

The Impact of the Coupling of Technology and Finance on the Real Economy: Mechanism, Path and Suggestion

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Abstract: Financial innovation and technological innovation are the two key entities for achieving an innovative economic system in China, and their coupling is a significant force driving the development of the real economy. This paper analyzes the factors and pathways through which the coupling system of technological innovation and financial innovation influences the development of the real economy, identifying that the factors affecting the development of the real economy through the coupled development of financial innovation and technological innovation include government, enterprises, and social environment. The pathways are achieved by changing the form of capital flow, technological breakthroughs, directional guidance, and transformations in the social landscape. Finally, combining the analysis presented in this article, relevant suggestions are proposed to coordinate the relationship between financial development and the real economy, stimulate corporate vitality, establish policy-oriented science and technology financial institutions, and focus on the structural aspects of real economy development.

Keywords: Scientific and technological innovation; financial innovation; coupling; development of the real economy.

1. Introduction

The development of the real economy relies on an innovative economic system. If China wants to become an innovative country and promote the development of the real economy, the integration of financial innovation and technological innovation is a crucial link, and their coupled development can become an important driving force for Chinese real economic growth.

Despite the increasing emphasis on the integration of technological innovation and financial innovation in recent years, accelerating their practical integration and intensifying efforts to build a robust real economy, China still faces several prominent issues: In terms of innovation, there is a lack of coordination between Chinese financial innovation and technological innovation, primarily due to their insufficient and uneven development; the disconnection between Chinese enterprises technological innovation capabilities and financial services is severe, with small innovative enterprises often overlooked by financial markets and unable to secure financial support, making it difficult for Chinese largest and most dynamic innovative groups to connect with finance; since technological innovation often comes with risks, heavy R&D costs and uncertain market prospects can hinder corporate innovation activities; Chinese entities for technological and financial innovation are underdeveloped and lack clear division of labor, leading to a significant disconnection between financial innovation and technological innovation. In terms of real economy development, some entities in Chinese real economy are negligent and lack dedication, leading to frequent financial activities and arbitrary misuse of financial instruments; many large real enterprises have shifted their investment focus to the virtual economy, particularly in real estate; monopolistic industries such as electricity and oil lack market competition and investment channels; internet and artificial intelligence are competitive industry over competition depresses industry profits; a large amount of private capital is detached from the real economy and enters investment markets or equity trading.

Therefore, it is essential to study the relationship between the coupling system of scientific and technological innovation and financial innovation and the development of the real economy, deepen theoretical research on the integration of scientific and technological innovation and financial innovation, and provide theoretical guidance for developing an innovative real economy.

2. Research Literature

Currently, most domestic research focuses on the impact of single technological innovations and financial innovations on the real economy. In theory, it is generally believed that the financial system plays a crucial role in promoting technological innovation, and only through continuous investment in technological innovation by the financial system during economic development can the economy achieve effective growth^[1-2]. From the perspective of the relationship between finance and enterprises, finance can provide adequate financial support and effective financial services for enterprises technological transformation projects, leveraging the advantages of high-quality capital allocation and accelerated information transmission efficiency at the micro level during this stage. Consequently, enterprises can significantly promote social entity economic growth through the updating and creation of production processes and technologies during and after technological transformation^[3]. The financial industry can significantly influence the development process of the real economy in promoting technological innovation, and this process has the attribute of being low-carbon and environmentally friendly. Moreover, it is pointed out that the market profits generated by technological innovation will guide the investment desire for financial innovation and its risk control capabilities^[4]. And the low-carbon development of the real economy requires the support of the financial industry in the innovation process (including direct financial support and corresponding financial services). Financial entities such as banks lack advantages in promoting technological progress, and

technological innovation and economic growth can be promoted by achieving overall diversification of the financial structure and high-level development of the financial industry itself^[5]. The empirical results show that financial availability, digital finance and fintech innovation have a positive impact on the development of the real economy, and find the influence path^[6-9].

Few studies have considered the relationship between technological innovation, financial innovation, and the real economy simultaneously. Zhang Lin (2016) used spatial econometrics to study the impact of financial progress, technological innovation, and the combination of technological innovation and financial innovation (product of indices) on the real economy, and the results showed that all three had significant positive effects^[10]. Guo Yujian (2020) studied the impact of technological innovation and financial development on the real economy in various provinces. The results show that there are spatial and heterogeneous effects on the growth of the real economy, and the development of scientific and technological innovation and finance can promote the development of the real economy well^[11]. Liu Guangyan and Zhao Ying (2022) examined the impact of financial development and scientific and technological innovation on economic growth based on spatial spillover effect and moderating effect^[12].

