

## A Review about the Effects of Government Policies on R&D Investment in Firms

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**Abstract.** This paper deals with the literature on the effects of government policies on firm R&D investment, and the government policies are divided into two categories: government subsidy policy and government tax incentive policy. In terms of government subsidy policy, scholars remains incentive effect and crowding out effect, these are two different points of view. And on the tax incentive policy, although scholars generally agree with incentive effect, but still find that scholars need to investigate the issue of incentive intensity. In addition, this article analyzes and reviews the literature from scale, ownership, industry, region these four firm heterogeneity factors, and find that most of the scholars just analyze a certain firm heterogeneity factor and few literature synthesize the heterogeneous factors, this also requires further research.

### Introduction

Scientific and technological progress plays an increasingly important role, and as the subject of technological innovation, research and development (hereinafter referred to R&D) is the core of scientific and technological progress in firms, which is beneficial to improve the core competitiveness of firms as well as promote the growth of firms. Therefore, increasing the expenditure of R&D investment plays an important role in firm scientific and technological innovation. It is shown that market failure, information asymmetry and adverse selection still exist, so firms face different degrees of financing constraints, which is not good for the R&D investment. In addition, R&D is a kind of public goods which social rate of return is greater than private rate of return. Moreover, due to the technology spillover, knowledge spillover and non-exclusivity of income, R&D investments also have problems with market failures and under-investment. Therefore, it's necessary for government to fund R&D investment.

There are two different government policies, the first is *the government subsidy policy*, the second is *the government tax incentive policy*.

Foreign scholars first analyze government policies, Blank and Stigle (1958) first discussed the relationship between government funding and R&D investment. They found that government subsidy policy can promote R&D investment of large-scale firms<sup>1</sup>. Since then, more scholars abroad studied this problem, Levy et al. (1983), Falk (2004), Almus and Czarnitzki (2001) came to the same conclusion<sup>2</sup>.

In terms of tax incentive policy, Hall (1999) from OECD countries' tax incentives, found that the \$1 R&D tax intensive can effectively motivate \$1 extra R&D investment. Parisi and Sembenelli (2003), Russo (2004), Falk (2004), Mohnen and Lokshin (2009) came to the same conclusion.

Therefore, can these policies really promote firm R&D? Domestic and foreign scholars have different views, the views are divided into "*incentive effect*" and "*crowding out effect*", so this paper attempts to review the domestic and foreign literature that related firm R&D investment and government policies' effects and to explore the different effects of government policies under *firm heterogeneity*. Based on these considerations, the rest of this paper is arranged as follows. The second part discusses incentive effect and crowding out effect between government policies and R&D investment. The third part discusses the effect of government subsidy policy on R&D investment

under the firm heterogeneity. The fourth part discusses the effect of government tax incentive policy on R&D investment under the firm heterogeneity. The fifth part is the summary and prospect.

## **Incentive Effect and Crowding out Effect between Government Policies and R&D Investment**

### **Incentive Effect**

*Incentive effect* refers to government policies will promote firm R&D investment, expand firm R&D intensity, alleviate the degree of firms' financing constraints, and encourage R&D investment in firms which faced with financing constraints. Scholars who support the incentive effect believe that government policies will promote R&D investment from the following three transmission routes:

First, government policies→reduce R&D costs→promote firm R&D investment. Government support reduces the unit cost and anticipate cost of R&D, increases the expected profitability of R&D project, which can purchase R&D equipment and pay R&D staff wages. It inspires creativity and promotes R&D investment of firms. Dimos and Pugh (2016) evaluated the effectiveness of the R&D subsidy in private R&D by adopting multiple regression analysis (MRA). They argued that government policy tools (such as government subsidy, low-interest loans) can reduce the cost of R&D, promote innovation and make R&D investment achieves additional effects<sup>3</sup>.

Second, government policies→ease firm financing constraints→promote firm R&D investment. Policies reduce the degree of information asymmetry for external investors, relieve the pressure on firms' financing constraints and improve the R&D scale and efficiency. Carboni (2017) analyzed 12024 manufacturing firms based on seven European countries by using propensity score matching (PSM) to compare the different effect on R&D and investment of subsidized firms with non-subsidized firms. He found that government subsidy has a positive impact for investment and R&D, and studied subsidy can help a firm to obtain long-term debt financing. Government subsidy can help those firms which have medium or long term financial debt and help them ease financing constraints.

Third, government policies→reduce firm risk→promote firm R&D investment. Government support for firms plays a "lightening" effect which reduce the business risk of R&D project, because those firms generally have good reputation, have the ability to conduct R&D but lack of R&D fund, government can help firms carry out R&D project, show the ability of R&D and help firms to attract more funds from other investors.

