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Aslı Güler*

Financial Inclusion and Financial Literacy: A Composite Index and Clustering Approach

Finansal Kapsayıcılık ve Finansal Okuryazarlık: Bileşik Endeks ve Kümeleme Yaklaşımı

Abstract

This study examines the association between financial inclusion and financial literacy across 30 OECD countries. A composite Financial Inclusion Index covering access, usage, and depth is constructed using Principal Component Analysis, and countries are grouped through K-means clustering. The resulting clusters are compared in terms of overall financial inclusion, its underlying dimensions and indicators, and financial literacy, highlighting areas requiring further development across the dimensions of financial inclusion. The findings indicate a positive but non-linear and heterogeneous association between financial inclusion and financial literacy. Substantial heterogeneity emerges among countries transitioning from medium to high financial inclusion, while similar financial inclusion profiles may correspond to markedly different financial literacy levels.

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Öz

Bu çalışma, 30 OECD ülkesinde finansal kapsayıcılık ile finansal okuryazarlık arasındaki ilişkiyi incelemektedir. Erişim, kullanım ve derinlik boyutlarını kapsayan bileşik bir Finansal Kapsayıcılık Endeksi, Temel Bileşenler Analizi kullanılarak oluşturulmuş ve ülkeler K-means (K-ortalama) kümeleme yöntemiyle gruplandırılmıştır. Elde edilen kümeler; genel finansal kapsayıcılık düzeyleri, alt boyutları ve göstergeleri ile finansal okuryazarlık açısından karşılaştırılmış ve finansal kapsayıcılığın boyutları itibarıyla geliştirilmesi gereken alanlar vurgulanmıştır. Bulgular, finansal kapsayıcılık ile finansal okuryazarlık arasında pozitif, ancak doğrusal olmayan ve heterojen bir ilişki olduğunu göstermektedir. Orta düzeyden yüksek finansal kapsayıcılığa geçiş gösteren ülkeler arasında belirgin bir heterojenlik ortaya çıkarken, benzer finansal kapsayıcılık profillerine sahip ülkelerde finansal okuryazarlık düzeylerinin önemli ölçüde farklılaşabildiği görülmektedir.

Keywords

Financial inclusion, Financial literacy, Principal Component Analysis, Cluster analysis

Anahtar Kelimeler

Finansal kapsayıcılık, Finansal okuryazarlık, Temel Bileşen Analizi, Kümeleme analizi

* Ordu Üniversitesi, asliguler@odu.edu.tr, ORCID: 0000-0002-2900-1184.

Introduction

Financial literacy is widely recognized as one of the essential life skills of the twenty-first century. It contributes to individuals' ability to make more informed choices regarding spending, saving, and investment and to manage their financial resources more effectively. In this respect, financial literacy supports the improvement of both individual and societal financial well-being by enhancing individuals' knowledge and skills in financial matters (OECD, 2023). The importance of financial literacy has gained broader recognition particularly in the aftermath of the 2008 Global Financial Crisis, as the potential consequences of individuals' inadequate knowledge when facing complex financial products and risks became more apparent. Following these developments, many countries developed and implemented national financial education strategies, while policies aimed at improving financial literacy became increasingly prominent on economic and social policy agendas.

Although the concept of financial literacy in its modern form is relatively recent, the idea that individuals need to possess knowledge of financial matters has much deeper historical roots. One early example of this idea can be found in a letter sent by John Adams to Thomas Jefferson in 1787. In this letter, Adams (1787) drew attention to financial ignorance as a potential source of economic problems, stating that "All the Perplexities, Confusions and Distresses in America, arise... from downright Ignorance of the Nature of Coin, Credit and Circulation." Although the term financial literacy has subsequently been widely used by governments, international organizations, and researchers, a standardized definition of the concept has only emerged relatively recently. Some studies have treated financial literacy as synonymous with "financial knowledge," while others have adopted a broader approach by including the ability to perform basic calculations in addition to financial knowledge. Other approaches have defined financial literacy as the ability to evaluate complex financial instruments and make decisions regarding financial products that are consistent with individuals' long-term interests (Garg & Singh, 2018: 174).

A comprehensive definition that has gained international acceptance brings together these different perspectives. Accordingly, financial literacy is defined as a combination of the awareness, knowledge, skills, attitudes, and behaviors necessary to make sound financial decisions and ultimately achieve individual financial well-being. Based on this definition, financial literacy is generally considered in terms of three core components: financial knowledge and skills, financial attitudes, and financial behaviors. Financial knowledge refers to an individual's level of understanding of basic concepts such as simple and compound interest, risk-return trade-offs, and inflation, whereas financial skills refer to the capacity to apply such knowledge in everyday financial situations. Financial attitudes encompass individuals' orientations and preferences toward money, saving, spending, borrowing, and planning for the future. In this respect, attitudes play an important role in translating financial knowledge and skills into be-

havior. For example, individuals who hold unfavorable attitudes toward saving for the future or who prioritize short-term consumption over long-term financial security may be less likely to build precautionary savings or engage in regular financial planning. Financial behavior represents the dimension of financial literacy that is reflected in individuals' actual financial decisions and practices. Indeed, the benefits of financial literacy depend on the extent to which knowledge, skills, and attitudes can be translated into positive financial behaviors. Behaviors such as budgeting and regular saving can contribute to financial well-being, whereas excessive borrowing, uninformed use of credit, and engagement in highly leveraged transactions may adversely affect individual financial well-being (Atkinson & Messy, 2012; TEB, 2013; OECD, 2014).

Financial literacy can enable individuals to search more actively for the information they need when selecting financial products and services, use such information more effectively, and assess financial risks more appropriately (Lührmann et al., 2015: 1; Fanta & Mutsonziwa, 2021: 1). Given its importance for individual and societal well-being, identifying the channels through which individuals' financial capabilities are shaped is essential for developing policies and strategies aimed at improving financial literacy. One such channel is financial inclusion. Financial inclusion refers to the extent to which individuals and businesses can access and effectively use financial products and services that meet their needs and benefit from them in a safe and appropriate manner (Demirgüç-Kunt et al., 2017). Greater financial inclusion can support economic and social empowerment and enhance well-being by enabling individuals to access and use essential financial services, including savings, credit, payments, insurance, and money transfers. Accordingly, expanding access to and effective use of financial services has become an important policy objective worldwide (Bongomin et al., 2020: 2).

While financial integration and digitalization have made financial products and services more accessible to broader segments of the population and thereby contributed to greater financial inclusion, they have also increased the complexity of financial systems and the products they offer. This process creates new financial opportunities for individuals while simultaneously introducing new risks and challenges associated with making informed use of these opportunities. In addition, as population ageing has accelerated and pressures on the sustainability of pay-as-you-go pension systems have intensified, reforms implemented in many countries have shifted pension systems toward arrangements in which individuals assume greater responsibility for their financial security. Consequently, individuals have increasingly been required to save, invest, and manage their expenditures effectively over the course of their lives. In this context, the importance of private pension plans and other saving and investment instruments has increased, while many critical financial decisions, including investment choices and retirement planning, have increasingly shifted from governments and employers to individuals (OECD, 2014: 118; OECD, 2022: 7–8).

These consequences may be more pronounced among individuals with lower levels of financial literacy. Individuals with less financial knowledge have been found to be more likely

to engage in high-cost transactions, pay higher fees, and use costly forms of borrowing; they may also have greater difficulty assessing the extent of their debt or understanding their overall debt position (Lusardi & Tufano, 2015: 333). In this context, financial literacy is a critical factor in enabling individuals to make sound financial decisions in areas such as saving, investment, borrowing, risk management, and retirement planning (Lusardi, 2015: 639–640).

