial literacy, and gender inequities. Research indicates that enhancing mobile money systems and advancing financial literacy, particularly for women and low-income populations, may close the financial inclusion gap. The report emphasizes the need for a more inclusive financial environment to guarantee fair economic growth.

Keywords : Financial inclusion, LASSO, Digital finance, Gender, Economic development.

INTRODUCTION

Financial inclusion is recognised as the sustainable delivery of affordable financial services that integrate individuals living in poverty into the formal economy, thereby decreasing household poverty rates and mitigating vulnerability to future poverty. Its beneficial effects have been observed across diverse nations and contexts(Jiang & Liu, 2022; Koomson et al., 2020). Access to and use of formal financial services by individuals who are generally marginalised from the financial system (Omar & Inaba, 2020; Saha & Qin, 2022). Financial inclusion diminishes poverty rates by facilitating access to banking, credit, savings and insurance. This enables individuals to mitigate risks, invest in education and business, and stabilise consumption during challenging periods (Koomson et al., 2020; Nyarko et al., 2023). An inclusive financial system is, therefore, highly desirable to enable the poor to access funds, grow capital, move funds, reduce the risk of poverty reduction, and improve standards of living.

Greater financial inclusion enables low-income people to start creating a saving culture, invest, and access funding (Ansong et al., 2021; Silva & Pino, 2024). Financial inclusion also enables them to avoid income shocks during emergencies, such as illness or loss of employment (Al-Hanawi et al., 2020; Kim et al., 2024). Financial inclusion is increasingly being viewed as both a business opportunity and social responsibility because the mobile communication sector and microfinance institutions, as important financial inclusion agents, participate in inclusion programs (Mishra et al., 2024; Ramzan et al., 2021; D. Vo et al., 2021).

On the other hand, financial exclusion creates social instability and increases income inequality within societies (Gaies, 2024; Khan & Khan, 2023). It has also been linked to social exclusion, which increases economic, social, and political inequality (Gaies, 2024; Mussida & Parisi, 2021; Pardue & Shelton, 2024).

The basic financial inclusion channels include the facilitation of daily financial transactions, such as government transfers and other public services, sending money home, paying a utility bill, or receiving wages, instead of using cash, which is less efficient, riskier, and requires face-to-face interaction. Financial services help boost earning capacity by enabling investments in education, health, housing, and businesses, and smooth consumption and bolster resilience to shocks such as disease, job loss, or a weak harvest through remittances and basic savings, lending, and insurance products.

Since 2010, the G-20 and World Bank have led initiatives to increase financial inclusion in developing countries to help them reduce poverty levels (Vo et al., 2021). Digital finance is one of the best ways of improving financial inclusion. They have also been defined as financial services delivered through mobile phones, personal computers, the Internet, or cards linked to reliable digital payment systems (Sushma, 2020; Tay et al., 2022). Although there is no standard definition of digital finance, there is some consensus that digital finance encompasses all products, services, technology, and/or infrastructure that enable individuals and companies to have access to payments, savings, and credit facilities via the Internet (online) through digital devices (Wang & Huang, 2023). The goal of using digital finance is to contribute to financial inclusion, poverty reduction, and economic growth in developing economies (Gao, 2023; Tay et al., 2022; Yaqin & Safuan, 2023). While financial inclusion is not a Sustainable Development Goal (SDG) by itself, it is positioned prominently as an enabler of other developmental goals" such as eradicating poverty (SDG 1), promoting economic growth (SDG 8), and reducing inequality (SDG 10).

East African countries have acknowledged the benefits they can realise from the level of financial inclusion in their societies and have thus integrated it as part of their national strategy (NFIF, 2018; Van Hove & Dubus, 2019). In particular, Tanzania has implemented the National Financial Inclusion Framework 2018–2022. This is the second framework to be implemented by the Financial Inclusion National Council, built from the first Framework, which ended in December 2016. This Framework's thrust was on the use of financial services after raising the level of access to formal financial services in the first framework. To ensure that the level of financial inclusion usage is increased, the framework integrates the private and public sectors in a way that enables lower-income earners to open low-value accounts. Other initiatives include enabling full interoperability between all bank accounts and mobile money wallets, driving rural agent growth, and creating incentives for the deployment of new agent networks that allow them to serve the cash-in/cash-out needs of all customers in their community, regardless of their provider. The vision of this Framework is to observe financial services that meet the needs of people and their businesses, consistent with supporting livelihoods, resilience, and job creation.

