



## Analysis of financial literacy and its effects on financial inclusion in Uganda\*

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### Abstract

*The paper investigates whether financial literacy influences financial inclusion in Uganda on the premise that there are currently few to no studies that investigate this causality and the general lack of consensus on an appropriate measure for financial literacy. It uses data from the FinScope (2018) consumer survey on Uganda and applies Principal Component Analysis (PCA) to construct a composite financial literacy index of the adult bankable population (16 years and older). The index is then regressed - alongside other demand-side control variables, against a measure of financial inclusion using logistic models. Our measure of financial literacy significantly and positively affects financial inclusion in Uganda even in the presence of variables like age, gender, income, and education. Individuals who make financial ends meet, plan for their financial future welfare, seek financial advice, and are receptive towards technology, are 'ceteris paribus', more likely to be financially included than not. Technology and mobile money adoption enhance financial inclusion while more men are financially included than women. While the dataset is limited to demand-side variables of Uganda and cannot be generalised, comparative cross-country studies with robust datasets are needed to provide further insights. The paper advances a novel approach for measuring financial literacy for developing economies while contributing to efforts to standardize an international measure. It also provides empirical insights to support the notion that financial literacy should be addressed more holistically and recommends this approach for improving financial inclusion in Uganda and globally.*

**Keywords:** Financial literacy; Financial Inclusion; Principal Component Analysis; Logistic Regression; Uganda

**JEL Classifications:** G40; G53; F65

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\* This paper is extracted from the corresponding author's thesis entitled "The Effect of Financial Literacy on Financial inclusion: Evidence from Uganda."

## Introduction

Financial inclusion or the access to, and the appropriate use of formal financial services continues to feature prominently on the global agenda of developed and developing nations alike. The Global Findex Report of 2017 indicates that over 30% of the world's adult population (about 1.7 billion people), is unbanked while in economies of Africa, only 63% of the population has access to financial services which includes mobile money accounts (World Bank, 2017). In Uganda, for instance, the demographics represent a decline in formal banking from 20% in 2013 to 11% in 2018 and a 7% increase in the financially excluded during this period (FinScope, 2013, 2018). This lack of access to finance is often the cause of the persistent income inequalities within economies and contributes to the slower growth among them (Beck, Demirgüç-Kunt & Honohan, 2009).

Dealing progressively with financial inclusion should include both supply and demand-side aspects to financial exclusion (Triki & Faye, 2013; Atkinson & Messy, 2013; Beck & De La Torre, 2007), where demand factors relate to the users of financial products or services and reflect the met and unmet financial needs, while supply factors comprise of structural characteristics of regulated financial institutions and include; geographical access and product density, product and service designs, pricing and technology, among others (World Bank, 2012). Such factors provide useful insights to advancing financial inclusion globally in terms of identifying the demand and supply-side impediments and/or the strategic imperatives needed to increase financial access and use.

Notably, while the multidimensional nature of financial inclusion requires such policy interventions to enable the uptake of formal financial products and services (Sarma, 2015; Arun & Kamath, 2015; Beck, 2013; Beck & Demirgüç-Kunt, 2008; Mahendra, 2006), current strategies bias towards supply-side factors whose data sources are arguably available. This undermines the value of certain demand-side factors like financial literacy which promote financial access. Grohmann, Kluhs & Menkhoff (2018) observe that while increasing financial access requires good financial infrastructures with improved financial depth, institutional proximity, low cost of accounts, and sound financial compliance, such infrastructures also require informed customers – those that possess a higher level of financial knowledge. They assert that "informed customers make better decisions for themselves and their businesses and support the effectiveness of the financial system by demanding more sophisticated financial services and financial inclusion" (Grohmann *et al.*, 2018: 84).

Current literature indicates the role financial literacy plays in advancing formal financial access albeit such causality lacks empirical support. Atkinson & Kempson, (2008) observe that while there is a great deal of policy interest in finding ways of establishing how individuals manage their money, such information has not always been linked to financial inclusion literature. Firstly, recent work on financial literacy indicates that consumers lack the very basic financial knowledge necessary to guide their financial decisions (Guiso & Viviano, 2015). This undermines efforts to promote financial inclusion since policymakers need to know how people make financial decisions and/or manage finances to ensure that their interactions with financial institutions are beneficial (Atkinson & Kempson, 2008).

Secondly, Arun and Kamath (2015) recognize that financial literacy and consumer education are critical drivers of the broader focus on financial exclusion and for meeting the needs of the currently unbanked. Efforts at the country level reflect global policy interests in financial inclusion, financial education, consumer protection and evidence that financial literacy and financial inclusion are related since the role of financial education to financial inclusion is to encourage behaviour change (Atkinson & Messy, 2013). Financial literacy relates to an input – financial knowledge, which influences several other outputs that include, but are not limited to; financial behavior (Hilgert & Hogarth, 2003), financial confidence (Xia, Wang & Li, 2014), and financial planning (Alhenawi & Elkhal, 2013). Additionally, financial literacy is itself regarded as a by-product of financial education, which invariably influences financial decisions (Hastings, *et al.*, 2013; Atkinson & Messy, 2013; Huston, 2010).

Consequently, Atkinson & Messy (2013) correlate financial literacy with financial inclusion by linking product awareness to product choice, while Dev (2006) identifies it as one of the impediments to financial access for poor small-scale farmers in India. Swamy (2014) and Baporikar, (2021) respectively, identify it as a critical enabler for the financial inclusion of women and small-scale entrepreneurs in India, and the World Bank (2012) - as a tool that increases financial awareness and helps to enhance the desire for financial services. It is therefore essential for policymakers to understand how people make financial choices and manage finances to be certain of their interactions with financial institutions (Ramji, 2009; Atkinson & Kempson, 2008).

However, while financial literacy is theoretically regarded as a key determinant of financial inclusion, little is known about this concept in Africa (Triki & Faye, 2013).