Individuals may be able to compensate for gaps in their knowledge to some extent through professional advice or reliable sources of information. However, low levels of financial literacy may also reduce investors' likelihood of seeking financial advice and their ability to benefit effectively from such services. Calcagno and Monticone (2015) find that less financially literate investors are less likely to seek advice from financial advisors and that, when they do seek advice, advisors provide more information to more knowledgeable investors. In this respect, financial literacy can also be regarded as an important factor shaping the quality of financial advice available to individuals during the financial decision-making process.

Although the relationship between financial literacy and financial inclusion is often viewed in terms of two complementary factors, the direction of the relationship in the literature has predominantly been examined from financial literacy to financial inclusion (Pavón Cuéllar, 2025; Grohmann & Menkhoff, 2017, 2021; Grohmann et al., 2018). A common finding across these studies is that higher levels of financial knowledge and skills encourage individuals to open bank accounts, save, and use credit and insurance products. Financial literacy may help individuals who are accessing financial products for the first time or who have limited financial experience to evaluate different options more effectively, manage their financial resources more efficiently, and select products that are appropriate for their future needs. However, financial education aimed at improving individuals' budgeting, saving, and use of financial products cannot readily be translated into practice unless appropriate, accessible, and secure financial products and services are available (OECD, 2014: 26).

Conversely, as individuals are increasingly exposed to financial decisions and products and gain greater experience with financial services such as bank accounts, credit products, and retirement financing, they may develop a better understanding of the relationships among saving, interest, risk, fees, maturity, and returns through real-life experience. This process can be understood through a learning-by-doing perspective, whereby financial experience may contribute to the development of financial knowledge and skills (Cole et al., 2011; Frijns et al., 2013; Wang & Liu, 2023).

In this respect, institutions that connect depositors and borrowers and actively participate in financial decision-making processes through the products and services they provide can help improve financial literacy and awareness by recognizing these decision-making moments, when customers may require greater guidance, as “teachable moments.” Against this backdrop, the provision of financial education alongside financial products and services may enable financial knowledge to be translated into concrete decisions and behaviors, while the experience gained through the use of these products and services may, in turn, reinforce

financial knowledge and capabilities. Taken together, these considerations point to a potential feedback loop between financial literacy and financial inclusion. Financial literacy and financial inclusion should therefore not be considered as isolated policy objectives. Strengthening financial inclusion may require not only demand-side interventions aimed at improving individuals' financial knowledge and capabilities, but also supply-side conditions that enable individuals to access, use, and gain experience with financial products and services (Bongomin et al., 2020: 4; OECD, 2014: 26).

While the existing literature has extensively examined the role of financial literacy in promoting financial inclusion, the financial inclusion side of this interaction has received comparatively less systematic attention, particularly within a multidimensional cross-country framework. In this context, this study jointly considers the access, usage, and depth dimensions of financial inclusion and examines how differences across these dimensions are associated with countries' levels of financial literacy, thereby providing an initial framework for a more comprehensive assessment of the relationship between the two concepts.

The study contributes to the literature in three main respects. First, it adopts a multidimensional perspective by considering access, usage, and depth as distinct but complementary dimensions of financial inclusion, rather than relying on a single measure or a limited set of indicators. Second, it constructs composite indices for financial inclusion and its underlying dimensions using Principal Component Analysis (PCA), thereby allowing the relative contribution of the underlying indicators to be determined through a data-driven weighting approach. Third, it employs K-means cluster analysis to identify groups of countries with similar financial inclusion profiles and examines these groups in conjunction with their financial literacy levels. This approach makes it possible to identify not only differences in the overall level of financial inclusion, but also heterogeneity across countries in the dimensions of financial inclusion and their corresponding financial literacy profiles.

The study consists of seven sections. The second section reviews the existing literature on the subject. The third section describes the methodological approach and analytical procedures employed in the study. The fourth section introduces the dataset and provides information on the variables used in the analysis. The fifth section details the process of constructing the financial inclusion index. The sixth section presents the cluster analysis and discusses the findings obtained from the analysis. The seventh and final section provides an overall assessment of the main findings and presents policy recommendations based on the results.

Literature Review

The vast majority of the literature examining the relationship between financial literacy and financial inclusion conceptualizes the direction of causality as running primarily in one direction. The central hypothesis underlying these studies is that financial literacy enhances financial inclusion. A prominent contribution within this strand of the literature is the study by

Grohmann et al. (2018). Using an instrumental variable (IV) regression approach, the authors find evidence supporting the view that financial literacy promotes financial inclusion even after accounting for institutional differences. By examining financial inclusion across its different dimensions, the study indicates that financial literacy acts as a substitute for financial infrastructure in terms of access to financial services, while serving as a complement to financial depth in terms of the use of financial services. The findings suggest that as financial literacy increases, individuals can make more effective use of the limited financial infrastructure available, thereby reducing their marginal need for more sophisticated financial services. At the same time, possessing adequate financial knowledge and skills increases the likelihood of using more sophisticated financial services.

A subsequent study by Grohmann and Menkhoff (2021), based on micro-level data, also provides evidence of the importance of financial literacy for financial inclusion. The cross-country findings indicate that financial supply- and demand-side factors tend to function largely as substitutes in low-income countries, whereas they exhibit a more complementary relationship in high-income economies. In particular, the study emphasizes the importance of improving financial literacy in high-income economies to enable individuals to make more effective use of the financial services available to them.

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Similarly, Fanta and Mutsonziwa (2021), using a sample of 6,029 individuals from Kenya and Tanzania, found that financial literacy constitutes a strong driver of financial inclusion. Reddy et al. (2024), drawing on survey data collected from owners of micro, small, and medium-sized enterprises, examined the relationship between financial literacy and the access, usage, and quality dimensions of financial inclusion. Their findings indicate that financial literacy is positively and statistically associated with all three dimensions. Taken together, these studies suggest that financial knowledge and skills can strengthen individuals' capacity to participate in the financial system and make effective use of available financial services. From the perspective of savings, Morgan and Long (2020) examine the relationship between financial literacy, financial inclusion, and savings behavior. Their findings show that financial literacy is positively associated with both financial inclusion and savings. They further demonstrate that individuals with higher financial literacy scores are more likely to hold savings in both formal and informal forms than those with lower financial literacy scores, even after controlling for income and education. The authors also find that the association between financial literacy and financial inclusion varies across different measures of financial inclusion, highlighting the multidimensional nature of this relationship.

However, conceptualizing the relationship between financial literacy and financial inclusion exclusively in this direction may overlook the potential role of individuals' experiences within the financial system in developing their knowledge and skills. While financial literacy may encourage individuals to open bank accounts, save, and use credit or insurance products, making financial services accessible and usable may also encourage individuals to make more financial decisions and interact more frequently with financial products. Such interactions

may, in turn, contribute to the development of financial knowledge and skills. From this perspective, financial experience can be understood not only as a means through which individuals translate theoretical knowledge into practice but also as a learning mechanism through which new knowledge and skills are acquired.

One study supporting this argument is Cole et al. (2011), who conducted field experiments in India and Indonesia and found that the effect of financial education programs on bank account ownership was limited, whereas small monetary incentives generated stronger effects on account opening. The study also found that the new accounts opened as a result of the intervention remained open and active two years later, suggesting that financial experience may have persistent effects on financial knowledge and behavior. These findings indicate that financial literacy interventions should be considered alongside incentives that facilitate the use of financial products, appropriate financial product design, and mechanisms that promote continued interaction with the financial system.

