Modeling FinTech Variables on the Profitability of Banks and Financial Institutions Using a Dynamic Systems Approach

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Abstract

The present study aims to model FinTech variables and their impact on the profitability of banks and financial institutions. FinTech has become a significant factor in reducing financial intermediation, accelerating this process. Consequently, many customers have left commercial banks and turned to FinTech companies. In fact, FinTech has eliminated temporal and spatial limitations. However, these changes have not left banks unaffected, exposing them to various threats. Issues such as resource shortages, delays in collecting receivables, or even their potential loss, external threats, and competition with other banks are factors that may result from outdated banking technologies. This research adopts a dynamic systems approach, which provides a comprehensive dynamic perspective for modeling, combining quantitative and qualitative aspects to simulate a phenomenon over time. The present study is a mixed-method (qualitative and quantitative) research, which is applied in terms of its objective and descriptive-exploratory in terms of data collection method. It is conducted in two qualitative and quantitative sections. The analysis of the positive feedback loop indicates a dynamic process in which risk management and evaluation positively influence each other. Moreover, based on the research findings, FinTech has a positive impact on profitability and efficiency in the banking industry.

Keywords: *FinTech, bank profitability, dynamic systems approach.*

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1. Introduction

In the era of the Fourth Industrial Revolution, digital technologies such as big data and cloud computing are rapidly developing. FinTech, which originates from the integration of finance and technology, emerged when there was a need for dynamic integration. The emergence and development of financial technology have significantly impacted financial institutions, particularly commercial banks [1]. FinTech has accelerated the reduction of financial intermediation, prompting a large number of customers to leave commercial banks and turn to FinTech companies, breaking temporal and spatial limitations [2]. Online services and intelligent robots introduced by financial technology have replaced offline labor, reducing costs. FinTech can enhance the innovative awareness of commercial banks, emphasizing innovative talents and continuously fostering the creation of new products and services. Commercial banks actively collaborate with FinTech companies, improving the accuracy of customer identification through big data technologies and enhancing the risk-pricing capabilities of commercial banks [3].

Today, the focus on the competitive landscape has created challenges for FinTech development in the banking industry. In business, the continuous development of financial technology leads to interest rates becoming more market-oriented, which undoubtedly changes the debt structure of commercial banks, subsequently increasing the cost of obligations. Ultimately, this will impact bank profitability. Regarding debt, the continuous development of internet technology means that a large volume of funds no longer needs to pass through traditional financial institutions like commercial banks and can instead be transferred via the internet. While this method benefits the supply and demand of funds by increasing efficiency, it undoubtedly has a specific impact on the business and profitability of traditional banks [4]. Financial technology encourages commercial banks to innovate products, services, and other innovations to improve operational efficiency and reduce costs. FinTech has brought transparency to the financial sector, reducing risks, improving customer access to financial services, lowering costs, and increasing speed [5]. FinTech is composed of various elements such as big data, cloud computing, the Internet of Things, blockchain, and others, creating complex relationships when determining the effects of each on bank profitability.

Overall, with the vast technological changes affecting human societies, banks have not been immune to these transformations and have faced numerous threats. Internal issues such as resource shortages, delays in receivables collection, or even their potential loss, and external threats such as competition with other banks, may result from outdated banking technologies [6]. Financial and banking technologies have emerged to provide innovative services. FinTech offers opportunities to create new services and business models while posing challenges for traditional financial service providers. A lack of time for auditing and financial matters, increased financial regulations and the need to adapt to them, the need for financial system security, the expansion of trade interactions, and other factors have laid the foundation for the emergence of financial technologies [7]. Financial technology examines traditional banking systems, assesses current and potential risks, and offers secure pathways in the financial and banking sectors. Based on the needs of banks, the design of new hardware and software in the financial domain is prioritized [8]. The advantage of FinTech companies lies in their flexibility, agility, precise customer needs assessment, and departure from any traditional systems [9].

