FACTORS INFLUENCING THE ADOPTION OF DIGITAL BANKING SERVICES OFFERED BY VIETNAMESE COMMERCIAL BANKS AMONG INDIVIDUAL CUSTOMERS IN THE MEKONG DELTA REGION: THE MODERATING ROLE OF GOVERNMENT SUPPORT AND DEMOGRAPHICS

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Abstract: ***This study examines factors affecting the adoption of digital banking services among customers in the Mekong Delta region, using data from 589 surveys and a PLS-SEM model. Integrating TAM, UTAUT, and DOI, the results show that Perceived Benefits (PB), Green Concern (GC), and Social Influence (SI) positively influence adoption, while Risk Dimension (RD) has a negative effect. Government Support (GS) plays a moderating role by strengthening positive factors and reducing barriers, and demographic characteristics also influence adoption behavior.***

• Keywords: *digital banking services adoption, government support, green concern, Mekong Delta region, perceived benefits.*

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1. Introduction

Amidst the rapid digital transformation, digital banking has become a key driver of change in the financial operations at Vietnamese commercial banks. However, in the Mekong Delta Region (MDR), individual customers' adoption of digital banking services remains limited. Although these customers are well aware of the benefits related to convenience and positive environmental impacts, users in this region still face significant barriers arising from traditional transaction habits and concerns regarding security and privacy.

Therefore, this study focuses on analyzing the factors influencing personal and social benefits, as well as the barriers directly affecting the adoption of digital banking services by users in this region. In particular, the study emphasizes the moderating role of Government Support (GS) in amplifying positive impacts and mitigating negative effects, thereby enhancing user confidence in adopting digital banking services from Vietnamese commercial banks. Consequently, the study proposes several solutions to help these banks retain existing customers and attract potential ones; simultaneously, it recommends policies aimed at building a safe and sustainable digital financial ecosystem in the digital era.

2. Litereture review

2.1. Perceived Benefits (PB)

Perceived Benefits are determined by the convergence of functional value and service innovation characteristics. Based on the TAM model, an empirical study (Safeena et al., 2014) identified two core components: Perceived Usefulness and Perceived Ease of Use, which reflect the advantages of online banking. Additionally, this study intergrates relative advantage and compatibility within the DOI framework (Rogers, 2003), drawing on empirical research (Tan & Teo, 2000) regarding the adoption of online banking.

2.2. Risk Dimension (RD)

The Risk Dimension creates resistance based on the theory of perceived risk (Bauer, 1960). Empirical research (Safeena et al., 2014) has shown that perceived risk and complexity are major obstacles, particularly concerns about security and cumbersome authentication processes. Furthermore, (Laukkanen, 2016) highlighted traditional barriers, specifically the preference for physical interaction with bank staff. The lack of human presence in significant transactions, such as loans and savings, creates a psychological barrier, making it difficult for customers to abandon traditional methods and transition fully to digital banking.

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2.3. Social Influences (SI)

The acceptance of digital banking also possesses a community-based nature. (Safeena et al., 2014) confirmed that subjective norms (pressure from family and colleagues) strongly influence usage decisions. Additionally, image-related factors serve as intrinsic motivators. According to (Venkatesh et al., 2003), using advanced financial services helps individuals assert their status and technological savvy, thereby promoting adoption as a means of integrating into the digitalization trend.

2.4. Green Concern (GC)

The VBN (Stern, 2000), theoretical framework on environmental behavior is applied to sustainable consumption trends in the digital era. Although concepts of green perceived value and green trust are typically associated with tangible goods (Chen, 2010; Chen & Chang, 2012). Consequently, these studies show that users are willing to commit to the service as part of a responsible consumption lifestyle.

3. Theoretical foundations, models, and research hypotheses

3.1. Foundational Theory

Technology Acceptance Model (TAM) (Davis, 1989): This framework identifies perceived usefulness and ease of use as the primary intrinsic motivators driving the adoption of digital banking services.

