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# Analysis of Financing Tools for Science and Technology-based Small and Medium-sized Enterprises

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**Abstract.** Contemporarily, there has been extensive debate surrounding the challenges of financing and high costs encountered by science and technology-based small and medium-sized enterprises (SMEs). One of the primary factors contributing to this issue is the inadequate alignment between traditional financial models and SMEs. In accordance with the national imperative to vigorously advance new high-quality productive forces, it is of paramount importance to bolster science and technology enterprises as the vanguards of China's scientific and technological innovation. The seamless integration of finance and technology serves as a potent enabler in realizing this objective. The study examines the mismatch between conventional financial instruments and the specific needs of science and technology-based SMEs, while also delving into the characteristics and viable solutions for investment tools required by such SMEs. It reveals that the future development trajectory of investment tools for technology-based SMEs lies in fostering equity financing through venture capital and promoting bond financing based on light assets. On this basis, it is advocated for robust advancement of an investment-lending linkage mechanism to effectively broaden avenues for financing and strengthen intellectual property protection. This contribution offers valuable insights into shaping the future landscape of financial tools tailored to technology-based SMEs.

**Keywords:** Financing tools; traditional financing channels; science and technology-based small and medium-sized enterprises (SMEs).

## 1. Introduction

In September 2023, with China's proposal to enhance the development of new high-quality productivity, bolstering the nation's capacity for scientific and technological innovation has emerged as a paramount concern. Science and technology-based SMEs contribute approximately 70% to technological innovation, not only serving as the primary driving force behind it but also furnishing robust impetus for economic growth.

Science and technology-based SMEs are characterized by their knowledge-intensive nature, initial small scale, and heavy reliance on intangible assets, light fixed assets, and potential for scalable growth [1]. Finance is designed to support the real economy, but traditional financial instruments currently fall short in meeting the financing needs of special market entities such as science and technology-based SMEs with high funding requirements, long return cycles, and light asset characteristics. Credit indicators for science and technology-based SMEs are limited, rendering them unable to provide the necessary collateral [2]. Moreover, science and technology-based SMEs are confronted with substantial developmental risks and are highly susceptible to the business environment in which they operate, rendering it challenging for them to accurately anticipate the overall situation. Consequently, the conventional financial credit model that prioritizes collateral and guarantees is incongruent with the attributes of tech-based small and medium-sized enterprises [3]. Traditional finance involves the generation of commercial value through analysis of historical financial data, whereas tech finance entails the creation of technological credit based on the commercial value derived from technological advancements and anticipated sustained innovation capacity, highlighting a fundamental distinction between these two approaches [4]. In the traditional finance sector, science and technology-based SMEs also encounter challenges in meeting the information disclosure requirements for direct listing financing, facing the risk of loss of control rights

during listing financing, and finding it difficult to use market-based, income-based, and cost-based valuation methods to assess small and medium-sized technology enterprises [5]. Finance plays a crucial role in resource allocation, and science and technology-based SMEs should be the focal point of national resource allocation. The financial system serves as the lifeblood of the economy, not only providing essential capital for technology enterprises but also facilitating self-renewal and functional expansion [6]. Therefore, the organic integration of finance and technology enterprises is beneficial for the mutual development of both parties.

Currently, it is imperative to conduct an in-depth analysis of the characteristics of science and technology-based SMEs, while also scrutinizing the inadequacies of traditional financial services for these entities. This examination will facilitate the identification of fundamental attributes that future financial instruments tailored for science and technology-based small SMEs enterprises should embody.

## 2. Characteristics of Science and Technology-Based SMEs

A science and technology-based SME refers to an enterprise that is founded on scientific and technological principles, with technological innovation as its core driving force. Its primary business activities include research and development, technology transfer, technical consulting, and technical services. They typically possess a high level of expertise in specific fields and can enhance their competitiveness through technological innovation. Small and medium-sized enterprises that are science and technology-based play a crucial role in driving economic growth, promoting technological advancement, and strengthening national innovation capabilities. Fig. 1 illustrates that by 2023, the quantity of science and technology-based SMEs in China is projected to reach 563,354, with the Yangtze River Delta and Pearl River Delta regions serving as primary hubs for such enterprises. Additionally, Fig. 2 demonstrates a consistent annual increase in corporate research and development (R&D) expenditures within China, with notable contributions from technology-based SMEs. Nevertheless, when compared to other industries or large enterprises within the same sector, technology-based SMEs encounter significant constraints in terms of financing.