Financial inclusion has proven to be a potential transformative agent that ensures a more financially inclusive society, and leads to poverty reduction. The adoption and use of digital services positively affects and shapes daily financial activities that potentially contribute to the economic growth of society (Aleksandrova et al., 2022; Vrontis

et al., 2022). Despite the expected benefits and efforts, the level of financial inclusion usage in Tanzania is still low. Most of those excluded were people living in rural areas, smallholder farmers, youth, and women.

According to the (Demirgüç-Kunt et al., 2021), Tanzania still performs very poorly in almost all financialinclusion usage aspects compared to its neighbouring countries, Kenya and Uganda. For example, according to the (Demirgüç-Kunt et al., 2021), only 13.34% of people with low incomes borrowed money in 2021 from formal financial institutions, while the rate was 29% in Uganda and 39.69% in Kenya. About 33.3% of people experiencing poverty made payments through digital platforms, compared to 43.5% and 65% in Uganda and Kenya, respectively. While only 31% of poor own mobile money accounts in Tanzania, the rates are 37.7% and 56% in Uganda and Kenya, respectively.

Economic statistics from the (worldbank, 2023) show that the economic outlook in terms of GDP growth was favorable, statistics indicate that the GDP growth rate for Tanzania stood at 5.1%, Uganda at 5.3%, and Kenya's at 5.6%. In 2022, Tanzania's GDP growth rate was 4.6%, Kenya's was 4.9%, and Uganda's was 4.6%. In 2021, Tanzania's GDP growth rate was 4.3%, Kenya's was 7.6%, and Uganda's was 3.5%. It is expected that such economic growth will also be reflected in financial inclusion levels. According to Patrick, (1966) finance growth theory, economic growth should lead to the development of financial services.

Therefore, this study aims to establish the factors that cause Tanzania's financial inclusion level to lag behind that of its neighbouring countries, Kenya and Uganda, despite the favourable economic growth recently experienced by Tanzania. Specifically, this study explores the factors related to accessibility and usage of formal financial services among Tanzanians.

The urgency of this study arises from Tanzania's markedly lower financial inclusion rates relative to its neighbouring countries, Kenya and Uganda, despite its considerable economic advancement. The presence of such disparities in financial inclusion among nations sharing borders underscores the need to investigate the mechanisms leading to its existence, thus making it a vital field of research. The novelty of this research lies in its utilisation of data from four Global Findex survey waves dated 2011, 2014, 2017, and 2021. The extensive dataset offers detailed insight into the difficulties and potential for improving financial inclusion. Utilisation of the Least Absolute Shrinkage and Selection Operator (LASSO) post-selection inference method to address issues with high-dimensional data and model selection bias further enhances the novelty of this study. This technique uses feature selection to create a sparse model and ordinary least squares regression to infer from selected features, ensuring viable conclusions and robustness in model selection despite the large number of variables.

Financial inclusion is a multidimensional phenomenon that requires multidimensional measurement, the use of multidimensional measurement provides a more accurate and nuanced picture of financial inclusion, revealing disparities across different population groups and regions (Nuzzo & Piermattei, 2020; Sharma & Changkakati, 2022). Such measurements should combine indicators that represent various dimensions of financial inclusion, such as accessibility (accounts ownership per 1,000 adults in banks and MFIs), availability (number of banks and MFI branches, ATMs, Agent banks), and usage (number of adults who have savings and/or who have borrowed funds from Banks or MFIs). Numerous studies that have researched in the factors affecting financial inclusion (Bekele, 2023; Cicchiello et al., 2021; Dar & Ahmed, 2021; Govindapuram et al., 2023; mose & Thomi, 2021; Njanike & Mpofu, 2024; Nsiah & Tweneboah, 2023; Ondabu & Oyaro, 2024; Ozili, 2020). However, studies explaining why countries have different levels of financial inclusion are limited. A study by Lotto (2022) assessed financial inclusion in East Africa by comparing Tanzania with other East African countries. However, this study used Findex data from 2017, before the implementation of the National Financial Inclusion Framework 2018 – 2022. This study does not consider multidimensional financial inclusion indicators. Instead, formal savings, credit, and account ownership were used as proxies for financial inclusion. Wanjiku and Fatoki (2019) assessed the factors that determine financial inclusion in East Africa, but financial inclusion was only measured using domestic credit to the private sector by banks. Bekele, (2023)conducted a comparative study of the determinants of financial inclusion between Kenya and Ethiopia by calculating the financial inclusion index using penetration, availability, and usage data from the 2017 Global Findex. Despite the multitude of academic work by researchers, challenges persist in addressing financial inclusion. This study improves on previous studies by using the latest available Global Findex. Survey data (2021), while incorporating data from prior surveys to form stacked cross-sectional data, thus facilitating LASSO regression to capture nuanced, multidimensional indicators (accessibility, availability, and usage). updated data and advanced analytical methods offer innovative tools to provide further insight and assist in addressing persistent gaps in understanding financial inclusion disparities.