Financial literacy refers to the ability to make informed choices and effective decisions regarding money (Huston, 2010). It includes financial knowledge, attitudes, behaviors, and skills that influence decision-making and apply to real-life processes, with the result of improved financial wellbeing for the individual (Atkinson & Messy, 2011). However, the current theoretical stance on the financial literacy — financial inclusion paradigm is prescriptive in that while several studies recognise the role of financial literacy, very few to none provide substantive empirical evidence to prove their claims (Bay, Catusus & Johed, 2012; Atkinson & Messy, 2011; Atkinson & Kempson, 2008). For instance, recent policy interventions highlight in part the need for financial literacy through financial education initiatives- as a critical enabler to financial inclusion. Yet, there seem to be no studies that empirically confirm a possible causality between these two concepts. It is therefore presumptuous to conclude as a rule of thumb, that increasing financial literacy automatically translates into good financial behavior and facilitates the uptake of formal financial products and services, without empirical evidence to back the claim.

Conversely, the function of financial literacy cannot be underestimated since several findings associate, 'ceteris paribus', a lack of financial literacy or its determinants with: (1) voluntary financial self-exclusion and the growth in informal financial markets (Arun & Kamath, 2015; Servon & Kaestner, 2008); (2) low saving and borrowing behavior (Sayinzoga, Bulte & Lensink., 2016; Lusardi & Mitchell, 2007); and (3) poor financial investments and retirement planning (Mouna & Anis, 2017; Bucher-Koenen & Lusardi, 2011). The growing complexity of financial solutions requires astute financial skills and capabilities so that a lack thereof causes individuals to shun the services other factors assumed constant. Research indicates that consumers of financial offerings shy away from them if they lack the financial skills sets or capabilities necessary to manage them effectively (Zakaria & Sabri, 2013; World Bank, 2012; Servon & Kaetner, 2008; Kempson & Whyley, 1999). Several plausible factors explain the lack of a common consensus on the financial literacy – financial inclusion paradigm. First, there is currently no standard measure of financial literacy since several theoretical, but divergent views exist on how the term is conceptualised and quantified. Secondly, there are fewer data sources that reliably measure financial literacy because only a few known survey studies exclusively measure the latter to capture the salient attributes of the concept. Conversely, a significant number of studies quite exhaustively explore financial inclusion. Finally, most studies apply to the more developed economies, and it is only until recently that some have shifted their focus to developing economies.

Additionally, empirical literature about this relationship is scanty for both developed and developing economies and the reasons for this are twofold. First, most studies do not measure financial literacy in its entirety. Rather, they apply aspects of the concept like; individual self-efficacy or financial confidence (Mindra *et al*, 2017; Kramer, 2016), financial knowledge (Gatherwood & Weber, 2017; Assad, 2015), investment or saving behavior (Guiso & Viviano, 2015), and/or a combination of the above depending on the aim of the study (Rieger, 2020). This suggests that the concept definition- financial literacy, is never covered exhaustively. Secondly, financial literacy measures, as applied, rarely relate to financial inclusion per se. Most studies investigate the concept as it relates to; stock market participation (Xia, *et al*, 2014), youth development (Garg & Singh, 2018), financial crises (Klapper *et al*, 2013), and others, but rarely cover a holistic overview on financial inclusion as it is internationally defined. Accordingly, the relationship between financial literacy and financial inclusion remains a research challenge that warrants investigation.

This paper is significant for several reasons. First, it collates existing literature on financial literacy to empirically argue that measurement of the concept is not entirely a function of financial knowledge, astute technological acuity, and/or numeracy skills. It opines that while such aspects are important, several other factors like financial behavior, attitudes, and skills are necessary to assess the application of financial knowledge. In this regard, it extends the theoretical and empirical discourse on measuring financial literacy and contributes to efforts for standardising the measure. Secondly, it makes a practical contribution to the empirical discourse for investigating the causality between financial literacy and financial inclusion especially for developing economies like Uganda. Several empirical studies among developed economies merely assess components of financial literacy and very few relate them to financial inclusion per se. We argue that this approach for measuring financial literacy is well suited for the less developed economies, like those in Africa.

As such, our paper extends the empirical discourse by investigating how financial literacy influences financial inclusion in Uganda. The study uses FinScope<sup>†</sup> survey data and applies Principal Component Analysis (PCA) to several theoretical underpinnings- to develop a composite financial literacy index for Uganda. Thereafter, it applies a logistic regression procedure to assess whether this index influences financial inclusion in the country. Based on theoretical underpinnings, we hypothesise that financial literacy has a positive and significant impact on financial inclusion in Uganda.

The rest of the paper is organized as follows. Section 2 provides a theoretical framework on financial literacy and sets the precedence for developing the financial literacy index. Section 3 discusses the methodological issues applied in analysing the relationship between financial literacy and financial inclusion, while section 4 provides the main analysis. The last section provides the findings, recommendations, and policy implications.

### **A theoretical framework on financial literacy**

Despite the proliferation of academic discourse and policy interventions linking financial literacy to financial inclusion, there is no conclusive empirical evidence that confirms a direct cause and effect relationship between the two concepts. Possible alternative explanations for this vary and include: (1) the fallacy that most financially literate individuals – as a rule of thumb, make good financial decisions (Alsemgeest, 2015); (2) the lack of an appropriate yardstick with which to measure financial literacy (Remund, 2010; Huston, 2010); (3) the possibility that financial literacy is endogenous to other financial inclusion proxies which mirror and/or suppress its intended effect (Grohmann, Kluhs & Menkhoff, 2018); (4) the challenges involved in obtaining and analyzing subjective financial literacy data (Atkinson & Messy, 2013; Hung, Parker & Yoong, 2009); (5) the broad dimensions in the financial literacy construct which extend from the easy-to-know financial management concepts, to broader concepts that encompass applications of personal finance behavior (Remund, 2010; Huston, 2010); and (6) the possible lag effects in financial literacy interventions whose impact cannot be appraised at the point of application (Drexler, Fischer & Schoar, 2014; Cole & Shastri, 2009).

