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Risk Analysis Model in Digital Banking and Its Impact on the Investment Portfolio of Financial Institutions

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Abstract

The present study aims to develop a risk analysis model in digital banking and examine its impact on the investment portfolio of financial institutions. This research is applied in nature, as it addresses a real-world issue and its findings can provide effective solutions for financial institution managers to enhance and optimize their investment portfolios. In terms of data collection methods, this study is descriptive and employs a survey-analytical approach. The statistical population includes experts, managers, and elites in the banking industry in Tehran. The sample size was determined using the sampling formula for an unlimited population and Morgan's table, resulting in a selection of 384 participants. The data collection tool was a questionnaire based on a five-point Likert scale. The collected data were analyzed using descriptive statistical indices such as mean, standard deviation, and range of variation. To examine conceptual relationships, structural equation modeling (SEM) was employed based on the partial least squares (PLS) method using SmartPLS3 software. This method was chosen due to its compatibility with specific conditions, such as non-normal data distribution and small sample sizes. The results of structural equation modeling were presented and analyzed through the software outputs. The findings of the study indicate that effective risk management associated with digital transformation has a direct impact on improving and optimizing investment portfolios. These findings can assist financial institution managers in designing sustainable strategies and mitigating risks arising from the digitalization process.

Keywords: Risk Analysis, Digital Banking, Investment Portfolio, Financial Institutions

1. Introduction

In recent decades, digital banking has undergone significant transformations due to the rapid advancement of information and communication technologies. These developments have not only altered the way banking services are delivered but have also influenced various dimensions of financial risk. Banks and financial institutions, in an effort to remain competitive and enhance efficiency, have increasingly adopted modern technologies such as digital payments, online banking, and digital portfolio management (Mahmood & Ahmed, 2022; Zhou et al., 2019). In this regard, risk analysis, as a fundamental component of financial and investment decision-making, plays a crucial role in managing financial activities within banks and monetary institutions. The risks associated with digital banking, including cyber risks, systemic risks, credit risks, and digital operational risks, pose significant challenges for financial institutions, particularly in Iran, necessitating the development of new and up-to-date analytical models (Saputra et al., 2022; Zabala Aguayo & Ślusarczyk, 2020).

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On a global scale, different countries have developed various risk analysis models in digital banking depending on their level of digital banking maturity and technological infrastructure, which have significant implications for financial institutions' investment portfolios. The digital banking ecosystem must be structured in a way that integrates different stakeholders into a connected network to best meet customer needs (Zakari et al., 2021). In this digital ecosystem, infrastructure, including digital platforms and regulatory frameworks, should be designed and implemented to facilitate transactions. As a result, banks' customers and partner companies become interconnected, forming an efficient network. The ultimate goal of digital banking is to provide a simplified and personalized customer experience, aiming to shift perspectives away from traditional banking models (Rajabpour & Alizadeh, 2024).

Digital banking is a modern concept in the banking industry that aims to enhance online and mobile services through the adoption of digital technologies (Alinejadi et al., 2022). Contrary to common belief, digital banking is not synonymous with online or branchless banking; rather, it signifies a transformation from transaction-based services to advisory-based interactions within physical bank branches (Alizadeh & Foroughi, 2023). The current business model in banking follows a product-centric approach, which increases complexity and reduces flexibility in banking operations (Pramanik et al., 2019). As a result, banks have been compelled to expand their human capital to maintain operational efficiency, yet they have shown reluctance to innovate in response to changes in the business environment. The digital banking ecosystem represents the future of banking, serving as a strategic solution for digital transformation in the financial sector (Khan et al., 2022; Mahmood & Ahmed, 2022; Mehrani et al., 2022). It allows financial institutions to provide services such as fund transfers, account management, loan applications, online payments, and investments without requiring physical customer presence. This transformation is facilitated by digital tools and software systems that streamline banking processes and reduce the need for in-person visits (Popov & Khripunov, 2019).

