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The impact of blockchain technology on customer attitude and behavioral intentions in the banking sector

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ABSTRACT

This study examines customer attitudes towards blockchain technology (BCT)-supported banking applications in Oman and explores the relationship between these attitudes and behavioral intentions, highlighting the influencing factors. Blockchain Technology (BCT) has disrupted the banking sector, but understanding customer attitudes towards BCT-supported banking applications and their impact on behavior remains limited. In pursuit of this objective, a quantitative research design was employed, involving the collection of data from retail bank customers in Oman through a structured questionnaire. The collected data underwent rigorous analysis using a robust Structural Equation Model, confirming the constructs' validity, reliability, and distinctiveness. The study uncovered that BCT has a positive impact on various aspects of the banking sector, including customer service quality, regulatory compliance, secured transactions, and cost reduction. By augmenting transparency, efficiency, and trust in banking transactions, BCT significantly improves customer attitudes towards BCT-supported banks. Furthermore, the research reveals that positive attitudes play a pivotal role in influencing customers' intentions to prefer and continue using these blockchain-backed banks. The study also highlights the importance of trust factors and transaction frequency as moderators in shaping customer attitudes and behavioral intentions in this context. The insights gleaned from this research hold practical significance for banks operating in Oman, offering guidance for tailored marketing campaigns, product design, and aligning their offerings with customer expectations in the realm of blockchain-supported banking applications. Additionally, the study provides practical recommendations for the successful implementation and adoption of blockchain-supported financial applications within the banking sector.

Contribution/ Originality: This study not only underscores the significance of constructs such as quality customer service, design, and trust but also provides actionable insights for practitioners. It contributes to theoretical understanding, validates measurement scales, and emphasizes the one-dimensionality of the constructs. These distinctions advance the field, setting it apart from other studies.

1. INTRODUCTION

1.1. Blockchain Technology in Banking Sector

The banking sector plays a crucial role in economic development (Kamta, Avom, Ndeffo, & Moumie, 2020). Noted that Asian and African countries dominated by banking sector services (Claude, Ibrahim, Fantcho, & Ndesil, 2020) pointed out the importance of banking credit in Gross Domestic Product (GDP), which is the main economic indicator that represents the total value of goods and services produced by a country for a specific period. Banks deposit money, and it is the engine that drives the economy (Wijaya, Nurjanana, & Kurniawan, 2022). The adoption of emerging technologies such as BCT drives the growth and success of the banking sector. BCT is a distributed digital ledger that securely and transparently records transactions. Initially designed as a distributed ledger system for Bitcoin, BCT emerged as a pioneering financial technology (Ali, Ally, & Dwivedi, 2020; Carrick, 2016). Blockchain technology is the primary design driver behind the success of cryptocurrencies (Hashemi, Nishikawa, & Dandapani, 2020). Integrating blockchain with existing banking systems enhances operational capabilities and synergy between counterparties (Cocco, Pinna, & Marchesi, 2017). However, BCT is still in the early stages of development (Andoni et al., 2019). Both academia and industry perceive blockchain technology as an emerging disruptive force (Grover, Kar, Janssen, & Ilavarasan, 2019; Samadhiya, Kumar, Agrawal, Kazancoglu, & Agrawal, 2023). It consists of a chain of blocks, where each block contains a cryptographic hash of the previous block, making it tamper-proof. BCT gained popularity owing to the surge in Bitcoin prices in 2016, leading to a rapid rise in blockchain patent applications (Sim & Jang, 2023). Fintech such as BCT lowers transaction information costs and enhances market transparency (Yao & Song, 2021). The digital economy relies heavily on blockchain technology as its core infrastructure (Karuppiah, Sankaranarayanan, & Ali, 2023). Due to quick convergence of technology-enabled innovations, the financial service sector has undergone a remarkable acceleration in change (Nguyen, 2022). The adoption of FinTech greatly enhances the quality and efficiency of innovation within companies (Cao, Chen, Lu, Xu, & Zhang, 2023).

The inevitability of FinTech companies embracing blockchain technology is undeniable (Renduchintala, Alfauri, Yang, Pietro, & Jain, 2022). BCT is driving a profound revolution towards decentralization (Wang & Su, 2020). Digital finance technology enhances bank competition and expands credit availability, thus fostering corporate innovation (Zhang, Wang, Wang, & Wang, 2023).Wu, Luo, and Tao (2023) found that FinTech development effectively boosts bank credit expansion with a sustained relationship, even after addressing endogeneity concerns. According to Carbo, Gardener, and Williams (2003) technical progress has resulted in an average annual reduction of approximately 3.4% in the total costs for savings banks. As digital technologies continue to expand at a rapid pace, financial sectors are increasingly focusing their attention on these transformations, recognizing their significant impact on the global economy (Mohd Faizal, Jaffar, & Mohd Nor, 2022; Prisco, Abdallah, Morande, & Gheith, 2022). A network of computers that validates and verifies transactions maintains a ledger, doing away with the need for intermediaries (Raddatz, Coyne, Menard, & Crossler, 2023; Rehman et al., 2022). This allows for secure and direct peer-to-peer transactions, reducing costs and increasing efficiency. The BCT ensures preservation of the transaction history, which in turn boosts the overall trustworthiness of the entire process (Rehman et al., 2022). BCT can be applied in several sectors, particularly in supply chains, banking, and healthcare. It offers a potential remedy for a variety of challenging problems owing to its distinctive qualities of transparency, immutability, and decentralization. In the banking industry, BCT is used to boost productivity, openness, and security. The introduction of BCT has significantly altered the technological characteristics and business models of conventional banks (Chang et al., 2020). The development of virtual currencies such as Bitcoin, which provides an alternative to conventional fiat currencies, is a significant use of BCT. Smart contracts, which may automate different financial operations such as loan disbursements and insurance claims, are also made using blockchain technology. In the past, criminals took advantage of the banking industry, particularly by using financial institutions illegally to launder money (Naheem, 2019). In addition to streamlining procedures such as cross-border payments and Know Your Customer (KYC) compliance, BCT is used to improve the security and privacy of financial data. Overall, the use of BCT in banking has the potential to reduce costs and boost efficiency, and the expectations and awareness of retail banking customers concerning banking applications secured by blockchain technology correlate strongly with their degree of knowledge and awareness of the technology itself. The need to teach customers about blockchain, its advantages, and how to improve their banking experience cannot be overstated. Customers' desires and expectations are likely to change as they gain more knowledge about the blockchain. Researchers have shown significant interest in the rapid advancement of digital technology (Kong & Liu, 2023). It is important to note that, while some customers may have high expectations and awareness of blockchain technology, others may have limited knowledge or may not fully understand its implications. Hence, effective communication, user-friendly interfaces, and simplified explanations of blockchain-based banking applications are essential for bridging the knowledge gap and effectively managing customer expectations. However, despite the substantial benefits offered by BCT, there is a limited understanding of the factors influencing customers' behavioral intentions towards commercial banks that adopt this technology, specifically in the retail banking sector. Despite its usefulness, BCT has been the subject of limited research and industrial implementation (Prisco et al., 2022). Mathivathanan, Mathiyazhagan, Rana, Khorana, and Dwivedi (2021) studied barriers to the adoption of blockchain technology and the interrelationships between these barriers. Karuppiah et al. (2023) found that the challenges associated with blockchain technology are amplified by the absence of technical expertise, highlighting the crucial need for skilled professionals in this field. The research problem lies in the need to measure and comprehend these factors comprehensively to bridge the existing knowledge gap. Understanding customer preferences and expectations is vital for commercial banks to leverage BCT effectively, align their strategies with customer needs, enhance satisfaction levels, and drive the adoption of blockchain-supported banking services. The research gap in the research topic is the lack of a comprehensive understanding of the factors that influence customers' attitudes towards blockchain-supported banking applications and how these attitudes subsequently impact customers' behavioral intentions to prefer and continue using banks supported by Blockchain Technology. Although blockchain technology has gained significant attention in the banking sector, there is limited research focusing specifically on customer attitudes and their influence on behavioral intentions in the context of blockchain-supported banking applications. Currently, there is a restricted level of understanding and proficiency in Blockchain technology (Hashemi et al., 2020).