The progression of literature on financial literacy tends to broaden the latter's definition from simple easy-to-know financial concepts (or financial knowledge) to broader but complex aspects that define astute financial education concepts and emphasize the application of knowledge and/or consistent financial behavior (financial capability). For instance, Schmeiser & Seligman (2013) and Huston (2010) defines it as the ability to understand financial information and to make logical decisions based on that information. Atkinson & Messy (2011) broaden this definition to include attitudes, behaviors, and skills in decision-making- that is, applying knowledge and skills to daily life activities, for the improved financial welfare of an individual. Remund (2010) defines it as the extent to which one understands important financial concepts and confidently uses them to manage one's finances – through the application of short-term decision-making and long-range financial planning processes and while mindful of life events and changing economic conditions. Vitt *et al.* (2015) define it as the ability to comprehend and manage personal financial conditions that affect an individual's wellbeing.

While there are clear overlaps in the above definitions, it is evident that over time, financial literacy definitions have ranged from simplistic ones that emphasize easy-to-know financial management concepts, to complex ones that include such terms as financial education, financial knowledge, financial confidence, financial behaviour, financial planning, personal finance, and others. These extensions stress not only the need for financial knowledge but also a shift in individual financial behaviour (financial capability). Additionally, the terms financial literacy, financial knowledge, and financial education are often regarded as similar which hinders the adoption of a standardized yardstick for measuring financial literacy (Huston, 2010). Several studies interchangeably apply these concepts in the empirical discourse on financial inclusion, yet the concepts are distinct albeit interconnected (see; Allen *et al.* 2016; Assad, 2015; Alhenawi & Elkhal, 2013; Robb, 2012; Capuano & Ramsay, 2011; Cole & Shastri 2009).

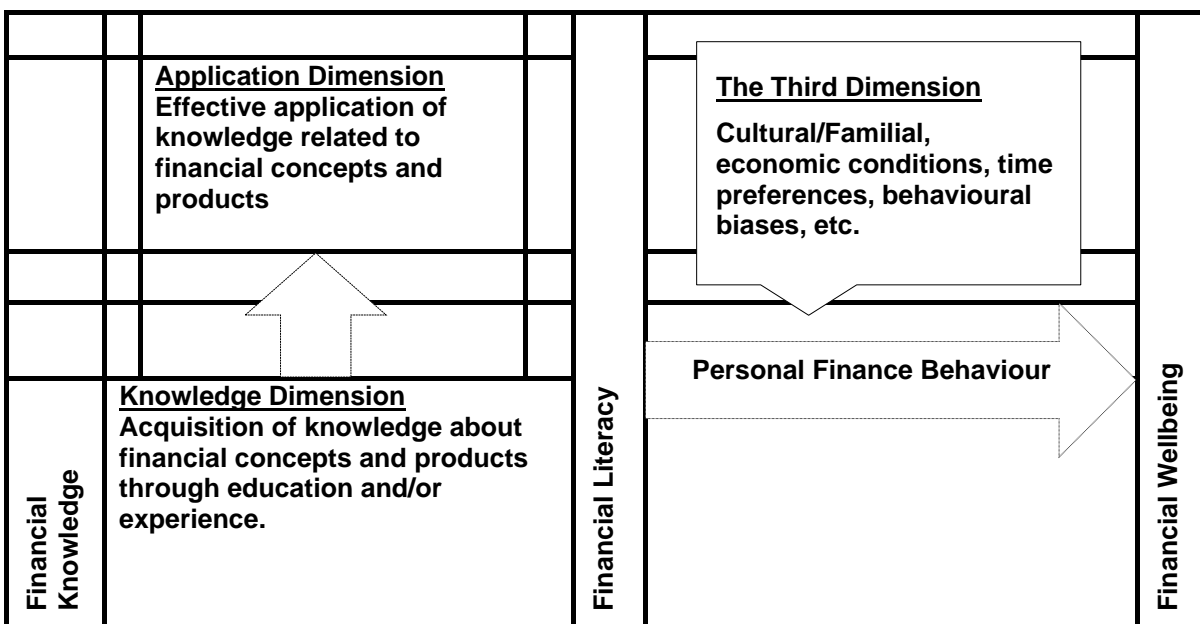
Nonetheless, most of these studies, in principle, agree with Hastings *et al.* (2013), Huston (2010), and Remund (2010) that the financial literacy definition should go beyond knowledge about financial concepts and rather apply such knowledge to individuals' daily livelihoods for achieving financial success. This

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<sup>†</sup> The FinScope survey tool developed by FinMark Trust of South Africa is a nationally representative survey of consumer perceptions about financial services and issues that provides insights into how people source their income and manage their financial lives.

provides the antecedents on which financial literacy is currently conceptualized and operationalized since approaches that cover knowledge alone are not necessarily indicative of a person's capability to make sound financial decisions (Hung *et al.*, 2009).

Consequently, Huston (2010) concludes that this term is a personal attribute that should be defined and measured by how well an individual comprehends and applies finance-related information. It is these attributes that influence an individual's financial behavior to increase their lifetime utility from consumption and enhance financial wellbeing. She contends that while one may lack numeracy skills as a critical financial literacy enabler, available tools such as calculators and computer software programs compensate for such deficiencies. She concludes that eliciting information about personal finance behavior is more appropriate than focusing on numeracy skills (see also, Grohmann *et al.*, 2018). Figure 1 below depicts the association between financial knowledge, financial education, financial literacy, financial behavior, and financial wellbeing as proposed by Huston (2010), which collectively extend the financial literacy definition into financial capability and provide a novel approach for measuring financial literacy.



**Figure 1:** Framework for measuring financial literacy  
**Source:** Adapted from Huston (2010)

The Figure indicates, firstly, that while financial literacy encompasses financial knowledge, it must include an extra dimension namely, application in which an individual must confidently apply the acquired knowledge. Furthermore, knowledge and application become insufficient if they do not incorporate a personal finance knowledge component that ensures the ultimate financial wellbeing of the individual in his/her environment (Kempson *et al.*, 2013; Huston, 2010; Atkinson & Messy, 2008). Secondly, it contends that an advanced approach to conceptualizing and measuring financial literacy should encompass such key terms as financial awareness, acquired actions, belief systems, values, and behaviors, that usually lie beyond the knowledge domain.

