

Research on Mechanism of Government Subsidy to Promote the Growth of Innovative Investment

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Abstract: Based on the cash holdings of enterprises, this paper studies the growth of innovation investment transmission mechanism of incentive policies and the efficiency of innovation investment, in order to provides a theoretical basis at the micro level for the formulation and adjustment of innovation policies. Taking China's a-share listed companies from 2012 to 2015 as samples, the mediating effect of cash holdings on the relationship between Government subsidies and R&D investment was tested by multiple linear regression. The results show that : (1) Government subsidies help companies to improve R&D investment; (2) Government subsidies make enterprises tend to use the increased cash holdings directly to increase their R&D investment. (3) Cash holding is an intermediary variable between government subsidizes and R&D investment. That is to say, the macro-innovation incentive policies of government subsidizes have the promotion effect on the growth of innovation investment based on the conduction of cash holdings. Finally, some policy suggestions are put forward to promote enterprises to increase innovation investment.

Keywords: Cash holding; Innovation investment; Government subsidizes

1. Introduction

Technological innovation is the decisive factor for sustained economic growth and the fundamental way to fully tap the potential of enterprises and enhance their value, it is the key to enhancing the comprehensive national strength. The 18th national congress of the communist party of China also stressed that scientific and technological innovation is the strategic support for improving social productivity and overall national strength and must be placed at the core of the overall national development. The essence of the governments carry out "innovation-driven development strategy" is increasing investment in innovation and improving its efficiency. However, whether the national innovation subsidy policy can promote the growth of innovation investment through the cash holdings of enterprises, so as to alleviate the constraints of financing restriction, increase the intensity of innovation investment and improve the efficiency of innovation investment of enterprises, this issue that needs to be further studied and explored.

2. Literature Review

Due to the characteristics of innovation investment, such as high risk, high uncertainty, high information asymmetry and inter-period income, the financing constraint and agency problem are serious, which greatly restrict the innovation investment of enterprises. Innovation investment has gradually become the focus of scholars' atten-

tion and research. Previous studies have shown that cash holdings of enterprises have a significant positive effect on innovation investment of enterprises, while financing constraints, corporate governance mechanism and various preferential policies have a significant impact on cash holdings of enterprises, as detailed below.

Government subsidies: domestic and foreign scholars have not reached a unified conclusion on the impact of government subsidies on R&D investment of enterprises. Some scholars believe that government subsidies have a promoting effect on R&D investment of enterprises, while some scholars believe that government subsidies have an crowding out and substitution effect on R&D investment of enterprises. Pottels berghe and Capron (1997) found that enterprises will be more active in R&D activities than other enterprises if they can receive long-term government subsidies. The government provides different forms of financial subsidies to enterprises, and the final promotion effect will be different. Therefore, the government should strengthen and improve the new form of financial subsidies to improve the effectiveness of subsidies. Cheng Hua and Zhao Xiang (2008) pay attention to the relationship between enterprise size, government subsidy intensity and enterprise R&D investment, they found that the government subsidy has a significant promotion effect on the R&D investment of enterprises in the following year, and the government subsidy has a better promotion effect on the R&D investment of larger enterprises. Zhao Kangsheng and Xie Shiyu (2017) in-

investigated the influence of government subsidies on R&D investment of enterprises from different perspectives, such as enterprise scale, absorption capacity and financial development level in the region of enterprise. The results showed that government subsidies have an obvious promoting effect on R&D investment of enterprises.

While studying the incentive effect, some scholars also studied the crowding out effect and substitution effect of government subsidies on the enterprises R&D investment. Lichteberg(1987) believed that government subsidies do not have such a great incentive effect on enterprises' R&D investment, and to some extent, they inhibit enterprises' R&D activities. Heshmati and Loof(2005) using Switzerland data, the study found that government subsidies can only increase investment of small manufacturing and service enterprises, and will replace the R&D investment of enterprises after the increase of government subsidies to a certain extent. Boeing (2014) found that the R&D investment of enterprises is affected by factors such as early investment and number of patents, and the government subsidy will reduce the R&D investment of enterprises, but it will remain neutral in the later stage based on the data of Chinese enterprises. Take 2006 data as an example, each additional Yuan of government subsidy will reduce enterprises' investment in independent research and development by 0.5 Yuan. Gao Hongwei (2011) selected large state-owned enterprises as research samples, analyzed the crowding out effect of government subsidies on R&D investment of enterprises from the perspective of game theory, and made a comparative analysis of the different effects of manufacturing, service and R&D state-owned enterprises. Hao Leidi(2014) selected the three company of new and high industry on government subsidies and the influence of the relationship between R&D spending has carried on the empirical analysis, the result is that the government subsidies has inhibitory effect on high and new technology enterprise R&D input, this is mainly by the research on government subsidies early in foreign countries mainly focused on the need for government intervention.