Risk analysis is a critical aspect of risk management in financial institutions, focusing on assessing and forecasting potential threats that may impact assets, operations, and reputation. Given the complexity of digital infrastructure, rapid market changes, and emerging threats such as cyberattacks and technological disruptions, risk analysis has become increasingly significant in digital banking (Aghamohammadi et al., 2021; Alizadeh et al., 2024). The integration of digital technologies has introduced new risks that require comprehensive analysis. Cyber risks, for example, have become a major challenge for financial institutions due to hacker attacks, data breaches, and service disruptions. Additionally, IT risks include technical failures, software malfunctions, and network infrastructure issues, which can lead to operational breakdowns and reduced customer trust (Mehrani et al., 2022). Operational and systemic risks arise from human errors, weaknesses in internal processes, and deficiencies in the technologies used for transactions, leading to software failures, service inaccessibility, and system malfunctions. Moreover, regulatory and compliance risks related to data privacy laws, security regulations, and cross-border legal complexities are becoming increasingly significant in digital banking due to varying legal frameworks across different countries (Ke et al., 2017).

The investment portfolio of financial institutions comprises a diversified set of assets and financial instruments managed by entities such as banks, investment funds, and insurance companies to mitigate risk, ensure liquidity, and achieve long-term financial objectives (Mehrani et al., 2022). Market volatility, interest rate fluctuations, macroeconomic conditions, and regulatory changes significantly impact portfolio performance. Additionally, the emergence of new financial technologies such as blockchain and cryptocurrencies has created novel investment opportunities, pushing financial institutions to adapt their strategies (Lozano, 2016; Lubis et al., 2019). A well-structured investment portfolio should be designed to balance asset diversification, risk exposure, and expected returns to align with institutional goals.

Within the digital ecosystem, customer-centric solutions are proactively and preemptively developed based on big data analytics related to banking products and their partners. Consequently, the platform can adapt to customers' habits, preferences, and behaviors to offer customized solutions. From a security perspective, banks must also apply robust identification and authentication processes for their new partners (Lubis et al., 2019). Risk analysis models in digital banking play a vital role in assessing and managing emerging risks within financial systems. These risks, including cyber risks, credit risks, and risks stemming from technological disruptions, directly affect the performance of financial institutions and their investment

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portfolios. Digital banking, as one of the most significant transformations in the financial sector, necessitates that monetary institutions employ updated risk analysis models to anticipate and mitigate these risks (Zakari et al., 2021).

It is evident that the effective implementation of information technology significantly contributes to the organization and management of institutions, facilitates resource management, optimizes workflows, and enhances time efficiency. Despite the remarkable advancements in new technologies, some organizations either fail to fully embrace such innovations or proceed at an extremely slow pace in making adoption decisions and implementing them. Meanwhile, certain managers, despite their willingness to adopt the best available technologies in business, tend to overlook the human and organizational impacts of these technologies. This oversight may stem from their inability to leverage these technologies effectively against competitors or their failure to capitalize on the opportunities these technologies present. To address this issue, it is crucial to understand the capabilities of these technologies, their adequacy for business operations, their potential benefits, and the necessity of cultivating a new management mindset. In Iran, despite the rapid expansion of digital banking, many financial institutions have yet to implement these models effectively. This issue becomes particularly critical when confronting cyber risks and global financial fluctuations that can impact investments. On the other hand, advanced risk analysis models for digital banking have been developed globally, significantly influencing financial institutions' investment decisions. This study aims to examine and analyze the latest digital risk analysis models and adapt them to the specific conditions of Iran. By doing so, it seeks to contribute to optimizing financial institutions' investment portfolios and assist them in leveraging modern tools to develop strategic approaches for managing digital and economic risks.

2. Methods and Materials

The present study is applied in nature, as it investigates a real-world issue and specialized knowledge, and its findings and results can be utilized by managers of Refah Bank to enhance the investment portfolio of relevant financial institutions. In terms of data collection methodology, the study is descriptive and employs a survey-analytical approach, aligning with the research objectives and hypotheses. This approach allows for the acquisition of necessary data through a sampling framework based on the studied variables, thereby identifying relationships between them and integrating these findings into the future decision-making process of financial institutions.

This study examines and analyzes the development of the investment portfolio of financial institutions within Refah Bank. The primary research problem is to investigate the relationship and impact of various variables on the financial and investment decision-making processes of monetary institutions. Using the collected data, the goal is to identify and analyze the relationships among these variables and optimize the investment portfolio.

The data collection method is descriptive and survey-based, utilizing a questionnaire as the primary tool for gathering information. The target population includes banking industry experts, managers, and financial institution elites in Tehran. A simple random sampling method was applied to select 384 participants from the target population. These individuals were randomly chosen from banks and financial institutions in Tehran. The sample size for the study was determined using the sampling formula for an unlimited population and based on Morgan’s table, with a 5% error margin, resulting in 384 participants.