THEORETICAL FRAMEWORK AND HYPOTHESES

The Finance-Growth Nexus Theory (Patrick, 1966) asserts that financial development fosters economic growth. The theory suggests that a country's economic growth improves its financial infrastructure, which leads to greater access to and use of financial services. The Digital Financial Inclusion Model emphasises the role of digital technologies (mobile money, internet banking) as a disruptive force in traditional financial systems, particularly in rural and underserved areas(N'dri & Kakinaka, 2020; Shaikh et al., 2023). The Behavioral Economics Framework provides various factors, including trust in financial institutions, financial literacy, and socioeconomic barriers, as significant factors in the adoption of financial services. Institutional Theory emphasises the role of government policies, regulatory frameworks, and financial intermediaries in shaping access and usage patterns. Based on the theoretical framework and problem statement, the following hypotheses are proposed:

- H₁: There is a difference in the financial inclusion levels (as measured by the Financial Inclusion Index) between Tanzania, Kenya, and Uganda.
- H₂: Access to and usage of financial services, such as borrowing from banks, credit cards, and debit cards, enhances overall financial inclusion in Kenya, Uganda, and Tanzania.
- H₃: Socioeconomic factors, such as income level, education, and gender, have a significant impact on financial inclusion levels in Tanzania, Kenya, and Uganda.

RESEARCH METHODS

Data

This study used cross-sectional micro-level data from the Global Findex Database. The database provides information on individual characteristics and financial inclusion indicators collected through national representative surveys in four waves dated 2011, 2014, 2017, and 2021.

Measurement of financial inclusion

Most studies estimate the financial inclusion index by using macro-level data. However, Sarma, (2012) asserts that the index can also be constructed at the macro- and micro-levels, depending on the objective of the study. In this study, because the objective is to analyse the micro-level differences in financial inclusion, the index was calculated at the micro level following the method of Bekele, (2023) by applying the dimensions and indicators. Two dimensions, usage and accessibility, were used to calculate the financial inclusion index. Researchers believe that analysing financial inclusion through accessibility and usage allows for a more nuanced understanding of the determinants of financial inclusion in a particular context. Additionally, these are the dimensions recommended by the Findex World database, which was used as the data source for this study. The results provided in the dimensions allow policymakers and organisations to tailor relevant interventions to address specific challenges within each dimension.

The accessibility dimension was measured by account (measured by the percentage of the population with a bank account), Mobile Money Services (the percentage of the population using mobile money service), and credit or debit card accessibility (the percentage of the population having a debit or credit card). Usage of financial services was measured by saving (percentage of the population who save money at a bank or another type of financial institution, percentage of population who save money using a mobile money account), borrowing (percentage of population who save money using a mobile money account), borrowing (percentage of population who save money using a mobile money account), borrowing who have borrowed money from any financial institution, and percentage of respondents who have borrowed money account), and digital transactions (percentage of population that use a mobile phone or the Internet to pay bills, send money to relatives or friends, and/or buy things online).

Data Analysis Technique

The Financial Inclusion Index (FinI) was constructed by combining accessibility and usage indicators into a composite index. For each country (Tanzania, Kenya, Uganda), we normalise each financial inclusion indicator to a common scale (e.g. between 0 and 1) and then calculate the weighted average of accessibility and usage dimensions to derive the overall FinI score.

