Financial Economics Research; Vol.3, No.6; 2026
E-ISSN: 3006-3663 P-ISSN: 3006-3655
DOI: https://doi.org/10.70267/fer.v3n6.141148
Published by: Zeus Press

A Literature Review of Risk Management in Commercial Banks' Technology-Finance Business

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Abstract

As innovation-driven development continues to advance, technology finance has been placed first among China's five major areas of financial work. Yet technology-oriented firms are typically asset-light and operate under high uncertainty, leaving commercial banks exposed to several overlapping forms of risk when serving them. This article reviews the literature on risk management in commercial banks' technology-finance business and organizes existing evidence around five dimensions: the regional institutional environment, customer credit risk, business models, risk-sharing mechanisms, and bank-level risk-management strategies. The literature does not reach a uniform conclusion on how technology finance affects banks' risk taking. Some studies report a risk-reducing effect, often with substantial regional heterogeneity, whereas others identify greater risk exposure and imbalances between risk and return. Credit-risk assessment has meanwhile moved beyond reliance on a single set of financial indicators toward broader multidimensional evaluation. Much of the existing evidence, however, is based on regional banks, individual cases, or narrowly defined business samples. Larger-sample tests remain limited. Future research can make use of data generated by the expansion of pilot programs to examine more carefully the conditions under which existing conclusions hold.

Keywords

technology finance, commercial banks, credit risk, risk sharing, risk management

1. Introduction

Technology finance has become an important means of directing financial resources toward the real economy and supporting the development of new quality productive forces [1,2]. The General Office of the State Council placed technology finance first among the "five major areas" of financial work in its Guiding Opinions on Advancing the Five Major Areas of Financial Services [3]. Commercial banks now participate in this ecosystem through conventional lending, investment-loan linkage arrangements, supply-chain finance, and related instruments [4,5]. Sheng Tianxiang and colleagues [6], working from an institutional-logics perspective, further explain how technology-finance models in large commercial banks emerge and evolve. At the same time, technology enterprises are often asset-light, fast-growing, and highly uncertain. Financing methods such as intellectual-property pledge lending can widen access to funds, but they also expose banks to multiple, interacting risks [7,8].

Research has gradually moved from broad comparisons of financing models toward more detailed investigation of risk mechanisms. Earlier studies concentrated on model choice and development paths [2],

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and later work extended to risk compensation in intellectual-property pledge finance [4] and the accumulation of risks in investment-loan linkage arrangements [5,9]. More recent research places greater emphasis on risk identification and assessment. Ke Jian and colleagues [10] construct a default-risk evaluation system for technology firms and identify R&D capacity and debt-service capacity as major determinants of default. Xia Yiqun and Sheng Guangyin [11] argue that information asymmetry and difficulties in patent valuation are central problems in patent-pledge financing. Zuo Xiaohui and Ma Yun [12] find that technology finance can reduce the risk taking of regional banks, although the effect differs across regions. Using panel data from 593 banks, Huang Xinfei and colleagues [13] likewise report that patent-pledge loans can lower bank risk by improving the structure of credit portfolios. By contrast, Zhang Fengyi and Xu Shihan [9] identify overlapping risks in investment-loan linkage activities of city commercial banks. Ning Xiaohua and Deng Ke [14] show that four major risk-sharing tools involve a trade-off between risk mitigation and moral-hazard control, while Li Xiaoqing [15] highlights a clear asymmetry between risk and return in investment-loan linkage. Xiang Dong [16] adds that technology insurance can serve both risk-compensation and loss-reduction functions.

Two problems remain unresolved. First, empirical findings on the relationship between technology finance and bank risk taking do not always correspond with observations at the business level, and a consistent understanding has yet to emerge. Second, comparisons of risk-sharing instruments are not well integrated with research on banks' own risk-management strategies. Zheng Xinru and Ruan Chao [7], Lü Lin [4], and Yan Mingkai [17] all propose practical approaches, but each addresses only part of the broader problem.

Against this background, this review organizes the literature along five dimensions: regional institutional conditions, customer credit risk, business-model risk, risk-sharing mechanisms, and risk-management strategies. The aim is to provide a more coherent analytical framework for subsequent research while also offering a practical reference for banks seeking to improve risk controls and balance risk against return.

