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Do Government R&D Subsidies Affect Enterprises' Access to External Financing?

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Abstract

This paper investigates data of listed companies of Shenzhen Stock Exchange in 2011-2013, and the result shows that listed companies received government R&D subsidies can get more external financing and the positive impact of the certification effect generated by receiving an R&D subsidy is stronger for equity financing than for debt financing. Furthermore, the effect is more significant in high-tech enterprises.

Key words: Government R&D subsidies; External financing; Financial constraints

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INTRODUCTION

To promote technology innovation, governments usually would give some R&D subsidies to enterprises. As governments R&D subsidies continued increasing in recent years, the effectiveness of the policy has got more and more attention. However, current researches in the field mainly focused on the effect of government R&D subsidies on enterprises' R&D expenditure. Few studies concern its role in alleviating enterprises' financing constraints. Therefore, analyzing the impact of public R&D funding on enterprises' access to external financing will not only provide a better understanding of the role of public R&D funding plays in technology innovation, but also be beneficial for governments to make funding policy specifically.

To examine the impacts of government R&D subsidies on enterprises' access to external financing, we are going to answer the following questions. (a) Do government R&D subsidies affect enterprises' access to external financing? (b) Does external financing come from debt financing or equity financing? (c) Is the effect of government R&D subsidies more significant to high-tech enterprises? This paper investigates data of listed companies of Shenzhen Stock Exchange in 2011-2013, and the result shows that listed companies received government R&D subsidies can get more external financing, especially equity financing. Furthermore, the positive impact of the certification effect generated by receiving an R&D subsidy is more significant for high-tech enterprises.

The remainder of the paper is structured as follows. Section 1 presents a brief literature review and puts forward our hypotheses. Section 2 provides a description of the model and sample used. The results of our study are presented in Section 3. The paper ends with conclusions.

1. LITERATURE REVIEW AND HYPOTHESES DEVELOPMENT

It is widely viewed that research and development activities are usually underinvested in a freely competitive market place because of market failure. Due to the technology spillover, private enterprises can not have all social benefit brought by high and new technology exclusively, which would make enterprises' private cost higher than private benefit. So, enterprises have to reduce R&D investment (Arrow, 1962). One of the main policies to correct market failure is government subsidizing enterprises' R&D activities directly. Government R&D

subsidies not only can reduce research cost and risk of enterprises, but also can shorten the gap between private benefits and social benefits of R&D activities. Then, R&D investment would become profitable, and enterprises are willing to expand R&D investment. There are a large number of literature found that government R&D subsidies indeed can effectively stimulate enterprises' R&D expenditure (Lach, 2002; Zhang & Wu, 2014).

In addition, government R&D grants also play an important role in increasing enterprises' access to external financing.

Enterprises' R&D projects are generally faced with financing constraints (Harhoff, 1998). This is determined by the following characteristics of R&D investment. First, the information between entrepreneurs and external investors is asymmetrical. Generally speaking, entrepreneurs frequently have better information about the likelihood of success and expected returns of the innovation project than potential investors. But entrepreneurs are reluctant to reveal their innovative ideas to the marketplace and the fact that there could be a substantial cost to revealing information to their competitors reduces the quality of the signal they can make about a potential project. Therefore, the information on R&D projects disclosed by entrepreneur is often fuzzy (Anton & Yao, 1998). The marketplace for financing the R&D projects looks like the "lemons market" modeled by Akerlof (1970). The lemons' premium for R&D will be higher than that for ordinary investment because investors are often lack of sufficient information to assess R&D projects when the projects are long-term R&D investments than when they are more short-term or low-risk projects (Leland & Pyle, 1977; Myers & Majluf, 1984). Although the enterprise accounting standards require listed companies to reveal information about R&D projects, but this can only reduce the degree of information asymmetry and can not completely eliminate the information asymmetry. Lemons' premium still exists. Second, R&D staffs' compensation accounts for a large proportion of R&D expenditure, which embedded in the human capital of the firm's employees, and therefore lost if they leave or are fired. R&D project usually needs to experience a long period of time from idea to commercialization. This implies that R&D spending at the firm level typically behaves as though it has high adjustment costs (Lach & Schankerman, 1988). So, potential investors require quite high rate of return of R&D projects to cover the adjustment cost. In addition, because human capital can not be used for mortgage loans, enterprises lack of credit collateral to obtain bank loans, which undoubtedly further exacerbated financing constraints of enterprises.

