

A Literature Review on the Effect of Financial Subsidy Allocation on Stimulating Firm Innovation

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Abstract

Through the collation and summary analysis of the literature, it is found that the research on the allocation of financial subsidies mainly focuses on the conceptual discussion, influencing factors, and modeling methods. Scholars in various countries believe that financial subsidies are mainly used to stimulate enterprise innovation from the perspectives of financial subsidy signal effect, risk expectation effect, capital spillover effect, and alleviation of financing constraints; many scholars have also made theoretical exploration by means of econometric regression analysis, simulation mathematics and mathematical optimization of complex systems, and double difference models, respectively. In general, China's financial subsidy allocation method has gone through several stages, each with different objectives and characteristics, and the mechanism behind the action varies greatly. At the same time, the speed of economic development in different regions of China varies, and most of the existing academic literature can only examine the impact of national financial subsidies on the development and innovation of local enterprises from various macro-level data, but does not fully reveal the geographical characteristics of the process of financial subsidies in China. Therefore, the future can further strengthen the research on the implementation of China's fiscal subsidy policy, industry and regional paths, which has important academic value in promoting the promotion of the transformation and optimization of industrial system upgrading and regional gradient transfer development policy coordination and articulation.

Keywords

Financial Subsidies; Firm Innovation; Literature Review.

1. Introduction

As China's economy is in the stage of high-speed growth to high-quality development, the drawbacks of the current economic growth mode are highlighted. In order to overcome the challenges facing economic development, China needs to transform its economic growth from factor-driven to innovation-driven. Enhancing the innovation capability of enterprises is an important way to remove the technological "neck" of the country and realize the transformation of the economic growth mode, while financial subsidies are the commonly used policy tools to stimulate enterprise innovation. How to formulate an effective fiscal subsidy policy to stimulate enterprise innovation has become an important issue of common concern in both academic and political circles.

2. Concepts, Data Sources and Indicator Systems Related to the Effect of Financial Subsidy Allocation on Stimulating Firm Innovation

2.1. Concepts Related to the Effect of Financial Subsidy Allocation on Stimulating Firm Innovation

The rational use of fiscal subsidy tools by the government to stimulate enterprise innovation is an important path to realize the transformation of economic growth mode from factor-driven to innovation-driven. The existing domestic and foreign literature has extensively explored the effects of fiscal subsidies on industry innovation, but inconsistent research findings have been reached. One type of literature argues that fiscal subsidies promote firm innovation and generate innovation incentives (Wolff & Reinthaler, 2008; Aschhoff, 2009) [1]. Another body of literature argues that fiscal subsidies inhibit firm innovation and generate innovation crowding out (Wallsten, 2000; Görg & Holger, 2007) [2]. There is also a body of literature that argues that fiscal subsidies do not have an impact on firm innovation (Falk, 2004) [3]. From a theoretical point of view, Nelson and Arrow argue that fiscal subsidies can address innovation market failures from the point of view of positive externalities and information asymmetries, and thus stimulate firms to innovate [4, 5]. Lerner points out that financial subsidies can provide government certification to firms, sending "certification signals" to the innovation financing market, reducing the cost of obtaining innovation financing and thus incentivizing innovation [6]. However, there is information asymmetry between firms and the government, and the government is unable to effectively screen firms' innovations and allocate financial subsidies to innovative firms with real capital needs. The government is motivated by reducing the risk of using financial funds, and those projects that are both disruptive and high-risk are difficult to be supported by financial subsidies [7, 8]. In conclusion, there is no consensus on the corresponding concept of the incentive effect of financial subsidies on firm innovation.

2.2. Data Sources and Indicator System of the Effect of Financial Subsidy Allocation on Stimulating Innovation in Firms

This paper finds that foreign studies use enterprise data sources for generally OECD databases, as well as enterprise databases of countries around the world. The basic data sources for the empirical methodological studies of domestic enterprises are mainly for the database of large industrial enterprises in China of the National Bureau of Statistics, data sources of listed companies, and data sources of regional enterprises (e.g., enterprise data of a province or a city). In recent years, a series of theoretical studies on innovation in the field of capital have been conducted by domestic and foreign enterprises, and the classical literature often uses indicators such as R&D Spending, R&D Intensity, and R&D Per Employee to measure innovation investment. Currently, the financial subsidies granted by the government to enterprises in China mainly include price subsidies, tax subsidies, loss subsidies, in-kind subsidies, and interest subsidies. Most of the studies correlate the financial subsidies with the firms' investment in innovation by establishing an econometric model.

