

Research on the Influencing Factors of Innovation Capability of Chinese Listed Companies Driven by Digital Economy

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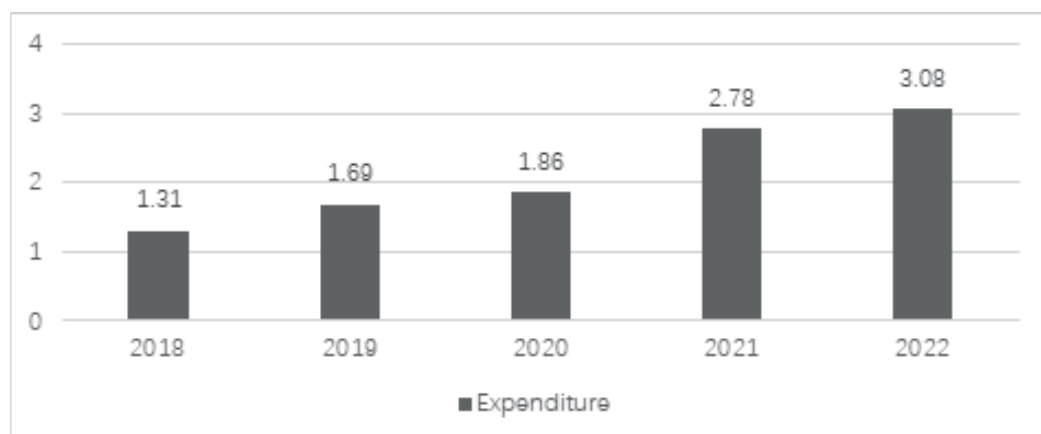
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Abstract: Due to the impetus of the digital economy, the enhancement of innovation capacity among listed companies has become a significant area of research. The author commences by examining the current state of innovation capacity among listed companies in China, with a particular focus on exploring technological innovation and R&D investment factors. The study revealed that many domestic enterprises are experiencing several challenges, including the lagging of high-precision technology, insufficient independent innovation capacity, and difficulties with financing. This article integrates the digital economy, enterprise innovation capacity, technological innovation, and R&D investment into a unified analytical framework. It employs data from China's R&D expenditure, the number of high-tech enterprises, and the number of patents acquired by four nations in 2022 to perform a study spanning from 2018 to 2022, which shows that technological innovation and R&D investment can facilitate advancement in enterprise innovation capacity. Lastly, the article merges existing literature and research findings from both domestic and international sources. It also provides corresponding recommendations and suggestions for addressing the primary issues faced by Chinese enterprises in innovation development.

Keywords: digital economy; Technological innovation; R & D investment; Innovation ability

1. Introduction

Since the introduction of economic reforms and liberalization, China's economy has grown from a state of poverty to become the world's second-largest economy, demonstrating the country's rapid development. However, it is important to acknowledge that China is still lagging in high-tech industries, lacking independent innovation and incomplete knowledge of core technologies amongst other issues. Technological breakthroughs and innovation are increasingly crucial to the development of China's strength. As China embarks on the fourth industrial revolution, the government has prioritized the development of a digital economy. The digital economy has been earmarked as a key national priority and a pivotal aspect of the "14th Five-Year Plan" for China's development. In contrast to the enterprise sector's leadership during the industrial economy era, the digital economy is seeing advancements in technologies such as the Internet of Things (IoT), blockchain, and cloud computing that transcend the time and space limitations of traditional enterprises' innovation, disrupting the traditional innovation paradigm.



Source: National Bureau of Statistics, Ministry of Finance

Figure 1 China's R & D expenditure in 2018-2022 (unit: trillion yuan)

Investing in scientific research is critical to an enterprise's innovation capability, and the amount of money, time, and effort allocated to this plays a decisive role. The China R&D Expenditure Report (2022) shows that during the 13th Five-Year Plan period, China's enterprises' R&D expenditure is set to reach RMB 1.86 trillion, accounting for 76.2% of the overall society's R&D expenditure (Figure 1), with an average annual growth rate of 11.3%. In the traditional model, higher investment in R&D is widely believed to be associated with a stronger innovation capability of the enterprise. In the era of the digital economy, listed companies can take advantage of digital technology to reduce R&D costs while improving their innovation capability. The reduction of redundant costs can be reinvested in R&D, enabling companies to gradually form a virtuous circle.⁶

