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Original Paper

The Risk Suitable Online Banking Adoption Model for Elderly Individuals in Thailand

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Abstract *- This study examines the factors influencing the adoption of online banking among elderly individuals in Thailand. Specifically, it explores the relationship between six dimensions of perceived risk-financial, performance, privacy, security, social, and time risk-and the role of electronic Word-Of-Mouth (e-WOM) in shaping behavioral intentions toward online banking adoption. A multi-stage sampling approach was employed to collect data from 480 respondents in Thailand, and Structural Equation Modeling (SEM) was utilized for data analysis. The findings indicate that perceived risk and e-WOM significantly impact the adoption and usage of online banking among the elderly. Perceived risk plays a crucial role in shaping users' decisions, while e-WOM serves as a mediating factor between perceived risk and behavioral intention. These results underscore the importance of managing perceived risks and leveraging positive e-WOM to encourage online banking adoption among elderly users. This study offers practical implications for two key stakeholders. First, online banking developers can use these insights to design user-friendly and accessible banking systems that align with the needs and lifestyles of elderly users. Second, executives and policymakers can develop strategic initiatives and regulatory frameworks that mitigate perceived risks while enhancing consumer trust and engagement. To providing a comprehensive understanding of the factors influencing online banking adoption among the elderly, this research contributes to the existing literature and offers actionable insights for enhancing user acceptance and engagement with digital financial services.*

Keywords *- Online banking, Perceived risk, e-WOM, Behavioral intentions, SEM.*

1. Introduction

Online banking has revolutionized organizational procedures, having profound effects on bank employees. Digital transformations in the banking sector drive operational cost efficiency, with less impact on physical branches and employment[1]. The study revealed banking employees' perceptions toward adopting and integrating digital banking into their daily routines. Both management and employees generally express satisfaction with digitalization trends, despite potential concerns about income loss and job displacement. Cybersecurity emerges as a significant challenge, and education is viewed as crucial for improving organizational skills and effectiveness[2]. emphasize that complexities, such as the COVID-19 pandemic, pose significant challenges for businesses in today's uncertain environment.

To address these challenges, they propose Business Model Dynamics as a strategic solution. Adds that IT transformations pave the way for new business model solutions in the financial service industry. According to [3] acknowledges that while literature has explored digital transformation aspects, its nature and implications remain underexplored. They propose a model incorporating the ethical dimension and the role of capabilities.

The Thailand banking sector is flourishing, playing a vital role in development and economic growth. According to the authors [4] Technological advancements have reshaped the Thailand banking and financial landscape, introducing new products and services such as mobile and internet banking. According to the study supports observations, focusing on financial innovations that have led to significant improvements in banking services and operations, while also acknowledging the benefits and challenges of evolving banking trends.

Due to heightened competition, pressure on spreads, and systemic changes, banks must adopt a holistic approach to meet customer needs and capture market share. Banks' survival and profit growth hinge on productivity, efficiency, and a shift in employee mindset. To retain customers, banks must adopt new technologies and enhance internal procedures. In Deutsche Bank's competitive actions in the digitalizing

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European banking industry, suggesting the Red Queen theory for achieving successful performance in a hyper-competitive environment. This theory emphasizes developing the capability to rapidly identify and capitalize on innovative opportunities to maintain a competitive edge[5].

A primary concern for banks in this context is customers' perceived risks associated with transitioning from physical channels to the IB and its adoption. By recognizing and analyzing these risks, banks can develop strategies to attract and retain IB customers. Perceived risk theory, a central concept in IB adoption research, measures customers' perceived risk dimensions in Information Technology (IT) adoption[6]. Over the past decades, limited studies have examined these dimensions within the IB adoption context.

The moderating role of awareness in the impact of perceived risk dimensions on IB adoption by customers. Their research model examined the effect of IB awareness on each perceived risk dimension and the influence of these dimensions on IB adoption intention. Results indicated that, except for social risk, other dimensions of perceived risk (time, financial, performance, security, and privacy) negatively impacted the intention to adopt IB[7].

Their supplementary analysis also demonstrated the moderating role of awareness in this negative effect. In response to the rapid pace of technological change, banks must constantly update their strategies to align with customer needs in a secure environment. This involves gathering and analyzing customer feedback on perceived risks and service value, adapting strategies accordingly, and equipping themselves with the latest adaptation technologies[5]. Informing the banking system about the evolving customer perceptions of risk dimensions and their impact on IB adoption over time allows them to re-prioritize and refine existing strategies to mitigate these risks.

Moreover, E-WOM acts as a mediator between involvement on social networking sites and purchase intentions [8]. Examined E-WOM's effect on Facebook toward hotel booking intentions, user trust, attitudes, and website perceptions. Positive Facebook comments significantly influence hotel booking intentions, user attitudes, trust, and website perceptions more than negative comments. According to [9] explored E-WOM's influence on the internet and Social Networking Sites (SNS) across product types, considering gender as a mediating variable.

The study found differences between perceptions from the internet and SNS. Females favored SNS recommendations over internet recommendations for purchasing mobile phones and travel services compared to males. According to the author [10] concluded that extensive social media use and reliance on E-WOM can lead to impulsive consumption of visually appealing but unnecessary products. However, in the field of IB adoption, most studies are cross-sectional, measuring customer views at a single point in time and basing their analysis and suggestions on that data.

The proposed Risk Suitable Online Banking Adoption Model for elderly individuals in Thailand aims to reduce customers' perception of risk and increase online adoption, positively influencing their future intentions to use these services. Many older adults struggle with technological anxiety, usability issues, and security concerns, which deter them from fully engaging with online banking platforms. While prior studies of [11] highlight ease of use and perceived usefulness as primary adoption drivers, these models may not fully capture the risk perceptions and financial literacy constraints unique to elderly individuals.

This research focuses on three primary areas: understanding the role of various perceived risk dimensions in elderly customer's adoption of online banking services in Thailand, identifying the importance of e-WOM strategies to improve online banking adoption, and fostering stronger intentions to adopt online banking through these strategies. By implementing such strategies, banks can create an environment that encourages e-WOM and builds confidence in online banking services.

2. Literature Review

This study focuses on the examination of perceived risk as a key factor in defining and predicting individuals' mindsets, trust, and behavioral intentions towards the adoption of online banking. A proposed research model (see Figure 1) is presented to address this research question. The following sections will explore the different variables proposed in this research and their expected relationships with behavioral expectations regarding the adoption and retention of digital banking services.