Data were collected using a Likert-scale questionnaire with five response options: strongly disagree (1), disagree (2), neutral (3), agree (4), and strongly agree (5). In this questionnaire, respondents were asked to express their views on the study variables.

For data analysis, descriptive statistics, including mean, standard deviation, minimum, and maximum values, were employed, along with structural equation modeling (SEM) to examine relationships among variables (Table 1). Statistical software such as SPSS and SmartPLS3 was utilized for data analysis.

3. Findings and Results

Based on the obtained results, recommendations will be provided to improve investment strategies and financial decision-making.

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Table 1. Descriptive Statistics of Research Variables

Variables	Mean	Skewness	Kurtosis	Variance	Range
C01	3.6	0.808	0.002	0.375	3
C02	3.775	1.461	-0.584	0.446	3.33
C03	4.0842	-0.058	-0.263	0.231	2.33
C04	3.825	-0.216	0.566	0.225	2
C05	3.6729	-0.496	0.314	0.339	2.25
C06	4.2229	-0.625	-0.47	0.358	2
C07	4.0938	0.018	-0.032	0.192	2.25
C08	3.8734	-0.883	0.163	0.465	2.5
C09	3.7405	-0.301	-0.171	0.473	3
C10	4.3938	-0.241	-0.621	0.302	2
C11	4.1	-0.938	0.134	0.319	2
C12	3.8397	0.273	-0.318	0.399	3
C13	4.1542	-0.8	0.051	0.259	2
C14	3.9	0.088	-0.558	0.439	3
C15	3.9125	1.215	-0.628	0.41	3
C16	4.1417	1.677	-0.749	0.213	2.67
C17	3.6937	-0.001	0.041	0.459	3

Before evaluating structural relationships, multicollinearity must be assessed to ensure that the regression results are not biased. In statistics, the Variance Inflation Factor (VIF) assesses the severity of multicollinearity in an Ordinary Least Squares (OLS) regression analysis. The severity of multicollinearity can be analyzed by examining the magnitude of the VIF value. This index indicates the extent to which variance in estimated coefficients is inflated due to collinearity. If the VIF value exceeds 5, it is considered a critical level of inflation, while the ideal VIF value is 3 or less.

Table 2. Multicollinearity Test (VIF)

Variable	VIF
C01	1.472
C02	1.193
C03	1.239
C04	1.170
C05	1.045
C06	1.161
C07	1.249
C08	2.687
C09	2.566
C10	1.258
C11	1.166
C12	1.402
C13	1.562
C14	1.085
C15	1.003
C16	1.005
C17	1.252

The software output after testing the conceptual research model is presented in Figures 1 and 2.

