The Impact of Government Subsidies on Corporate R&D: An Overview

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Keywords: Enterprise R&D, Government subsidy, Effect analysis, Effect pathway.

Abstract. This paper attempts to explore the impact of government subsidies on R&D and conduct effect analysis in order to provide the government with the support for formulating policies and guide the enterprise R&D innovation management. We mainly reviewed the relevant documents of government subsidies and enterprise R&D in the past ten years through the framework of “effect pathway—impact effect—influence factors”. It was found that the leverage effect, the crowding-out effect and the mixing effect are all reasonable. The conclusions are not uniform because the influence factors are numerous, and the sample objects, sample data, and research methods used by scholars are different. If we consider the heterogeneity factor comprehensively, we will get more objective and accurate answers.

Introduction

Socialism with Chinese characteristics has entered a new era. Chinese economy is in a critical period of transforming its development mode, optimizing its economic structure, and transforming its growth momentum. Building a modern economic system is an urgent requirement to cross the border. Modernization can only be a fantasy without innovation. How to effectively promote the improvement of independent innovation capability at the national and enterprise levels has become one of the research areas that domestic scholars and policy makers need to focus on.

The Chinese government has formulated and implemented a series of policies to improve the technological innovation of enterprises. In recent years, China's R&D tax preferential policy tools have been gradually enriched. A series of policies have been issued on deductions in technology development costs, VAT exemptions on import tariffs on scientific research and technology development supplies, high-tech corporate income tax reductions, tax reductions for investment of Venture capital investment companies for unlisted high-tech SMEs.

So, is the series of policies implemented by the government to support enterprise R&D effective? Does government subsidy really play a role in promoting R&D? This article reviews the literature in related fields over the past decade, mainly by three aspects: how government subsidies affect enterprise R&D that is the effect pathway; exactly how the impact of government subsidies on R&D, that is, impact effect; and what factors will affect this effect, namely influence factors. It can not only provide the government with the basis and support for formulating policies, but can guide the company's research and development innovation management after effective analysis of these issues.

Theoretical Foundations

Government subsidies can produce two different effects on corporate R&D activities in theory: the leverage effect and the crowding-out effect. If there is a complementary relationship between government subsidies and corporate R&D, government subsidies will attract more corporate R&D investment and create “leverage effect”; if the two generally have an alternative relationship, there will be a “crowding-out effect”. With regard to the impact of government subsidies on corporate R&D, scholars often use Keynesian economic theory, information asymmetry theory, and agency theory to justify it.
Theoretical Basis of Leverage Effect

The world economic crisis that emerged in the early 1930s challenged traditional economic theory, and Smith’s view that relying on the market, the “invisible hand”, to enable resources to achieve optimal allocation was questioned. At this time, General Theory of Employment, Information and Money was published, which advocated replacing economic liberalism with the economic policies and state intervention. Keynes believes that the principle of “invisible hand” is correct but not unconditional. Only in the absence of externalities can the market optimize the allocation of social resources. Nevertheless, externalities are widespread in reality, so the state needs to intervene in the economy to eliminate the impact of externalities on the economy and achieve optimal allocation of resources. Therefore, the government should give full play to the positive role of enterprise R&D and innovation in building a modern economy system.

Arrow (1962) pointed out that R&D activities have strong positive externalities, that is, the developers of R&D activities can not fully occupy all the benefits brought by R&D activities when they bear all the R&D costs, so their personal income is generally less than Social benefits. The enthusiasm of enterprises to actively carry out research and development innovation has declined due to the existence of “market failure”. Pigou (1920) proposed that the government can use subsidies to correct positive externalities, thereby promoting corporate enthusiasm for research and development. Therefore, government subsidies are leveraged for corporate R&D.

Theoretical Basis of Crowding-out Effect

Due to the existence of information asymmetry and principal-agent problems, it is often difficult for the government to identify projects which are worthy of government subsidies, and there are pre-emptive choices. Moreover, it is difficult for the government to have a comprehensive and detailed understanding of the implementation degree and effect of the subsidy program. Therefore, whether the enterprise actually uses government subsidies for research and development is still to be investigated. In addition, since government subsidies usually focus on specific industries, technologies or projects, companies will give priority to projects that can accept subsidies and abandon projects that would otherwise be developed but lack government support. Therefore, government subsidies have squeezed out corporate R&D.

