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Research article

Decoding sustainable finance: A Multi-Criteria Approach to financial inclusion barriers in High-Income Economies

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Abstract: Financial inclusion is crucial for poverty reduction and inclusive growth. Although most research has focused on developing economies, increasing social exclusion in developed nations calls for a closer look at the barriers impeding financial inclusion in these contexts. This study examines how demand-side, supply-side and institutional/regulatory factors interrelate in developed countries. A comprehensive literature review identified key barriers, which were then evaluated by a panel of 12 experts from academia and the financial industry through structured questionnaires and in-depth interviews. The study applied fuzzy DEMATEL to uncover causal relationships, used interpretive structural modeling (ISM) to establish a hierarchical structure of the barriers and conducted MICMAC analysis to classify them based on driving and dependence power. Findings indicate that the most critical obstacles are primarily institutional and supply-side in nature, including the absence of a coordinated national policy, inadequate regulations, limited rural financial services, restricted banking access and unsuitable financial products. While demand-side factors, such as low financial literacy and a lack of trust in the financial system, were observed, their influence was comparatively lower. The results underscore the complexity and interdependence of barriers to financial inclusion in developed countries. They challenge the assumption that high-income economies naturally foster inclusivity, suggesting that policies focusing solely on demand-side factors are insufficient. Instead, coordinated strategies addressing multiple barriers simultaneously are essential for advancing financial inclusion and promoting inclusive growth.

Keywords: financial inclusion; sustainable finance; developed economies; Multi-criteria decision models; Fuzzy DEMATEL; ISM; MICMAC

JEL Codes: G20, O16, I38

1. Introduction

In the rapidly evolving global economy, equitable access to financial services has emerged as a cornerstone for sustainable financial development by reducing poverty, fostering economic empowerment, and driving inclusive growth (Corrado & Corrado, 2017; Omar & Inaba, 2020; Khan et al., 2022). Achieving this objective requires the creation of an inclusive system that integrates economic, social, and environmental considerations, thereby overcoming existing barriers to access and utilization of these services.

Against this backdrop, financial inclusion programs have gained prominence on the agendas of numerous governments and organizations worldwide. According to the World Bank's Global Findex Database 2021, 76% of adults globally now have an account with a financial institution or mobile money provider, up from 69% in 2017, reflecting substantial progress driven by concerted policy efforts (Demirgüç-Kunt et al., 2022). Moreover, over 60 countries have implemented or are developing national financial inclusion strategies (NFIS) to systematically promote financial inclusion (World Bank, 2024). For example, the European Commission adopted the Digital Finance Strategy in 2020 to enhance digital financial inclusion across EU member states (European Commission, 2020). Similarly, the United States released the National Strategy for Financial Literacy 2020, aiming to improve financial education and inclusion nationwide (U.S. Financial Literacy and Education Commission, 2020). These initiatives underscore the growing recognition of financial inclusion as a critical driver of economic development and social equity.

In this context, adopting more sustainable financial practices can align financial markets with the Sustainable Development Goals (SDGs) of the United Nations (Ziolo et al., 2021). Such alignment contributes to long-term risk mitigation and fosters more equitable and sustainable economic development. Consequently, this approach facilitates the removal of existing barriers to financial inclusion, thus enhancing the resilience and inclusivity of the financial ecosystem through sustainable practices.

In examining the existing literature on barriers to financial inclusion, it becomes apparent that, despite the substantial volume of research available, the predominant focus is on the obstacles encountered by developing economies. This emphasis stems from the underlying assumption that issues related to financial inclusion are more pressing in these regions. This has generated many studies focused on the obstacles to financial access in less affluent countries (Zins & Weill, 2016; Singh, 2021; Mossie, 2022; Ofoeda et al., 2024, among others). However, the increase in social exclusion and poverty rates along with other socioeconomic conditions in developed countries makes it necessary to increase research in this regard to overcome this gap. This will allow for the analysis and exploration of the problem of financial inclusion through the complexities of developed economies (OECD, 2019; World Bank, 2020).

Furthermore, the literature reveals a notable deficiency in comprehensive analyses that delve into the intricate interconnections among the various barriers to financial inclusion. In line with works such as Holloway et al. (2017), Nyagadza (2019), or Nsiah & Tweneboah (2023), three levels of financial

barriers have been considered: demand-side, supply-side, and institutional/regulatory. On this basis, numerous studies have separately elucidated the challenges for financial inclusion from these perspectives. Nonetheless, little research has addressed a unified examination (Johnson & Arnold, 2012; Ledgerwood & Gibson, 2013; Arun & Kamath, 2015; Ozili, 2020a). This fragmented approach has limited the understanding of how these barriers interact and combine, which may hinder a more efficient approach to overcoming them.

To address these gaps, this article presents a comprehensive analysis that unifies the examination of demand-side, supply-side, and institutional/regulatory barriers to financial inclusion in developed countries. The originality of our study is three-fold. First, we provide an integrated framework that considers all three levels of barriers simultaneously, which has not been extensively explored in the context of developed economies. Second, we employ the fuzzy DEMATEL-ISM-MICMAC methodology, a novel application in this field that allows us to model and analyze the complex causal relationships among the barriers. In particular, this methodology allows us to identify the hierarchical structure and interdependencies among the barriers, providing novel insights into their relative importance and influence. Third, our study employs a distinct methodological approach that sets it apart from previous research, providing unique insights into the dynamics of financial inclusion in developed economies, regions often perceived as financially advanced yet still facing persistent challenges. Therefore, this work not only fills a significant gap in the literature but also contributes to a more comprehensive understanding of sustainable finance in highly competitive contexts, paving the way for more inclusive and sustainable financial systems.

To proceed with the empirical study, the primary barriers to financial inclusion in developed countries were initially identified and categorized across demand-side, supply-side, and institutional/regulatory dimensions, drawing on a comprehensive literature revision. Subsequently, a panel of experts, including both academics and professionals from the financial sector in Spain, was consulted to obtain a detailed assessment of the cause-and-effect relationships among these barriers. Upon compiling and synthesizing the perspectives of these experts, the fuzzy DEMATEL-ISM-MICMAC methodology, which integrates multi-criteria analysis techniques, was applied to evaluate the aggregated impact of the identified barriers.

Findings reveal that the most critical barriers include lack of income and physical access to bank branches and the reluctance of financial institutions to operate in rural areas; notably, the absence of a coordinated national policy on financial inclusion was identified as the most significant barrier. In this way, the most relevant barriers are a mix of supply-side and institutional/regulatory barriers and, to a lesser extent, demand-side barriers, highlighting the need for comprehensive policy to tackle these challenges for better financial inclusion. On the other hand, the more superficial barriers fall mainly on demand-side barriers, such as a lack of trust in the financial system and a lack of financial literacy.

These results provide a better understanding of the complexity and interdependence of the barriers in the context studied, offering valuable insights for policy formulation, intervention design, and strategic decision-making aimed at overcoming significant obstacles to financial inclusion.

The content of this article is organized into five sections. After the introduction, Section 2 presents the theoretical framework, which includes a literature review to define a set of barriers to financial inclusion in developed countries. Section 3 presents the research setting, including a description of the methodology, the analysis techniques, and the data collection procedure. Section 4 describes the results

of the empirical study. Finally, Section 5 presents the main conclusions and recommendations, along with the limitations of the work and future lines of research.

2. Literature review

2.1. Financial inclusion in developed countries

Financial inclusion, often considered a challenge exclusive to developing countries, is increasingly affecting developed nations. In this sense, the availability and equality of opportunities to access financial services are affected by the increase in bank branch closures, the digital divide, and the rise of the poverty line, even in countries with advanced financial infrastructures (Leyshon et al., 2008; Pazarbasioglu et al., 2020; Higgs et al., 2022). The case of Spain, with its significant contraction in the number of physical bank branches following the 2008 financial crisis (Maudos, 2017), serves as an illuminating example of how geographic and economic disparities can increase financial exclusion (Fernández-Olit et al., 2019). This trend is not unique to Spain, being repeated in several developed countries, driven by digitalization and cost-cutting measures that overlook segments of the population that lack digital literacy or access to technology (Kempson et al., 2004).

Moreover, the rising poverty line in developed countries introduces additional barriers to financial inclusion. As economic inequalities widen and the cost of living rises, more people are near or below the poverty line, making them vulnerable to exclusion from financial products due to increasingly stringent eligibility criteria, rising costs, or lack of services tailored to their needs (Jima & Makoni, 2023). While inevitable and positive in its innovation, the shift toward a digital banking model often inadvertently excludes those who are not ready to navigate the online financial sphere, further deepening the gap of financial exclusion (Hernández & Roberts, 2018; Mubarak & Suomi, 2022).

Furthermore, emerging technologies such as fintech innovations, central bank digital currencies (CBDCs), and instant payment methods are reshaping the landscape of financial services in developed countries. These technologies hold significant promise for enhancing financial inclusion by offering alternative financial products and reducing transaction costs (Ediagbonya & Tioluwani, 2023; Nnaomah et al., 2024; Yang et al., 2024). However, their adoption also presents challenges, particularly for vulnerable populations who may lack digital literacy or access to necessary technological infrastructure (Náñez Alonso et al., 2024; Salleh et al., 2024; Zhang et al., 2024). Recent studies highlight that while digital financial services can promote inclusive growth, they may also exacerbate existing inequalities if not carefully implemented (Alonso et al., 2023; Falaiye et al., 2024). For instance, the adoption of fintech among rural communities faces challenges related to infrastructure and user readiness (Salleh et al., 2024), emphasizing the need for policies that address both supply and demand factors in reducing financial exclusion (Zhang et al., 2024).

In essence, the debate around financial inclusion in developed countries illuminates an increasingly prevalent and underappreciated reality: a new approach to financial inclusion must be reached, encompassing the socioeconomic barriers that prevent a significant portion of the population from accessing essential financial services and addressing digital advances and their impact on financial exclusion. At the same time, it is necessary to emphasize the role that public institutions play or should play in universal financial inclusion in developed and developing countries, which requires innovative, inclusive, and empathetic solutions to bridge the existing gaps in our societies (Jima & Makoni, 2023).

2.2. Barriers to financial inclusion

The literature has paid extensive attention to the barriers provided by the Global Financial Inclusion (Global Findex). In this paper, we start by adapting and extending these concepts to address the reality of developed countries. According to works such as Holloway et al. (2017), Nyagadza (2019), or Nsiah & Tweneboah (2023), three levels of barriers have been defined: demand-side, supply-side, and institutional/regulatory barriers.

