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Digital Banking Adoption and Financial Inclusion in Vietnam: A Multi-Dimensional Analysis of User Perceptions and Socioeconomic Factors

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ABSTRACT: This study investigates the factors influencing digital banking adoption intention and its impact on perceived financial inclusion. By integrating the Technology Acceptance Model with trust theories and digital literacy concepts, we develop a comprehensive framework to understand the complex relationships among these variables. The research employs a mixed-method approach, combining structural equation modeling (SEM) and fuzzy-set qualitative comparative analysis (fsQCA) to analyze survey data from 587 respondents. Results from SEM reveal that perceived usefulness, perceived ease of use, institutional trust, technological trust, and social influence significantly affect digital banking adoption intention, which in turn positively influences perceived financial inclusion. Digital literacy moderates the relationships between perceived ease of use and adoption intention, as well as between technological trust and adoption intention. The fsQCA results complement these findings by identifying multiple configurations leading to high adoption intention and perceived financial inclusion, highlighting the equifinal nature of these relationships. This study contributes to the literature by providing a nuanced understanding of digital banking adoption and its link to financial inclusion, offering valuable insights for policymakers and financial institutions. The findings underscore the importance of enhancing perceived usefulness, ease of use, trust, and digital literacy to promote digital banking adoption and, consequently, financial inclusion.

KEYWORDS: Digital banking adoption, financial inclusion, technology acceptance model, trust, fuzzy-set qualitative comparative analysis

1. INTRODUCTION

The rapid proliferation of digital technologies has fundamentally transformed the global financial landscape, ushering in an era of unprecedented accessibility and efficiency in banking services. Digital banking, encompassing a broad spectrum of electronic financial services, has emerged as a pivotal force in driving financial inclusion and economic development worldwide (Ozili, 2018). This technological revolution in finance holds particular significance for emerging economies, where traditional banking infrastructure often falls short of meeting the needs of underserved populations (Demirgüç-Kunt et al., 2018).

Within this context, Vietnam presents a compelling case study. As one of Southeast Asia's fastest-growing economies, Vietnam has witnessed a remarkable surge in digital adoption across various sectors, with the financial services industry at the forefront of this transformation (Nguyen et al., 2020). The intersection of digital banking and financial inclusion in Vietnam offers a rich terrain for academic inquiry, promising insights that could inform both theory and practice in the broader field of financial technology and development economics.

The extant literature has extensively examined the technical aspects of digital banking adoption (Lee et al., 2019) and the macroeconomic implications of financial inclusion (Beck et al., 2007). However, there remains a critical gap in the understanding of how user perceptions and socioeconomic factors interplay to influence digital banking adoption and, consequently, financial inclusion. This gap is particularly pronounced in the context of emerging economies like Vietnam, where rapid technological advancement often outpaces societal adaptation (Tran and Corner, 2016).

This study aims to address this lacuna by conducting a multi-dimensional analysis of digital banking adoption and its impact on financial inclusion in Vietnam. By integrating user perceptions with socioeconomic factors, it offers a more nuanced and

comprehensive understanding of the dynamics at play. This approach not only contributes to the theoretical discourse on technology adoption in finance but also provides valuable insights for policymakers and industry practitioners seeking to enhance financial inclusion through digital means.

The novelty of this research lies in its holistic approach, which synthesises perspectives from finance, technology adoption, and development economics. By examining the intricate relationships between user perceptions, socioeconomic variables, and digital banking adoption, it moves beyond the traditional binary focus on either supply-side or demand-side factors. Instead, it proposes a more sophisticated model that captures the complex interplay of these elements within the unique socio-economic fabric of Vietnam.

Furthermore, this study makes a significant contribution by extending the Technology Acceptance Model (TAM) (Davis, 1989) and the Unified Theory of Acceptance and Use of Technology (UTAUT) (Venkatesh et al., 2003) to incorporate cultural and socioeconomic dimensions specific to emerging markets. This theoretical innovation not only enhances the understanding of technology adoption in diverse cultural contexts but also paves the way for more nuanced policy interventions aimed at promoting financial inclusion.

The implications of this research extend far beyond the borders of Vietnam. As developing nations worldwide grapple with the challenges of financial inclusion and digital transformation, the findings offer valuable insights that can inform policy formulation and implementation. Moreover, by illuminating the complex dynamics of digital banking adoption in an emerging market context, this study contributes to the broader academic discourse on the role of financial technology in fostering inclusive economic growth.

This research stands at the intersection of critical global trends – digitalisation, financial inclusion, and economic development. By providing a multi-dimensional analysis of digital banking adoption and its implications for financial inclusion in Vietnam, it not only addresses a significant gap in the literature but also offers actionable insights for policymakers and practitioners. As the world increasingly recognises the transformative potential of digital finance, studies such as this play a crucial role in ensuring that this potential is realised in a manner that is both effective and inclusive.

2. LITERATURE REVIEW

2.1. Theoretical Foundations

The adoption of digital banking and its impact on financial inclusion can be understood through several well-established theoretical frameworks. This section examines three key theories that provide the foundation for understanding technology adoption in the context of digital banking: the Technology Acceptance Model (TAM), the Unified Theory of Acceptance and Use of Technology (UTAUT), and the Diffusion of Innovation Theory (DOI).