2.1. Behavioral Intentions to Use Online Banking Adoption

Existing studies emphasize a diverse set of determinants that contribute to the acceptance of e-commerce transactions. Technology Acceptance Model (TAM) significantly advanced our understanding of technology acceptance, positing that it primarily stems from perceived usefulness and perceived ease of use by end-users [12]. These perceptions, in turn, shape attitudes toward usage, ultimately leading to the intention to use, which reflects user loyalty. Subsequent studies [13, 14] have confirmed the reliability and validity of TAM dimensions in assessing online banking adoption.

In the context of online banking, studies have shown that website content and design, navigation, interactivity, and security influence user satisfaction. According to [15] observed strong relationships between online banking service quality, customer satisfaction, and customer retention in the Korean context. According to [16] identified website design, transaction speed, security, information content, and customer

support service as significant antecedents of customer satisfaction in online banking in China. According to [17] found transaction processing and service availability to be crucial determinants of customer satisfaction in the online banking environment. Zhu and Chen (2012) [18] highlight the role of fairness, encompassing distributive fairness, procedural fairness, and informational fairness, in shaping experience-based customer satisfaction in online banking. They established that a consistently fair system promotes trust among users, ultimately contributing to a satisfying overall web-banking experience.

Despite the growing adoption of online banking worldwide, elderly individuals in Thailand face significant barriers in embracing these digital financial services. Existing research has primarily focused on general user adoption models (e.g., UTAUT, TAM) or security concerns in online banking, yet there remains a notable gap in studies addressing the specific risks and challenges faced by elderly users in developing economies. In Thailand, the adoption of online banking among the elderly remains relatively low due to technological barriers, security concerns, and a strong preference for traditional banking methods.

Many older adults struggle with mobile banking apps due to unfamiliarity with smartphones, complex authentication processes, and concerns about online fraud, which has been on the rise in the country. Additionally, language barriers and limited digital literacy further hinder adoption, particularly in rural areas where financial education is less accessible.

While major Thai banks, such as Bangkok Bank and Kasikornbank, have introduced senior-friendly digital services and educational programs, a significant portion of the elderly population still relies on in-person transactions. The government and financial institutions are working to improve digital inclusion by offering simplified banking apps, digital literacy training, and fraud prevention awareness campaigns to build trust and ease the transition to online banking for Thailand's aging population [4].

2.2. Perceived Risk

Perceived risk refers to customer's apprehension about potential negative consequences associated with critical factor in online banking adoption [19]. In other words, it reflects customer's perception and belief in the possibility of adverse outcomes in online and electronic exchanges [20]. According to [7] first introduced perceived risk theory, categorizing consumer preferences as either risk-taking or risk-reducing behavior. Perceived risk is a widely applied theory in IT adoption research, with IB being one of the IT contexts explored by researchers in this field. According to [7] state that PRT's distinctive feature is its focus on customers' negative perceived concerns (risks) regarding IT adoption, in contrast to other IT adoption theories and models. According to PRT, perceived risk is a multidimensional construct encompassing various risk dimensions [21]. Researchers in different contexts have considered different dimensions of perceived risk based on their specific product or service category [20]. In the context of IB, several researchers have employed PRT to examine the dimensions of the risks perceived by customers [1]. According to [7] identified six risk dimensions based on a literature review: performance, privacy, psychological, security, time, and social risks.

2.2.1. Performance Risk

Performance risk refers to the possibility of a product or service malfunctioning and failing to deliver the advertised features and benefits. In the context of IB, this risk can be associated with factors affecting the efficiency and effectiveness of IB from the customer's point of view, such as poor system performance due to slow download speeds, server downtime, or website maintenance [7]. This risk primarily relates to the bank's malfunction or shortcomings [19, 20] have recognized performance risk as a significant dimension of perceived risk in IB adoption.

Hypothesis 1: Performance risk significantly influences e-WOM towards online banking adoption.

2.2.2. Privacy Risk

Privacy risk centers on customers' concern about losing control over their private information [7]. In the IB context, consumers may fear identity theft during service usage due to hacker intervention or banks sharing customer data with third parties for other purposes [22]. According to [23] have acknowledged privacy risk as a perceived risk dimension in IB adoption.

Hypothesis 2: Privacy risk significantly influences e-WOM towards online banking adoption.

2.2.3. Psychological Risk

Psychological risk in the context of m-banking app usage refers to the potential concerns and anxieties that users may experience when engaging with the app due to factors related to their psychological well-being. Unsuccessful transactions through the app can lead to feelings of frustration, anxiety, or loss of self-esteem. Such experiences may even challenge the customer's self-image [24]. Several studies have also found that older customers may be hesitant to use m-banking apps because of the perceived psychological risk involved.

For example, older customers may be worried about making mistakes, being scammed, or losing their money. Additionally, they may not be comfortable using technology or may have difficulty learning how to use new apps [25]. Therefore, it is essential to conduct an evaluation of the psychological risk associated with the utilization of these applications. This necessity is substantiated by the subsequent hypothesis.

Hypothesis 3: Psychological risk significantly influences e-WOM towards online banking adoption.

2.2.4. Security Risk

Security refers to the capability to protect information against potential threats [26]. The general concept of security risk pertains to the possibility of misuse and fraud of personal information. In the context of IB, this risk encompasses concerns about internet security and IB systems security [22], including internet theft, hacking of bank sites, and unauthorized intrusion. Numerous studies, including those by [23], have highlighted the negative impact of security risk on IB adoption.

Hypothesis 4: Security risk significantly influences e-WOM towards online banking adoption.

2.2.5. Social Risk

Social risk represents the possibility of receiving negative feedback or responses from customers' social networks [22]. In the context of IB, this risk addresses customer concerns regarding potential negative views of family, friends, and colleagues about IB. It also includes concerns about the loss of social status in the event of fraud or errors, and the inability to directly contact and receive assistance from bank employees when using IB [7].

Hypothesis 5: Social risk significantly influences e-WOM towards online banking adoption.

2.2.6. Time Risk

Time risk can be broadly defined as the possibility of wasted time as a result of searching, repurchasing, and learning how to use a product or service. In the context of IB, this risk encompasses customer concerns about the time required to learn how to use IB troubleshoot problems (such as transaction errors), and complete transactions [7]. Studies by [23] have confirmed that time risk is one of the barriers to IB adoption.