Similarly, Frijns et al. (2013), in a study conducted in New Zealand, found that domestic students with experience using financial products such as student loans and retirement accounts had higher levels of financial literacy than international students without such experience. By employing an instrumental variable (IV) approach, the study provides evidence of the potential causal role of financial experience in shaping financial literacy.

Wang and Liu (2023) examined the relationship between homeownership and financial literacy in China from a “learning by doing” perspective and showed that borrowing experience, in particular, is associated with improvements in basic financial knowledge.

Using OECD/INFE microdata, Cupák et al. (2021) examined cross-country differences in financial literacy across 12 countries and found that individual characteristics such as age, education, income, and gender explained only part of the differences in average financial literacy across countries. The remaining differences were associated with macroeconomic and institutional factors, including life expectancy, social contribution rates, PISA mathematics scores, internet use, and stock market capitalization. These findings suggest that the economic, educational, technological, and financial environments in which individuals operate also matter for the development of financial knowledge and skills.

These findings are further supported by macro-level studies. Kozol (2025), in an analysis covering 143 countries, found a positive association between financial literacy and GDP per capita, educational attainment, internet access, and the quality of regulatory systems, while inflation was negatively associated with financial literacy. These relationships were more pronounced in countries with lower levels of financial literacy. The findings indicate that financial literacy is also related to countries’ levels of economic and financial development, educational attainment, digital infrastructure, and the regulatory and institutional quality of their markets and financial systems.

The importance of interaction with the financial system for financial learning also draws attention to the role of financial intermediaries. Because financial intermediaries are involved

in individuals' financial decision-making processes, the transactions and interactions they facilitate may provide an important learning environment through which individuals become familiar with financial products, use them, and make decisions concerning them. Bongomin et al. (2020), using data from rural areas of Uganda, show that training programs provided by microfinance institutions can improve individuals' ability to understand complex financial products and make financial decisions. In this respect, the study demonstrates that financial institutions are not merely providers of financial services but can also serve as institutional channels through which individuals' financial knowledge and skills are developed.

Finally, Klapper and Lusardi (2020) show that financial literacy levels vary considerably across countries even among individuals who have a financial account. This finding suggests that access to financial services alone is insufficient and that participation in the financial system does not automatically generate high levels of financial knowledge and skills. Accordingly, the relationship between financial inclusion and financial literacy should be assessed not only in terms of access but also with regard to the intensity of financial service use, the extent to which individuals encounter and interact with financial services, and the capacity of these experiences to translate into learning.

Overall, the literature suggests that conceptualizing the relationship between financial literacy and financial inclusion as unidirectional may be insufficient. On the one hand, financial knowledge and skills can facilitate individuals' access to and effective use of financial products and services. On the other hand, interactions with the financial system can provide individuals with opportunities to learn through actual financial decisions and experiences. Therefore, considering financial inclusion not only as an outcome of financial literacy but also as a potential channel through which financial literacy can develop may contribute to a more comprehensive understanding of the relationship between the two concepts.

Research Framework and Methodology

This study examines the association between financial inclusion and financial literacy within a cross-country comparative framework, approaching their relationship from the perspective of financial inclusion. Given the multidimensional nature of financial inclusion, which cannot be adequately represented by a single indicator or a limited set of financial measures, the study first constructs a composite financial inclusion index incorporating different dimensions of access to, use of, and depth of engagement with financial services. The index combines indicators reflecting individual-level financial behaviors and preferences with measures of physical and digital financial infrastructure, thereby capturing both demand- and supply-side aspects of financial inclusion. The financial inclusion index is constructed using Principal Component Analysis which is applied in two stages. In the first stage, the variables representing each dimension of financial inclusion are weighted according to their contribution within that dimension to construct separate indices for access, usage, and depth. In the second stage, these three

sub-indices are weighted to obtain the overall financial inclusion index. Thus, the weights used in both the construction of the sub-indices and the final composite index are determined by the underlying structure of the data rather than by subjective judgments.

Beyond examining the statistical association between the two concepts, the study seeks to provide a diagnostic and comparative assessment of countries' financial inclusion profiles. Accordingly, countries are grouped using the K-means clustering algorithm based on the constructed financial inclusion index, with the number of clusters determined according to cluster-validity criteria. The resulting groups are then characterized by comparing their overall financial inclusion scores, sub-indices, underlying indicators, and financial literacy levels. This approach makes it possible not only to identify countries and country groups with relatively weaker financial inclusion, but also to determine which dimensions of financial inclusion remain comparatively underdeveloped within each group and where potential areas for improvement may exist. Furthermore, the visualization of countries according to their financial inclusion profiles and financial literacy levels helps reveal cases in which the two dimensions do not follow the general cross-country pattern, thereby highlighting within-cluster heterogeneity and providing a basis for examining potential country-specific factors underlying these differences.

Finally, the association between the constructed financial inclusion index and financial literacy is examined using Pearson correlation and robust regression analysis. Given the cross-sectional nature of the data, the findings are interpreted in terms of statistical association rather than causal effects.

In sum, the methodological structure of the study consists of five main stages:

- i) **Construction of the Composite Financial Inclusion Index:** In the first stage, composite indices are constructed for access, usage, and depth using principal component analysis. These sub-indices are subsequently combined to obtain the overall financial inclusion index.
- ii) **Cluster Analysis:** Based on the overall financial inclusion index, countries are grouped according to similarities in their financial inclusion profiles using the K-means clustering algorithm. The number of clusters is determined based on cluster-validity criteria.
- iii) **Cluster Characterization:** The identified country groups are compared in terms of the overall financial inclusion index, its sub-indices, the underlying indicators, and financial literacy levels to identify their respective strengths and areas of relative weakness.
- iv) **Visualization and Cross-Country Comparison:** Scatter plots are used to examine the association between financial inclusion and financial literacy across countries and within the identified clusters. This visualization helps identify general patterns as well as countries that diverge from those patterns.

- v) **Regression Analysis:** Finally, Pearson correlation and robust regression analysis are employed to examine the statistical association between the composite financial inclusion index and financial literacy. Given the cross-sectional design, the results are interpreted as associations rather than causal effects.

Data Description

This study analyzes a total of 30 developed and developing countries to examine the association between financial inclusion and financial literacy. To facilitate meaningful cross-country comparisons, the empirical framework is built around these two core conceptual dimensions. Because the indicators used in the analysis are compiled and updated at different intervals, the study does not impose a common reference year across all variables. Instead, the most recent representative and reliable data available for each indicator and country are used. This approach is particularly important for dynamic areas such as financial literacy and financial inclusion, where relying on outdated observations may not adequately reflect current conditions. Accordingly, selecting indicator-specific data years in accordance with the reporting and updating cycles of each country provides a more accurate representation of their contemporary financial profiles. The primary objective is therefore to characterize countries according to their current levels of financial inclusion and financial literacy and to examine the association between these two dimensions across countries.

Financial Literacy Scores

The financial literacy scores for each country were obtained from the International Survey of Adult Financial Literacy report published in 2023 by the OECD's International Network on Financial Education (INFE). The financial literacy score is constructed from indicators capturing individuals' financial knowledge, attitudes, and behaviors. Since Türkiye was not included in the OECD/INFE report, data for Türkiye were obtained from the Financial Literacy, Access, and Digital Maturity in Türkiye (2022) report published by Boğaziçi University's Center for Analytics and Insights Research, which applies the same methodology (Karaca, 2022)¹.