2.1.1. Technology Acceptance Model (TAM)

The Technology Acceptance Model, introduced by Davis (1989), has been widely used to explain user acceptance of new technologies. TAM posits that perceived usefulness and perceived ease of use are the primary determinants of an individual's intention to use a new technology. In the context of digital banking, numerous studies have applied TAM to understand user adoption behaviours. For instance, Pikkarainen et al. (2004) found that perceived usefulness was a strong predictor of online banking adoption in Finland. Similarly, Wang et al. (2003) extended TAM to include perceived credibility as an additional factor influencing the adoption of internet banking services in Taiwan.

However, while TAM provides a solid foundation for understanding technology adoption, it has limitations in capturing the full complexity of digital banking adoption, particularly in diverse cultural contexts. Researchers have noted that TAM may oversimplify the adoption process and fail to account for social and cultural factors that are particularly relevant in emerging economies (Bagozzi, 2007).

2.1.2. Unified Theory of Acceptance and Use of Technology (UTAUT)

To address some of the limitations of TAM, Venkatesh et al. (2003) proposed the Unified Theory of Acceptance and Use of Technology (UTAUT). This model integrates elements from eight prominent technology acceptance theories, including TAM, and introduces four key constructs: performance expectancy, effort expectancy, social influence, and facilitating conditions. UTAUT also considers moderating factors such as age, gender, experience, and voluntariness of use. UTAUT has been applied extensively in digital banking research. For example, Martins et al. (2014) used UTAUT to study internet banking adoption in Portugal, finding that performance expectancy, effort expectancy, and social influence were significant predictors of behavioural intention. In the context of mobile banking, Yu (2012) applied UTAUT to examine adoption behaviour in Taiwan, revealing that social influence played a crucial role in shaping user intentions. Despite its comprehensive nature, UTAUT has been criticised for its complexity and the potential for multicollinearity among its constructs (Bagozzi, 2007). Moreover, like TAM, UTAUT may not fully capture the nuances of technology adoption in diverse cultural settings, particularly in emerging economies like Vietnam.

2.1.3. Diffusion of Innovation Theory (DOI)

The Diffusion of Innovation Theory, developed by Rogers (2003), offers a broader perspective on how new ideas and technologies spread within a social system. DOI identifies five key attributes that influence the adoption of an innovation: relative advantage, compatibility, complexity, trialability, and observability. Additionally, DOI categorises adopters into five groups based on their innovativeness: innovators, early adopters, early majority, late majority, and laggards. In the context of digital banking, DOI has been used to explain the diffusion of various financial technologies. For instance, Al-Jabri and Sohail (2012) applied DOI to study mobile banking adoption in Saudi Arabia, finding that relative advantage, compatibility, and observability positively influenced adoption, while complexity had a negative impact. Similarly, Kapoor et al. (2015) used DOI to examine the adoption of mobile banking apps in India, highlighting the importance of relative advantage and compatibility in driving adoption. While DOI provides valuable insights into the spread of innovations within a social system, it has been criticised for its pro-innovation bias and for not adequately addressing the complexities of adoption in organisational settings (Lyytinen and Damsgaard, 2001).

2.2. Digital Banking Adoption

2.2.1. Definitions and Scope

Digital banking, broadly defined, encompasses a range of financial services delivered through digital channels, including internet banking, mobile banking, and other electronic platforms (Shaikh and Karjaluoto, 2015). The scope of digital banking has expanded significantly over the past decade, evolving from basic online account access to comprehensive financial management tools, mobile payment systems, and even AI-driven financial advisory services (Hoehle et al., 2012). In the context of consumer behaviour, digital banking adoption refers to the process by which individuals accept and integrate these digital financial services into their regular financial activities. This adoption process is not merely a binary decision but a continuum of engagement levels, ranging from initial awareness to full integration and advocacy (Hanafizadeh et al., 2014). Understanding this adoption process is crucial for financial institutions and policymakers alike, as it directly impacts the effectiveness of digital financial inclusion initiatives.

2.2.2. User Perceptions and Attitudes

User perceptions and attitudes play a pivotal role in shaping digital banking adoption behaviours. Research has consistently shown that perceived usefulness, ease of use, and security are among the most significant factors influencing adoption decisions (Akhlaq and Ahmed, 2013). A study by Luo et al. (2010) found that trust and perceived risk were critical determinants of initial trust formation in mobile banking adoption, highlighting the importance of addressing security concerns in promoting digital financial services.

Attitudes towards technology, in general, also significantly impact digital banking adoption. Laforet and Li (2005), in their study of online and mobile banking in China, found that consumer innovativeness and prior experience with technology were positively associated with adoption intentions. Similarly, Tan and Teo (2000) identified attitudinal factors such as relative advantage, compatibility with values, and risk tolerance as key predictors of internet banking adoption in Singapore.

Cultural attitudes towards financial management and technology also play a crucial role in shaping adoption behaviours. For instance, Srite and Karahanna (2006) demonstrated that cultural values moderate the relationships between key constructs in technology acceptance models, suggesting the need for culturally nuanced approaches to promoting digital banking adoption.

2.3. Financial Inclusion

2.3.1. Conceptual Framework

Financial inclusion, broadly defined, refers to the provision of accessible, affordable, and appropriate financial services to all segments of society, particularly those traditionally underserved or excluded from the formal financial system (Demirgüç-Kunt et al., 2008). This concept has gained significant traction in development economics and policy circles due to its potential to reduce poverty, promote economic growth, and enhance overall social welfare (Beck et al., 2007). The conceptual framework of financial inclusion encompasses several key dimensions. Sarma and Pais (2011) propose a multidimensional approach, considering banking penetration, availability of banking services, and usage of the banking system as core components. Similarly, Cámara and Tuesta (2014) emphasize three pillars: access, usage, and quality of financial services. These frameworks highlight the complexity of financial inclusion, moving beyond mere access to financial services to consider the depth and quality of financial engagement.