Owing to the lack of knowledge regarding how consumers' views translate into actual behaviors and how these behaviors affect long-term customer loyalty and engagement, there is a research gap in this area. By addressing this research gap, this study offers insightful information about the connection between views and behavioral intentions, enabling banks to create more focused marketing campaigns, enhance the usability and design of their products, and better match their offerings with customer expectations. Understanding the variables that affect consumer perceptions and behavioral intentions will help blockchain-supported financial apps be implemented and adopted successfully. This study addresses this research gap by employing a robust structural equation model (SEM) to examine the intricate relationships between several significant factors. This study has the following specific objectives: a) to investigate the factors influencing customers' attitudes towards commercial banks supported by BCT in the Oman retail banking sector. This includes examining the impact of customer service quality, regulatory compliance, secured transactions, BCT design, and cost reduction on customers' attitudes towards BCT-supported banks. b) to understand the impact of customers' attitudes towards BCT-supported banks on their behavioral intentions to prefer and continue using these banks; and c) to explore the moderating role of trust factors and customers' frequency of banking transactions for varying services in the relationship between customers' attitudes and behavioral intentions towards BCT-supported banks.

By analyzing these factors and their effects, this study seeks to provide valuable insights and guidance to commercial banks in Oman. Understanding the factors that influence customer behavioral intentions will enable banks to tailor their offerings, address concerns, and create a conducive ecosystem for blockchain adoption. This study is essential to maximize the potential of blockchain technology and meet the evolving needs of customers, ultimately contributing to the advancement of the Omani retail banking sector. Understanding customer attitudes is crucial for banks to tailor their strategies, enhance customer satisfaction, and drive their adoption of blockchain technology. This study bridges the existing knowledge gap and provides valuable insights for banks to effectively leverage blockchain technology, enhance customer satisfaction, and drive adoption in the banking sector. This understanding will help banks address potential barriers, overcome resistance, and effectively promote the adoption of blockchain technology in the banking sector. Furthermore, examining the link between customers' attitudes and their behavioral intentions to prefer and continue using banks supported by the Blockchain Technology is essential.

This paper is divided into six sections, and the subsequent section presents the theoretical background and development of the hypotheses. Methodology adopted in this study. The fourth section presents the results and discussions based on an analysis using the Structural Equation Model (SEM). section offers the concl usion of the paper and summarizes the key findings. Finally, the sixth section explores the implications of the research, discusses its limitations, and highlights potential areas for further research.

2. THEORETICAL BACKGROUND AND HYPOTHESES DEVELOPMENT

2.1. Quality of Customer Service (QCS) Improved by Blockchain Technology (BCT)

Banks can improve customer service in various ways using BCT. BCT transparency allows participants to view all transactions in a distributed ledger and builds customer trust. Customers exhibited a significant level of trust in the implementation of blockchain technology (Wu, Fan, & Cao, 2023). The BCT facilitates an increase in the quality of products and services (Jain, Singh, Chaturvedi, & Rakesh, 2020; Niranjanamurthy, Nithya, & Jagannatha, 2019) and holds great potential for enhancing the confidentiality of banking transactions (Raddatz et al., 2023). It also reduces errors and fraud and ensures accurate and secure records (Garg et al., 2021).BCT eliminates intermediaries, accelerates transactions, and enables faster fund transfers. BCT offers a solution for effectively managing and documenting transactions within a banking system (Bagrecha, Polishwala, Mehrotra, Sharma, & Thakare, 2020). The BCT feature of real-time tracking keeps users updated (Attaran, 2022) and helps banks promptly address relevant issues; reconciliation is easier with BCT because all transactions are recorded, reducing manual effort. Overall, the BCT enhances efficiency (Esfahbodi, Pang, & Peng, 2022), transparency, and accuracy in banking, and trust is the main attraction of the BCT (Ali et al., 2020). The preceding discussion provides the groundwork for formulating the following hypotheses:

H_1: The Quality of customer service (QCS) provided by banks with BCT, has a positive impact on customers' Attitude towards banks.

H_2: The Quality of customer service (QCS) provided by banks with BCT, has a positive impact on customers' Behavioral intention (BI) to continue with banks supported by BCT.

2.2. Design of Blockchain Technology (BCT) Streamline the User Experience

Design encompasses the impact of user experience factors such as navigation, aesthetics, and layout on user inclination to utilize the system (Albayati, Kim, & Rho, 2020). Blockchain technology (BCT) is designed for simplicity and easy navigation (Lian, Chen, Shen, & Chen, 2020) and provides a user-friendly interface for customers to access and view transactions. With its user-friendly payment interface, BCT can revolutionize payment processes globally, particularly in emerging markets (Hashemi et al., 2020). Among all technologies in the FinTech domain, BCT is one of the most promising and advanced (Ali et al., 2020). Its transparent nature enables all transactions to be recorded in a decentralized and immutable manner, thereby ensuring complete visibility and security for customers. The simplicity and user-friendliness of BCT positively affect customers' attitudes towards banks, enhancing their overall banking experience (Albayati et al., 2020). Transparency fosters trust and confidence by allowing customers to verify the accuracy of their financial records independently and mitigate fraud-related concerns. BCT offers realistic solutions to banking issues (Surekha, Sangeetha, Aarthy, Kavitha, & Anuradha, 2022). Additionally, the simplified design of BCT reduces complexity and barriers to entry, encouraging broader adoption and empowering customers in their financial transactions. The simple and user-friendly design of a BCT shapes customer attitudes towards banks. Based on this discussion, the following hypothesis was formulated:

H_3: The Design banking application supported by BCT has a positive impact on customers' Attitude towards banks.

2.3. BCT Facilitates Regulatory Compliance (RC)

Banks supported by the BCT streamline regulatory compliance through mechanisms that enhance system resilience, ensure immutable business rules, and simplify processes. BCT addresses compliance challenges and fund management security (Zhu & Zhou, 2016). BCT helps streamline regulatory compliance by utilizing a distributed ledger system for transparent and secure transaction recording and verification (Garg et al., 2021). This transparency simplifies audits and improves efficiency by providing regulators with easy access to transactional information. By leveraging blockchain technology, BCT plays a pivotal role in reducing regulatory expenses and addressing technical challenges (Wang & Su, 2020).The implementation of the BCT ensures the immutability of business rules through smart contracts. These self-executing contracts are stored on the blockchain, automated, and enforce compliance-related rules, reducing the risk of non-compliance owing to human error or manipulation. Smart contracts are self-executing contracts with predefined conditions and actions that are stored on the blockchain (Patki & Sople, 2020). BCT enhances system resilience for regulatory compliance through its decentralized nature. Distributing the ledger across multiple network nodes increases security and reliability, thereby minimizing the risk of data breaches, fraud, or tampering. Furthermore, the utilization of BCT enhances the resilience of the system in terms of regulatory compliance (Chang et al., 2020). Integrating BCT into banks facilitates regulatory compliance by streamlining processes, enforcing immutable business rules, and enhancing systemic resilience. This enables banks to meet regulatory requirements efficiently, reduce errors or manipulation, and demonstrate trust and transparency with their regulators. Building on the preceding discussion, the following hypothesis is formulated:

H_4: The regulatory compliance feature of BCT supported banking application has a positive impact on customers' Attitude towards banks.

2.4. BCT Ensures Secured Transactions (ST)

Trust is crucial for reliable interactions in which partners expect each other to behave reasonably and as anticipated. Security concerns in banking transactions are essential (Garg et al., 2021). In BCT, trust is a key characteristic that facilitates secure transactions and eliminates the need for intermediaries (Centobelli, Cerchione, Del Vecchio, Oropallo, & Secundo, 2022). Banks supported by BCT ensure secure banking transactions (ST) by implementing various features that prevent financial fraud and tampering, creating an immutable audit trail, ensuring data control and protection, reducing errors in transactions, and providing a secure payment process. Blockchain technology inherently fosters trust among users, often without their explicit awareness, because the distributed and immutable nature of blockchain ensures transparency and security, inspiring confidence in the system (Mishra & Kaushik, 2023). Using blockchain's distributed database could help with trust issues in business chains by providing openness, anonymity, and permanent records, which would get rid of the problems that come with them (Ullah, Mugahed Al-rahmi, & Alkhalifah, 2021). The key aspect of blockchain technology (BCT) is the creation of an immutable audit trial. BCT ensures transparent and accountable record-keeping by recording each transaction in a block linked to the previous block, forming a chain. This eliminates retroactive alterations and provides reliable auditing trials. The decentralized nature of the BCT eliminates the need for a central authority, reduces the risk of a single point of failure, and enhances data control and protection. Robust cryptographic techniques secure data and transactions, whereas consensus algorithms validate and authorize transactions, thereby making fraudulent activities challenging. Blockchain automates and streamlines transaction processes, thus reducing human errors. Smart contracts enforce predefined rules and minimize discrepancies. Expanding on the previous discussion leads to the following hypothesis:

H_5: The feature of Secured transactions (ST) of BCT supported banking applications has a positive effect on customers' Attitude (ATT) towards banks.