Data for the Financial Inclusion Index

Because financial inclusion is inherently multidimensional, relying on single metrics like account ownership or ATM density, proves insufficient for accurate measurement (Camara and Tuesta, 2014: 5; Nguyen, 2021: 79). While Sarma (2015, 2016) pioneered the multidimensional Financial Inclusion Index (FII) focusing on banking penetration, service availability, and system usage, her model was constrained by supply-side aggregates and lacked active household-level data.

Other prominent frameworks in the literature, such as the IMF (Sviryzdenka, 2016) and Chehayeb (2024), emphasize the critical role of ‘financial depth’ alongside ‘access’ and ‘usage’ to capture the true scale of financial inclusion. However, they rely on country-level macroeconomic aggregates (such as credit-to-GDP ratios) to proxy usage and depth. Conversely, other prominent multidimensional indices, such as the one constructed by Camara and Tuesta (2014), focus almost exclusively on demand-side survey barriers.

To address these limitations, the index constructed in this study offers two distinct advantages. First, it integrates both supply- and demand-side perspectives by merging physical banking infrastructure with individual financial behaviors. Second, instead of relying on country-level macroeconomic aggregates to proxy usage and depth, this study repurposes these concepts at the micro-level, utilizing direct individual-use indicators.

Integrating these distinct perspectives, the financial inclusion index in this study was constructed based on three fundamental dimensions—access, usage, and depth—by synthesizing the dimensional frameworks proposed by Camara and Tuesta (2014), Sarma (2015, 2016), Sviryzdenka (2016), and Chehayeb (2024). Sub-indices representing each dimension were created using relevant indicators, which were then combined to form an overall composite index. This approach enabled the multidimensional structure to be summarized into a single index value, providing a unified metric for cross-country comparisons.

Accordingly, the indicators utilized in these sub-dimensions were selected based on the following criteria:

- i) Access: Measures both physical and digital entry points to the financial system.
- ii) Usage: Evaluates the active transaction behavior of individuals through digital and mobile channels, capturing the active utilization.
- iii) Depth: Assesses the advanced and sustainable engagement of individuals with the formal financial system through savings and credit retrieval, aligned with broad-based financial development frameworks.

The indicators were sourced from the World Bank’s Global Findex Database 2021, which provides country-level indicators derived from nationally representative individual-level survey data (World Bank, 2022). Based on these criteria, the selected indicators and their corresponding descriptions for each sub-index are presented in Table 1.

Table 1
Indicators Included in the Financial Inclusion Index

Dimension	Abbreviation	Included Indicators	Rationale
Access	FinAcc	Financial institution account (% age 15+)	Physical and digital infrastructure indicate access to the financial system.
	BankBranch	Commercial bank branches (per 100,000 adults)	
	IntUse	Individuals using the Internet (% of population)	

Dimension	Abbreviation	Included Indicators	Rationale
Usage	MobilePay	Use a mobile phone or the internet to make payments, buy things, or send/receive money using a financial institution account (% age 15+)	Active use of accounts indicates conscious usage behavior.
	DigitalPay	Made a digital payment (% age 15+)	
	CardUse	Used a debit or credit card (% age 15+)	
Depth	Saved	Saved at a financial institution or using a mobile money account, older (% age 25+)	Reflects deep and sustainable relationships with the financial system.
	Borrowed	Borrowed from a formal financial institution, older (% age 25+)	
	OwnCard	Owns a debit or credit card (% age 15+)	

Construction of the Financial Inclusion Index

In the literature, composite financial inclusion indices have been developed using both parametric and non-parametric methods. In parametric methods, the weights assigned to the indicators in the index are externally and intuitively determined by researchers (Nguyen, 2021). However, such indices can be highly sensitive to even small changes in the assigned weights (Lockwood, 2004). Therefore, in the first stage of this study, following the approach of Camara and Tuesta (2014), a multidimensional financial inclusion index was constructed for 30 developed and developing countries using a two-step Principal Component Analysis (PCA) method in which the weights were determined internally. The process of constructing the index was carried out in two stages:

In the first stage, the variables were normalized using the z-score standardization method due to their being measured on different scales. Then, PCA was applied separately for each dimension, and the first component (COMP1) was used to represent each respective sub-index, as it explained the largest proportion of the total variance among the principal components (see Appendix 1). Accordingly, three separate sub-indices were obtained for access, usage, and depth. Each sub-index was calculated using Equation 1:

$$D_i^k = \sum_{j=1}^3 w_j^k x Z_{ij}^k \quad (1)$$

In Equation 1, $k \in \{a, u, d\}$ denotes the sub-index type (access, usage, depth). w_j^k , represents the weight of the j -th indicator in the relevant sub-index, obtained through PCA; Z_{ij}^k , refers to the standardized value of the j -th indicator related to sub-index k for country i .

In the second stage, the previously obtained sub-indices for access, usage, and depth were re-normalized, and a second PCA was applied to these sub-indices. Using the first component obtained at this stage, the financial inclusion index was calculated via Equation 2, which includes the relative weights of each sub-dimension.

$$FII_i = g_1 D_i^a + g_2 D_i^u + g_3 D_i^d \quad (2)$$

In Equation 2, FII_i represents the financial inclusion index for country i , while D_i^a , D_i^u and D_i^d denote the access, usage, and depth sub-index values of country i , respectively. g_1 , g_2 , and g_3 are the weights that represent the contribution of each sub-index to the overall index. These weights are determined based on the component loadings and variance proportions obtained from the PCA results.

To assess the suitability of the data for principal component analysis, the Kaiser-Meyer-Olkin (KMO) test was applied. The results of the KMO test are presented in Appendix 2. The factor loadings of the first principal component for the access, usage, and depth indices were found to be 0.5723, 0.5836, and 0.5761, respectively, indicating that all dimensions contribute similarly to this component. This finding supports the notion that the first principal component provides a robust structure for representing overall financial inclusion. The access, usage, and depth sub-index values, together with the composite financial inclusion index values, are presented in Appendix 3.

Cluster Analysis and Comparative Findings

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Financial Inclusion-Based Country Classification and Cluster Profiles

Using the financial inclusion index, countries were grouped into three categories—low, medium, and high inclusion—through the K-means clustering algorithm. A univariate K-means approach was preferred over quantile-based grouping and hierarchical clustering because it allows countries with similar financial inclusion index values to be grouped together, resulting in more homogeneous clusters (MacQueen, 1967; Hartigan & Wong, 1979; Jain, 2010). Moreover, unlike hierarchical clustering, which may be sensitive to the choice of linkage method and the point at which clusters are defined, K-means provides a direct and centroid-based partition of the observations (Kaufman & Rousseeuw, 1990).

The Elbow method was initially used to identify an appropriate number of clusters. The within-cluster sum of squares (WSS) was calculated for values of k ranging from 1 to 10. The results indicated a noticeable elbow at $k = 3$, after which further reductions in WSS became relatively limited. To verify the statistical validity of the country partitions beyond the visual insights of the Elbow method, the clustering quality is evaluated using formal diagnostic criteria. First, the Calinski–Harabasz (CH) pseudo-F index was computed across alternative clustering solutions (see Appendix 5). The CH statistic increased from 74.20 for the two-cluster solution to 104.75 for the three-cluster solution, indicating that a three-group partition yields superior internal cohesion and clearer external boundaries compared to a binary division.

Next, the mathematical stability and assignment accuracy of this three-cluster model are verified using the silhouette coefficient across the sample of 30 countries (see Appendix 6). The analysis produced an average silhouette score of 0.774 (SD = 0.231), with individual values ranging from 0.020 to 0.944. According to Kaufman and Rousseeuw (1990: 88), an average silhouette width between 0.71 and 1.00 indicates a strong clustering structure. Accordingly, the average silhouette score indicates a strong overall clustering structure for the three-cluster solution, confirming that observations are highly congruent with their assigned cohorts and isolated from neighboring ones.