2. Regional Institutional Environment

2.1 Policy Framework and Top-Level Design

Research on the policy system for technology finance generally follows three directions: comparison of international and domestic experience, interpretation of major policy documents, and analysis of underlying institutional logic. Zhou Ali [2] compares technology-finance markets in the United States, Japan, South Korea, and several advanced Chinese regions and classifies them into government-led, market-driven, and mixed models. In 2025, the General Office of the State Council issued guidance on the five major areas of financial work, placing technology finance in the leading strategic position and providing top-level institutional design for its development [3]. Sheng Tianxiang and colleagues [6] use institutional-logics theory to explain both the sources of commercial banks' motivation to develop technology-finance services and the way those motivations are translated into organizational practice.

Although this literature offers several useful perspectives, much of it remains descriptive or historical. Empirical evaluation of policy implementation is still limited. Existing work nevertheless makes clear that a relatively complete policy framework and top-level institutional design are important preconditions for banks to expand technology-finance services. Once such a framework is in place, the more difficult questions concern whether implementation has the same effect across regions and how institutional differences ultimately shape banks' risk exposure.

2.2 Regional Heterogeneity and Bank Risk

Studies of technology finance and bank risk generally identify a risk-reducing effect, but they also show that the magnitude of that effect varies considerably across regions. Zuo Xiaohui and Ma Yun [12], using entropy weighting and system-GMM estimation, find that technology finance can lower the risk-taking level of regional banks. Hu Huanhuan and Liu Chuanming [18] use a super-efficiency SBM model and the Dagum Gini coefficient to measure technology-finance efficiency across 30 provinces and show that regional disparities evolve over time. Huang Xinfei and colleagues [13], using panel data for 593 banks, find that patent-pledge lending can reduce bank risk by improving credit structure, taking the analysis from a broad macro perspective into the composition of banks' loan portfolios.

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Taken together, the studies use different samples and methods but broadly suggest that technology finance can contribute to lower financial risk and that the literature is becoming more fine-grained. Important disagreements remain, however. Many conclusions are drawn from regional banks or narrowly defined business samples, and the results are rarely tested against one another directly. Regional heterogeneity should therefore be treated as an important contextual condition rather than a secondary detail. Beyond the institutional and regional level, effective risk management also depends on how banks identify and assess credit risk at the customer level.

3. Customer Credit Risk

3.1 Mechanisms of Credit-Risk Identification

Research on the credit risk of technology enterprises mainly approaches the issue from two directions: the sources of risk and the strategic interaction between banks and borrowers. Wu Yaoyao [19] reviews the internal and external causes of credit risk in technology-oriented small and medium-sized enterprises and identifies information asymmetry and insufficient collateral as major sources of exposure. Xia Yiqun and Sheng Guangyin [11] construct an evolutionary game model and show that information asymmetry between banks and firms, together with difficulties in assessing patent value, is central to effective-default risk in patent-pledge financing.

Although the two studies use different methods, both point to information asymmetry as a core mechanism in the emergence and identification of credit risk. The literature has also moved from static lists of risk factors toward dynamic analysis of strategic interaction. A remaining weakness is that many studies still stop at describing the causes of risk and provide relatively little explanation of how newer identification tools, such as big-data applications or innovation-score systems, actually work. Credit-risk identification is therefore only the starting point. Once risk has been identified, banks still need an evaluation framework capable of measuring it with reasonable accuracy.

3.2 Credit-Risk Assessment Systems

Building a suitable credit-risk assessment system is widely regarded as a key part of commercial banks' efforts to manage technology-enterprise risk. Yi Jianhua and Guo Feng [20] examine the migration of credit risk in a supply-chain-finance setting and develop a corresponding set of evaluation indicators. Ke Jian and colleagues [10] establish a seven-dimensional default-risk evaluation system using the entropy method and find that R&D capability and debt-service capacity are particularly important determinants. Hu Ling and Ding Hui [21] summarize three models used by Chinese commercial banks to identify and evaluate technology enterprises and call for a more standardized credit-evaluation framework.

The methods differ across studies, but they share a common objective: overcoming the weakness of traditional financial ratios when applied to asset-light firms. Credit evaluation is consequently moving from isolated indicators toward broader, multidimensional systems. At the same time, different frameworks rely on different indicator definitions, which makes comparison across systems difficult. Improving the scientific consistency of credit assessment is therefore central to technology-finance risk management. Customer-level credit risk, however, is only one part of the problem. The business models used to provide technology finance carry their own risks.