Hypothesis 6: Time risk significantly influences e-WOM towards online banking adoption.

2.3. e-WOM

Engaging in eWOM demonstrates the customers' willingness to try new ideas or become pioneers in any endeavor. e-WOM refers to past, present, or future customer expressions highlighting favorable or unfavorable aspects of products and services within an online community [27]. Sharing many similarities with traditional Word-Of-Mouth (WOM), e-WOM's distinctive feature lies in its ability to reach a vast audience [27]. e-WOM manifests on social media in a variety of ways. Customers can intentionally share information about brands, products, and services without being paid. Alternatively, they can display interest in a brand simply by 'liking', commenting, or becoming a member of a brand's page. Advertisers also utilize social media, websites, and accounts to post advertisements [28]. Social networks like Facebook, LinkedIn, X, Google, and YouTube offer diverse formats such as chat rooms, review sites, and blogs that facilitate the spread e-WOM [29]. The effectiveness of e-WOM is enhanced by its lack of time or place constraints, making it a potent marketing avenue. However, e-WOM does not entirely replace traditional WOM [30]. Online customers can be categorized into two types: those who actively post their thoughts and opinions, and silent customers who read feedback from others [31]. Information shared online is often written and can persist indefinitely, unlike traditional WOM. However, a drawback of e-WOM is the potential anonymity of those sharing opinions [34].

According to [33] examined the influence of e-WOM on mobile banking acceptance in Iran. It explored how various factors impact the adoption of mobile banking services. Their findings revealed that WOM was the primary factor influencing user attitudes toward mobile banking, and that positive WOM affects other factors related to mobile banking acceptance. While previous research in Iran focused on numerous determinants of mobile banking acceptance, few studies specifically examined the role of WOM.

Hypothesis 7: e-WOM directly influences behavioral intentions in online banking adoption.

Despite previous empirical studies failing to find evidence that perceived risk, e-WOM, and adoption to use mediate the relationship between perceived risk and online banking adoption in Thailand, this study aims to investigate the potential indirect influence of perceived risk and adoption to use on online banking utilization. Specifically, this study explores the mediating role of e-WOM (H8, H9, H10, H11, H12 and H13).

Hypothesis 8: Performance risk indirectly influences online banking adoption through e-WOM as a mediator.

Hypothesis 9: Privacy risk indirectly influences online banking adoption through e-WOM as a mediator.

Hypothesis 10: Psychological risk indirectly influences online banking adoption through e-WOM as a mediator.

Hypothesis 11: Security risk indirectly influences online banking adoption through e-WOM as a mediator.

Hypothesis 12: Social risk indirectly influences online banking adoption through e-WOM as a mediator.

Hypothesis 13: Time risk indirectly influences online banking adoption through e-WOM as a mediator.

Drawing on theoretical frameworks and empirical evidence, this research paper proposes a set of hypotheses to evaluate the factors that influence individuals' behavioral intentions to use internet banking services. It also develops a comprehensive model (Figure 1) to illustrate the relationships between these factors. The study focuses on evaluating various factors that significantly impact business performance, including service quality, perceived risk, and trust. Perceived risk and trust are considered intervening variables in this study. The primary data collection method was a questionnaire-based survey conducted in Thailand. A comprehensive analysis using Structural Equation Modelling (SEM) was conducted on a sample of 4580 valid questionnaires. The study aimed to gain insights into how internet banking can improve the overall image of a bank by investigating the impact of perceived risk and trust on individuals' behavioral intentions to use internet banking services. It also sought to address security concerns and identify potential future challenges.