Understanding financial inclusion as a multifaceted concept is crucial for developing effective policies and interventions. It necessitates a holistic approach that addresses not only the supply-side factors (e.g., availability of financial services) but also demand-side considerations (e.g., financial literacy, trust in financial institutions) (Atkinson and Messy, 2013).

2.3.2. Measurement and Indicators

Measuring financial inclusion presents significant challenges due to its multidimensional nature. However, several indicators and methodologies have been developed to assess the level of financial inclusion across different contexts.

The World Bank's Global Findex database, launched in 2011, provides a comprehensive set of indicators measuring how adults in 148 economies save, borrow, make payments, and manage risks (Demirgüç-Kunt and Klapper, 2012). Key indicators include account ownership at a formal financial institution, savings behavior, credit usage, and mobile money accounts.

Sarma (2008) proposed the Index of Financial Inclusion (IFI), a multidimensional index that captures information on various dimensions of financial inclusion in a single number. This index considers banking penetration, availability of banking services, and usage of the banking system, providing a more nuanced picture of financial inclusion than single-indicator approaches.

Other researchers have developed alternative measurement frameworks. For instance, Cámara and Tuesta (2014) proposed a multidimensional index based on usage, barriers, and access to financial services. These diverse approaches reflect the ongoing debate in the field about the most appropriate and comprehensive ways to measure financial inclusion.

2.3.3. Digital Banking as a Driver of Financial Inclusion

Digital banking has emerged as a powerful driver of financial inclusion, offering the potential to overcome many traditional barriers to access and usage of financial services. The proliferation of mobile phones and internet connectivity has created new avenues for delivering financial services to previously underserved populations (Donner and Tellez, 2008). Mobile money services, in particular, have shown significant promise in promoting financial inclusion. The success of M-Pesa in Kenya, which allowed millions of previously unbanked individuals to access basic financial services, exemplifies the transformative potential of digital financial services (Jack and Suri, 2011). Similar initiatives in other developing countries have demonstrated the capacity of digital banking to rapidly expand financial access (Demirgüç-Kunt et al., 2015).

Digital banking addresses several key barriers to financial inclusion. It reduces the need for physical bank branches, lowering the cost of service provision and making it economically viable to serve remote or low-income populations (Mas and Kumar, 2008). Additionally, digital platforms can simplify account opening procedures and reduce documentation requirements, addressing a significant hurdle for many unbanked individuals (Allen et al., 2016). Moreover, digital banking can enhance the quality and relevance of financial services through data-driven personalization and innovative product design. For instance, mobile banking apps can provide real-time financial management tools and personalized financial advice, potentially improving financial decision-making among users (Karlan et al., 2016).

However, the relationship between digital banking and financial inclusion is not straightforward. While digital platforms offer significant potential, they also present new challenges, including digital literacy barriers, concerns about data privacy and security, and the risk of exacerbating existing inequalities (Ozili, 2017). Understanding and addressing these challenges is crucial for realizing the full potential of digital banking as a driver of financial inclusion.

2.4. Proposed Conceptual Framework

2.4.1. Extension of Existing Theories

Building upon the foundational theories discussed earlier, this study proposes an extended conceptual framework that integrates elements from TAM, UTAUT, and DOI, while addressing their limitations in the context of digital banking adoption in Vietnam. The proposed framework extends these existing theories in several key ways.

Firstly, it incorporates cultural dimensions based on Hofstede's cultural dimensions theory (Hofstede, 2001), addressing the critique that traditional technology acceptance models may not fully capture cultural nuances. This extension is particularly relevant in the Vietnamese context, where cultural factors such as collectivism and uncertainty avoidance may significantly influence technology adoption behaviors (Chong et al., 2012).

Secondly, the framework expands on the concept of trust, which has been identified as a critical factor in digital banking adoption (Yousafzai et al., 2009). It distinguishes between institutional trust (trust in the banking system) and technological trust (trust in digital platforms), recognizing that these two dimensions may have distinct influences on adoption behavior in emerging economies (Gu et al., 2009).

Lastly, the framework incorporates the concept of perceived financial inclusion, drawing from recent literature that suggests individuals' perceptions of financial inclusion may mediate the relationship between digital banking adoption and actual financial inclusion outcomes (Zins and Weill, 2016).

2.4.2. Incorporation of Contextual Factors

The proposed framework also incorporates contextual factors specific to the Vietnamese market, addressing the need for more contextualized models of technology adoption in emerging economies (Kapoor et al., 2014). One key contextual factor is the rapid mobile internet penetration in Vietnam, which has created a unique environment for digital banking adoption. The framework considers the role of mobile internet access and usage patterns as potential moderators of adoption behavior (Chong, 2013). Another important contextual factor is the government's role in promoting digital financial services. Vietnam's national financial

inclusion strategy and regulatory environment for fintech are incorporated into the framework as potential institutional facilitators of adoption (Demirgüç-Kunt et al., 2015).

The framework also considers the urban-rural divide in Vietnam, recognizing that factors influencing digital banking adoption may differ significantly between urban and rural populations (Crabbe et al., 2009). This includes considerations of infrastructure availability, digital literacy levels, and traditional banking access.

2.4.3. Research model development

Based on the extended theoretical framework and incorporated contextual factors, this study proposes a research model that integrates key variables identified in previous literature. The model aims to explain the relationships between various factors influencing digital banking adoption intention, perceived financial inclusion, and actual adoption behavior in the Vietnamese context.