Therefore, the current operationalization and measurement of financial literacy hinge on three slightly overlapping approaches that stem from the depth in the financial literacy definition itself. The first and most common of these focuses on financial knowledge and by contrast applies a minor role to values, behavior, and a broader perspective to critical thinking (Silgoner *et al.*, 2015). This approach, like some others, uses survey data to assess financial knowledge through an evaluation of concepts like interest rates, inflation, numeracy skills, time value of money, and risk diversification – which collectively and supposedly mirror financial decisions like savings and investments (Lusardi & Mitchell, 2014), and where a higher proportion of correct responses represents higher financial literacy (Klapper *et al.*, 2016). This approach is limited by its inability to capture certain salient attitudinal and behavioral characteristics of the population and biases certain uneducated groups common among the developing economies (Atkinson & Messy, 2012).

The second interrogates personal attributes that influence financial knowledge such as attitudes, behavior, cognitive abilities, and other social traits like education, age, and gender (Silgoner *et al.*, 2015), and how they relate to financial decisions like budgeting, managing money, financial planning, and product choice. While this approach appears to ameliorate the first, it does not explain how financial literacy elements interrelate and/or which element contributes most to effective decision-making (Silgoner *et al.*, 2015).

The third and most comprehensive approach fairly aligns with the above albeit it investigates the relationship between financial knowledge and behavior (Silgoner *et al.*, 2015). This approach conceptualizes and operationalizes the financial literacy construct into five domains which include: (1) knowledge about concepts of finance; (2) ability to communicate them; (3) skill in managing personal finances; (4) making appropriate financial decisions; and (5) effective planning for future financial needs (Remund, 2010). Briefly, it argues that financial literacy is better operationalized and measured using two sub-dimensions, namely, understanding personal finance knowledge and applying it (Huston, 2010).

Our study follows the latter approach in constructing a composite financial literacy index for Uganda to assess its impact on financial inclusion. We follow the argument that financial knowledge should improve one's skills sets which in turn influence how one manages money, so that, knowledge and applied experience work in tandem (Remund, 2010). Moreover, to ensure the completeness of the index, we incorporate the four main financial literacy content domains as suggested by Huston (2010), which include; financial knowledge, borrowing behavior, saving/investment behavior, and financial planning. These concepts are sufficiently encompassed by four personal finance content domains suggested by Atkinson *et al.* (2007) and relate to 'managing money', 'planning ahead', 'choosing financial products' and 'staying informed'.

While limited to data suitability, this approach ameliorates the other two by ensuring first, that it sufficiently covers the financial literacy definition as provided by the Organization of Economic Co-operation and Development (OECD: 2015). Secondly, it translates complex financial concepts related to risk, interest rates, and inflation into simpler comparable questions that are easier to interpret. It, therefore, facilitates a move towards a more standardized measure for financial literacy. Thirdly, it provides simple-to-understand questions that eliminate response bias. Lastly, it widens the applicability of the index to apply beyond advanced economies.

## Data and Methodology

### The data

Our study data mined secondary consumer information from a nationally representative consumer survey sample of Uganda commissioned by FinScope IV in 2018 under the auspices of FinMark Trust (South Africa). The survey tracked the overall financial inclusion trends in the country since 2007 for benchmarking against other countries within the region, provided insights into policy and market levels to enhance financial inclusion, and described the financial services needs of the adult bankable population (individuals 16 years or older). The semi-structured questionnaire covered a broad scope of questions ranging from individual demographics to money-generating activities and expenditure, cash flow and risk management activities, savings, borrowings, payments, and knowledge about financial products, services, and service providers (FinScope, 2018). The survey used a three-stage stratified sampling approach to identify 320 enumeration areas (EAs) accounting for 3200 respondents countrywide (adults 16 years and older). Using a probability proportional to size sampling (PPS) method, it randomly targeted 316 EAs accounting for 3002 respondents countrywide. This represented a 94% response rate constituting 18.6 million (or 43%) bankable adults in Uganda.

### Developing a financial literacy index composite

The development of a composite financial literacy index – using Principal Component Analysis (PCA), was premised on the operationalization of four financial literacy domains/constructs known from the literature to collectively represent a financially astute individual. These included: *money management*; *planning ahead*; *choosing financial products*; and *staying informed*. Four initial processes were followed in the operationalization of these constructs to confirm construct validity and fulfill the preconditions for running PCA. These included: (1) identification and theoretical definition of the constructs; (2) items/questions identification, selection, and checks for possible overlaps, which involved a process of mapping using Microsoft Excel; (3) binary coding of 0 and 1 of selected items to align the latter with the structure of each

construct; and (4) operationalization of that construct within the index. For clarity, each 'financially savvy' response was coded as one (1), and zero (0) otherwise in line with the OECD/INFE (2015) toolkit for measuring financial literacy. Lastly, an assessment and distribution of items (frequencies) within each domain were conducted to identify and exclude items with low variability. PCA was then run on the selected items in each construct to assess for any underlying relationships.

Key questions and data pertinent to each of these constructs were selected from the FinScope (2018) consumer survey instrument in Uganda. The *money management* domain measured the respondents' ability to manage money (Remund 2010) and explored how organized an individual is at paying bills, keeping and using financial records, as well as budgeting for lumpy and unexpected expenditures (FinLit, 2012). Typical questions selected under this domain interrogated the day-to-day financial decisions of individuals either to save, budget, or meet daily expenses (Atkinson & Kempson, 2013; Atkinson & Messy, 2012; Remund, 2010). The *planning ahead* domain measured one's ability to manage unexpected events and/or plan for the future. It investigated whether one puts aside substantial savings using the various financial products and services available. Furthermore, it assessed how individuals plan for their retirement and whether such plans are sufficient to afford them a decent lifestyle (FinLit, 2012). Atkinson & Kempson (2008) define this domain as planning for security and risk in which significant short-term goals such as buying a car or planning a wedding, and long-term goals, like retirement planning and insurance, are considered.

