Research on the Influence of Government Subsidy on Enterprise Innovation

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ABSTRACT

In today's rapidly changing technology, both the national level and the enterprise level have promoted innovation to a strategic height, but due to the high cost of innovation, market failure and other reasons, the government needs to take action to promote the innovation of enterprises. The results show that the government subsidy promotes the innovation investment of enterprises. With the increase of the amount of government subsidy received, enterprises will invest more funds in research and development activities. Government subsidies can promote the innovation output of enterprises, that is, the innovation output of enterprises will be promoted with the increase of subsidies. At the same time, in the innovation mechanism of enterprises, the government subsidy brings positive effect on innovation output through the intermediary variable of innovation input.

Keywords: Government subsidies; Innovation input; Innovation output; The mediation effect

1. INTRODUCTION

According to the " 2021 National Economic and Social Development Statistical Bulletin" released by the National Bureau of Statistics, the annual R&D expenditure in 2021 will be 2,786.4 billion yuan, an increase of about 14.2% compared with the previous year. The increase in R&D investment has promoted a great leap in China's scientific and technological level and helped the country to rank among the great powers of scientific and technological innovation . Many emerging companies have sprung up like mushrooms after a spring rain. At the same time, in order to maintain their competitive advantages, large companies that already have a solid foundation have also included innovation in their corporate strategies. Due to the large cost of investment in the research and development stage of innovation activities, it is difficult to control, for enterprises, there is a risk of failure in innovation activities. It is very difficult to completely rely on the internal financing of the enterprise, and the loss of R&D failure is not conducive to the sustainable development of the enterprise in the future. As an important builder of the external business environment of enterprises, the role of the government in the development of enterprises cannot be underestimated. In the context of encouraging innovation, the state encourages the innovation activities of enterprises by issuing government subsidies and other forms of industrial policies and related preferential policies in various industries.

In the process of government subsidies to enterprises, there will be moral risks such as adverse selection caused by information asymmetry, so that high subsidies may not promote enterprises to increase investment in innovation activities and therefore not bring more innovation products. Therefore, it is necessary to study the influence of government subsidies on enterprise innovation, which can bring certain practical significance to the government's subsidy incentive policies and the establishment of a sound innovation activity mechanism for enterprises. Based on this, this paper explores the impact of government subsidies on innovation output from two aspects, and analyzes the role of corporate innovation investment in the impact of government subsidies on innovation output, and selects China's A-share listed companies. Empirical analysis is carried out on the data in the selected years, and relevant suggestions are put forward accordingly.

2. THEORETICAL ANALYSIS AND RESEARCH ASSUMPTIONS

2.1. Government Subsidies and Corporate Innovation Investment

Due to the necessity of government subsidies in enterprise innovation activities, the research on the impact of government subsidies on enterprise innovation ability has received extensive attention from scholars at home and abroad. Scholars believe that the impact of government subsidies on enterprise innovation investment can be divided into incentive effect, crowding out effect and threshold effect [1][2] . Incentive effect refers to the positive effect of government subsidies on the R&D expenditure of enterprises . Emmanuel [3]'s research found that government subsidies to enterprises can play a signaling role, making it more conducive to the fundraising of enterprises. Cao Yang and Yi Qiqi [4] found,in a study of listed companies in China's biopharmaceutical manufacturing industry that government subsidies can promote enterprises to increase innovation investment, and continuous government subsidies have a positive moderating effect on R&D investment and corporate performance. In addition, in further research by scholars, it is found that government subsidies play a role in promoting enterprise innovation investment, and continuous subsidy distribution can bring better results [5][6]. And in different regions, the influence of government subsidies is different [7] , but in general, the increase of government subsidies is conducive to the improvement of enterprises' innovation investment . The crowding-out effect is when an increase in government subsidies crowds out funds that firms would otherwise use for R&D. In the research of scholars, the externalities of funding sources and information asymmetry lead to the crowding-out effect of subsidies on R&D investment, so that enterprises that do not receive government subsidies invest more funds in research activities than enterprises that receive them[8][9]. The threshold effect is an extension of the incentive effect. Some scholars have found that the incentive effect of government subsidies will change with the intensity of the subsidy. When the subsidy intensity increases to a critical value, the incentive effect is constantly decreasing [10].