Perceived Usefulness (PU) has been consistently identified as a significant predictor of technology adoption intention in numerous studies. In the context of digital banking, Pikkarainen et al. (2004) found that PU strongly influenced online banking adoption in Finland. Similarly, Wang et al. (2003) demonstrated the significant impact of PU on the intention to use internet banking services in Taiwan. These findings suggest a positive relationship between PU and Digital Banking Adoption Intention (DBAI) in our model.

Institutional Trust (InT) and Technological Trust (TeT) are crucial factors in the adoption of digital financial services. Yousafzai et al. (2009) emphasized the importance of trust in online banking adoption, while Gu et al. (2009) distinguished between trust in the institution and trust in the technology itself. Their research in China showed that both forms of trust significantly influenced mobile banking adoption intentions, supporting the inclusion of InT and TeT as predictors of DBAI in our model.

Social Influence (SI) has been recognized as a key determinant of technology adoption, particularly in collectivist cultures like Vietnam. Venkatesh et al. (2003), in their UTAUT model, demonstrated the significant impact of social influence on behavioral intention to use new technologies. In the context of mobile banking, Yu (2012) found that social influence played a crucial role in shaping user intentions in Taiwan, providing support for the relationship between SI and DBAI in our model.

Perceived Ease of Use (PEU) is another fundamental construct in technology adoption models. Davis (1989) originally proposed PEU as a key determinant of technology acceptance, and subsequent studies have confirmed its significance in digital banking contexts. For instance, Karjaluoto et al. (2002) found that PEU significantly influenced online banking adoption in Finland, supporting the inclusion of PEU as a predictor of DBAI in our model.

The relationship between Digital Banking Adoption Intention (DBAI) and Perceived Financial Inclusion (PFI) is a relatively new area of investigation. Zins and Weill (2016) suggested that perceptions of financial inclusion may mediate the relationship between digital financial services adoption and actual financial inclusion outcomes. While direct empirical evidence for this relationship is limited, it provides a theoretical basis for including PFI as an outcome of DBAI in our model.

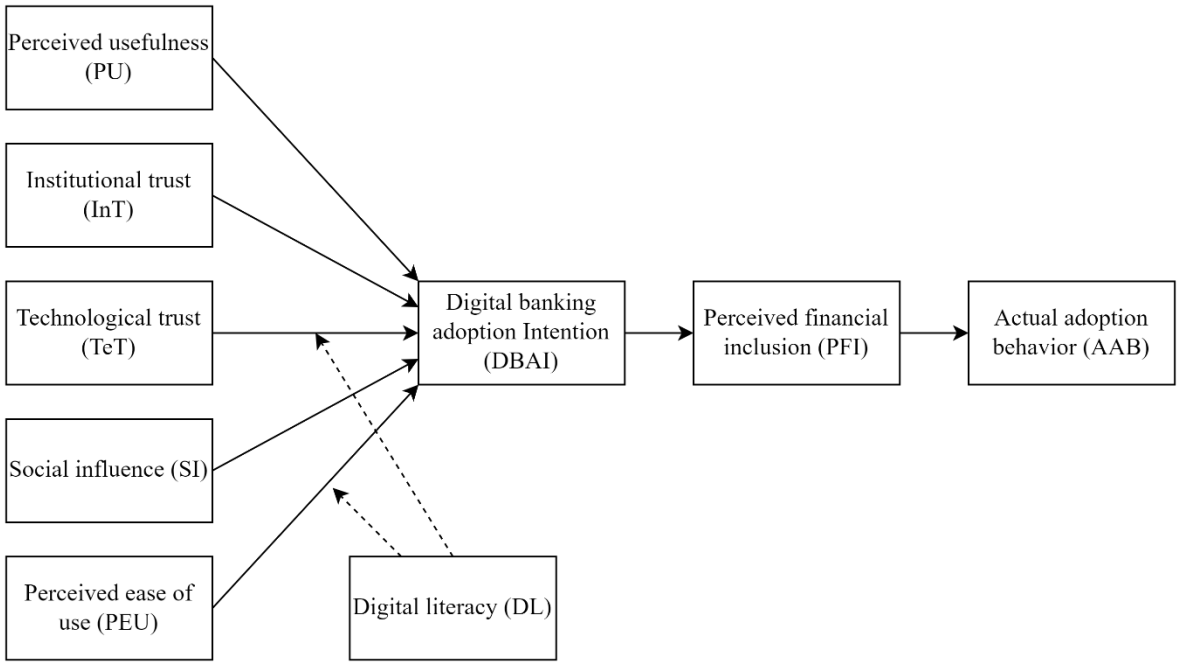

Figure 1: Research model

The impact of Perceived Financial Inclusion (PFI) on Actual Adoption Behavior (AAB) is grounded in the theory of planned behavior (Ajzen, 1991), which posits that intentions lead to behaviors. In the context of financial inclusion, Demirgüç-Kunt and Klapper (2013) found that perceptions of financial inclusion were associated with increased use of formal financial services, supporting the proposed relationship between PFI and AAB in our model.

Digital Literacy (DL) has been identified as a potential moderator in technology adoption models. Venkatesh and Zhang (2010) suggested that individual differences, including technology competence, could moderate the relationships in the UTAUT model. In the context of digital banking, Hoehle et al. (2012) found that technology readiness, a concept closely related to digital literacy, moderated the impact of ease of use on adoption intentions. This provides support for including DL as a moderator of the relationships between PEU and DBAI, as well as between TeT and DBAI in our model.