A total of 47 variables from the usage, accessibility, and socioeconomic dimensions were incorporated in this study, and a summary of operational variables and statistics are presented in Appendices 1 and 2, respectively. Such a large number of variables results in high-dimensional data with a large number of features in relation to the number of observations. The Least Absolute Shrinkage and Selection Operator (LASSO) post-selection inference method was used in this study to address problems caused by high-dimensional data and model selection bias. This approach mirrors the technique proposed by Belloni et al., (2019) for drawing conclusions from high-

dimensional models. The method performed feature selection to create a sparse model via LASSO and used ordinary least squares regression to make inferences from the selected features. This approach ensured that accurate conclusions were reached despite the presence of a large number of variables and offered robustness in the model selection. To enhance the robustness of the LASSO variable selection pipeline for grid search configuration, the leave-one-out cross validation (LOOCV) technique was employed in Python with the goal of minimising the root mean squared error and fine-tuning the LASSO's hyper parameter. The LOOCV approach was preferred because of the small number of observations and large number of variables.

RESULTS AND DISCUSSION Results

The results presented in Table 1 reveal that Kenya has the highest weighted average accessibility score (0.38) among the three countries, indicating relatively better availability of financial services and infrastructure. Kenya had the highest usage score (0.32), reflecting a higher level of engagement and utilisation of financial services. Kenya's Finl score is the highest (0.35), suggesting that it has the best overall financial inclusion performance among the three countries, combining accessibility and usage. This reflects its robust infrastructure and widespread adoption of mobile money platforms such as M-Pesa.

Tanzania has the lowest accessibility score (0.18), which implies that access to financial services is more limited than in Kenya and Uganda. Tanzania also has the lowest usage score (0.13), indicating lower levels of financial service utilisation. Tanzania, with the lowest FinI score, is the weakest among the three, reflecting both limited access and lower usage of financial services, suggesting barriers such as inadequate infrastructure and limited financial literacy, despite showing favourable economic growth in recent years. Uganda, while intermediate in performance, demonstrated high potential with progressive FinI improvements between 2011 and 2021.

Country	Year	Accessibility Score	Usage Score	Finl
Kenya	2011	0.309	0.000	0.154
Kenya	2014	0.714	0.833	0.774
Kenya	2017	0.845	0.665	0.755
Kenya	2021	0.511	0.744	0.627
Kenya (W-Av. score)		0.380188	0.323455	0.351821
Tanzania	2011	0.461	0.314	0.388
Tanzania	2014	0.328	0.805	0.567
Tanzania	2017	0.509	0.547	0.528
Tanzania	2021	0.586	0.424	0.505
Tanzania (W-Av. score)		0.183957	0.132060	0.158009
Uganda	2011	0.178	0.000	0.089
Uganda	2014	0.619	0.766	0.693
Uganda	2017	0.579	0.934	0.757
Uganda	2021	0.956	0.989	0.973
Uganda (W-Av. score)		0.240555	0.211050	0.225803

Source: Data Proceed (2025)

The results of the LASSO analysis were characterised by several coefficients being reduced to zero, signifying that those variables possess little predictive value in the model and hence are of no value for further analysis. Appendix 3 presents the LASSO coefficients. Several variables possessed non-zero coefficients, signifying their status as significant predictors; hence, they can be used for further analysis. The year variable has a positive coefficient, indicating that, ceteris paribus, there exists an upward temporal trend in financial inclusion. Such general improvements may arise from technological advancements, policy changes, or economic expansion which take time to take effect. Several other researchers have arrived at similar conclusions (Daud & Ahmad, 2023; Goel, 2023; Oanh, 2024). Bank account holding among those with secondary education is also positive, indicating that persons with secondary education are more likely to be financially included, which could be the result of education instilling superior economic behaviours among school goers, signifying the importance of education in promoting financial inclusion. The positive coefficient of debit card ownership among individuals with primary education suggests that financial instruments such as a debit card may enhance financial inclusion among less-educated demographics. The coefficients also indicate that the participation of women in the labour force correlates

with improved financial inclusion outcomes. The positive coefficients for borrowing across different demographics, particularly for the poor (0.07) and those with a primary education (0.05), demonstrate that access to borrowing facilities may facilitate financial inclusion. All the coefficients of credit card use among the youth, the rich, and females are negative, suggesting that credit cards are not a viable financial instrument that can predict improvement in financial inclusion. This is rather intriguing; however, considering the heightened debt load and charges associated with credit card use, they are more likely to result in financial exclusion than inclusion. The escalated credit card debt brought about by poor planning, financial illiteracy, and psychosocial behaviours may result in financial hardship, prompting users to stay away from mainstream financing options. Payne et al., (2019) had similar observation particularly on people with low risk tolerance who were more likely to be financially excluded as a result of credit card mismanagement. A negative coefficient of GDP per capita, Internet users, and government education spending might be an indication of diminishing returns to scale on economic growth, digital division among Internet users, and inefficiencies in government spending on education, respectively. Inequalities arise when economic expansion fails to affect the majority of the population, making per capita GDP a negative predictor of financial inclusion.