Although the CH index continues to increase as the number of clusters rises, additional clusters would create intermediate categories, making differences in financial inclusion levels more difficult to interpret and reducing the analytical clarity of the relationship under investigation. The three-cluster solution was therefore retained, as it was supported by both the Elbow and silhouette criteria, while additional clusters were not supported by the Elbow criterion. Accordingly, countries were classified into three financial inclusion groups—low, medium, and high—as presented in Table 2.

Table 2
Country Groups Based On The Financial Inclusion Index

Cluster	Countries
1-Low	Albania, Indonesia, Panama, Philippines, Romania
2-Medium	Chile, Croatia, Cyprus, Greece, Hungary, Lithuania, Malaysia, Poland, Portugal, Saudi Arabia, Thailand, Türkiye, Uruguay
3-High	Estonia, Finland, France, Germany, Ireland, Italy, Korea, Latvia, Malta, Netherlands, Spain, Sweden

Based on this classification, Table 3 reports the average financial literacy scores, Financial Inclusion Index (FII), financial inclusion sub-indices, and underlying financial indicators for each cluster.

Table 3 shows that financial literacy differs at low, medium, and high levels of financial inclusion, with higher levels of financial inclusion corresponding to higher levels of financial literacy. Specifically, the average financial literacy score in Cluster 1, comprising countries with low financial inclusion, is 56.05, while in Cluster 3, comprising countries with high financial inclusion, this score rises to 65.05. This finding is interesting because it indicates that financial inclusion and financial literacy differ together across the groups.

The detailed analysis of clusters based on the indicators shows that the countries included in Cluster 1 have a quite low rate of financial account ownership (51%). Conversely, the number of bank branches per 10,000 people is higher in this cluster than in the other two clusters (17.18). Nevertheless, digital access and usage indicators remain relatively low. Internet access stands at 77.5%, mobile banking usage at 18%, and digital payment usage at 34%. This pattern suggests that, despite the relatively widespread availability of traditional banking

Table 3

Country Clusters Based on the Financial Inclusion Index and Cluster-Specific Mean Values of Financial Literacy and Related Indicators

Indicator	Abbreviation	Clusters			Total Avg.
		1-Low	2-Medium	3-High	
Financial Literacy Index	FL	56.05	60.62	65.05	61.63
Financial Inclusion Index	FII	-3.08	-0.14	1.43	0.00
Access Index	Access	-2.44	0.13	0.87	0.00
Financial Account Ownership	FinAcc	0.51	0.88	0.99	0.86
Internet Usage	IntUse	77.50	88.87	92.07	88.25
Bank Branch Density	BankBranch	17.18	13.52	16.06	15.15
Usage Index	Usage	-3.06	-0.11	1.39	0.00
Mobile Payment Usage	MobilePay	0.18	0.54	0.73	0.56
Digital Payment Usage	DigitalPay	0.34	0.77	0.96	0.78
Card Usage	CardUse	0.20	0.63	0.90	0.67
Depth Index	Depth	-2.47	-0.41	1.48	0.00
Savings	Saved	0.18	0.33	0.58	0.41
Borrowing	Borrowed	0.16	0.29	0.49	0.35
Card Ownership	OwnCard	0.36	0.77	0.94	0.77

infrastructure, digital financial services have not yet been sufficiently adopted or utilized. In addition, the low levels of credit card usage, saving, and access to credit indicate that the depth dimension of financial inclusion also remains limited in these countries. The fact that all indices representing the access, usage, and depth dimensions take negative values further identifies this cluster as the group with the lowest level of financial inclusion. In this context, improving financial inclusion in Cluster 1 requires not only expanding traditional financial infrastructure but also increasing access to and use of digital financial services, strengthening digital financial literacy, and implementing financial education and policy measures that support saving and responsible credit use.

Cluster 2 consists of countries with moderate levels of financial inclusion and financial literacy. While the rate of financial account ownership is relatively high in this group (88%), the number of bank branches is lower compared to other groups (13.52). This indicates that digital financial tools are used more effectively despite limited physical access. Indeed, relatively high usage rates of mobile banking (54%) and digital payments (77%) are prominent indicators of this group. On the other hand, while the access dimension shows a positive value in this group, the usage and depth dimensions have negative values. The results show that traditional and digital financial tools are used effectively in these countries, but there are opportunities for improvement in terms of financial depth indicators such as savings and credit.

Cluster 3 is characterized by countries with high levels of financial inclusion and financial literacy, as well as above-average values across financial indicators. In these countries, individuals have broad access to both traditional and digital financial services and use them extensively. A notable finding is that, although the number of bank branches remains around the average level, mobile banking usage (73%), digital payment usage (96%), credit card usage (90%), and saving rates (58%) are particularly high. This pattern suggests that when existing financial systems are used more effectively, the marginal need for additional physical infrastructure may decrease. The positive values observed across all access, usage, and depth dimensions indicate strong performance in terms of individuals' participation in the financial system, their use of available financial instruments, and their ability to benefit from more advanced financial services. They also suggest a strong degree of integration with the financial system and well-established financial behaviors. In this context, these countries represent an important setting in which the next stage of financial inclusion may involve the development and wider use of more advanced financial products and services.

Overall, although traditional financial access is relatively high in Cluster 1, the level of financial literacy remains considerably lower than in Cluster 3. This finding highlights the importance of examining the access, usage, and depth dimensions of financial inclusion separately in relation to financial literacy. In addition, despite the relatively high level of physical access in this cluster, the limited access to and use of digital financial services point to a need to strengthen digital infrastructure and digital literacy in these countries. In contrast, although the number of bank branches is relatively low in Clusters 2 and 3, the widespread use of digital channels suggests that financial digitalization may reduce dependence on physical infrastructure. Another important difference across the clusters is observed in saving rates. While the saving rate is around 60% in Cluster 3, it remains below 20% in Cluster 1. This finding underscores that, in the context of socioeconomic development, financial inclusion is not limited to access alone and that the usage and depth dimensions also play an important role.

To assess whether the differences across the clusters are statistically significant, the Kruskal-Wallis test was applied (Appendix 7). This non-parametric test is suitable for comparing three or more independent groups. The findings indicate statistically significant differences across the clusters for all examined indicators, including financial literacy, the Financial Inclusion Index, and its access, usage, and depth dimensions, as well as their underlying indicators.