3. Factors Influencing the Innovation Incentive Effect of Financial Subsidies for Enterprises

3.1. A Study on the Influence of Non-Financial Subsidy Factors on the Incentive Effect of Financial Subsidies for Innovation

A general examination of the impact of fiscal subsidies on firm innovation has not yielded consistent conclusions: there is evidence supporting the incentive effect of fiscal subsidies on innovation, evidence supporting the crowding out effect of fiscal subsidies on innovation, and studies finding no significant effect relationship between fiscal subsidies and firm R&D

investment. Researchers argue that past empirical studies have treated the effect of fiscal subsidies on firm innovation as a black box, failing to reveal the mechanism of action involved, leading to an important reason for the confusion in the study. Thus, literature studying the mechanism of the impact of fiscal subsidies on firm innovation began to emerge, mainly examining the impact of non-fiscal subsidy factors such as firm characteristics, market competition and institutional environment on the incentive effect of fiscal subsidies on innovation.

3.2. The Influence of Firms' Own Characteristics on the Incentive Effect of Financial Subsidies for Innovation

3.2.1. The Effect of Firm Size on the Incentive Effect of Financial Subsidies for Innovation

The incentive effect of financial subsidies on innovation is affected by the size of enterprises. From the perspective of innovation motivation, large enterprises tend to adopt a prudent business strategy and make R&D decisions more carefully in order to maintain their market position, and the incentive effect of financial subsidies on large enterprises will be weakened. From the viewpoint of innovation capability, innovation activities are characterized by high investment and high risk, and innovation success requires continuous financial support. There are obvious differences between large enterprises and SMEs in terms of innovation motivation and the degree of financing constraints faced by them, and the degree of financing constraints faced by enterprises will directly affect their innovation decisions. Large enterprises have strong capital strength and are easily favored by the capital market, and their internal and external financing channels are more open, so financing for innovative enterprises is not a problem faced by large enterprises; what affects large enterprises' innovation decisions is mainly the competitive market environment and their own strategic decisions, and although financial subsidies further reduce the financing constraints of large enterprises, financial subsidies cannot largely influence their innovation decisions. In general, large firms have better innovation capabilities than SMEs, but SMEs have stronger incentives to innovate than large firms (González & Pazó, 2008) [9].

3.2.2. The Effect of Firm Nature on the Incentive Effect of Financial Subsidies for Innovation

In China, SOEs have natural ties with the government and are more likely to rely on political connections to obtain government subsidies. Due to the lack of political connections and rent-seeking opportunities, private firms rely more on their own innovation strength to obtain government innovation subsidies, and will use government subsidies more effectively and with more innovation incentives compared to SOEs (Liu et al., 2012; Rui Xi Li and Jun Hong Bai, 2013) [10].

Secondly, private firms receive financial subsidies to alleviate the financing constraints faced by R&D activities, thus motivating private firms to conduct R&D activities. Luan, Q. and Luo, Shougui (2017) used data from 2008-2014 enterprises in Shanghai and examined the impact of financial subsidies on enterprise innovation using the propensity score matching method, and the empirical results showed that financial subsidies significantly contributed to the increase in the number of patent applications by private enterprises [11].

3.2.3. The Effect of Corporate Political Affiliation on the Incentive Effect of Financial Subsidies for Innovation

Political affiliation refers to the links established between a firm and government officials. Existing research shows that firms with political connections can obtain policy and credit advantages. First, by establishing political connections, firms are more likely to receive government policy preferences, especially in regions with low marketization levels and

imperfect legal systems, and firms with political connections are more likely to receive financial subsidies and be able to enjoy lower effective tax rates (Chen, Donghua, 2003; Faccio, 2006)[12, 13]. Second, political connections can send positive signals to the market that firms have good development prospects and government support, which can help reduce the cost of external financing for firms (Fan et al., 2007)[14].