In recent years, several factors, such as increasing bank competition, expanding technology, growing technology adoption, and raising societal welfare levels, have changed customer needs. However, the traditional banking structure, despite fundamental changes, was still unable to meet the ever more complex and important customer needs. These unmet needs created a gap between banks and customers, paving the way for the emergence of FinTech companies. Changing customer behavior and their desire to directly manage their money and personalize the services they receive further widened the gap between banks and customers. FinTech companies, lacking the structural complexities of banks, were better able to identify customer needs due to their close interactions with customers. FinTech companies emerged when the financial and banking industry was unable to innovate in a way that would revolutionize value creation. Furthermore, customers had many reasons to lose trust in banks—high costs, slow services, lack of transparency, discrimination between customers, among others—and no better solutions were offered by the banks to resolve these issues. Analysts believe that a digital revolution is occurring in the financial and banking services industry. Although the digital revolution exists in all industries, its effects on banking are particularly intense and widespread, as evidenced by the rapid growth of financial technologies. Modern financial technologies are not bound to traditional systems and make extensive efforts to capture

the market. At first glance, modern financial technologies might seem like dangerous competitors to banks, but a more thorough examination reveals that these new players can assist banks by offering faster, cheaper, and easier services [10].

In general, FinTech innovation affects bank development in two ways: external FinTech innovation and internal FinTech innovation within banks. External FinTech innovation refers to FinTech companies outside of banks, which can impact the development of commercial banks through competitive effects and technological spillovers (Jin et al., 2020). Most existing studies examine the impact of external FinTech innovation on the banking industry, while the internal FinTech innovation of banks, particularly its effect on risk-taking at the micro level, should be investigated. FinTech innovation enhances banks' risk control capabilities by improving capital adequacy ratios.

System dynamics is a method for studying and managing complex systems with feedback. In this approach, a picture of the system is created based on existing feedback loops and delays to better understand the dynamic behavior of complex systems. System dynamics is a comprehensive dynamic approach to modeling, combining quantitative and qualitative aspects to simulate a phenomenon over time.

Few studies have examined the impact of FinTech development on bank performance, and they are mostly descriptive analyses of potential opportunities and threats [11-13].

With the advancement of technology, financial and banking services, like other industries, are evolving. The impact of modern technologies is such that they not only increase the profitability of banks and financial institutions but also accelerate service delivery and improve customer satisfaction. The banking industry in the country has made progress, but no significant changes have occurred in the business platform. Therefore, it is necessary for regulators and senior banking managers to have a different perspective on modern financial technologies and consider them as drivers of transformation in the new business platform for the banking industry. Additionally, FinTech innovations have the potential to offer a wide range of benefits, particularly improved efficiency, cost reduction, enhanced risk assessment, superior customer experience, and greater financial inclusion in the insurance industry. Improvements in communication networks and processing capacity have led to faster payment processes, thereby improving the performance of insurance companies through online platforms with reduced processing times.

Considering the mentioned points and the potential for implementing a dynamic system in banking services, the question arises: Can FinTech variables be modeled on the profitability of banks and financial institutions using a dynamic systems approach?

2. Methodology

The present study is a mixed-method research (qualitative and quantitative), applied in nature, and descriptive-exploratory in terms of data collection. The study will be conducted in both qualitative and quantitative sections. In the qualitative section, content analysis will be used in three stages: open coding, axial coding, and selective coding.

Semi-structured interviews with experts, including theoretical experts (university professors) and practical experts (bank managers), will be conducted. To provide solutions for the research problem and to understand the importance of the subject, a dynamic systems modeling approach will be used. A dynamic model of the relationships between FinTech variables and the profitability of banks and financial institutions will be developed and used in the qualitative section. The model will be created using a dynamic systems approach and will be computer-simulated using Vensim software, followed by model testing.

In the first step of the research, variables will be determined qualitatively. In the second step, after reviewing the causal-loop and flow models proposed in the study and consulting experts, the variables influencing the profitability of banks and financial institutions will be examined. In the third step, data analysis will be performed.

For data collection, various theories regarding the relationship between FinTech variables and the profitability of banks and financial institutions will first be reviewed. Based on the collected theoretical foundations, the required economic data for the variables will be gathered from official statistical sources, such as the Statistical Center of Iran, the Economic Time Series Database, and CODAL. In the qualitative section, data analysis will be performed using MAXQDA software.

3. Findings

The results from the qualitative section and the thematic analysis approach in the banking industry are presented in Table 1.