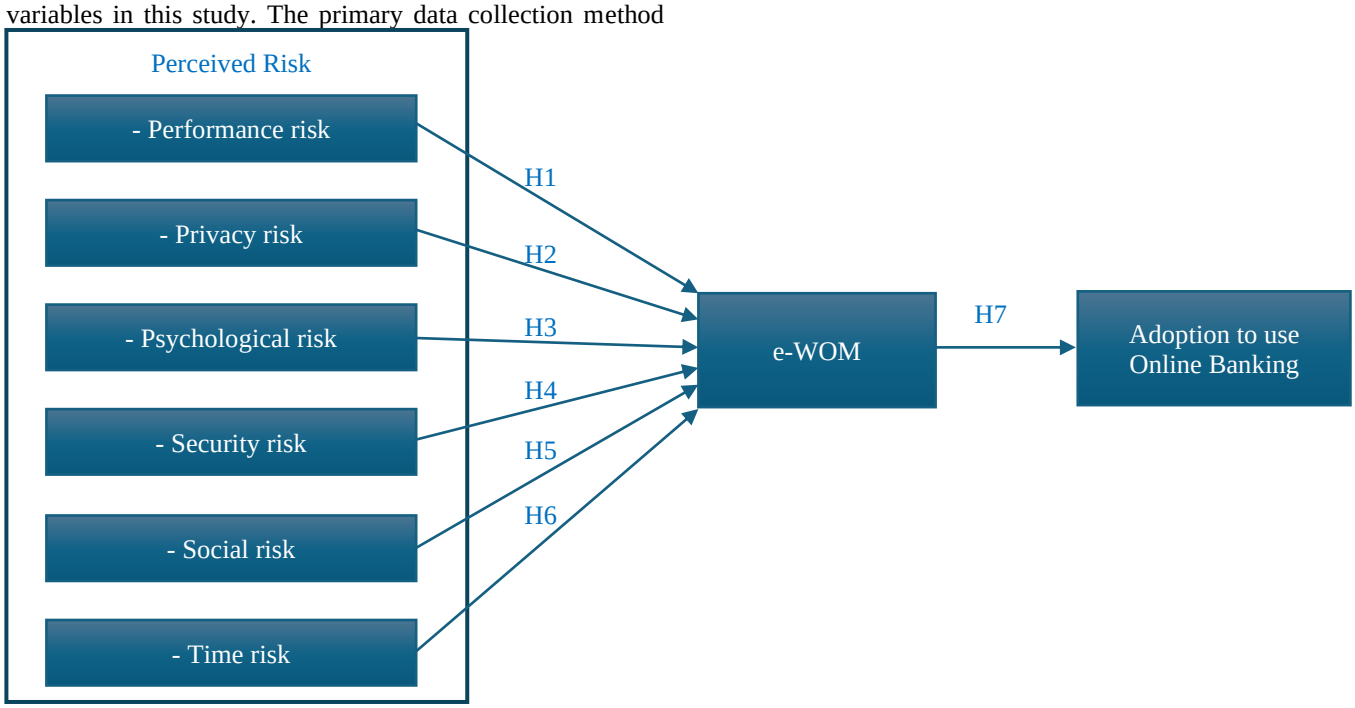

Fig. 1 Pictorial representation of the model

3. Methodology

3.1. Population, Sampling, and Data Collection

Due to the extensive population size and limited available data on the total number of individuals, [34] provided a widely used guideline for determining an appropriate sample size for Structural Equation Modeling (SEM). They recommended that the minimum sample size should be 5 to 10 times the number of parameters to be estimated to ensure statistical stability and reliable results. Thus, this research involves 26 × 15 parameters, leading to a minimum required sample size of 390 participants. This ensures statistical stability and sufficient power for the SEM analysis.

A multi-stage sampling approach was utilized for participant selection. Initially, comprehensive data was gathered from all major banks in Thailand offering online banking services. Subsequently, a simple random sampling technique, the lottery method [35], was used to select half of the banks from each of the three size categories (large, medium, and small). This resulted in a sample of 2 banks from the large category, 2 from the medium category, and 3 from the small category. In the last stage, quota sampling ensured representative sample groups. The target was a minimum of 400 respondents, with 50% (200) from large banks, 35% (140) from medium banks, and 15% (60) from small banks [36]. The sample is a group of 505 Thai adults aged 55 years and older who usually access the Internet and are able to conduct financial transactions through online banking.

Data collection involved online questionnaires administered to respondents meeting three inclusion criteria: (1) Thai nationals with savings accounts in Thai commercial banks, (2) registered online banking users, and (3) experience utilizing online banking. Online questionnaires were distributed via social media [37]. The process with an initial respondent chosen through simple random sampling. Subsequent participants were recommended by initial respondents or received questionnaires directly. The online questionnaires were specifically designed to collect data from participants, considering their gender, age, education, occupation, and income to ensure a comprehensive examination of internet banking services across various

demographic characteristics. The sample size was deemed adequate for the research objectives.

3.2. Variable Measurement

This study employed a three-factor model comprising of perceived risk, e-WOM, and adoption to use as key factors explaining the inclination toward online banking adoption among elderly individuals in Thailand. A structured questionnaire consisting of 8 statements under three constructs served as the survey instrument. Responses were measured on a 5-point Likert scale (strongly disagree (1) - strongly agree (5)) and obtained from 505 banking customers in Thailand. After data cleaning and removal of invalid responses, data from 480 customers were retained for the final analysis.

3.3. Measurement Validation

A preliminary test was conducted with 30 individuals knowledgeable about internet banking in Thailand to ensure the instrument's reliability and validity. Feedback on structure, word choice, formatting, language, and rating scales was collected and analyzed using IBM SPSS version 20. A reliability test on 54 questionnaire items yielded a Cronbach's alpha of 0.903, exceeding the 0.7 threshold, indicating high internal consistency [38].

3.4. Constructs of the Research Model

The proposed research model consists of 8 latent constructs. A latent construct cannot be measured directly but can be represented or measured by one or more variables (indicators). An observed (measured) variable is a specific item or response obtained from respondents through a questionnaire or from some form of observation. Measured variables serve as indicators of latent constructs. A set of these indicators is associated with individual latent constructs and is specified by the researcher [39].In our study, we validate the construct of perceived risk using 22 measured variables, e-WOM with 4 measured variables, and adoption to use with 3 measured variables. These constructs are considered major factors influencing online banking adoption, with the overall online banking adoption among the elderly being the ultimate outcome construct.

4. Results and Discussion

This study employed a range of statistical methods to analyze the data, including frequency and descriptive statistics (averages, percentages, variances, and tests for normality to assess one-dimensionality), Confirmatory Factor Analysis (CFA), convergent validity (Average Variance Extracted, AVE), discriminant validity, and Structural Equation Modeling (SEM).

These methods were utilized to assess the reliability and validity of the collected data to explore the relationships between the variables under investigation. SEM, in particular, has been widely recognized as a valuable confirmatory method for assessing and enhancing theoretical models [40].

4.1. Characteristics of the Respondents

A demographic analysis of the 480 respondents showed that the majority were women (57%), aged 31-35 (37.00%), with undergraduate degrees (52.30%), employed as government servants (28.50%), and earning monthly incomes above 20,000 Baht (48.7%). About 36.60% of the respondents had 1-3 years of experience using internet banking. The demographic analysis is summarized in Figure 2.

