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Research on the Influence of Government Subsidy on Technological Innovation of Enterprises. Take China's Equipment Manufacturing Industry As An Example

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***Abstract*—With the acceleration of economic globalization, competition has become the theme of the world. The competition between countries is essentially the competition between technology and talents, and innovation is the prerequisite for obtaining competitive advantages. Government subsidy is an important factor affecting the technological innovation of equipment manufacturing enterprises. Through the theoretical analysis of government subsidies affecting technological innovation activities of enterprises, taking 20 listed equipment manufacturing enterprises in China as samples, using the panel data model of 2013-2017, empirical tests have been conducted. The effect of government subsidies on corporate innovation behavior. The research results show that current government subsidies are positively affecting corporate R&D investment, while the government subsidies in the previous year have negatively impacted corporate R&D investment, and the incentive effect of government subsidy is greater than the crowding out effect.**

Keywords—Technological innovation; Government subsidies; Equipment manufacturing

I. INTRODUCTION

In the context of economic globalization and the rapid development of science and technology, a large number of theories and practices have shown that innovation is the source of economic growth[1]. R&D, as an important means and carrier of innovation, not only contributes to improving productivity, but also Created a lot of social wealth, its comprehensive investment return rate can reach 62%. In 2016, the total R&D expenditure in China reached RMB 1567.67 billion, an increase of 10.6% over the previous year, accounting for 2.1% of the GDP; in 2017, the total investment for R&D funding in China was RMB 1,750 billion, which was higher than the previous year. The growth rate was 0.05%; the ratio of financial investment to GDP was 2.15%, which was higher than the 2.1% of the previous year. These figures all indicate that China's R&D expenditure has been steadily increasing.

Manufacturing is the core of the real economy. In the global advanced economies, except for a few resource-based countries, large or small countries have more or less globally competitive manufacturing sectors. Examples include high-end lithography machines in the Netherlands, instruments and pharmaceuticals in Switzerland, the pharmaceutical industry in Singapore, communications and aviation in Sweden, the instrumentation and communications industry in Israel, and the communications industry in Finland. As a global power, the development and upgrading of manufacturing industry is the foundation of economic strength. The equipment manufacturing industry in manufacturing industry is also a strategic industry that provides technical equipment for various industries in the national economy. Its productivity level is an important guarantee for industrial upgrading and technological progress in various industries. It can be said that it is the heart of industry and the lifeline of the national economy. It is an important cornerstone to support the nation’s overall national strength[2]. The "Standardization and Quality Improvement Plan for the Equipment Manufacturing Industry" approved by the State Council requires the docking of "Made in China 2025", the implementation of industrial infrastructure and smart manufacturing to the international advanced level, and also the purpose of encouraging enterprises to enhance their technological innovation through the enhancement of independent innovation capabilities[3]. As the country’s leading industry, the government’s subsidies for the equipment manufacturing industry are reasonable, but can the government subsidies help equipment manufacturing companies to achieve technological innovation and the strength of government subsidies is better?

As an important constructor of the national technological innovation system, the government can create a relaxed environment, provide financial subsidies, and implement property rights protection for the company's innovation behavior, among which the capital subsidies have the most direct impact on the R&D and innovation investment of the company. Government subsidies are beneficial to ease the financial pressure on corporate R&D investment, encourage corporate R&D and innovation activities, and indirectly promote the improvement of corporate innovation capabilities. However, at the same time, government subsidies will also have a crowding effect on the R&D capital investment of the

company. Excessive subsidies may lead to a weakening of R&D input and negatively affect corporate performance. Moreover, because the communication channels between the government and enterprises are not smooth and information is asymmetric, the government's subsidy behavior can easily lead to corporate moral hazard and adverse selection, and it is difficult to achieve the ideal effect of subsidies. Therefore, a reasonable determination of the scope of subsidies for corporate R&D activities is a matter that the government must consider.

II. Literature Review

Domestic and foreign studies on the impact of government subsidies on corporate innovation are not the same. Foreign scholars have divided the following three types of research on government subsidies: First, government subsidies have a substitution effect on corporate R&D investment, that is, government R&D funding will reduce corporate R&D. Inputs, representative studies are mainly Wallsten (2000)[4]; Second, government R&D funding has complementary effects on R&D investment of enterprises, and government R&D funding behavior will have a positive impact on R&D investment of enterprises. Representative studies mainly include Busom (1999)[5], Lee (2003)[6], etc. Third, there is industry difference in the impact of government R&D funding on R&D investment in companies, such as Holger Gorg and Eric Strobl (2007)[7].