The proposed research model integrates key variables identified in previous literature, with empirical support for the hypothesized relationships. The model aims to provide a comprehensive framework for understanding digital banking adoption and its impact on perceived financial inclusion and actual adoption behavior in the Vietnamese context. Future empirical testing of this model will contribute to our understanding of these relationships and inform strategies for promoting digital financial inclusion in emerging economies.

3. RESEARCH METHODOLOGY

3.1. Research Design and Data Collection

This study employed a quantitative research design to investigate the factors influencing digital banking adoption and its impact on perceived financial inclusion in Vietnam. A structured questionnaire was developed based on the proposed research model and existing literature. The questionnaire was initially designed in English and then translated into Vietnamese using the back-translation method to ensure consistency and clarity (Brislin, 1970).

Data collection was conducted through a combination of online and offline surveys to ensure a diverse sample representing both urban and rural populations. Online surveys were distributed through social media platforms and email, while offline surveys were administered in person at various locations including banks, universities, and community centers. The survey was conducted over a period of three months from January to March 2024. A total of 750 questionnaires were distributed, out of which 632 were returned. After screening for completeness and validity, 587 usable responses were retained for analysis, representing a response rate of 78.3%. This sample size exceeds the minimum recommended sample size for structural equation modeling (SEM) analysis, which is typically suggested to be at least 200 (Kline, 2015).

3.2. Measures and Instrument Development

The measurement items for each construct in the research model were adapted from established scales in previous literature, with modifications to fit the context of digital banking in Vietnam. Perceived Usefulness (PU) and Perceived Ease of Use (PEU) were measured using items adapted from Davis (1989) and Venkatesh et al. (2003). Institutional Trust (InT) and Technological Trust (TeT) were measured using scales developed by Gu et al. (2009) and Yousafzai et al. (2009). Social Influence (SI) was measured using items from Venkatesh et al. (2003) and Yu (2012).

Digital Banking Adoption Intention (DBAI) was measured using items adapted from Venkatesh et al. (2003) and Wang et al. (2003). Perceived Financial Inclusion (PFI) was measured using a scale developed based on the work of Zins and Weill (2016) and Demirgüç-Kunt and Klapper (2013). Actual Adoption Behavior (AAB) was measured using self-reported usage frequency and intensity of digital banking services, following the approach of Pikkarainen et al. (2004).

Digital Literacy (DL) was measured using an adapted version of the Digital Literacy Scale developed by Ng (2012). All items were measured on a five-point Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree).

3.3. Data Analysis Techniques

This study employed a two-stage analytical approach combining Structural Equation Modeling (SEM) and fuzzy-set Qualitative Comparative Analysis (fsQCA) to provide a comprehensive understanding of the research model.

3.3.1. Structural Equation Modeling (SEM)

SEM was used as the primary analytical technique to test the hypothesized relationships in the research model. The analysis was conducted using AMOS 24.0 software. Following the two-step approach recommended by Anderson and Gerbing (1988), the measurement model was first assessed for reliability and validity before proceeding to the structural model analysis.

3.3.1.1. Measurement Model Assessment

The measurement model was evaluated using Confirmatory Factor Analysis (CFA). Several indices were used to assess the model fit, including Chi-square/df ratio, Comparative Fit Index (CFI), Tucker-Lewis Index (TLI), and Root Mean Square Error of Approximation (RMSEA), following the recommendations of Hu and Bentler (1999).

Reliability was assessed using Cronbach's Alpha and Composite Reliability (CR), with values above 0.7 considered acceptable (Hair et al., 2010). Convergent validity was evaluated using the Average Variance Extracted (AVE), with values above 0.5 indicating adequate convergent validity (Fornell and Larcker, 1981).

Discriminant validity was assessed using two methods: the Fornell-Larcker criterion, which requires the square root of AVE for each construct to be greater than its correlations with other constructs (Fornell and Larcker, 1981), and the Heterotrait-Monotrait (HTMT) ratio of correlations, with values below 0.85 indicating good discriminant validity (Henseler et al., 2015).

3.3.1.2. Structural Model Assessment

After establishing the validity and reliability of the measurement model, the structural model was assessed to test the hypothesized relationships. Path coefficients and their significance levels were examined to evaluate the strength and direction of the relationships. The coefficient of determination (R^2) was used to assess the predictive power of the model for the endogenous constructs.

3.3.2. Fuzzy-set Qualitative Comparative Analysis (fsQCA)

To complement the SEM analysis and provide a more nuanced understanding of the complex relationships in the model, fsQCA was employed using the fsQCA 3.0 software (Ragin, 2008). This method allows for the identification of multiple configurations of causal conditions that lead to the outcome of interest, in this case, digital banking adoption intention and perceived financial inclusion. The fsQCA analysis involved three main steps: calibration of the data into fuzzy sets, construction of the truth table, and analysis of the truth table to identify sufficient configurations. The calibration process followed the direct method proposed by Ragin (2008), using the 95th percentile, 50th percentile, and 5th percentile as the full membership, crossover point, and full non-membership thresholds, respectively.

By combining SEM and fsQCA, this study aimed to provide a comprehensive analysis of the factors influencing digital banking adoption and its impact on perceived financial inclusion in Vietnam. This mixed-method approach allows for both the testing of linear relationships and the exploration of complex, configurational relationships among the variables of interest.