Diffusion of Innovations (DOI) Theory (Rogers, 2003): This theory explains innovation adoption through several key characteristics, including relative advantage and compatibility as facilitators, and complexity as a significant barrier.

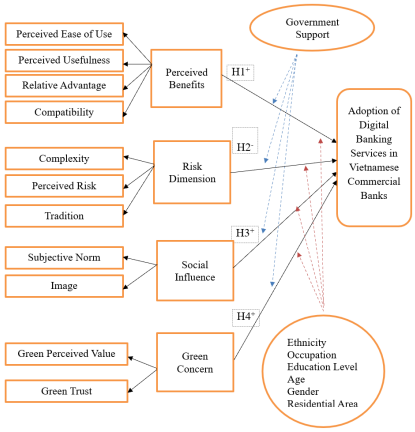
Unified Theory of Acceptance and Use of Technology (UTAUT) (Venkatesh et al., 2003): This framework demonstrates the impact of social influence as an independent variable and highlights the moderating role of facilitating conditions (such as Government Support) on user behavior.

Perceived Risk Theory (Bauer, 1960): This theory provides a framework for explaining customer hesitation caused by various risk dimensions, including security and financial risks in online transactions.

Value-Belief-Norm (VBN) Theory (Stern, 2000): As a foundational theory of environmental behavior, VBN links ecological consciousness with perceived green values and beliefs within the context of sustainable consumption.

3.2. Research Model

Figure 1. Model of individual customers' adoption of digital banking services offered by Vietnamese commercial banks



3.3. Research hypotheses

The research hypotheses were formulated based on the TAM, UTAUT, and DOI theories, as well as the empirical studies (Safeena et al., 2014) and (Chen & Chang, 2012), specifically:

H1–H4: Perceived Benefits (PB), Social Influence (SI), and Green Perceived Value (GC) are hypothesized to have significant positive impacts on the adoption of digital banking services offered by Vietnamese commercial banks among individual customers in the MDR, while Risk Dimension (RD) is expected to exert a negative effect on this adoption

H5–H8: Government Support (GS) is hypothesized to positively moderate the relationships between the independent variables (PB, RD, SI, GC) and the adoption of digital banking services offered by Vietnamese commercial banks among individual customers in the MDR. Specifically, GS strengthens the positive effects of PB, SI, and GC, while mitigating the negative impact of RD on this adoption.

H9–H14: Demographic factors, including ethnicity (H9), occupation (H10), education level (H11), age (H12), gender (H13), and residential area (H14), are hypothesized to significantly moderate the relationships between the independent variables (PB, RD, SI, GC) and the dependent variable, which is the adoption of digital banking services (UA) offered by Vietnamese commercial banks among individual customers in the MDR.

4. Research methodology

4.1. Sample Size, Sampling Method, and Sample Characteristics

Sample Size

Following the principle proposed (Hair Jnr et al., 2010), the minimum sample size should be ten times the number of observed variables to ensure the reliability of

the statistical tests. Since the research model includes 55 observed variables, the study required at least 550 observations. In practice, the sample size reached 589 valid responses out of a total of 650 surveys collected.

Sampling Method

Convenience sampling was employed for the following reasons (Saunders et al., 2011): (1) Ensuring the confidentiality of bank customers' information (Bornstein et al., 2013); (2) Enhancing objectivity by collecting data at multiple locations; and (3) Ensuring the target population was reached through a rigorous screening process within the survey questionnaire (Creswell & Creswell, 2017).

Sample Characteristics

The survey participants met the following criteria: (i) Individual customers of Vietnamese commercial banks residing in the MDR; (ii) Using a smartphone and having an internet connection; (iii) Being willing to use or currently using digital banking services from Vietnamese commercial banks; and (iv) Being 18 years of age or older.