3.3. Study on the Influence of Financial Subsidy Factors on the Incentive Effect of Financial Subsidy Innovation

After the general examination of the impact of fiscal subsidies on firm innovation did not yield consistent conclusions, some scholars began to turn to the study of the impact of non-fiscal subsidy factors, such as firm characteristics, market competition and institutional environment, on the incentive effect of fiscal subsidies on innovation, and this research direction has achieved some results in recent years. However, a small number of scholars also began to focus on the characteristics of fiscal subsidies themselves and examine the influence of fiscal subsidy factors on the incentive effect of fiscal subsidy innovation. The factors of financial subsidies that scholars currently focus on include the scale of financial subsidies, the type of financial subsidies and the distribution mechanism of financial subsidies. Among them, the scale of fiscal subsidies is the earliest fiscal subsidy factor that scholars began to study.

3.3.1. The Effect of the Size of Financial Subsidies on the Incentive Effect of Financial Subsidies for Innovation

An empirical study by Hong Liu et al. (2012)[15], based on a sample of Chinese listed companies from 2007-2009, shows that fiscal subsidies have an inverted U-shaped effect on firms' innovation inputs, and that fiscal subsidies significantly promote firms' innovation inputs at the initial stage, and then have a crowding-out effect on firms' innovation inputs as the size of government subsidies continues to increase beyond the optimal subsidy value (Dai & Chen, 2015) used the generalized propensity score method to examine the effect of different fiscal subsidy intensities on the innovation incentive effect of fiscal subsidies based on the database of Chinese industrial enterprises, and the results show that the intensity of fiscal subsidies has an inverted U-shaped relationship with firms' private innovation inputs, and there exists an optimal subsidy size, and fiscal subsidies exceeding the optimal subsidy size will lead to complete crowding out of firms' private innovation inputs [16]. In addition, there are also empirical studies that find a positive U-shaped effect of fiscal subsidies on firm innovation. Using data from 2010-2014 SMEs listed companies, Zhou and Wu (2017) examine the impact of fiscal subsidies on firm innovation, and the Tobit model regression results show that fiscal subsidies have a positive U-shaped impact on firm innovation, and can only play an innovative incentive role when the intensity of fiscal subsidies exceeds a certain level [17].

It is further argued in the literature that the impact of fiscal subsidies on firm innovation shows a double-inflection point inverted U-shape. Using a constructed stochastic frontier model, Fan Zhang and Wei Sun (2018) examined the effect of the fiscal subsidy system on the motivation of Chinese firms to sustain innovation [18]. The analysis of the empirical results showed that the effect of fiscal subsidies and the efficiency of promoting firm management innovation showed a bipolar inflection point or inverted U-shaped relationship. The nonlinear effect of fiscal subsidies on firm innovation has strong policy implications: for a given fiscal budget, a moderate level of subsidies covering more firms is better than a large number of subsidies concentrated on a few firms (Marino et al., 2016)[19].

3.3.2. The Effect of Financial Subsidy Categories on the Incentive Effect of Financial Subsidies for Innovation

Some scholars have conducted pioneering studies around the classification and role comparison of financial subsidies. Wu Qiang and Liu Bei (2014) constructed a dynamic game

model and found that ratio subsidies can effectively stimulate original innovation in strategic emerging industries, while the effect of fixed subsidies is smaller than that of ratio subsidies [20]. Zhang J et al. (2015) examined the effects of different types of financial subsidies on the innovation activities of enterprises by matching the industrial enterprise database, the patent database of the State Patent Office and the innovation fund data of science and technology-based SMEs [21]. The empirical results show that in an environment with lagging financial development, the loan subsidy type fiscal subsidy policy can effectively motivate firms to innovate; the non-reimbursable funding type does not significantly promote firms' private R&D investment. Different types of financial subsidies play different roles. Among them, two types of fiscal subsidies, promoting innovative activities and promoting the concentration of innovative talents, have an incentive effect on firm innovation. The direction and magnitude of the effect of subsidies promoting innovation culture and promoting enterprise development depend on other types of subsidies, while subsidies promoting financial integration have no effect at all.