Table 1. Main and Sub-Themes (Banking Industry)

No.	Main Theme	Sub-Themes
1	Risk Management and Planning	1. Risk Management and Evaluation
		2. Strategy and Planning
2	Financial and Economic System	1. Financial and Banking System
		2. Macroeconomics
3	Marketing and Customer Management	1. Market and Customer Management
		2. Data and Market Analysis
4	Technology	1. Information and Communication Technology
		2. Operations Management

The results from the analysis of the positive feedback loop indicate a dynamic process where risk management and evaluation positively influence each other. Improvement in risk management leads to more accurate risk evaluation, which in turn enhances risk management. This positive feedback loop helps organizations continuously improve and respond effectively to new challenges and risks.

Ultimately, risk management and evaluation are inseparable components of a dynamic system that continuously influence each other positively.

The results from the causal-loop of strategy and planning show that strategy influences planning. Specifically, the formulation of long-term strategies to achieve organizational goals, along with creating a clear vision for the organization's future as a guide for planning and determining business strategies, plays a significant role in achieving a desirable position in the market. In fact, these strategies help organizations make more effective plans to achieve their objectives.

Simulation Results

The results from simulating FinTech applications in Iran's banking industry using Vensim software for 12 months are as follows:

- **Increased Financial Inclusion**
- The simulation shows that FinTech innovations can help increase financial inclusion in Iran. Currently, a significant portion of the Iranian population is either unbanked or underbanked. FinTech can help close these gaps by offering digital financial services and easy access, which is particularly important for disadvantaged groups and remote areas with limited access to financial services.
- **Regulatory Challenges**
- The simulation results suggest a need for alignment with existing laws and regulations to facilitate the adoption of FinTech strategies in Iran's banking sector. Establishing a clear legal and regulatory framework can promote transparency, reduce costs, and enable faster service delivery. Without this framework, banks and FinTech companies may face serious barriers to development and innovation.
- **Opportunities for Cost Reduction**
- The simulation demonstrates that implementing FinTech can lead to cost reductions in the banking industry. By automating processes and using digital technologies, banks can streamline their operations and achieve greater efficiency. These cost reductions can help banks offer more competitive prices and attract new customers.
- **Improved Customer Experience**
- FinTech has the potential to transform customer experiences in Iranian banks. By offering innovative digital services and personalized solutions, banks can increase customer satisfaction and loyalty. This can lead to greater customer engagement with banks and increased use of financial services.
- **Regulatory and Infrastructure Challenges**
- The results indicate a need for strong infrastructure and tools to support the implementation of FinTech strategies in Iran's banking industry. Developing the necessary technological infrastructure and addressing regulatory barriers is crucial for the successful adoption of FinTech. Without these infrastructures, banks will not be able to fully leverage modern technologies.
- **Towards a Smart Economy**
- The simulation suggests that the adoption of FinTech in Iran's banking sector is a step towards a smart economy. By utilizing digital technologies and data-driven insights, banks can make more informed decisions and provide better services. These changes not only help improve bank

performance but also contribute to the overall economic development of the country.

In general, the simulation using Vensim software highlights the potential benefits and challenges associated with the implementation of FinTech in Iran's banking industry. While FinTech presents opportunities for financial inclusion, cost reduction, and improved customer experiences, addressing regulatory and infrastructural gaps is crucial to realizing these benefits and moving towards a smart economy. These findings can help policymakers and banking managers design effective strategies to enhance performance and foster innovation in Iran's banking sector.

Figure 1 shows the simulated trends for three key topics in the banking industry over a 12-month period: digital capabilities, organizational capabilities, and analysis of the current conditions. In the figure, the lines represent the normal significance of each topic over time.