For enterprises, innovation activities have high economic costs and failure risks, and risk-averse managers will not easily choose innovation strategies. As an important constructor of the business environment of enterprises, the government will have an impact on the behavior of enterprises. According to the Accounting Standards for Business Enterprises, government subsidies are free economic resources from the government, and enterprises do not need to deliver goods or services to the government. . Based on this, this paper believes that government subsidies can promote the innovation investment of enterprises, and proposes hypothesis 1.

H1:Government subsidy promotes enterprise innovation investmen.

2.2. Government Subsidies and Corporate Innovation Output

The ultimate purpose of government innovation subsidy is to enhance the innovation capability of enterprises and bring more innovation output. Based on the theory of market failure and a large number of studies, it has been shown that due to the externality of innovation activities, it needs to be developed under the measures of direct government subsidies and tax incentives. means of performance.

In the research of scholars, government subsidies have a promoting effect on the innovation output of enterprises. Yan Huahong et al. [8]found that government subsidies have a significant effect on stimulating corporate innovation activities, and can significantly improve corporate innovation output and innovation efficiency. At the same time, the nature of firm ownership has no significant impact on firm innovation. Studies in different industries generally show that government subsidies have a positive effect on innovation output. The increase of government subsidies will increase the number of enterprises' innovation output. A further study on the sources of R&D funds of enterprises found that financial subsidies from external sources are more effective in transforming innovation output into products needed by the market. Zheng Chunmei and Li Pei[9].in their research on high-tech enterprises listed on the Growth Enterprise Market, found that government subsidies have a significant positive incentive effect on the number of patents produced by enterprises' innovation and the profits brought by innovation. And Zuo Linli and Zhang Yanfei [10]based on the data of China's small and medium-sized board listed companies, empirical analysis concluded that government subsidies have a significant role in promoting innovation performance. And it is recommended to establish a sound subsidy mechanism at the government level and maintain a correct government-enterprise relationship at the enterprise level.

In recent years, with the continuous improvement of my country's intellectual property system, the innovative output of enterprises will have legal benefits after applying for authorization, which reduces the losses caused by low-cost plagiarism, and has a sound legal system to protect the company's R&D personnel will also be more invested in the R&D of innovative outputs, and enterprises are also willing to invest enough R&D expenditures in innovative activities. These are all necessary conditions for the production of technological achievements. With the increase of government subsidies,

the innovation output of enterprises is also increased accordingly. Xu Weixiang[11]believes that due to the lag in the innovation output of enterprises, that is, the government subsidies and innovation input received in the current year will not produce results in the same period, so the amount of innovation output in the (t+1) period is selected for research. . Therefore, this paper believes that government subsidies can promote the innovation output of enterprises, so hypothesis 2 is proposed:

H2:Government subsidies promote the innovation output of enterprises

2.3. Research on the Relationship between Government Subsidies, Innovation Input and Innovation Output

In the research on the impact of government subsidies on enterprise innovation, it is also necessary to consider the relationship between government subsidies, enterprise innovation input and innovation output. In the research on innovation output, many people have added innovation input as an intermediary variable to analyze. Researchers found in their research on listed companies in China's equipment manufacturing industry that scholars' research shows that in the government In the process of subsidy to enterprise innovation output, R&D investment is used as a mediating variable, which has a positive effect on innovation performance through mediating variables[12][13]. In the consideration of the relationship between the three by Qiao Sen and Zeng Hengfang [14], both the moderating effect and the mediating effect were studied. In the process of innovation, R&D investment can play a mediating role, and at the same time, government subsidies have a significant positive moderating role in the impact of innovation input on innovation output performance. As a result, the government actively guides enterprises to invest in innovation activities through subsidies, which improves the innovation ability of enterprises. Enterprises in different operating environments, the strength of the role of the three is also different. Scholars have studied the effect of government subsidies on enterprise innovation activities by region and by ownership system. The conclusion shows that government subsidies in state-owned enterprises will inhibit the innovation performance of enterprises. Between innovation input and innovation output, the moderating effect of government subsidies will vary with the experience of the enterprise and the development of the region. The government of small and medium-sized enterprises in underdeveloped areas should increase the intensity of direct subsidies [15][16].