Hausman (1978) specification test	Coef.	breusch pagan LM test	Coef.
Chi-square test value	0.26	Chi-square test value	0
P-value	0.99	P-value	1

Source: Data Proceed (2025)

Following the selection of variables via the Least Absolute Shrinkage and Selection Operator (LASSO), an evaluation of multicollinearity was performed using a correlation matrix, and the variables with Variance Inflation Factor (VIF) values greater than 10 were dropped from further analysis. Table 2 presents the Hausman and Breusch–Pagan statistics, which demonstrate a rejection of the fixed effects model, whereas the Breusch-Pagan test indicated that the random effects model did not provide any improvement over the pooled Ordinary Least Squares (OLS) approach. As a result, pooled OLS with robust standard errors was utilised to draw inferences from the variables deemed important by LASSO after taking into account the variables whose combination did not infringe the OLS assumptions. Assessments for heteroskedasticity were performed using the Pagan Weisberg test, and the normality of residuals was checked via the Shapiro-Wilk test, which indicated that the assumptions required for pooled OLS were satisfied, and the results are presented in Table 3.

Table 3: Pagan/Weisberg and Shapiro Wilk S	Statistics
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Breusch–Pagan/Cook–Weisberg test for heteroskedasticity	Coef.	shapiro wilk test for normal data	Coef.
Chi-square test value	0.73	Z	0.488
P-value	0.39	Prob>z	0.313

Source: Data Proceed (2025)

The pooled OLS results presented in Table 4 indicate that credit card usage among females exerted a negative impact on financial inclusion, and the results are significant at the five percent threshold only in the models that include the percentage of women in the labour force, and they are insignificant in its absence. Debit card usage and borrowing from banks by individuals with a primary education demonstrated a significant positive influence on financial inclusion only in the model containing women's participation in the labour force. This could be an indication that having more women in the workforce enhances society's financial engagement due to the broader economic and social implications of being in the labour force and the positive feedback loop between financial inclusion and labour force participation. These outcomes mirror the conclusions reached by Alosheibat et al. (2023) and Balasubramanian & Kuppusamy (2021).

Our findings align with the existing literature on the importance of financial services in driving inclusion (Manyika et al., 2016; Ozili, 2017). Kenya's leadership in financial inclusion reflects deliberate policy measures such as agent banking and widespread mobile penetration. Uganda's progressive improvements can be attributed to sustained government efforts to promote financial literacy and rural outreach.

Conversely, Tanzania's lag in financial inclusion, despite favourable economic growth, challenges the finance-growth nexus theory (Patrick, 1966). Insufficient digital payment systems and the rural-urban divide are regarded as structural barriers that hinder financial service adoption. Limited access among women and low-income groups emphasises the need for inclusive financial policies targeting vulnerable populations.

Table 4. Regresion Coefficients				
	(1)	(2)	(3)	(4)
	finl	finl	finl	finl
creditcf	-10.20***	-7.89*	-7.81*	-10.39***
	(0.87)	(3.11)	(2.89)	(1.04)
debitcpr	5.41***	3.91*	3.96*	5.17***
	(0.26)	(1.62)	(1.64)	(0.31)
borrbankpr	3.12***	3.38*	3.38*	3.13***
	(0.36)	(1.25)	(1.17)	(0.36)
Individuals using the internet	-0.00	0.00		
-	(0.00)	(0.00)		
Percentage of women in the workforce	0.28***			0.27***
-	(0.03)			(0.03)
_cons	-13.82***	0.07	0.07	-13.30***
	(1.24)	(0.20)	(0.18)	(1.23)
Ν	12	12	12	12

Robust standard errors in parentheses

* p < 0.05, ** p < 0.01, *** p < 0.001

Source: Data Proceed (2025)