Thus firms will be forced to use internal funds for R&D projects. Internal financing has several advantages: no need of collateral; no adverse selection problem; no enlarge financial crisis etc.. But if enterprises only rely on internal funds for R&D projects, they may encounter a lot of difficulties. Fist of all, funds needed to collect may exceed internal funds, creating a funding gap. This funding gap may prevent firms, especially for SMEs, from undertaking economically viable innovation projects. Second, R&D projects need sustaining fund supplies. However, firms' profits may be volatile because of economy cycle, which implies internal funds can not satisfy this kind of fund demand.

So, it is important for innovation projects to obtain external funds. To increase enterprises' access to external financing, the first thing to solve is to reduce information asymmetry between entrepreneurs and external investors. One feasible way is that external investors collect information through intermediaries, such as government agencies, industry associations and consulting agencies. Government grants indeed contain some important information. Enterprises must apply to the relevant government agency if they want to obtain government subsidies. Government agencies will collect information to review the feasibility of R&D projects and whether the enterprise has corresponding technical advantages after receiving the enterprise's application. Generally speaking, the information collected by government agencies is much more and better. This is because government agencies, due to more experience with similar projects in the past, have a sound project review system. Lerner (1999) shows that due to more intensive analysis government agencies perform a significantly better screening and thus have an improved perception of the project's focus and riskiness. Besides, because of the neutrality and confidentiality of government agencies, enterprises do not have to worry about innovation projects would be emulated by competitors when disclosed more information to government agencies. Therefore, applications of poor quality enterprises have been filtered out as much as possible through government agencies' project review system. That means most projects obtained government subsidies are feasible and promising, and the enterprise also has the technical advantages that R&D projects required. So, government R&D subsidies could play an important role in certifying enterprises' quality and technological merits of the enterprises' projects (Lerner, 1999; Meuleman & Maeseneire, 2012). External investors can distinguish enterprises' quality according to whether the enterprise received government grants when they can not collect sufficient information to evaluate the enterprise. Government R&D subsidies can firm external investors' confidence, thereby increasing enterprises' access to external financing.

Based on the above argument, we put forward the following hypothesis.

Hypothesis 1. Receiving government R&D subsidies increases enterprises' access to external financing.

Furthermore, the positive effect of government R&D subsidies may differ between debt and equity. Accord to peck order theories (Myers & Majluf, 1984), information asymmetry problem is most serious for equity. External

investors would require a considerable lemon's premium when issuing equity. Therefore, the certification effect of government R&D subsidies may be the most significant for attracting equity. Lerner (1999) and Feldman and Kelley (2006) indeed find that R&D grants serve as a signal for good quality of SMEs that promotes attracting a particular source of new equity, namely venture capital.

Hypothesis 2a. The positive impact of the certification effect generated by receiving an R&D subsidy is stronger for equity financing than for debt financing.

On the other hand, it is known to all that venture capitalists, as specialized financial intermediaries, are good at collecting and processing information, and thus may alleviate information problems faced by R&D projects (Gompers & Lerner, 1999). However, it is much harder for banks to reduce information asymmetry. What makes the work of challenging is that it requires a profound understanding of how the firm and its markets operate. Giudici and Paleari (2000) pointed out that banks have limited competency in correctly evaluating high-tech enterprises' innovation projects, leading to excessive collaterals required. Smaller firms suffer most from these problems. Based on these analyses, we put forward another hypothesis.

Hypothesis 2b. The positive impact of the certification effect generated by receiving an R&D subsidy is stronger for debt financing than for equity financing.