After receiving the government subsidy, the enterprise will use the funds as investment in innovation activities to purchase assets related to R&D activities or use it for expenses related to R&D activities. Facilities

and R&D personnel can gradually establish a complete R&D environment, so the overall level of innovation will be improved. These factors are all necessary conditions for obtaining innovative outputs. Therefore, it is believed that government subsidies will affect the innovation output of enterprises through the intermediary of innovation input.In the internal mechanism of innovation of enterprises, innovation investment will exist as a mediating variable between the two between. At the same time, according to the three-step method of the mediation effect test, on the basis of the first two hypotheses, Hypothesis 3 is proposed to test the relationship between innovation input and innovation output of enterprises.

H3:Innovation input plays a mediating role in the impact of government subsidies on innovation output.

3. Research Design

3.1. Sample Selection and Data Sources

This paper selects the data of all A-share listed companies in Shanghai and Shenzhen stock markets from 2014 to 2018 as the research sample, excludes special industries such as finance and insurance, and reduces the research errors caused by the special nature of the industry; excludes ST companies; Companies with missing or outlier control variables. Finally, a total of 16,010 samples from 3,202 listed companies in five years were selected as samples for observation. In order to avoid the influence of outliers on the regression results, the continuous variables were Winsorized at the 1% and 99% percentiles .

The annual report data and other auxiliary data of listed companies required for this study come from: Guotai'an CSMAR database, wind database, including the amount of government subsidies, corporate R&D investment, corporate asset-liability ratio, return on net assets, major shareholder shareholding ratio, company The total assets come from the Wind database, and the number of patents applied for by the company comes from the Guotai'an CSMAR database.

3.2. Variable Selection

The explanatory variable in the study is government subsidy, which is the amount of government subsidy received by the target company in the corresponding year, and the selected data unit is million yuan. The explained variable is enterprise innovation investment , which is the percentage of R&D investment in operating income. Due to the different scales of companies, the absolute value of its data is also different. Therefore, in order to avoid the error caused by the absolute value of the data, the ratio of R&D investment in operating income is selected. Percentage, which reflects the intensity of enterprises' investment in innovation as an indicator to measure. The innovation output is measured by the number of applied

patents . According to my country's "Patent Law", patents can be divided into three types: invention patents, utility model patents, and design patents. The number of patents in this article is the total number of patents applied by the company, and these three patent categories are not subdivided. Drawing on Zhang Xindong and Wu Junjun [17] in their empirical research, considering the objectivity and validity of data, the number of applied patents is used to measure innovation output.

Table 1 Variable Definition Table

variable category	variable name	symbol	description
Explanatory variables	government subsidy	Sub	The number of government subsidies received by listed companies in the current year
Explained variable	Enterprise innovation investment	Input	R&D expenditures in the current year as a percentage of operating income for the same period
	Enterprise innovation output	Output	Number of patents applied for in the year (patent)
control variable	Company Size	Size	The natural logarithm of the firm's total assets
	Ownership concentration	Share	Shareholding ratio of the largest shareholder
	Roe	ROE	Ratio of Net Profit to Average Shareholders' Equity
	solvency	Gearing	Debt ratio, total liabilities divided by total assets
	company growth	Growth	Increase as a % of total prior period assets

3.3. Model Design

According to the hypothesis of the previous research and the definition of related variables, in order to test the impact of government subsidies on enterprise innovation investment, a model is established to test:

$$\text{Input}_{it}= \beta_0+ \beta_1\text{Sub}_{it}+ \beta_2\text{Size}_{it}+ \beta_3\text{Share}+$$
$$\beta_4\text{ROE}_{it}+ \beta_5\text{Growth}_{it}+ \beta_6\text{Gearing}_{it}+ \varepsilon_{it}(1)$$

