



# The signal effect of Government R&D Subsidies in China: Does ownership matter?



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## ABSTRACT

R&D subsidies as a policy instrument are used to reduce market failure, apart from its input and output additionality, the notion of behavioural additionality has caused increasingly interest. We focus on the signal/certification effect of behavioural additionality, which means that government grants may serve as a signal for private investors. The signal effect is a certification enhancing a firm's access to external finance. The objective is to examine the impact of different ownership nature to the signal/certification effect. We use data on Chinese listed corporations from 2009 to 2013. The results show that receiving R&D subsidies increases the likelihood that firms will raise external finance, and the state-owned enterprises can receive more subsidies than private enterprises. However, the signal effect of R&D grants is stronger in private enterprises than that in state-owned enterprises of China, indicating that the ownership nature does matter in the R&D subsidies certification effect. This paper enriches current literature of government R&D subsidies by providing empirical evidences in Chinese mixed market.

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## 1. Introduction

Government subsidies for R&D are intended to alleviate market failures in R&D activities, which may be caused by spillovers of ideas to competitors or a low appropriability rate (Kleer, 2010). In recent years Chinese government has paid more and more attention to scientific and technological activities and the expenditures on them continue to increase. According to "China Science and Technology Statistics Yearbook 2013", intramural expenditure on R&D has increased from 154.0 to 1331.2 billion yuan (RMB) from 2003 to 2014, of which the government funds increased from 46.1 to 319.5 billion yuan. Why does the government increase R&D subsidy significantly? Can the subsidy policy affect the R&D activities of enterprises?

Generally speaking, the R&D subsidies from government have positive effects to innovative enterprises' activities, for example, alleviating their tendency to underinvestment in R&D activities (Meuleman and Maeseneire, 2012). However, another effect of R&D subsidies, the signal effect or certification effect has not attracted enough attention. The signal/certification effect means that the government can certify that the granted enterprises are valuable to investment to private financiers by subsidies, thus government grants may serve as a signal for nice

investments to private investors (Meuleman and Maeseneire, 2012). In this paper, we examine this effect empirically, that is, whether government subsidies to R&D increase external R&D investments, improving enterprises' access to external finance in general in Chinese context, and whether the effect is different in different ownership structure, such as state-owned and private enterprises.

From the perspective of additionality, most of the literatures on R&D subsidies are primarily concerned with whether a government grant has positive effects on input (e.g., increase in R&D efforts) and/or output additionality (e.g., increase in growth/employment/number of patents). Our analysis evaluates another additionality effect, i.e. behavioural additionality, it means that obtaining a grant may induce changes in the enterprise's behavior. From a systemic view on innovation processes, innovations are created within a complex web of interactions between different actors of the innovation system (Fischer, 2001). So more general, the behavioural additionality may also change the behavior of other actors towards the enterprises, for example, it may change the behavior of banks towards the enterprise (Meuleman and Maeseneire, 2012). The signal/certification effect, as a kind of behavioural additionality, means that government officials may certify firms worth investing by granting subsidies. Given the uncertainty, receiving a subsidy might act as an observable indicator of the unobservable

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applicant's quality (Hauessler et al., 2012). Consequently, R&D subsidies weaken the information asymmetries, beneficial for external financing.

As for ownership, actually, public firms are present in several industries such as banking and insurance, gasoline distribution, radio, television, automobile and steel, health-care and energy (Anderson et al., 1997). And there are a great many public firms in China, because of the special market situation of Chinese transition economy, state-owned and private enterprises have coexisted in the market for a long time, which is also known as the mixed market. Chinese economic transition from centralized to open makes it a particularly interesting context to examine the links between ownership and government R&D subsidies effects. State-owned enterprises (SOEs) are directly controlled by the government, as the controlling owner of shares, will the government grant more R&D subsidies to SOEs than to private enterprises? Moreover, are there some differences about the signal/certification effect of government R&D subsidies between the state-owned and private enterprises?

We address those questions based on the case of Chinese listed corporations. Xu and Xu (2013) consider that the government R&D subsidy is even more important for firms in emerging economies, such as China. And the study of R&D activities in mixed markets is becoming increasingly popular from a theoretical perspective (e.g. Poyago-Theotoky, 1998; Ishibashi and Matsumura, 2006; Cato, 2011). However, most of the literatures about the roles of R&D subsidies in mixed markets are based on game model, for example, Gil-Moltó et al. (2011) propose a model to examine the use of subsidies to R&D in a mixed and a private duopoly market, and they take social welfare maximization as the goal of SOEs, which is not accord with the reality of Chinese SOEs. In fact, Chinese SOEs are not to maximize the welfare of society as the goal, but pursuit more objects. It is well known that the chairmen of the SOEs are appointed by Chinese government so they also may seek the politicians' personal goals, such as solving the problem of employment to win the election etc. Above all, SOEs are researched in the context of China as a peculiarity of the state-managed economy (e.g., Yusuf et al., 2006; Guan et al., 2009; Chan and Daim, 2011). In addition, the differences between SOEs and private enterprises is not only reflected in different objective functions, these two kinds of enterprises are different in investment behaviors, R&D efficiency, communication mode and frequency with the government, these differences can also influence R&D subsidy effect to themselves. Thus it is valuable to test the R&D subsidies effects in Chinese mixed market, which can extend the R&D subsidy research scope.