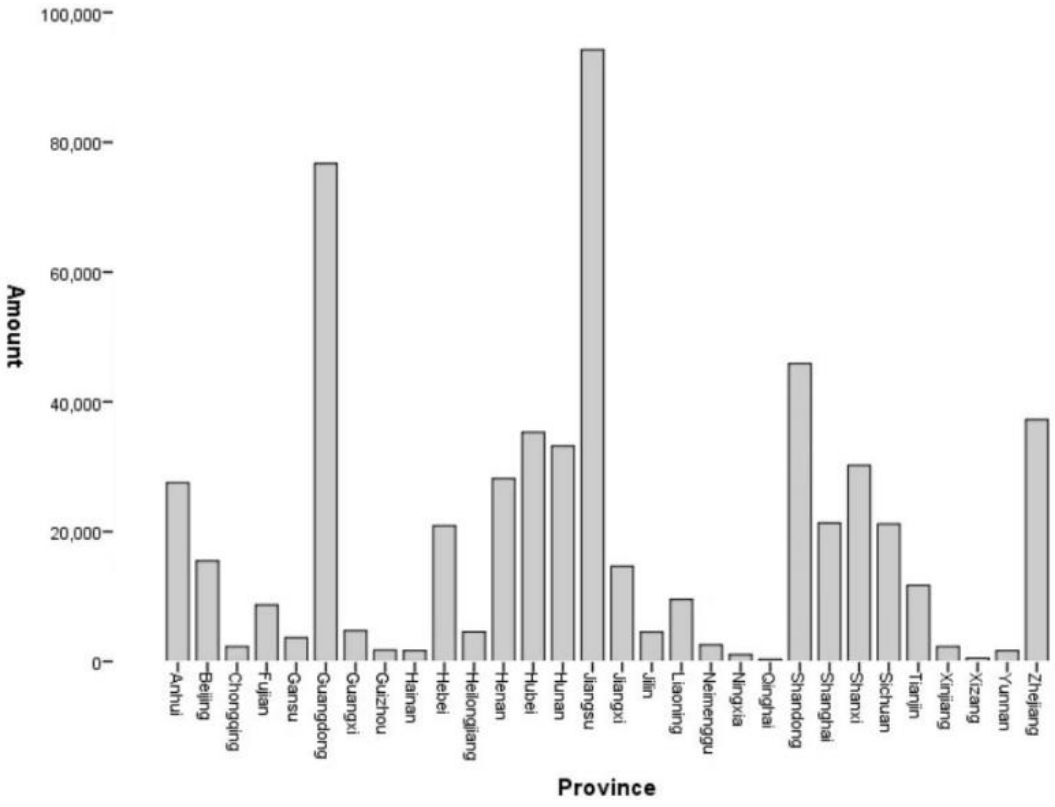


**Fig 1.** The number of science and technology enterprises in various provinces and cities that were included in the database in 2023.