Cash holdings: Cash holding is a hot and difficult problem in domestic and foreign research. Hall et al.(1993) discussed the influence of cash flow on R&D investment under three different institutional backgrounds based on the data of technology companies in the United States, Japan and France, and found that cash flow had a greater impact on R&D investment in American companies. Carter Bloch(2003) found in his investigation and research on Danish companies that the financial situation restricts the R&D investment of enterprises. Opler et al. (1999) studied the cash holding behaviors of listed companies in the United States for 23 consecutive years since 1971, and believed that the greater the cash holding, the greater the R&D intensity and the positive relationship

existed between them. Schroth and Szalay (2007) believe that cash preparation in advance is the first step for enterprises to participate in technological innovation competition, which can not only ensure the continuous capital input to a certain extent, but also get ahead of the competition. Bates, Kahle and Stulz (BKS, 2009) discussed the recent surge of cash holdings of American industrial enterprises and believed that the increase of R&D investment was one of the main explanations for the increase of cash holdings. Brown and Petersen (2011) showed that there is a situation in the real society where cash reserves are used to keep R&D expenses within a certain range by investigating American companies.

3. Theoretical Analysis and Hypothesis Proposal

Economic theory holds that scientific and technological activities, especially enterprise R&D activities, have the nature of public products. Therefore, the private rate of return on R&D activities is lower than the social. As a result, resource investment in R&D activities for the production of technical knowledge or information will be insufficient, which is lower than the optimal level of investment needed by the society, resulting in "market Failure" (Arrow, 1962) in the supply of R&D activities (Arrow, 1962). Due to the existence of market failure, some appropriate forms of government intervention are needed to prevent or reduce "market failure". On the other hand, R&D activities have spillover effects. There are free hitchhikers who imitate and learn in the market. Their personal benefits are lower than social benefits, while their personal costs are higher than social costs.

Government subsidy, as an external source of funding for R&D investment, is a project of cash inflow from the perspective of accounting treatment, which increases the cash holdings of enterprises under the same circumstances. Government subsidies can be explained in the following aspects: government subsidies directly allocate funds to enterprises for R&D, reducing the cost of R&D activities and providing financial support for the expansion of investment scale. For enterprises that invest less in R&D, the sunk costs of R&D projects can be reduced by purchasing fixed assets with government subsidies. If the R&D investment level of the enterprise remains unchanged, reducing its cost is equivalent to increasing the revenue of R&D activities, so that the enterprise has excess funds to continue the continuous development of innovative projects. In the initial stage of research and development, financial allocation, government subsidies and government incentives such as setting up special technology investment funds can effectively help enterprises raise research and development funds and guide the inflow of social capital. Therefore, both from the perspective of reducing difficulties in R&D financing and making up for the uncertainty of innovation activities,

and from the perspective of compensating for the risk sharing mechanism of enterprise losses, government subsidies play a role in encouraging enterprises to carry out R&D innovation both before and after the event.

Government subsidies reduce the R&D costs of enterprises through direct financial support. When the R&D costs are reduced, enterprises have greater incentives to carry out R&D activities. Therefore, the research and development investment of enterprises increases with the increase of government subsidies, it's showing a positive correlation. From the perspective of capital efficiency, government subsidies can increase the cash holdings of enterprises in a certain period of time, and more available funds will bring greater benefits to enterprises. At the same time, government subsidies can make up for the R&D risks of enterprises to a certain extent, so that enterprises can reduce the possibility of losses caused by R&D failures, thus enhancing the willingness of enterprises to carry out R&D activities. From the perspective of externality, government subsidy funds increase the funds that can be used for R&D investment by enterprises, so that enterprises can have more funds to increase R&D personnel and purchase R&D equipment, thus improving the R&D level of enterprises, driving the R&D atmosphere of the whole industry, and ultimately benefiting the whole industry and society. Bai Yukun (2012) from two aspects social and business performance measure efficiency of subsidies policy support, select new energy in China listed companies as research samples, the study found that government subsidy can increase the corporate cash holdings bring certain advantages, but the profitability of the enterprise have no obvious role in promoting.

