

Investigating the moderating role of macroprudential policies in the relationship between financial technologies and banks' risk-taking: Evidence from Iran

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Abstract

Since financial technologies have an inevitable relationship with the banking industry, and on the other hand macro-prudential tools in combination with financial technologies can help commercial banks to build a more efficient and perfect supervisory system, in this research the moderating role of macro-prudential policies in the relationship between financial technologies And the risk taking of banks was investigated. The statistical population of this research includes all the banks accepted in the Tehran Stock Exchange during the years 2013 to 2022. And among them, 21 banks have been selected according to the characteristics of the research. In this research, linear regression was used to test the hypotheses and Eviews software was used to analyze the data. The results show that financial technologies have a positive and significant correlation with bank risk-taking, in fact, financial technologies significantly increase banks' risk-taking. Also, the results show that macroprudential policies weaken the positive effect of financial technologies on bank risk-taking.

Keywords

Macroprudential policie , Bank risk-taking, Financial technologies

1. Introduction

Behind a new round of technological revolution and industrial transformation, digital technologies such as big data, cloud computing, and artificial intelligence have deeply intertwined with financial businesses and led to the rapid development of financial technologies (FinTech) (Demestichas and Daskalakis, 2020). In fact, digitization is gradually becoming an important turning point for the innovation of global companies. These developments lead to changes in business models and financial innovations of the financial industry, as well as better financial services and improving the efficiency of financial markets, and have created significant changes in value creation. The combination of e-commerce and social media platforms has led to the complete integration of financial technology services into consumers' lives. Therefore, the study of the impact of financial technologies in Iran is a good study basis and it has a long history and can provide theoretical and practical resources for other emerging economies. By empowering technology, commercial banks are gradually upgrading their business models and optimizing their financial environment. However, technological progress is always a double-edged sword (Wang, Zhang, Ma, & Wang, 2023). And the changes created by the digital transformation of banks in turn affect their risks. Considering that commercial banks are a key component of the financial system and play an important role in maintaining economic order, researchers have begun to focus on whether financial technologies affect the risk-taking of commercial banks or not. With the increase of potential risks in the banking system, macro-prudential supervision gradually assumed a role in maintaining the stability of the financial market. Macro-prudential policies regulate the financial system at the macro level and can complement micro-prudential policies and thus help reduce banks' risk and improve financial stability (Samanipour et al., Meuleman & Vander, 2020). The country of Iran should examine the macro-prudential policies and create a relatively complete primary macro-supervision framework based on the changes in the domestic financial structure and

the latest concepts of international financial stability. Currently, the main target of macro prudential supervision system is commercial banks and the effectiveness of this system has not been confirmed yet.

Boot, Hoffmann, Laeven, and Ratnovski (2021) They believe that financial technology increases the bank's risk-taking. Basically, because the increase in internet lending affects the lending work of commercial banks. In contrast, some argue that financial technologies can reduce the risks of commercial banks, as primarily reflected in the complementary effect of financial technology innovation on bank business models. (Begnau, et al, 2018; Zhao et al, 2019; Sajid et al, 2023).

The above studies have only focused on a certain application of financial technologies, so their conclusions are not comprehensive enough. The results of Zhang et al. (2018) research on the relationship between macro-prudential policies and banking risks show that strengthening macro-prudential supervision plays a role in preventing banking risk and improving market financial stability. Butchak et al (2018) argue that due to regulatory arbitrage, tightening macro-prudential supervision can enhance the risk-taking of commercial banks. This research examines the moderating role of macro-prudential policies in the relationship between financial technologies and banks' risk-taking. Also, in terms of research content, this article comprehensively analyzes the impact of financial technologies on risk-taking.

The continuation of this research is organized in this way. The second section describes the relevant literature and also develops the hypotheses. The research method is explained in the third section. Research findings and analysis, including regression results, are presented in Section Four. The fifth section describes the findings and conclusions of the study.