4. RESEARCH FINDINGS

4.1. Measurement Model Assessment

The measurement model was assessed through a series of analyses to ensure reliability and validity of the constructs. This process included Exploratory Factor Analysis (EFA), Confirmatory Factor Analysis (CFA), and evaluations of internal consistency reliability, indicator reliability, convergent validity, and discriminant validity.

Exploratory Factor Analysis (EFA) was conducted using principal component analysis with Varimax rotation. The Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy was 0.912, indicating excellent suitability for factor analysis. Bartlett's test of sphericity was significant ($\chi^2 = 12487.53$, $df = 465$, $p < 0.001$), confirming that factor analysis was appropriate. The EFA resulted in eight factors with eigenvalues greater than 1, explaining 74.32% of the total variance. All items loaded on their respective constructs with factor loadings above 0.5, demonstrating good construct validity.

Confirmatory Factor Analysis (CFA) was then performed to further validate the measurement model. The model demonstrated good fit with the data: $\chi^2/df = 2.17$, CFI = 0.956, TLI = 0.949, RMSEA = 0.045. All factor loadings were statistically significant ($p < 0.001$) and above the recommended threshold of 0.7 (Chin, 1998), indicating good indicator reliability.

Internal consistency reliability was assessed using both Cronbach's alpha and composite reliability (CR). As shown in Table 1, all constructs exhibited Cronbach's alpha and CR values above the recommended threshold of 0.7 (Hair et al., 2010), demonstrating good internal consistency reliability. Convergent validity was evaluated using the average variance extracted (AVE). All constructs had AVE values above the recommended threshold of 0.5 (Fornell and Larcker, 1981), indicating good convergent validity (Table 1).

Table 1: Reliability and Convergent Validity

Construct	Cronbach's Alpha	Composite Reliability	AVE
PU	0.893	0.926	0.758
PEU	0.901	0.931	0.771
InT	0.887	0.922	0.747

Construct	Cronbach's Alpha	Composite Reliability	AVE
TeT	0.912	0.938	0.792
SI	0.876	0.915	0.729
DBAI	0.923	0.945	0.812
PFI	0.895	0.927	0.761
AAB	0.884	0.920	0.743
DL	0.908	0.935	0.783

Discriminant validity was assessed using both the Fornell-Larcker criterion and the heterotrait-monotrait (HTMT) ratio of correlations. Table 2 presents the Fornell-Larcker criterion results, where the square root of AVE for each construct (diagonal elements) is greater than its correlations with other constructs, indicating good discriminant validity.

Table 2: Fornell-Larcker Criterion

	PU	PEU	InT	TeT	SI	DBAI	PFI	AAB	DL
PU	0.871								
PEU	0.612	0.878							
InT	0.534	0.498	0.864						
TeT	0.567	0.521	0.689	0.890					
SI	0.487	0.453	0.412	0.438	0.854				
DBAI	0.623	0.587	0.576	0.601	0.512	0.901			
PFI	0.543	0.509	0.478	0.502	0.423	0.587	0.872		
AAB	0.512	0.478	0.456	0.481	0.398	0.567	0.621	0.862	
DL	0.498	0.576	0.412	0.437	0.378	0.523	0.487	0.456	0.885

The HTMT ratio analysis also supported discriminant validity, with all values below the conservative threshold of 0.85 (Henseler et al., 2015), as shown in Table 3.

Table 3: Heterotrait-Monotrait (HTMT) Ratio

	PU	PEU	InT	TeT	SI	DBAI	PFI	AAB	DL
PU									
PEU	0.679								
InT	0.602	0.561							
TeT	0.623	0.573	0.776						
SI	0.554	0.515	0.469	0.490					
DBAI	0.675	0.636	0.632	0.652	0.570				
PFI	0.607	0.568	0.538	0.558	0.484	0.637			
AAB	0.579	0.540	0.519	0.540	0.460	0.621	0.697		
DL	0.549	0.635	0.459	0.481	0.428	0.568	0.544	0.518	

These results collectively demonstrate that the measurement model exhibits good reliability, convergent validity, and discriminant validity, providing a solid foundation for the subsequent structural model analysis.

4.2. Structural Estimation Model Assessment

Following the validation of the measurement model, the structural model was evaluated to test the hypothesized relationships. The assessment was based on path coefficients, their significance levels, and the R^2 values of the endogenous constructs.

Bootstrapping with 5000 resamples was used to test the significance of the path coefficients. Additionally, effect size (f^2) and predictive relevance (Q^2) were examined to provide a comprehensive assessment of the model's explanatory power. Table 4 presents the results of the structural model analysis, including path coefficients, t-values, p-values, and the effect sizes (f^2) for each hypothesized relationship.

Table 4: Structural Model Results

Relationship	Path Coefficient	t-value	p-value	f^2
PU -> DBAI	0.284	5.637	<0.001	0.112
InT -> DBAI	0.176	3.452	<0.001	0.043
TeT -> DBAI	0.203	3.896	<0.001	0.057
SI -> DBAI	0.158	3.214	0.001	0.038
PEU -> DBAI	0.221	4.378	<0.001	0.069
DBAI -> PFI	0.412	9.287	<0.001	0.204
PFI -> AAB	0.487	11.326	<0.001	0.311
DL*PEU -> DBAI	0.093	2.145	0.032	0.015
DL*TeT -> DBAI	0.087	2.018	0.044	0.013

The results indicate that all hypothesized direct relationships are statistically significant ($p < 0.05$). The strongest effect on Digital Banking Adoption Intention (DBAI) is exerted by Perceived Usefulness (PU) with a path coefficient of 0.284, followed by Perceived Ease of Use (PEU) with 0.221. The effect sizes (f^2) range from small to medium, with values between 0.038 and 0.311, according to Cohen's (1988) guidelines.