Based on the above analysis, the relationship between government subsidies, cash holdings and R&D investment can be inferred as follows: Companies to receive government subsidies funds, enterprises will have more cash to be used to make strategic investment, the increase enterprise's R&D, to enhance enterprise's innovation ability and sustainable development ability, the enhancement enterprise's future development ability and competition ability, growth ability, eventually get enterprise of high yield and investors higher expectations of future development, so as to improve the market value of enterprises; On the contrary, when there is no government subsidy fund income, the enterprise may be insufficient in cash flow. The enterprise will maintain more free cash flow to repay debts or distribute dividends, so as to improve enterprise performance and obtain short-term remuneration. That is to say, the influence of government subsidies on R&D investment can be partially or completely transmitted through cash holdings of intermediary variables (as shown in figure 1 below).

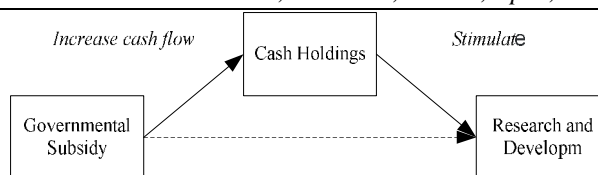


Figure 1. The moderating effect diagram of government subsidies on the relationship between cash holdings and R&D investment

Combined with the above analysis, when the government provides subsidies, the constraints on R&D financing of enterprises are eased. Cash holdings of enterprises will increase with the availability of government subsidies, and R&D investment will also increase with the increase of government subsidies. Therefore, based on the above theoretical analysis and the definition of mediating variables, this paper proposes the following hypotheses:

Hypothesis 1a: Government subsidies are positively correlated with R&D investment.

Hypothesis 2a: The government subsidies and cash holdings are related.

Hypothesis 3a: Cash holdings is the relationship between government subsidies and R&D intermediary variable.

4. The Choice of Variable Measurement and Research Model

4.1. The choice of variable measurement

4.1.1. Main variables selection and measurement

Additional innovation investment $\Delta R\&D$: the dependent variable is a supplementary innovation $\Delta R\&D$. Innovation investment in R&D reflects the enterprise's innovation activity and the innovation ability, $\Delta R\&D$ used to reflect the increase in current enterprise for R&D investment (superaddition), in order to avoid no R&D investment enterprise is invalid, in the measurement, the natural logarithm of the increase of enterprise R&D investment using the current period ($\Delta R\&D + 1$) is taken for standardization.

Cash holdings(CASH): In this paper, Cash holdings are measured by the sum of monetary assets and transactional financial assets in the balance sheet, and the natural logarithm is taken for standardization.

Government Subsidy (GOVS) : It means that an enterprise obtains monetary assets or non-monetary assets free of charge from the government, but does not include the capital invested by the government as the owner of the enterprise.

4.1.2. All indexes used in this research model and their connotation interpretation

All indexes used in this research model and their connotation interpretation are shown in Table 1.

Table 1. Variables used in the Model and Variable Interpretation

Variable		Variable definition
ΔR&D	=	Additional innovation investment, ΔR&D used to reflect the increase in current enterprise for R&D investment, in order to avoid no R&D investment enterprise is invalid, in the measurement, the natural logarithm of the increase of enterprise R&D investment using the current period (ΔR&D +1) is taken for standardization.
CASH	=	Cash holdings are measured by the natural logarithm of the sum of monetary assets and transactional financial assets in the balance sheet.
GOVS	=	The natural logarithm of the total amount of government subsidies was used for standardization.
SIZE	=	The size of the company, take the natural logarithm of the total assets.
CFO	=	The net cash flow of operating, represented by the ratio of the free cash flow of the enterprise in the current year to the total assets.
ROA	=	Return on assets.
GROW	=	The growth of an enterprise is indicated by the growth rate of main business income.
TBQ	=	TowbinQ, the calculation method of this paper is (annual stock market value + total liabilities)/ total assets.
LEV	=	Financial leverage, expressed as the asset-liability ratio.
FH	=	Share proportion of the largest shareholder.
AGE	=	The age from the establishment of the company to the sample year.
ε	=	Error term