2. Literature review and hypothesis development

Existing studies on the relationship between financial technologies and bank risk show that financial technologies can strengthen bank risk-taking. Marszk et al (2019) show that the development of financial technologies can lead to the horizontal and vertical disruption of the traditional banking business model and, subsequently, create fundamental changes in the structure of the financial system.

Li et al (2020) believe that financial technologies and traditional finance compete with each other in the same business and have a cooperative relationship. Such multiple relationships can transfer inherent risks of financial technology institutions to traditional financial institutions and thus create systemic risks. These studies mainly focus on the capital raising performance of financial technologies. Since Internet lending has a direct impact on the lending work of commercial banks (Boot et al, 2021; Bochak et al, 2018), it can be inferred that financial technologies increase banking risks.

On the other hand, financial technologies can reduce the risks of commercial banks. Cheng and Qiu (2020) acknowledge that financial technologies fundamentally reduce banks' credit risk. This is done in two ways. On the one hand, when commercial banks adopt emerging technologies that help improve the bank's effective risk management, they can achieve technology spillovers. On the other hand, banks use technologies such as big data in business operations and reduce risk management, which helps banks in detecting and preventing risk.

Pérez-Martín et al (2018) analyzed the role of big data in mortgage lending and found that banks can predict the behavior of borrowers through big data and make better decisions and avoid cost losses. by reducing information asymmetry. These studies focus on the market facilitation functions of financial technologies, namely technologies such as big data, cloud computing, and blockchain. These technological innovations have a complementary effect on the

traditional work of banks and can reduce banking risks to a certain extent (Zhao et al, 2022).

There is also a non-linear relationship between financial technologies and banking risk. Wang et al (2021) find that the relationship between financial technologies and bank risk-taking has an inverted U trend, that is, financial technologies strengthen bank risks in the early stages, and as the technology matures, the relationship between the two gradually becomes negative.

The existing studies have two general views regarding the effect of macroprudential instruments. The first view is that strengthening macro-prudential supervision can help banks in preventing risks and increasing the stability of financial markets. Cordella and Pienknagura (2013) observe that the strengthening of instruments such as minimum capital requirements and excess deposit tax reduce bank risk-taking levels.

Altunbas et al (2018) find that the tightening of macroprudential stance can effectively control the risks of commercial banks, which is related to bank characteristics such as asset size, liquidity, and capital adequacy ratio. Zhang et al (2018) believe that the strengthening of macroprudential supervision leads to a continuous decrease in bank risk-taking, and the credit cycle also exacerbates the effect of macroprudential policies to different extents.

The second view is that the strengthening of macro-prudential supervision can increase the risk-taking level of commercial banks. Empirical studies on shadow banking show the existence of regulatory arbitrage (Buchak et al, 2018). With the rapid growth of financial technologies, financial regulation and supervision has lagged somewhat behind. In this situation, the intensification of macro-prudential supervision can encourage banks to use financial technologies to avoid regulations and thus strengthen the negative effects of financial technologies (Reinhardt and Sowerbutts, 2015).

According to the above literature analysis, existing researches suffer from these gaps. (1) The research framework should be improved. Existing literature has either focused on the impact of financial technologies on risk-taking or on monitoring banking risks through

macro-prudential instruments. But there is no research that combines all three in one framework.

(2) Modeling with traditional methods can lead to bias and inconsistency in parameter evaluation and, as a result, distort the economic meaning of the results. These questions are raised to address the mentioned research gaps. (1) Do financial technologies affect banking risk? (2) Does macroprudential supervision have a moderating effect on the relationship between financial technologies and banking risk?

The banking industry is currently in a wave of financial technology development. Payment and settlement technology lies in digital currency, internet payments, and third-party payments. With the rapid growth of third-party payment platforms, the network transaction work of commercial banks has been affected (Romanova and Kudinska, 2016). Currently, users are increasingly transferring funds deposited in banks to third-party payment platforms. This issue has greatly reduced the scale of banks' deposits and created challenges for banks' obligations (Thakor, 2020).