This comparison also underscores the pivotal role of accessibility in fostering usage. Without sufficient infrastructure (e.g. bank branches, ATMs, and mobile agents), financial products remain underutilised, stalling efforts to enhance financial inclusion across East Africa. Meanwhile, while enhanced access to financial products such as credit cards and debit cards is often beneficial, some adverse effects begin to be noted when demographic characteristics such as gender and educational attainment are considered, providing an array of the influence of participation of women and individuals with primary education within the models in pooled OLS. **Discussion**

Our findings challenge the simplicity of the finance–growth nexus by showing that economic growth (e.g. Tanzania's 6.1% GDP growth) does not automatically translate into higher financial inclusion. This discrepancy might stem from the unequitable trickle-down of growth effects, where public spending provides nonlinear outcomes benefiting certain groups of people and living out others. Poor infrastructure, the financial literacy gap, and other structural barriers might also be the reason for low financial inclusion despite economic growth. The differences in financial inclusion levels between Kenya and Tanzania highlight the significance of Institutional Theory and the role of private-sector innovation.

Credit cards seem to be a double-edged sword, as their negative coefficient affects women and youth, which could be a sign of structural and behavioural friction. Credit card misuse might lead to stricter lending criteria which eventually sideline credit card holders from being further integrated into the financial system because of poor credit history. In essence, the issuance of credit cards to any individual needs to be accompanied by financial education to prevent them from falling into debt traps by misunderstanding the time value of money and how interest tends to compound when the debt is not handled with palliative care to ensure its sustainability and repayment.

The results further signify that financial inclusion is not easily achieved with a one-fits-all approach because it does not automatically provide equal benefits to all groups. In developing nations and marginalised groups, tailored interventions and persistent policy support in conjunction with the development of infrastructure are required. Financial inclusion is a significant weapon for decreasing poverty and inequality; nevertheless, the success of this instrument is contingent on policies that are specifically targeted, infrastructure that is supporting, and management that is ongoing to ensure that every aspect of the challenges arising is handled uniquely and contextually.

CONCLUSION

This study concludes that Kenya's superior financial inclusion stems from its mature digital financial ecosystem, whereas Tanzania's low performance highlights critical gaps in financial accessibility and usage. Uganda's trajectory offers valuable lessons in leveraging inclusive policies to improve financial inclusion. The study also concludes that amongst the factors that positively affecting financial inclusion are the use of debit cards,

borrowing from banks and participation of women in labor force while credit cards especially amongst female users negatively affect financial inclusion

The study recommends the following: a) Expand Digital Finance Infrastructure: Tanzania should emphasise mobile money agents' investments and interoperable payment systems to bridge rural-urban gaps; b) Enhance Financial Literacy: The public and private sectors should collaborate to deliver tailored financial education programs; c) Promote Gender-Inclusive Policies: Address barriers faced by women through targeted financial products and services; d) Leverage Public-Private Partnerships (PPPs): The government should engage the private sector to scale and speed up financial infrastructure in underserved areas.

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APPENDICES

Appendix 1: Summary of operational variables

Type of	Name	Variable Definition	Expected	d Source of Data	
Variable			Sign		
Dependent	Finl	A weighted average Composite index that	+	Global Findex	
		combines normalized accessibility and		Database &	
		usage indicators		Researcher	
				calculation	
Independent	Bank acc (F)	Percentage of females with a bank	+	Global Findex	
		account		Database	
	Bank acc (M)	Percentage of males with a bank account	+	Global Findex	
				Database	
	Bank acc (Yng)	Percentage of young individuals (e.g., 15-	+	Global Findex	
		24 years) with a bank account		Database	
	Bank acc (Old)	Percentage of older individuals (e.g., 65+	+	Global Findex	
	Dank and (Dr)	years) with a bank account		Database Clobal Finday	
	Darik acc (PI)	education that owned a bank account	+		
	Bank acc (Sec)	Porcentage of individuals with secondary	<u>т</u>	Clobal Eindex	
	Dalik acc (Sec)	education that owns a bank account	т		
	Bank acc (Poor)	Percentage of low-income individuals with	_	Global Finder	
		a bank account	т	Database	
	Bank acc (Rich)	Percentage of high-income individuals	+	Global Findex	
		with a bank account		Database	
	CreditC (F)	Percentage of females with a credit card	+	Global Findex	
				Database	
	CreditC (M)	Percentage of males with a credit card	+	Global Findex	
				Database	
	CreditC (Yng)	Percentage of young individuals with a	+	Global Findex	
		credit card		Database	
	CreditC (Old)	Percentage of older individuals with a	+	Global Findex	
		credit card		Database	
	CreditC (Pr)	Percentage of individuals with primary	/ + Global Fir		
		education owning a credit card		Database	
	CreditC (Sec)	Percentage of individuals with secondary	+	Global Findex	
		education owning a credit card		Database	
	CreditC (Poor)	Percentage of low-income individuals with	+	Global Findex	
		a credit card		Database	
	CreditC (Rich)	Percentage of high-income individuals	+	Global Findex	
	Dahito (E)	With a credit card		Database Clobal Finday	
		Percentage of remaies with a debit card	+		
	DebitC(M)	Percentage of males with a debit card	_	Global Finder	
		r ercentage of males with a debit card	т	Database	
	DehitC (Yng)	Percentage of young individuals with a	+	Global Findex	
	Dobito (Thg)	debit card		Database	
	DebitC (Old)	Percentage of older individuals with a	+	Global Findex	
		debit card		Database	
	DebitC (Pr)	Percentage of individuals with primary	+	Global Findex	
		education owning a debit card		Database	
	DebitC (Sec)	Percentage of individuals with secondarv	+	Global Findex	
	· · /	education owning a debit card		Database	