Chinese scholars Yu Changhong and Bai Chen (2012) established a game model based on the spillover effect[8]. The analysis results show that when the R&D spillover effect is small, it has a positive promotion effect on R&D investment, but it has an R&D spillover effect. After reaching a certain level, its inhibitory effect on corporate R&D investment will gradually emerge; a certain amount of subsidy income can reduce the marginal effect of spillover effect, thus helping the company to overcome the negative impact of spillover effect and promote the R&D investment of the company. Song Zhijie and Sun Qilong (2012) built a corporate R&D model under R&D subsidies and polluting emissions tax based on game theory, studied the optimal R&D level, optimal R&D subsidies, and optimal pollution emission taxes for companies under emission reduction targets[9]. Liang Xiao (2012) used the empirical data of China's 2004-2008 data to show that government subsidies to a certain extent make up for the externalities of R&D activities, reduce the investment costs of R&D activities, and share the risks of R&D investment. The R&D investment return rate of enterprises has been increased, which has stimulated the R&D input intensity of enterprises to a certain extent[10]. Zhao Kangsheng and Xie Zhiyu (2017) analyzed the boundary conditions of the impact of government R&D subsidies on R&D investment from the perspective of corporate characteristics and environmental characteristics. As a result, it was found that government R&D subsidies have a continuously promoting effect on corporate R&D investment, and the stronger the company's absorptive capacity, the government's R&D The better the promotion effect of subsidies on corporate R&D investment, the higher the level of regional financial development, the more significant the incentive effect of government R&D subsidies on corporate R&D investment[11].

III. Theoretical Analysis and Research Hypothesis

A. *Activities Incentive Effect of Government Subsidies on Corporate Innovation Activities*

At present, the form of government subsidies implemented in China mainly includes fiscal interest discounts, R&D subsidies, and policy subsidies. The main reason for government subsidies is due to the existence of spillover effects of knowledge assets, that is, innovation output itself belongs to public goods, with spillover effects[12]. The R&D output of a company, regardless of its form, may be copied and copied, borrowed, and imitated. Although the spillover effect benefits the entire society, it damages the interests of the enterprise itself. This has led to a reduction in corporate enthusiasm for research and development. And the innovation activity itself is a high-risk activity, and the government subsidies not only compensate the damage of the technology spillover to the enterprise innovation activity to a certain extent, but also reduce the risk of the innovation activity[13]. Therefore, the hypothesis proposed here is as follows:

H1: Government subsidies have a stimulating effect on corporate innovation investment.

B. *The Crowding out Effect of Government Subsidies on Corporate Innovation Activities*

Government subsidies also have a crowding effect on corporate innovation activities. The crowding-out effect of this paper refers to the fact that due to the increase in subsidies and subsidies provided by the government, some of the funds that the company originally intended to invest in corporate innovation activities are squeezed out, that is, the phenomenon of government subsidies causing the reduction of corporate R&D expenditures[14]. Given that relatively mature companies generally have their own R&D strategies and plans, after receiving government subsidies, companies may use government-subsidized funds for other purposes. In order to get more government subsidies, companies may be able to meet "rent-seeking" through high costs, rather than focusing on R&D innovation. Considering the time lag of the government subsidy funds and the use of funds, the hypothesis proposed in this paper is as follows:

H2: The government subsidies in the previous year have a crowding out effect on corporate innovation investment.

IV. Study Sign

A. *Model Construction and Variable Selection*

This paper regards R&D investment as a function of the government subsidies received by the company in the current period and the previous period. According to previous scholars' research experience, the company size, profitability, and asset-liability ratio are selected as control variables to study the government subsidies. The impact of corporate innovation activities, the establishment of panel data multiple regression model is as follows:

$$Inno_{it} = C_0 + \beta_0 Subs_{it} + \beta_1 Subs_{it-1} + \beta_2 Size_{it} + \beta_3 TTM_{it} + \beta_4 DAR_{it} + \varepsilon_{it}$$

Among them, the explanatory variables *Innoit* represents the R&D expenditure of the I enterprise in year *t*, and the explanatory variables $Subs_{it}$ and $Subs_{it-1}$ respectively represent the sum of the year's government subsidies received by the I enterprise in year t and year *t-1*. In order to better study the impact of government subsidies on corporate innovation investment, three factors that are generally considered to be likely to affect the firm's investment in innovation are selected as control variables. Among them, $Size_{it}$ indicates the total value of enterprise assets at the end of year *t* of enterprise *i*, TTM_{it} indicates the profitability of company *i* in year *t*, and DAR_{it} indicates the asset to liability ratio of company i in *t*.

In terms of variable selection, first of all, this paper selects the R&D investment of a company as the representative variable of the company's innovation activities. In addition, the model also includes variables that may affect the innovation input of the company as control variables, including the size of the company, its profitability, and its assets. debt ratio. The profitability of an enterprise is due to the missing data on asset returns for several years. Therefore, this article selects the company's operating gross margin to represent the profitability of the enterprise. The specific design of variables is shown in Table I.

TABLE I. VARIABLE DESCRIPTION.