2.2.1. Demand-side barriers

Demand-side barriers in developed countries encompass a range of obstacles linked to some extent to consumers of financial products that impede the provision of financial services to all population segments. Lack of confidence in the financial system (B01) often stems from past financial crises and scandals, which can deter individuals from participating in the banking system. This issue is compounded by a lack of financial (B02) and technological literacy (B03), which are crucial for engaging with modern financial services. Many individuals lack the necessary skills to navigate online banking platforms or understand complex financial products. Furthermore, barriers to obtaining formal identification (B05) can prevent access to financial services, a challenge that disproportionately affects marginalized groups. The influence of social and family circles (B06) also plays a significant role, as negative perceptions can discourage engagement with financial institutions.

Additionally, the lack of income (B04) restricts the ability of individuals to engage with financial products meaningfully. Finally, due to distance or inconvenient opening hours, the difficulty of accessing bank branches hinders face-to-face interactions (B07) that some customers prefer or require for their banking needs. Together, these demand-side barriers highlight the multifaceted challenges in ensuring equitable access to financial services.

2.2.2. Supply-side barriers

On the supply side, barriers reflect consumers' challenges and constraints in accessing and using financial services. Limited face-to-face customer service (B08) and low availability of urban bank branches (B09) signal a shift toward online banking, which can exclude those without digital access or a preference for physical banking. Asymmetric information costs (B10) and complex terms and conditions attached to financial products (B11) add to the confusion and mistrust among potential users of financial services. These issues are exacerbated by financial institutions' reluctance to establish branches in rural areas (B12), leaving significant population segments without convenient access to banking services. The demand-side barriers thus underscore the gap between the services offered by financial institutions and the needs and preferences of potential customers, particularly in underserved areas.

2.2.3. Institutional/regulatory barriers

Institutional/regulatory barriers entail systemic and structural challenges that hinder the achievement of financial inclusion. Administrative policies' abandonment of rural or isolated areas (B13) reflects a need for more targeted support for financial services in these regions. Bureaucratic

and overburdened administrative offices (B14) can make accessing financial services a daunting task, plagued by inefficiency and complexity. The absence of a coordinated national policy and strategy on financial inclusion (B15) leads to fragmented efforts and missed opportunities for holistic improvement. Furthermore, a weak consumer protection regulatory framework (B16) undermines confidence in the financial system, deterring consumer engagement. Institutional and regulatory barriers thus represent significant obstacles to creating an inclusive financial ecosystem that serves the needs of all citizens, especially those in marginalized communities. Table 1 summarizes the main barriers analyzed above, including the main bibliographic sources that refer to them.

Table 1. List of barriers to financial inclusion. Source: Own elaboration.

Barrier dimension	Code	Barrier description	Source
Demand-side	B01	Lack of confidence in the financial system	Di Giannatale & Roa (2019), Nyagadza (2019), Khmous & Besim (2020), Singh (2021), Tinta et al. (2022), Nsiah & Tweneboah (2023)
	B02	Lack of financial literacy	Beck & De la Torre (2007), Fernandes et al. (2014), Lusardi & Mitchell (2014), Di Giannatale & Roa (2019), Nyagadza (2019), Singh (2021), Aparna & Anthuvan (2022), Nsiah & Tweneboah (2023), Náñez Alonso et al. (2024)
	B03	Lack of technological literacy	Holloway et al. (2017), Náñez Alonso et al. (2024)
	B04	Lack of income	Beck & De La Torre (2007), Di Giannatale & Roa (2019), Nyagadza (2019), Khmous & Besim (2020), Aparna & Anthuvan (2022), Jima & Makoni (2023)
	B05	Barriers to obtaining formal identification (ID, address, etc.)	Holloway et al. (2017), Khmous & Besim (2020), Aparna & Anthuvan (2022), Tinta et al. (2022)
	B06	Influence of social and family circle	Di Giannatale & Roa (2019), Khmous & Besim (2020), Aparna & Anthuvan (2022)
	B07	Difficulty of face-to-face access to bank branches due to distance and/or opening hours offered to the public	Khmous & Besim (2020), Aparna & Anthuvan (2022), Tinta et al. (2022), Nsiah & Tweneboah (2023)

Continued on next page

Barrier dimension	Code	Barrier description	Source
Supply-side	B08	Limited face-to-face customer service	Bourreau & Valleti (2015), Citizens Advice Bureaux (2020)
	B09	Low availability of urban bank branches	Jiménez (2019), Camacho et al. (2021)
	B10	Asymmetric information cost	Beck et al. (2008), Holloway et al. (2017), Di Giannatale & Roa (2019), Aparna & Anthuvan (2022)
	B11	Complex and confusing terms and conditions attached to products	Nandru et al. (2015, 2016), Aparna & Anthuvan (2022)
	B12	Financial institutions' reluctance to establish branches in rural areas	Nyagadza (2019), Martín-Oliver et al. (2020), Camacho et al. (2021)
Institutional/regulatory-side	B13	Abandonment by administration of rural/isolated areas	Wang et al. (2019)
	B14	Administrative offices are bureaucratic and/or overburdened	Diniz et al. (2012), Siano et al. (2020)
	B15	Absence of coordinated and proactive national policy and strategy on financial inclusion	Nyagadza (2019)
	B16	Weak consumer protection regulatory framework	Nyagadza (2019)

3. Methodology

When dealing with the causal relationships between existing barriers, the interdependence and interconnectedness of these barriers and their complex nature, together with the imprecision and uncertainty associated with expert assessment, make traditional models unsuitable for achieving these objectives.

In this sense, different multi-criteria decision-making (MCDM) methods have been used in order to overcome these problems in the study of the barriers; among them, DEMATEL (Decision-Making Trial and Evaluation Laboratory), ISM (Interpretative Structural Modelling), and MICMAC (Matrice d'Impacts Croisés Multiplication Appliquée à un Classement) have been shown to be the most effective in resolving the complexity of the interdependence of the barriers. In addition, several studies, such as Wu & Lee (2007) and Lin (2013), proposed to extend DEMATEL by integrating it with fuzzy set theory in order to accommodate the uncertainties inherent in expert judgments.

The integration of all the previous methodologies, through the application of a joint procedure referred to in the literature as fuzzy DEMATEL-ISM-MICMAC (Shanker & Barve, 2021; Feng et al., 2023; Alqershy & Shi, 2023), offers a robust framework to explore and analyze complex causal relationships among various factors or barriers within a system. This methodology is particularly useful in identifying and understanding the intricate interdependencies and influence dynamics among elements that contribute to a specific issue or challenge, where traditional linear models fail to capture the nuances of interdependencies and influences among factors. Each component of the methodology serves a unique purpose, and together, they provide a comprehensive framework for systemic analysis.

The DEMATEL method is instrumental in discerning the complex causal relationships and interdependencies among barriers. It effectively maps and quantifies the influence of various factors on each other, thus unveiling the structure of the problem at hand (Gabus & Fontela, 1972). However, the conventional DEMATEL approach may not fully accommodate the ambiguity and imprecision inherent in expert judgments.

Accordingly, to enhance the DEMATEL method's capacity to handle uncertainty and imprecision in expert evaluations, the fuzzy set theory introduced by Zadeh (1965) is integrated, resulting in the fuzzy-DEMATEL methodology. Fuzzy set theory enables the incorporation of linguistic variables and subjective judgments, thus offering a more nuanced and accurate representation of the complexities involved in expert assessments (Zadeh, 1965). This integration facilitates a more refined analysis of the interactions and the degree of influence among barriers, accommodating the inherent uncertainty and vagueness of human judgment.

Building on the insights gleaned from fuzzy DEMATEL, the ISM technique further elucidates the hierarchical structure of these barriers, providing a multi-level framework that reveals the direct and indirect relationships among the identified factors (Warfield, 1974). ISM transforms the complex, fuzzy DEMATEL-derived relationships into a clear, structured model, delineating the pathways through which barriers influence one another.

The incorporation of MICMAC analysis complements the fuzzy DEMATEL-ISM framework by assessing the driving power and dependence of barriers, offering a strategic perspective on their relative importance and influence (Duperrin & Godet, 1973). MICMAC analysis helps in prioritizing barriers to intervention by identifying those with significant influence on others and those that are highly dependent.

Together, the fuzzy DEMATEL-ISM-MICMAC methodology provides a comprehensive, nuanced, and systematic approach to understanding the causal relationships between barriers, demonstrating its robustness in a myriad of recent research contributions (Shanker & Barve, 2021; Vishwakarma et al., 2022; Alqershy & Shi, 2023; Feng et al., 2023). This methodology addresses the complexity and interdependence of barriers and effectively incorporates the uncertainty and imprecision of expert judgments, making it particularly suited for studies in contexts characterized by complexity and uncertainty. Through this approach, researchers and practitioners can gain deep insights into the structure and dynamics of barriers, facilitating informed decision-making and the development of targeted strategies for overcoming these obstacles. Figure 1 depicts the fuzzy DEMATEL-ISM-MICMAC methodology employed in this study, which is adapted from prior works including those by Alqershy & Shi (2023) and Feng et al. (2023).