Effect Pathway and Relevant Research

As for the impact of government subsidies on corporate R&D, there are three perspectives after actual analysis: leverage effect, crowding-out effect and mixed effect.

Leverage Effect Pathway

Government subsidies mainly stimulate enterprise R&D investment from the following aspects:

First, government subsidies—R&D costs—R&D investment. Government subsidies can directly reduce the company R&D costs. The use of government subsidies to purchase or update research equipment is equivalent to reducing the cost of sunk for companies that have not been researched and developed. While for companies with more R&D investment, the fixed costs of other R&D projects will be reduced, and the profit of other projects will be increased. It will reduce the marginal cost of enterprise R&D.

Second, government subsidies—R&D risks—R&D investment. When the government subsidizes a R&D project, it means that the government is interested in the results of the project, which increases the future market demand of the enterprise and increases the expected return of the company R&D. Moreover, the government will share information on relevant R&D projects with enterprises while directly subsidizing, and share and reduce the risk of enterprise R&D failure [1].

Third, government subsidies—financing constraints—R&D investment. Government subsidies can effectively alleviate corporate financing constraints. The financing effects of government subsidies are divided into direct effects and indirect effects. Direct effects refer to direct government subsidies to corporate R&D projects that can mitigate corporate financing constraints.
And government subsidies will release positive signals [2]. Comparing with other high-risk projects, private investors will give priority to government-funded projects, thereby enhancing the ability to obtain external financing, so that companies will have sufficient funds for R&D activities[3].

Finally, government subsidies—innovative capabilities—R&D inputs. In the implementation of government-funded R&D projects, funded companies will generate new knowledge and technology which will expand enterprise basic knowledge and can be used to further research to increase R&D investment. From the perspective of knowledge spillovers, the knowledge and technology spillovers that companies generate will benefit competitors and increase the probability of success in research projects. From the perspective of subsidy spillovers, the spillover effect of subsidies will make future R&D activities face lower fixed costs, which have a positive impact on the profitability of non-subsidized projects[4].

In summary, government subsidies can reduce the risk of failure of corporate R&D costs and the financing constraints, and bridge the gap between private and social benefits obtained by R&D. Therefore, enterprises will actively increase R&D investment.

Crowding-out Effect Pathway

Although the logic of the R&D investment of government-funded enterprises is not biased, it is unfortunate that there will be deviations in the implementation process. The reasons why government subsidies will squeeze out corporate R&D expenditures are as follows:

First, government subsidies—R&D factor prices—R&D investment. Demand for R&D resources will be increased because of the government subsidies, so the price of R&D resource and the cost of R&D activities will rise. It will reduce the expected rate of return on R&D activities and companies will abandon R&D projects to other profitable projects. In addition, for other competing companies that are not funded, it is equivalent to relatively raising the R&D cost and reducing the return on investment of R&D. Therefore, the government-funded R&D project may prevent other competitors from carrying out similar R&D projects.

Second, government subsidies—resource allocation—R&D investment. The government is no more efficient than market mechanisms in arranging R&D resources, because government subsidies will change the reconfiguration of R&D resources in different areas. The government subsidy will cause “inefficiency”. Since the evaluation of the effect of subsidies is carried out afterwards according to the behavior of the recipients, it is inevitable that the choice will be deviated, which is an important manifestation of the distortion of R&D resource allocation. In addition, government subsidies usually focus on specific industries, technologies or projects. So the role of subsidy policy is not really exerted, but it will inhibit the corporate R&D under such a screening mechanism.

Mixed Effect Pathway

There is an optimal government subsidy value for each project. Increasing subsidies can induce R&D investment before reaching the optimal value. After the optimal value, continuing to increase subsidies will replace R&D investment. The risk of launching R&D projects is too great in the earlier stage of R&D investment. If the company bears the risk alone, it will weaken its enthusiasm for innovation. At this time, if the government conducts R&D subsidies, it will reduce the risk of innovation investment and encourage R&D investment. The government subsidies at the stage are more of a leverage effect. When the government subsidies reach a certain scale, it will only replace the R&D investment of enterprises if the scale of subsidies continues to increase[5].