DebitC (Poor)	Percentage of low-income individuals with a debit card	+	Global Findex Database
DebitC (Rich)	Percentage of high-income individuals with a debit card	+	Global Findex Database
SavBank (F)	Percentage of females with savings in a bank	+	Global Findex Database
SavBank (M)	Percentage of males with savings in a bank	+	Global Findex Database
SavBank (Yng)	Percentage of young individuals with savings in a bank	+	Global Findex Database
SavBank (Old)	Percentage of older individuals with savings in a bank	+	Global Findex Database
SavBank (Pr)	Percentage of individuals with primary education having a savings in a bank	+	Global Findex Database
SavBank (Sec)	Percentage of individuals with secondary education having a savings in a bank	+	Global Findex Database
SavBank (Poor)	Percentage of low-income individuals with savings in a bank	+	Global Findex Database
SavBank (Rich)	Percentage of high-income individuals with savings in a bank	+	Global Findex Database
BorrBank (F)	Percentage of females with a bank loan	+	Global Findex Database
BorrBank (M)	Percentage of males with a bank loan	+	Global Findex Database
BorrBank (Yng)	Percentage of young individuals with a bank loan	+	Global Findex Database
BorrBank (Old)	Percentage of older individuals with a bank loan	+	Global Findex Database
BorrBank (Pr)	Percentage of individuals with primary education having a bank loan	+	Global Findex Database
BorrBank (Sec)	Percentage of individuals with secondary education having a bank loan	+	Global Findex Database
BorrBank (Poor)	Percentage of low-income individuals with a bank loan	+	Global Findex Database
BorrBank (Rich)	Percentage of high-income individuals with a bank loan	+	Global Findex Database
Median age of the population	Median age of the population in years Gross Domestic Product per capita (in	+/- +	World bank
GDP per capita Individuals using the	USD) Percentage of the population using the	+	World bank
internet Percentage of the population living in	internet Percentage of the population residing in urban areas	+	World bank
urban areas Percentage of	Percentage of women participating in the	+	World bank
women in the workforce	Number of mobile phase subscriptions		Mandal havele
subscriptions per	per 100 people	+	vvoria dank
Govt exp on education	Government expenditure on education as a percentage of GDP	+	World bank