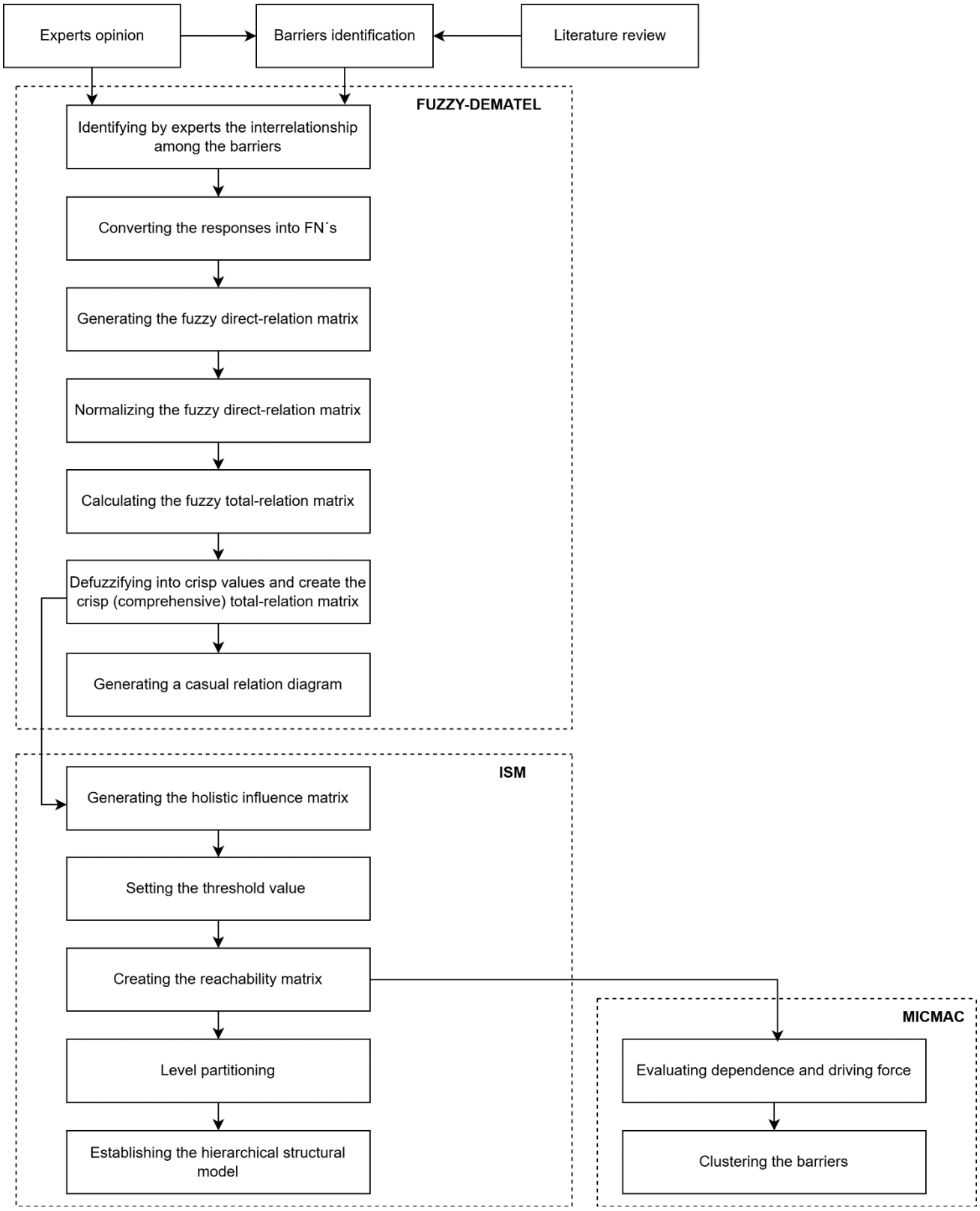

Figure 1. Diagram depicting the procedure combining hybrid fuzzy DEMATEL, ISM, and MICMAC methodologies.

3.1. The fuzzy DEMATEL-ISM-MICMAC procedure

The fuzzy DEMATEL-ISM-MICMAC approach applied in this work consists of a total of 11 steps. The procedure for each of these steps is described below.

Step 1: Identification of interrelationships among the barriers by experts

To determine the model of the relationships among the 16 barriers compiled above, a 16 × 16 matrix is initially created for each expert, storing the responses received from each of them based on the codification in Table 2. This way, each element in matrix *k* represents the influence considered by expert *k* of barrier *i* (in rows) on barrier *j* (in columns).

Table 2. Scale employed by the experts.

Code	Linguistic term
1	No influence
2	Very low influence
3	Low influence
4	High influence
5	Very high influence

Step 2: Converting the responses into fuzzy numbers

The impact of each element in a row on each element in a column of this matrix can be represented as a fuzzy number. Accordingly, the matrices obtained from the experts are re-coded using the fuzzy 5-point scale shown in Table 3 (Wu et al., 2015).

Table 3. Fuzzy scale used in the model.

Code	Linguistic term	Low (l)	Medium (m)	Upper (u)
1	No influence	0	0	0.25
2	Very low influence	0	0.25	0.5
3	Low influence	0.25	0.5	0.75
4	High influence	0.5	0.75	1
5	Very high influence	0.75	1	1

Step 3: Generating the fuzzy direct-relation matrix

The arithmetic mean of all experts' opinions is then used to generate the direct relation matrix $\tilde{Z}$.

$$\tilde{Z} = \begin{bmatrix} 0 & \cdots & \tilde{z}_{n1} \\ \vdots & \ddots & \vdots \\ \tilde{z}_{1n} & \cdots & 0 \end{bmatrix} \quad (1)$$

Step 4: Normalizing the fuzzy direct-relation matrix

The normalized fuzzy direct-relation matrix $\tilde{X}$ can be obtained using the following equations:

$$\tilde{X} = \left[\tilde{x}_{ij}\right]_{nxn} (i, j = 1,2,3, \dots, n) \quad (2)$$

$$\tilde{x}_{ij} = \frac{\tilde{z}_{ij}}{r} = \left(\frac{l_{ij}}{r}, \frac{m_{ij}}{r}, \frac{u_{ij}}{r}\right) \quad (3)$$

where:

$$r = \max_{i,j}\left\{\max_{i} \sum_{j=1}^{n} u_{ij}, \max_{j} \sum_{i=1}^{n} u_{ij}\right\} \qquad i, j \in \{1,2,3, \dots, n\} \quad (4)$$

Step 5: Calculating the fuzzy total-relation matrix

In this step, the fuzzy total-relation matrix $\tilde{T}$ can be calculated by considering the following formulae:

$$\tilde{T} = \left[\tilde{t}_{ij}\right]_{nxn} \quad i, j \in \{1,2,3, \dots, n\} \quad (5)$$

$$\tilde{T} = \lim_{k \to +\infty} (\tilde{x}^1 \oplus \tilde{x}^2 \oplus \dots \oplus \tilde{x}^k) \quad (6)$$

If each element of the fuzzy total-relation matrix is expressed as $\tilde{t}_{ij} = (l''_{ij}, m''_{ij}, u''_{ij})$, it can be calculated as follows:

$$[l''_{ij}] = x_l \times (I - x_l)^{-1} \quad (7)$$

$$[m''_{ij}] = x_m \times (I - x_m)^{-1} \quad (8)$$

$$[u''_{ij}] = x_u \times (I - x_u)^{-1} \quad (9)$$

Step 6: Defuzzifying into crisp values

The method proposed by Opricovic & Tzeng (2003) to convert fuzzy data into crisp scores is used to obtain crisp values of the comprehensive total-relation matrix (T matrix), also known as comprehensive influence matrix. The steps of this method are as follows:

$$l_{ij}^n = \frac{\left(l_{ij}^t - \min l_{ij}^t\right)}{\Delta_{min}^{max}} \quad (10)$$

$$m_{ij}^n = \frac{(m_{ij}^t - \min l_{ij}^t)}{\Delta_{min}^{max}} \quad (11)$$

$$u_{ij}^n = \frac{(u_{ij}^t - \min l_{ij}^t)}{\Delta_{min}^{max}} \quad (12)$$

So that:

$$\Delta_{min}^{max} = \max u_{ij}^t - \min l_{ij}^t \quad (13)$$

The following two equations are then used to calculate the upper and lower limits of the normalized values:

$$l_{ij}^{s} = {m_{ij}^{n}}/{(1 + m_{ij}^{n} - l_{ij}^{n})} \tag{14}$$

$$u_{ij}^{s} = {u_{ij}^{n}}/{(1 + u_{ij}^{n} - l_{ij}^{n})} \tag{15}$$

Finally, the following formulae are applied to obtain the total normalized crisp values:

$$T = \left[t_{ij}\right]_{nxn} \quad i, j \in \{1,2,3, \dots, n\} \tag{16}$$

$$t_{ij} = \frac{[l_{ij}^{s}\left(1 - l_{ij}^{s}\right) + u_{ij}^{s} \times u_{ij}^{s}]}{[1 - l_{ij}^{s} + u_{ij}^{s}]} \tag{17}$$

Step 7: Obtaining the final output and creating the causal relation diagram

The next step is applied to find out the sum of each row and each column of the comprehensive influence matrix obtained in the previous step. The sum of rows (D) and columns (R) can be obtained as follows:

$$D = \sum_{j=1}^{n} t_{ij} \tag{18}$$

$$R = \sum_{i=1}^{n} t_{ij} \tag{19}$$

The D+R and D-R values for each barrier can then be calculated and subsequently graphically represented using the causal relation diagram. Their interpretation runs along the following lines:

- The D+R horizontal vector denotes the level of significance that each barrier holds within the overall system. Essentially, D+R reflects the impact of a barrier on the entire system as well as the influence of other barriers on this particular barrier.
- On the other hand, the D-R vertical vector represents the extent to which a barrier influences the system. In broad terms, a positive D-R value indicates a causal variable, while a negative D-R value signifies an effect.

Step 8: Obtaining the holistic influence matrix

Upon the development of the fuzzy DEMATEL method, the investigation progresses to the implementation of the interpretative structural modeling (ISM) procedure. At this stage, the holistic influence matrix is derived from the comprehensive influence matrix T and the identity matrix I, according to the following formula:

$$H = T + I = \left[h_{ij}\right]_{nxn} \quad i, j \in \{1,2,3, \dots, n\} \tag{20}$$

Step 9: Setting the threshold value and calculating the reachability matrix

In this step, experts are prompted to set a threshold value λ to determine the presence or absence of a relationship between pairs of elements of the H matrix. Subsequently, the reachability matrix S is calculated, indicating whether an element can reach another directly or indirectly, depending on the threshold value λ defined by experts for the elements of the holistic influence matrix H. This is crucial

for identifying underlying relationships between variables and for simplifying the comprehensive influence matrix. The procedure developed in this stage is based on the following equations:

$$S = \left[s_{ij}\right]_{nxn} \quad i,j \in \{1,2,3,\dots,n\} \tag{21}$$

$$s_{ij} = \begin{cases} 1, h_{ij} > \lambda & i,j \in \{1,2,3,\dots,n\} \\ 0, h_{ij} \leq \lambda & i,j \in \{1,2,3,\dots,n\} \end{cases} \tag{22}$$

Step 10: Determining the hierarchical structural model for the barriers

Based on the reachability matrix *S*, the output set $P(ai)$, the input set $T(ai)$, and the intersection set $Q(ai) = P(ai) \cap T(ai)$ are identified for each barrier. Should $Q(ai)$ equal $P(ai)$, the barrier in question is considered a first-level barrier. Following this determination, barriers are removed from the sets and this process is repeated to categorize all barriers into a hierarchical structure.