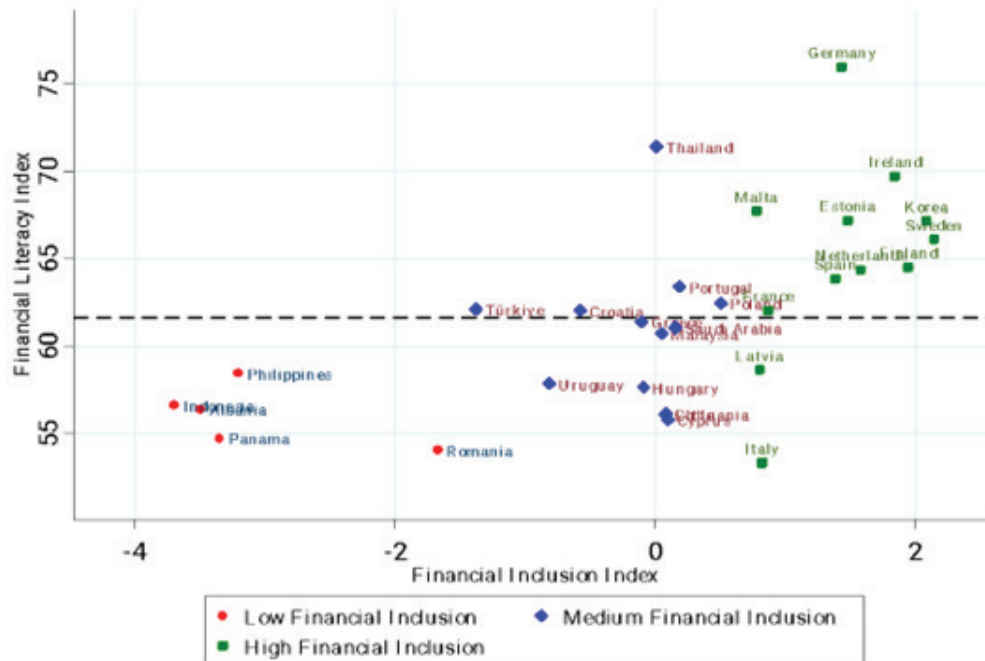
Visualization of Clusters

In Fig. 1, countries are presented in a two-dimensional scatter plot according to the K-means clusters based on the Financial Inclusion Index, together with their financial literacy scores. Each cluster is represented by different colors (red: low, blue: medium, green: high financial inclusion) to represent their respective groups. The use of different colors for each cluster al-

allows for observation of the cluster-level pattern between these two variables, as well as the individual positions of the countries. This visualization facilitates the analysis of each country's relative position in terms of financial inclusion and its relationship with other countries that have similar financial inclusion profiles. The horizontal dashed line in the graph represents the average financial literacy score across the entire sample.

Overall, Fig. 1 suggests a clear positive association between financial inclusion and financial literacy. Countries with relatively low levels of financial inclusion, such as Panama, Indonesia, Albania, and the Philippines, generally exhibit financial literacy scores below the sample average. In contrast, countries in the high-financial-inclusion cluster, such as Germany, Ireland, and Korea, tend to be positioned at relatively high levels on both indices. This pattern is consistent with the proposition that financial inclusion and financial literacy may reinforce one another through a potential feedback mechanism, whereby participation in an inclusive financial system may provide individuals with greater opportunities to acquire financial experience and strengthen their financial knowledge and capabilities, while higher financial literacy may, in turn, support more effective engagement with financial products and services.

Fig. 1
Financial Literacy Patterns across Clusters Based on the Financial Inclusion Index



Although Figure 1 points to an overall positive association between financial inclusion and financial literacy, this relationship is neither linear nor homogeneous across countries. Rather than following a uniform pattern, the two dimensions exhibit considerable divergence, particularly among countries with medium and relatively high levels of financial inclusion. For example, Uruguay, Hungary, and Cyprus, which belong to the medium-financial-inclusion cluster, display financial literacy levels close to those observed in countries with relatively low financial inclusion. In contrast, Türkiye, Croatia, and Portugal are positioned above the sample-average financial literacy level, represented by the horizontal reference line. These contrasting profiles indicate that countries with broadly similar levels of financial inclusion may differ substantially in terms of financial literacy.

Heterogeneity becomes increasingly pronounced as countries move from medium toward higher levels of financial inclusion. Thailand provides a notable example: although classified within the medium-financial-inclusion cluster, it records a financial literacy score of approximately 71, which is higher than that observed in several countries positioned at higher levels of financial inclusion. This pattern suggests that relatively high financial literacy may coexist with a less developed financial infrastructure, consistent with the view that financial literacy and financial infrastructure can act as substitutes in facilitating access to financial services (Grohmann et al., 2018). Conversely, Italy and Latvia, despite belonging to the high-financial-inclusion cluster, exhibit financial literacy levels below the sample average. These cases suggest that a relatively high level of financial inclusion does not necessarily coincide with a similarly high level of financial literacy and, conversely, that relatively high financial literacy may be observed even in the absence of a correspondingly high level of financial inclusion. The extent to which financial inclusion and financial literacy co-develop may be contingent on the larger context within which individuals make their financial choices. The variation across countries may be explained by differences in terms of educational opportunities, socioeconomic conditions, digital access and technological development, institutional quality and consumer protection, as well as cultural and behavioral characteristics. This interpretation is also in line with the literature stressing the role of education, income, digital access, and institutional conditions in explaining cross-country differences in financial literacy (Cupák et al., 2021; Kozol, 2025).

These findings have important implications for policy design. Countries with financial literacy levels below the sample average should not be expected to improve financial literacy simply by further expanding financial inclusion. Likewise, strengthening financial education alone may have limited effects where individuals face constraints in accessing, using, or benefiting from appropriate financial products and services. Thus, neither expanding financial inclusion alone nor strengthening financial education alone may be sufficient; a more effective policy approach requires coordinated improvements in both dimensions. The divergent country profiles therefore point to the need for a policy approach that addresses both the supply- and demand-side aspects of financial participation. Expanding access to financial services and

enhancing their effective use and depth should be complemented by financial education and broader measures aimed at improving educational opportunities, digital capabilities, socioeconomic conditions, consumer protection, and institutional quality. This multidimensional approach is particularly important for countries situated in the transition from medium to high levels of financial inclusion, where substantial heterogeneity is observed in financial literacy outcomes.

Regression Analysis

The overall relationship between the Financial Inclusion Index (FII) and financial literacy was assessed using Pearson correlation and a simple OLS regression with standardized variables and heteroskedasticity-robust standard errors. Following White (1980), heteroskedasticity-robust standard errors were used to provide inference that is robust to potential heteroskedasticity. The Pearson correlation indicates a positive and statistically significant association between FII and financial literacy ($r = 0.593$, $p < 0.001$). The regression results yield the same standardized coefficient ($\beta = 0.593$, $p < 0.001$), as expected in a single-predictor model with standardized variables, while the model explains 35.1% of the variation in financial literacy scores ($R^2 = 0.351$). Overall, these findings indicate a positive linear association between financial inclusion and financial literacy at the aggregate level. This association is broadly consistent with previous evidence showing that participation in financial markets and financial experience are associated with higher levels of financial literacy (Cole et al., 2011; Frijns et al., 2013; Wang & Liu, 2023).

Table 4
 OLS Regression Results with Heteroskedasticity-Robust Standard Errors for Financial Literacy and the Financial Inclusion Index

Variable	Coefficient	Standard Error	t-statistic	p-value	95% Confidence
FII	0.5928***	.10539	5.62	0.000	[.376913, .808705]
Constant	6.22e-09	0.14963	-0.00	1.00	[-.30651, .306518]
F-Statistic	31.64***				
R2	0.35				
Pearson Correlation (r)	0.5928***	0.006			

Note: *** indicates statistical significance at the 1% level.

Evaluation of the Findings, Policy Implications, and Conclusion

This study examines the relationship between financial inclusion and financial literacy within a multidimensional framework that jointly considers the access, usage, and depth dimensions of financial inclusion. To this end, a composite financial inclusion index based on data-driven weighting was constructed, countries were grouped according to their financial inclusion pro-

files using the K-means method, and the access, usage, and depth dimensions of each cluster were evaluated together with financial literacy levels. The findings indicate that higher levels of financial inclusion are generally associated with higher levels of financial literacy, although this relationship is neither linear nor homogeneous. In particular, the differences observed among countries at the transition point between medium and high levels of financial inclusion indicate that financial inclusion and financial literacy do not correspond in the same way across countries.