From the perspective of enterprise innovation output, we measure the impact of government subsidies, and establish model 2 to test hypothesis 2, the impact of government subsidies on enterprise innovation output.

$$\text{Output}_{it+1}= \beta_0+ \beta_1\text{Sub}_{it}+ \beta_2\text{Size}_{it}+ \beta_3\text{Share}+$$
$$\beta_4\text{ROE}_{it}+ \beta_5\text{Growth}_{it}+ \beta_6\text{Gearing}_{it}+ \varepsilon_{it}(2)$$

In order to study whether corporate innovation input plays a mediating role in the influence of government subsidies on corporate innovation output, a model is constructed combining the three steps of mediation effect test[18].

$$\text{Output}_{it+1}= \beta_0+ \beta_1\text{Sub}_{it}+ \Sigma\text{control} + \varepsilon_{it}(2)$$
$$\text{Input}_{it}= \beta_0+ \beta_1'\text{Sub}_{it}+ \Sigma\text{control} + \varepsilon_{it}(1)$$
$$\text{Output}_{it+1}= \beta_0+ \beta_1''\text{Sub}_{it}+ \beta_2\text{Input}_{it}++ \Sigma\text{control} + \varepsilon_{it}(3)$$

Based on the first two formulas, here we use Equation 4-3 to test whether there is a mediating effect between government subsidies and corporate innovation output.

4. EMPIRICAL ANALYSIS

4.1. Descriptive Statistics

Descriptive statistics are carried out on the selected indicator variables. During the five-year period from

2014 to 2018, the average amount of government subsidies received by enterprises was 36 million yuan , indicating that listed companies received more government subsidies. In general, R&D investment does not account for a large proportion of operating income. The nature of the industry in which each company is located leads to this result, and the innovation output of different companies varies greatly. At present, the innovation level of my country's listed companies still needs to be improved. According to the results of descriptive statistics in this paper, it is found that the average value of enterprise innovation investment is only 4.658%. According to the experience value and the ratio of other countries, the current level of innovation investment of listed companies in my country is not high, and there is still a lot of room for improvement.

4.2. Regression Analysis

4.2.1. The Impact of Government Subsidies on Enterprise Innovation Investment

Table 2 Multiple regression results

variable	(1)	(2)	(3)
	Input	Output	Output
Sub	0.007***	1.102***	1.008***
	(10.092)	(23.054)	(20.350)
Input			5.339***
			(7.754)
Size	−0.745***	24.500***	28.628***
	(-18.811)	(7.969)	(9.188)
Share	−0.032***	0.095	0.384**
	(-12.610)	(0.532)	(2.116)
ROE	−0.009**	1.398***	1.356***
	(-2.554)	(5.208)	(4.940)
Gearing	−0.046***	0.0001	0.245
	(-19.659)	(0.000)	(1.445)
Growth	0.008	0.031	0.009
	(8.255)	(0.497)	(0.142)
Constant term	23.560***	−520.463***	−651.751***
	(28.641)	(-8.218)	(-10.034)
adjustedR²	0.134	0.332	0.331
F value	311.404	238.379	191.545

Note: ***, **, and * indicate significant at the 1%, 5%, and 10% levels, respectively.

Model 1 is used to study the influence of government subsidies on enterprise innovation investment, in which government subsidies are explanatory variables, and enterprise innovation investment is an explained variable . According to the regression results, it can be found that the regression coefficient of the government subsidy Sub

variable is 0.007, the t value is 10.092, and the sig value is much less than 0.01. Therefore, in the statistical sense, the explanatory variable is positively correlated with the explained variable, and it is significant at 1%. significantly on the level. It shows that with the increase of the amount of government subsidies, the innovation investment of enterprises will also increase, and the cash flow brought by the government subsidies allows enterprises to have additional funds to invest in their own innovation investment activities, which also confirms that This paper proposes the hypothesis that government subsidies have a promoting effect on corporate innovation investment.