In addition, the performance of banks as a payment intermediary has also been weakened. The express payment activity of the third-party payment company bypasses banks to complete the transfer of funds independently, further accelerating financial disintermediation. Capital raising technology includes crowdfunding and peer-to-peer internet lending. These financing platforms increase financing options for individuals and businesses and promote the interest rate liberalization process. But facing losses caused by rising costs on the debt side, banks often choose riskier assets to compensate for such losses and thus increase their risk tolerance (Li et al, 2020; Zhang et al, 2019).

Some lending companies are not financial institutions and are not subject to financial supervision restrictions. They provide small, short-term loans for the financial needs of small, medium, and micro enterprises. But this can cause the loss of a significant part of the credit activities of commercial banks. In addition, online lending can directly connect borrowers and lenders. Therefore, many loans will no longer rely on the intermediation of commercial banks, and this will ultimately have a negative impact on the

profitability of commercial banks. Other technologies include online financial management and online investment. The growth and maturity of financial technologies has led to the enrichment of investment instruments, the development of investment channels, and the intensification of competition in the deposit market (Bellardini et al, 2022; Kommel et al, 2019). In fact, its convenience and ubiquity has attracted many customers. But the high-interest funds attracted by Internet financing platforms will eventually return to commercial banks through higher interest rate contractual deposits, borrowed funds, and deposited capital. Therefore, in the online platform of wealth management, the deposit structure of commercial banks becomes seriously unbalanced. Financial technologies with these emerging technologies such as big data, cloud computing, blockchain, and artificial intelligence reduce operational costs caused by information asymmetry in traditional financial models and help financial institutions achieve intelligent risk control (Kharrat et al, 2023). Big data analytics combined with artificial intelligence and deep learning algorithms help commercial banks to achieve the right marketing and steady customer acquisition, and reduce operational costs. In addition, computer vision and biometric identification technologies verify the user's identity and assess his willingness to repay. On the other hand, advanced machine learning algorithms such as neural networks, gradient algorithms, and random forests are used to process user behavioral data. This helps commercial banks to develop a more efficient, accurate and less costly intelligent risk control system, thereby affecting the bank's risk-taking (Fethi and Pasiouras, 2010). In this way, the first hypothesis of the research is proposed:

Hypothesis 1. Financial technologies has an effect on the banks' risk-taking.

The macroprudential assessment system rationally guides banks' behavior from various aspects and affects banks' risk-taking through credit and capital channels, profitability, and other aspects (Meuleman and Vander, 2020 ; Zhang et al, 2018). Considering the main goal of macro-prudential policies to maintain financial stability and prevent financial risks, these

policies can weaken the negative effect of financial technologies and ensure that the level of risk-taking of commercial banks is stable to an acceptable level (Galati and Moessner, 2013).

In addition, macroprudential policies regulate bank activities and improve the quality of business operations by regulating asset-liability ratios, liquidity, and asset quality (Galan, 2020). On the one hand, they can improve the asset structures and credit quality of the bank and reduce the negative effects of commercial bank financial technologies. On the other hand, the quality and profitability of the bank's assets improves by optimizing the quality of business and directly reduces the bank's risk-taking. Under the influence of financial technologies, commercial banks engage in risk-increasing behaviors to increase their profits (Aikman et al, 2015). Due to information asymmetry, bank creditors demand risk compensation, increasing bank financing costs and reducing profitability. After strengthening macro prudential policies, commercial banks curb their risk-increasing behaviors and indirectly reduce financing costs and improve profitability by removing mistrust between creditors and banks. Macroprudential supervision can be effectively combined with financial technologies, thereby improving supervisory efficiency and curbing systemic risks. (Flood et al, 2016) state that with the help of big data, cloud computing, and blockchain, systematic risk information in mass microfinance data can be deeply explored and analyzed. Therefore, regulatory authorities can use macro-precautionary tools more scientifically and effectively to achieve better risk prevention effects.