Step 11: Assessing the dependence and driving force and clustering the barriers

Finally, each barrier is assessed in terms of its dependence and driving power using MICMAC analysis. The driving power (DR) reflects the influence level that one specific barrier has over another, whereas the dependence power (DE) shows how much a factor is influenced by other factors. From these criteria and the reachability matrix *S*, barriers are classified into four quadrants (autonomous, dependent, linkage, and independent), which helps better understand how to manage or focus interventions to overcome the barriers. DR and DE are calculated according to the following equations (Jiang et al., 2019):

$$DR_i = \sum_{j=1}^{n} s_{ij} \quad i \in \{1,2,3,\dots,n\} \tag{23}$$

$$DE_j = \sum_{i=1}^{n} s_{ij} \quad j \in \{1,2,3,\dots,n\} \tag{24}$$

3.2. Data collection and samples

For the purpose of obtaining an assessment of the direct influence of pairwise barriers to financial inclusion, a total of twelve experts were consulted. Data collection involved consulting these experts through structured questionnaires and in-depth interviews to obtain their assessments of the direct influence among the identified barriers. The selection of these experts was based on a combination of factors, including their professional roles, areas of expertise, and contributions to the field of financial inclusion. We ensured a diversified representation by incorporating experts from the financial sector (including specialists in banking, fintech, and regulatory agencies) and academia. In particular, the expert panel consisted of a total of four academics specializing in finance and eight professionals from the financial industry. These have worked in recent years in several Spanish leading financial institutions, occupying relevant management positions. All experts interviewed have more than ten years of experience in the financial sector.

To validate their expertise, we reviewed their professional qualifications, published works, and participation in industry forums or policy-making activities. To ensure the validity and reliability of the data, we implemented measures such as triangulating perspectives by including both academics and industry professionals, conducting consistency checks on the experts' assessments, and assuring anonymity to encourage honest and unbiased responses. Although the reliance on expert judgments

introduces subjectivity, these steps help mitigate potential biases and enhance the credibility of the findings. To minimize selection bias, we employed a purposive sampling strategy and cross-referenced recommendations from multiple sources. These measures aimed to ensure a balanced and representative panel of experts.

The fieldwork was conducted between January and March 2024, during which we carried out interviews and collected data from the selected experts. Their expertise can, therefore, be relied upon to draw reliable conclusions on the barriers to financial inclusion. Table 4 summarizes the main characteristics of the selected experts.

Table 4. Main characteristics of the experts.

Expert characteristics	Percentage
Gender	
Female	41.67
Male	58.33
Educational background	
Bachelor	50
Master	16.67
PhD	33.33
Experience	
Between 10 and 15 years	25
Between 15 and 20 years	25
More than 20 years	50

4. Results

4.1. Fuzzy DEMATEL results

The first stage of the methodology involves collecting the responses of the different experts. Each expert was asked to identify the relationships between the different barriers, following the pattern shown in Table 2. By way of illustration, Table 5 shows the response obtained from one of the experts interviewed during this stage of the procedure.

Throughout Steps 2, 3, and 4 of the procedure, experts' responses were converted into fuzzy numbers. Upon calculation of the arithmetic mean of the twelve experts' responses and the resulting matrix normalization, the normalized fuzzy direct relationship matrix was obtained (Table 6).

The development of Steps 5 and 6 allowed obtaining the comprehensive influence matrix from the calculation and defuzzyfying the fuzzy total-relation matrix. The comprehensive influence matrix reflects the degree to which each barrier is affected by other barriers by means of crisp values (Table 7).

Next, Step 7 involved calculating the values of D, R, D+R, and D-R from the comprehensive influence matrix to obtain the cause-and-effect model (Table 8). D+R and D-R values were used to graphically represent the cause-and-effect digraph on the barriers to financial inclusion (Figure 2).

Table 5. Response from one of the experts interviewed.

	B01	B02	B03	B04	B05	B06	B07	B08	B09	B10	B11	B12	B13	B14	B15	B16
B01	0	5	2	2	1	1	1	1	1	1	1	1	1	1	1	1
B02	5	0	1	2	1	1	1	1	1	1	1	1	1	1	1	1
B03	4	4	0	3	4	1	1	1	1	1	1	1	1	1	1	1
B04	4	5	5	0	5	4	4	2	1	5	2	1	1	1	1	1
B05	3	2	2	4	0	1	1	1	1	4	5	1	1	5	1	1
B06	5	4	4	5	4	0	3	1	1	4	1	1	1	4	1	1
B07	3	1	1	1	1	1	0	4	3	4	4	2	1	1	1	1
B08	4	3	1	1	1	1	5	0	2	4	4	2	1	1	1	1
B09	3	3	1	1	1	1	5	4	0	4	3	1	1	1	1	1
B10	5	4	1	1	1	1	1	1	1	0	4	1	1	1	1	1
B11	5	4	1	1	1	1	1	1	1	4	0	1	1	1	1	1
B12	4	3	1	1	1	1	5	5	1	5	4	0	4	1	1	1
B13	4	4	4	3	4	3	5	5	1	4	3	5	0	5	1	1
B14	1	1	1	3	5	1	3	1	1	1	3	1	1	0	1	1
B15	5	5	4	2	3	3	4	4	3	4	4	5	5	3	0	5
B16	5	3	1	1	1	3	3	3	1	5	5	4	4	4	5	0

Table 6. Normalized fuzzy direct-relation matrix.

	B01	B02	B03	B04	B05	B06	B07	B08	B09	B10	B11	B12	B13	B14	B15	B16
B01	(0.00,0.00,0.00)	(0.04,0.07,0.08)	(0.02,0.04,0.06)	(0.01,0.03,0.05)	(0.01,0.02,0.04)	(0.01,0.03,0.05)	(0.01,0.01,0.04)	(0.01,0.02,0.04)	(0.01,0.03,0.05)	(0.02,0.04,0.05)	(0.02,0.03,0.05)	(0.00,0.01,0.03)	(0.00,0.01,0.03)	(0.01,0.01,0.03)	(0.01,0.02,0.04)	(0.02,0.04,0.05)
B02	(0.05,0.07,0.08)	(0.00,0.00,0.00)	(0.01,0.03,0.05)	(0.02,0.04,0.06)	(0.01,0.02,0.04)	(0.00,0.01,0.04)	(0.00,0.00,0.02)	(0.00,0.00,0.02)	(0.00,0.01,0.03)	(0.01,0.01,0.03)	(0.01,0.02,0.04)	(0.02,0.03,0.05)	(0.00,0.01,0.03)	(0.00,0.01,0.03)	(0.00,0.01,0.03)	(0.00,0.01,0.03)
B03	(0.04,0.06,0.07)	(0.03,0.05,0.06)	(0.00,0.00,0.00)	(0.01,0.03,0.05)	(0.02,0.03,0.05)	(0.00,0.01,0.03)	(0.00,0.00,0.02)	(0.01,0.01,0.03)	(0.00,0.00,0.02)	(0.01,0.02,0.04)	(0.02,0.03,0.05)	(0.01,0.01,0.03)	(0.02,0.04,0.05)	(0.00,0.00,0.02)	(0.00,0.01,0.03)	(0.01,0.02,0.04)
B04	(0.03,0.05,0.07)	(0.03,0.04,0.06)	(0.03,0.05,0.06)	(0.00,0.00,0.00)	(0.04,0.06,0.07)	(0.02,0.04,0.06)	(0.04,0.06,0.08)	(0.01,0.01,0.04)	(0.01,0.02,0.04)	(0.02,0.04,0.06)	(0.01,0.02,0.04)	(0.01,0.01,0.03)	(0.01,0.01,0.03)	(0.00,0.00,0.02)	(0.00,0.00,0.02)	(0.00,0.00,0.02)
B05	(0.01,0.04,0.05)	(0.01,0.02,0.04)	(0.01,0.02,0.04)	(0.04,0.06,0.07)	(0.00,0.00,0.00)	(0.01,0.02,0.04)	(0.01,0.01,0.03)	(0.00,0.00,0.02)	(0.00,0.00,0.02)	(0.01,0.02,0.04)	(0.01,0.03,0.05)	(0.00,0.00,0.02)	(0.01,0.01,0.03)	(0.03,0.05,0.06)	(0.00,0.00,0.02)	(0.00,0.00,0.02)
B06	(0.04,0.06,0.08)	(0.02,0.04,0.06)	(0.02,0.04,0.06)	(0.02,0.04,0.05)	(0.02,0.04,0.05)	(0.00,0.00,0.00)	(0.01,0.03,0.05)	(0.00,0.01,0.03)	(0.00,0.01,0.03)	(0.01,0.02,0.04)	(0.00,0.01,0.03)	(0.00,0.00,0.02)	(0.00,0.00,0.02)	(0.01,0.01,0.04)	(0.00,0.00,0.02)	(0.00,0.00,0.02)
B07	(0.02,0.04,0.06)	(0.01,0.01,0.03)	(0.00,0.00,0.02)	(0.01,0.03,0.05)	(0.01,0.01,0.03)	(0.00,0.01,0.03)	(0.00,0.00,0.00)	(0.04,0.06,0.07)	(0.04,0.06,0.07)	(0.02,0.04,0.05)	(0.02,0.03,0.05)	(0.03,0.05,0.07)	(0.03,0.05,0.06)	(0.00,0.01,0.03)	(0.01,0.02,0.04)	(0.00,0.01,0.03)