2.5. Cost reductions (CR) Through BCT

Banks supported by BCT reduce the costs of banking transactions through various features (Mishra & Kaushik, 2023). This includes cutting infrastructure costs, eliminating intermediaries, minimizing interbank transaction costs, and lowering administrative and operating expenses. These measures benefit both banks and customers, shaping their attitudes towards BCT-supported banks. Das and Das (2007) found that banks have witnessed notable cost reductions, reaching as high as 5% in the recent period, attributable to technological advancements. BCT reduces infrastructure costs by eliminating the need for a centralized server or data center (Patki & Sople, 2020). This decentralized approach allows banks to allocate resources to improve their services and customer experience (Esfahbodi et al., 2022). Eliminating intermediaries simplifies transactions and reduces fees for both banks and customers. BCT enables direct peer-to-peer transactions, bypassing clearinghouses, payment processors, and the corresponding banks. BCT minimizes interbank transaction costs by facilitating direct execution and streamlining settlement processes (Cocco et al., 2017). This reduces the need for intermediaries and administrative efforts, thus benefiting both the banks and customers. BCT lowers administrative and operating costs by automating processes and using smart contracts (Esfahbodi et al., 2022). This reduces manual intervention, paperwork, and auditing effort. Cost reductions influence customer attitudes towards BCT-supported banks by offering competitive pricing, lower fees, faster transactions, and enhanced trust and security. Expanding on the previous discourse, the development of the subsequent hypotheses emerges.

H_6: The cost reduction (CR) achieved by banks with BCT has a positive effect on customers' Attitude (ATT) towards banks.

H_7: The cost reduction (CR) achieved by banks with BCT has a positive impact on customers' Behavioral intention (BI) to continue with banks supported by BCT.

2.6. Customers 'Attitude (ATT) and Behavioral Intention (BI) to Continue with Banks Supported by the BCT Application

Customers' attitudes (ATT) towards banks supported by BCT can positively impact their behavioral intentions (BI) to continue banking with these institutions. The results of Esfahbodi et al. (2022) suggest that the perceived usefulness of a product or service has a significant influence on the intention to adopt it. When customers perceive BCT as a valuable (Attaran, 2022), desirable, and interesting feature, it fosters a favorable attitude towards banks utilizing this technology (Raddatz et al., 2023). This perception arises from recognizing BCT as a beneficial attribute that enhances the overall banking experience by providing secure and transparent transactions, streamlined processes, and improved data integrity. Consequently, customers develop a positive attitude towards banks supported by BCT. The banking industry holds promising prospects for the application of blockchain technology, which is a fundamental and essential technology (Guo & Liang, 2016). These attitudes increase the likelihood that customers will maintain their banking relationship, conduct additional transactions, and show loyalty to the BCT-enabled services offered by these banks.

H_8: Customers' Behavioral intention (BI) to continue with banks supported by the BCT application is influenced by their attitude (ATT) towards the application.

3. METHODOLOGY

This study employs a quantitative research design that incorporates deductive reasoning by drawing upon existing literature and theories to formulate hypotheses. This study utilized surveys as the primary data collection method and employed a Structural Equation Model (SEM) to test the hypotheses. The SEM has become a key multivariate analysis (Ringle, Sarstedt, Mitchell, & Gudergan, 2020). The analysis was conducted using the Partial Least Squares - Structural Equation Model (PLS-SEM) technique, utilizing the latest version (8.00) of the WarpPLS software. SEM is an exceptionally versatile technique that empowers analysts to adopt the most suitable hypotheses for their research (Iglesias Antelo & Levy Mangin, 2010). A similar study was conducted by Andoni et al. (2019), but by adopting the Unified Theory of Acceptance and Use of Technology (UTAUT), which is a theoretical framework in information systems that predicts individuals' acceptance and use of new technologies, whereas Thommandru and Chakka (2023) studied Recalibrating the Banking Sector with Blockchain Technology. Madaan, Kumar, and Bhushan (2020) studied the current landscape of BCT and examined its genesis and operational mechanisms while also providing a succinct overview of the technology's features and the obstacles it encounters. The structured questionnaire used in this study consists of three parts. The first part collected demographic information from the respondents. The second part assessed the respondents' experience with online banking, including the duration of their online banking usage and the frequency of their transactions across different services. The third part evaluates the factors influencing customers' intentions (BI) to prefer and continue using commercial banks that employ BCT.

Data was collected through a questionnaire from retail bank customers in Oman's major cities. WarpPLS Software (power level: 0.800) was used to determine sample size based on minimum absolute path coefficients. The inverse-square root method suggested 160, while the gamma-exponential method estimated 146, which is particularly valuable in empirical studies.

We collected voluntary email survey responses, sending follow-up emails to encourage participation and clarifying the research's academic nature. Respondents were assured of confidentiality due to Central Bank of Oman regulations. Employing convenience sampling (Nguyen, Nguyen, Ngoc, & Duc, 2023), we gathered 319 responses, striving for statewide representation. Our analysis employed the Structural Equation Model (SEM), which is widely applied in academia for model assessment (Kabir & Islam, 2021). The Structural Equation Model (SEM) adopted in this study was evaluated in two stages. First, the measurement model was assessed by analyzing the structural loading of the constructs and their items, as well as by evaluating Composite Reliability, Average Variance Extracted, Cronbach's Alpha, Variance Inflation Factors, and Discriminant Validity.

Following the assessment of the measurement model, the Structural Model was analyzed by examining the model fit indices, path coefficients, and T-ratios for path coefficients, conducting mediation analysis, and exploring moderating effects. The key strength of this study is that it rigorously tested the hypotheses using quantitative methodology. Other statistical methods would not have allowed for the simultaneous analysis of various relationships between variables, but PLS-SEM would have. The questionnaire was divided into three parts. Part one focused on gathering the respondents' demographic details. Part two measured respondents' experience with online banking, including the duration of their online banking usage and the frequency of their banking transactions across various services.

Part three assessed the factors influencing customers' Behavioral Intention (BI) to prefer and continue using commercial banks that use BCT. To ensure the accuracy and relevance of the measures used, an extensive literature review was conducted, and necessary modifications were made. Constructs were assessed using a five-point Likert scale (Raddatz et al., 2023).

Table 1 lists these constructs and their corresponding items. The constructs and indicators from previous studies were slightly adjusted to align with the requirements of this study.

4. RESULTS AND DISCUSSIONS

4.1. Assessment of Measurement Model

4.1.1. Structure Loading

Before testing the hypotheses in the inner model, it was crucial to ensure the evaluation and validation of the measurement model (Fu, Ding, & Yu, 2023; Nguyen et al., 2023). In SEM analysis, structural loading is a measure of how well a measured variable (indicator) represents a latent variable (construct). A factor-loading coefficient, which is a number between zero and one, typically serves as its representation. A higher structure loading indicates a stronger relationship between the indicator and the latent variable. To establish reliability, each item's loading value must meet or exceed 0.70 (Albayati et al., 2020). The calculation of structural loadings is based on the partial least squares (PLS) approach.

$$Y = c\lambda X + \varepsilon \quad (1)$$

Where:

Y = the observed indicator (manifest variable).

λ (lambda) = the structure loading (path coefficient) between the latent construct (X) and the observed indicator (Y).

X = the latent construct (latent variable).

c (gamma) = the scaling factor (weight) between the latent construct and the observed indicator.

ε (epsilon) = the error term or residual, capturing the unexplained variation in the observed indicator.