Even though much attention has been given to the input and output additionality, the effect of R&D grants on firms' ability to raise external financing has attracted virtually no scrutiny, especially to different ownership nature. In this paper, we examine whether obtaining an R&D grant facilitates state-owned and private enterprises' subsequent access to external financing as a consequence of the signal/certification effect. Our work also adds to the subsidy policy literature since we examine the impact of receiving an R&D grant on external investment of both state-owned and private enterprises.

Especially, to the best of our knowledge, no previous study has investigated the effect of obtaining R&D subsidies on the enterprises' access to debt financing. Esty and Megginson (2003) argue that debt markets have supplied a much larger proportion of external finance than equity markets. Similarly, Qian and Strahan (2007) also point out that banks are the main external funding providers in most countries. China also has a bank-centered capital market with many state-owned and private enterprises in transition economy, so exploring whether the subsidies can induce more investments from banks or not, comparing the induced investment amount to state-owned and private enterprises in Chinese context, can deliver important insights into impacts of public R&D support in Chinese SOEs and private firms, also enlightening other transition economies.

The remainder of the paper is structured as follows. In the next section, a brief literature review is provided and the research hypotheses are developed. A description of the method and sample used are then presented. Next, the empirical results are described and the impact of the

R&D subsidy is analyzed. Last, the findings and limitations are discussed and some interesting topics for further research are pointed out.

## 2. Literature review and hypotheses development

After a long time attention to the relationship between government R&D subsidies and enterprise R&D activities, gradually in recent years scholars have focused on another role of R&D subsidies, which serve as a signal for good investments to outside investors, and it is proved that the government R&D subsidy can provide the choice standards for R&D projects to external investors, promoting enterprises with subsidies to attract more external investments. Narayanan et al. (2000) argue that actions related to governmental agencies, like approving new products, granting patents or awarding subsidies, may serve as an information signal to other investors. Takalo and Tanayama (2010) provide a theoretical model in which public R&D subsidies may yield a positive signal to market-based financiers. Empirically, based on 1435 small business innovation research (SBIR) awardees from 1983 to 1985, Lerner (1999) finds that R&D grants provide a positive signal about enterprise quality and technological merits of the firms' projects, thereby alleviating capital market imperfections that facilitates attracting venture capital. He attributes capital market imperfections, specifically the difficulty to raise capital for uncertain R&D projects due to information asymmetries as a source of difference in performance.

The asymmetric information between firms and investors is usually considered as an important reason for preventing enterprise to attract external investment, and R&D intensive companies are particularly vulnerable to distress because the R&D activities involve many technical details and secrets. The activities need participants not only have professional knowledge, but full participation in the process of research, at this circumstances the R&D information is mainly predominated by the enterprises. Instead, due to the limited professional knowledge, outside investors are difficult to evaluate the advantages and disadvantages as well as the expected return of R&D projects, so it is difficult for them to support the R&D projects financially. Hall (2002) reviews the possible underinvestment in R&D caused by capital market imperfections. From the perspective of accounting, she finds that there is no capitalized value for R&D in a firm's balance sheet. Asymmetric information between borrowers and lenders may then cause potential lenders to be reluctant to fund R&D due to its inherent risk, even if the borrower promised high expected returns.

On the other side, as the R&D activities have positive externalities, even if enterprises want to attract external investment, but for the purpose of self-protection, enterprises will not disclose a large number of R&D information publicly, which further aggravates the information asymmetry between themselves and investors. In addition, the R&D projects often have high risks, so investors keep cautious on R&D investment. The government can use the "visible hand" to intervene when facing market failure, playing an important role of macroeconomic regulation. Among them, government R&D subsidies can play an important role in certifying firms' quality and technological merits of the R&D projects, thus the effect of R&D subsidy is not only limited to directly reduce the cost of R&D, but as a positive signal for good prospects of the enterprises gained subsidies to outside investors. The National Governors Association (NGA) also claims that "an SBIR award provides a signal to angel investors that these technologies hold promise and an opportunity to leverage their investments with another source of early-stage funding" (NGA, 2008, p.7). Specially, the signal effect works through the following two ways.

Firstly, in order to make the subsidies have positive effects to the projects, governments will be rigorous in the process of evaluating R&D projects. With a perfect R&D project identification standard system, the evaluation results from the governments can be transferred to outside investors through the form of R&D subsidies. Governments might be better motivated to screen projects than market-based financiers because of different objective functions and potential free rider problems among private financiers (Meuleman and Maeseeneire, 2012). The governments often set up special organizations and invite lots of experts to choose

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