4. Business-Model Risk

4.1 Risks in Investment-Loan Linkage

Investment-loan linkage has attracted particular attention because it combines equity-like and debt-based financing. This arrangement expands the range of services available to technology enterprises, but it can also produce several layers of interconnected risk. Zhang Fengyi and Xu Shihan [9], using a Beijing city commercial bank as a case, identify overlapping credit, legal, and valuation risks. Li Jinhao and colleagues [5], working at the ecosystem level, point to information asymmetry between commercial banks and venture-capital institutions and to imbalances in the allocation of returns.

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These studies operate at different levels—one is a micro-level case analysis and the other focuses on ecosystem mechanisms—but both reveal structural problems involving cross-institutional risk transmission and asymmetric risk-return allocation. Whether conclusions based on individual cases can be generalized remains uncertain and requires larger-sample evidence. Investment-loan linkage therefore illustrates the cross-market and cross-institutional character of technology-finance risk. Related risks also arise in indirect financing based on commercial credit and supply chains.

4.2 Commercial Credit and Supply-Chain Risk

Research on commercial credit and supply-chain finance approaches business-model risk from two main angles. Zhang Cuiwei and colleagues [1] argue that commercial credit can help firms smooth investment in innovation and that bill-based financing can ease financing constraints faced by technology enterprises. Xing Miao and Dong Xinglin [22], from a supply-chain-finance perspective, build a risk-evaluation index system for intellectual-property pledge financing using the analytic hierarchy process and fuzzy comprehensive evaluation.

The two studies emphasize different issues—one the expansion of financing channels and the other quantitative risk assessment—but both address the relationship between the flow of funds and the flow of risk. Their findings also highlight a recurring tension in supply-chain finance: credit enhancement and risk transmission can occur at the same time. These competing effects need to be examined within a common framework rather than in isolation. Once business-model risks have been identified, the institutional question becomes how they should be shared and absorbed.

5. Risk-Sharing Mechanisms

5.1 Fiscal Compensation and Risk Sharing

Fiscal risk-compensation schemes are frequently treated as a basic institutional tool for reducing credit risk in technology finance. Han Qingxiao and Qi Peng [8] develop a bank-firm model and use a multi-period difference-in-differences approach to examine whether risk compensation for intellectual-property pledge financing increases both the scale and share of lending. Liu Mingzhu [23] investigates pilot programs for knowledge-value credit loans in Chongqing, Guangdong, and other regions and summarizes the operation of local risk-compensation funds. Liu Mingzhu and colleagues [24] subsequently construct a mathematical model to assess the chain effects among four subsystems within the compensation reform.

Although the studies use different methods, they all suggest that fiscal compensation can help distribute bank risk. The research also shows a progression from evaluation of policy effects toward analysis of system-wide interactions. One limitation is that much of the evidence still focuses on quantitative outcomes such as loan volume, while the possibility that compensation itself may generate moral hazard has received less attention. Fiscal compensation is therefore an important foundation of risk sharing, but it is not the only tool. Government-guided funds, guarantees, insurance, and other mechanisms also require comparison.

5.2 Comparison of Multiple Risk-Sharing Tools

Beyond fiscal compensation, some studies compare different instruments and examine their respective governance functions. Ning Xiaohua and Deng Ke [14] use incomplete-contract theory to compare government-guided funds, guarantees, insurance, and investment-loan linkage, finding a trade-off between reducing risk and containing moral hazard. Xiang Dong [16] focuses on technology insurance, discussing both its compensation and loss-reduction functions and considering how a technology-insurance model with Chinese characteristics might be developed.

Although the objects of analysis differ, both lines of research point toward the need for coordinated use of several tools rather than reliance on a single mechanism. The literature is therefore moving from instrument-by-instrument evaluation toward the design of combined arrangements. A gap remains between this comparative work and research on banks' internal risk-management procedures: existing studies do not yet explain clearly which risk-sharing instrument should be embedded in which stage of a bank's risk-control

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process. Coordinated allocation of instruments is thus a key issue, but the effectiveness of any external arrangement ultimately depends on the bank's own management practices.

6. Risk-Management Strategies

6.1 Risk Types and Identification

In banks' own risk-control practice, credit risk, market risk, liquidity risk, and other forms of exposure often interact. This creates a need for a composite system of risk identification. Zheng Xinru and Ruan Chao [7] and Lü Lin [4] both provide systematic classifications of risks in commercial banks' technology-finance business. The former identifies four major categories of risk and proposes corresponding preventive measures, while the latter starts from the particular characteristics of technology-finance activities and argues for a composite control framework with differentiated responses.