2. DATA, MODEL AND METHODS

2.1 Data

This paper selects data of listed companies of the Shenzhen Stock Exchange in 2011-2013 as sample. Because Feldman and Kelley (2005) found that the positive impact of the certification effect generated by receiving an R&D subsidy is stronger for SMEs than large enterprises, while SMEs in China are mainly concentrated in the Shenzhen Stock Exchange. We filter the initial sample according to the following steps. (a) Eliminate companies listed after 2011. (b) Eliminate listed companies under special treatment, listed companies in financial industry, and listed companies that did not disclose information about government grants. (c) Eliminate extreme values triple standard difference method. Our final sample contains 1,129 listed companies, 3,193 observations. The financial data of listed companies used in this paper are derived from the CSMAR database.

We refer to annual reports of the listed companies to learn whether they received government R&D subsidies. The annual reports of the listed companies come from CNINF—the information disclosure website designated by the China Securities Regulatory Commission.

Government R&D subsidies are presented as "Non-operating income" in the income statements or "specific accounts payable", "other non-current liabilities" in the balance sheets. We process classification items for the three accounts, and judge whether the company has received government R&D subsidies.

2.2 Model and variables

2.2.1 Model

In order to examine the effect of the government R&D subsidies on companies' debt financing or equity financing, this paper constructs the following model:

$$Y_{i,t} = \beta_0 + \beta_1 GOV_{i,t} + \beta_2 SG_{i,t} + \beta_3 \mathrm{SIZE}_{i,t-1} + \beta_4 SOE_{i,t} + \beta_5 ROA_{i,t-1} + \beta_6 LEV_{i,t-1} +$$

$$\beta_7 LIQ_{i,t-1} + \beta_8 \mathrm{YEAR}_{12} + \beta_9 \mathrm{YEAR}_{13} + \sum_{i=1}^{39} \beta_{9+i} \mathrm{INDUSTRY}_i + \varepsilon_{i,t} \quad .$$

2.2.2 Variables

$Y_{i,t}$, the dependent variable, represent the financing of company i in year t. To distinguish between debt financing and equity financing, long-term debt financing and short-term debt financing, it is divided into four forms: (a) Interest bearing debt financing ($IBD_{i,t}$). It is equal to the sum of the increase value of short-term loans, non-current liabilities due in a year, long-term loans, long-term accounts payable, and bonds payable in year t divided by the total assets at the beginning of year t; (b) External equity financing ($EQU_{i,t}$). It is equal to the net increase value of equity in year t divided by the total assets at the beginning of year t. According to the definition of Baker (2003), the net increase value of equity equals the increase value of equity in book value minus the increase value of retained earnings; (c) Short-term interest bearing debt financing ($SIBD_{i,t}$). It is equal to the sum of short-term loans and non-current liabilities due in a year divided by the total assets at the beginning of year t; (d) Long-term interest bearing debt financing ($\mathrm{LIBD}_{i,t}$). It is equal to the sum of the increase value of long-term loans, long-term accounts payable, and bonds payable in year t divided by the total assets at the beginning of year t. $GOV_{i,t}$, which represents government R&D subsidies, is a dummy variable. $GOV_{i,t}$ equals 1 if company i received a government R&D subsidy in year t, 0 otherwise. $SG_{i,t}$ represents sales revenue growth of company i in year t. $SIZE_{i,t\text{-}1}$, which represents the size of company i, equals the natural logarithm of total assets at the beginning of year t. $SOE_{i,t}$ represents the ownership property of company i in year t. $SOE_{i,t}$ equals 1 if the controlling shareholder of company i is the SASAC, state organs, local governments or state-owned enterprise, 0 otherwise. $ROA_{i,t\text{-}1}$, $LEV_{i,t\text{-}1}$, and $LIQ_{i,t\text{-}1}$ respectively represent the rate of return on total assets, the asset-liability ration, the liquidity ration of company i in year t-1; YEAR_{12} and YEAR_{13} are used to control time differences. If the observation is in 2012, $YEAR_{12}$ equals 1; if not, YEAR_{12}

equals 0. If the observation is in 2013, $YEAR_{13}$ equals 1; if not, $YEAR_{13}$ equals 0. $INDUSTRY_i$ is industry dummy variables, used to control industry differences. According to *Industry Classification Guidance of Listed Companies* issued by the CSRC, the listed companies in the sample are classified into 40 industries.