Continued on next page

	B01	B02	B03	B04	B05	B06	B07	B08	B09	B10	B11	B12	B13	B14	B15	B16
B08	(0.05,0.07,0.08)	(0.01,0.03,0.04)	(0.01,0.01,0.03)	(0.01,0.01,0.03)	(0.01,0.01,0.03)	(0.01,0.01,0.03)	(0.06,0.08,0.08)	(0.00,0.00,0.00)	(0.04,0.06,0.07)	(0.03,0.04,0.06)	(0.03,0.05,0.07)	(0.04,0.06,0.07)	(0.04,0.05,0.07)	(0.01,0.02,0.04)	(0.01,0.02,0.04)	(0.01,0.02,0.04)
B09	(0.03,0.05,0.06)	(0.01,0.03,0.04)	(0.00,0.00,0.02)	(0.00,0.01,0.03)	(0.00,0.00,0.02)	(0.01,0.01,0.04)	(0.06,0.08,0.08)	(0.05,0.07,0.08)	(0.00,0.00,0.00)	(0.03,0.04,0.06)	(0.02,0.04,0.06)	(0.01,0.01,0.03)	(0.01,0.03,0.04)	(0.01,0.02,0.04)	(0.01,0.02,0.04)	(0.01,0.02,0.04)
B10	(0.05,0.07,0.08)	(0.03,0.05,0.07)	(0.01,0.01,0.03)	(0.01,0.01,0.03)	(0.00,0.00,0.02)	(0.01,0.01,0.04)	(0.01,0.01,0.03)	(0.01,0.01,0.03)	(0.01,0.01,0.03)	(0.00,0.00,0.00)	(0.02,0.04,0.06)	(0.00,0.00,0.02)	(0.01,0.01,0.03)	(0.00,0.00,0.02)	(0.00,0.01,0.03)	(0.01,0.01,0.03)
B11	(0.06,0.08,0.08)	(0.05,0.07,0.08)	(0.02,0.04,0.05)	(0.01,0.01,0.03)	(0.00,0.01,0.03)	(0.01,0.01,0.03)	(0.01,0.01,0.03)	(0.00,0.01,0.03)	(0.02,0.03,0.05)	(0.03,0.05,0.07)	(0.00,0.00,0.00)	(0.02,0.03,0.05)	(0.03,0.05,0.06)	(0.00,0.00,0.02)	(0.01,0.01,0.03)	(0.01,0.03,0.05)
B12	(0.03,0.05,0.07)	(0.02,0.04,0.06)	(0.01,0.01,0.03)	(0.00,0.00,0.02)	(0.00,0.01,0.03)	(0.00,0.01,0.03)	(0.05,0.07,0.08)	(0.05,0.07,0.08)	(0.01,0.01,0.03)	(0.02,0.04,0.05)	(0.02,0.03,0.05)	(0.00,0.00,0.00)	(0.05,0.07,0.08)	(0.01,0.01,0.04)	(0.01,0.03,0.05)	(0.00,0.01,0.03)
B13	(0.04,0.06,0.07)	(0.01,0.03,0.05)	(0.03,0.05,0.06)	(0.01,0.01,0.04)	(0.03,0.05,0.06)	(0.01,0.03,0.05)	(0.05,0.07,0.08)	(0.05,0.07,0.08)	(0.01,0.03,0.04)	(0.03,0.04,0.06)	(0.03,0.05,0.07)	(0.06,0.08,0.08)	(0.00,0.00,0.00)	(0.03,0.04,0.06)	(0.02,0.04,0.05)	(0.02,0.04,0.05)
B14	(0.01,0.01,0.03)	(0.01,0.01,0.03)	(0.00,0.01,0.03)	(0.01,0.01,0.04)	(0.04,0.05,0.07)	(0.01,0.01,0.03)	(0.01,0.02,0.04)	(0.01,0.02,0.04)	(0.01,0.01,0.04)	(0.01,0.01,0.03)	(0.02,0.04,0.05)	(0.01,0.03,0.05)	(0.01,0.03,0.04)	(0.00,0.00,0.00)	(0.00,0.01,0.03)	(0.01,0.01,0.03)
B15	(0.02,0.04,0.05)	(0.02,0.04,0.06)	(0.02,0.03,0.05)	(0.00,0.01,0.03)	(0.01,0.03,0.04)	(0.01,0.02,0.04)	(0.03,0.04,0.06)	(0.03,0.04,0.06)	(0.02,0.04,0.05)	(0.03,0.04,0.06)	(0.02,0.04,0.06)	(0.03,0.04,0.06)	(0.06,0.08,0.08)	(0.01,0.02,0.04)	(0.00,0.00,0.00)	(0.05,0.07,0.08)
B16	(0.03,0.05,0.06)	(0.01,0.03,0.05)	(0.01,0.01,0.04)	(0.00,0.00,0.02)	(0.01,0.01,0.03)	(0.01,0.02,0.04)	(0.02,0.03,0.05)	(0.01,0.03,0.05)	(0.01,0.01,0.04)	(0.04,0.05,0.07)	(0.03,0.05,0.06)	(0.04,0.06,0.08)	(0.05,0.07,0.08)	(0.01,0.03,0.05)	(0.05,0.07,0.08)	(0.00,0.00,0.00)

Table 7. Comprehensive influence matrix.

	B01	B02	B03	B04	B05	B06	B07	B08	B09	B10	B11	B12	B13	B14	B15	B16
B01	0.052	0.099	0.063	0.053	0.048	0.052	0.051	0.052	0.055	0.07	0.069	0.04	0.043	0.036	0.044	0.059
B02	0.104	0.033	0.053	0.061	0.044	0.037	0.031	0.027	0.03	0.046	0.05	0.056	0.035	0.026	0.033	0.031
B03	0.097	0.082	0.026	0.051	0.058	0.033	0.034	0.041	0.026	0.053	0.065	0.043	0.063	0.022	0.029	0.043
B04	0.103	0.081	0.074	0.03	0.084	0.063	0.093	0.048	0.051	0.075	0.058	0.045	0.048	0.025	0.025	0.028
B05	0.073	0.053	0.045	0.077	0.023	0.043	0.042	0.024	0.023	0.049	0.056	0.025	0.039	0.061	0.018	0.022
B06	0.099	0.072	0.063	0.058	0.058	0.019	0.055	0.033	0.032	0.051	0.038	0.025	0.027	0.034	0.019	0.023
B07	0.095	0.061	0.037	0.053	0.044	0.037	0.045	0.091	0.084	0.076	0.075	0.087	0.084	0.033	0.049	0.039
B08	0.127	0.078	0.052	0.047	0.048	0.045	0.12	0.046	0.094	0.088	0.095	0.094	0.095	0.048	0.052	0.054
B09	0.1	0.07	0.034	0.038	0.032	0.042	0.113	0.099	0.034	0.081	0.08	0.053	0.066	0.043	0.047	0.05
B10	0.108	0.084	0.04	0.037	0.026	0.037	0.044	0.041	0.04	0.028	0.069	0.028	0.041	0.019	0.028	0.036
B11	0.128	0.106	0.066	0.044	0.038	0.042	0.054	0.047	0.063	0.089	0.041	0.068	0.081	0.027	0.042	0.056
B12	0.106	0.084	0.048	0.035	0.042	0.038	0.11	0.105	0.054	0.078	0.078	0.042	0.104	0.042	0.055	0.046
B13	0.126	0.086	0.084	0.054	0.082	0.06	0.119	0.111	0.069	0.093	0.104	0.118	0.055	0.07	0.068	0.07
B14	0.058	0.05	0.035	0.04	0.073	0.036	0.054	0.048	0.041	0.046	0.066	0.054	0.056	0.018	0.03	0.035
B15	0.104	0.091	0.071	0.044	0.062	0.053	0.091	0.086	0.072	0.09	0.09	0.086	0.119	0.05	0.034	0.096
B16	0.111	0.08	0.054	0.036	0.049	0.051	0.082	0.073	0.058	0.097	0.094	0.099	0.108	0.056	0.093	0.035

Table 8. Results of the cause-and-effect model.

	D	R	D + R	D - R
B01	0.886	1.59	2.476	-0.703
B02	0.697	1.21	1.907	-0.513
B03	0.764	0.846	1.61	-0.082
B04	0.931	0.758	1.689	0.173
B05	0.675	0.81	1.485	-0.135
B06	0.706	0.686	1.392	0.02
B07	0.99	1.139	2.129	-0.15
B08	1.183	0.973	2.156	0.21
B09	0.984	0.826	1.81	0.157
B10	0.703	1.109	1.811	-0.406
B11	0.99	1.129	2.119	-0.139
B12	1.067	0.963	2.03	0.104
B13	1.37	1.062	2.432	0.308
B14	0.739	0.609	1.348	0.131
B15	1.238	0.667	1.905	0.571
B16	1.176	0.723	1.899	0.454

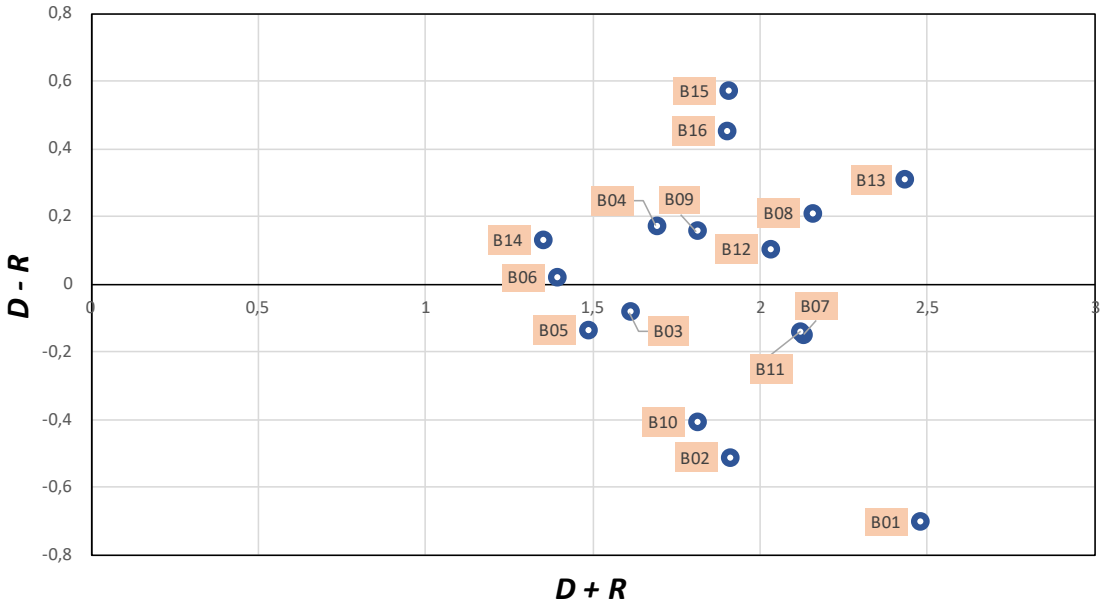

Figure 2. Cause-and-effect digraph on the barriers to financial inclusion.