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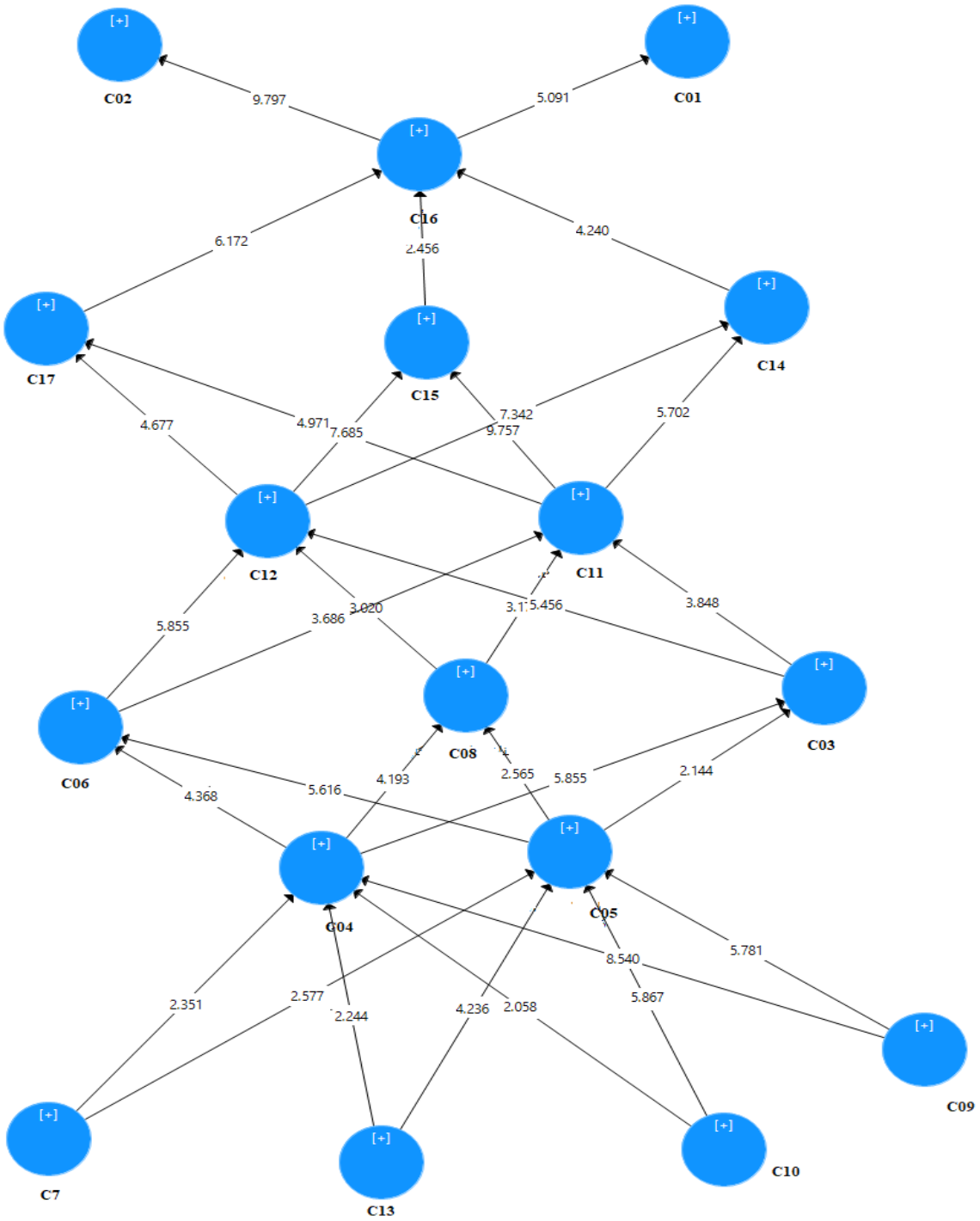


Figure 1. Overall Research Model: T-Statistics for Bootstrapping (Outer Model)

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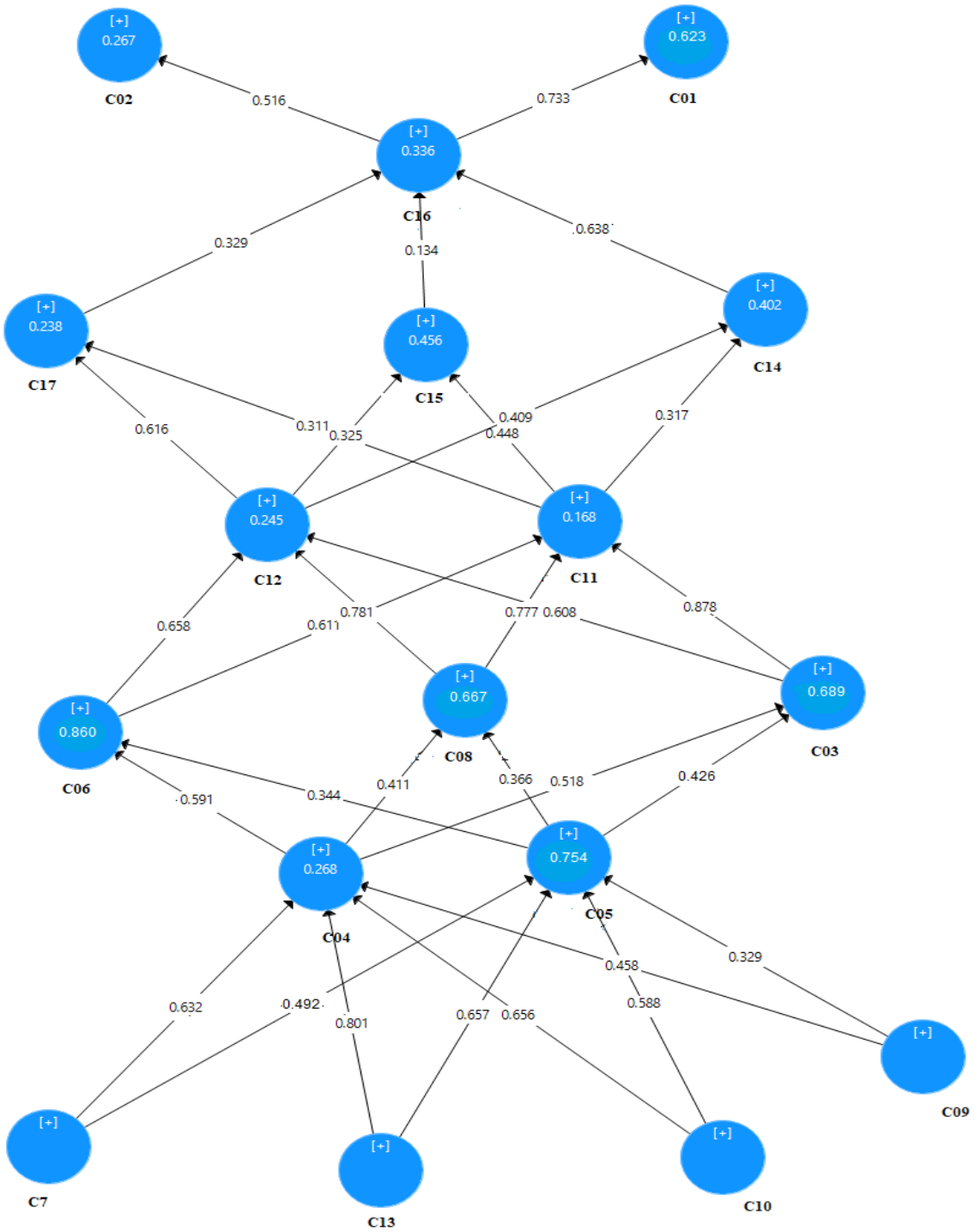