The *choosing financial products* domain measured whether individuals adopt and use the different financial offerings on the market and whether they, in the process, seek professional advice before making such decisions to compare the costs and benefits of each and exclude the risky ones (FinLit, 2012). Atkinson & Kempson (2008) contend that this domain relates to financial inclusion since it indicates whether individuals trust financial institutions based on the information supplied or the lack thereof.

The *staying informed* domain investigated whether respondents keep abreast with trends in their financial markets and assessed the different methods they use to obtain information. It also interrogated respondents' self-reliance (personal access and interpretation of information) and the engagement of third parties in making decisions- including one's ability to seek redress for poor or unprofessional financial conduct (FinLit, 2012).

PCA was done using the Statistical Package for Social Scientists version 25 (SPSS v25) and included the following steps: (1) a generation of the correlation matrix; (2) an assessment of variances into communalities; (3) extraction of the component solution; and (4) rotation and interpretation. To fulfill these underlying preconditions, certain process diagnostics were ascertained. First, the data suitability for factor analysis was assessed through the criteria of sample size and the strength of the correlation among variables. Hair *et al.* (2014) and Pallant (2011) contend that larger sample sizes (over 350 respondents) are suitable for reliable PCA output while Pallant (2011) recommends intercorrelation coefficients of 0.3 and above, among items to justify the PCA procedure.

Secondly, the factorability of the data was assessed through two statistical measures which included Bartlett's test of sphericity which tests the overall significance of all correlations within a correlation matrix, and the Kaiser-Meyer-Olkin (KMO) measure which tests for sampling adequacy. Pallant (2011) argues that the former should be significant at the  $p < 0.05$  level, while the latter, which ranges between 0 and 1, should have a suggested minimum value of 0.5 for acceptable factor analysis (Hair *et al.*, 2014).

PCA reduces the dimensionality of rich data to identify principal components or latent factors that carry the same underlying meaning. As such, it was applied to the set of questions in each domain to extract those that capture the underlying concept about the domain and exclude those that do not. The technique analyzed the correlation matrix of the questions' dataset and extracted latent variables that are explained by the same underlying concept. These latent components then became the empirical manifestations of financial literacy, particular to that domain (OECD, 2016; Atkinson *et al.*, 2013 and Atkinson & Messy, 2012), and were easier to analyze (FinLit, 2012).

To fulfill the above, we did the following: (1) examined the factor-loading matrix to identify significant loadings in the baseline PCA model including the accompanying measures of factorability; (2) identified and excluded items with low communalities (values of 0.3 and below) in line with Hair *et al.* (2014); (3) rerun PCA to assess for improved significance in the factor loadings of retained items, and (4) assessed for internal consistency reliability by calculating the Cronbach's Alpha (alpha) and the Inter-Item Correlation Matrix (IIC). According

to Hair *et al.* (2014), the Cronbach's Alpha measures internal consistency and ranges between 0 and 1, with values of 0.6 or lower considered unacceptable. However, when obtained, an assessment of the IIC is recommended with a score of 0.2 and above, considered acceptable (Pallant, 2011). In instances where both values are low, items with low squared correlations are identified and excluded and a rerun of the PCA output is done to assess for improvement. Stage (5) identified and assigned meaning (based on conceptual foundation) to the factor solutions or dimensions to which all variables had significant loadings. This process was guided by statistical diagnostics that included: factor rotation (where applicable), total variances, and scree plots. Stage (6) calculated and compared each domain's overall score based on the count of financially savvy responses, at the one end, and the overall statistical output of PCA, at the other.

Output from PCA computes a score for each latent component. Atkinson *et al.* (2013) compute this score as the weighted sum of the variables in that component. The analysis constructs a score  $S_c$  for each component  $C$  of financial literacy given as a linear combination of the standardized variables  $V_1, \dots, V_2, \dots, V_k$  contained in the dataset and having a common correlation matrix  $\Sigma$ . The main advantage of PCA is the component weights are calculated rather than predetermined and therefore represent the relative importance of each component to financial literacy. The model equation is depicted in equation 1 as follows:

$$S_c = W_{c1} \frac{V_1 - \mu_1}{\sigma_1} + W_{c2} \frac{V_2 - \mu_2}{\sigma_2} + \dots + W_{ck} \frac{V_k - \mu_k}{\sigma_k} \tag{1}$$

Where:

$c$  denotes the component of financial literacy containing variables ( $V$ )

$S_c$  denotes the overall score of the component

$W$  denotes the weights which are currently unknown

$\mu$  and  $\sigma$  denote the mean and standard deviation of the variables  $V$

Finally, our results were corroborated with a count measure of financial literacy where each component score was normalized to vary between 0 and 1 (0%-100%). Notably, both measures produced similar results. After PCA, the *money management* component identified one factor loading which was re-specified and labelled as 'making ends meet' (MM) based on the overall implied meaning of items contained therein. The *planning ahead* construct identified two factor loadings and these components were similarly labelled as 'planning for the future' (PA1) and 'attitude towards planning for the future' (PA2) respectively. The *choosing financial products* domain identified one factor loading which was renamed as 'seeking financial advice' (CFP), while the *staying informed* construct identified two factor loadings, and they were renamed as 'attitude towards technology' (SI1) and 'monitoring economic indicators' (SI2) respectively. A collective score of these domains constituted the composite financial literacy index such that an individual who scored above 50% on each of the domains or had an overall score of above 50%, was arbitrarily considered to be financially literate.

### Dependent and independent variables

Grohmann *et al.* (2018) and Fungacova & Weill, (2015) identify four main financial inclusion proxies common to the literature that measure financial access and use. These include the proportion of adults who own a formal bank and/or mobile money account (*formal account*), the proportion who own a credit card (*formal credit*), the proportion who used their bank account to save in the last 12 months (*formal-use saving*) and the proportion who used their credit card during the past 12 months (*formal-use credit*). Most studies employ either or all the above depending on the aspects under investigation and/or the suitability of the dataset. Our study defined financial inclusion as the proportion of adults who own a formal account due to a limitation of the survey instrument and dataset.