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Appendix	2 [.] summar	v statistics
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Variable	Count	mean	std	min	max
Finl	12	0.57	0.26	0.09	0.97
Bank acc (F)	12	0.29	0.14	0.14	0.52
Bank acc (M)	12	0.38	0.15	0.21	0.65
Bank acc (Yng)	12	0.29	0.14	0.12	0.48
Bank acc (Old)	12	0.36	0.15	0.19	0.59
Bank acc (Pr)	12	0.22	0.09	0.07	0.36
Bank acc (Sec)	12	0.49	0.15	0.26	0.75
Bank acc (Poor)	12	0.21	0.11	0.09	0.37
Bank acc (Rich)	12	0.42	0.17	0.23	0.68
CreditC (F)	12	0.02	0.02	0	0.05
CreditC (M)	12	0.04	0.03	0	0.08
CreditC (Yng)	12	0.03	0.02	0	0.08
CreditC (Old)	12	0.03	0.02	0	0.07
CreditC (Pr)	12	0.01	0.01	0	0.04
CreditC (Sec)	12	0.05	0.04	0	0.11
CreditC (Poor)	12	0.01	0.01	0	0.04
CreditC (Rich)	12	0.04	0.03	0	0.09
DebitC (F)	12	0.16	0.09	0.07	0.33
DebitC (M)	12	0.24	0.1	0.13	0.45
DebitC (Yng)	12	0 17	0.1	0.06	0.34
DebitC (Old)	12	0.22	0.09	0.13	0.39
DebitC (Pr)	12	0.09	0.00	0.04	0.00
DebitC (Sec)	12	0.33	0.12	0.16	0.54
DebitC (Poor)	12	0.09	0.05	0.03	0.19
DebitC (Rich)	12	0.27	0.13	0.15	0.5
SavBank (F)	12	0.13	0.07	0.04	0.28
SavBank (M)	12	0.2	0.1	0.08	0.36
SavBank (Yng)	12	0.14	0.07	0.00	0.00
SavBank (Old)	12	0.18	0.07	0.06	0.32
SavBank (Pr)	12	0.10	0.00	0.03	0.02
SavBank (Sec)	12	0.27	0.09	0.00	0.45
SavBank (Poor)	12	0.08	0.04	0.02	0.16
SavBank (Rich)	12	0.22	0.1	0.02	0.4
BorrBank (F)	12	0.11	0.05	0.03	0.19
BorrBank (M)	12	0.14	0.00	0.06	0.25
BorrBank (Yng)	12	0.08	0.05	0.02	0.17
BorrBank (Old)	12	0.15	0.00	0.02	0.25
BorrBank (Pr)	12	0.09	0.05	0.03	0.17
BorrBank (Sec)	12	0.00	0.06	0.08	0.26
BorrBank (Poor)	12	0.10	0.00	0.00	0.20
BorrBank (Old) 1	12	0.00	0.00	0.02	0.10
median age of the nonulation	12	16.47	1 38	14 28	19.02
ado per capita	12	2 939 07	003 NA	2 134 00	5 338 90
individuals using the internet	12	13.6	10.85	32	38 25
Percentage of the nonulation living in urban areas	12	27	10.00	20	36
nercentage of women in the workforce	12	<u>4</u> 9 07	03 0.51	48.2	<u>1</u> 9 0
Mobile phone subscriptions per 100 people	12		10 71	-0.2 50	-10.0 103
nout explore subscriptions per 100 people	12	3 68	1 1/	1 0	<u>1</u> 20
you exp on equivation	12	0.00	1.14	1.3	4.3

Appendix 3: LASSO coefficients

Variable	Coefficients
year	0.09
C_id	0.00
Bank acc (F)	0.00
Bank acc (M)	0.00
Bank acc (Yng)	0.00
Bank acc (Old)	0.00
Bank acc (Pr)	0.00
Bank acc (Sec)	0.08
Bank acc (Poor)	0.00
Bank acc (Rich)	0.00
CreditC (F)	-0.05
CreditC (M)	0.00
CreditC (Yng)	-0.07
CreditC (Old)	0.00
CreditC (Pr)	0.00
CreditC (Sec)	0.00
CreditC (Poor)	0.00
CreditC (Rich)	-0.01
DebitC (F)	0.00
DebitC (M)	0.00
DebitC (Yng)	0.00
DebitC (Old)	0.00
DebitC (Pr)	0.10
DebitC (Sec)	0.00
DebitC (Poor)	0.00
DebitC (Rich)	0.00
SavBank (F)	0.00
SavBank (M)	0.00
SavBank (Yng)	0.00
SavBank (Old)	0.00
SavBank (Pr)	0.00
SavBank (Sec)	0.00
SavBank (Poor)	0.00
SavBank (Rich)	0.00
BorrBank (F)	0.00
BorrBank (M)	0.00
BorrBank (Yng)	0.01
BorrBank (Old)	0.00
BorrBank (Pr)	0.05
BorrBank (Sec)	0.01
BorrBank (Poor)	0.07
BorrBank (Old).1	0.00
median age of the population	0.00
gdp per capita	-0.09
individuals using the internet	-0.01
Percentage of the population living in urban areas.	0.00
percentage of women in the workforce	0.10
Mobile phone subscriptions per 100 people	0.00
govt exp on education	-0.01