Structure loading (λ) indicates the strength and direction of the relationship between the latent construct and the observed indicator (Ghasemzadeh, Heydari, & Mansourfar, 2021). This represents the weight assigned to the latent construct in predicting the observed indicator. The results of the structural loading presented in Table 1 provide strong support for the constructs examined in this study. Specifically, the construct of QCS, representing quality customer service, exhibited robust loadings ranging from 0.926 to 0.953 across its four items. Similarly, the DN construct, which represents the design of the BCT, showed substantial loadings ranging from 0.910 to 0.929 for its three items. The RC construct, which measures regulatory compliance, also displays notable loadings, ranging from 0.898 to 0.919 across its four items. Additionally, the construct ST, capturing secured transactions, demonstrated reasonably reliable loadings, ranging from 0.852 to 0.914 for its four items. Regarding cost reductions (CR), the construct exhibited loadings ranging from 0.725 to 0.952 across its four items, indicating some variation in the strength of the relationships between the items and the construct. The ATT construct, measuring attitudes towards BCT-supported banks, shows moderate to strong associations with loadings ranging from 0.861 to 0.884 across its four items. Similarly, the BI construct, representing behavioral intention, displayed reasonably robust loadings ranging from 0.847 to 0.887 across the three items. Moving on to the moderator constructs, TT, which measures trust, exhibits high loadings ranging from 0.941 to 0.963 across its three items, indicating a strong relationship. Finally, the moderator constructs FRE, capturing the frequency of banking transactions, and demonstrates reasonably reliable loadings ranging from 0.783 to 0.860 across its seven items. Overall, these findings provide robust support for the validity and reliability of the scales used in this study.

4.1.2. Composite Reliability

Composite reliability (CR) is a measure of the internal consistency or reliability of latent constructs in a structural equation modeling (SEM) analysis (Nguyen et al., 2023).

$$CR = (\sum \lambda^2) / (\sum \lambda^2 + \sum \psi) \quad (2)$$

Where:

CR = Composite reliability.

λ (lambda) = the structure loading (path coefficient) between the latent construct and its indicators.

ψ (psi) = the unique or specific variance of each indicator.

The calculation involves summing the squared structure loadings (λ^2) and dividing them by the sum of the squared structure loadings (λ^2) plus the sum of the unique variances (ψ) for each indicator of the latent construct. Composite reliability (CR) ranges from 0 to 1, with values ≥ 0.7 typically considered acceptable for reliability. Table 1 displays the SEM model-generated results of the composite reliability analysis, offering insights into the internal consistency and reliability of the various constructs in this study. These results are crucial for assessing the robustness and validity of a measurement model. A high CR indicates that the items are highly correlated and that they are all measuring the same thing. The CR values in this study are all above 0.7, which is the generally accepted minimum threshold for acceptable CR. This indicates that the items in each construct measure a single underlying latent construct.

Table1. Structure loading, composite reliability, AVE, and Cronbach alpha.

Constructs	Items	Loading	Composite reliability (CR)	Average variance extracted (AVE)	Cronbach' s alpha	Full collinearity VIFs
Quality of customer service (QCS)	QCS 1: BCT will improve the transparency of banking transactions	0.926	0.970	0.889	0.959	3.134
	QCS 2: BCT will increase data accuracy and facilitate faster bank reconciliations	0.943				
	QCS 3: BCT will facilitate faster banking transactions	0.953				
	QCS 4: BCT will help in tracking real-time banking transactions	0.951				
Design (DN)	DN 1: I expect BCT supported banking application to be similar to the one I used previously	0.91	0.944	0.849	0.911	2.951
	DN 2: I expect the BCT-supported banking application is simple to navigate	0.925				
	DN 3: I expect the BCT-supported banking application to clearly show my transaction activities	0.929				
Regulatory compliance (RC)	RC 1: BCT will streamline the business process	0.911	0.950	0.827	0.930	3.443
	RC 2: BCT will ensure immutable business rules	0.91				
	RC 3 BCT will improve regulatory compliance	0.919				
	RC 4: BCT will enhance the system's resilience	0.898				
Secured transactions (ST)	ST 1: BCT will prevent financial fraud and tempering	0.896	0.938	0.791	0.911	4.980
	ST 2: BCT will create an immutable audit trail	0.914				
	ST 3: BCT will ensure data control and protection	0.852				
	ST 4: BCT will reduce errors in transactions and ensure a secured payment process	0.894				
Cost reductions (CR)	CR 1: BCT will help banks to reduce infrastructure costs and the benefits may be passed on to customers	0.927	0.934	0.783	0.904	2.443
	CR 2: BCT will eliminate intermediaries and brings down the transaction costs	0.725				
	CR 3: BCT will reduce the transaction costs between bank-to-bank transactions	0.952				
	CR 4: BCT will reduce banks' administrative and operating costs	0.917				
Attitude (ATT)	ATT 1: It is a good idea to have a banking application supported by BCT	0.861	0.926	0.757	0.893	3.657
	ATT 2: In my opinion, it is desirable to use a banking application supported by BCT	0.872				
	ATT 3: Overall, my attitude towards banking applications supported by BCT is favorable	0.863				

Constructs	Items	Loading	Composite reliability (CR)	Average variance extracted (AVE)	Cronbach's alpha	Full collinearity VIFs
	ATT 4: I am interested to use a banking application supported by BCT	0.884				
BI (Behavioral intention)	INT 1: I intend to select and continue with banks that are supported by BCT	0.887	0.902	0.754	0.836	3.958
	INT 2: I intend to avail banking services that are supported by BCT	0.847				
	INT 3: I intend to increase the frequency and type of transactions through banking applications that would be supported by BCT	0.87				
Trust (TT)	TT 1: Banking services that are supported by BCT are trustworthy	0.941	0.965	0.901	0.945	2.260
	TT 2: The banks that are supported by BCT would give the impression that they keep promises and commitments	0.963				
	TT 3: I believe the banks with BCT keep my best interests in mind	0.944				
Frequency of online banking (FRE)	FRE 1: Travels and hotel bookings	0.86	0.934	0.668	0.917	1.898
	FRE 2: Bill and fees payments	0.784				
	FRE 3: Online shopping	0.818				
	FRE 4: Online stock market and investment transactions	0.783				
	FRE 5: Balance enquiry and other enquiries	0.84				
	FRE 6: Fund transfer	0.835				
	FRE 7: Request for cheque books and other enquiries	0.799				

The composite reliability values obtained for the constructs in this study demonstrate high levels of internal consistency. The construct "Quality of Customer Service" (QCS) achieved a value of 0.970, indicating strong reliability in capturing the concept of quality customer service. Similarly, the construct "Design" (DN) yielded a value of 0.944, suggesting strong internal consistency for design-related items. "Regulatory Compliance" (RC) exhibited a value of 0.950, indicating reliability in measuring regulatory compliance. "Secured Transactions" (ST) achieved a value of 0.938, reflecting high internal consistency in measuring secured transactions. "Cost Reductions" (CR) demonstrated a value of 0.934, indicating strong consistency in capturing cost reduction items. "Attitude" (ATT) obtained a value of 0.926, implying good internal consistency for attitude measurement. "BI (Behavioral Intention)" achieved a value of 0.902, suggesting acceptable internal consistency for behavioral intention items. "Trust" (TT) yielded a value of 0.965, indicating high internal consistency for trust measurement. Finally, the Frequency of Online Banking" (FRE) is 0.934, reflecting strong consistency in measuring the frequency of online banking. Overall, the composite reliability values ranged from 0.902 to 0.970, indicating that the measurement items for each construct were reliable and consistent in capturing the intended concepts. These findings suggest that the measurement model used in this study is robust and valid for further analysis and interpretation.

4.1.3. Average Variance Extracted (AVE)

The Average Variance Extracted (AVE) values obtained through the Structural Equation Modeling (SEM) analysis provide important insights into the convergent validity of the constructs examined in the study. These values indicate the extent to which the measurement items within each construct capture underlying concepts (Albayati et al., 2020; Lian et al., 2020).

$$AVE = (\Sigma\lambda^2) / (\Sigma\lambda^2 + \Sigma\varepsilon) \qquad (3)$$

Where: AVE = Average variance extracted.

$\Sigma\lambda^2$ = The sum of squared factor loadings for all items associated with the construct.

$\Sigma\varepsilon$ = The sum of error variances for all items associated with the construct.