The above theoretical and empirical research affirms that financial development and technological advancement have a positive impact on the real economy, including direct growth of the real economy and green growth of the real economy, which are encompassed by the concept of real economic development. Although a few scholars have considered the impact of financial development and technological innovation on the real economy simultaneously, they have not yet addressed their synergistic effects. A thorough analysis of the mechanisms and pathways through which fintech and technological innovation interact to influence the real economy is of significant practical importance for promoting the healthy and rapid development of the real economy.

3. The Connotation of Coupling and Coordination Between Scientific and Technological Innovation and Financial Innovation

To define the coupling system of technological innovation and financial innovation, it is first necessary to clarify the concept of coupling. Coupling originates from physics, referring to the positive interaction between two or more subsystems within a system during their interactions, forming a dynamic relationship characterized by mutual dependence, coordination, and promotion. Secondly, definitions of the two subsystems, technological innovation and financial innovation, are provided. The financial innovation subsystem is a dynamic system that provides possibilities for financial innovation through aspects such as the number of participants in financial markets, the driving force for financial market innovation, and the demand for financial market innovation. Similarly, technological innovation follows this pattern. Thus, a complete definition of the coupling system between financial development and technological innovation is formed. That is, the subsystems of technological innovation and financial innovation influence each other and promote each other, forming a positive interactive dynamic process.

By analogy with the concept of coupling in physics, this forms a dual-system coupling model. In this system, the following connotations should be included: financial innovation and technological innovation mutually promote each other; the internal structure of financial innovation interacts with the internal structure of technological innovation; the emergence of technological innovation drives the generation and demand for financial innovation; the emergence of financial innovation serves as the environmental foundation for promoting the formation of technological innovation.

4. Mechanism of the Coupling Effect of Financial Innovation and Scientific and Technological Innovation on The Development of The Real Economy

The emergence of technological innovation requires a financial service environment capable of allocating high-quality resources. At the same time, science and technology bring about new social appearances and new market orientations, which in turn promote the development process of the financial industry, providing an environment for new financial innovations. Based on the definition of the coupling between technological innovation and financial innovation, which refers to the interaction between technological innovation and financial innovation achieving positive interaction. The coupled development of both comprehensively promotes the advancement of the innovation system, and this development will form a positive feedback on the emergence of technological innovation and financial innovation, thereby achieving a sustainable and continuously cyclic "technology-finance" system progress, driving the healthy development of society and the economy.

4.1. Mechanism analysis of the coupling development of financial innovation and scientific and technological innovation affecting the real economy

The impact of the coupling development of financial innovation and scientific and technological innovation on the development of the real economy mainly includes three aspects: government, enterprise and social environment.

First, the government provides new policy guidance for the coupled development of financial innovation and technological innovation, creating a favorable environment for the emergence of technological innovation and financial innovation; similarly, the emergence of technological innovation and financial innovation brings about entirely new market directions and technological challenges, which in turn pose challenges to government regulation. Moreover, technological innovation and financial innovation offer new tools for macroeconomic regulation by the government. On this basis, the government will promote the development of the real economy from both positive and negative perspectives. Due to the governments investment in technological innovation and financial innovation, a favorable environment will also be created for the real economy, as innovations often originate from the real industry sector, and the governments policy inclination towards innovation will similarly improve the environment for the

development of the real economy.

Second, enterprises are the main body of the real economy and also the innovative subject of technological innovation and financial innovation. For state-owned enterprises (SOEs), they are the pillar of the national economy and an important guarantee for implementing the Party's key decisions, bearing the responsibility of promoting the development of the real economy is a necessary requirement of their characteristics. At the same time, SOEs should also take on the responsibility of national innovation, which is not only reflected in the emergence of technological and financial innovation but also in pointing out new directions for national innovation, which represents both the will of the country and the direction of the market. Meanwhile, the direction of innovation also points the way for the development of the real economy, broadening the channels for its development, with the main body of its development not only reflected in the interaction among various departments within SOEs but also in the external integration and connection between SOEs. In contrast, private enterprises, due to their relatively smaller scale, have less appeal for high-precision talents compared to SOEs and receive less policy support, thus they should place greater emphasis on the step of technology diffusion, including both the first-level technological innovation and the second-level technological innovation.

