



The Impact of Financial Technology Investment on Corporate Innovation: Based on the Perspective of the Digital Economy

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Abstract. The world is now gradually entering the era of digital economy, and the wide application of digital economy not only profoundly affects the transformation and upgrading of traditional industries and gives rise to new industries, but also promotes the adjustment of government macro policies to a certain extent. This paper explores the relationship between government financial investment in science and technology and enterprise innovation based on the perspective of digital economy development in China's domestic environment, the reasons for changes in government financial investment in science and technology, and the reasons for the influence of government policies on the development of enterprise science and technology innovation. Ultimately, it is hoped that the empirical and theoretical analysis will lead to the conclusion that government macroeconomic regulation has an impact on enterprise technological innovation, which will bring some insight to China's economic development and enterprise innovation thinking.

Keywords: Science and technology innovation · Macro-control · Fiscal policy · Empirical analysis · Enterprise development

1 Introduction

In recent years, with the rapid development of the world's science and technology and economic power, the Chinese government also attaches great importance to science and innovation, and Chinese enterprises, especially science and innovation-oriented enterprises, as an important subject in the process of national science and technology innovation development, largely influence the overall development of science and technology in China. Therefore, Chinese central and local governments have introduced industrial support and economic subsidy policies to support innovation, entrepreneurship and creativity of high-tech enterprises, and have tried to create a favorable policy and business environment for the development of science and technology innovation through a series of fiscal and monetary policies such as reducing the cost of science and technology

innovation, lowering the market entry threshold, implementing the registration system reform in the stock market, and establishing the science and technology innovation board. Therefore, there are good conditions for the development of science and innovation enterprises in China, which also increase the competitive pressure of science and innovation enterprises. At the same time, a series of national policies to encourage science and technology innovation, coupled with the increasingly competitive market environment, make it possible for enterprises to find opportunities in the red sea with strong competitiveness only through continuous innovation, and establish a competitive advantage of differentiation.

Up to now, the problems of poor financing environment, difficulties in financing, lack of funding and a series of policies to support technological innovation, and difficult conditions for survival and development of micro, small and medium-sized enterprises are still very prominent among the innovative problems of enterprises. Therefore, at this stage, it is urgent for the Chinese government to adopt certain fiscal policies, especially to provide sufficient financial support for technological innovation of SMEs, and to establish a multi-level financial support system including finance, banks, and capital market to support technological innovation of SMEs. At the same time, in the context of the development of digital economy, China's economy is also moving towards high-quality development, and its development model needs to change from an investment-based to an innovation-driven economy. The development of the digital economy provides a new platform and opportunity for economic development transformation and enterprise technology innovation, helps build a new digital industrial system and economic and industrial ecology, and provides new momentum to achieve innovation-driven economic development. Therefore, in order to meet the environmental development, the Chinese government should take a series of measures to further promote the implementation of digital economy policies, accelerate the deep cross-fertilization of digital information technology such as big data and Internet of Things with the real economy, guide enterprises to carry out digital transformation and scientific and technological innovation activities, and promote enterprises, especially small and medium-sized enterprises in science and technology, to achieve lasting and high-quality innovative development.

1.1 Literature Review

Many scholars in China have studied the impact of government financial investment in science and technology on corporate innovation. Ruyi Xie [1] (2022) used the data of all A-share listed companies from 2008–2018 as the research object, and finally screened 7903 data considering the availability of each data. The above data were obtained from the Guotaian database and screened according to three conditions such as excluding samples of mergers and reorganizations according to the research needs. The three variables of “enterprise innovation performance”, “direct financial investment in science and technology” and “tax incentives” were used for model construction and empirical analysis, regression analysis and robustness test. According to the data, it is concluded that both direct financial investment in science and technology and tax incentives have positive incentive effects on enterprise innovation performance. In his article, Yunjian Xiong [2] (2020) also focuses on the obstacles and solutions to the financing process of small, medium, and micro science and technology innovative enterprises, which can