Relevant Literature Research

Some scholars have found that government subsidies have a leverage effect on R&D investment through empirical research. Junhong BAI et al[6] concluded that government R&D funding has a significant positive impact on improving the technological innovation efficiency of enterprises by using the panel data of large and medium-sized industrial enterprises in China from the perspective
of efficiency. Liang Shu[7] using the data of various provinces in China to find that government subsidies have a positive guiding effect on corporate fund raising. Weimin XIE et al[1] has also shown that government R&D funding has stimulated corporate R&D spending.

The crowding-out effect view is also supported by related literature. It is believed that under the premise of a certain amount of investment in research and development projects, government R&D subsidies will squeeze private funds out of the original advances, resulting in government funds losing their role due to the reduction of private investment[8]. Cristiano[9] support the rationality of the extrusion effect.

With the further study, some scholars have found that government R&D subsidies have a u-shaped relationship with corporate R&D. Hong LIU[10] based on the empirical research of Chinese listed companies, it is found that government subsidies will have incentive effects and crowding-out effects on R&D. The distribution of the two effects is inverted U-shaped. Dai[11] who used the generalized propensity score matching method and the sample data of Chinese manufacturing enterprises.

A few documents believe that the relationship between government subsidies and R&D investment is not significant. It does not increase the R&D investment of enterprises, nor does it exclude R&D investment. The implementation effect of government subsidies is very neutral[12,13].

In addition, many scholars have conducted further in-depth research and analyzed the role of different forms of government subsidies for corporate R&D. Government subsidies mainly include fiscal direct grants and indirect tax incentives. The impact of direct financial allocation on corporate R&D has not yet been unified. Six found that direct financial allocations were complementary to the company's own R&D expenditures, and only one commented that there was no significant relationship between the direct financial allocations and enterprise R&D in the seven research reports referenced by David et al. However, Michael and Pearce[14], Anna[15] considered that direct funding is inefficient, the government needs to promote innovation through indirect ways such as institutions, taxation and legal procedures.

Most studies have shown that tax incentives have a leverage effect on corporate R&D. For example, Yang[16] discovered that R&D tax incentives has a significant incentive effect. Enterprises that receive tax reductions have invested 53.80% more R&D funds than those that have not. Using the high-tech industry data to use the CGE model. Tongbin ZHANG[17] found tax incentives can stimulate high-tech enterprises to increase R&D investment by reducing costs. However, the implementation of tax incentives has also been questioned. When increasing R&D investment can bring additional deduction benefits to enterprises, enterprises will use the high information asymmetry characteristics of R&D activities to increase the R&D investment intensity of their reports through earnings management, increase the pre-tax deduction amount, and reduce their own tax burden. The actual R&D investment intensity has not increased[18]. Some scholars believe that there is an inverted u-type relationship between government tax incentives and corporate R&D. Haihong FENG[19] found that the optimal policy intensity range for government tax incentives is [3.93%, 12.00%]. When the government's tax incentives are less powerful, the leverage is weaker. The leverage of the R&D investment of the enterprise is significantly enhanced if the policy intensity is within this range. The government tax incentives will squeeze out the R&D when the policy strength exceeds the critical value.

**Research Review**

At present, some studies have noticed that the effect of government subsidies is affected by corporate factors, government factors and market environment factors. Only by systematically examining the changes in these influence factors can we make a reasonable judgment on the actual role of government subsidies. The resource-based theory emphasizes that the resources within the enterprise are the basis for the company's formulation and implementation strategy. The enterprise R&D needs a large amount of continuous resources. Therefore, the resource endowment structure
of the enterprise, such as the scale of the enterprise, capital, political connection, etc., will affect the success of the enterprise R&D and the actual R&D investment. Factors such as the strength of government funding, the choice of funding targets, and the stability of funding policies can also affect the effectiveness of government subsidies. In addition, there are differences in the degree of marketization, development level and institutional environment in various regions of China, which will have an impact on the actual role of government subsidies.

Because the factors affecting the effect of government subsidies on R&D of enterprises are complicated, and the research objects, sample data, research methods, etc. chosen by scholars are different, scholars have disputes about the impact of government subsidies on R&D. The leverage effect and the crowding-out effect are not separated from each other. The effect of the government subsidy on the R&D of the enterprise is ultimately the result of the superposition of the two forces. Taking all kinds of heterogeneity factors into consideration comprehensively, we will get more objective and accurate answers.

Acknowledgement

This research was financially supported by Shaanxi Province Social Science Foundation Project (No.2018D24) and Soft Science Research Project (No.2018KRM138).