3. RESULT AND ANALYSIS

3.1 Descriptive Statistics of Variables

Descriptive statistics of variables are presented in Table 1. In the 3,193 observations of the sample, 1,843 observations received government R&D subsides, accounting for 57.7%. Mean of interest bearing debt financing, short-term interest bearing debt financing, long-term interest bearing debt financing and external equity financing respectively account for 4.1%, 14.0%, 1.5% and 6.2% of the total assets.

3.2 Result

The model analyzes the sample with the OLS methodof Eviews7.2 and the result are presented in Table 2. Column 1 shows that the regression coefficient of $GOV_{i,t}$ is 0.015, accounting for 1.5% of the total assets. And it means that companies received government R&D subsidies obtain more 33 million interest bearing debt financing than those not received government R&D subsidies if the total assets equal to the mean value.

Column 2 shows that the regression coefficient of $GOV_{i,t}$ is significantly positive in model 2 (short-term interest bearing debt financing model), while column 3 shows that the regression coefficient of $GOV_{i,t}$ is not significant in model 3 (long-term interest bearing debt financing model). It is implied that the positive impact of the certification effect generated by receiving an R&D subsidy is stronger for short-term interest bearing debt financing than for long-term interest bearing debt financing. This may be due to the characteristics of the innovative projects. As a result of the uncertainty, enormous amount of investment, and long payback period features, innovation project investment is very risky. Although government R&D subsidies have played a positive role in the quality certification, but external creditors, for prudent consideration, only willing to provide short-term loans.

Column 4 shows that the regression coefficient of $GOV_{i,t}$ is also significantly positive in model 4 (external equity financing model), which means receiving government R&D subsidies increase enterprises' access to external equity financing. Companies received government R&D subsidies obtain more 44 million external equity financing if the total assets equal to the mean value.

Compared column 1 with column 4 in Table 2, we can see that the regression coefficient of $GOV_{i,t}$ in model 4 is bigger than that in model 1. It is imply that the positive impact of the certification effect generated by receiving an R&D subsidy is stronger for equity financing than for debt financing, supporting hypothesis 2a.

Table 1
Descriptive Statistics

Variables	Mean	Median	Maximum	Minimum	Standard deviation
$IBD_{i,t}$	0.041	0.008	1.072	-0.562	0.112
$SIBD_{i,t}$	0.140	0.099	1.260	0.000	0.152
$LIBD_{i,t}$	0.015	0.000	0.633	-0.257	0.069
$EQU_{i,t}$	0.062	0.002	3.186	-0.231	0.247
$GOV_{i,t}$	0.577	1	1	0	0.494
$SG_{i,t}$	0.190	0.133	8.202	-0.946	0.472
$SIZE_{i,t-1}$	21.521	21.345	25.765	18.181	1.064
$SOE_{i,t}$	0.337	0	1	0	0.473
$ROA_{i,t-1}$	0.069	0.061	0.922	-0.421	0.059
$LEV_{i,t-1}$	0.388	0.370	1.556	0.016	0.221
$LIQ_{i,t-1}$	3.328	1.918	21.970	0.061	3.577

Table 2
Government R&D Subsidies' Effect on Enterprises' Financing

Variables	IBD (1)	SIBD (2)	LIBD (3)	EQU (4)
$GOV_{i,t}$	0.015*** (3.301)	0.016*** (3.174)	0.003 (1.095)	0.020** (2.059)
$SG_{i,t}$	0.044*** (10.687)	0.024*** (5.539)	0.013*** (5.209)	0.050*** (5.769)
$SIZE_{i,t-1}$	0.019*** (8.092)	0.001 (0.247)	0.009*** (6.333)	-0.082*** (-16.753)
$SOE_{i,t}$	-0.020*** (-4.236)	-0.046*** (-9.170)	-0.003 (-0.965)	-0.015 (-1.564)
$ROA_{i,t-1}$	-0.012 (-0.341)	-0.204*** (-5.544)	0.024 (1.129)	1.073*** (14.895)
$LEV_{i,t-1}$	-0.048*** (-3.335)	0.415*** (26.862)	-0.029*** (-3.195)	0.304*** (10.046)
$LIQ_{i,t-1}$	-0.003*** (-4.380)	-0.002** (-2.122)	-0.002*** (-3.956)	-0.004** (-2.397)
Intercept	-0.344*** (-6.500)	-0.061 (-1.088)	-0.176*** (-5.311)	1.591*** (14.381)
Year	Control	Control	Control	Control
Industry	Control	Control	Control	Control
N	3193	3193	3193	3193
F statistic	6.965***	51.047***	4.424***	15.104***
Adj. R^2	0.082	0.429	0.049	0.175

Note. Figures in Table 2 present the regression coefficient; value in parentheses is the *t*-statistic regression coefficient, *, ** and *** respectively represent they are significant levels of 10%, 5% and 1% on a statistical basis.