Additionally, our study employed four demand-side independent variables in the model specification and estimation processes. These included: age, gender, income, and education. The choice of these proxies was supported by empirical theory while the exclusion of other supply-side proxies was limited by the survey instrument and dataset. Table 1 below shows the extracted proxies, their source questions, and *a priori* expectations as supported by empirical discourse. It is possible that our empirical findings from these variables may not align with the *a priori* expectations below due to the sensitivity of the regressions, the nature of the data, and/or the choice of the proxies themselves.



**Table 1:** Study proxies, their source questions, and a *priori* expectations

Variable	Proxy used	Source from Fin Scope Uganda (2018) survey	Expected sign
Financial inclusion (FI)	Bank account ownership (including mobile money accounts)	K1	+/-
Financial literacy	Financial literacy Index	Constructed using PCA	(+) Grohmann <i>et al.</i> (2018); Nanziri & Leibbrandt (2018); Arun & Kamath (2015); Cole <i>et al.</i> (2011).
Age	Respondent's age	C7	(+) Overall financial inclusion increases with age Dar & Ahmed, (2021); Allen <i>et al.</i> , (2016:17)
Gender	Respondent's gender	C8	(+) Common to the male gender, Zins & Weill (2016); Swamy (2014)
Income	Respondent's monthly income	D8	(+) Dar & Ahmed, (2021); Zins & Weill (2016); Arun & Kamath (2015)
Education	Respondent's educational attainment	C10	(+/-) Dar & Ahmed, (2021); Allen <i>et al.</i> (2016); Zins & Weill (2016); Atkinson & Messy, (2013)

**Source:** Author's compilation

### Model specification and estimation

We applied a binary logistic model to examine the effect of financial literacy on financial inclusion in Uganda. This decision was informed firstly by the observation that there is a paucity of studies specifically investigating this causality (Grohmann *et al.*, 2018; OECD, 2015; Atkinson & Messy, 2013). Secondly, binary logistic regressions are particularly suitable for analyzing cross-sectional data and explain the outcome of a dichotomous (0/1) dependent variable of interest, subject to a set of influencing covariates (Greene, 2008).

Our study investigated whether an individual opts to have (and probably use) a formal account (financial inclusion), subject to a set of explanatory factors. The dichotomous nature of ownership and implied use of a formal account was denoted as 1 and 0 otherwise and is expressed as follows:

Financial inclusion =

{ 1 = success, if an individual owns and uses a formal financial account  
 { 0 = Failure, if an individual does not own a formal financial account

The binary logistic equation for the study is specified as follows:

$$finInc_i^k = \beta_0 + \beta_1 finLit_i + \beta_2 X_i + e_i \tag{2}$$

Where:

$finInc_i$  represents the dependent variable with an expected outcome of 1 if an individual  $i$  owns a formal financial account and 0 otherwise.

$finLit_i$  is a financial literacy score of an individual  $i$  computed for a collective set of financial literacy constructs - with an anticipated positive sign according to Grohmann *et al.* (2018); Nanziri & Leibbrandt, (2017), and Arun & Kamath, (2015).

Essentially,  $finLit_i^k = f_n (MM + PA1 + PA2 + CFP + SI1 + SI2)$  as indicated in section 3.2 above.

$X_i$  represents a variable measure of our control variables; age, gender, income, and education, parsimoniously determined using PCA,

$\beta_0$  and  $\beta_2$  represent the model coefficients of the independent variables respectively, and  $e_i$  represents an error term.

The study modeled the chance that financial inclusion by a bankable adult in Uganda is a function of financial literacy defined by six constructs- *money management* (MM), *planning for the future* (PA1), *attitude towards planning for the future* (PA2), *choosing financial products* (CFP), *monitoring economic indicators* (SI1), *attitude towards technology* (SI2) and four control variables; *age*, *gender*, *income*, and *education*. The estimation followed a comparison between a null (constant only) model and a full (constant and explanatory variables) model to assess for 'goodness of fit'. A statistically significant difference between these models indicates a causality between predictor variables and the dependent variable (Tabachnick & Fidell, 2007). The null model serves as a baseline for comparison and confirms whether the correct number of outcome cases are specified and analyzed before the inclusion of independent variables. In our case, coding of 1 denoted a financially included individual and 0 otherwise.

The full model provides the output of the logistic regression after the inclusion of all predictor variables. Here, several model diagnostics are applied to confirm model 'goodness of fit'. First, the Omnibus Tests provide likelihood ratio tests to confirm whether the inclusion of predictor variables significantly improves the model fit. A statistically significant decrease in the -2 log-likelihood values at a chi-square value of  $p \leq 0.05$  confirms this. Conversely, the Hosmer & Lemeshow test supports model fit when this chi-square value is insignificant at the 0.05 level.

Secondly, the pseudo R square statistics which include the Cox & Snell R Square and the Nagelkerke R Square measure the amount of variation in the dependent variable explained by the model and range from 0 to 1. Values closer to 1 indicate high model adequacy. The classification table serves to predict how well the correct category for each case is specified – in this case categories of financially included and financially not included individuals. It also provides the percentage accuracy in classification with higher percentages indicating model adequacy (Pallant, 2011).

Thirdly, the 'variables in the equation' table indicate the weights each predictor variable makes towards the model. It computes the probability of financial inclusion using odds ratios such that predictor-variable odds ratios greater than one indicate higher chances of a financial inclusion outcome with the reverse here being true. The Wald test measures the significance of each coefficient in the logistic output such that, coefficients with statistically significant values of  $p \leq 0.05$  indicate that the variable explains the financial inclusion outcome (Makina, 2012; Pallant, 2011). Finally, *B* coefficients determine the probability that a case falls into one category and not the other, while *Exp (B)* coefficients represent the change in odds of a given category of outcome, with a unit increase in the predictor variable (Pallant, 2011; Tabachnick & Fidell, 2007). The following section details the analysis.

## Analysis and Findings

The binary logistic output below models the chance that a bankable adult in Uganda is financially included based on a predictive set of variables. Table 2 presents the null model depicting the output without independent variables and representing the baseline model for comparison.