2. Theoretical Review and Prospect

Currently, numerous scholars both nationally and internationally have conducted thorough research concerning the progress of innovation capacity among listed companies. This paper aims to further investigate the factors affecting the innovation capability of corporations due to the preceding findings. Drawing from research by Peiwen Bai and Yu Li (2021) on corporate innovation capability, one can define it as a series of abilities linked to increasing the level of enterprise innovation. These competencies include technological innovation, investment in R&D, and business management. Enhancing the innovation capacity of enterprises plays a crucial role in advancing the industrial structure and labor productivity, thus promoting swift economic growth (Duan Haiyan, 2021). The digital economy has provided new elements for the development of enterprise innovation capability. According to Li Haijian (2021), the digital economy empowers enterprises' production and operation by leveraging big data, cloud computing, and other digital technologies. This accelerates the process of digitalization and compels businesses to shift from traditional to intelligent technology, leading to enhanced innovation capabilities. Currently, Chinese businesses are undergoing constant digital transformation and rapidly building innovative enterprises. According to Lv Wei (2023), a domestic scholar, China's enterprise innovation has entered a new stage that is marked by a heightened awareness of innovation, diversification of technological innovation, and increased investment in innovation.

2.1 The impact of technological innovation on innovation capability

China's listed companies are increasingly aware of the impact of digital technology on enterprise innovation with the arrival of Industry 4.0, also known as the post-industrial era. Sun Q (2018) states that the widespread use of digital technology will provide innovation resources and power to enterprises, thus advancing the era of technological innovation. For instance, big data differs from traditional offline information gathering and examination and enables listed companies to analyze market trends and obtain consumer preferences. This reduces information asymmetry between the listed companies and the market (Bu Min, 2020), facilitates prompt product updates, and indirectly promotes the innovation of production technology. According to Song Yang (2020), the digital economy has both a direct and indirect promotional effect on technological innovation, with the direct effect being more pronounced. Liu Shulin, Li Mengjie, et al. (2022) suggest that enterprise digitalization can effectively foster technological innovation in businesses by mitigating resource coupling drawbacks, bridging resource mismatches, improving internal synergy, and lowering innovation costs. Enhancing the enterprise's technological innovation level is a crucial element in improving its innovation capacity. The digital economy has facilitated digital industrialization and industrial digitization processes, thus paving the way for listed companies to introduce innovative technology.

2.2 The impact of R & D investment on innovation capability

Several Chinese scholars have conducted research and concluded that investment in R&D has a positive impact on the innovative capacity of enterprises. Wang Chao and Jiang Ping (2018) carried out an empirical analysis of the Chinese industry and found that a long-term increase in R&D funding has a greater positive impact on enterprise innovation. Ma Jingmei and Zhao Wenjing (2021) concluded, based on a study of 17 Chinese high-tech industries from 1995 to 2020, that R&D investment has a significant positive impact on the innovation of enterprises. Zhang Jianqiang (2023) observed that the R&D investment of enterprises has a large impact on their innovative ability. China's Ministry of Science and Technology reports that social R&D expenditure has increased every year since 2015, with the 2022 expenditure exceeding three trillion yuan. The government is aware that "science and technology is the first productive force". It consistently offers listed companies policies that are favorable to business. Tax incentives and financial subsidies are two methods that the government

commonly uses to intervene in the R&D activities of businesses (Shao Jiaojiao, 2023). The government’s support significantly reduces the pressure on businesses regarding R&D funding. In the current digital economy, listed companies should proactively use advanced technologies in R&D and production, such as artificial intelligence, cloud computing, and big data, to enhance the efficiency of their R&D efforts and utilize research funds effectively. Xu Xianchun (2023) stated that the digital economy’s factors of production are characterized by low costs and high efficiency. This environment is conducive to businesses reducing marginal input during production and operations while providing a new perspective on R&D fund growth.