4.2. Data Analysis

The study employed the PLS-SEM technique using SmartPLS software. The analysis followed the standard two-stage procedure (Hair et al., 2022) such as:

Stage 1: Measurement Model Evaluation

The reliability and scale validity were assessed. Internal consistency was measured using Cronbach's Alpha and Composite Reliability (CR), both required to be ≥ 0.7. Convergent validity was evaluated based on factor loadings (> 0.7), Average Variance Extracted (AVE > 0.5). Discriminant validity was verified using the Fornell-Larcker criterion and the Heterotrait-Monotrait (HTMT) ratio with a threshold of < 0.85 (Fornell & Larcker, 1981).

Stage 2: Structural Model Evaluation

Research hypotheses were tested using the bootstrapping technique (5.000 resamples). Evaluation was based on path coefficients (β) and significance levels ($p<0.05$). Additionally, the model was assessed for multicollinearity (VIF<5), explanatory power $R2 \geq 0.25$), and predictive power ($Q^2 > 0$)

Multigroup Analysis (MGA). To compare differences across various demographic groups, the study first employed the MICOM procedure to ensure measurement invariance. Subsequently, the PLS-MGA technique was applied to identify statistically significant differences in path coefficients across groups ($p < 0.05$).

5. Research results

5.1. Results of Preliminary Assessment of Cronbach's Alpha Reliability and Exploratory Factor Analysis (EFA) in Stage 1

Cronbach's Alpha was used to assess the internal consistency of the scales. According to the standard (Hair et al., 2022), a scale meets the criteria when the Cronbach's Alpha coefficient is > 0.7 and corrected item-total correlation is > 0.3.

EFA was conducted to identify the latent structure and convergent validity of the observed variables (Hair et al., 2022). The specific results for the variables were as follows:

• Independent variables: KMO value = 0.915 > 0.5 and Bartlett's test was statistically significant (Sig. = 0.000), confirming that the data was fully suitable for factor analysis. Twelve factors were extracted at the Eigenvalue level of 1.016 > 1, explaining 71.387% > 50% of the cumulative variance across the 50 observed variables.

• Moderator variable (GS): Achieved KMO = 0.882; Sig. = 0.000; Eigenvalue = 2.743; and total extracted variance reached 68.575%. This factor effectively explains the variance of its 4 observed items.

• Dependent variable (UA): Achieved KMO = 0.708; Sig. = 0.000; Eigenvalue = 2.125, and the total variance explained reached 70.839% for the 3 observed variables involved.

5.2. Results of the First-order Measurement Model Evaluation (Stage 1)

Indicator Reliability: The analysis results showed that all first-order observed variables and the GS moderator variable achieved outer loadings exceeding 0.70. This demonstrates that the indicators effectively reflect the research concepts and satisfy the requirements for explained variance (Hair et al., 2022).

Internal Consistency Reliability: All scales yielded Cronbach's Alpha coefficients and Composite Reliability (CR) values ranging from 0.70 to 0.95. These results confirm the high stability of the measurement structure, with no evidence of redundancy or content overlap among the indicators

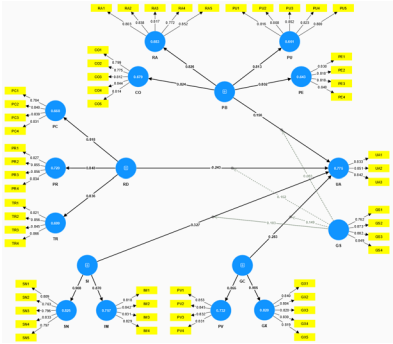
Convergent Validity: The Average Variance Extracted (AVE) for all latent variables was above 0.50. This implies that the theoretical concepts explain more than 50% of the variance in the component observed variables, ensuring the model's convergent validity

Discriminant Validity: According to Fornell and Larcker (1981), the square roots of the AVE values along the main diagonal [ranging from 0.800 to 0.847] were all greater than the correlation coefficients between the constructs, confirming clear boundaries between the concepts.