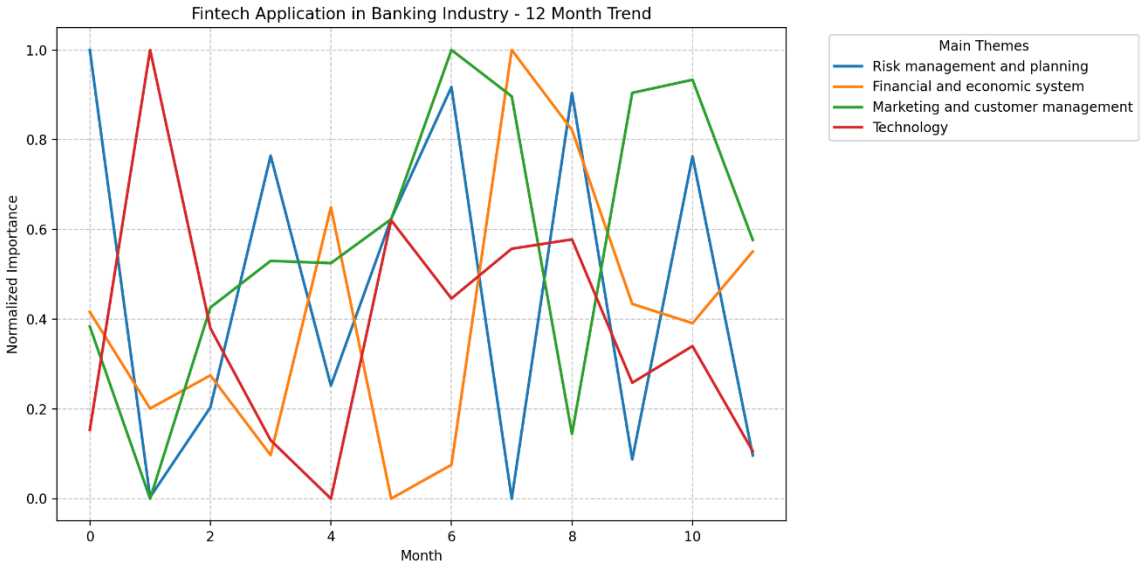

Figure 1. Simulation Trend Chart (12-Month Banking Industry)

Digital Capabilities

This trend shows a strong upward slope, indicating a significant increase in the focus on digital transformation throughout the year. Digital capabilities refer to the set of skills and knowledge related to using digital technologies to enhance organizational performance. The increased focus on digital transformation reflects that organizations are increasingly seeking to integrate advanced technologies into their processes and products to better meet customer needs and gain a competitive edge in the industry. This upward trend may also indicate growing investment in training and developing employees to acquire the necessary digital skills.

Organizational Capabilities

The trend remains relatively stable with slight fluctuations, indicating a consistent focus on enhancing organizational capabilities. Organizational capabilities refer to an organization's capacity to effectively coordinate resources and processes to achieve strategic goals. The relative stability in this trend suggests that organizations are continuously striving to improve their structures, culture, and leadership to respond more effectively to environmental changes and maintain a competitive advantage. This may also involve investing in leadership development and fostering a culture of innovation and flexibility across the organization.

Current Conditions Analysis

This topic shows a slight upward trend, indicating a gradual increase in focus on analyzing current conditions. Current conditions analysis refers to a thorough examination of the organization's internal and external environment to identify strengths, weaknesses, opportunities, and threats. The gradual increase in focus suggests that organizations are increasingly seeking to better understand their competitive environment and identify potential opportunities for growth and innovation. This could include investments in market research, customer data analysis, and continuous monitoring of industry developments, enabling organizations to make more informed strategic decisions.

According to the research findings, there is a significant gap between the banking and insurance industries in adopting and applying FinTech technologies. While the banking sector has embraced FinTech innovations and

experienced significant progress, the insurance industry has been relatively slow in adapting to these transformations.

This chart illustrates the trends and changes in four key topics in the banking industry over one year:

- **Risk Management and Planning**
- This topic shows significant fluctuations throughout the year, peaking at the beginning and mid-year. This indicates a strong focus on risk management strategies during these periods. Agile planning is an iterative process that helps teams move from concept to implementation by highlighting critical stages of product development. Risk management is tied to organizational goals and can be effectively utilized when the organization's objectives are comprehensive, inclusive, and clear.
- **Financial and Economic System**
- This topic follows a moderate and relatively stable trend, with a slight increase toward the end of the year. This indicates a consistent emphasis on financial systems and macroeconomic factors. Strategic risks related to decision-making (such as the potential unsuitability of a system) are considered strategic risks, which are accepted with the expectation of achieving benefits.
- **Marketing and Customer Management**
- This topic shows a gradual increase throughout the year, reaching its peak at the end. This reflects the growing importance of market analysis and customer management strategies. A risk management plan should be proportionate to the project and take human factors, including potential errors, into account.
- **Technology**
- This topic peaked at the beginning of the year and then declined. This initial focus highlights technological advancements and operations management. The use of artificial intelligence and advanced technologies to automate inefficient manual processes is an effective way to enhance an organization's risk management program.