**Table 2:** The null model

Case Processing Summary							
Unweighted Cases <sup>a</sup>		N		Percent			
Selected Cases	Included in Analysis	2859		95,2			
	Missing Cases	143		4,8			
	Total	3002		100,0			
Unselected Cases		0		0,0			
Total		3002		100,0			
a. If weight is in effect, see classification table for the total number of cases.							
Classification Table <sup>a,b</sup>							
Observed			Predicted		Percentage Correct		
			Financial inclusion	Not included			
Step 0	Financial inclusion [K1_1]	Not included	0	802	0,0		
		Included	0	2057	100,0		
Overall Percentage					71,9		
a. Constant is included in the model.							
b. The cut value is .500							
Variables in the Equation							
		B	S.E.	Wald	df	Sig.	Exp(B)
Step 0	Constant	0,942	0,042	511,917	1	0,000	2,565
Variables not in the Equation <sup>a</sup>							
	Variables	Score	df	Sig.			
Step 0	MM_count_s	85,697	1	0,000			
	PA_1_count_s	138,722	1	0,000			
	PA_2_count_s	257,055	1	0,000			
	CFP_count_s	318,529	1	0,000			
	SI_1_count_s	297,928	1	0,000			
	SI_2_count_s	212,266	1	0,000			
	Age (C7)	9,894	1	0,002			
	Gender (C8)	1,569	1	0,210			
	Monthly income (D8)	15,903	1	0,000			
Educational level (C10)	236,657	1	0,000				
a. Residual Chi-Squares are not computed because of redundancies.							

**Source:** Author's compilation.

The table indicates that the overall analysis was conducted on 2859 cases out of a total sample of 3002 individuals. This represented 95.2% of the original sample with 4.8% of them omitted for missing information. The classification table indicates how well the null model predicts the broad measure of financial inclusion. Given the cases of the two decision outcomes (financially included and financially not included), 71.9% (2057/2859) of these cases opted to be financially included while 28.1% (802/2859) did not. Without the inclusion of independent variables, the study predicted that if for every case, an individual opts to be financially included, the null model would be accurate 71.9% of the time. This indicates that the dataset is a good fit for replication.

Furthermore, the “variables in the equation” table indicates that the Chi-square statistic does not equate to zero and/or is statistically significant at the 5% level (Tabachnick & Fidell, 2007). As such, we rejected the null hypothesis and concluded that the predicted odds ratio for financial inclusion in the null model is 2.565

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and is statistically significant at the 1% level. Similarly, all predictor variable scores excluding gender (C8), indicate non-zero values at statistically significant *p*-values (0.000) lower than the critical 5% level. This implies that including these variables in the null model would improve its predictability. We, therefore, nested both models and did a between-model comparison to assess for statistical improvement in model fit. Table 3 below shows the full model output following the addition of independent variables.

**Table 3:** The full model

Omnibus Tests of Model Coefficients									
		Chi-square		df		Sig.			
Step 1	Step	704,513		10		0,000			
	Block	704,513		10		0,000			
	Model	704,513		10		0,000			
Model Summary									
Step		-2 Log likelihood		Cox & Snell R Square		Nagelkerke R			
1		2688.785 <sup>a</sup>		0,218		0,314			
a. Estimation terminated at iteration number 7 because parameter estimates changed by less than .001.									
Hosmer and Lemeshow Test									
Step		Chi-square		df		Sig.			
1		7,910		8		0,442			
Classification Table <sup>a</sup>									
				Predicted					
				Financial inclusion [K1_1]		Percentage			
Observed				Not included		Included		Correct	
Step 1	Financial inclusion [K1_1]	Not included		334		468		41,6	
		Included		209		1848		89,8	
		Overall Percentage						76,3	
a. The cut value is .500									
Variables in the Equation									
								95% C.I. for	
		B		S.E.		Wald		df	
						Sig.		Exp(B)	
								Lower	
								Upper	
Step 1 <sup>a</sup>	MM_count_s	0,321	0,136	5,587	1	0,018	1,379	1,056	1,800
	PA_1_count_s	0,821	0,197	17,420	1	0,000	2,272	1,545	3,341
	PA_2_count_s	0,707	0,182	15,067	1	0,000	2,029	1,419	2,900
	CFP_count_s	1,057	0,326	10,498	1	0,001	2,879	1,519	5,457
	SI_1_count_s	0,760	0,420	3,271	1	0,071	2,137	0,938	4,868
	SI_2_count_s	0,953	0,158	36,598	1	0,000	2,594	1,905	3,533
	Age (C7)	0,015	0,003	20,421	1	0,000	1,015	1,008	1,021
	Gender (C8)	-0,320	0,103	9,658	1	0,002	0,726	0,593	0,888
	Monthly income (D8)	0,000	0,000	18,108	1	0,000	1,000	1,000	1,000
	Educational level	0,804	0,080	101,877	1	0,000	2,233	1,911	2,611
Constant	-2,872	0,252	129,750	1	0,000	0,057			
a. Variable(s) entered on step 1: MM_count_s, PA_1_count_s, PA_2_count_s, CFP_count_s, SI_1_count_s, SI_2_count_s, C7: Age, C8: Gender, D8: Monthly income , C10: Highest educational level									

**Source:** Author's compilation

From the table above, the Omnibus test has a chi-square value of 704.513 on 10 degrees of freedom (df) and a block *p*-value of 0.000. This *p*-value is lower than the 0.05 level of significance implying that the full

model, containing all the independent variables, performs better than SPSS's original guess in the null model and confirms an improved model "goodness of fit" (Pallant, 2011). Conversely, the Hosmer-Lemeshow chi-square test indicates a value of 7.910 at a statistically insignificant  $p$ -value of 0.442 – again confirming improved model fit as explained above. Furthermore, the model summary indicates a reduction in the  $-2LL$  values between the models. This statistic decreased from 3393.298 (2688.785 + 704.513) in the intercept-only model, to 2688.785 in the full model. The reduction suggests an improvement in 'model fit' between the latter and former models and confirms that adding predictor variables significantly improves the model's adequacy (Hair, et al. 2014).