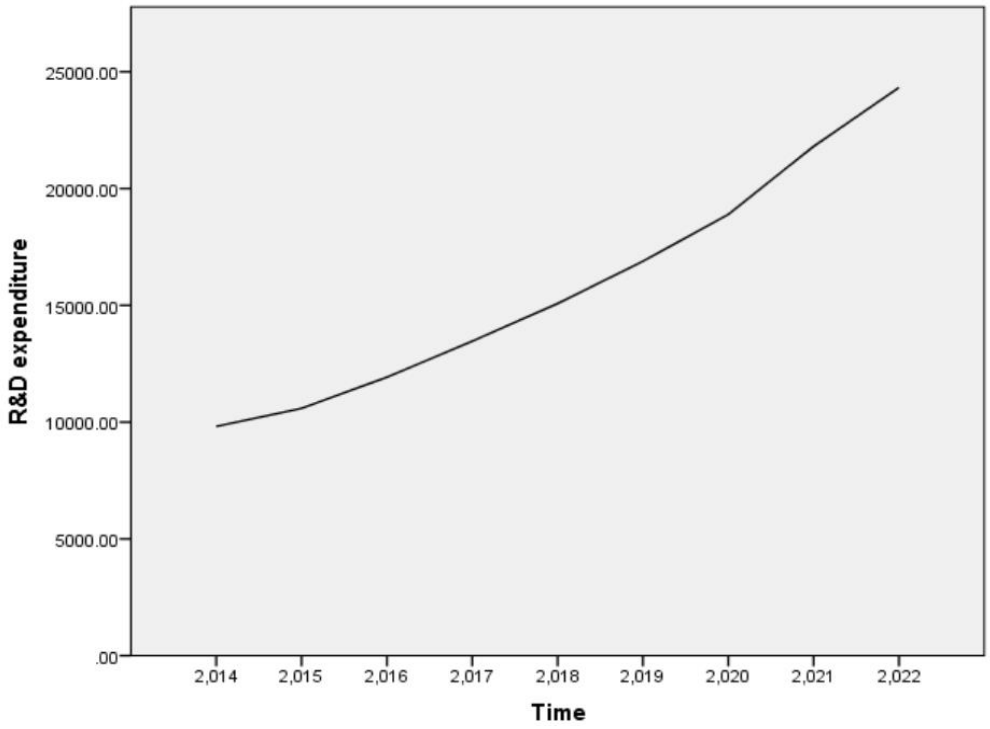


**Fig 2.** Expenditure on Research and Development by Enterprises in 2023.

Compared to large enterprises in the science and technology sector, science and technology-based SMEs face limited resources and lower information transparency. In comparison to other industries, these tech SMEs allocate a significant portion of their main business income to research and development expenses, leading to higher operational uncertainty and risk. However, upon achieving success, they also yield relatively higher returns due to their high-risk, high-return intrinsic. In addition, the asset structure of science and technology-based SMEs is dominated by intangible assets, primarily in the form of intellectual property. These characteristics result in financing challenges for such enterprises within traditional funding channels, including a lack of fixed assets as collateral, information asymmetry, and high financing costs. Traditional financial channels for funding have proven to be inadequate in effectively serving science and technology-based SMEs. Research through questionnaire surveys has revealed that science and technology-based SMEs face narrow financing channels, concentrated financing methods, and are subject to various constraints in their financing [7].

**Table 1.** Traditional Financial Funding Channels.

| | |
|---|---|
| Traditional Financial Funding Channels | Bank loans |
| | Business credit |
| | Issue bonds |
| | Equity financing |
| | Lease financing |
| | Guaranteed Loan |
| | Government Loans and Subsidies |
| | Trade finance |
| | Inter-enterprise borrowing |
| | Letter of Credit |

## 3. The Traditional Financial Financing Supply System is not aligned

Traditional financial channels for enterprise financing encompass the avenues through which businesses secure financial backing from conventional financial institutions, such as banks and credit

organizations, as delineated in Table 1. These channels prioritize collateral, creditworthiness, and guarantees in the financing process, characteristics that are not well-suited for science and technology-based SMEs. The following are two common shortcomings of traditional financing channels in the process of providing funding for science and technology-based SMEs.

Loan financing refers to the process wherein a business or individual obtains funds from a lender by borrowing, and the lender decides whether to provide the loan based on an evaluation of the borrower's creditworthiness. Financing science and technology-based SMEs through loans often requires sufficient fixed assets as collateral, which is a resource that these enterprises typically lack. The absence of collateral ultimately leads to limitations on the loan amounts available. Furthermore, the loan approval process in banks is intricate and time-consuming, which hinders science and technology-based SMEs from obtaining timely financial support for continuous investment in research and development. Moreover, the revenue and cash flow of science and technology-based SMEs may exhibit volatility due to an extended return period for research and development (R&D) investment. Furthermore, loan obligations necessitate regular repayment of principal and interest, thereby amplifying the financial risk for these SMEs. Lastly, financial institutions lack expertise in assessing the business models and risks associated with technology-based enterprises, further compounding the challenge of securing loan approvals.