Third, in terms of the social environment, due to the advancement of technological innovation and financial innovation, it will significantly alter the appearance of society. From the First and Second Industrial Revolutions and more recent technological revolutions, we can see that changes in the social environment have not only transformed peoples mindsets but also altered economic development patterns. Changes in peoples thinking not only influence the concepts and scope of the real economy but also modify the importance people place on the real economy, which is a crucial aspect in promoting the development of the real economy. The transformation of economic development patterns is influenced by both technological innovation and financial innovation, which alters the flow of social resources, including human resources, capital flows, government policy inclinations, and more, all of which significantly impact the real economy.

4.2. The coupling development of financial innovation and scientific and technological innovation affects the real economy

The coupling development of financial innovation and scientific and technological innovation will play a significant positive role in the real economy, including the following four paths.

(1) The emergence of scientific and technological innovation and financial innovation will produce new forms of capital flow. Diversified forms of capital flow accelerate the turnover speed of capital and better absorb private assets, thus driving the development of the real economy.

(2) The deep integration of financial innovation and technological innovation has accelerated the rapid development of informatization, with breakthroughs in technologies such as artificial intelligence, blockchain, cloud computing, and big data driving the emergence and growth of new financial industries and institutions. This has broken the traditional banking-dominated control over financial resources, optimized resource allocation, revitalized the financial market system, promoted the diversification of

financial institution operations, expanded the service scope of financial institutions and the financial industry, enabling financial institutions to achieve more specialized development. All these have laid the foundation for the real economy in terms of industrial structure adjustment and production method optimization and upgrading, while also providing more and better financing channels, reducing transaction costs for technology-based small and medium-sized enterprises (SMEs), improving the capital structure of technology-based SMEs, broadening their operating space, enhancing market profitability, and better enabling technological innovation to generate capital appreciation, thereby creating new growth points for the real economy.

(3) The coupled development of financial innovation and technological innovation will point the way for the development of new real economy sectors. Continuous guidance from the financial sector enables the real economy sector to adapt to market demands better, choosing development directions that suit market needs, thus promoting the transformation of the real economy. This transformation not only changes the market situation but also plays a guiding role in promoting new technological innovation and financial innovation. The coupling of technological innovation and financial innovation has clarified the direction for the real economy, and the development of real economy industries has put forward requirements for technological progress, which in turn has driven the emergence of technological innovation and financial innovation.

(4) The coupled development of financial innovation and technological innovation will have a significant impact on the social landscape, especially when they occur frequently and with deep coupling. This impact will not be confined to a single region but will extend to a country or even the entire human world, affecting not only the economy and social structure but also peoples perceptions. As the coupling degree of technological innovation and financial innovation deepens, the real economy itself will continuously innovate new directions.

At the same time, it is important to note that during the coupled development of financial innovation and technological innovation, there exist potential risks that can inhibit the real economy. On one hand, due to the many supportive policies implemented by national policies for small and medium-sized technology-based enterprises (SMEs), if regulatory enforcement is inadequate, it will disrupt the real economy market, harm the development of the real economy, and cause financial institutions to have doubts about reinvesting in SMEs, further deteriorating the financing environment for the real economy industry. On the other hand, the information asymmetry between the real economy sector and financial institutions leads to significant technical cognitive biases between financial institutions and technology-based SMEs, as well as manufacturing industries that support technology. As the industry becomes more specialized, the information asymmetry becomes increasingly severe, making it almost impossible for financial institutions to understand the core production technologies held by the real economy sector. Due to the inability to accurately assess the market prospects of real economy enterprises, the economic benefits they bring are difficult to evaluate, leading to potential misallocation of financial resources and increasing the potential risks associated with technological loans from financial institutions. This not only has adverse

effects on the development of the real economy but also undermines the emergence of technological innovation, potentially disrupting the coupled system of financial innovation and technological innovation.

It can be said that the coupling system of financial innovation and technological innovation exhibits a positive feedback relationship with the real economy. The better the coupling system of financial innovation and technological innovation, the better the real economy tends to be, and the development of the real economy will also promote the development of the coupling system of financial innovation and technological innovation in the same direction. Conversely, if the coupling system of financial innovation and technological innovation is poor, the real economy tends to be worse, and similarly, the lagging development of the real economy will hinder the healthy development of the coupling system of financial innovation and technological innovation. Therefore, promoting the development of the real economy places demands on the governments excellent macro-regulation capabilities.