In addition, the Cox & Snell and the Nagelkerke pseudo squares which explain the variation in the dependent variable explained by the model, have estimated values of 0.218 and 0.314 respectively, suggesting that between 21.8% and 31.4% of the model's variability is explained by the predictor variables. This model has an improved Percentage Accuracy of Classification (PAC) of 76.3% compared to 71.9% for the null/intercept-only model and accurately classifies 89.8% of the cases as financially included (true positives) and 41.6% of them as financially not included (true negatives). As such, the positive predictive value of the model was 79.8% (1848/ (468 + 1848)) while the negative predictive value was 61.5% (334/ (209 + 334)) (Pallant, (2011)). These results confirm that the full model has a higher predictive ability compared to the null/intercept-only model.

Additionally, the 'variables in the equation' section indicate the weight each predictor variable makes towards the dependent variable, financial inclusion. The Wald statistic shows that all independent variables excluding SI1 (monitoring economic indicators) add significantly to the predictability of the model at  $p$ -values lower than the 5% level of significance. This means that each variable is a significant driver of financial inclusion in Uganda. Similarly, all control variables except gender (C8), have a positive directional influence on financial inclusion as indicated by their  $B$  – coefficients. We concluded that these variables have a positive and significant influence ( $p$ -value  $\leq 0.05$ ) on financial inclusion in Uganda and re-specified the full model equation as follows:

$$\text{finInc} = -2.872 + 0.321 \text{ MM} + 0.821 \text{ PA1} + 0.707 \text{ PA2} + 1.057 \text{ CFP} + 0.953 \text{ SI2} + 0.015 \text{ age} + 0.001 \text{ income} + 0.804 \text{ education} - 0.320 \text{ gender} \quad (3)$$

Where:

*finInc* = financial inclusion in Uganda  
*MM* = money management (making ends meet)  
*PA1* = planning ahead (planning for the future)  
*PA2* = planning ahead (attitude towards planning for the future)  
*CFP* = choosing financial products (seeking financial advice),  
*SI2* = staying informed (attitude towards technology).

In the final analysis, the odds ratios that a bankable Ugandan is financially included are represented by the predictor variable's  $Exp(B)$  coefficient. Each statistically significant coefficient greater than one indicates the probability of being financially included (Makina, 2012). Accordingly, the following observations were made about the bankable population of Uganda, 'ceteris paribus': (1) individuals who 'make financial ends meet' are 1.379 times more likely to be financially included; (2) those who plan for their future financial welfare have a 2.272 times greater chance of being financially included; (3) individuals who have a positive attitude towards planning for their future financial welfare are 2.029 times more likely to be financially included; (4) those that seek financial advice before choosing financial products have 2.879 greater chances of being financially included than not; (5) individuals who are receptive towards the evolution of technology are 2.594 times more likely to be financially included; (6) older individuals are 1.015 times more financially included than their younger counterparts; (7) income affects financial inclusion positively; (8) educated individuals are more financially included than uneducated or less educated individuals by 2.233 times; and (9) males are 0.725 times less financially excluded than females implying that the former are potentially more financially literate than the latter (Panos & Wilson, 2020).

In summary, the full model with all predictors, was statistically significant with a chi-square value of  $X^2(10, N = 2859) = 704.513$ ,  $p \leq 0.001$  confirming that it distinguished between respondents who are financially included or not. This model explained 31.4% of the variance in the financial inclusion status of bankable Ugandans according to the Nagelkerke  $R^2$ , and correctly classified 76.3% of these cases as included. While

our findings cannot be validated by comparison due to a scarcity of very similar studies, we utilize existing empirical literature on logistic regressions to confirm model robustness. Norusis (2007) and Tabachnick & Fidell, (2007), confirm that fitting a good model depends on; (1) the difference in the  $-2LL$  values between the models which represents the extent to which the collective parameter estimates of the models make the observed residuals "more likely", and (2) a large sample size which ensures that the deviance (likelihood-ratio test) between models is minimal but significant. Both these conditions were met to confirm that our models were robust to the data.

## Conclusion

To conclude, we confirm that our measure of financial literacy has a positive and statistically significant influence on financial inclusion in Uganda based on a demand for financial services perspective, and our findings align closely with recent empirical literature (see: Morgan & Long, 2020). Moreover, we confirm that our measure – albeit in the absence of supply-side factors- exhibits a stronger demand influence on financial inclusion than other control variables used in the study. We acknowledge a possible limitation to these findings based on the lack of a robust dataset and/or model which includes both types of variables. However, based on a demand perspective, our findings suggest that measuring financial literacy for developing economies should not be based on a 'one size fits all' criterion that emphasises knowledge about financial concepts and numeracy. Rather, this measure should incorporate aspects of individual financial attributes, behaviours, and skills.

We find that individuals who make financial ends meet, plan for their financial future welfare, seek financial advice before choosing financial products, and/or are receptive towards the evolution of technology, have a greater chance of being financially included than not, other factors assumed constant. Similarly, income, age, and education influence financial inclusion positively to confirm a priori expectations, while adult bankable males use more formal financial services than their female counterparts (see also, Morgan & Long, 2020).

These findings suggest the financial literacy and/or financial education policy interventions, when applied, could enhance the financial inclusion efforts in Uganda, other factors assumed constant. Findings also stimulate further research and empirical debate on efforts to develop a global yardstick for measuring financial literacy. To this, we argue that such efforts should account for other individual socio-economic, political, and infrastructural characteristics that influence financial inclusion differently between developed and developing economies. Similarly, aspects of technology advancement, mobile money use, and financial inclusion for women need further study.

Finally, our study is without limitations. First, owing to a limitation in our dataset, we apply only four demand-side control variables, one measure of financial inclusion, and no supply-side variables to our model. This results from a dearth of survey studies that investigate both demand and supply aspects to financial inclusion. Future studies need such robust survey data sets to assess the possible effects of both supply and demand factors on financial inclusion. Secondly, we use a FinScope (2018) database of Uganda whose survey instrument is not necessarily aligned to measure financial literacy. We recommend that future survey designs cover a broader scope to include measures on individual financial behavior as is common to the less developed demographics of Africa.

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