The AVE values ranged from 0.668 to 0.901 (Table 1).The construct "Quality of Customer Service" (QCS) had an AVE value of 0.889, while "Design" (DN) had a value of 0.849, "Regulatory Compliance" (RC) had a value of 0.827, "Secured Transactions" (ST) had a value of 0.791, "Cost Reductions" (CR) had a value of 0.783, "Attitude" (ATT) had a value of 0.757, "BI (Behavioral Intention)" had a value of 0.754, "Trust" (TT) had a value of 0.901, and "Frequency of Online Banking" (FRE) had a value of 0.668. These AVE values indicate that the measurement items within each construct explain a substantial proportion of the variance, ranging from approximately 66.8% to 90.1%. This suggests that the measurement model used in this study exhibits good convergent validity as the measurement items effectively capture the intended concepts (Nguyen et al., 2023). The average variance extracted (AVE) values for the constructs in this study were all above 0.5, which is the generally accepted minimum threshold for acceptable AVE. This indicates that the items in each construct measure a construct that is distinct from other constructs. These findings enhance the credibility of the results and provide a solid basis for meaningful interpretations and analyses. However, the AVE value for the Frequency of Online Banking (FRE) is relatively low. This suggests that the items in this construct may not measure a construct distinct from other constructs. This should be further investigated in future studies.

4.1.4. Cronbach's Alpha

Cronbach's Alpha is a measure of internal consistency and reliability and ranges from 0 to 1, where higher values indicate greater reliability. It assesses the extent to which the items within a construct are interrelated and measures the same underlying concepts (Jain et al., 2020; Rehman et al., 2022).

Equation of Cronbach's Alpha:

$$\alpha = (k / (k - 1)) * (1 - (\Sigma\sigma^2\_e / \sigma^2\_x)) \quad (4)$$

Where: α = Cronbach's Alpha coefficient, k = the number of items in the construct, $\Sigma\sigma^2\_e$ = the sum of error variances for all items associated with the construct, and σ^2_x = the variance of the construct.

The internal consistency and reliability of the measurement items for the constructs in this study were assessed using Cronbach's alpha (Table 1). The construct "Quality of Customer Service" (QCS) exhibited a high level of internal consistency (α = 0.959), indicating strong reliability and consistency in capturing the concept of quality customer service. Similarly, the construct "Design" (DN) demonstrated good internal consistency (α = 0.911) for items related to design. "Regulatory Compliance" (RC) showed strong internal consistency (α = 0.930) for the associated measurement items.

The internal consistency of the "Secured Transactions" (ST) and "Cost Reductions" (CR) constructs was high, with Cronbach's alpha values of α = 0.911 and α = 0.904, respectively. Similarly, the construct "Attitude" (ATT) exhibited good reliability and consistency, with Cronbach's alpha of α = 0.893. The "BI (Behavioral Intention)" construct showed acceptable internal consistency, with Cronbach's alpha of α = 0.836. Furthermore, the construct "Trust" (TT) demonstrated high internal consistency, with a Cronbach's alpha of 0.945. Lastly, the "Frequency of Online Banking" (FRE) construct displayed good reliability and consistency, with a Cronbach's alpha of α = 0.917. Overall, Cronbach's alpha values for all constructs ranged from 0.836 to 0.959, indicating strong internal consistency and reliability of the measurement items within each construct. It is worth noting that all Cronbach's alpha estimates for the constructs in this study exceeded the commonly accepted minimum threshold of 0.7, thereby affirming their acceptability. These findings reinforce the robustness and reliability of the measurement model used in this study, further enhancing the credibility of the research findings for subsequent analyses and interpretations.

4.1.5. The Full Collinearity Variance Inflation Factors (VIFs)

The VIFs obtained through SEM analysis offer insight into the presence of multicollinearity among the constructs examined in this study. VIFs assess the degree to which predictor variables are linearly related to each other, and values above a threshold level of 5.0 indicate a potential issue of multicollinearity.

$$VIF = 1 / (1 - R\hat{}2) \qquad (5)$$

Where'

R^2 is the coefficient of determination obtained from regressing each predictor variable on all other predictor variables. Table 1 shows the VIF values of all the constructs applied in this study. The Quality of Customer Service (QCS) showed a moderate level of collinearity, with a VIF value of 3.134. Design (DN) and Regulatory Compliance (RC) also exhibited moderate levels of collinearity, with VIF values of 2.951 and 3.443, respectively. Secured Transactions (ST) showed a relatively higher VIF value of 4.980; however, it was well within the acceptable level of 5.0. Cost reduction (CR), attitude (ATT), and Behavioral Intention (BI) displayed VIF values of 2.443, 3.657, and 3.958, respectively, indicating moderate levels of collinearity. Trust (TT) demonstrated a moderate level of collinearity, with a VIF value of 2.260. In contrast, the Frequency of Online Banking (FRE) has a relatively lower VIF value of 1.898, suggesting a lower level of collinearity among the predictors. Overall, the VIF values in this study range from 1.898 to 4.980. This means that some constructs have moderate levels of collinearity with their predictors, but none of the constructs have VIF values that are too high, which would mean they have severe multicollinearity.

4.1.6. Discriminant Validity Test

This study applied a discriminant validity test to the latent constructs under investigation. The results in Table 2 provide valuable insights into the distinctiveness of constructs and their interrelationships. This is how well each construct can separate itself from other constructs in the models (Kamble, Gunasekaran, & Arha, 2019; Raddatz et al., 2023) and identify its own unique variation.

$$Inter - correlation\ estimate = Squared\ root\ of\ AVE\_i * Squared\ root\ of\ AVE\_j \qquad (6)$$

Where:

The squared roots of AVE_i represents the square roots of the Average Variance Extracted (AVE) for construct i.

The squared root of AVE_j represents the square root of the Average Variance Extracted (AVE) for construct j.

The diagonal values of the correlation matrix represent the square roots of the AVE for each construct, indicating the percentage of variance that the construct's indicators account for. In the correlation matrix, the square roots of Average Variance Extracted (AVE) stand in for the variance that each construct indicator explains. The off-diagonal values indicate the intercorrelations between latent constructs. These findings affirm the strong discriminant validity of the constructs. Notably, the diagonal values (square roots of AVE) always came out higher than the off-diagonal values. This shows that each construct shares more variation with its own indicators than with others, which supports the idea that they are unique. For example, the Quality of Customer Service (QCS) construct boasts a high squared root of AVE at 0.943, signifying a substantial variance explanation in its indicators and a clear distinction from other constructs. Similarly, Design (DN) exhibited a strong squared root of AVE at 0.921, further confirming its discriminant nature. There are moderate to strong correlations between the constructs, with estimates ranging from 0.514 to 0.910. However, these coefficients always fall below the squared root of AVE values, which means that the shared variance between the constructs is less than the unique variance captured by their indicators.

Table 2. Discriminant validity test results.

Constructs	QCS	DN	RC	ST	CR	ATT	BI
QCS	0.943						
DN	0.663	0.921					
RC	0.686	0.735	0.910				
ST	0.773	0.731	0.729	0.889			
CR	0.652	0.514	0.541	0.734	0.885		
ATT	0.706	0.71	0.693	0.783	0.629	0.870	
BI	0.722	0.686	0.671	0.8	0.656	0.794	0.868

Note: The squared roots of AVE are shown as diagonal values whereas the off-diagonal values are the estimates of inter-correlation between the latent constructs.

4.2. Assessment of Structural Model

Once the reliability and validity of the measurement model have been confirmed, the subsequent step in PLS-SEM analysis involves evaluating the structural model. This assessment aimed to ascertain the relevance of the constructs employed in the model and their ability to capture relationships. The assessment was performed by analyzing the path coefficients, mediation effects, and moderation effects. Redundancy through convergent validity of the formatively measured construct is very important in SEM analysis (Ringle et al., 2020).

4.2.1. The Model Fit Indices

The model fit indices provide an indication of how well the proposed model aligns with the observed data. Several indices were evaluated in this study. Table 3 presents the model fit and quality indices. The average block VIF (AVIF) was 2.861, below the recommended threshold of 5 and closer to the ideal value of 3.3, indicating low multicollinearity among the observed variables. Similarly, the average full collinearity VIF (AFVIF) was 3.02, within the acceptable range, further supporting the adequacy of the model fit. The TenenhausGoF (GoF) index, which evaluates the overall goodness of fit between the model and data, was 0.765, falling within the small effect size range defined as 0.1 or greater, suggesting a modest but statistically significant fit of the model. Simpson's paradox ratio (SPR) was 0.9, exceeding the acceptable threshold of 0.7, indicating a relatively lower level of Simpson's paradox and validating the relationships observed in the overall data. The R-squared contribution ratio (RSCR) was 0.972, demonstrating the model's ability to explain a substantial portion of the variance in the observed data. The statistical suppression ratio (SSR) was 1, surpassing the acceptable threshold of 0.7, signifying successful capture of statistical suppression. The nonlinear bivariate causality direction ratio (NLBCDR) was 0.9, which was higher than the acceptable level of 0.7. This meant that the model correctly showed nonlinear casual relationships. The SEM adopted in this study indicated sound model fit and quality.