The terminology differs somewhat, but both studies emphasize the layered and overlapping nature of technology-finance risk. Risk identification is gradually shifting from isolated classification toward more integrated frameworks. Existing classifications are becoming more similar, yet common standards are still lacking, and new risks associated with technological change are not always captured. Accurate identification remains a prerequisite for designing effective controls.

6.2 Control Strategies and Risk-Management Systems

Research on control strategies generally converges on one broad principle: commercial banks need risk-management arrangements that cover the full life cycle of technology enterprises. Chen Qianqian [25] develops a theoretical framework linking technology-finance development with risk control across stages of enterprise development. Li Xiaoqing [15] summarizes mature international experience in technology-finance risk management and translates it into recommendations suited to Chinese commercial banks. Yan Mingkai [17] approaches the issue from domestic practice, analyzing the risks involved in bank technology-finance activities and proposing corresponding management strategies.

These studies differ in emphasis, but all try to correct the poor fit between conventional bank risk-control models and the characteristics of technology enterprises. The literature shows a progression from theoretical construction, to international comparison, to domestic adaptation. A major limitation is that many recommendations remain normative and have not been tested empirically for effectiveness. Systematic risk-control strategy therefore represents the practical endpoint of the literature reviewed here, while the five dimensions considered above also reveal where further integration is needed.

7. Review and Research Outlook

Across the literature, a common view is that technology finance can reduce bank risk taking and that sound credit-evaluation systems and diversified risk-sharing mechanisms are central to effective control. Yet findings differ on both the direction of the overall risk effect and the conditions under which it occurs. Zuo Xiaohui and Ma Yun [12] and Huang Xinfei and colleagues [13] report risk-reducing effects, whereas Zhang Fengyi and Xu Shihan [9] and Li Xiaoqing [15] emphasize accumulated risk and asymmetric risk-return structures in investment-loan linkage. Differences in sample composition, methodology, and institutional background may account for part of this divergence.

Three shortcomings stand out. First, much of the available evidence comes from regional banks, individual pilot projects, or specific business samples. The external validity of case-based conclusions therefore needs to be tested with larger samples. Second, a substantial share of the literature relies on normative analysis or experience-based discussion, with relatively little causal evidence on whether particular policies or risk-control strategies are effective. Third, important disagreements remain unresolved, including whether risk compensation creates moral hazard and whether credit enhancement or risk transmission dominates in supply-chain settings. The sources of these differences have not yet been examined systematically.

Future research could respond in several ways. Larger samples generated after the expansion of investment-loan linkage pilots can be used to test the boundary conditions of earlier case findings. Difference-in-

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differences and related quasi-experimental methods can be applied to evaluate the effects of compensation mechanisms and control strategies. Grouped analysis by region and business type may also help identify when risk-reducing effects dominate and when risk accumulation becomes more important.

8. Conclusion

This review summarizes research on risk management in commercial banks' technology-finance business across five dimensions: regional institutional conditions, customer credit risk, business-model risk, risk-sharing mechanisms, and risk-management strategies. Existing studies have not reached a single conclusion on the direction of technology finance's effect on bank risk taking. Some provide evidence of risk reduction and substantial regional heterogeneity, while others identify cumulative risk and unequal distribution of risk and return in investment-loan linkage.

Credit-risk assessment is moving away from traditional financial indicators toward multidimensional frameworks that consider firms across their life cycles. Fiscal compensation and diversified risk-sharing tools can reduce risk exposure, but they also raise questions about the control of moral hazard. By bringing together findings that are often scattered across separate strands of research, this review provides a more systematic framework for subsequent studies and a theoretical reference for commercial banks seeking to improve technology-finance risk controls and achieve a more workable balance between risk and return.

The review is nevertheless limited by the scope of the literature and the way the evidence is classified. It focuses mainly on recent Chinese journal research, with less attention to international experience and earlier institutional evolution. Many findings are based on regional banks or narrowly defined business samples, so their generalizability still requires larger-sample testing. Future research can use new data produced by the expansion of investment-loan linkage pilots, apply methods such as difference-in-differences to evaluate compensation schemes and control strategies, and use regional and business-type subsamples to identify the conditions under which risk reduction or risk accumulation occurs. In practice, commercial banks should continue to develop composite risk-management systems covering the full enterprise life cycle and differentiate their strategies according to regional conditions and business type.

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Funding

This research received no external funding.

Conflicts of Interest

The authors declare no conflict of interest.

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Acknowledgment

This paper is an output of the science project.

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