The Impact of Banking Fintech on Systemic Risk:
A Risk Attribution Decomposition Based Perspective

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Abstract. The development of fintech has brought profound changes to the banking industry, and there is a general concern about the degree of fintech empowerment for commercial banks. This paper constructs an indicator of the degree of bank fintech use and examines the impact of fintech use on commercial bank systemic risk and its subcomponents using data from 37 listed banks from 2011 to 2022. It is found that fintech utilization significantly increases commercial banks' systemic risk, mainly through increasing interbank correlation risk.

Keywords: Bank FinTech, Systemic risk, CoVaR

1 Introduction

In recent years, fintech has gained a booming development globally with its asset-light and highly innovative advantages, and its practical application in the traditional financial industry is more iconic and has a wider scope of influence than any previous technological innovation in the financial field. Murinde et al.(2022)[6] find that fintech and traditional finance are bound to form a symbiotic pattern that intersects with each other in the future. However, the development of FinTech is also a "double-edged sword". While alleviating the constraints of corporate financing and improving the efficiency of resource allocation[4], FinTech has also exposed problems such as the lack of wind control means and insufficient regulatory capacity. Against the backdrop of the interpenetration of finance and technology, it is necessary to study the impact of the development of fintech on the systemic risk of banks, which is conducive to clarifying the role of fintech in the development of commercial banks to help the real economy.

2 Literature Review

Currently, although there is no consensus on the relevant academic studies, most of them agree that fintech increases the systemic risk of banks[3]. When a bank is subject to risky shocks, information unfavorable to the banking sector will spread rapidly in the market due to the fact that fintech widens the information dissemination channels of the banking sector[1], and under the information asymmetry, investors will act irrationally and erode the value of banking institutions in the capital market, when banking

J. Liao et al. (eds.), *Proceedings of the 2024 2nd International Conference on Digital Economy and Management Science (CDEMS 2024)*, Advances in Economics, Business and Management Research 292,
https://doi.org/10.2991/978-94-6463-488-4_13

institutions will sell their assets in the market to supplement their liquidity and value-at-risk constraints[7]. In this case, the contagion effect of external risk shocks will be further amplified, contributing to the emergence of systemic risk in banks. Lee (2018)[5] argues that there are also new types of risks triggered by non-financial factors, such as underlying information technology, which may also trigger systemic financial risk. Therefore, this paper proposes the following hypotheses:

H1: The use of fintech makes banks more systemically risky

H2: Fintech exacerbates bank systemic risk by increasing the Gamma

3 Data and Variables

3.1 Constructing the Systemic Risk Indicator

In this paper, we use the CoVaR method proposed by Adrian and Brunnermeier (2016)[2] to measure the systemic risk of banks. Its calculation process is as follows:

$$Prob(R^{system} \leq CoVaR_q^{system|i} | R^i = VaR_q^i) = q \tag{1}$$

$$Prob(R^{system} \leq CoVaR_q^{system|i,median} | R^i = median^i) = q \tag{2}$$

where R denotes the rate of return of institution i. CoVaR measures the impact of individual institution failures on systemic risk.

$$\Delta CoVaR_{q,t}^i = CoVaR_{q,t}^{system|i} - CoVaR_{q,t}^{system|i,median} \tag{3}$$

$$R_t^i = \alpha^i + \beta^i M_{t-1} + \varepsilon^i \tag{4}$$

where R_t^i is the return of bank i in time t and M_{t-1} is the volatility of the entire market in time t-1.

$$R_t^{system} = \alpha^{system|i} + \beta^{system|i} M_{t-1} + \gamma^{system|i} R_t^i + \varepsilon^{system|i} \tag{5}$$

If a 50% confidence interval is taken, the regression equation is obtained as:

$$R_t^{i,median} = \alpha^{i,median} + \beta^{i,median} M_{t-1} + \varepsilon^{i,median} \tag{6}$$

Calculations using the regression coefficients obtained from the aforementioned quantile regressions yield the value of systematic risk for bank i as:

$$CoVaR_{q,t}^{system|i} = \hat{\alpha}^{system|i} + \hat{\beta}^{system|i} M_{t-1} + \hat{\gamma}^{system|i} VaR_{q,t}^i \tag{7}$$

$$CoVaR_{q,t}^{system|i,median} = \hat{\alpha}^{system|i} + \hat{\beta}^{system|i} M_{t-1} + \hat{\gamma}^{system|i} R_t^{i,median} \tag{8}$$

$$\Delta CoVaR_{q,t}^i = CoVaR_{q,t}^{system|i,median} - CoVaR_{q,t}^{system|i} = \hat{\gamma}^{system|i}(R_t^{i,median} - VaR_{q,t}^i) \tag{9}$$