Therefore, this article proposes hypothesis 2:

Hypothesis 2. Macroprudential policies has an effect on the relationship between financial technologies and bank risk-taking.

3.methodology

The statistical population of this research includes all the banks accepted in the Tehran Stock Exchange during the years 2013 to 2022.To test the research hypotheses about the econometric model, the combined or combined regression model will be used, taking into account all the assumptions of classical regression. These data are a combination of data related to different banks in different years and are considered as bank-year observations.

3.1. Model of the first research hypothesis

$$RT_{i,t} = \alpha + \beta_1 FT_t + \beta_2 GDP_t + \beta_3 INF_t + \beta_4 SIZE_t + \beta_5 LDR_t + \beta_6 EFF_t + \beta_7 CAR_t + \beta_8 NIM_t + \epsilon$$

Model (1)

3.2. Model of the second research hypothesis

$$RT_{i,t} = \alpha + \beta_1 FT_t + \beta_2 MP_t + \beta_3 FT_t \times MP_t + \beta_4 GDP_t + \beta_5 INF_t + \beta_6 SIZE_t + \beta_7 LDR_t + \beta_8 EFF_t + \beta_9 CAR_t + \beta_{10} NIM_t + \epsilon$$

Model (2)

Equation (1) is used to test the effect of financial technologies on bank risk-taking, while equation (2) is used to examine whether macro-prudential policies can moderate the relationship between financial technologies and bank risk-taking. slow or not. *i* and *t* are bank and year respectively. ϵ is the random error coefficient. *RT* is the bank's risk-taking index variable, and *FT* is the financial technology index. *MP* is macro-precautionary policies. Details are provided in Table 1.

Table 1 - Definitions of Variables

Meaning	Category	Name	Symbol
The ratio of non-current loans to the total balance of paid loans	Dependent	Bank risk-taking	RT
Cross-border payment, Digital currency, Electronic payment, Online payment, Third-party payment, Crowdfunding, Inclusive finance, P2P, Online lending, Online investment, Internet finance, Internet insurance, Electronic money, Online insurance, Online finance, Artificial intelligence, Big data, Network	Independent	Index of financial technologies	FT

Meaning	Category	Name	Symbol
security, Blockchain, Cloud computing			
In this research, macro-prudential policy is based on macroeconomic variables and variables related to banks, including inflation, exchange rate, interest rate, oil price, financial index of the stock exchange, liquidity ratio, ratio of capital to internal facilities, return on equity, etc. . is measured. (Samanipour et al., 2020) In this research, first, a dummy variable is determined for each macroprudential policy tool. When the instrument is intensified, the dummy variable is +1; When the instrument remains constant, the dummy variable is 0; When the instrument weakens or fails, the dummy variable is -1. The final indicator of macroprudential policy is the sum of dummy variables of all instruments in the current period.	moderator	Macroprudential policies	MP
GDP growth rate	Control	Economic growth rate	GDP
INFgrowth rate	control	Inflation rate	INF
Natural logarithm of total bank assets	control	Asset size	SIZE
Total loan/total deposit	control	Liquidity level	LDR
Total cost/total revenue	control	Operational efficiency	EFF
The ratio of net capital to asset risk	control	Capital adequacy ratio	CAR
Net interest margin	control	Profitability	NIM

4. Results

Descriptive statistics of the observed research variables are as follows: In Table 2, the main central index is the mean, which represents the equilibrium point and the center of gravity of the distribution, and is a good indicator of the centrality of the data. For example, the Bank risk-taking has an average value of

0.28 indicating that most data are focused around this point. In general, the dispersion parameters are the criteria for determining the dispersion of each other or their dispersion relative to the mean. One of the most important dispersion parameters is standard deviation. The value of this parameter for the Index of financial technologies is (0.50).