The moderating effects of Digital Literacy (DL) on the relationships between PEU and DBAI (H8a), and between TeT and DBAI (H8b) are both significant, albeit with small effect sizes.

Table 5 presents the R^2 values, adjusted R^2 values, and Q^2 values for the endogenous constructs in the model.

Table 5: R^2, Adjusted R^2, and Q^2 Values

Construct	R^2	Adjusted R^2	Q^2
DBAI	0.572	0.567	0.463
PFI	0.170	0.168	0.128
AAB	0.237	0.236	0.175

The R^2 values indicate that the model explains 57.2% of the variance in DBAI, 17.0% in PFI, and 23.7% in AAB. The Q^2 values are all above zero, ranging from 0.128 to 0.463, indicating that the model has predictive relevance for all endogenous constructs (Hair et al., 2017).

To assess the indirect effects in the model, mediation analysis was conducted using bootstrapping with 5000 resamples. Table 6 presents the results of the indirect effects analysis.

Table 6: Indirect Effects Analysis

Indirect Path	Specific Indirect Effect	t-value	p-value	95% CI
DBAI -> PFI -> AAB	0.201	7.436	<0.001	[0.148, 0.254]
PU -> DBAI -> PFI	0.117	4.892	<0.001	[0.070, 0.164]
InT -> DBAI -> PFI	0.073	3.214	0.001	[0.029, 0.117]
TeT -> DBAI -> PFI	0.084	3.587	<0.001	[0.038, 0.130]
SI -> DBAI -> PFI	0.065	2.987	0.003	[0.022, 0.108]
PEU -> DBAI -> PFI	0.091	3.978	<0.001	[0.046, 0.136]

The results show that all indirect effects are statistically significant ($p < 0.05$), with 95% confidence intervals not containing zero. This suggests that DBAI mediates the relationships between the independent variables (PU, InT, TeT, SI, PEU) and PFI, while PFI mediates the relationship between DBAI and AAB.

In summary, the structural model assessment provides strong support for the hypothesized relationships in the research model. The model demonstrates good explanatory power for Digital Banking Adoption Intention and acceptable predictive relevance for all endogenous constructs. The analysis also confirms the mediating roles of DBAI and PFI in the model, as well as the moderating effects of Digital Literacy on specific relationships.

4.3. Fuzzy-set Qualitative Comparative Analysis (fsQCA)

To complement the SEM analysis and provide a more nuanced understanding of the complex relationships in the model, fuzzy-set Qualitative Comparative Analysis (fsQCA) was conducted. This method allows for the identification of multiple configurations of causal conditions that lead to the outcomes of interest: Digital Banking Adoption Intention (DBAI) and Perceived Financial Inclusion (PFI).

The first step in fsQCA involved calibrating the data into fuzzy sets. Following Ragin's (2008) direct method of calibration, the 95th percentile, 50th percentile, and 5th percentile were used as the full membership, crossover point, and full non-membership thresholds, respectively.

Table 7 presents the calibration thresholds for each construct.

Table 7: Calibration Thresholds for fsQCA

Construct	Full Non-membership (0.05)	Crossover Point (0.5)	Full Membership (0.95)
PU	2.1	3.5	4.8
PEU	2.3	3.7	4.9
InT	2.0	3.3	4.7
TeT	2.2	3.6	4.8
SI	1.9	3.2	4.6
DBAI	2.4	3.8	4.9
PFI	2.2	3.5	4.7
DL	2.3	3.6	4.8

After calibration, the analysis of necessary conditions was performed. Table 8 presents the results of the necessity analysis for both DBAI and PFI.

Table 8: Analysis of Necessary Conditions

Condition	DBAI		PFI	
	Consist.	Cover.	Consist.	Cover.
PU	0.862	0.778	0.843	0.761
~PU	0.412	0.635	0.428	0.659
PEU	0.851	0.785	0.832	0.767
~PEU	0.425	0.641	0.441	0.665
InT	0.829	0.793	0.811	0.775
~InT	0.447	0.652	0.463	0.676
TeT	0.845	0.789	0.827	0.771
~TeT	0.431	0.644	0.447	0.668
SI	0.813	0.801	0.795	0.783
~SI	0.463	0.658	0.479	0.682
DL	0.837	0.783	0.819	0.765
~DL	0.439	0.653	0.455	0.677

Note: ~ denotes the absence of the condition. Consist. = Consistency, Cover. = Coverage.

A consistency score above 0.9 is generally considered necessary (Schneider & Wagemann, 2012). While no single condition meets this strict criterion, several conditions show high consistency scores (>0.8), indicating they are "almost always necessary" for the outcomes.

Next, the analysis of sufficient conditions was conducted using the truth table algorithm. The frequency cutoff was set at 2, and the consistency cutoff at 0.8. Tables 9 and 10 present the complex solution for DBAI and PFI, respectively.