3.3.3. The Effect of Financial Subsidy Allocation Mechanism on the Incentive Effect of Financial Subsidy Innovation

Colombo (2011) was the first to start focusing on the impact of financial subsidy allocation mechanisms on the incentive effect of financial subsidies for innovation. Using data collected on fiscal subsidies that incentivize firms to innovate in Italy, he classified fiscal subsidies into selective and non-selective subsidies depending on the project evaluation and funding process [22]. Since selective subsidies are concentrated on large projects with large subsidy amounts that need to be obtained through competition, they can reduce the problem of information asymmetry and therefore have a greater effect on promoting firm innovation. Guo Yan et al. (2015) examined the impact of the financial subsidy project screening mechanism on the final effect based on the matching data of innovation funds of science and technology SMEs and the patent output of enterprises [23]. After using the propensity score matching method to solve the endogenous problem of the model, they found that firms receiving innovation funds had higher patent counts, new product output values, and export values than similar firms not receiving innovation funds, and this effect was significantly enhanced after the selection mechanism shifted from centralized to decentralized in 2005.

4. A Study on the Modeling Method of the Incentive Effect of Financial Subsidies on Firm Innovation

In the existing literature, there are fewer studies on fiscal policy support for enterprise innovation through theoretical models. Most of them analyze the relationship between them by establishing econometric models, i.e., using multivariate statistics and other theoretical methods in the designed index system to integrate different levels and types of data information, and finally finish the quantitative scoring and classification of the incentive effect of fiscal subsidies on enterprise innovation. Most domestic studies do not use methods that address the endogeneity of the model (e.g., PSM, 10 DID, RD, etc.), and only use OLS or Tobit regression. Deyin Chu et al. (2016) analyzed the incentive effect of financial subsidies and tax incentives on enterprise science and technology innovation by building a panel data model [24]. Wu Sikang et al. (2014) analyzed the impact of paid and unpaid financial subsidies on corporate science and technology innovation by building a Probit model and Tobit model [25]. Guo Qin (2017) scored the regional innovation capability using GPCA model by using the enterprise science and technology innovation indicators of 30 Chinese provinces and cities [26]. The tripartite game model of Qi Yong et al. (2019) includes government, enterprises, and financial institutions to study the influencing factors of greening innovation production of enterprises through game analysis [27].

However, foreign studies focus on models that address the endogeneity problem, while constructing quadratic functions to exclude the possibility of confounding results and reduce the result error to a greater extent. Aerts & Schmidt (2008) use double difference to overcome the model endogeneity problem using firm-level data from Finland and Germany, and the results support the incentive effect of financial subsidies on firms' private R&D. Howell (2017) overcame the model endogeneity problem using breakpoint regression using US DOE funded program data and confirmed the incentive effect of fiscal subsidies on firm innovation [28]. Görg & Strobl (2007) used firm-level data for Ireland data and found that fiscal subsidies on SME R&D investment using double difference (DID) to solve the model endogeneity problem but financial subsidies have a significant crowding out effect on R&D investment by large firms. Different modeling approaches have their own advantages and disadvantages. Econometric methods predict future trends through past statistical relationships, but the coefficients in the equation are fixed and difficult to describe technological changes, factor substitution, and behavioral changes. These methods are usually used in conjunction with scenario analysis methods when forecasting.

5. Literature Review and Recommendations

5.1. Literature Review

Most of the current research literature still focuses on the incentive effect of financial subsidies on firm innovation, i.e., how "effective" the subsidies are. However, both foreign and domestic studies, both theoretical and empirical, have come to inconsistent conclusions, both in support of the evidence that fiscal subsidies stimulate firm innovation and in support of the evidence that they crowd out firm innovation. In a sense, the inconsistent findings also coincide with the fact that financial subsidies do vary from time to time and from place to place on firm innovation, so the attempt to find the direction and magnitude of the impact of financial subsidies on firm innovation in a general sense is not very significant in theory and practice, and it is extremely easy to fall into the dilemma of confusing research findings. We found that the data used in the existing empirical studies on fiscal subsidies and enterprise innovation are divided into macro-level data and micro-level data, and the use of macro-level data to examine the impact of fiscal subsidies on enterprise innovation has the following shortcomings: first, the use of cross-country data for research is plagued by national heterogeneity, as different countries have different market environments, cultural practices, and legal environments, etc. There are significant differences between countries in terms of market environment, cultural practices, legal environment, etc., and the estimation results using different country samples may differ significantly (Mansfield & Switzer, 1984) [29]. Second, macro-level data are obtained by summing micro-level data, and although the correlation between the summed data is higher, it is difficult to directly apply the conclusions obtained from the summed data to the analysis of the behavior of micro subjects, and the amount of financial subsidies received by enterprises often varies greatly. The use of macro-aggregate data does not allow the analysis of the heterogeneous effects of fiscal subsidies on different firms, and thus lacks guidance for the formulation of specific fiscal subsidy policies. (David et al., 2000) [30].