4.2.2. The Impact of Government Subsidies on Enterprise Innovation Output

According to the results of regression analysis, in Model2, government subsidy is the explanatory variable, and enterprise innovation output is the explained variable . It can be seen from the regression results that the government subsidy Sub received by the enterprise and the number of patents applied for by the enterprise are significantly positively correlated at the 1% confidence level. The regression coefficient is 3.702, and the t value is 37.143. The adjustment of the multiple regression The latter R^2 is 0.390, indicating that the model has a good goodness of fit , and the explanatory variables explain 39.00% of the explained variables. This also proves the expectation of Hypothesis 2 of this paper, that is, government subsidies can promote the innovation output of enterprises. When the amount of government subsidies to enterprises increases, it will promote the innovation output of enterprises to a certain extent, that is, the number of patent applications of enterprises will increase accordingly, which also indirectly proves that the innovation output of listed companies in my country is gradually improving. .

4.2.3. The Mediating Role of Innovation Input

Judging from the test results of the mediation effect, the regression results are in line with the mediation effect test, that is, between government subsidies and innovation output, corporate innovation input plays a mediating role. After an enterprise receives government subsidies, it will increase its investment in innovation. According to the requirements of China's accounting standards, government subsidies are divided into asset-related subsidies and income -related subsidies. In other words, the subsidies received are used to increase the needs of research and development activities. When the company's innovation investment intensity increases, a perfect innovation environment is built , which helps to improve the overall innovation level, thus affecting the company's innovation output, and with With the increase of innovation input of enterprises, the innovation output of enterprises will also increase. Therefore, for the

government, it can affect its innovation output by increasing subsidies to enterprises. For enterprises, receiving government subsidies will promote the input of innovation activities, which is a necessary condition for innovation output, which will then increase the number of innovation output.

5. CONCLUSION

Government subsidies play a role in promoting the innovation input of listed companies. Enterprises should pay more attention to the importance of innovation and increase investment in innovation activities. The increase in the amount of government subsidies received can alleviate the financial problems faced by enterprises in innovation activities, allowing enterprises to invest more funds for asset acquisition and period expenses related to innovation activities. To build a sound innovation environment and improve the innovation level of enterprises, it is necessary to increase the amount of subsidies for developing industries, and to provide subsidies to enterprises with development prospects in a timely manner.

Government subsidies play a role in promoting the innovation output of listed companies. When the amount of government subsidies increases, the amount of innovation output of enterprises increases accordingly. Since the innovation activities of enterprises require a lot of financial support, if there is not enough capital surplus, enterprise managers generally do not choose innovative activities with high risks, but instead choose more stable investment activities. It is crucial to continuously improve the government subsidy mechanism at the government level, increase the supervision of the subsidy process, and ensure that the funds are implemented; for enterprises, when the government subsidies received by enterprises increase, the risks that enterprises need to undertake in innovation activities It is a kind of financial guarantee for the innovation activities of enterprises. In order to increase the investment in innovation activities to improve its innovation level, the subsidy received is reasonably invested in innovation research and development activities, and effective innovation output can be generated to continuously improve its competitive advantage in the industry.

The innovation input of enterprises plays a mediating role in the impact of government subsidies on innovation output. Innovation input as an intermediary variable can have a positive effect on the output of enterprise innovation. Therefore, it is particularly important for enterprises to establish a sound innovation mechanism. The increased government subsidies will encourage enterprises to invest more funds in R&D and innovation activities, thus establishing a perfect innovation environment and improving the innovation level of enterprises, which is conducive to the production of more innovation achievements. Therefore, for enterprises, it is

necessary to strengthen their own innovation transformation ability, increase investment in innovation activities, and at the same time improve their own innovation level, and convert the invested funds into innovation output reasonably and effectively. Because the fundamental purpose of innovation activities is to obtain a certain level of innovation output and to continue innovation as the source of economic development. Enterprises with a sound innovation mechanism can reduce the loss and waste in the innovation process, efficiently use the invested funds in R&D innovation activities, and convert them into their own innovation output. Maintaining active innovation momentum can give companies their own competitive advantage in the increasingly fierce industry competition.

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