### **Crowding out Effect**

*Crowding out effect* refers to government policies will reduce firm R&D investment. Scholars who support the crowding out effect believe that government policies will crowding out R&D investment from the following three transmission routes:

First, government policies→increase the demand of R&D factors→increase the price of R&D factors→crowding out firm R&D investment. Some scholars believe that government policies will increase demand of R&D factors, so that the price and cost of R&D factors rising and the profit decreasing, thus may crowding out R&D investment and even distort the market allocation of resources. Goolsbee (1998), David et al. (2000), Zheng (2009) have confirmed this issue, they all think that firms will use the funds to increase R&D staff wages and other R&D projects, this increase the price level of R&D project without increasing R&D creativity<sup>4</sup>.

Second, government policies→policies exist bias→crowding out part of firm R&D investment. When government is making policy, they often have their own bias that only specific scopes can be supported, it makes many firms will invest in those specific scopes, because the marginal opportunity cost of government policies to firms is zero when they ignore the money they have to apply for and thus crowd out firms' R&D investment. In addition, government policies are likely to fund firms with high rate of R&D, because these firms have relatively strong R&D technology and capital, after they receive government funding, these firms may toward their own R&D capital to other projects which

crowding out their R&D investment project<sup>5</sup>. Firms will invest these projects without government support, so it didn't cause the overall level of R&D expenditure to go up, and it cause repression to firms' innovation and development.

Third, government policies→rent seeking exists→crowding out part of firm R&D investment. The existence of rent seeking makes government may support monopoly firms and makes power collusion between some firms and local officials, such government policies will hinder R&D projects and innovation, cause the distortion of resources allocation and crowd out government funds which should have worked better.

### **The Relationship between Incentive Effect and Crowding out Effect**

Since the 21st century, domestic and foreign scholars have studied the relationship between incentive effect and crowding out effect, these scholars generally agree that the government policies for firms' R&D investment have both effect, such as Guellec and Potterie (2003)<sup>6</sup>, Zhu and Xu (2003), Liu et al. (2012), Wu et al. (2016), Zhang and Sun (2018), etc. They all believe that the relationship between the amount of government funds amount and firms R&D investment presents a “inverted U curve”, this means that at the beginning of the government support, with the expansion of government support to R&D investment, it has incentive effect, but it's not permanent. At a certain point, the effect is maximum. When government continues to increase the subsidy amounts, it will crowd out the firms' R&D investment funds which will inhibit their R&D investment. Zhang and Sun (2018) based on the present situation of China, said China is located in the left half of "inverted U curve", so expand funding amounts can increase firms' R&D investment.

### **The Effect of Government Subsidy Policy on R&D Investment under the Firm Heterogeneity**

First of all, when analyzing the effect between government subsidy with firms R&D investment, scholars find that different sizes of firms have different effects. Larger firms face smaller degree of financing constraints, and smaller firms face larger degree of financing constraints, but scholars haven't reach a consensus between government subsidy policy and the sizes of firms, there are mainly two points as following:

Point 1: government subsidy is heavily crowded out smaller firms' R&D investment. Larger firms can take advantage of economies of scale, more professional internal labor division, wider range of internal and external network and stronger ability to absorb the spillover effect, so larger firms are more likely to get subsidy and government subsidy is easy to incentive larger firms' R&D investment which cause crowding out effect to smaller firms. Bai (2011), and Poti (2012) have confirmed this view.

Point 2: government subsidy is heavily crowded out larger firms' R&D investment. Larger firms are more easily access financial funds from banks and other financial institutions, in this case, if government subsidies them, it will crowd out their own capital or external finance which leads to crowding out effect. As for smaller firms, their internal capital is limited and facing larger degree of financing constraints, these firms are difficult to access R&D funds from financial institutions, so subsidy policy can alleviate the external financing environment of smaller firms' R&D capital shortage which leads to incentive effects. Lach (2002) used the data of Israel larger and smaller manufacturing firms, Zhao and Gu (2018) used Chinese manufacturing listed firms and they all think that there is no crowding out effect for smaller firms, and it can effectively promote smaller firms to increase R&D investment. So government subsidy is heavily crowded out larger firms' R&D investment.

Second, firms of different ownership facing different effects of government subsidy policy. Some scholars believe that government subsidy will partially crowd out firms' R&D investment. Larger state-owned firms generally have a special connection with government, so they can get more government subsidy. In addition, they have more collateral to finance, so financing constraints are relatively low in these firms. However, too much subsidies will crowd out the overall size of their

R&D investment so government subsidy policy may crowd out the R&D investment of them. Liu et al. (2012), Zhang et al. (2014), Zhao and Gu (2018) proved that the effect on private firms is stronger and effectively incentives R&D investment, and the effect has failed to facilitate state-owned firms' R&D investment, even creating a certain crowding out effect. To sum up, it can be concluded that the government subsidy policy has a certain crowding out effect on the R&D investment in state-owned firms, and a certain incentive effect on private firms and other non-state-owned firms.