3.3 Further Analysis

To further analyze the positive impacts of government R&D subsidies on enterprises in different industries, we divide the sample into two groups-high-tech enterprises group and non high-tech enterprises group. There is no clear definition of high-tech industries in China so far, but high-tech industries include medicine and medical equipment manufacturing, aerospace manufacturing, computer and office equipment manufacturing, instruments manufacturing and electronics and communication equipment manufacturing, according to the regulations of

OECD. So we classify companies in these five industries into high-tech enterprises group, and the others into non high-tech enterprises group.

Table 4 presents the result. Column 1 and column 3 show that the regression coefficients of $GOV_{i,t}$ are both significantly positive, but it is bigger in high-tech enterprises group than in non high-tech enterprises group. Column 2 and column 4 show the same result, but significance of regression coefficients is decreased due to sample reduction. It is indicated that the positive impact of the certification effect generated by receiving an R&D subsidy exists both in high-tech enterprises and non high-tech enterprises, but is more significant in high-tech enterprises.

Table 3
The Effect of Government R&D Subsidy in Different Industries

Variables	High-tech enterprises group		Non high-tech enterprises group	
	IBD (1)	EQU (2)	IBD (3)	EQU (4)
$GOV_{i,t}$	0.018*** (3.498)	0.019 (1.467)	0.013* (1.806)	0.007 (0.579)
$SG_{i,t}$	0.067*** (11.289)	0.076*** (5.153)	0.034*** (5.769)	0.036*** (3.552)
$SIZE_{i,t-1}$	0.012*** (4.586)	-0.085*** (-12.808)	0.024*** (6.538)	-0.068*** (-10.719)
$SOE_{i,t}$	-0.015*** (-2.699)	-0.020 (-1.444)	-0.024*** (-3.262)	0.000 (0.015)
$ROA_{i,t-1}$	-0.072* (-1.724)	1.514*** (14.519)	-0.017 (-0.321)	0.655*** (7.037)
$LEV_{i,t-1}$	-0.031* (-1.738)	0.442*** (10.000)	-0.048** (-2.171)	0.167*** (4.380)
$LIQ_{i,t-1}$	-0.004*** (-4.385)	0.000 (0.073)	-0.002 (-1.185)	-0.006** (-2.328)
Intercept	-0.216*** (-3.962)	1.637*** (12.103)	-0.440*** (-5.912)	1.450*** (11.255)
Year	Control	Control	Control	Control
N	1802	1802	1391	1391
F statistic	21.938***	55.502***	9.949***	22.604***
Adj.R^2	0.095	0.214	0.055	0.123

Note. Figures in Table 3 present the regression coefficient; value in parentheses is the *t*-statistic regression coefficient, *, ** and *** respectively represent they are significant levels of 10%, 5% and 1% level on a statistical basis.

CONCLUSION

This paper investigates data of listed companies of Shenzhen Stock Exchange in 2011-2013, and the result shows that listed companies received government R&D subsidies can get more external financing and the positive impact of the certification effect generated by receiving an R&D subsidy is stronger for equity financing than for debt financing. Furthermore, the effect is more significant in high-tech enterprises.

The conclusions of this paper have important implications for government departments and enterprises management. Government R&D subsidies can not only reduce the cost of innovation, but also can increase enterprises' access to external financing. The policy of providing R&D subsidies to promote technology innovation is effective in the background that capital market is imperfect. Besides, the conclusions indicate that governments should take full account of industry characteristics and scale when select target enterprises. For enterprises management, they should understand subsidy policies fully and duly, and could consider applying R&D subsidies when R&D project need financing.

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