3.2 Decomposing systemic risk

The expression calculated from $\Delta \mathrm{CoVaR}^{\mathrm{i}}_{\mathrm{q,t}}$ obtained above can be discretized:

$$Alpha = (\hat{\alpha}^{i,median} - \hat{\alpha}^{i}); Beta = \left(\hat{\beta}^{i,median} - \hat{\beta}^{i}\right) M_{t-1}; Gamma = \hat{\gamma}^{system|i} \tag{10}$$

$$\Delta CoVaR^{i}_{q,t} = Gamma \times (Alpha + Beta) \tag{11}$$

Where Alpha is the bank idiosyncratic risk, Beta is the bank's macro risk exposure level and Gamma is the bank's systemic correlation risk.

3.3 Constructing Banking Fintech

First, this paper selects keywords related to bank fintech from five dimensions, as shown in Table 1. Secondly, the bank name is matched with each keyword for searching, and web crawler technology is used to obtain the news search results of each bank from 2011 to 2022, and irrelevant links are filtered out. Finally, as shown in Fig. 1,with the help of factor analysis to construct the degree of independent use of fintech by each bank, and standardize the results to get the index of fintech development in the banking system, the larger the index, the higher the degree of fintech development.

Table 1. Initial lexicons for the FinTech index.

payment settlement	Resource allocation	risk management	online channel	Technology Path
Third party payments	Online Financing	Internet finance	Mobile Banking	Big data
Mobile payment	Online Loans	Intelligent Investment Advisor	E-Banking	Cloud technology
Digital currency	Network investment	Internet Wealth Management	Pocket Banking	blockchain
Online payment	Online investment	Internet Insurance	Open Banking	Internet of Things
NFC payments	Crowdfunding	Online Financial Management	Internet Banking	mobile Internet
Cell Phone Payments	Internet Lending	Internet Money Management	Mobile	smart

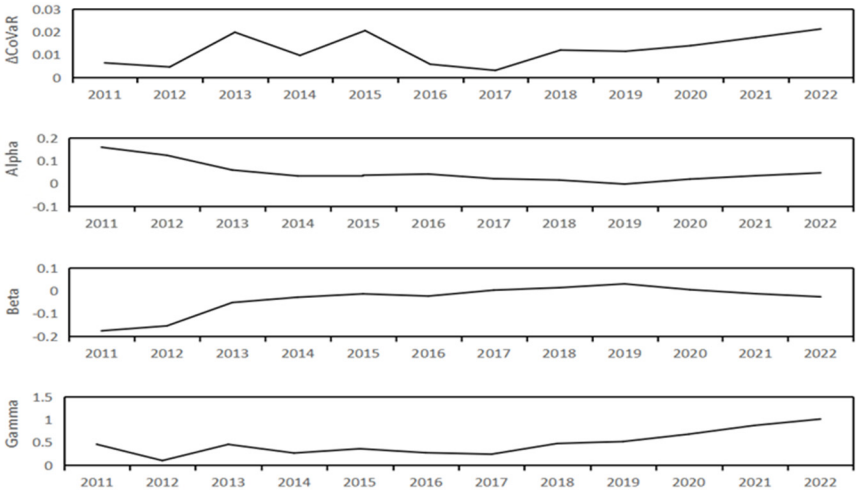

Fig. 1. The development of bank FinTech.

3.4 Other Variables and Data Sources

The research sample of this paper is the panel data of 37 listed banks in China from 2011 to 2022, and the basic data are mainly obtained from the Wind database. As shown in Table 2. Bank size, return on total assets and non-performing loan ratio are selected as bank-level control variables, and GDP growth rate, M2 growth rate and inflation rate are selected as macro-level control variables.