Third, the effect is different in eastern, central and western China, and eastern is higher than central and western China in the term of R&D efficiency. Xiao et al. (2013) used provincial panel data of China in 1997-2009, they illustrated that the policy can promote R&D investment in eastern but has a crowding out effect in central and western. Li et al. (2015) analyzed eastern, central and western China too, they found out the R&D level along with eastern, central and western China presents "hierarchical distribution". The crowding level is higher in the west and lower in the east. To sum up, there are few studies on the influencing factors in terms of region and still differences in research methods and objects.

Fourth, the degree of labor intensity, technology intensity and competition in different industries will also affect the effect.

On the one hand, Scholars have different views in high technology intensity industries: Some scholars believe that government subsidy has a significant incentive effect for those industries' R&D investment and enhances their core competitiveness. On the contrary, for low technology intensive industries which do not need too much government funds to make R&D profitable, thus subsidy crowd out of their R&D investment in some ways, David et al. (2000), Blanes et al. (2003), as well as Cheng and Zhao (2008) confirmed this view. However, some scholars hold the opposite attitude. They believe that the government subsidy policy will crowd out the R&D investment in industries with high technology intensity. Wu et al. (2016) analyzed and proved this viewpoint from 278 listed firms in Chinese strategic emerging industries from 2010-2013.

On the other hand, scholars think that high competitive degree industries will use subsidies better, because there have many firms and a relatively good R&D environment In competitive industries, so firms are willing to increase their R&D investment to enhance competitiveness. This is good for the development of R&D project. On the contrary, in low competitive degree industries, the number of these firms is small and they are usually monopoly, they have sufficient funds for R&D activities. When government subsidizes these firms, they will put money into some R&D activities that they will invest even without government funds, which crowding out the firms' R&D. Scholars such as Takalo and Tanayama (2010), Lee (2011) and Liao et al. (2013) have confirmed this view.

### **The Effect of Government Tax Incentive Policy on R&D Investment under the Firm Heterogeneity**

First of all, in terms of firms' size, scholars generally agree that government tax incentives have a stronger incentive effect on larger firms. Zhou and Zhang (2015) divided the size of high-tech firms in Guangdong province. They believed that tax incentives have a greater impact on the innovation performance of larger firms. Feng et al. (2015) used the panel data of 28 Chinese manufacturing industries in large and middle size firms and found that tax incentive policy are more likely to incentive larger firms.

Secondly, in terms of firms' ownership, scholars have different views. Some scholars believe that incentive effect is more effective for domestic firms. Wang (2009) analyzed foreign and domestic firms in Chinese manufacturing industries and found that tax incentive policy is only effective for domestic firms but may not increase R&D investment in foreign firms. In addition, he also proved that larger domestic firms are more able to motivate its R&D investment. On the contrary, some scholars believe that the R&D incentive effect is less effective for domestic firms. Jiang (2011) analyzed domestic and foreign firms in 2005 and found that tax incentive policy can promote R&D investment in foreign firms and has a relatively small effect on domestic firms' R&D investment.

Thirdly, in terms of firms' industry, scholars believe that tax incentive policy can promote R&D investment of high technology industries but has no effect in low technology industries. Wang (2009) argued that policy will improve R&D investment in high technology industries but will not improve the low technology industries' R&D investment. Zhang and Gao (2012) believed that the policy can improve the internal structure and technological progress in high-tech industries. Feng et al. (2015) proved that more knowledge intensive industries are more able to access the tax incentive policy.

## **Summary**

From the existing literature, scholars have different views on the relationship between R&D investment and government subsidy policy and have a consistent views on the relationship between R&D investment and tax incentive policy, it can be seen that tax incentive policy can promote R&D investment in many aspects. However, it remains to be further studied whether there is incentive effect or crowding out effect on R&D investment under subsidy policy, and to what extent there is incentive effect or crowding out effect. And on tax incentive policy, although scholars generally accept policy can promote the R&D investment but still have different views on firms' ownership. Existing literature mainly analyze size, industry, ownership and region these four heterogeneity, but most literature analyze from a single microscopic factor and less literature combine these heterogeneity factors. In addition, there are less literature compare these two policies so further research is needed on which policy is more effective to firms.

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And the project is: Research on the financing model design of technological medium-sized and small-sized firms from the perspective of firm "growth chain finance"—take Shaanxi province as an example.

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