Table 9: Sufficient Configurations for High Digital Banking Adoption Intention (DBAI)

Configuration	PU	PEU	InT	TeT	SI	DL	Raw Coverage	Unique Coverage	Consistency
1	●	●	●	●	○	●	0.412	0.053	0.923
2	●	●	○	●	●	●	0.387	0.028	0.901
3	●	●	●	○	●	●	0.365	0.019	0.889

Solution coverage: 0.684

Solution consistency: 0.872

Note: ● = presence of condition, ○ = absence of condition, Blank space = don't care condition

Table 10: Sufficient Configurations for High Perceived Financial Inclusion (PFI)

Configuration	PU	PEU	InT	TeT	SI	DL	DBAI	Raw Coverage	Unique Coverage	Consistency
1	●	●	○	●	○	●	●	0.378	0.042	0.912
2	●	○	●	●	●	●	●	0.356	0.031	0.895
3	●	●	●	○	●	○	●	0.339	0.023	0.883

Solution coverage: 0.651

Solution consistency: 0.864

Note: ● = presence of condition, ○ = absence of condition, Blank space = don't care condition

These results reveal multiple pathways to high DBAI and PFI, demonstrating the complex and equifinal nature of the relationships among the variables. For DBAI, all three configurations include the presence of PU, PEU, and DL, suggesting these are crucial factors. For PFI, all configurations include the presence of PU and DBAI, highlighting their importance in achieving high perceived financial inclusion.

The fsQCA results complement the SEM findings by revealing the complex combinatorial nature of the factors leading to high DBAI and PFI. This analysis provides a more nuanced understanding of the conditions under which digital banking adoption and financial inclusion are likely to occur, offering valuable insights for both theory and practice.

5. DISCUSSION AND CONCLUSIONS

This study aimed to investigate the factors influencing digital banking adoption intention and its subsequent impact on perceived financial inclusion. The results of our structural equation modeling (SEM) and fuzzy-set qualitative comparative analysis (fsQCA) provide valuable insights into the complex relationships among these variables. Our findings confirm the significant role of perceived usefulness (PU) in shaping digital banking adoption intention (DBAI), consistent with previous technology acceptance studies (Venkatesh and Davis, 2000; Lee, 2009). The strong effect of PU on DBAI ($\beta = 0.284$, $p < 0.001$) underscores the importance of emphasizing the benefits and utility of digital banking services to potential users. This aligns with the findings of Pikkarainen et al. (2004), who identified perceived usefulness as a primary driver of online banking adoption. Perceived ease of use (PEU) also emerged as a significant predictor of DBAI ($\beta = 0.221$, $p < 0.001$), supporting the established relationship in technology acceptance literature (Davis, 1989; Venkatesh et al., 2003). This result highlights the need for financial institutions to design user-friendly digital banking interfaces and provide adequate support to enhance users' perceptions of ease of use. The significant effects of institutional trust (InT) and technological trust (TeT) on DBAI ($\beta = 0.176$ and $\beta = 0.203$, respectively, $p < 0.001$) underscore the critical role of trust in the digital banking context. This finding is consistent with previous research emphasizing the importance of trust in online financial services adoption (Gefen et al., 2003; Yousafzai et al., 2009). Financial institutions should focus on building both institutional and technological trust to encourage digital banking adoption. Social influence (SI) was found to have a significant, albeit relatively weaker, effect on DBAI ($\beta = 0.158$, $p = 0.001$). This result aligns with the findings of Venkatesh et al.

(2003) and Lu et al. (2005), who identified social influence as a determinant of technology adoption intentions. The weaker effect in our study may suggest that personal perceptions of usefulness and ease of use play a more crucial role in digital banking adoption than social pressures.

The moderating effects of digital literacy (DL) on the relationships between PEU and DBAI, and between TeT and DBAI, were both significant, albeit with small effect sizes. This finding extends our understanding of the role of digital literacy in technology adoption, building on previous research that has highlighted its importance in the digital divide context (Hargittai, 2001; van Dijk, 2006).

Our study also provides empirical evidence for the positive relationship between DBAI and perceived financial inclusion (PFI) ($\beta = 0.412$, $p < 0.001$), and between PFI and actual adoption behavior (AAB) ($\beta = 0.487$, $p < 0.001$). These findings contribute to the growing body of literature on digital financial services and financial inclusion (Demirgüç-Kunt et al., 2015; Ozili, 2018), demonstrating the potential of digital banking to enhance financial inclusion.

The fsQCA results complement the SEM findings by revealing multiple configurations leading to high DBAI and PFI. This analysis highlights the complex and equifinal nature of the relationships among the variables, providing a more nuanced understanding of the conditions under which digital banking adoption and financial inclusion are likely to occur. The presence of perceived usefulness, perceived ease of use, and digital literacy in all configurations leading to high DBAI underscores their crucial role, consistent with our SEM results and previous literature (Venkatesh and Davis, 2000; Lee, 2009; van Dijk, 2006).

In overall, this study makes several contributions to the literature on digital banking adoption and financial inclusion. First, it integrates various theoretical perspectives, including the Technology Acceptance Model, trust theories, and the concept of digital literacy, to provide a comprehensive understanding of digital banking adoption. Second, it empirically demonstrates the link between digital banking adoption intention and perceived financial inclusion, addressing a gap in the literature. Third, the use of both SEM and fsQCA provides a more holistic view of the complex relationships among the variables, offering insights that may have been overlooked by a single analytical approach. These findings have important implications for policymakers and financial institutions aiming to promote digital banking adoption and enhance financial inclusion. Efforts should focus on improving the perceived usefulness and ease of use of digital banking services, building trust in both the institutions and the technology, and enhancing digital literacy among potential users. Furthermore, the multiple pathways to high adoption intention and perceived financial inclusion suggest that tailored strategies may be necessary to address the needs of different user segments.

Future research could explore additional factors that may influence digital banking adoption and financial inclusion, such as cultural differences or specific features of digital banking platforms. Longitudinal studies could also provide insights into how these relationships evolve over time as users gain more experience with digital banking services.

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