Table 2. Variable selection and descriptive statistics

Variable	Variable Definition	Mean	sd
ΔCoVaR	The difference between the extreme returns of an individual bank in its normal state and the banking system in its extreme state	0.0118	0.0202
Alpha	Decomposition by ΔCoVaR yields	0.0429	0.2287
Beta	Decomposition by ΔCoVaR yields	-0.0278	0.3251
Gamma	Decomposition by ΔCoVaR yields	0.4682	0.6041
Fintech	Degree of bank fintech utilization	0.1682	0.3320
SIZE	Natural logarithm of asset size	27.9712	1.6814
ROA	return on total assets	0.0094	0.0029
NPL	non-performing loan ratio	0.0135	0.0053
RGDP	GDP per capita growth rate	0.0627	0.0605
INF	CPI chain growth rate	0.1055	0.0379
M2	Money supply (M2) growth rate	0.0248	0.0118

4 Empirical Method and Results

4.1 Baseline Model

To test H1 and H2, this paper establishes equation (14) for regression analysis. The results in Table 3 indicate that bank fintech has a significant positive impact on systemic risk. The impact of FinTech on the three components of systemic risk varies. Specifically, bank fintech has a significant positive effect on Gamma, while the effect on Alpha and Beta is insignificant. In other words, bank fintech increases systemic risk by exacerbating the transmission of interconnected risks among banks.

$$RISK_{i,t} = \beta_0 + \beta_1 Fintech_{i,t} + \beta_2 BANK_{i,t} + \beta_3 MACRO_t + \omega_i + \gamma_t + \varepsilon_{i,t} \quad (12)$$

Table 3. The impact of bank fintech on systemic risk and its subcomponents

	(1)	(2)	(3)	(4)
Variable	ΔCoVaR	Alpha	Beta	Gamma
Fintech	0.0073*	-0.0042	0.0434	0.3850**
	(1.7938)	(-0.0709)	(0.4850)	(2.4567)
Bank control variables	YES	YES	YES	YES
Macro control variables	YES	YES	YES	YES
ID FE	YES	YES	YES	YES
Year FE	YES	YES	YES	YES
Observations	327	327	327	327
R-squared	0.5609	0.3484	0.3208	0.7573

Note: t-values in parentheses in the table; ***, **, and * represent significant at the 1%, 5%, and 10% levels, respectively. Same below.

4.2 Robustness Tests

DID approach. In 2015, the PBOC issued "Guiding Opinion on Promoting the Healthy Development of Internet Finance" to support the stable development of FinTech. This paper takes it as a policy shock, adds the interaction term of the policy dummy variable Treat and the time dummy variable Post.

$$RISK_{i,t} = \alpha + \beta Treat_{i,t} * Post_{i,t} + \gamma Control_{i,t} + Bank_i + Year_t + \varepsilon_{i,t} \quad (13)$$

As shown in Table 4, the coefficients of the interaction terms are all significantly positive, and the results of this paper are robust.

Table 4. Difference in differences approach

	(1)	(2)
Variable	ΔCoVaR	Gamma
Treat*Post	0.0173**	0.1651*
	(2.1605)	(1.6983)
Bank control variables	YES	YES
Macro control variables	YES	YES

ID FE	YES	YES
Year FE	YES	YES
Observations	327	327
R-squared	0.5807	0.7501

5 Conclusion

This paper finds that bank fintech significantly increases systemic risk, mainly through interbank connectivity risk. The paper makes the following recommendations: First, policymakers should be alert to the liquidity risks associated with cooperation and competition among financial institutions, and pay attention to the potential channel of "Fintech-network connectivity-bank systemic risk". Secondly, regulators need to make appropriate use of fintech to improve regulatory efficiency.

References

1. Anjan V. Thakor. Fintech and banking: What do we know? [J]. Journal of Financial Intermediation. 2020,41:100833. https://doi.org/10.1016/j.jff.2019.100833
2. Adrian, T. and M. K. Brunnermeier, 2016, “CoVaR”, American Economic Review, 106(7), pp. 1705~1741.
3. Cheng M, Qu Y. Does bank FinTech reduce credit risk? Evidence from China[J]. Pacific-Basin Finance Journal, 2020, 63.https://doi.org/10.1016/j.pacfin.2020.101398
4. Ding N, Gu L, Peng Y. Fintech, financial constraints and innovation: Evidence from China[J]. Journal of Corporate Finance, 2022,73:102194. https://doi.org/10.1016/j.jcorpfin.2022.102194
5. Lee I.,Shin Y. J.Fintech:Ecosystem, Business Models,Investment Decisions,and Challenges. Business Horizons,2018,61(1). http://dx.doi.org/10.1016/j.bushor.2017.09.003
6. Murinde V, Rizopoulos E, Zachariadis M. The impact of the FinTech revolution on the future of banking: Opportunities and risks[J]. International Review of Financial Analysis, 2022,81(3):1-27. https://doi.org/10.1016/j.irfa.2022.102103
7. Shin H S. Risk and Liquidity[J]. Oup Catalogue, 2010,17(3):315–329. DOI: 10.1016/j.jfi.2008.02.003.