Corporate bonds refer to debt instruments issued by companies to raise capital from investors. Investors who purchase corporate bonds are essentially lending money to the issuing company, and in return, the company commits to paying a predetermined interest rate over a specified period and repaying the principal amount upon bond maturity. Owing to the absence of robust credit ratings for science and technology-based SMEs, their business models and financial conditions may not enjoy widespread understanding and trust from investors. This could potentially impact investor confidence and the interest rates at which corporate bonds are issued. Furthermore, the stringent entry requirements for China's financial capital market pose a significant barrier for science and technology-based SMEs seeking to obtain the necessary qualifications for issuing corporate bonds [8]. Even if they manage to meet these qualifications, the associated legal, accounting, and underwriting fees are notably high, thereby further escalating the financing costs of such enterprises. Finally, the financing terms of corporate bonds are not synchronized with the business cycle of science and technology-based SMEs. Corporate bonds typically represent long-term liabilities, whereas science and technology-based SMEs necessitate more adaptable short-term funding. The fixed interest expenses associated with long-term corporate debt also place greater demands on the enterprise's cash flow management.

## 4. Development Directions of Financing Tools

In the context of equity financing, compared to traditional financial channels, equity-based financing tools are better suited to the unique characteristics of science and technology-based SMEs with limited assets, heightened risks, and potential for high returns. However, science and technology-based SMEs also find it difficult to meet the information disclosure and listing requirements of traditional equity financing. Therefore, the development of new financing tools based on equity investment is particularly important for addressing the financing challenges faced by science and technology-based SMEs, with venture capital being a prime example. Venture capital is a form of private equity investment that primarily provides funding to companies with high growth potential and in the expansion stage. Investors are usually professional financial investors with a high risk tolerance and an understanding of the high-risk, high-return characteristics of science and technology-based enterprises. Venture capital has addressed the issue of unequal risk and return in traditional financing channels, while also providing a substantial amount of funding for science and technology-based SMEs. It is advisable to promote the entry of venture capital into the market, and it is recommended that leading technology enterprises establish venture capital firms. It is also suggested to introduce mature foreign venture capital institutions in order to provide financial support for science and technology-based SMEs, thereby assisting them in increasing their investment in

innovation. It is advisable to promote the entry of venture capital into the market, and it is recommended that leading technology enterprises establish venture capital firms. It is also suggested to introduce mature foreign venture capital institutions to provide financial support for science and technology-based SMEs, thereby assisting them in increasing their investment in innovation [9].

In the context of traditional financial institutions. In response to the light asset characteristics of science and technology-based SMEs, traditional financial institutions can explore the development of loans using patents from these enterprises as collateral. This enables companies to utilize their intellectual property to enhance their credibility and secure funding. Through data analysis of the SME board and the small and medium-sized enterprise board, it was revealed that intellectual property pledge financing can effectively alleviate the financing constraints of small and medium-sized enterprises. Moreover, when the holding ratio of senior executives is low, intellectual property pledge financing can also exert a positive impact on enterprise performance [10]. The banking industry needs to continuously explore more reasonable valuation methods for science and technology-based SMEs. It is essential to fully leverage the role of big data in evaluating the intangible assets of science and technology-based SMEs, while also reducing the reliance on traditional collateral requirements for such enterprises [11]. Given the potential for rapid fluctuations in the intellectual property value of science and technology-based SMEs, it is advisable to implement a dynamic evaluation mechanism that bases valuation on reasonableness. This involves regular assessment of the current market value of pledged assets to ensure a more accurate and equitable appraised value. This not only facilitates the expansion of potential financing opportunities for science and technology-based SMEs, but also enables banks to proactively manage risks. Considering the high-risk nature of technology-based small and medium-sized enterprises, traditional financial institutions may consider pursuing joint guarantee arrangements and multi-party collaborations. Joint guarantee involves multiple guarantee institutions providing collective assurance for a loan project. This approach serves to disperse the risk associated with a single guarantee company, thereby enhancing loan security. Furthermore, joint guarantee not only disperses concentrated risks associated with one-to-one guarantees but also alleviates the constraints on the guarantee quota imposed by individual guarantee companies to some extent [12]. Multi-party cooperation in the financial industry involves collaboration among banks, financial institutions, guarantee companies, insurance firms, investment entities, government departments, and other relevant stakeholders. As the financial sector becomes increasingly intelligent and digitized, traditional financial institutions must effectively harness the technological advantages and innovative capabilities of other entities to achieve complementary benefits [13]. Simultaneously, through resource integration across multiple parties, these institutions can offer more specialized and comprehensive services to enterprises while also reducing financing costs by sharing expenses among various stakeholders. In the future, commercial banks need to enhance their operational mechanisms and systems, innovate financial products, and explore service models, with a particular emphasis on delivering advanced science and technology self-sufficiency as a primary service area. They will also establish a sustainable framework for serving the science and technology finance sector [14].