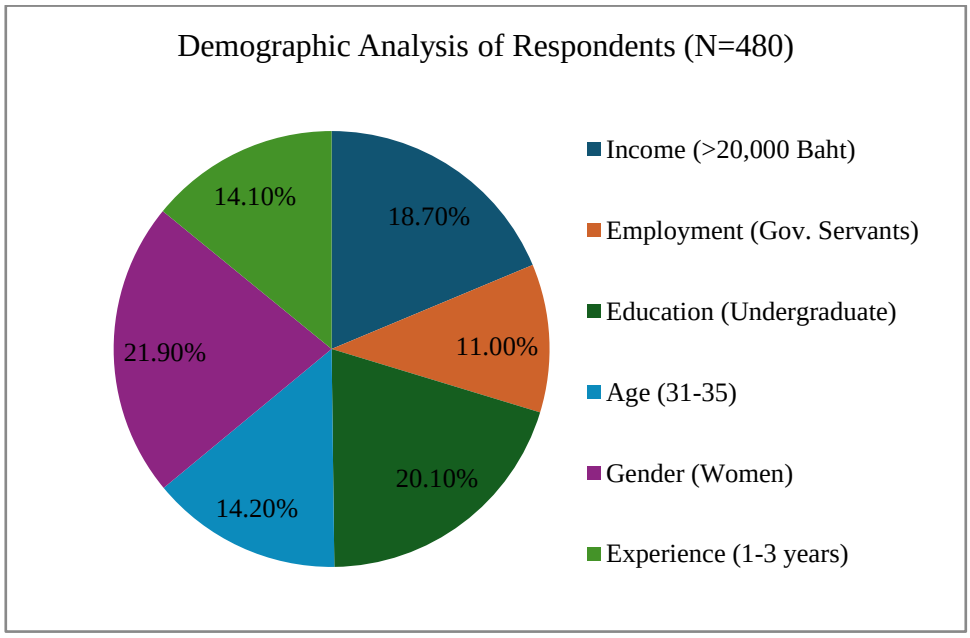

Fig. 2 Pictorial representation of demographic

4.2. Test for Normality

The measurement model was developed through a three-stage approach. In the first stage, the data distribution was assessed for normality, a critical assumption for many statistical tests. Skewness and kurtosis values were employed to evaluate normality, within the acceptable ranges of -2.0 to 2.0 and -7.0 to 7.0, respectively. In the second stage, the internal consistency and reliability of the constructs were evaluated using Cronbach's alpha, a widely recognized reliability measure in social science research, where values above 0.70 are generally considered acceptable. Following the reliability assessment of the 51-item questionnaire, Cronbach's alpha values for the constructs were: SQ: 0.926, PCR: 0.902, and BI: 0.880. However, the observed variable for social risk yielded a Cronbach's alpha below the 0.7 threshold, leading to the exclusion of items PS1 and PS2 from the analysis model. In the third stage, to further assess the reliability of the measurement model, the standardized regression weights of each item were analyzed. Items with standardized factor loadings below 0.6 were removed, following the recommendations of [40]. Consequently, eleven items - PF4, SP13, SP10, SR5, SR7, ST2, PP13, PT18, SE20, SE21, and SE22 - were excluded for not meeting this criterion. Composite reliability and AVE values were calculated using fully standardized solutions from the CFA results (Hult et al., 2004) [41]. The findings from these analyses are summarized in Table 1.

Table 1. Construct reliability findings

Constructs	Observed Variables	Cronbach's Alpha (α)
Perceived Risk		**0.902**
	Performance risk (PE10, PE11, PE12)	0.712
	Privacy risk (PR14, PR15, PR16)	0.782
	Psychological risk (PY7, PY8, PY9)	0.806
	Security risk (PS5, PS6)	0.804
	Social risk (PO17, PO18, PO19, PO20)	0.806
	Time risk (PT17, PT18, PT19, PT20)	0.804
e-WOM	WOM1, WOM2, WOM3 and WOM4	**0.880**
Adoption to Use	AU1, AU2, and AU3	**0.880**

4.3. Convergent Validity

The analysis of standardized loadings and validity (Table 2) indicates that all observed values for factor loadings, CR, and AVEmeet the predetermined criteria, suggesting satisfactory convergent validity of the research findings.

The assessment of convergent validity in this present inquiry was conducted using three criteria - factor loadings, CR, and AVE - as recommended by Fornell and Larcker (1981)[42]. Factor loadings measure the strength of the relationship between items on a scale and a latent variable, while CR assesses the consistency of results by determining the extent to which items are free from random error.

AVE gauges the proportion of variance explained by the latent variable relative to random measurement error. For satisfactory convergent validity, each criterion must exceed specified thresholds: factor loadings should be above 0.6 [43], CR values should be above 0.7 [40], and AVE values should be above 0.5 [42]. The examination in Table 2 confirms that all observed values for factor loadings, CR, and AVE meet these predetermined criteria. Therefore, the available data supports the conclusion that the convergent validity of the research findings is deemed satisfactory.

4.4. Discriminant Validity

To evaluate whether the constructs were distinct from each other, the square root of AVE for each construct was calculated. This value was then compared to the correlations between the variables and other constructs to confirm their distinctiveness [42].

Table 2. Assessment of standardized loadings and validity

	Standardized Loadings			**Discriminant Validity**						
Construct		**CR**	**AVE**	**e-WOM**	**BI**	**PS**	**PR**	**PE**	**PO**	**PY**
e-WOM	-0.668	0.718	0.509	0.678						
BI	0.758 – 0.928	0.880	0.711	0.615	0.501					
Security risk	0.637 – 0.753	0.911	0.836	0.325	0.337	0.486				
Privacy risk	0.533 – 0.730	0.775	0.538	0.422	0.102	0.399	0.418			
Performance risk	0.877 – 0.949	0.682	0.510	0.302	0.308	0.292	0.615	0.555		
Social risk	0.877 – 0.949	0.862	0.676	0.183	0.167	0.267	0.398	0.315	0.415	
Time risk	0.761 – 0.870	0.674	0.500	0.442	0.484	0.545	0.264	0.301	0.398	0.506

Based on the results, the square root of the AVE values is significantly higher than the correlation values (as shown in Table 2). This outcome further supports the existence of robust discriminant validity of the constructs included in this investigation.

4.5. Measurement Model and Structural Model Assessment

4.5.1. Measurement Model

In the second phase of the study, a comprehensive set of 39 items was utilized to evaluate the effectiveness and efficiency of the Confirmatory Factor Analysis (CFA) framework. The adequacy of the Structural Equation Model (SEM) was based on its ability to accurately replicate the observed covariance matrix of the indicator variables. Model fit was assessed using several indices, categorized into four distinct groups as outlined by Hair et al. (2010) [38]: (1) Chi-square measures, which include degrees of freedom (df), probability, and chi-square statistics; (2) Absolute fit indices, which consist of Root Mean Square Residual (RMR), Root Mean Square Error of Approximation (RMSEA), and Goodness-of-Fit Index (GFI); (3) Parsimony fit indices, which comprise the Parsimony Normed Fit Index (PNFI) and the adjusted Goodness-of-Fit Index (AGFI); and (4) Incremental fit indices, which include the Normed Fit Index (NFI) and the Comparative Fit Index (CFI).

The chi-square ($\chi 2$) statistic is the only inferential statistic among the SEM fit indices, while the others are descriptive. This implies that the chi-square test can be used to test the null hypothesis that the model perfectly fits the data, while the other indices provide guidance on the model's fit-quality (Iacobucci, 2010)[44].

4.5.2. Structural Model

The results presented in Table 3 and Figure 3 indicate that the measurement model demonstrated a satisfactory fit (χ^2 = 1139.72, df = 362, p-value > 0.05), supported by other fit indices that fall within acceptable ranges (RMSEA = 0.046, RMR = 0.048, CFI = 0.910, IFI = 0.910, TLI = 0.895, AGFI = 0.850, and PNFI = 0.757).