4.2. ISM results

Following the application of the fuzzy DEMATEL method, the results of the ISM procedure, obtained in Steps 8, 9, and 10 of the methodology, are presented. Table 9 showcases the results of the holistic influence matrix derived from the comprehensive influence matrix. It encapsulates the comprehensive impact assessment among identified barriers to social inclusion and quantifies both

direct and indirect influences, providing a nuanced understanding of the interplay between these barriers and their collective impact on social inclusion efforts.

To generate the reachability matrix, it is crucial to set a significant threshold value based on the holistic influence matrix. This threshold was determined based on the consensus of the experts involved in our study. We presented the experts with alternative threshold values and conducted sensitivity tests to assess the impact of each threshold on our analysis. The experts evaluated each option by considering how the threshold affected the consistency, robustness, and interpretability of the resulting network structure. Specifically, they assessed whether each threshold appropriately distinguished significant relationships between factors without overestimating or underestimating the connections. After careful evaluation and sensitivity testing, the experts agreed that a threshold of 0.07 provided the most consistent network structure for our analysis of financial inclusion barriers. Table 10 illustrates the reachability matrix derived after applying this specific criterion.

In the final stage of the ISM procedure, the hierarchical structure of the barriers is established, aligning with the methodology outlined in Step 10. This step conclusively determines the layered positioning of each barrier, providing a strategic framework for addressing them systematically (Table 11).

To enhance the comprehensibility of these findings, data from Table 11 were transformed into a visual depiction, illustrating the hierarchical structure of the barriers to financial inclusion. This is presented in Figure 3. The four levels obtained can be described as follows: Level 1 represents surface direct barriers, referring to the most visible and accessible barriers in the analysis. They are the first to be encountered and are generally the simplest to identify. Level 2 represents emerging barriers, implying those that start to become evident after the more superficial ones have been considered. These may possess a more complex nature and could indicate underlying issues that necessitate deeper exploration. Level 3 represents middle root barriers, representing those that are more deeply ingrained in the structure of financial inclusion but are not the deepest. They represent intermediate issues that require a more detailed understanding of systems and behaviors. Finally, Level 4 represents deep root barriers, representing the most fundamental and challenging-to-alter barriers. These are deeply intrinsic to the system or structure of financial inclusion and require long-term solutions and significant structural changes.

Table 9. Holistic influence matrix.

	B01	B02	B03	B04	B05	B06	B07	B08	B09	B10	B11	B12	B13	B14	B15	B16
B01	1.052	0.099	0.063	0.053	0.048	0.052	0.051	0.052	0.055	0.07	0.069	0.04	0.043	0.036	0.044	0.059
B02	0.104	1.033	0.053	0.061	0.044	0.037	0.031	0.027	0.03	0.046	0.05	0.056	0.035	0.026	0.033	0.031
B03	0.097	0.082	1.026	0.051	0.058	0.033	0.034	0.041	0.026	0.053	0.065	0.043	0.063	0.022	0.029	0.043
B04	0.103	0.081	0.074	1.03	0.084	0.063	0.093	0.048	0.051	0.075	0.058	0.045	0.048	0.025	0.025	0.028
B05	0.073	0.053	0.045	0.077	1.023	0.043	0.042	0.024	0.023	0.049	0.056	0.025	0.039	0.061	0.018	0.022
B06	0.099	0.072	0.063	0.058	0.058	1.019	0.055	0.033	0.032	0.051	0.038	0.025	0.027	0.034	0.019	0.023
B07	0.095	0.061	0.037	0.053	0.044	0.037	1.045	0.091	0.084	0.076	0.075	0.087	0.084	0.033	0.049	0.039
B08	0.127	0.078	0.052	0.047	0.048	0.045	0.12	1.046	0.094	0.088	0.095	0.094	0.095	0.048	0.052	0.054
B09	0.1	0.07	0.034	0.038	0.032	0.042	0.113	0.099	1.034	0.081	0.08	0.053	0.066	0.043	0.047	0.05
B10	0.108	0.084	0.04	0.037	0.026	0.037	0.044	0.041	0.04	1.028	0.069	0.028	0.041	0.019	0.028	0.036
B11	0.128	0.106	0.066	0.044	0.038	0.042	0.054	0.047	0.063	0.089	1.041	0.068	0.081	0.027	0.042	0.056
B12	0.106	0.084	0.048	0.035	0.042	0.038	0.11	0.105	0.054	0.078	0.078	1.042	0.104	0.042	0.055	0.046
B13	0.126	0.086	0.084	0.054	0.082	0.06	0.119	0.111	0.069	0.093	0.104	0.118	1.055	0.07	0.068	0.07
B14	0.058	0.05	0.035	0.04	0.073	0.036	0.054	0.048	0.041	0.046	0.066	0.054	0.056	1.018	0.03	0.035
B15	0.104	0.091	0.071	0.044	0.062	0.053	0.091	0.086	0.072	0.09	0.09	0.086	0.119	0.05	1.034	0.096
B16	0.111	0.08	0.054	0.036	0.049	0.051	0.082	0.073	0.058	0.097	0.094	0.099	0.108	0.056	0.093	1.035

Table 10. Reachability matrix.

	B01	B02	B03	B04	B05	B06	B07	B08	B09	B10	B11	B12	B13	B14	B15	B16	DR
B01	1	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	3
B02	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
B03	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	3
B04	1	1	1	1	1	0	1	0	0	1	0	0	0	0	0	0	7
B05	1	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	3
B06	1	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	3
B07	1	0	0	0	0	0	1	1	1	1	1	1	1	0	0	0	8
B08	1	1	0	0	0	0	1	1	1	1	1	1	1	0	0	0	9
B09	1	1	0	0	0	0	1	1	1	1	1	0	0	0	0	0	7
B10	1	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	3
B11	1	1	0	0	0	0	0	0	0	1	1	0	1	0	0	0	5
B12	1	1	0	0	0	0	1	1	0	1	1	1	1	0	0	0	8
B13	1	1	1	0	1	0	1	1	0	1	1	1	1	1	0	1	12
B14	0	0	0	0	1	0	0	0	0	0	0	0	0	1	0	0	2
B15	1	1	1	0	0	0	1	1	1	1	1	1	1	0	1	1	12
B16	1	1	0	0	0	0	1	1	0	1	1	1	1	0	1	1	10
DE	15	13	4	2	4	1	8	7	4	11	8	6	7	2	2	3	

Table 11. Level partition of the ISM model.

	P(ai)	T(ai)	Q(ai)	Level
B01	01, 02, 10	01, 02, 03, 04, 05, 06, 07, 08, 09, 10, 11, 12, 13, 15, 16	01, 02, 10	1
B02	01, 02	01, 02, 03, 04, 06, 08, 09, 10, 11, 12, 13, 15, 16	01, 02	1
B03	01, 02, 03	03, 04, 13, 15	03	2
B04	01, 02, 03, 04, 05, 07, 10	04, 05	04, 05	4
B05	01, 04, 05	04, 05, 13, 14	04, 05	2
B06	01, 02, 06	06	06	2
B07	01, 07, 08, 09, 10, 11, 12, 13	04, 07, 08, 09, 12, 13, 15, 16	07, 08, 09, 12, 13	3
B08	01, 02, 07, 08, 09, 10, 11, 12, 13	07, 08, 09, 12, 13, 15, 16	07, 08, 09, 12, 13	3
B09	01, 02, 07, 08, 09, 10, 11	07, 08, 09, 15	07, 08, 09	3
B10	01, 02, 10	01, 04, 07, 08, 09, 10, 11, 12, 13, 15, 16	01, 10	2
B11	01, 02, 10, 11, 13	07, 08, 09, 11, 12, 13, 15, 16	11, 13	2
B12	01, 02, 07, 08, 10, 11, 12, 13	07, 08, 12, 13, 15, 16	07, 08, 12, 13	3
B13	01, 02, 03, 05, 07, 08, 10, 11, 12, 13, 14, 16	07, 08, 11, 12, 13, 15, 16	07, 08, 11, 12, 13, 16	4
B14	05, 14	13, 14	14	3
B15	01, 02, 03, 07, 08, 09, 10, 11, 12, 13, 15, 16	15, 16	15, 16	4
B16	01, 02, 07, 08, 10, 11, 12, 13, 15, 16	13, 15, 16	13, 15, 16	4

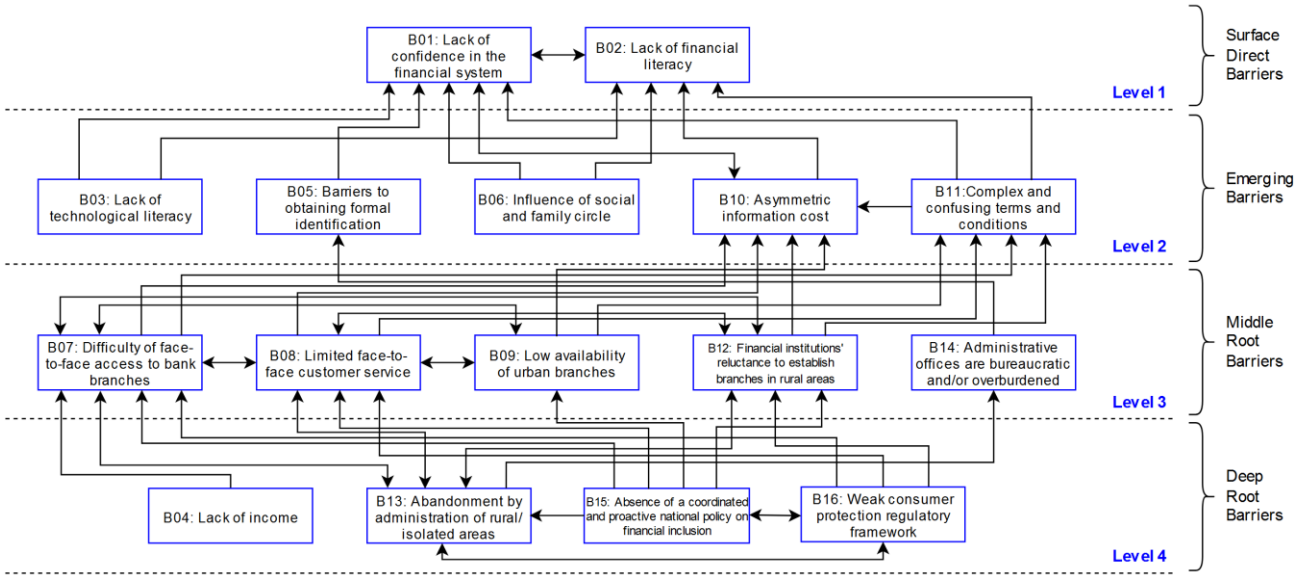

Figure 3. Hierarchical structure of the barriers to financial inclusion.