be an inspiration for the Chinese government to formulate financial investment plans in science and technology. Mark and, Zhang Tingting [3] (2019) selected a large amount of data from GEM listed companies in SZSE as the research sample and used EXCEL2010 and STATA13.0 for data processing and analysis. Similar conclusions were eventually obtained. Xue Xia Piao [4] (2021) in his article combined with the industrial life cycle characteristics to conduct a theoretical analysis of government financial science and technology investment affecting the degree of enterprise innovation finally found that the government financial science and technology investment has different effects on the innovativeness of enterprises at different stages, but overall shows a positive effect. In his paper, Hu Shaoyu [5] (2021) analyzed the growth mechanism of government financial investment in science and technology by comparing the annual R&D data and the proportion of research expenditure to total R&D expenditure in a longitudinal analysis. Yang, Shixin, Liu, Weiping, and Zou, Ziyun [6] (2021) examined the incentive effect of fiscal policy on enterprise innovation based on further research and in-depth quantitative analysis on the issue. Similar conclusions were obtained by constructing a regression model using the number of patent applications rather than the number of grants as the explanatory variable. Wan [7] (2022), on the other hand, synthesized a series of policies promulgated by the Chinese government in recent years and the effects of governance for comparative analysis, and obtained the conclusion that the government's fiscal science and technology policies have been effective in stimulating and guiding enterprises.

1.2 Impact of Government Financial Investment in Science and Technology on Enterprise Innovation

In China, there is an overall environment of “mass entrepreneurship and innovation” to stimulate innovation, and the 14th Five-Year Plan of China also repeatedly mentions the implementation of the concept of innovation development. In China's competitive market environment, “innovation” has also become an important and even decisive factor in determining the development of enterprises. At the same time, with the continuous development of digital economy and Internet+, the commercialization and extensive use of AI in real life, the emergence of a series of innovative products, and the competitive situation that many enterprises in the same field have followed the footsteps of innovation to occupy the market, all indicate that “innovation” has become a powerful driving force for enterprise development. Among them, some small and medium-sized enterprises have some innovative ideas, but they lack innovation ability and capital, thus leading to a large number of small and medium-sized science and technology enterprises cannot obtain sustainable development, while some science and technology giants also need stronger science and technology innovation power to empower them at a certain level, therefore, after comparing and analyzing the factors affecting the innovative development of enterprises, we found that in the overall context of socialist market economy with Chinese characteristics In the overall context of the socialist market economy with Chinese characteristics and under the premise that national macro-control plays an important role, the Chinese government's financial expenditure, financial investment and financial subsidies in the field of scientific research are the most important factors affecting the innovation power of enterprises and their motivation and sustainability.

In this regard, the Oxford Handbook of Innovation has proposed three main indicators to measure the level of innovation: R&D investment data, patent application/grant/citation data, and bibliometric data. For enterprises, we can focus on the first two indicators, while R&D investment can be another important indicator to measure enterprise innovation, which is also the main indicator to measure the level of innovation in the international arena. During the period 2020–2023, the Chinese government has issued a series of programmatic documents to encourage enterprises to innovate in science and technology, while expanding financial allocations and increasing financial subsidies to support enterprises in scientific research and innovation, the results of which can be partially reflected in the data on R&D investment and R&D results statistics of enterprises. According to China's National Bureau of Statistics: In 2020, enterprises spent 186.78 billion RMB on R&D, up 10.4% from the previous year; accounting for 76.6% of China's national R&D spending and contributing 77.9% to China's growth, up 0.2 and 9.4 percentage points from the previous year, respectively, further enhancing the pulling effect. The input intensity (the ratio of R&D expenditure to business revenue, the same below) was 1.41%, 0.09 percentage points higher than the previous year. 2021, the proportion of enterprise R&D expenditure to the whole China was 76.9%, 0.3 percentage points higher than the previous year, and the main position of enterprise innovation was further consolidated. Among them, the R&D expenditure of high-tech manufacturing enterprises is 568.46 billion yuan, an increase of 22.3%, and the investment intensity is 2.71%, an increase of 0.05 percentage points over the previous year. 2022, China's social research and experimental development (R&D) expenditure reaches 308.70 billion yuan, an increase of 10.4% over the previous year, and the data overall shows a good development trend of maintaining a steady upward trend, and the enterprise R&D. According to the data, the R&D investment of enterprises is also predicted to continue to show an upward trend.