This chart provides insights into how these topics have evolved over time, reflecting the dynamic nature of FinTech application in the banking industry. Risk management and planning, financial and economic systems, marketing and customer management, and technology are four key topics that are prioritized in this industry, and their changes over time can be observed in this trend chart.

Overall, the banking sector has been at the forefront of FinTech adoption. Neobanks, which are fully digital banks, have become highly popular, disrupting the traditional banking landscape. Today, banks are utilizing FinTech innovations such as mobile banking apps, digital payment services, AI-powered chatbots and virtual assistants for customer support, big data analytics for personalized product recommendations and fraud detection, and blockchain technology for secure and transparent transactions. In fact, these FinTech solutions enable banks to provide more convenient, efficient, and customer-centric services, leading to increased customer satisfaction and loyalty.

The results from the positive feedback loop analysis show that risk management and evaluation are dynamic and positive processes. Risk management acts as a crucial component in the evaluation process, helping organizations take more effective actions by identifying and assessing risks. On the other hand, accurate evaluation contributes to improving risk management.

This positive loop indicates that if one factor in the loop changes in one direction, it reinforces the changes in the same direction. For example, with improved risk management, a more accurate risk assessment is performed, which in turn helps further improve risk management.

4. Discussion and Conclusion

The findings of this study offer valuable insights into the role of FinTech in shaping the profitability and operational efficiency of banks and financial institutions in the context of the Iranian banking sector. Through qualitative and quantitative analysis, the study highlights the influence of digital capabilities, risk management, organizational efficiency, and customer engagement, all of which are essential factors in understanding the dynamic relationship between FinTech and bank profitability.

One of the key results from the simulation using Vensim software is the positive impact of FinTech innovations on financial inclusion. In Iran, a significant portion of the population remains unbanked or underbanked, and the introduction of digital financial services through FinTech is helping to bridge this gap. This finding aligns with previous research by Abad-Segura et al. (2020), who emphasized that FinTech increases access to financial services by offering digital solutions, especially in underserved regions. The digitalization of financial services allows banks to reach

rural and marginalized populations more effectively, thus contributing to greater financial inclusion. The ability of FinTech to drive financial inclusion is further supported by the findings of Li et al. (2022), who observed that the adoption of FinTech in commercial banks not only improves access to financial services but also enhances financial empowerment, particularly for women in rural areas [14].

Another critical finding is the potential cost savings enabled by FinTech through automation and process optimization. The results demonstrate that implementing FinTech solutions can significantly reduce operational costs for banks by streamlining processes, reducing manual labor, and eliminating inefficiencies. This finding is in line with earlier studies, such as those conducted by Fernando and Dharmastuti (2021), who highlighted the transformative power of FinTech in reducing costs and enhancing operational efficiency [9]. By automating key banking functions, such as risk assessment and customer onboarding, banks can lower transaction costs and pass these savings on to customers in the form of more competitive pricing, which in turn attracts new customers and drives profitability [4].

In terms of risk management, the study's findings reveal that the integration of FinTech into banking systems leads to improvements in risk management practices. The simulation results show that FinTech can enhance risk assessment accuracy, which helps banks to identify and mitigate potential risks more effectively. This outcome is supported by Yao and Song (2021), who found that the application of big data and AI technologies in FinTech allows banks to refine their risk management models, leading to more precise credit risk evaluations [3]. Similarly, Kou et al. (2019) observed that the use of machine learning and advanced analytics in FinTech could improve systemic risk analysis in the financial sector, offering banks a competitive edge in managing market risks [8].