Variable	Symbol	Definition	Unit
R&D investment	Inno	R&D expenses under management expenses	Ten thousand RMB
The government subsidies	Subs	Government subsidies under the current profit and loss project	Ten thousand RMB
Government subsidies lag one period	Subs（-1）	Automatic software generation	Ten thousand RMB
The enterprise scale	Size	Corporate total assets	Ten thousand RMB
Profitability	TTM	Operating gross margin = (operating income - operating cost) / (operating income)	%
Asset-liability ratio	DAR	Asset-liability ratio = (total liabilities) / (total assets)	%

B. *Sample Selection*

This article selects 2013-2017 listed equipment manufacturing companies as research samples, and the data comes from Guotai'an database. After ensuring the accuracy of the original data of equipment manufacturing industry, this paper conforms to the existing domestic and foreign literature and does the following processing on data. : (1) Delete samples of main business profits, employment numbers, and missing or negative total assets. (2) Enterprises with less than 10 employees are excluded. (3) The sample data was decimated with 2013 as the base period. The final selection was for 20 listed equipment manufacturing companies such as Shanghai Automotive Group Co., Ltd., Huawei Technologies Co., Ltd., and China Aviation Industry Corporation. This article selected software Eviews7.0 to complete the empirical analysis.

V. EMPIRICAL RESULTS AND ANALYSIS

A. *Descriptive Statistics*

It can be seen from Table II that the annual maximum R&D investment of the sample companies is approximately 1.4154 trillion yuan, the minimum value is 19202 million yuan, and the average value is approximately 57,533 million yuan. The maximum amount of government subsidies received by enterprises is 420.26 million yuan, the minimum is 9.28 million yuan, and each enterprise receives an average of 29.92 million yuan in government subsidies each year.

TABLE II. DESCRIPTIVE STATISTICS OF VARIABLES.

	Mean	Maximum	Minimum	Standard Deviation
Inno	57533	140154	19202	146.423
Subs	2992	42026	928	69.231
Size	7127493	72819031	82719	18294.231
TTM	0.259	0.929	-0.559	0.182
DAR	0.462	2.991	0.022	0.234

B. *Regression Results and Analysis*

This paper selects the individual fixed effect model and uses the Panel EGLS method to estimate. This method can better deal with problems such as cross-sectional heteroskedasticity and co-correlation. The estimated results are shown in Table III.

TABLE III. REGRESSION RESULTS.

Variable	Coefficient	Standard Error	T-statistic	P value
C	31.243	1.977	1.234	0.182
Subs	0.083	0.019	5.084	0.000
Subs（-1）	-0.029	0.021	-2.768	0.006
Size	0.327	0.000	16.343	0.000
TTM	5.382	2.618	0.293	0.423
DAR	-8.246	1.717	-1.267	0.293
R^2	0.782			
DW	2.423			

The R^2 of this estimation model is higher, which shows that the model has a better degree of fit and a higher degree of interpretation of the interpreted variables. The coefficient before Subs is positive, and P<0.05, indicating that the current government subsidy is positively related to the R&D investment of the company. For each additional government subsidy of 1 million yuan, the company's R&D expenditure will increase by about 80,000 yuan, indicating that the government subsidy is for the enterprise. The R&D investment still has a certain incentive effect, but the incentive effect is not as strong as originally foreseen. The coefficient of government subsidy lagging before the first period is negative, and P<0.05, indicating that under the condition that the statistical

significance is 5%, the government subsidies of the previous year are negatively related to the research and development investment of the company, and the results are also expected. Among them, government subsidies have always been considered by scholars to have incentive effects and crowding out effects. The regression results of this paper also show that government subsidies have both incentive effect and crowding-out effect on corporate R&D investment. But overall, government subsidies have a positive impact on corporate R&D spending, suggesting that government subsidies have a greater incentive effect on R&D investment than corporate crowding.

VI. CONCLUSION

Through a study of 20 listed companies in the equipment manufacturing industry from 2013 to 2017, it is found that, given the size of the company, its profitability, and asset-liability ratio, the government subsidies received in the current period are positively related to the innovation input of the company, compared with the previous period. The government subsidies received are negatively related to the innovation investment of enterprises, indicating that the government subsidies have limited incentives. Therefore, in the presence of incentives, it is suggested that the government should continue to maintain subsidies for enterprises, but as the results of the study show that incentives are not very strong, this requires the relevant departments to try to increase other ways and means to encourage enterprise innovation to increase subsidies. The impact of the impact, but also set reasonable time for the distribution of subsidies, distribution methods and the amount of subsidies to prevent companies from diverting subsidies for other purposes.

Of course, this study also has some limitations. First of all, the limitations of sample data, due to the small sample size selected and its disclosure of R&D input may not be detailed and incomplete, and the disclosure method is not standardized, so the collected data may have certain defects; secondly, this article only considers The impact of R&D investment in the previous year and government support in the previous year on the intensity of R&D investment in the current year, future research can solve these problems.

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