Table 3. Evaluation of model fit using fit indices

Fit Indices	Fit Criteria	Measurement Model	Structural Model
Chi Square ($\chi 2$)		651.46	1139.72
Degrees of Freedom		179	362
P-value	≥ 0.5	0.000	0.000
CMIN ($\chi 2$)/DF	< 5.00	3.639	3.886
RMSEA	≤ 0.05	0.045	0.046
RMR	≤ 0.05	0.047	0.048
CFI	≥ 0.9	0.918	0.910
TLI	≥ 0.8	0.904	0.895
IFI	≥ 0.9	0.918	0.910
AGFI	≥ 0.8	0.857	0.850
PNFI	≥ 0.5	0.759	0.757

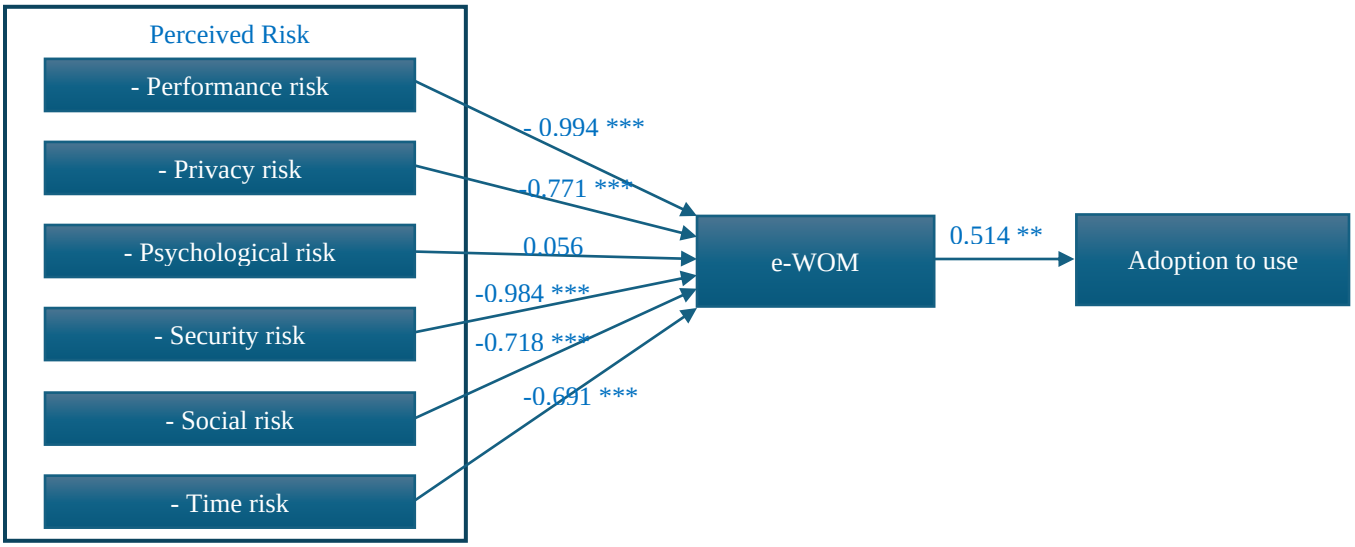

Fig. 3 Summary of the model

4.6. Hypotheses Testing

The final analysis revealed a significant relationship between the seven variables and the adoption of online banking, with an R-squared value of 0.498. This indicates that the model's hypotheses, specifically H1, H2, H4, H5, H6, and H7, collectively explained 49.8% of the variance in adoption.

All six hypotheses were strongly supported by the findings, with beta coefficients as follows: H1: -0.994 ($p \leq 0.000$), H2: -0.771 ($p \leq 0.000$), H4: -0.984 ($p \leq 0.000$), H5: -0.718 ($p \leq 0.000$), H6: -0.691 ($p \leq 0.000$), and H7: -0.514 ($p \leq 0.000$), respectively. However, Hypothesis H3 ($\beta = 0.056$, $p \leq 0.346$) was rejected, as it did not show a significant relationship between the variables (Table 4, Figure 3).

The indirect effects of perceived risk on BI through attitude and trust were comparable. To assess the difference in these indirect effects, a bootstrapped sampling distribution was generated with 2,000 replications. In Amos 21, a user-defined estimate was employed to test the difference in indirect effects.

The study findings support hypotheses H5 and H6, indicating that attitude and trust mediate the relationship between perceived risk and BI. Specifically, the indirect effect of perceived risk on BI through both attitude and trust ($\beta = 0.509$, $p \leq 0.000$) was significantly greater than the indirect effect of perceived risk on BI through attitude alone ($\beta = -0.043$, $p \leq 0.00$)

Table 4. Summary of effects and hypotheses testing outcomes

Hypotheses	Result	Standardized Estimates
Hypothesis 1: Performance risk significantly influences e-WOM towards online banking adoption.	Supported	-0.994***
Hypothesis 2: Privacy risk significantly influences e-WOM towards online banking adoption.	Supported	-0.771***
Hypothesis 3: Psychological risk significantly influences e-WOM towards online banking adoption.	Not Supported	0.056
Hypothesis 4: Security risk significantly influences e-WOM towards online banking adoption.	Supported	-0.984***
Hypothesis 5: Social risk significantly influences e-WOM towards online banking adoption.	Supported	-0.718***
Hypothesis 6: Time risk significantly influences e-WOM towards online banking adoption.	Supported	-0.691***
Hypothesis 7: e-WOM directly influences online banking adoption.	Supported	-0.514***
Hypothesis 8: Performance risk indirectly influences online banking adoption through e-WOM as a mediator.	Supported	0.509***
Hypothesis 9: Privacy risk indirectly influences online banking adoption through e-WOM as a mediator.	Supported	0.509***
Hypothesis 10: Psychological risk indirectly influences online banking adoption through e-WOM as a mediator.	Supported	0.509***
Hypothesis 11: Security risk indirectly influences online banking adoption through e-WOM as a mediator.	Supported	0.509***
Hypothesis 12: Social risk indirectly influences online banking adoption through e-WOM as a mediator.	Supported	0.509***
Hypothesis 13: Time risk indirectly influences online banking adoption through e-WOM as a mediator.	Supported	0.509***