For small and medium-sized science and technology enterprises, most of them have weak risk resistance, and it is difficult to rely on their future innovative investment in the current market environment, but the lack of innovation does not have a good development prospect, so this contradiction has led to some small and medium-sized science and technology enterprises once faced a very embarrassing situation [2]. At the same time, there are many problems that need to be broken through, such as the lack of R&D awareness and the complete reliance on imitation of competing products for product updates and iterations. For all enterprises, a series of risk factors will be considered when formulating innovation strategies, but most SMEs are not yet able to successfully cross the first curve and usher in the second curve of growth. Therefore, the support from the external environment may help enterprises to adjust and optimize their future R&D strategies and product planning and give them the confidence and confidence to continue their innovation development.

The issue of the impact of government financial inputs on firm innovativeness is still controversial in current academic circles [3]. This is related to the existence of heterogeneity in the research population (listed companies, etc.), the definition of innovation variables (innovation inputs, etc.) and measurement methods (LP, OP algorithm for measuring total factor productivity, etc.) in the process of multiple quantitative analyses. In order to test the impact of government financial subsidies on the innovation

capacity (number of patent outputs) of enterprises, some scholars conducted quantitative analysis and finally obtained the following conclusions: (i) in general, the increase of financial subsidies can significantly increase the number of patent applications of enterprises. ②Financial subsidies to enterprises can release signals or there is a certain implicit guaranteed mechanism, which can significantly increase the scale of enterprise debt funds, reduce the risk assessment of banks, insurance companies and other financial institutions on enterprises, thus reducing the cost of credit financing for enterprises, which helps to increase the cash inflow of enterprises and promote enterprise innovation. ③The relationship between government financial subsidies to technology-based enterprises and enterprise innovation is heterogeneous across the different industrial life cycles in which the enterprises are located. The relationship between financial subsidies and enterprise innovation is examined from the perspective of industry life cycle, and it is found that the effect of increasing financial subsidies on enterprise innovation is more significant for enterprises in the formative and growth stage industries. The results are consistent and stable for both instrumental variables regression and regression model replacement. Therefore, the existence of heterogeneity lies in the fact that there are significant differences in the number of firms and firm performance within industries with different industrial cycles, which will eventually directly affect the innovation behavior and outcomes of firms.

It is concluded from the study that the role of government support for enterprises relying on financial science and technology inputs during the growth of technology-based enterprises can be divided into stage differences [4]. In the growth stage, the main task of the enterprises is to develop and improve their products and to develop the market in the early stage, therefore, they need multi-channel financing to prepare sufficient financial support for the initial product development and testing stage and the market development and promotion stage. The Chinese government needs to take timely financial measures, i.e., financial subsidies, to provide sufficient financial support and preferential welfare treatment for science and technology-based enterprises to successfully pass the growth period. In addition, the Chinese government can establish various science and innovation funds, such as policy guarantee funds and venture capital guidance funds, to help science and innovation enterprises to successfully complete their incubation and growth. For the enterprises in the mature stage, their operation mode and development strategy have been relatively perfect and on track, and some leading science and technology enterprises have good operation condition and low risk, so they can easily get a lot of capital support from capital market and financial institutions. To maximize the financial role, the government will choose to smoothly withdraw the financial resources at an appropriate time to prevent the enterprises from becoming dependent on government resources. Finally, during the recession period of science and innovation enterprises, the business performance of some enterprises will decline and the risk of survival will increase, so during this period the government will screen the enterprises and select high-quality enterprises that still have certain growth value to provide financial subsidies for science and technology, so that these temporarily poorly run enterprises can get out of bankruptcy and extend their life cycle and thus enhance their innovation. The government's financial investment in science and technology has been found to be very effective in various industries.