4.3. MICMAC analysis results

Wrapping up the entire procedural development, the DE and DR values derived from Table 10 facilitate the identification of dependence and driving forces for the MICMAC analysis. Leveraging this data, the barriers can be categorized into the four quadrants outlined in the methodology. Figure 4 provides a meaningful representation of the clusters derived from this analysis.

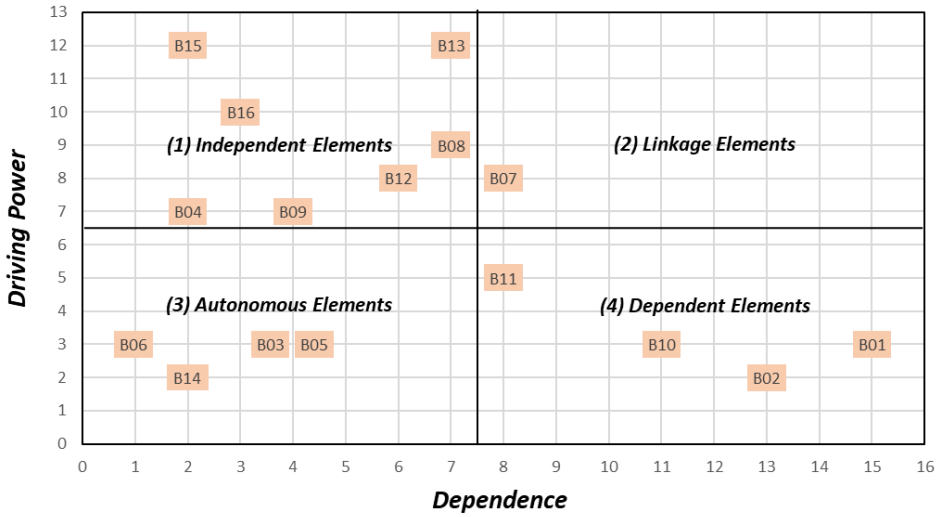

Figure 4. Clustering of the barriers to financial inclusion based on MICMAC analysis.

5. Discussion

The results obtained from the application of the combined fuzzy DEMATEL–ISM–MICMAC approach underscore the importance of specific obstacles that hinder financial inclusion in developed countries. The highlighted barriers are: "Absence of coordinated and proactive national policy and strategy on financial inclusion" (B15), "Weak consumer protection regulatory framework" (B16), "Abandonment by administration of rural/isolated areas" (B13), "Limited face-to-face customer service" (B08), "Lack of income" (B04), "Low availability of urban bank branches" (B09), and "Financial institutions' reluctance to establish branches in rural areas" (B12). These barriers cover, although not all with the same intensity, the three dimensions explored (demand, supply, and institutional/regulatory barriers), standing out as the most impactful, profoundly affecting all other identified barriers. Referred to as causal barriers, they are located in the first quadrant of Figure 4 and span the lower two tiers of the hierarchical model presented in Figure 3. This placement underscores their critical role within the established hierarchical framework.

Focusing on the ISM results, barrier B15 influences higher-level barriers B07, B08, B09, B12, and B16. Simultaneously, it influences barriers at the same level such as B13 and B16. The latter also influences B15, creating a reciprocal relationship between them. Conversely, barrier B04 does not receive any influence from other barriers, yet it exerts a meaningful impact on barriers at levels 3 and 2, as illustrated in Figure 3 and Table 10. These four specific barriers—B04, B13, B15, and B16—located at the fourth level of the hierarchical model (Figure 3), are identified in this methodology as

having the most significant influence over the entire system. This aligns with prior research indicating that these barriers are key challenges in achieving financial inclusion in developed economies. For instance, several contributions in different contexts of developed economies, such as the UK (Devlin, 2009), 18 Eastern European countries and 5 Western European economies (Corrado & Corrado, 2015), or Spain (Fernández-Olit et al., 2018) highlighted household income as a key variable in explaining financial exclusion. Similarly, studies from diverse developed economies like the UK (McKillop et al., 2007, 2011; Prabhakar, 2013), along with broader analyses (Figart, 2013; Marron, 2013; Sinclair, 2013, 2014; Berry, 2015), underline the crucial influence of regulatory changes, government strategies, and policy initiatives on financial inclusion. Finally, research conducted in developed nations, including Spain and Poland, underscores the issues of financial inclusion present in rural areas due to the absence of private investments and the lack of supportive policies from the government in these regions (Náñez Alonso et al., 2022, 2023; Alonso et al., 2023).

Barriers at the third level of the ISM hierarchical model represent intermediate challenges that are significantly influenced by more fundamental underlying issues identified in level 4 of our model. Despite this, these barriers continue to have a profound impact on the system's higher-level challenges, warranting close attention.

Primarily, these barriers are sustained by the difficulties that clients from developed countries face in accessing banking services due to limited operating hours or the low availability of branches in both urban and rural contexts (barriers B07, B08, B09, and B12). According to Alamá & Tortosa-Ausina (2012), in recent years, there has been a significant reduction in the number of bank branches in Spain, particularly following the economic and financial crisis that began in 2008. This decline in bank branches has been more pronounced in smaller and socioeconomically lower-level populations, potentially exacerbating financial exclusion in these areas. Similar to the situation in Spain, the United States has also experienced a notable reduction in the number of bank branches, especially affecting rural areas and those with lower socioeconomic levels. In New York City, for example, according to the Association for Neighborhood & Housing Development, over a quarter of bank branch closures between 2011 and 2020 occurred in low- and moderate-income census tracts, significantly impacting communities historically marginalized from financial services. According to our results, these four barriers have a causal effect on two of the barriers of the second level of the hierarchical mode (barriers B10 and B11). In this regard, the reduction in the number of bank branches clearly hinders face-to-face service and eventually the clients' understanding of the increasingly complex terms and conditions of banking products, as well as access to better credit terms (Broady, et al., 2021). Similarly, this reduction also hampers the accumulation of credit histories and other financial data on clients, contributing to information asymmetry because banks have fewer data available to assess the credit risk of these clients. Additionally, bank branches often serve as financial education hubs, where clients can learn about financial products and money management. The reduction of branches may limit these opportunities, leaving some clients with less knowledge on how to manage their finances or how banking products can benefit them, thus also producing an information asymmetry cost (Cole et al., 2011).

Parallel to these obstacles, and from a governmental perspective, the remaining barrier at the third level of the hierarchical model (B14) addresses the existing issue linked to the overburdened state of administrative offices which, according to our results, also contributes to the challenges that many individuals, particularly immigrants in developed countries, face in obtaining the necessary formal identification to utilize financial services (B05). In this regard, Chishti & Gelatt (2022) detail how the

United States immigration court system is overwhelmed by a record number of pending cases, illustrating inefficiencies and administrative overload in processing immigrant documentation. This backlog can severely delay immigrants' ability to obtain the legal documents required to access financial services and other essential services.

Barriers at level two of the hierarchical model represent emerging demand and supply-side issues that are gaining visibility and may be influenced by barriers from lower levels. First, in a society increasingly dependent on technology, the Internet, and the services provided through it by companies, the lack of technological skills among financial product users (B03) can significantly affect access to these services and lead to financial exclusion (Anheier & Juergensmeyer, 2012). This barrier is influenced only by barriers at level four of the hierarchical model. Specifically, according to Table 10, a lack of income, coupled with government inaction or inadequate policies, leads to technological illiteracy, which in turn causes deficiencies in financial literacy (B02) and trust in the financial system (B01).

Furthermore, according to Atkinson & Messy (2012), legal issues (B05) cause countless inconveniences for users in accessing financial services. For example, the lack of formal identification necessary to acquire financial products, such as residency cards, can delay immigrants from acquiring financial products in developed countries, which, according to our results, can lead to a loss of confidence in the financial system (B01).

Additionally, the influence of the family circle (B06) functions as an independent factor in the system, unaffected by any of the barriers analyzed. The family context helps shape consumer perceptions related to the financial system in developed countries, thus contributing to their financial education (Mandell, 2008; Jorgensen & Savla, 2010). Our results confirm these arguments, demonstrating the direct causal relationship between this factor and consumers' confidence in the financial system, as well as the financial literacy they acquire.

The presence of asymmetric information costs (B10) and complex, confusing terms and conditions attached to products (B11) are the final two barriers at the third level. Our results confirm the influence of these supply-side barriers on consumer confidence in the financial system (B01), aligning with studies in the European context that highlight the positive effect of offline service perception and customer orientation on brand trust in the banking sector, such as Van Esterik-Plasmeijer & Van Raaij (2017) and Bravo et al. (2019). In this context, users' difficulties in understanding the terms and conditions of various products, coupled with the feeling of lacking all necessary information for decision-making, clearly erodes confidence in financial institutions. Our results also confirm the direct influence of these two barriers on consumers' financial literacy. Thus, the lack of better information management by institutions and its availability to consumers significantly affects the level of financial knowledge acquired by financial service consumers. As Fort et al. (2016) suggest from a study in the Italian banking context, financial institutions have a significant role in fostering the accumulation of financial knowledge by customers.

Finally, the two barriers located at the first level of the hierarchical model, the lack of confidence in the financial system (B01) and the lack of financial literacy (B02), represent demand-side barriers. They are the most visible and accessible barriers in our analysis in developed countries, having been extensively studied in the literature (Tully & Bassett, 2010; Atkinson & Messy, 2012; Basaran & Bagheri, 2020; Lamboglia & Stacchini, 2022). Despite this visibility, their presence, according to our model, is dependent on a myriad of barriers that exist at lower levels. On the other hand, these two barriers are fed back, generating a mutually reinforcing effect.

As a final remark, it is important to note the relevant role that emerging financial technologies, such as social currencies, central bank digital currencies (CBDCs), and instant payment systems, are increasingly playing in the landscape of financial inclusion in developed countries. These innovations have the potential to modify existing barriers and create new opportunities for financial inclusion. For example, CBDCs and fintech solutions can provide alternative channels for accessing financial services, potentially alleviating barriers related to limited physical banking infrastructure (barriers B08, B09, and B12) and enhancing access for underserved populations (Lannquist & Tan, 2023; Ediagbonya & Tioluwani, 2023; Nnaomah et al., 2024). Social currencies can foster community-based financial ecosystems, which may help address issues of trust in the financial system (B01) and financial literacy (B02) by promoting local engagement and education (Albert et al., 2024).