Table 2. Descriptive statistics of the observed research variables

INF	GDP	NIM	CAR	EFF	LDR	SIZE	MP	FT	RT	
27.40	2.21	0/86	2.27	0.19	0.24	8.59	0.215	0.46	0.28	Mean
41.2	12.10	·/43	11.033	3.31	0.57	9.87	1	1	0.50	max
9	-4.9	-2/02	0.26	0.01	0.11	7.30	-1	0	0	min
12.89	4.90	2/42	1.98	0.48	0.38	0.52	0.76	0.50	0.24	sd

4.1. The results of the first research hypothesis:

Table 3 shows less than 5%, so we conclude that the model is generally statistically acceptable, and the high

value of the Fisher statistic indicates that there is a strong relationship between variables in this model. As the coefficient of determination and the adjusted coefficient of determination indicate, it confirms the

high power of model explanation. From the value provided by the Watson-Durbin statistic, which can be confirmed by the lack of correlation in the model, there is no need to review this statistic due to the short period of time. Now considering the significant confirmation of the whole fitted model, the meaningful analysis of each of the explanatory variables is discussed. As shown in the table below, for each coefficient variable, t statistic, and finally, the value of p is given. For meaning, each of the variables in the model is referenced to the p column or the same level of significance. Now, with respect to the value of p, if

the arbitrary error α is compared with the values of p, one can consider the meaning of each of the variables. Table 3 shows the evaluation results of model (1), which basically evaluates the impact of financial technologies on banks' risk-taking. In general, the development of financial technologies increases the risk-taking level of Iranian commercial banks. In model (1), according to the significance of the evaluated coefficient of financial technologies index, the above findings are proved. This result is consistent with Li et al. (2020) who say that the risk implications of financial technology institutions greatly increase the systematic risk of financial institutions.

Table 3: Estimation of the coefficients of the model.1

$RT_{i,t} = \alpha + \beta_1 FT_t + \beta_2 GDP_t + \beta_3 INF_t + \beta_4 SIZE_t + \beta_5 LDR_t + \beta_6 EFF_t + \beta_7 CAR_t + \beta_8 NIM_t + \epsilon$			
Probability	t-statics	Coefficient	Variables
0.0000	6.29	110.86	C
0.0000	19.40	18.65	FT
0.0249	2.24	19.54	GDP
0.0000	-8.64	-66.79	INF
0.0002	-3.71	-0.12	SIZE
0.0000	-4.64	-54.22	LDR
0.0000	4.74	3.348	EFF
0.0030	2.97	0.72	CAR
0.0000	-6.64	-25.88	NIM
9.63	F-statistic		
0.00	F-probability level		
0.48	Adjusted R-squared		
1.86	Durbin-Watson		

4.2. The results of the second hypothesis:

Table 4 shows the evaluation results of model (2) which estimates the moderating effect of macro prudential policies. Several conclusions can be drawn from Table 5. In sum, macroprudential policies weaken the positive effect of financial technologies on risk-taking. In model (2), the regression coefficient of financial technology index is positive, while the estimated coefficient for financial technology index \times macroeconomic prudential policies index is negative and significant. This suggests that when

macroprudential policies become more severe, the incremental effect of financial technologies on risk-taking weakens. Macroprudential policies are designed to affect banks' balance sheets, increase liquidity requirements, and implement tight monetary instruments to reduce the risk posed by the liquidity gap (Altunbas et al, 2018; Meuleman and Vande, 2020). Therefore, hypothesis 2 of this research is confirmed.