The findings suggest that differentiated policy strategies are needed rather than a one-size-fits-all approach to financial inclusion. For countries in Cluster 1, policy priorities should focus on expanding digital financial access and encouraging the active use of financial services. Investments in digital infrastructure, affordable mobile banking services, simplified account-opening procedures, and targeted digital financial literacy programs may help reduce the gap between the availability of financial infrastructure and its actual use. Particular attention should also be paid to saving and responsible borrowing. The low levels observed for these indicators suggest that expanding access alone may not be sufficient to deepen financial inclusion.

In Cluster 2, where access indicators are relatively strong but the usage and depth dimensions remain weaker, policies should shift from expanding basic access toward increasing the scope and intensity of financial service use. Promoting accessible savings and investment products and appropriate credit opportunities may contribute to strengthening the depth dimension of financial inclusion. Financial education programs should also go beyond basic financial concepts and focus on practical decision-making skills related to saving, borrowing, risk management, and long-term financial planning.

In Cluster 3, which consists of countries characterized by high levels of both financial inclusion and financial literacy, policy priorities may shift toward maintaining existing gains while strengthening the quality and sustainability of financial participation. In these countries, relatively high levels of access to financial services, the use of both traditional and digital channels, and indicators reflecting deeper and more established relationships with the financial system, such as saving, borrowing, and card ownership, suggest that policy attention may be directed less toward expanding basic access and more toward ensuring that existing financial participation is maintained in a conscious, secure, and responsible manner. In this context, policies that support the safe and responsible use of digital financial services, strengthen consumer protection, increase financial risk awareness, and enable individuals to make more effective use of existing financial products are particularly important. As digitalization becomes increasingly important in the use of financial services, raising awareness not only of the convenience provided by financial technologies but also of digital fraud, data security, and financial risks may contribute to the sustainability of the relatively high level of financial inclusion observed in these countries. Accordingly, the policy objective in these countries should not be limited to maintaining the level of financial participation, but should also aim to ensure

that the gains achieved across the access, usage, and depth dimensions are supported by safe, informed, and sustainable financial participation.

When the clusters are considered together, it becomes clear that financial inclusion cannot be adequately assessed solely in terms of access to financial services. In Cluster 1, the relatively weak levels of digital usage, saving, and borrowing despite the presence of a certain degree of physical financial infrastructure indicate that access alone does not ensure strong integration into the financial system. In Cluster 2, the relatively strong level of access combined with more limited usage and depth dimensions suggests that being included in the financial system does not necessarily imply intensive and diversified use of financial services. Therefore, policy design aimed at strengthening financial inclusion should distinguish between the access, usage, and depth dimensions and prioritize interventions according to the dimension in which each country or country group remains relatively weaker.

At the country level, the relationship between financial inclusion and financial literacy exhibits a clear but non-linear pattern. In general, countries with lower levels of financial inclusion tend to have relatively lower levels of financial literacy, whereas countries with higher levels of financial inclusion generally exhibit higher levels of financial literacy. However, the relationship becomes more heterogeneous across countries within the transition zone between medium and high levels of financial inclusion, with some countries deviating markedly from the overall pattern. This indicates that similar levels of financial inclusion do not always correspond to similar levels of financial literacy across countries. Therefore, the relationship between financial inclusion and financial literacy may not be sufficiently understood solely in terms of the development of the financial system; educational, socioeconomic, and sociocultural conditions should also be considered when interpreting these differences.

In this respect, Thailand represents a notable case, as its financial literacy level is higher than that of some countries with more advanced levels of financial inclusion despite being classified in Cluster 2. Thailand's performance may be considered in conjunction with institutional efforts to improve financial literacy in the country. In particular, the "Advancing National Financial Literacy" project implemented in 2017 through cooperation between the Bank of Thailand and the Asian Development Bank aimed to strengthen financial literacy awareness and sound personal financial practices, particularly among young workers, while online awareness and action campaigns constituted important components of the initiative (ADB, 2017). The case of Thailand is therefore noteworthy because it suggests that the correspondence between financial inclusion and financial literacy cannot be explained solely by the development of the financial system and that demand-side factors, such as financial education and awareness policies, may also be associated with this pattern.

In contrast, Italy represents a notable case in the opposite direction, as it belongs to the high-financial-inclusion cluster despite having a financial literacy level below the cluster average. Italy's relatively low financial literacy performance may not be adequately explained by the level of access to financial services alone. A study conducted by the Bank of Italy based

on PISA 2012 reported that Italian students' financial literacy levels were approximately 7% below the OECD average and identified lower levels of individual engagement with financial matters as one possible explanation for this gap (Montanaro & Romagnoli, 2016: 5). In addition, research showing that responsibility for economic and financial decision-making within Italian households varies among family members suggests that financial decisions may be concentrated among particular household members (Bertocchi et al., 2014). These findings suggest that high access to financial services in Italy does not necessarily imply that individuals are equally involved in financial decision-making processes or have similar opportunities to gain financial experience. In addition, according to the World Bank's 2023 data, the share of the population aged 25 and above with at least a bachelor's degree or equivalent was 17.58% in Italy, the lowest level among the countries in Cluster 3. This suggests that socio-economic characteristics should also be considered when assessing why Italy's financial literacy level differs from that of other countries with high levels of financial inclusion. Nevertheless, more detailed micro-level research is required before concluding that this difference is directly attributable to family structure or educational attainment.

Conclusion

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The findings indicate that the interaction between financial literacy and financial inclusion may not be explained solely by the development of the financial system and access to financial services and that socioeconomic and sociocultural factors may also play a role in these differences. Accordingly, policies aimed at improving financial inclusion and financial literacy should be designed using a country-specific approach that takes into account the characteristics of countries' existing financial systems and social contexts. In countries where financial inclusion is already relatively high, greater emphasis may be placed on strengthening individuals' ability to use existing financial services effectively, consciously, and responsibly rather than further expanding financial access. In this regard, financial education should be more closely integrated into formal education and lifelong learning programs, while digital financial literacy initiatives should be developed to address the increasing diversity and complexity of online financial services. As the digitalization of financial systems exposes individuals to a wider range of financial products and services as well as new financial risks, strengthening digital security awareness, financial risk awareness, and informed financial decision-making skills is particularly important for sustaining financial inclusion in these countries.

By contrast, in countries with lower levels of financial inclusion, a more comprehensive policy approach may be achieved by implementing supply-side policies aimed at improving access to and use of financial services alongside financial literacy education and awareness programs. As illustrated by the case of Thailand, institutional initiatives and awareness pro-

grams aimed at improving financial literacy may complement policies designed to strengthen financial inclusion. Such an approach would not only support the provision of financial services to individuals but also encourage them to understand and use these services effectively and responsibly, thereby contributing to stronger integration into the financial system.

Limitations of the Study

The first limitation of the study is that the analysis was restricted to 30 countries due to data constraints. Using a larger country sample could contribute to assessing different patterns between financial inclusion and financial literacy across a broader group of countries and increase the generalizability of the findings. In addition, the cross-sectional nature of the study does not allow the direction of the relationship between financial inclusion and financial literacy or potential mechanisms of reciprocal causality to be directly tested. Therefore, the findings presented in this study should not be interpreted as causal relationships but rather in terms of the co-movement of the variables and the observed patterns across countries.

Secondly, although differences in financial inclusion and financial literacy across countries may be related to educational and sociocultural factors, these factors were not directly incorporated into the main analysis. Therefore, interpretations concerning countries that deviate from the general pattern, particularly Thailand and Italy, should not be regarded as explanations of the observed differences but rather as possible explanations that are consistent with existing literature and country characteristics and that should be tested in future research. Future studies using individual-level microdata, broader country samples, panel datasets, and country-specific institutional and sociocultural variables could provide a more detailed examination of the direction of the relationship between financial inclusion and financial literacy and the mechanisms underlying this relationship.