Furthermore, the HTMT ratios between variable pairs were all below 0.85. According to Hair et al. (2022), this result demonstrates that the research structures are

completely distinct and show no statistical overlap in content. Therefore, the Stage 1 PLS-SEM measurement model is validated, specifically:

Figure 2. The research model for Stage 1 of PLS-SEM



Source: Authored by PLS_SEM

5.3. Results of Evaluation of the Second-Order Measurement Model (Stage 2)

The evaluation results for the second-order constructs (GC, GS, PB, RD, SI, and UA) indicated that all scales satisfied the requirements for reliability, convergent validity, and discriminant validity through the following five steps:

Reliability of Indicators (Outer Loadings): All first-order variables had Outer Loading coefficients linked to their corresponding second-order variables exceeding the 0.7 threshold (ranging from 0.808 to 0.893).

Internal Consistency Reliability: All reliability indices fell within acceptable ranges. Cronbach's Alpha coefficients for the second-order variables were all > 0.7 (lowest for GC: 0.713; highest for GS: 0.847). Composite reliability (rho_a, rho_c) ranged stably from 0.713 to 0.901, confirming high internal consistency among the components of the second-order variables.

Average Variance Extracted (AVE): The AVE values for all second-order constructs were above 0.5 (ranging from 0.667 to 0.792). This demonstrates that a significant portion of the variance is explained by the latent variables, ensuring convergent validity.

Discriminant Validity (Fornell–Larcker Criterion): The square roots of the AVE values for the second-order constructs on the main diagonal (ranging from 0.817 to 0.890) were all greater than the correlation coefficients between them and other constructs. This confirms that the model's constructs are distinct and do not overlap conceptually.

Discriminant Validity (HTMT criterion): The HTMT ratios between all pairs of latent variables were below the strict threshold of 0.85 (with the highest value being 0.845). This result reinforces the clear discriminant validity between the measurement structures in the research model.

5.4. Structural Model Evaluation

The VIF values for independent variables (GC, GS, PB, RD, SI) ranged from 1.049 to 1.466, well below the threshold of 5 (Hair et al., 2022). This confirms the absence of multicollinearity, ensuring the reliability of subsequent hypothesis testing

The structural model was evaluated using the bootstrapping technique (5,000 resamples). The results supported all four direct hypotheses ($p < 0.05$). Specifically, PB ($\beta = 0.156$; $p = 0.000$) had a significant positive effect on UA, consistent with (Safeena et al., 2014) regarding the role of perceived benefits. Conversely, RD ($\beta = -0.243$; $p = 0.000$) exerted a significant negative effect, highlighting the impact of cognitive barriers as found in previous studies (Nguyen-Viet & Ngoc Huynh, 2021; Safeena et al., 2014). SI ($\beta = 0.326$; $p = 0.000$) emerged as the strongest positive predictor, aligning with (Venkatesh et al., 2003) and (Safeena et al., 2014) Additionally, GC ($\beta = 0.281$; $p = 0.000$) showed a significant positive impact, supporting the findings of (Chen & Chang, 2012) on the role of green perceived values. Overall, SI was the most influential factor, followed by GC, RD, and PB.

5.5. Results of the Moderation Test

The structural model analysis, using bootstrapping (5,000 samples), confirmed that all moderating effects on UA were statistically significant ($p < 0.05$). With positive β coefficients for all interaction terms, GS effectively amplified the positive impacts of SI, GC, and PB on UA while mitigating the negative effect of RD.

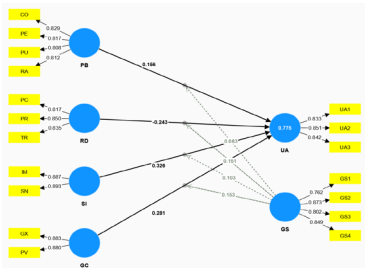
Furthermore, an adjusted R^2 of 0.771 indicates that the model explains 77.1% of the variance in adoption behavior. According to (Hair et al., 2022), this reflects substantial explanatory power, validating the significant role of both independent and moderating variables in predicting customer behavior.