4.2. Research model construction

Referring to previous studies, and based on the design of this study and the added variables, the following regression models are given to verify the above assumptions respectively:

$$\Delta R\&D_{it} = a_0 + a_1 GOVS_{it} + a_2 SIZE_{it} + a_3 LEV_{it} + a_4 CFO_{it} + a_5 FH_{it} + a_6 TBQ_{it} + a_7 GROW_{it} + a_8 ROA_{it} + a_9 AGE_{it} + \epsilon$$

(model 1a)

$$CASH_{it} = b_0 + b_1 GOVS_{it} + b_2 SIZE_{it} + b_3 LEV_{it} + b_4 CFO_{it} + b_5 FH_{it} + b_6 TBQ_{it} + b_7 GROW_{it} + b_8 ROA_{it} + b_9 AGE_{it} + \epsilon$$

(model 2a)

$$\Delta R\&D_{it} = c_0 + c_1 GOVS_{it} + c_2 CASH_{it} + c_3 SIZE_{it} + c_4 LEV_{it} + c_5 CFO_{it} + c_6 FH_{it} + c_7 TBQ_{it} + c_8 GROW_{it} + c_9 ROA_{it} + c_{10} AGE_{it} + \epsilon$$

(model 3a)

Model (1a) will be used to test the impact of government subsidies on R&D investment; Model (2a) will be used to test the effect of government subsidies on free cash flow; Model (3a) will be used to test the mediating effect of cash holdings on the relationship between government subsidies and R&D investment, according to the theory of intermediary effect, if the coefficient of the three models a1, b1, c1 and c2, were significantly, Cash holdings(CASH) is intervening variable between the government subsidies(GOVS) and additional quantity (ΔR&D).

5. Sample Selection and Data

5.1. Sample selection and data sources

In this paper, a-share listed companies in Shanghai and Shenzhen from 2012 to 2015 were selected as the overall sample, and the annual data of all is 10512 companies were initially obtained from the CSMAR database. On this basis, according to the following standards to do the

elimination :(1) wipe off unless the a-share listed company; (2) remove companies of finance, education and press and publishing; (3) remove the companies with negative asset-liability ratio and greater than 1; (4) remove the company with negative earnings before interest and tax; (5) the company with zero or negative income tax expense removed; (6) excluding the companies with incomplete data and extreme values, the research samples of Shenzhen and Shanghai a-shares composed of 4211 annual company observations were finally obtained.

The R&D investment data, cash holdings, corporate governance and other financial data in the sample were drawn from the CSMAR database. The government subsidy data are obtained by manually consulting from the annual reports of Shenzhen and Shanghai from 2012 to 2015. The annual report data are from Juchao information network. The government subsidy data are collected manually from the notes to the financial statements of listed companies (notes to the consolidated financial statements— cash flow statement items).

5.2. Descriptive statistics

The descriptive statistical results of each variable in the sample are shown in table 2. As can be seen from table 2, (1) Cash holdings are 26.1056 at the highest, 12.4705 at the lowest, and 20.4371 at the average. (2) The maximum of Δ R&D is 23, the minimum value of 0, the gap between enterprise and the enterprise is bigger. (3)The shareholding ratio of the largest shareholder in China ranges from 0.29% at the lowest level to 92.26% at the highest level, with an average value of 36.75%, indicating that the overall shareholding ratio of the largest shareholder in China's listed companies is quite different.