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- 1 Since the OECD report also calculates the financial literacy levels of some countries, such as Malaysia and Spain, using data from 2021, the use of Turkey's 2022 data maintains methodological consistency. Furthermore, the OECD report itself notes that results for certain countries are based on surveys conducted in different years. Therefore, the use of Turkey's data, collected between June and July 2022 and calculated using a comparable methodology, does not compromise the validity of cross-country analyses.

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Appendix 1

Principal Component Estimates for the Sub-Indices and Overall Financial Inclusion Index

Component	Eigenvalue	Difference	Proportion	Cumulative		Component Loadings	
Access Index			FinAcc			BankBranch	IntUse
Comp1	1.64876	0.648944	0.5496	0.5496	0.707	-0.0185	0.7069
Comp2	0.999818	0.648398	0.3333	0.8829	0.007	0.9998	0.0186
Comp3	0.35142	—	0.1171	1.0000	0.707	0.0078	-0.7070
Usage Index				MobilePay		DigitalPay	CardUse
Comp1	2.84332	2.72673	0.9478	0.9478	0.570	0.5839	0.5779
Comp2	0.116594	0.076509	0.0389	0.9866	0.798	-0.2296	-0.5561
Comp3	0.040084	—	0.0134	1.0000	0.192	-0.7787	0.5973
Depth Index				Saved		Borrowed	OwnCard
Comp1	2.31337	1.83689	0.7711	0.7711	0.588	0.5361	0.6050
Comp2	0.476482	0.266331	0.1588	0.9299	-0.47	0.8344	—
Comp3	0.210151	—	0.0701	1.0000	0.651	0.1280	—
Financial Inclusion Index				Access		Usage	Depth
Comp1	2.7915	2.6561	0.9305	0.9305	0.572	0.5836	0.5761
Comp2	0.13539	0.0623	0.0451	0.9756	0.766	-0.1309	—
Comp3	0.0731	—	0.0244	1.0000	0.291	-0.8014	—

Appendix 2

Kaiser-Meyer-Olkin sample adequacy test results

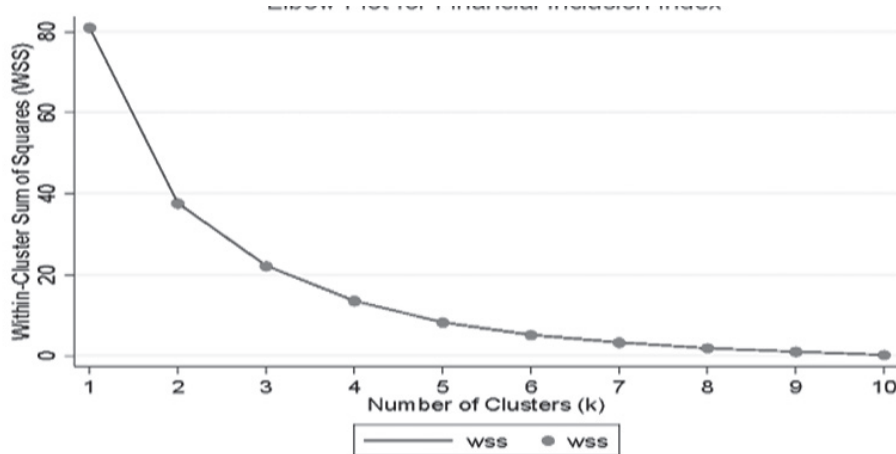
Index	Indicators	KMO Value	Index		KMO Value	
Access Index	FinAcc	0.5000	Depth Index		Saved	0.6615
	IntUse	0.5291		Borrowed	0.8241	
	BankBranch	0.5000		OwnCard	0.6329	
	Overall KMO	0.5000		Overall KMO	0.6856	
Usage Index	MobilePay	0.8573	Financial Inclusion Index		Access	0.8233
	DigitalPay	0.6735		Usage	0.7045	
	CardUse	0.7402		Depth	0.7774	
	Overall KMO	0.7474		Overall KMO	0.7640	

Appendix 3**Financial Inclusion Indices for Access, Usage, and Depth, and Financial Literacy Scores by Country**

Countries	Access Index	Usage Index	Depth Index	Financial Inclusion Index	Financial Literacy Scores
Albania	-2.20	-3.97	-3.01	-3.50	56.40
Chile	0.57	0.11	-0.56	0.08	56.11
Croatia	-0.39	-0.54	-0.56	-0.57	62.03
Cyprus	0.43	0.16	-0.40	0.10	55.79
Estonia	0.81	1.85	1.27	1.48	67.21
Finland	1.02	2.00	2.12	1.95	64.51
France	0.25	0.94	1.14	0.87	62.04
Germany	0.84	1.21	1.69	1.43	75.97
Greece	-0.15	0.68	-0.70	-0.10	61.38
Hungary	0.15	0.30	-0.68	-0.09	57.65
Indonesia	-3.55	-3.47	-2.42	-3.70	56.62
Ireland	1.37	1.45	1.94	1.85	69.70
Italy	0.14	0.83	1.25	0.82	53.34
Korea	1.34	1.65	2.41	2.08	67.17
Latvia	0.69	1.30	0.12	0.81	58.64
Lithuania	0.25	0.43	-0.46	0.09	56.14
Malaysia	1.01	-1.06	-0.08	0.05	60.69
Malta	0.72	0.60	0.67	0.78	67.73
Netherlands	0.97	1.71	1.46	1.58	64.37
Panama	-2.63	-3.20	-2.82	-3.35	54.73
Philippines	-2.87	-3.02	-2.33	-3.21	58.45
Poland	0.26	1.07	0.06	0.51	62.46
Portugal	-0.12	0.41	0.28	0.19	63.41
Romania	-0.97	-1.63	-1.78	-1.67	54.04
S.Arabia	0.69	-0.05	-0.34	0.16	61.06
Spain	1.12	1.14	1.30	1.38	63.85
Sweden	1.21	2.03	2.38	2.15	66.09
Thailand	0.31	-0.36	-0.01	0.01	71.38
Türkiye	-0.97	-1.33	-1.27	-1.38	62.10
Uruguay	-0.29	-1.25	-0.66	-0.81	57.83

Appendix 4

Elbow Plot for Country Clustering Based on Financial Inclusion Index

**Appendix 5**

Validation of the Optimal Number of Clusters Using the Calinski-Harabasz Criterion

Number of Clusters (k)	Calinski-Harabasz pseudo-F score
2	74.20
3	104.75
4	109.65
5	290.64

755

Appendix 6

Descriptive Statistics of Silhouette Coefficients for Cluster Validation (k=3)

Variable I	Obs	Mean	Std. dev	Min	Max
Silhouette	30	.7744938	.2312435	.0200321	.9438453

Appendix 7

Kruskal-Wallis Test Results for Financial Inclusion Indicators

Indicator	(χ^2)	Prob.	Indicator	(χ^2)	p-value
FL	9.053	0.0108	IntUse	14.127	0.0009
FII	25.806	0.0001	MobilePay	16.080	0.0003
Access	20.759	0.0001	DigitalPay	22.222	0.0001
Usage	21.027	0.0001	CardUse	21.530	0.0001
Depth	25.806	0.0001	Saved	24.289	0.0001
FinAcc	22.888	0.0001	Borrowed	16.547	0.0003
Bankbranch	13.597	0.0019	OwnCard	22.315	0.0001