Despite the positive impacts of FinTech, the study also highlights the regulatory challenges that banks in Iran face. The simulation shows that without a clear and supportive regulatory framework, the adoption of FinTech may be hindered, limiting its potential benefits. The need for a robust regulatory environment is consistent with the findings of Cornelli et al. (2020), who argued that regulations must evolve to keep pace with technological advancements in the financial sector [6]. As financial technologies continue to disrupt traditional banking models, the creation of comprehensive legal frameworks that address issues such as data privacy, cybersecurity, and digital identity verification becomes increasingly critical [15].

The findings also suggest that the insurance sector lags behind the banking industry in terms of adopting FinTech innovations. While banks have embraced digital transformation, resulting in improved customer engagement and operational efficiency, the insurance industry has been slower to integrate these technologies. This discrepancy echoes the conclusions of Haber et al. (2018), who found that while FinTech has revolutionized banking, the insurance sector remains relatively conservative, struggling to adopt technologies like blockchain and AI at the same pace [16]. This slow adoption may be attributed to the complex regulatory environment and the nature of insurance products, which are often less adaptable to digital platforms compared to banking services.

In addition to these findings, the study demonstrates that FinTech has the potential to transform customer experiences by offering personalized and efficient services. The use of AI-driven chatbots, mobile banking apps, and big data analytics allows banks to deliver tailored financial products to individual customers, thereby increasing customer satisfaction and loyalty. This outcome is supported by Abbas and Shaheen (2021), who found that FinTech innovations in Saudi Arabia's banking sector have significantly improved customer service by enabling real-time interactions and providing customized solutions [10]. Moreover, Yao and Song (2021) noted that digital financial services lead to greater customer retention, as personalized experiences foster deeper relationships between banks and their clients [3].

The positive feedback loop identified in the study underscores the symbiotic relationship between risk management and evaluation, where improvements in one area lead to enhancements in the other. This dynamic process creates a self-reinforcing cycle of continuous improvement, enabling banks to respond more effectively to emerging risks and market changes. This finding is consistent with research by Almulla and Aljughaiman (2021), who emphasized that FinTech improves both risk management and decision-making processes by providing real-time data and predictive analytics, allowing banks to proactively address potential issues before they escalate [17].

Despite the valuable insights provided by this study, several limitations must be acknowledged. First, the study focuses on the Iranian banking sector, which may limit the generalizability of the findings to other regions with different regulatory environments, technological infrastructures, and customer behaviors. Additionally, the study's reliance on simulation modeling, while useful for

exploring dynamic processes, may not fully capture the complexities of real-world banking operations. Furthermore, the qualitative section of the research relies heavily on expert interviews, which, while informative, may introduce biases based on the subjective experiences and perspectives of the participants. Future research should consider expanding the scope of the study to include empirical data from multiple regions and different types of financial institutions, such as microfinance organizations and digital-only banks.

Future research should focus on a deeper exploration of the regulatory challenges faced by banks when integrating FinTech solutions. As the results of this study suggest, regulatory barriers play a significant role in determining the success of FinTech adoption, and further investigation is needed to identify the specific legal and policy frameworks that facilitate or hinder innovation in the financial sector. Additionally, researchers should explore the long-term impact of FinTech on financial inclusion, particularly in emerging markets where access to financial services remains limited. Another promising avenue for future research is the examination of how different FinTech applications, such as blockchain and AI, affect risk management practices across various financial sectors, including insurance and asset management. Finally, comparative studies examining the adoption of FinTech across different regions and financial industries would provide valuable insights into the global trends shaping the future of banking.

To leverage the benefits of FinTech, banking institutions should invest in developing digital capabilities among their workforce. This includes training employees in the use of advanced technologies, such as artificial intelligence and big data analytics, to improve decision-making and operational efficiency. Additionally, banks should establish strong partnerships with FinTech companies to co-develop innovative financial products and services that cater to the evolving needs of their customers. In terms of risk management, banks should integrate AI-powered tools that allow for real-time risk assessments and predictive analysis, enabling them to respond more proactively to emerging threats. Finally, regulatory bodies should collaborate with the banking sector to create a transparent and supportive legal framework that encourages the safe and secure adoption of FinTech solutions, fostering innovation while protecting consumer interests.

Authors' Contributions

Authors equally contributed to this article.

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Declaration of Interest

The authors report no conflict of interest.

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Ethical Considerations

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

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