5. Discussion

The data analysis has yielded several key findings with relevant interpretations and implications, discussed as follows:

The primary risk influencing online banking adoption among the elderly in Thailand is performance risk. This finding suggests that as performance risk, its negative impact on the adoption model also lessens. The stability of performance risk indicates that customers continue to express concerns about slow loading times, server errors, website maintenance, and unmet expectations related to online banking benefits. These concerns persist, leading to hesitation in adoption. Consistent with these results, Roy et al. (2017) [20] highlighted performance risk as a critical factor in online banking adoption, recommending banks emphasize the benefits of improved IB efficiency in advertising. Matsuo et al. (2018) [19] also underscored this risk's role, noting that a focus on social learning and influence theories could mitigate it. Notably, the security risk path coefficient has increased to 0.984, indicating that over time, customers perceive greater security concerns, which impacts their reluctance to adopt online banking. Feelings of insecurity about sending and receiving Key concerns include the security of financial data

transmission, unauthorized access (e.g., hackers), and overall internet security as an online banking platform.

These heightened security concerns align with Chang et al. (2018)[23], who emphasized potential online banking security issues, such as complex hardware requirements, additional authentication layers, hidden fees, and weak password protocols. Salem et al. (2019) [22] similarly stressed the importance of perceived technology security in influencing customers' willingness for online banking adoption. Their study analyzed Thailand's cybersecurity risks in online banking, proposing models to bridge gaps between banks and their customers.

Privacy risk, with a path coefficient change to -0.771, indicates that as customers' awareness of privacy risks grows, so does their hesitance toward online banking. Concerns over unsolicited messages, unauthorized data sharing, and unconsented use of financial data continue to hinder adoption. Chang et al. (2018) [23] noted the increasing importance of privacy risk due to the growth of sensitive data in online banking, advocating for comprehensive privacy policies to reduce this risk. Hanafizadeh and Khedmatgozar (2014) [7] highlighted customer education on IB privacy laws, while Salem et al. (2019) [22] recommended regular communication to reassure customers regarding their privacy protections.

Time risk, with a path coefficient of - 0.691, remains a consideration, reflecting customers' concerns about time investment in learning, transaction processing, and error resolution in online banking. However, its impact on adoption intention has decreased. Hanafizadeh and Khedmatgozar (2014) [7] suggested reducing time risk through expanded help centers and tutorial demonstrations. Among Thailand's 14 Central Bank-licensed banks, these initiatives may align with observed decreases in time risk, though the effect remains substantial and warrants continued improvement.

The insignificance of psychological risk highlights that online banking adoption does not adversely impact customer mental well-being; rather, it may support it. Customers are generally unbothered by the lack of face-to- face interaction with bank personnel, possibly due to their familiarity with online and telephone support options. Increased availability of help centers further supports this conclusion, consistent with online banking (Fadare et al., 2016) [25].

5.1. The Mediating Role of e-WOM

The findings of this study reveal that the relationship between perceived risk and online banking adoption is significantly mediated by e-WOM, underscoring its influence in the adoption process, particularly when consumers perceive a high degree of risk. Perceived risk in online banking adoption encompasses factors such as performance, privacy, psychological, security, social, and time risks. One crucial aspect of perceived risk is the potential financial loss during online transactions, given the susceptibility of online banking to fraudulent activities. The findings suggest that customers' trust in online banking systems can reduce this perceived financial risk, facilitating a positive adoption behavior.

Performance risk also plays a substantial role in online banking. Personal information security risk involves concerns about the misuse of personal and financial data shared within online platforms. In a digital era, prone to data breaches and identity theft, e-WOM serves a critical function in reassuring consumers about the safety and privacy of their personal information. Nonetheless, this study found a relatively large standard error, suggesting considerable variability, which may be attributable to individual differences in risk tolerance, online banking habits, and demographic factors. This underscores the need for further research across specific demographic groups.

Interestingly, the study found that e-WOM is not a significant mediator between psychological risk and online banking adoption. This might indicate that while psychological risk correlates with online banking adoption, it may not be as strongly influenced by e-WOM. Psychological risk generally relates to the perception of a secure transaction environment that protects consumers from cyber threats and data breaches.

While psychological risk is often a precursor to trust in online banking models, this study suggests it may have a lesser influence on adoption behavior than previously assumed. This could be due to the improved security measures now standard in online banking platforms, such as advanced encryption, secure payment methods, and stringent privacy policies, which have collectively enhanced transaction security. As online banking systems adopt these advanced security technologies, security may become a prerequisite rather than a differentiating factor in consumers' decision-making. Consumers, often lacking technical knowledge about online security, may instead rely on cues such as website design, brand reputation, and third-party certifications to assess security levels rather than the specifics of security protocols (Lee et al., 2021). [5] Perceived security thus functions as a baseline requirement for online banking.

E-WOM refers to digital word-of-mouth, whereby consumers share product-related information online (Mehrad and Mohammadi, 2016)[33]. It is identified as a potential influencer in online banking adoption, as users often consult reviews and ratings when making decisions.

However, despite its informative nature, consumers may still rely more on their trust in the platform than on e-WOM content. This could be due to concerns over e-WOM's authenticity, with the prevalence of potentially manipulated or fake reviews online (Tantrabundit, 2018)[32]. Further research should address this disparity, considering variables

like the type of online service, demographic characteristics, and platform specifics. This study highlights the importance of addressing perceived risks in online banking. Banks should prioritize user education on internet banking's ease of use, which may reduce anxiety. Offering intuitive access to real-time financial transactions can build user confidence and encourage positive word-of-mouth. To leverage these insights, banks should devise strategies that prioritize service quality, foster trust, and mitigate consumer risks.

For instance, a robust notification system integrated with account access would alert users to account activity, detecting unauthorized actions in real-time. Such proactive measures build trust and create a secure banking environment.

Additionally, allowing easy access to transaction history and providing round-the-clock support enhance user engagement and satisfaction. While perceived risks remain integral to online banking adoption, this study highlights that performance, privacy, security, social, and time risks all significantly impact consumer behavior. Consequently, banks must ensure a reliable banking system that minimizes transaction failures and provides a seamless one-stop experience user experience.