5. Policy Recommendations

For Chinese real economy to sustain its development, it must seek strength internally, stimulate the intrinsic vitality of real economy enterprises, deepen innovation model reforms, and build an innovative market model framework. To meet the requirements for Chinese healthy economic development, adjusting the industrial structure between the real economy and the virtual economy, and fostering coordinated development between technological innovation and financial innovation has become an inevitable choice. In light of the current stage of coupling development between technological innovation and financial innovation in our country, and the level of real economy development, the following suggestions are proposed:

(1) Leverage the role of the financial industry in promoting the real economy, integrate the financial organizational system, standardize the distribution of financial cluster organizations, and coordinate the relationship between financial development and the real economy. Improve the efficiency of financial services for the real economy through appropriate policies, build a good financial information platform, leverage the financial sectors role in providing capital support and services to the real economy, plan a virtuous cycle development model between the financial industry and the real economy, reduce financial leverage, and minimize the generation of financial bubbles.

(2) Stimulate the vitality of enterprises as the main players in technological and financial innovation, leveraging their significant role in driving innovation. Break down the fragmented situation at the national governance level, strengthen technical transfer and cooperation exchanges between provinces, enabling better circulation of scientific and technological elements across provinces, enhancing the innovation capabilities and levels of economically less developed provinces, and fully leveraging the role of technological innovation in promoting the overall social and economic model and its corresponding ability to drive the development of the real economy.

(3) Establish policy-oriented science and technology financial institutions to provide financial products and services that are characteristic of the era and integrate big data platforms with artificial intelligence applications, thereby

increasing the probability of financial innovation and accelerating capital flow. Through policy formulation, optimize and innovate the integration methods and pathways of science and technology with finance in a location-specific manner, breaking down barriers to the circulation of technological and financial elements across regions, increasing the flow of elements between provinces, promoting national technology sharing, and achieving two-way matching of technology and finance.

(4) Focus on the structure of the real economy and attach importance to the core position of strategic emerging industries and future industries in the real economy. Give full play to the pivotal role of these industries in innovation-driven development, green development, and sustainable development.

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References

- [1] Merton R C, Bodie Z. The Design of Financial Systems: Towards a Synthesis of Function and Structure[J]. SSRN Electronic Journal, 2004, 3(10620):1388-1389.
- [2] Chen H, Yoon S. Does technology innovation in finance alleviate financing constraints and reduce debt-financing costs? Evidence from China[J]. Asia Pacific Business Review, 2022, 28(4):467-492.
- [3] Laeven L, Levine R, Michalopoulos S. Financial innovation and endogenous growth[J]. Journal of Financial Intermediation, 2015, 24(1):1-24.
- [4] Kumbhakar S C, Mavrotas G. Financial Sector Development and Total Factor Productivity Growth[J]. Palgrave Macmillan UK, 2008.
- [5] Wang Li. Analysis of the Impact of Fiscal Expenditure Structure on Economic Growth [J]. Modern Finance and Economics, 2007(08): 75-78.
- [6] Liu Yiwen, Chen Liang, Li Yi, Hu Zongyi. Empirical Study on the Effect of Financial Accessibility on Improving Investment Efficiency in the Real Economy [J]. Chinese Soft Science, 2019(11):42-54.
- [7] Boya, Prince Ran, Zhang Qian. Theoretical Mechanism and Empirical Test of Financial Technology Innovation Promoting the Development of the Real Economy [J]. Journal of Jiangsu University of Science and Technology (Social Sciences Edition), 2022, 22 (3): 93-101.
- [8] Zhou Lei, Ning Xinyi, Song Jiajia, etc. How financial technology innovation promotes high-quality development of the real economy: mechanism analysis and spatial measurement based on financial service efficiency [J]. Research on financial development, 2024 (1): 79-88.
- [9] Huinan, Wang Xin, Li Jinke. Research on the Effects and Mechanisms of Digital Financial Services for the Real Economy under the Background of New Quality Productivity [J]. Journal of Chongqing University (Social Sciences Edition), 2024 (11): 1-19.
- [10] Guo Yujiang. Financial development, technological innovation, and real economy growth: empirical research based on spatial econometrics [J]. Modern commerce and industry, 2020, 41 (22):18-19.

[11] Zhang Lin Financial development, technological innovation, and real economy growth: empirical research based on spatial econometrics [J]. Financial economics research, 2016, 31(01): 14-25.

[12] Liu Guangyan, Zhao Ying The impact of financial development and technological innovation on economic growth: an empirical study based on spatial spillover effects and regulatory effects [J]. Shandong Social Sciences, 2022 (7): 161-168.