And projects respectively are: Research on Countermeasures of Supporting Enterprises R&D in Shaanxi Province Financial Industry and Research on the Design of Financing Mode of SMEs from the Perspective of Enterprise's "Growth Chain Finance"—Taking Shaanxi Province as an Example.

References

[1] Xie Weimin, Tang Qingquan, Lu Wei, Government R&D funding, corporate R&D expenditure and independent innovation: empirical evidence from Chinese listed companies, J. Financial Research. 06 (2009) 86-99.

[2] Liang Shu, Zeng Lei, Financing Constraints? Government Financial Support and Enterprise R&D Investment, J. Value Engineering. 33 (2014) 116-118.

[3] Wang Gang, Xie Fuji, Jia You, Re-examination of the incentive mechanism of R&D subsidy policy—based on the investigation of external financing incentive mechanism, J. China Industrial Economy. (2017) 60-78.

[4] Boeing P, The Allocation and Effectiveness of China’s R&D Subsidies – Evidence from Listed Firms, J. Research Policy. 45(2016) 1774-1789.

[5] Xu Baoda, Zhao Shukuan, Inducing Effect and Extrusion Effect of Government Subsidy on R&D Investment, J. Science and Technology Management Research. 37(2017) 29-35.

[6] Bai Junhong, Is Chinese government R&D funding effective? Empirical evidence from large and medium-sized industrial enterprises, J. Economics (Quarterly). (2011) 1375-1400.

[7] Liang Shu, Feng Li, Chen Xiude, Research on the Impact of Financial Subsidy and Tax Expenditure on R&D Investment, J. Soft Science. 26 (2012) 32-35+50.

[8] Montmartin B, Herrera M, Internal and external effects of R&D subsidies and fiscal incentives: Empirical evidence using spatial dynamic panel models, J. Research Policy. 44 (2015) 1065-1079.

[9] Cristiano Antonelli, Francesco Crespi, The "Matthew effect" in R&D public subsidies: The Italian evidence, J. Technological Forecasting & Social Change. 80 (2013)1523-1534.

[10] Liu Hong, Xiao Meifeng, Tang Qingquan, The incentive and crowding effect of R&D subsidies on corporate R&D expenditures---An empirical analysis based on data of Chinese listed companies, J. Economic Management. 34(2012) 19-28.
[11] Dai X., Cheng L. The effect of Public Subsidies on Corporate R&D Investment: An Application of the Generalized Propensity Score, J. Technological Forecasting & Social Change. 90 (2015) 410-419.

[12] Marino M, Lhuillery S, Parrotta P, et al, Additionality or Crowding-out: an Overall Evaluation of Public R&D Subsidy on Private R&D Expenditure, J. Research Policy. 45 (2016) 1715-1730.

[13] Dimos C, Pugh G, The Effectiveness of R&D Subsidies: A Meta-regression Analysis of the Evaluation Literature, J. Research Policy. 45 (2016) 797-815.

[14] Michael S C, Pearce II J A, The need for innovation as a rationale for government involvement in entrepreneurship, J. Entrepreneurship & Regional Development. 21 (2009) 285-302.

[15] Shi Anna, Li Zhaoming, Huang Yongchun, The R&D Activities of Industrial Enterprises and the Transformation of Government R&D Subsidy Concept—Based on Evolutionary Game Perspective, J. China Science and Technology Forum. (2013) 12-17.

[16] Chih - Hai Yang, Chia - Hui Huang, Tony Chieh - Tse Hou. Tax incentives and R&D activity: Firm - level evidence from Taiwan, J. Research Policy. 41(2012) 1578 -1588.

[17] Zhang Tongbin, Gao Tiemei, Incentives of fiscal and taxation policies? High-tech industry development and industrial restructuring, J. Economic Research. 5 (2012) 58-70.

[18] Wu Zuguang, Wan Dizhen, Wu Weihua, The Impact of Taxation on Enterprise R&D Investment: Extrusion Effect and Tax Avoidance Incentive---Evidence from Chinese GEM Listed Companies, J. Research and Development Management. 25 (2013) 1-11.

[19] Feng Haihong, Qu Wei, Li Minglu, Is the tax preferential policy conducive to enterprises to increase investment in research and development? J. Science Research. 33 (2015) 665-673.