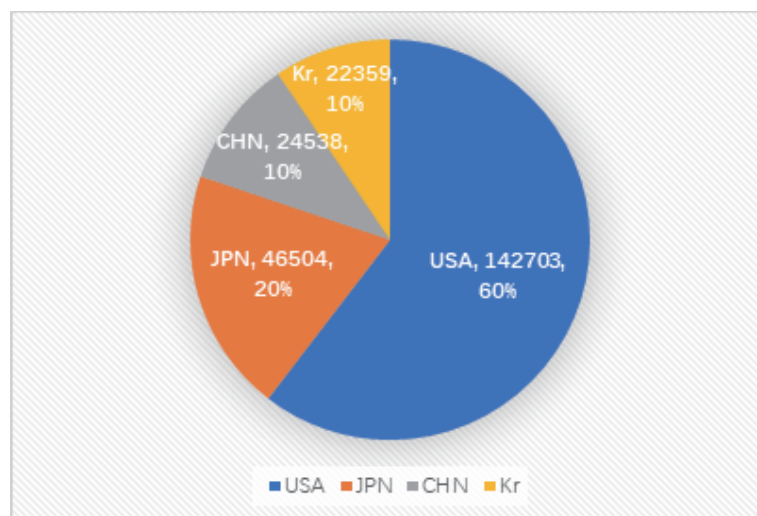
2.3 Comprehensive review

The development of an enterprise’s innovation ability is influenced by various factors, including investment in research and development and the scale of the enterprise. Enterprises can accelerate the flow of information, reduce the risk of information asymmetry in the market, and lower the cost of information access by embracing digital transformation and extensively and flexibly applying digital technology. When a listed company consistently pursues digital transformation, it not only fosters technological innovation but also minimizes the cost of such innovation. This decrease in innovation cost can be reinvested in research and development to further increase investment, which enhances the enterprise’s innovation ability in the long term.

3. Analysis of the Current Situation of Innovation Capability of Listed Companies

China’s industries are being continuously transformed by the digital economy, which accelerates the progress of enterprise innovation capabilities. High-tech enterprises can enhance their competitiveness in the domestic and international markets and attain sustainable development only by continually improving their innovation ability. Currently, there are still issues with the development of listed companies in China.

First, Chinese-listed companies are not globally competitive in high-end and cutting-edge technologies. Over the years, the number of valid patent inventions in China has grown. According to the latest statistics from the National Bureau of Statistics, the number of valid invention patents in China reached 4,212,000 by the end of 2022. According to IFI Claims Patent Services - an international financial institution - the latest data published shows that in 2022, US companies hold the highest number of patents with 142,703 (refer to Figure 2). Following this, Japanese companies hold 46,504 patents, whereas Chinese and Korean companies hold 24,538 and 22,359 patents, respectively. There is a considerable difference in the number of patents held between China and Western countries. This suggests a shortfall in technological innovation among Chinese businesses.



Source: IFI Claims Patent Services

Figure 2 Number of patents obtained in the four countries in 2022

Secondly, Chinese corporations often display inadequate innovation capabilities and an absence of a robust independent innovation system and inspirational working environment. The majority of these businesses have developed dedicated technology centers that oversee technology research and development, product development, and protection of intellectual property rights and patents. The technology center operating within an enterprise has a significant role in improving innovation capabilities, which are instrumental in driving progress. However, certain Chinese companies face problems such as unclear division of labor and redundancy, which result in lower R&D efficiency and hinder the development of innovation capabilities. The employee incentive systems in Chinese publicly listed firms need to be enhanced, especially since some corporations adopt excessively rigid hierarchies and prolonged working hours. Chinese publicly listed corporations ought to expedite the creation of reward mechanisms for their scientific and technological research and development staff and take proactive steps to upgrade their salary structures.

Thirdly, enterprises face the challenge of expensive and demanding financing. Additionally, listed companies commonly encounter financial barriers and insufficient funds to support technological research and development. The data shows that GEM enterprises invested 136.125 billion yuan in research and development (R&D) in 2021, marking a 29.08% year-on-year increase. High-tech industries, manufacturing industries, and other sectors require significant R&D investment. Thus, these enterprises are invariably confronted with the issues of prolonged R&D cycles and high investment costs. According to the data provided by the state science and technology department, the number of high-tech enterprises in China has surged from 181,000 in 2018 to 400,000 in 2022 (refer to Figure 3). The number of small and medium-sized science and technology enterprises reached 500,000, accounting for 68% of the national enterprises' R&D investment. In the country, funding research & development for science and technology enterprises is widely considered a critical aspect. Limiting an enterprise's R&D investment can negatively impact its scientific research quality and innovative potential.