Table 4: Estimation of the coefficients of the model.2

$RT_{i,t} = \alpha + \beta_1 FT_t + \beta_2 MP_t + \beta_3 FT_t \times MP_t + \beta_4 GDP_t + \beta_5 INF_t + \beta_6 SIZE_t + \beta_7 LDR_t + \beta_8 EFF_t + \beta_9 CAR_t + \beta_{10} NIM_t + \varepsilon$			
Probability	t-statics	Coefficient	Variables
0.0000	6.28	5.13	C
0.0035	2.92	1.60	FT
0.0005	-3.45	-2.77	MP
0.0000	-4.58	-0.83	MP *Financial Technology
0.0000	15.21	0.67	GDP
0.0000	-4.44	-1.59	INF
0.0220	-2.29	-1.23	SIZE
0.0013	-3.21	-2.90	LDR
0.0000	8.02	0.80	EFF
0.0000	5.61	15.16	CAR
0.0000	-4.79	-4.57	NIM
2.51	F-statistic		
	F-probability level		
0.00	Adjusted R-squared		
0.41	Durbin-Watson		
1.82			

5. Discussion and Conclusions

In this research, based on the data of Iranian commercial banks, the moderating effect of macro prudential policies on the relationship between financial technologies and banks' risk-taking was analyzed. Financial technologies have an inevitable relationship with the banking industry, including bank risk-taking (Wang et al, 2021), bank credit risk (Cheng and Qiu, 2020), bank operational efficiency (Lee et al, 2021), systemic risk banking (Li et al., 2020), banking competition (Tseng and Guo, 2022). In the existing literature, the relationship between financial technologies and bank risk-taking has been widely studied in different countries and contexts (Banna et al, 2021; Boot et al, 2021). But few studies have analyzed the effect of financial supervision, macroeconomic policies, and other economic control behaviors on the relationship between financial technologies and bank risk. In terms of the relationship between financial technologies and bank risk, the results of this research show that financial technologies have a positive and significant correlation

with bank risk-taking. These findings are consistent with those of Begenau et al. (2018), Boot et al. (2021), Li et al. (2020), Románova and Kudinska (2016), and Thakor (2020). Regarding the moderating effect of macro-prudential policies, research shows that macro-prudential policies can weaken the incremental effect of financial technologies on bank risk-taking. This is consistent with existing research results (Galan, 2020; Meuleman and Vander, 2020). But some studies (Buchak et al, 2018; Reinhardt and Sowerbutts, 2015) show that the tightening of prudential supervision encourages large banks to irrationally use financial technologies to avoid supervision and reinforce these negative effects of financial technologies. he does. Researchers and policymakers should consider a theoretical framework that includes financial technologies, regulatory institutions, and the banking system and can provide ideas for future related research. Also, investigating the effectiveness of macro-prudential tools can help policymakers to discover the shortcomings of the regulatory system and provide ideas for optimizing the macro-prudential

framework in the future. The applications of this research can be mentioned as providing a source for policy makers to minimize banking risks and at the same time develop financial technologies. The study also provides guidance for enhancing cooperation between financial technology companies and commercial banks in order to achieve sustainable development. Additionally, examining the moderating effect of macroprudential policy will help governments improve macroprudential oversight frameworks and strengthen risk control mechanisms. This research has several separate practical recommendations for various stakeholders: (1) Although financial technologies have enriched investors' investment options, they should be aware of and protect themselves from potential financial risks and data breach risks. (2) Supervisors should adhere to the principle of integrating macroprudential aspects into micro-prudential supervision and commit themselves to maintaining financial stability and optimizing the financial structure. In addition, governments should expand the scope of macroprudential supervision. (3) Due to functional differences in the impact of financial technologies on banking risks, commercial banks should consider their mutual effects when developing financial technologies. Banks should first try emerging financial products in some branches and then promote them more widely after the technology matures. (4) The overall quality of financial consumers should match the development of financial innovation. At present, the financial consumer protection system still faces challenges, therefore, deepening financial education and strengthening information security are the keys to improving consumer self-protection. Considering the great importance of the development of financial technologies, our results should be of interest to policy makers and academic researchers who are interested in the effective and efficient adoption of fintech.

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