Regarding the contribution of f2, the variables SI, GC, and RD exhibited moderate effects (ranging from 0.231 to 0.321), while PB had a small effect (0.081). The moderating effects of GS were all small (ranging from 0.029 to 0.117) but remained statistically significant and consistent with the characteristics of interaction terms in the PLS-SEM model.

The model showed strong predictive power with: Q2 = 0.765 > 0. Both RMSE (0.487) and MAE (0.373) fell within acceptable ranges, indicating high accuracy and minimal sensitivity to outliers. Furthermore, the model achieved a good fit with an SRMR of 0.050 <0,08 which was lower than the saturated model (0.052), confirming that structural relationships did not increase the model's error

So, all test statistics met the required criteria, so the Stage 2 PLS-SEM research model was presented as follows:

Figure 3. The research model for Stage 2 of PLS-SEM



Source: Authored by PLS_SEM

5.6. Results of Multigroup Analysis by Demographic Groups

5.6.1. Measurement Invariance Test (MICOM)

Step 1: Configural Invariance

The models across all demographic groups (ethnicity, occupation, education level, age, gender, and residential area) were established using an identical model structure, the same set of indicators, and the same PLS algorithm. This ensured configural invariance, providing a consistent basis for subsequent testing (Hair et al., 2022).

Step 2: Compositional Invariance

The results of the permutation test (with 5,000 permutations) for the six demographic variables indicated that the original correlations were high and the p-values exceeded 0.05 for all comparison pairs. Specifically, no statistically significant differences were found across ethnicities, occupations, educational levels, ages, genders, and residential areas. Thus, compositional invariance was confirmed for all demographic variables, satisfying the requirements for conducting Multi-Group Analysis (MGA) in PLS-SEM.

5.6.2. Multigroup Analysis (MGA)

Based on the p-value difference criterion, the majority of group comparisons showed no statistically significant differences ($p > 0.05$). However, the study highlights notable exceptions where significant differences were found, specifically in the SI → UA path between the Khmer and Kinh ethnic groups, and the PB → UA path between the 29–43 age group and those over 43 ($p < 0,05$)

Bootstrapping results confirmed that most relationships were significant at the 5% level, except for the PB → UA path in the postgraduate group. SI → UA emerged as the dominant predictor across nearly all segments, including Chinese–Khmer, Civil Servants–Students, Male–Female, Rural–Urban, and Young–Middle-Aged adults. Conversely, GC → UA was most prominent among the Kinh ethnic group, the self-employed, and university-educated individuals. These findings indicate that the model remains stable, demographic differences primarily manifest in effect intensity rather than direction.

6. Solutions and policy recommendations

Based on PLS-SEM results, Vietnamese commercial banks should prioritize interventions following the hierarchy of factors. Specifically, banks should leverage Social Influence (SI) through referral programs, social media, and employee support, while promoting Green Concern (GC) via transaction digitization, resource-saving features, and environmental reporting to bolster trust. To address barriers, Risk Dimension (RD) must be neutralized by strengthening security, simplifying UI/UX, and providing 24/7 support, while Perceived Benefits (PB) are maximized through optimized transaction speeds and advanced financial tools. Finally, implementing specialized segmentation for ethnic and age groups will enable tailor-made communications and instructional content, optimizing adoption across the Mekong Delta region.

Furthermore, the State Bank of Vietnam (SBV) should align support policies to: (i) amplify Social Influence (GS × SI) through robust legal frameworks and national campaigns; (ii) promote Green Concern (GS × GC) by providing capital support for banks to invest in environmental technologies, enabling them to establish incentive programs targeting users with green awareness in online transactions; (iii) maximize Perceived Benefits (GS × PB) via infrastructure development and e-KYC refinement; and (iv) minimize Risk Dimension (GS × RD) through stringent security standards and 24/7 fraud monitoring. Finally, both banks and the SBV must implement inclusive strategies tailored to ethnic and age-specific characteristics through localized communication and digital literacy programs, thereby narrowing the digital divide and promoting financial inclusion in the Mekong Delta region.

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