Table 2. Descriptive statistics of the whole sample deviation of the maximum

Variable	N	Min	Max	Mean	Standard
ΔR&D	4211	0	23.0000	3.6400	7.0640

GOVS	4211	0	22.0000	2.1300	5.7080
CASH	4211	12.4705	26.1056	20.4371	1.4798
FH	4211	0.2900	92.2600	36.7509	16.0426
CFO	4211	-0.7418	0.8759	0.0511	0.0789
TBQ	4211	0.2009	102.4296	2.4287	3.3001
SIZE	4211	17.7569	28.5087	22.4867	1.3806
LEV	4211	0.0282	0.9865	0.4950	0.1982
GROW	4211	-25.3690	4500.0156	4.4855	97.8009
ROA	4211	-0.0535	10.4009	0.0488	0.2105
AGE	4211	8.0000	40.0000	22.1100	4.5280

6. Empirical Results and Analysis

In order to further analyze the influence mechanism of government subsidies on R&D investment, the hypothesis was tested by the multiple regression model proposed previously. The results are shown in table 4-9:

Table 3 shows the regression results of models 1a, 2a and 3a, the regression results of the intermediary effect of cash holdings on the relationship between government investment and R&D investment.

According to the regression results of model (1a), there is a significant positive correlation between government subsidies and the increase of R&D investment in the current period, indicating that more government subsidies are conducive to enterprises' R&D investment, which verifies hypothesis 1a. This shows that government subsidies can indeed boost R&D investment. In the regression results of model (2a), there is a significant positive correlation between government subsidies and cash holdings, indicating that government subsidies significantly increase the cash held by enterprises. Since R&D innovation investment requires enterprises to have sufficient cash, the availability of government subsidy funds is

bound to promote enterprises to use more cash held for R&D investment, which verifies hypothesis 2a. Model (3a) adds control variable CASH on the basis of model (1a). At this point, both government subsidies and cash holdings are significantly positively correlated with the increase of R&D at the same time at the level of 0.01. So let's say hypothesis 3a is verified. It shows that cash holding is an intermediate variable between government subsidy and R&D investment, that is, enterprises receiving government subsidy tend to increase cash holding, so as to increase R&D innovation investment of enterprises.

This reflects that government subsidies have a significant impact on listed companies' R&D investment. First, government subsidies directly or indirectly increase the funds of enterprises and alleviate the negative impact of insufficient capital turnover caused by enterprises' investment in innovative projects. Secondly, government subsidies to a certain extent compensate for the costs and revenue risks brought by external R&D of enterprises, thus playing a role in promoting enterprises to carry out R&D innovation activities.

Table 3. Regression results of the mediating effect of cash holdings on the relationship between government subsidies and R&D investment

Dependent Variable	Model (1a) ΔR&D	Model (2a) CASH	Model (3a) ΔR&D
Constant	0.34(0.201)	-0.651***(-2.715)	0.551(0.325)
GOVS	0.796***(54.509)	0.011***(5.309)	0.792***(54.136)
CASH			0.323***(-2.963)
SIZE	0.155**(2.098)	0.962***(91.914)	-0.155(-1.212)
LEV	0.442(0.967)	-0.686***(-10.595)	0.664(1.435)
CFO	-3.768***(-3.527)	0.68***(-4.497)	-3.986***(-3.725)
TAQ	0.031(1.157)	0.021***(-5.477)	0.025(0.904)
FH	-0.011**(-2.005)	-0.002***(-2.636)	-0.011*(-1.889)
GROW	0.0000(-0.365)	0.0000(0.53)	0.0000(-0.39)
ROA	-0.383(-0.973)	0.118**(2.125)	-0.421(-1.071)
AGE	-0.07***(-3.607)	-0.01***(-3.819)	-0.066***(-3.431)
F	347.127***	1315.74***	313.87***
Adj R2	0.425	0.738	0.426
N	4211	4211	4211

Note: **, ** and * mean significant at 1%, 5% and 10% respectively.

7. Research Conclusions and Implications

This paper examines the mediating effect of cash holdings on the relationship between government subsidies and R&D investment by taking the a-share listed companies in China from 2012 to 2015 as samples. The results

show that: (1) Government subsidies help companies to improve R&D investment; (2) Government subsidies make enterprises tend to use the increased cash holdings directly to increase their R&D investment. (3) Cash holding is an intermediary variable between government subsidies and R&D investment. That is to say, the macro-

innovation incentive policies of government subsidizes have the promotion effect on the growth of innovation investment based on the conduction of cash holdings. Based on the above research conclusions, the following Suggestions are proposed: If want companies to focus on R&D and increase investment in R&D, Should try to give government subsidies to enterprises. Supply as much capital as possible to enterprises and increase their investment in research and development, so as to achieve the long-term benign development of innovation in China.

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