Table 3 Number of High-tech Enterprises in China in 2018-2022

	2018 年	2019 年	2020 年	2021 年	2022 年
Number of High-tech Enterprises (Unit: 10,000)	18.1	21.8	27.5	33	40
Year-on-year growth rate (unit: %)	27.8	20.4	26.1	20	21.2

Data source: Ministry of Science and Technology

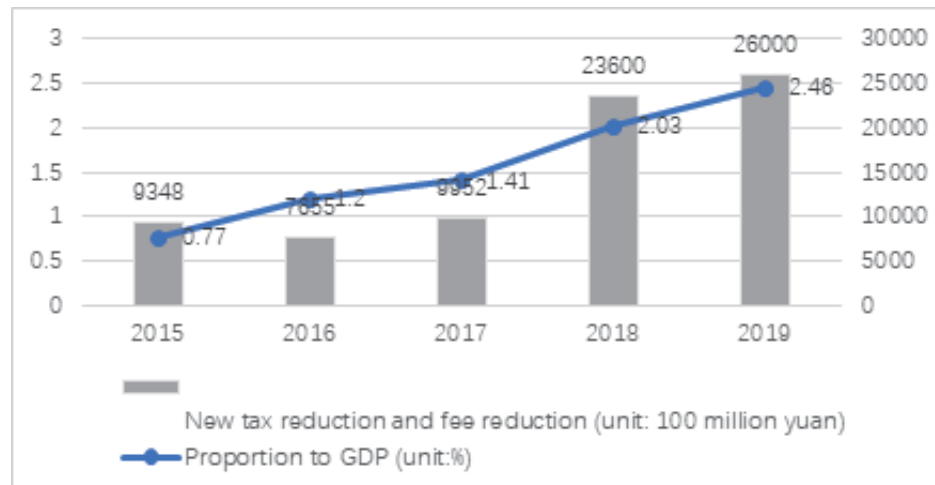
4. Main Factors Affecting the Innovation Ability of Listed Companies

Several factors influence the innovation ability of listed companies. According to Li Zhanlei's (2020) analysis of listed companies, factors such as the shareholding structure, enterprise scale, and board structure can impact a company's innovation ability. A study conducted by Chinese scholar Zheng Kun (2020) on China's GEM-listed companies in 2016-2019 showed that technological innovation has a direct impact on a company's innovation capacity. In a study by Li Tianhao (2020), 180 listed companies were extracted from the Cathay Pacific database using sampling selection. The results showed that increased R&D investment strengthens a company's innovation ability. The author collated and summarized existing research results from domestic scholars to explore the effect of technological innovation and R&D investment on the development of enterprise innovation capability.

Macro national policies and legal systems have a guiding and leading role for enterprises in the direction of technological innovation (Zhou Xiaohui, 2022). In general, the clarity of national policies and the robustness of the legal system protect the rights and interests of enterprises, accelerate technological innovation (Bu Min, 2022), and advance the innovativeness of the company. Taking a closer look, the size of listed companies significantly affects their innovation ability (Zhou Xiaohui, 2022). The scale of an enterprise determines its ability to innovate technologically. In general, technology innovation is feasible only for companies with a large scale, sufficient funds, and resources for innovation. Smaller enterprises are limited in their volume of researchers and access to information and lag behind large-scale listed companies in mainstream technology innovation.

When it comes to R&D investment, China has been consistently advocating enterprise-friendly policies. Two of the most frequent policy tools are tax incentives and government subsidies (Pu Jing, 2023). These tools have motivated enterprises to invest more in R&D activities. Throughout the 13th Five-Year Plan period, incentives and subsidies for Chinese enterprises have consistently been on the rise.