5.2. Implications for Theory

These findings show reveal that late majority adopters in Thailand exhibit particular concern regarding the potential for unreasonable charges associated with online banking, a specific type of perceived risk. To model the factors influencing customer satisfaction and behavioral intentions, the research employed a framework incorporating six dimensions of perceived risk: financial, social, psychological, performance, privacy, and time.

These results align with prior studies, which found similar priorities among early adopters (Wang et al., 2019). Patterns in mobile payment in China also show that higher usage correlates with concerns about loss and performance, while privacy concerns are more common with lower usage. These regional comparisons provide critical insights for mobile payment operators and policymakers in Asia Pacific and guide strategies for banks in Thailand to diversify services, meet various customer demands, and maintain competitiveness.

Previous research on online banking adoption, such as that conducted by Chang et al. (2023)[45], has largely overlooked the mediating role of e-WOM. This study, however, demonstrates the significant influence of attitude and trust as mediating variables in predicting behavioral intentions. By integrating perceived risk and e-WOM models, this study achieved a predictive accuracy of 80.80% for online banking adoption among the elderly in Thailand. This surpasses the performance of other studies, such as Chang et al. (2023) [45] TAM model, which explained 62.84%, and 59.43% of intentions in China and Japan, respectively.

5.3. Implications for Practice

Minimizing perceived risk can positively shape users' attitudes and trust, ultimately influencing their intent to use internet banking services. In Thailand, early adopters' express concerns over performance, privacy, psychological, security, social, and time-related risks. The adoption of online banking among Thailand's elderly population presents both opportunities and challenges, particularly concerning trust, security, and ease of use.

This study highlights the role of electronic Word-Of-Mouth (e-WOM) in influencing adoption decisions, emphasizing that user perceptions of online reviews and recommendations significantly shape their willingness to engage with digital banking services. Given the variability in e-WOM impact, financial institutions must implement strategic reputation management practices, ensuring that positive customer experiences are amplified while misinformation is mitigated.

Additionally, the study underscores the necessity of user education and real-time notification systems to enhance security awareness. By providing clear transaction alerts and accessible financial history, banks can help users differentiate between legitimate and fraudulent activities, reducing perceived security risks. To effectively address the needs of clients, banks should consider the following strategies:

- In case performance risk remains a key barrier to online banking adoption among elderly users, as concerns over system stability, slow loading times, server errors, and unmet expectations persist. To mitigate these concerns, banks should: optimize system performance by ensuring minimal downtime, faster loading speeds, and robust server capacity. Communicate reliability by proactively informing users of scheduled maintenance and providing alternative banking options during downtimes. Leverage social learning strategies by promoting testimonials and case studies showcasing successful user experiences with improved system performance.
- Security concerns highlight customers' growing reluctance to adopt online banking due to fears of financial data breaches, unauthorized access, and overall cybersecurity risks. To address this, practitioners should: Implement multi-layered security measures such as Two-Factor Authentication (2FA), biometric verification, and end-to-end encryption. Educate users on secure banking practices by offering interactive security workshops, webinars, and online resources on fraud prevention. Enhance transparency by providing clear information on security policies, fraud detection systems, and customer protection protocols. Develop fraud response teams to address threats proactively and ensure immediate assistance in case of security breaches.
- Mitigating privacy risks concern regarding unauthorized data sharing, unsolicited marketing, and unconsented

financial data usage. To reduce privacy risk, banks should: Adopt comprehensive privacy policies that clearly outline data collection, storage, and sharing practices. Strengthen user control by offering privacy settings that allow customers to manage data-sharing preferences. Implement consent-based marketing to ensure customers explicitly agree to receive promotional messages.

- Reducing Time-Related Barriers: Customers perceive online banking as time-consuming due to learning curves, transaction delays, and error resolution. To further reduce time-related adoption barriers, banks should: Expand digital help centres with AI-powered chatbots, 24/7 customer support, and live assistance options. Offer interactive tutorials and guided demos to facilitate easier onboarding for elderly users. Enhance transaction efficiency by simplifying user interfaces and minimizing steps for completing transactions. Improve error resolution speed through dedicated support teams specializing in troubleshooting online banking issues.

6. Conclusion

In conclusion, this study's practical implications suggest a focus on enhancing online banking performance, security, privacy, and time efficiency, while using e-WOM to positively influence user perceptions. Addressing perceived risks effectively can build trust, encouraging broader adoption of online banking services among the elderly in Thailand. Reducing perceived risks and improving customer confidence in online banking are vital to fostering adoption among elderly users in Thailand. Financial institutions should prioritize system reliability, security, privacy, and usability while leveraging e-WOM to build trust and ensure a seamless user experience.

The findings suggest several avenues for future research. Demographic-specific analyses could further investigate how perceived risks vary across age groups, socioeconomic statuses, and levels of technological familiarity, allowing for tailored online banking services. Another area for exploration is e-WOM's role in trust development, with a focus on the credibility of online reviews, the impact of social media, and the distinction between positive and negative e-WOM. Additionally, with increasing concerns over digital security and privacy, research could examine new models to mitigate risks and build consumer trust, particularly in response to evolving technologies and cyber threats. Longitudinal studies on perceived risks are also recommended to track changes in user perceptions and behaviors over time, providing insights into how technological, regulatory, and experiential shifts impact online banking adoption.

Furthermore, the findings suggest that balancing perceived risks and benefits is crucial for increasing online banking adoption rates among elderly users. While security concerns often deter engagement, streamlined transaction processes, high service quality, and transparent privacy policies can mitigate these barriers. Banks should invest in cybersecurity measures and implement user-friendly interfaces to improve trust and accessibility.

Marketing efforts should emphasize the benefits of digital banking while addressing specific concerns about performance and reliability. Additionally, reducing time-related barriers through enhanced customer support, interactive tutorials, and intuitive platform design can further facilitate adoption. These strategic interventions can contribute to a more inclusive digital financial ecosystem, ensuring that elderly users can engage confidently with online banking services.

Authors' Contribution

K.N. conceptualized and participated in research design, performed the research methodology, coordinated and supervised the data collection, and conducted the analysis assessment of univariate normality, convergent and discriminant validity, measurement model, structure model, hypothesis testing and the conclusion and discussion. A.C. coordinated the data collection, read and proofread, and edited the manuscript. Both authors read and approved the manuscript as submitted and agreed to be accountable for all aspects of the work.

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