In the context of government, the government has assumed a guiding and supportive role in facilitating financing for science and technology-based SMEs. The government can incentivize banks and financial institutions to collaborate with investment entities by establishing and enhancing the framework for investment and loan linkage. By means of the innovative and comprehensive financial service integrating stocks and bonds, the investment-lending linkage mechanism can offer more extensive, precise, and efficient financial support for SMEs in the science and technology sector [15]. The "investment-lending linkage mechanism" refers to a financial innovation model in which a bank, while extending loans, concurrently makes equity investments in the borrowing company through its subsidiary, affiliated companies, or cooperative investment institutions. The investment-lending linkage mechanism has the potential to enhance financing efficiency by reducing enterprise financing costs and mitigating information asymmetry between banks and enterprises [16]. Through the dual support of equity and debt, not only can the support for science and technology-based SMEs be

enhanced, but banks can also become shareholders of the enterprises and share in the profits, thus solving the problem of mismatch between the risks and rewards of traditional loan-granting banks. Furthermore, the government has been consistently enhancing its protection of intellectual property rights by enacting and refining pertinent laws and regulations on intellectual property-backed financing, as well as establishing an intellectual property incubation platform. Lastly, the government could establish a dedicated fund to invest in enterprises or serve as a guarantor for small and medium-sized science and technology-based enterprises, thereby furthering the facilitation of financing for such entities.

## 5. Conclusion

To sum up, this study has determined that science and technology-based SMEs face significant uncertainty and risk stemming from their substantial R&D investment and lengthy R&D cycle. Furthermore, their asset-light nature results in a lack of fixed assets. In the realm of traditional financial channels, small and medium-sized technology-based enterprises encounter challenges in meeting the requirements for fixed asset mortgage and credit rating necessary for loan financing. Moreover, the issuance of corporate bonds entails relatively high financing costs and an incompatible financing cycle for these enterprises. Hence, there exists a compatibility issue within traditional financial channels when it comes to funding science and technology-based SMEs. This study proposes that the advancement of financing mechanisms tailored to the specific needs of science and technology-based SMEs can be facilitated through the utilization of equity-based venture capital and loan financing secured by intellectual property assets. Conventional financial institutions should proactively engage in collaboration with other entities, amalgamate their respective strengths, and establish a robust joint guarantee and multi-party cooperation mechanism system. The government can further enhance the financing channels available to technology-based small and medium-sized enterprises by promoting the establishment of a venture debt financing mechanism, continually refining pertinent legislation and intellectual property services, establishing dedicated funds, and assuming a guarantor role. The contribution of this study lies in examining the specific factors contributing to the disparity between the characteristics of science and technology-based SMEs and traditional financial instruments, as well as proposing a roadmap for the advancement of financing mechanisms tailored to these enterprises. Nevertheless, existing research solely offers theoretical recommendations for future development without conducting empirical impact analysis, thus lacking data-driven support for enhancing financing efficiency for science and technology-based SMEs.

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