There are multiple reasons for the inconsistency in domestic studies. One is the problem of model estimation methods, causal inference methods are not commonly used, and most domestic studies do not use methods to solve the problem of model endogeneity (e.g., PSM, 10 DID, RD, etc.), but only use OLS or Tobit regressions, which makes the research conclusions difficult to be convincing. In addition, the robustness tests of some empirical studies are not sufficiently detailed to increase the chance of the findings, especially the earlier empirical studies, which only report the final main regression results and do not show the regression results of stepwise regression and transformed measures. Second, the existence of publication

bias. Many journals prefer to publish studies that demonstrate the incentive effects of financial subsidies for innovation in order to cater to authorities or government officials, and studies funded by local governments tend to argue that fiscal policy effectively promotes firm innovation (Stanley et al., 2008; Stanley et al., 2013)[31, 32].

5.2. Recommendation

The purpose of this paper is to analyze the influence mechanism of fiscal subsidies on enterprise innovation, to provide a new theoretical analysis perspective for exploring the incentive role of fiscal subsidies for innovation, and to propose the optimization path of fiscal subsidies policy for stimulating enterprise innovation in combination with the current fiscal subsidies policy in China. Combining the current problems of fiscal subsidies for stimulating enterprise innovation in China, the specific optimization path of fiscal subsidies in China is proposed to provide reference for the formulation of fiscal subsidy policies for stimulating enterprise innovation in China.

5.2.1. Actively Promote and Optimize the Reform of the Distribution of Financial Subsidies

The traditional way of allocating financial subsidies faces the problems of information asymmetry and government failure, and the introduction of competitive mechanisms into the field of financial subsidies can significantly enhance the incentive effect of financial subsidies on enterprise innovation. Specifically, we should develop a simple and efficient subsidy allocation process, reduce the application burden of enterprises, avoid ownership and scale discrimination, optimize the scale of financial subsidies, scientifically set the upper limit of the scale of financial subsidies according to the characteristics of enterprises and industries, enhance the independence and professionalism of the project review expert group, and improve the government's ability to identify innovative enterprises; increase the subsidies for basic and applied research, and optimize the innovation. The government should increase the subsidies for basic and applied research, and optimize the structure of investment in innovation; enhance the transparency of financial subsidy allocation, and let the procedure of financial subsidy allocation run under the "sunshine" and accept the supervision of the public.

5.2.2. Change the Traditional GDP-Based Assessment System and Add Enterprise Innovation and Other High-Quality Development Requirements to the Performance Assessment System

At present, China is facing the unprecedented change of the century and the economic development has entered the new normal. The traditional crude development represented by the simple pursuit of GDP growth can no longer meet the needs of China's comprehensive construction of a socialist modern country. Optimizing the performance appraisal system of officials and taking enterprise innovation as an important dimension of investigation can help motivate officials to formulate policies in accordance with the time and place, comprehensively enhance the level of enterprise innovation, improve the competitiveness of enterprises, and achieve high-quality economic development that unifies innovation, coordination, green, open and shared development.

5.2.3. Enhance the Level of Marketability and Optimize the Business Environment

Improving the socialist market economy system and providing the necessary institutional conditions for the effective operation of the market mechanism is an important manifestation of improving the level of marketization is to reduce excessive government intervention in economic operation, and the government's reduction of resource allocation activities can reduce the opportunities for enterprises to engage in power rent-seeking. To optimize the business environment, it is necessary to further improve laws and regulations, increase the

penalty for "subsidy fraud", increase the cost of rent-seeking for officials and enterprises, and reduce the occurrence of "subsidy-seeking" behavior.

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