Table 3. Model fit and quality indices.

Model fit static	Recommended value	Actual value
Average block VIF (AVIF)	Acceptable if <= 5 ideally <= 3.3	2.861
Average full collinearity VIF (AFVIF)	Acceptable if <= 5 ideally <= 3.3	3.02
Tenenhaus GoF	small >= 0.1, medium >= 0.25 large >= 0.36	0.765
Simpson's paradox ratio (SPR)	Acceptable if >= 0.7 ideally = 1	0.9
R-squared contribution ratio (RSCR)	Acceptable if >= 0.9 ideally = 1	0.972
Statistical suppression ratio (SSR)	Acceptable if >= 0.7	1
Nonlinear bivariate causality direction ratio (NLBCDR)	Acceptable if >= 0.7	0.9
Average block VIF (AVIF)	Acceptable if <= 5, ideally <= 3.3	2.861

4.2.2. Path Coefficients

Analyzing path coefficients in the SEM provides a comprehensive understanding of the relationships among variables, validates theoretical hypotheses, assists in model refinement, and provides practical implications. Path coefficients enable us to analyze the efficacy of the SEM model and provide precise descriptions of the basic trends in the data. The path coefficients and p-values must be considered to assess the findings and determine whether the hypotheses have been supported or disproven. Table 4 presents the relevant findings.

Hypothesis 1: QCS → ATT: The path coefficient for the initial hypothesis, QCS → ATT, is 0.113 ($p = 0.041$). This indicates a positive relationship between attitude (ATT) and Quality of Customer Service (QCS), and the results of Jain et al. (2020) support the present study's findings. Despite this association having minor statistical significance ($p < 0.05$), it implies that it is not prudent to adopt this theory. 99% of the time, Hypothesis 1 is ruled out.

Hypothesis 2: QCS → BI: The path coefficient for QCS BI, which is 0.270 (p 0.001), demonstrates the strong positive association between Quality of Customer Service (QCS) and Behavioral Intention (BI), and the findings are consistent with Jain et al. (2020). Using a 95% confidence level, the statistical significance of this link was high ($p < 0.001$), validating Hypothesis 2.

Hypothesis 3: DN → ATT: The path coefficient for DN → ATT is 0.219 ($p = 0.001$). This suggests a moderately positive relationship between Job Design (DN) and attitude (ATT). Statistical analysis confirmed the significance of this relationship ($p < 0.001$), supporting Hypothesis 3 at the 99% confidence level, whereas Albayati et al. (2020) found that the Design of BCT influences the perceived ease of use of customers.

Hypothesis 4: RC → ATT: For RC → ATT, the path coefficient is 0.113 ($p < 0.044$). This finding suggests that regulatory compliance (RC) and attitude (ATT) have tenuous positive associations. However, the statistical significance of this relationship was slight (p = 0. < 044), prompting further research in this field. 99% of the time, Hypothesis 4 is disproven. However, Albayati et al. (2020) indicates that regulatory support influences customer trust.

Hypothesis 5 (ST → ATT): The path coefficient for ST → ATT is 0.373 ($p < 0.001$), which suggests a strong positive relationship between Secured Transactions (ST) and Attitude (ATT), like the results found by Centobelli et al. (2022). Statistical analysis confirms the highly significant nature of this relationship ($p < 0.001$), supporting Hypothesis 5 at the 99% confidence level.

Hypothesis 6: CR → ATT: The path coefficient for CR → ATT is 0.099 ($p = 0.048$). This finding implies a weak positive relationship between cost reduction (CR) and attitude (ATT), which contrasts with the findings of Esfahbodi et al. (2022). Further research is required, as this relationship was only marginally statistically significant ($p = 0.048$). The probability of rejecting Hypothesis 6 was 99%.

Hypothesis 7: CR → BI: The path coefficient for CR → BI is 0.172 ($p < 0.001$), indicating a moderately positive relationship between cost reduction (CR) and Behavioral intention (BI), and the results are in line with Esfahbodi et al. (2022). Statistical analysis confirms the highly significant nature of this relationship ($p < 0.001$), supporting Hypothesis 7 at the 99% confidence level.

Hypothesis 8: ATT → BI: The path coefficient for ATT → BI is 0.499 ($p < 0.001$), suggesting a strong positive relationship between Attitude (ATT) and Behavioral intentions (BI). Statistical analysis confirms the highly significant nature of this relationship ($p < 0.001$), supporting Hypothesis 8 at the 99% confidence level. These results are in line with the findings of Esfahbodi et al. (2022).

Table 4. Path coefficients and p values.

Hypotheses	Path	Path coefficient	P values	Remarks
H 1	QCS → ATT	0.113	0.041	H1 rejected
H 2	QCS → BI	0.270	<0.001	H2 supported
H 3	DN → ATT	0.219	0.001	H3 supported
H 4	RC → ATT	0.113	<0.044	H4 rejected
H 5	ST → ATT	0.373	<0.001	H5 supported
H 6	CR → ATT	0.099	0.048	H6 rejected
H 7	CR → BI	0.172	<0.001	H7 supported
H 8	ATT → BI	0.499	<0.001	H8 supported

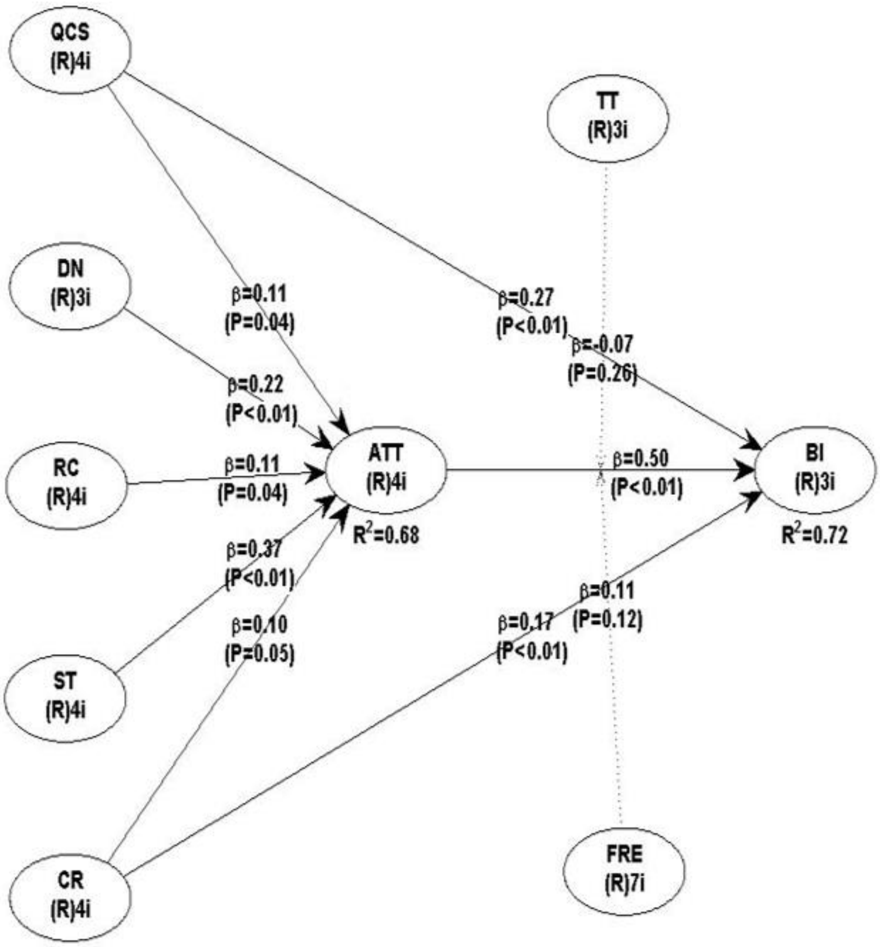

Figure 1. Structural model and results.

4.2.3. The T Ratios for Path Coefficients

The results of the T-ratios for path coefficients, obtained through SEM analysis using WarpPLS, provide valuable information regarding the significance of the relationships between the latent constructs in the study. T ratios indicate the strength and direction of the relationships and help determine whether these relationships are statistically significant.

$$T = \beta / SE(\beta) \quad (7)$$

Where:

β is the path coefficient.

SE(β) is the standard error of the path coefficient.