However, the adoption of these technologies also presents new challenges. Technological literacy (B03) becomes even more critical, as individuals need the skills to navigate digital platforms (Falaiye et al., 2024; Salleh et al., 2024). Additionally, regulatory barriers (B15 and B16) may arise due to the need for updated frameworks to govern these new forms of digital money (Ozili & Alonso, 2024). Without coordinated and proactive national policies, there is a risk that these technologies could exacerbate existing inequalities or create new forms of exclusion.

Therefore, while emerging financial technologies offer promising avenues to enhance financial inclusion, they must be integrated thoughtfully into existing financial ecosystems. Policymakers and financial institutions should work collaboratively to ensure that these technologies are accessible and secure and effectively address the barriers identified in our study. By doing so, they can contribute to a more inclusive financial environment that benefits all segments of the population.

6. Conclusions and limitations

This study enhances the discourse on financial inclusion within developed countries, challenging the prevailing belief that high-income economies automatically offer financial inclusivity. A thorough examination of the barriers to financial inclusion was carried out using the fuzzy DEMATEL-ISM-MICMAC methodology, revealing that these barriers are not only economic but also deeply rooted in social, cultural, and systemic factors. More specifically, the results reveal that the causal network facilitating financial inclusion in developed countries is sustained by a set of factors closely related to the institutional area (B13, B15, and B16), the supply area (B08, B09, and B12), and, to a lesser extent, the demand area (B04). As the hierarchical model progresses from the most significant to less significant levels, the focus shifts from barriers rooted in institutional- and supply-side aspects to more visible barriers on the customer side. However, these do not reflect the underlying cause of the problem. These findings contribute to the theoretical understanding of financial inclusion by highlighting the foundational role of institutional- and supply-side barriers in developed economies. They suggest that traditional models focusing predominantly on demand-side factors may be insufficient to fully explain financial exclusion in high-income countries.

Our study corroborates the results of previous research in developed countries. In this sense, contributions such as Anderloni & Carluccio (2007), Figart (2013), and Chen & Divanbeigi (2019) pointed to the importance of institutional aspects in the financial inclusion of individuals and firms. On the other hand, De la Cuesta González et al. (2016) and Fernández-Olit et al. (2019) revealed the relevant influence of supply-side aspects in financial inclusion processes. In this line, Imaeva et al.

(2014) and Grohmann & Menkhoff (2021) underlined that, in developed countries, demand-side aspects are relevant but depend on other areas.

The comparison of our findings with those from studies conducted in developing or emerging economies yields insightful conclusions. Most studies in these regions concentrate on demand-side factors, as evidenced by Hoyo et al. (2013) in Mexico and Bekele (2023) in Ethiopia and Kenya, or on both demand and supply sides, as illustrated by Kumar (2013) in India. Furthermore, contributions related to institutional aspects in developing countries are limited and predominantly focus on political stability and corruption, as noted by Nsiah & Tweneboah (2023). In contrast to these studies, which address barriers in isolation, our approach elucidates complex causality and offers a strategic framework for collectively addressing these barriers. Consequently, it would be beneficial to analyze these contexts using MCDM methods, as employed in this study, to enhance the understanding of the problem and facilitate more effective comparisons.

All in all, we honestly believe that this work takes a step beyond the existing literature by shedding light on the possible causality structure between barriers to financial inclusion in the often-neglected context of developed countries. From a theoretical standpoint, by integrating methodologies that map the dynamics between the various barriers, we enhance the conceptual framework and provide a basis for interventions that can effectively address multiple barriers simultaneously, challenging the conventional siloed analysis of financial inclusion and promoting a more holistic perspective that considers the interplay between different factors.

Complementing the theoretical contribution of this research, this paper provides relevant implications for financial institution managers and policymakers in designing comprehensive policies aimed at improving financial inclusion. In this regard, our study offers evidence-based guidance for developing policies that coherently address multiple barriers, thereby enhancing the effectiveness of financial inclusion initiatives. While our findings align with the objectives of current policies such as the OECD's principles on financial consumer protection and the EU's initiatives on digital finance, they suggest that greater emphasis should be placed on reforming institutional frameworks and enhancing supply-side offerings.

First, establishing a comprehensive national financial inclusion strategy is essential. This strategy should coordinate the efforts of government agencies, financial institutions, and non-governmental organizations to identify pockets of financial exclusion and develop targeted initiatives that address specific regional and demographic needs. For instance, policymakers could introduce regulatory reforms that simplify compliance procedures for financial institutions, encouraging them to expand services to underserved areas. Moreover, aligning with current policies such as the European Commission's Action Plan on Anti-Money Laundering, simplifying regulatory burdens could reduce operational costs for banks, allowing them to offer more affordable products. This would allow for establishing a proactive framework to address other barriers, such as consumer protection and access to services in rural areas. In this context, launching public awareness campaigns on consumer rights**,** implementing transparency initiatives, establishing customer feedback mechanisms, and providing responsive customer service can increase consumer confidence in the financial system, thereby reducing the impact of asymmetric information costs and complex product conditions. Rebuilding trust is imperative, and financial institutions and regulators should collaborate to enhance consumer protection frameworks and ensure ethical practices.

At the institutional level, it is crucial to address the lack of technological skills among consumers to prevent financial exclusion caused by the digital divide. Policymakers and financial institutions should invest in programs that enhance digital literacy, especially among vulnerable populations such as the elderly and low-income households. This could involve community workshops, online tutorials, and partnerships with educational institutions to provide training on using digital financial services. In addition, recognizing the influence of the family circle on financial perceptions and behaviors and engaging families and communities in financial education programs could leverage social dynamics to promote better financial habits and increase confidence in the financial system.

Similarly, institutions should allocate resources and implement policies to improve financial services in rural and isolated areas, providing incentives for financial institutions to operate in underserved regions and ensuring connectivity and technological infrastructure to support digital banking. This could involve leveraging existing initiatives, such as the European Commission's Digital Finance Strategy, to enhance connectivity and promote digital financial services in remote areas. Additionally, streamlining administrative processes to obtain necessary formal identification documents is vital, particularly for immigrants and marginalized groups. Governments should consider simplifying the procedures for obtaining identification and legal documentation required to access financial services, thus reducing barriers and promoting greater inclusion.

In the same vein, on the supply side, financial institutions should utilize government incentives to establish branches in underserved areas and implement flexible banking hours to meet the diverse needs of customers. Additionally, they should develop financial products tailored to low-income households and offer financial education programs. They should also focus on simplifying product terms and conditions and enhancing transparency to reduce asymmetric information costs to improve consumer understanding and trust. Implementing standardized disclosure practices and using plain language in communications can make financial products more accessible to a broader audience. On the other hand, financial institutions could collaborate with fintech companies to develop innovative digital solutions that lower transaction costs and increase accessibility. Initiatives such as the European Commission's Digital Finance Strategy provide a framework for fostering such collaborations. Additionally, implementing programs in line with the United States National Strategy for Financial Literacy could enhance financial education and consumer engagement, ensuring these innovations are both effective and secure. This includes creating affordable and accessible financial products, establishing agreements with community organizations to provide financial education, and implementing microfinance initiatives to support low-income entrepreneurs.

Our work is not without limitations. In this sense, we acknowledge that our study could be strengthened by incorporating a more diverse set of variables, such as psychological barriers or more granular socioeconomic data. Moreover, the reliance on the fuzzy DEMATEL-ISM-MICMAC methodology, while robust, presents limitations in its capacity to capture temporal dynamics between variables, which may restrict understanding of how barriers evolve in different financial and regulatory contexts. We also acknowledge the limitations of our geographically constrained sample size, which may affect the generalizability of the findings. Additionally, we recognize that the experts consulted may not fully represent the perspectives of populations directly affected by financial exclusion, such as marginalized or rural communities, potentially limiting the comprehensiveness of the insights into the barriers these groups face.

Future studies could integrate qualitative methods to enrich the findings. Expanding the expert panel to include representatives from marginalized communities and directly affected populations could provide more diverse insights, and the use of qualitative methods such as interviews or focus groups could offer a more holistic understanding of the barriers to financial inclusion. Additionally, a longitudinal approach could reveal how the influence of these barriers evolves over time, providing a dynamic and more robust view of the challenges of financial inclusion. Such a longitudinal perspective would allow for tracking the impact of specific policies or developments in digital financial infrastructure on reducing barriers over time.

Furthermore, this study opens avenues for future research to further explore individual barriers, particularly how emerging digital financial services could mitigate some of these challenges. Future research could also examine the role of cryptocurrencies and blockchain technologies as tools for enhancing financial access. Experimental studies or pilot programs evaluating these technologies in specific regions could provide empirical insights into their effectiveness in reducing financial barriers**.** Comparative studies across different developed countries could highlight unique national challenges and opportunities, offering a broader perspective on the strategies needed to foster financial inclusion globally. Similarly, extending the study to emerging economies with varying regulatory landscapes could reveal unique dynamics and offer guidance for global policy adaptation. In that sense, to replicate the study in emerging economies, the initial steps of the methodology should involve a thorough review and adaptation of the barriers identified, as specific challenges to financial inclusion, such as lower digital infrastructure (Ozili, 2020b) or high levels of informality (Allen et al., 2016), are often more pronounced or take different forms in these contexts. Incorporating such tailored barriers can provide a more accurate and contextually relevant analysis of these economies.

In conclusion, our work charts the landscape of financial barriers in developed countries and lays the groundwork for more holistic and integrated approaches to overcoming these obstacles. Our findings contribute to academic discourse and offer actionable insights for policymakers and practitioners committed to advancing financial inclusion in developed economies. By pioneering a methodological framework that offers new avenues for both theoretical exploration and practical policymaking, we aim to achieve a more financially inclusive global economy.

Author contributions

Jordi Capó Vicedo: concept development and study design; data collection; data analysis and interpretation; draft of article preparation; critical revision of the article for important intellectual content. José Vicente Tomás Miquel: concept development and study design; data collection; data analysis and interpretation; draft of article preparation; critical revision of the article for important intellectual content.

Use of AI tools declaration

The authors declare they have not used Artificial Intelligence (AI) tools in the creation of this article.

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Conflict of interest

All authors declare no conflicts of interest in this paper.

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