After concluding that government financial investment in science and technology has an important impact on enterprise innovation at all stages, we analyze the problems of the current government financial investment in science and technology to support enterprise innovation development. Firstly, the growth mechanism of Chinese government's financial investment in science and technology lacks certain stability. In order to enhance the innovation of enterprises, the Chinese government needs to build a stable growth system of financial investment in science and technology to ensure that the government's financial investment in science and technology for enterprises can maximize its effectiveness and effectively improve the innovation enthusiasm and innovation ability of enterprises. On the other hand, the government's financial science and technology investment policy lacks a good top-level design [5]. At present, the whole country actively responds to the national vigorous development of science and technology, construction and development of innovative enterprises, and constantly promote the innovative development of regional science and technology, which need to further increase the financial science and technology investment of the Chinese government for enterprises, so that enterprises can have sufficient financial science and technology funds to enhance their scientific and technological innovation ability.

The main body of enterprise innovation is the enterprise, which has strong exclusivity and is accompanied by high risk and large uncertainty. The risk is mainly from the financial, technical and management levels. When the innovation activity fails, the investment of the enterprise in the growth period becomes the actual loss, which will seriously affect the innovation enthusiasm and even the ability of the enterprise to survive and develop. On the other hand, even if a company succeeds in its innovation, the next step is to be tested by the market to see if it can be successfully completed and commercialized. At the same time, all firms in the market are risk-averse, and some venture capital firms do not support innovative investments in most firms due to risk aversion, so we can see that the objective existence of risk makes government investment in science and technology and a series of related interventions and support measures necessary.

The government's investment in science and technology promotes innovation by providing financial support to innovative enterprises and boosting their confidence in science and innovation projects, but at the same time, technological innovation is a risky investment activity. This can partially correct the market failure, enhance the innovation efficiency of enterprises, and indirectly reduce the investment risk rate of enterprises. After analyzing a large amount of data and enterprise cases, we found that there is a transition zone between "incentive effect" and "crowding out effect" of government's financial investment in science and technology on enterprise innovation, beyond which the reasonable zone is likely to lead to enterprises' opportunism or excessive the government's fiscal policy may be ineffective or even counterproductive if it exceeds this reasonable range [6]. From the perspective of resource acquisition, the government's financial allocation directly compensates or attacks the scarce funds or technological innovation resources that enterprises lack, which greatly enhances the innovation efficiency of enterprises, and at the same time reduces the cost of enterprises' innovative business activities, lowers their innovation risks, and alleviates the uncertainty brought by enterprises' innovative projects, thus compensating for the lack of innovation motivation and insufficient investment of innovation resources in the independent innovation

activities of science and innovation-oriented enterprises. Therefore, it can compensate for the market failure of insufficient innovation motivation and insufficient investment of innovation resources for science and innovation enterprises. On the other hand, the government's increased financial investment in science and technology can help boost the confidence of enterprises in innovation activities, bring them better future development prospects, and help them attract social financing, which ultimately plays a positive incentive role in the development of enterprises' innovation capacity. As a policy maker, the government has certain information disadvantages, so it may be difficult to screen which enterprises or industries should be supported and at which time to increase subsidies in order to achieve the goal of minimizing costs and maximizing benefits when expanding financial investment in science and technology in the early stage. These may lead to poor decision making or waste of public resources in the early stage, which may eventually lead to negative crowding-out effect of government financial investment in science and technology on enterprise innovation.

1.3 Conclusion and Implications

Based on a series of empirical studies, we can learn that in the context of rapid development of digital economy, financial investment in science and technology has an important positive impact on enterprise innovation within a certain limit. (2) The government should further increase the subsidies for the incubation, formation and growth stages of science and technology-based medium enterprises, to optimize the allocation of subsidies and enhance the efficiency of government financial resources and the innovation capability of enterprises. (3) For enterprises in mature and declining industries, financial inputs and subsidies should be implemented cautiously, and other policy tools can be explored to support them, such as innovation incentives, tax concessions and rebates, etc. (4) Further create a fair competitive market environment, use the market mechanism to screen out enterprises with strong innovation ability to give subsidies, encourage enterprises in innovation disadvantage to improve their production methods, stimulate innovation potential, and guide them to achieve technological improvement through innovation in a competitive environment, so as to enhance the innovation ability of enterprises.

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