Upon examining the T-ratios presented in Table 5, it was observed that several path coefficients were statistically significant at a predetermined significance level. The critical T-ratios provided in the note indicate the threshold for significance in the one- and two-tailed tests. As an illustration, the T-ratio for the path coefficient between attitude (ATT) and design (DN) was 3.04. This T-ratio is greater than the threshold T-ratio for one-tailed (1.645) and two-tailed tests (1.960), demonstrating a statistically significant connection. Like the one- and two-tailed crucial T ratios, the route coefficient between attitude (ATT) and secured transactions (ST) displays a T ratio of 4.011, which is significantly higher. The path coefficient between Behavioral Intention (BI) and Attitude (ATT) is particularly noteworthy, with a T ratio of 8.52. This T-ratio far exceeded both the one-tailed and two-tailed critical T-ratios, highlighting the highly significant relationship between these constructs.

Table 5. T ratios for path coefficients.

Constructs	QCS	DN	RC	ST	CR	ATT
ATT	1.741	3.04	1.712	4.011	1.67	
BI	3.867				4.242	8.52

Note: Critical T ratios, for one-tailed tests: 1.645 and for two-tailed tests: 1.960.

4.2.4. Mediation Analysis

Mediation analysis plays a crucial role in structural equation modeling (SEM) by examining the mediating mechanisms through which independent variables affect the dependent variables. This allows us to understand the underlying processes and pathways that explain the relationship between variables of interest.

$$Y = \lambda Y * X + \lambda MY * M + \varepsilon Y \quad (8)$$

Where:

Y = the dependent variable, X = the independent variable, M = the mediating variable, λY = the direct effect of X on Y, λ MY = the indirect effect of X on Y through M, and Ey = the error term associated with Y.

Table 6 shows the indirect effects of the constructs on BI for the paths with two segments. The QCS construct had a significant indirect effect (0.056) on BI with a relatively low effect size (0.042). This suggests that QCS → BI partially mediates ATT. The DN construct had a significant indirect effect (0.109) on BI with a moderate effect size (0.075). This suggests that ATT is partially mediating DN → BI. The RC construct had an indirect effect (0.056) on BI, but this was not statistically significant (P-value = 0.054). Therefore, RC → BI has full mediation through ATT. The ST construct had a significant indirect effect (0.186) on BI, with a relatively high effect size (0.149). Therefore, RC → BI has partial mediation through ATT. The CR construct had an indirect effect (0.049) on BI, which was statistically significant. Therefore, CR → BI has partial mediation through ATT.

Table 6. Indirect effects of constructs on BI for paths with 2 segments.

Path	Path coefficient	P values	Effect size	Outcome
QCS → BI	0.056	0.04	0.042	Partial mediation
DN → BI	0.109	0.003	0.075	Partial mediation
RC → BI	0.056	0.054	0.038	Full mediation
ST →BI	0.186	<0.001	0.149	Partial mediation
CR → BI	0.049	0.039	0.033	Partial mediation

Table 6 shows the results of the two SEM analysis segments that looked at how different parts affected ATT (attitude) and BI (behavioral intention). This study identified several important connections between the constructs and outcome variables. First, ATT (β = 0.113, p = 0.041) exhibits a favorable and statistically significant relationship with customer service quality (QCS), which explains approximately 8.1% of the variance in ATT. Additionally, QCS had an effect size of 24.4% and was substantially correlated with BI (β = 0.327, p < 0.001). These results imply that QCS contributes significantly to explaining approximately 24.4% of the variance in BI. Additionally, product or service design (DN) had a significant positive impact on ATT (β = 0.219, p = 0.001), accounting for approximately 16.0% of the variance in ATT. With an effect size of 7.5% and a significant impact on BI (β = 0.109, p = 0.003), DN also contributed to approximately 7.5% of the variance in BI. ATT showed a positive relationship with regulatory compliance (RC) (β = 0.113, p = 0.044), which accounted for approximately 8.0% of the variance in ATT. RC had a smaller effect on BI (β = 0.056, p = 0.054), accounting for approximately 3.8% of the BI variance. Secured transactions (ST) significantly influenced the ATT (β = 0.373, p < 0.001) and BI (β = 0.186, p < 0.001). The effect sizes indicated that ST explained approximately 29.3% of the variance in ATT and 14.9% of the variance in BI. Furthermore, cost reductions (CR) positively affected ATT (β = 0.099, p = 0.048), explaining approximately 6.3% of the variance in ATT. CR had a stronger effect on BI (β = 0.221, p < 0.001), accounting for approximately 14.9% of BI variance. Finally, ATT had a substantial and highly significant effect on BI (β = 0.499, p

< 0.001), with an effect size of 40.4%. This indicates that ATT explains approximately 40.4% of the variance in BI. These findings highlight the significant influences of various factors, such as QCS, DN, RC, ST, and CR, on both ATT and BI.

Table 7. Total effects of constructs on ATT and BI for paths with 2 segments.

Path	Path coefficient	P values	Effect size
QCS → ATT	0.113	0.041	0.081
QCS → BI	0.327	<0.001	0.244
DN → ATT	0.219	0.001	0.160
DN → BI	0.109	0.003	0.075
RC → ATT	0.113	0.044	0.080
RC → BI	0.056	0.054	0.038
ST → ATT	0.373	<0.001	0.293
ST → BI	0.186	<0.001	0.149
CR → ATT	0.099	0.048	0.063
CR → BI	0.221	<0.001	0.149
ATT → BI	0.499	<0.001	0.404

Table 7 presents the total effects of the constructs on ATT and BI for the paths with two segments. Positive path coefficients such as 0.113 for QCS → ATT and 0.327 for QCS → BI indicates positive relationships. These relationships were statistically significant, with P-values of 0.041 and <0.001, respectively. The effect sizes, represented as 0.081 and 0.244, respectively, demonstrate the practical significance of these associations. Similarly, other paths, including DN → ATT (0.219, P = 0.001, effect size = 0.160) and DN → BI (0.109, P = 0.003, effect size = 0.075), showed varying degrees of significance and effect size. These findings suggest the strength and significance of the relationships between the constructs and can be valuable in understanding their impact on Attitude (ATT) and Behavioral intention (BI) in the context of the study.

4.2.5. Moderating Effect of Trust (TT) and Frequency of Banking (FRE)

In Structural equation modeling (SEM) analysis, moderator effects refer to the influence of a variable on the relationship between two other variables. Moderator effect analysis involves examining the interaction between a latent construct (X) and a moderator construct (M) on a dependent latent construct (Y).

$$Y = \alpha X + \beta M + \gamma(X * M) + \varepsilon (9)$$

Where Y is the dependent latent construct (dependent variable), X is the independent latent construct (independent variable), M is the moderator construct, α is the path coefficient (structure loading) between X and Y, β is the path coefficient (structure loading) between M and Y, γ is the path coefficient (structure loading) between the interaction term (X*M) and Y, and ε is the error term or residual, capturing the unexplained variation in Y.

This interaction between X and M in predicting Y is what coefficient, which represents, captures as the moderator effect. The interaction term (X × M) is the product of the X and M scores for each observation. The magnitude and significance of coefficient γ indicate the strength and statistical significance of the moderator effect. A positive γ coefficient suggests a strengthening effect, whereas a negative γ coefficient suggests a weakening effect of the moderator construct on the relationship between X and Y. In this model, customers' trust (TT) in banks with BCT and Frequency of banking (FRE) were examined as potential moderators of the relationship between ATT (an independent variable) and BI (a dependent variable). The results are presented in Figure 1 (structural model and results).In the first scenario; the moderating effect of TT on the path from ATT to BI was assessed. A β value of -0.07 represents the standardized regression coefficient, indicating the strength and direction of the relationship between ATT and BI when TT is considered. In this case, the negative β value suggests that, as ATT increases, BI tends to decrease when controlling for the moderating effect of TT. However, a p-value of 0.26 indicates that this moderation effect is statistically insignificant. This means that the relationship between ATT and BI does not vary significantly based on the level. In the second scenario, the moderating effect of another variable called FRE (with its seven indicators) on the relationship between ATT and BI was examined. A β value of 0.11 represents the standardized regression coefficient and indicates the strength and direction of the relationship between ATT and BI when FRE is considered. However, the p value of 0.12 indicates that this moderation effect is statistically insignificant. This means that the relationship between ATT and BI does not vary significantly according to FRE level.