Figure 2. Overall Research Model: Factor Loadings (Outer Model)

To evaluate the model, the outer model was first used to measure the relationships between the latent variables and their respective indicators. The outer model examines the relationship between indicators (i.e., questionnaire items) and constructs. Essentially, unless it is confirmed that the questionnaire items adequately measure the latent variables, the relationships between variables cannot be tested. Additionally, to assess and validate the reliability and validity of the constructs in partial least squares structural equation modeling (PLS-SEM), factor loadings, Cronbach's alpha, composite reliability (CR), average variance extracted (AVE), and discriminant validity (Fornell-Larcker criterion) were calculated and presented.

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Table 3. Convergent Validity and Reliability of Research Variables

Variable	Cronbach's Alpha	AVE	CR
C01	0.726	0.563	0.816
C02	0.722	0.519	0.853
C03	0.738	0.534	0.740
C04	0.764	0.538	0.755
C05	0.865	0.530	0.801
C06	0.790	0.566	0.864
C07	0.737	0.601	0.783
C08	0.811	0.604	0.764
C09	0.825	0.633	0.758
C10	0.803	0.614	0.794
C11	0.784	0.628	0.733
C12	0.775	0.570	0.832
C13	0.856	0.611	0.896
C14	0.736	0.535	0.827
C15	0.794	0.582	0.736
C16	0.781	0.620	0.804
C17	0.764	0.609	0.763

After ensuring the validity of the measurement models through reliability testing, convergent validity, and discriminant validity, the results of the structural model can be presented. Unlike measurement models, the structural model does not consider questionnaire items and observed variables but focuses exclusively on latent variables and their relationships.

The R^2 coefficient is a measure that connects the measurement model with the structural model in structural equation modeling (SEM). It represents the extent to which the variations in dependent variables are explained by independent variables. A crucial point here is that R^2 is only calculated for endogenous (dependent) constructs, while for exogenous constructs, its value is zero. The higher the R^2 value for endogenous constructs, the better the model fit.

According to Chin (1998), R^2 values of 0.19, 0.33, and 0.67 indicate weak, moderate, and strong model fit, respectively. Similarly, Henseler (2009) and Hair et al. (2011) define 0.25, 0.50, and 0.75 as benchmark values for weak, moderate, and strong model fit, respectively.

Based on the results, the R^2 values for the endogenous constructs in this study indicate an adequate model fit. The R^2 coefficient for the dependent components suggests that 44.7% of the variance in the model's variables is explained by the combined effects of independent and dependent variables, which is considered highly acceptable.