This effort is geared towards enhancing the research capacity of these organizations and urging researchers to achieve more productive outcomes. Data from the National Bureau of Statistics shows that cumulative tax and fee reductions for enterprises in China during the 13th Five-Year Plan period reached 7.6 trillion yuan (as shown in Figure 4). Enterprise-friendly policies have reduced the risk of investment in research and development for enterprises to some extent, consequently boosting their confidence in the realm of scientific research. Developing enterprise innovation capability is a high-cost and high-risk activity with a long cycle that necessitates stable and adequate capital investments as insurance (Wang Yuzhe et al., 2019). Most of the firms in China's GEM are technology-driven and innovative companies with significant technology investments and high conversion rates, and they can effectively boost enterprise innovation ability (Li Tianhao, 2020).



Source: National Bureau of Statistics

Figure 4 China's new tax cuts and fee reductions during the 13th Five-Year Plan period

5. Countermeasures and Suggestions for Innovation Ability of Listed Companies

Firstly, enterprises should enhance their technological innovation capacity. China should accelerate the improvement of the market mechanism focused on technological innovation and emphasize the role of enterprises as primary innovators. China should promote the gathering of different innovation factors for these enterprises and establish an innovation system with enterprises as the main body and technological innovation as the guiding principle. The innovation ability of high-tech companies is commonly linked to the ideology of their entrepreneurs. The realization of innovation becomes feasible only when the enterprise's innovation consciousness and ability are in coherence. Listed companies can improve their technological innovation capability by managing the interplay between technological, product, and process innovation. It is important to avoid overlooking any of these aspects or failing to distinguish between their priorities.

Secondly, high-level scientific and technological innovative talents should be trained. The ability of high-level scientific and technological talents embodies the essence of technological innovation in enterprises. High-tech talents are vital resources for high-tech enterprises and serve as the foundation for the development of enterprise innovation ability, as well as the key carrier of technological innovation. Listed companies should follow the laws of talent growth and development, avoid seeking quick success and instant benefits, nurture young talents for sustainable growth, and pay attention to scientific and technological talents and innovative teams.

Thirdly, a favorable innovation environment should be created within the enterprise. Innovation ability is an important indicator to judge the level of an enterprise, and the development of innovation ability depends on the development of researchers in the final analysis. Managers should reduce the vicious competition within the enterprise, strive to create an environment with a strong innovation atmosphere, and encourage employees to boldly put forward innovative solutions.

6. Conclusion

This paper analyzes the current status and bottlenecks of the development of China's listed companies against the backdrop of the digital economy. It examines how the technological innovation and research and development investment of listed companies impact their innovation capacity under the digital drive. The findings are summarized by integrating relevant literature and data.

First, the study found that the digital economy can effectively promote the development of listed companies' innovation capacity. Digital technology provides new elements for the development of enterprise innovation ability, and it can be considered that digital transformation is the extrinsic motivation to promote enterprise innovation, while enterprise innovation is the intrinsic demand to achieve digital transformation. The size of the enterprise's innovation ability is not only related to whether it can stand firm in the fierce market competition but also epitomizes the level of innovation in China. Second, technological innovation can have a significant impact on enterprise innovation capability. Technological innovation ability is an important performance of an enterprise's innovation ability and is an objective indicator to assess whether the enterprise can develop in the long run. Driven by the digital economy, China's enterprises have set off a wave of digital transformation, accelerating the integration of digital technology with production technology, R&D technology, and other technologies, effectively promoting technological innovation, and then promoting the progress of enterprise innovation capacity. Third, R&D investment has a positive impact on the development of enterprise innovation ability. It is found that the capital investment of listed companies is positively correlated with the conversion rate of scientific research results and the speed of technology iteration. For this reason, the state has continuously introduced enterprise-friendly policies to reduce the pressure on enterprises in digital transformation, R&D investment, etc., and to lay a certain material foundation for enterprise innovation and development.

But we should also clearly recognize that there is still much room for progress in the innovation capacity of China's listed companies. First of all, the technological innovation ability of enterprises themselves can go further. At present, China's enterprises in technological innovation compared with international leading enterprises still have a certain gap. Especially in the field of high-precision technology, key technologies have been monopolized by Western powers for a long time. Secondly, enterprises are still lacking in the cultivation of high-tech talents and teams, and cannot make full use of external resources. Finally, the innovation environment of enterprises needs to be improved. One of the reasons why domestic enterprises are unable to keep up with the innovation ability is the lack of a good innovation environment, deformed corporate culture, and competition system will lead to the burial of many talents.

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