The moderating influence of TT on the relationship between ATT and BI is illustrated in Figure 2: Rocky 3D Graph. It depicts how the relationship between ATT and BI differs based on level. The correlation between ATT and BI is specifically 0.16 for TT = -2.32, indicating a tepidly negative association. The correlation is 0.08 at TT = -1.57, demonstrating that there is no meaningful link. However, the correlation increases to 0.65 at TT = -0.08, implying a very strong positive association. Like the previous example, the correlation for TT = 0.67 is 0.58 and shows a moderately favorable association. In contrast, when TT = 1.42, the correlation was − -0.08, indicating that there was no meaningful link. These findings suggest that as TT levels change, the relationship between ATT and BI varies, with TT acting as a moderator. In other words, the impact of ATT on BI differs depending on the TT level.

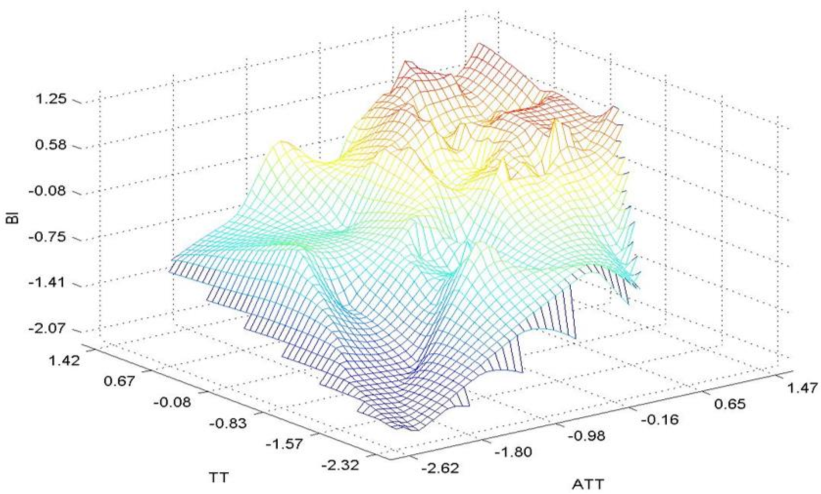

Figure 2. Rocky 3D- for moderating effect of TT in the path ATT → BI.

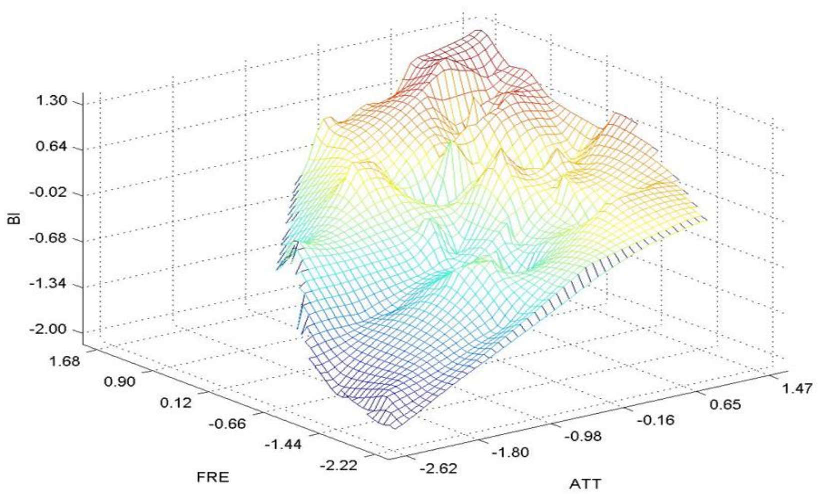

Figure 3. Rocky 3D graph for moderating effect of FRE in the path ATT → BI.

Figure 3: Rocky 3D Graph for the moderating effect of FRE in the path ATT → BI shows FRE values range from -2.22 to 1.68, with a mean of 0.14; ATT values range from -2.62 to 1.47, with a mean of -0.47; and BI values range from -2.00 to 1.30, with a mean of -0.35. The graph shows that the relationship between ATT and BI is stronger when FRE is higher. For example, when FRE is -2.22, the path coefficient from ATT to BI is 0.02. However, when FRE is 1.68, the path coefficient from ATT to BI is 0.72. This clearly shows that customers who frequently use online banking are more likely to have a positive attitude towards online banking and are therefore more likely to intend to use online banking in the future.

5. CONCLUSION

The results of the SEM analysis and discussions offer valuable insights into both the measurement model employed in the study and the relationships between the latent constructs. Overall, these findings robustly support the validity, reliability, and distinctiveness of the examined constructs. The structure loading analysis revealed strong relationships between the latent constructs and their respective indicators, particularly for Quality Customer Service, Design, Regulatory Compliance, and Secured Transactions. Additionally, constructs such as cost reduction, attitude, behavioral intention, trust, and the frequency of online banking exhibited moderate to strong associations with their indicators. The composite reliability analysis underscored high internal consistency (0.902–0.970), implying that the measurement items effectively captured the intended concepts. Average Variance Extracted (AVE) analysis demonstrated good convergent validity (0.668–0.901) for most constructs, although the Frequency of Online Banking warrants further investigation. Cronbach's alpha analysis further confirmed reliability (0.836–0.959), reinforcing the robustness of the proposed measurement model. The analysis of full collinearity variance inflation factors (VIFs) showed some constructs to be moderately collinear, but no severe multicollinearity problems were found, which suggests that the constructs are unique. As the square root of AVE values consistently exceeded the corresponding inter-correlation estimates, this showed that each construct explained more variance with its own indicators than with others.

Finally, the model fit indices indicated a good fit between the proposed model and the observed data. The average block VIF was below the recommended threshold, indicating low multicollinearity among the observed variables. In conclusion, this study's measurement model demonstrated robustness, reliability, and validity. The constructs showed strong relationships with their respective indicators, high internal consistency, good convergent validity, distinctiveness, and a good fit to the observed data. These findings support the credibility and validity of the study results and provide a solid foundation for further analysis and interpretation.

6. IMPLICATIONS, LIMITATIONS, AND SCOPE FOR FURTHER RESEARCH

6.1. Practical Implications

The findings of this study have significant practical implications in the field of investigation. First, it proves that the measurement scales used are valid and reliable. This means that they can accurately measure things like quality customer service, design, regulatory compliance, safe transactions, cost savings, attitude, behavior intention, trust, and how often someone uses online banking. These validated measurement scales could be valuable tools for practitioners and researchers to assess and measure constructs in similar contexts. Moreover, this study emphasizes the importance of various constructs in the context being studied. It's likely that these factors were very important in the area being studied because it had high composite reliability values and strong structural loadings for things like quality customer service, design regulatory compliance, safe transactions, and trust. This insight can guide practitioners in developing strategies and interventions to enhance these aspects in their organizations or systems. In addition, a discriminant validity test confirmed the distinctiveness of the constructs and their indicators. This implies that practitioners and researchers can focus on each construct separately without significant overlap or confusion. This allows for a more accurate understanding of the factors influencing the outcome variables and enables targeted interventions to enhance specific constructs.

6.2. Theoretical Contributions of the Research Findings

These research findings have theoretical implications for the field of study. First, it contributes to the theoretical understanding of the relationships between latent constructs and their indicators. High structural loadings indicate strong relationships between the constructs and their corresponding indicators, providing empirical evidence for the theoretical frameworks and models used in this study. Furthermore, this study contributes to the literature by validating and confirming the measurement scales used for the constructs. This strengthens the theoretical foundation of the field and provides a basis for further research and development. Researchers can rely on validated measurement scales in future studies to ensure consistency and comparability across different studies. Moreover, this study adds to the understanding of the internal consistency and reliability of the latent constructs. High composite reliability values indicate that the measurement items within each construct are highly correlated and measure the same underlying concepts. This finding supports the theoretical assumption that these constructs are unidimensional and provides evidence for the reliability of the measurement model employed.

In the end, evaluating the structural model and the model fit indices helps us understand how the constructs are related to each other and how they affect the outcome variables. The analysis of path coefficients, mediation effects, and moderation effects provides insights into the causal relationships and mechanisms at play. These findings can inform theoretical frameworks and models in the field, enabling researchers to refine and expand the existing theories. Overall, the practical and theoretical implications of the research findings contribute to the advancement of knowledge in this field. The validated measurement scales, understanding of construct relationships, and insights into causal mechanisms provide a solid foundation for future research, practical applications, and theory development.

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