4. Discussion and Conclusion

In the analysis of risk in digital banking and its impact on the investment portfolio of financial institutions, comparing the findings with previous research is crucial. Existing studies indicate that while digital banking offers numerous opportunities across various domains, it also presents new challenges and risks that require careful management. Research in the field of digital banking risk highlights cyber risks as one of the most significant concerns. According to a study conducted by Saputra et al. (2022), financial institutions that have rapidly transitioned to digital banking are more vulnerable to cyberattacks. This study also notes that due to the advancement of digital infrastructure, banks and financial institutions must continuously employ advanced security technologies to mitigate cyber threats (Saputra et al., 2022). These findings align with the results of this research, which emphasize that cyber risks are one of the fundamental challenges in digital banking and require specialized management.

From an investment portfolio perspective, previous research has demonstrated that diversification is one of the most effective strategies for risk management in financial markets. Studies (Mahmood & Ahmed, 2022; Mehrani et al., 2022) concluded that financial institutions can mitigate the adverse effects of market volatility on their investments by constructing diversified portfolios comprising various asset classes. These findings align with this study's emphasis on asset diversification and allocation across different risk categories, including low-risk financial assets, medium-risk assets, and high-risk assets. Particularly in the digital age, where emerging markets such as cryptocurrencies and new financial technologies are expanding, diversification in investment portfolios can help financial institutions protect themselves against digital and economic risks.

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Furthermore, studies on (Lubis et al., 2019; Mahmood & Ahmed, 2022; Mehrani et al., 2022; Pramanik et al., 2019) the impact of modern technologies on financial institution investments concluded that the use of artificial intelligence (AI) and big data analytics can assist financial institutions in simulating various risk scenarios and forecasting market developments. These findings correspond with the emphasis in this paper on employing advanced tools such as AI and big data analytics. Particularly in digital banking, where big data and new technologies play an increasingly vital role in risk management, leveraging these tools can help financial institutions anticipate and mitigate unforeseen risks.

Thus, based on comparisons with previous research, it can be concluded that while digital banking creates new opportunities for financial institution growth, it also introduces specific risks, particularly in the areas of cybersecurity, information technology, and market volatility. To manage these risks effectively, financial institutions must adopt advanced security technologies, utilize big data analytics, and develop diversified investment strategies. This approach will not only enable them to mitigate digital threats but also capitalize on opportunities in emerging markets.

The rapid advancements in information and communication technologies (ICTs) have led to fundamental transformations across industries, particularly in financial institutions. Digital banking, recognized as one of the most advanced and efficient methods for providing banking services, has been growing at an unprecedented pace. This form of banking enhances accessibility, speed, and cost-effectiveness in banking services, ultimately improving customer experience. However, the expansion of digital banking also presents challenges, with risk analysis being one of the most critical. Financial institutions, as key entities in the economy, face a wide range of risks. In digital banking, risk analysis involves cybersecurity threats, technological failures, data-related risks, and strategic investment risks.

In this context, financial institutions in Iran, which are among the pioneers in digital financial services, increasingly need to develop advanced risk assessment models and optimize their investment portfolios. Accordingly, the following recommendations are proposed:

Banks should promote positive interactions with customers to enhance their reputation among clients. Additionally, by leveraging social media and collecting customer feedback, banks can improve their brand image and credibility.

Financial institutions and banks can also create a positive customer experience, encouraging customers to engage in positive word-of-mouth marketing about the bank.

Managers should introduce special programs and promotional events to retain existing customers. Furthermore, by offering exclusive services to new customers and implementing customer acquisition programs, they can expand their customer base.

Selecting and updating cutting-edge technologies to enhance customer experience is crucial. Managers must possess the capability to forecast demand and manage the supply of digital services and products to prevent market imbalances and disruptions. The ability to adapt to sudden changes in demand and supply enables banks to optimize market performance.

In all research studies, limitations are an inevitable component, serving as a foundation for future investigations.

Despite the movement of Iranian banks toward digitalization, no bank in the country has fully transitioned to a completely digital model. The process of digital transformation in Iranian banks has been partial rather than complete. Therefore, current digital banking implementations are not yet fully developed.

One of the main limitations of this research was the lack of access to comprehensive and reliable data related to digital risks and the financial performance of monetary institutions. This limitation may have affected the precision of the analyses conducted in this study.

Ethical Considerations

All procedures performed in this study were under the ethical standards.

Acknowledgments

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Conflict of Interest

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