The Effect of the R&D Expenses Tax Super Deduction Policy in China ——an Empirical Analysis Based on GEM Companies

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ABSTRACT

Technology innovation is one of the most active factors in modern productivity. R&D activities, as a key link in technology innovation, have promoted the social and economic development. However, externalities, uncertainty and information asymmetry in R&D activities have inhibited corporate R&D activities. The Chinese government has implemented a R&D expenses tax super deduction policy to encourage companies' R&D activities, but whether the policy can achieve its expected goals after implementation is worth examining.

This paper first sorts out relevant domestic and foreign literature, elaborates the theoretical basis that the R&D expenses tax super deduction policy can encourage R&D and conducts a comparative analysis of domestic and foreign R&D expenses tax super deduction policy; then the panel data based on the R&D expenditures and patent applications of China's GEM listed companies is exploited by constructing the econometric model, empirically analyzing whether the implementation of policy can motivate companies to conduct R&D activities. The results show that there is strong evidence that the implementation of the R&D expenses tax super deduction policy has indeed a statistically significant positive effect on R&D activities.

Key words: Super deduction; R&D; Policy effect

1. Introduction

1.1. Subject Source

Technology innovation is one of the most active factors in modern productivity, and R&D activity is a key link in technology innovation. As the main output of the R&D activities, new technologieshave become a fundamental driving force for the continuous improvement of productivity and have promoted the social and economic development. Some domestic scholars have shown that technological progress has a positive effect on China's economic growth. Companies, as major participants in innovation and R&D activities, have large investment in innovation. They need to invest a lot of capital to purchase related equipment, hire relevant technical personnel, but the output of R&D activities is unstable and high-risk. At the same time, the output of R&D activities has quasi-public attribute which leads to the private benefit of the company is lower than the social benefit, inhibiting the company's R&D activity.

The government encourages companies to conduct R&D activities mainly through tax incentives and R&D subsidies. In 2008, 2013, 2015 and 2017, the Chinese government issued Caishui No. 116, Caishui No. 70, Caishui No. 119, and Caishui No. 34 respectively to provide relevant notices on the R&D expenses tax super deduction policy. From a theoretical point of view, the policy may have complementary or substitution effects in two different directions on R&D activities of companies.

Therefore, it is worthy of our examination to see how much effect can be brought about after the implementation of the policy, especially under the background of increasing the degree of tax preference after mass entrepreneurship and innovation.

1.2. The Significance of Research

At present, there are a large number of foreign and domestic researches that have empirically analyzed the effects of tax incentives and R&D subsidies to R&D activities,but the conclusion is still under discussion. Most of the researches show that both of these policy tools have encouraged companies' research and development. However, some studies have found that tax incentives have crowding out effect and the tax incentive for company R&D is not effective. In addition, most of the researches focus on overall impact of preferential tax policy. There are few studies on the effect of the R&D expenses tax super deduction policy, and there are also significant differences in conclusions. So further research is needed.

In order to accurately test the effect of the R&D expenses tax super deduction policy, this paper uses R&D input and output as explanatory variables on the basis of literature review and reference, and conducts empirical research on the basis of GEM companies. Reasons are listed as follows. First of all, GEM companies are high-tech enterprises in the majority. The development of high-tech companies is more dependent on innovation than that of the general companies. Therefore, these companies usually pay more attention to R&D and innovation activities, and generally

invest more in R&D activities. Second, the annual report data of GEM companies is more accurate and representative.

2. Literature Review

Since the R&D expenses tax super deduction policy has long been the subject of criticism, the scholar works have involved research into whether the policy has a positive effect on R&D activities and the discussion has never stopped. Those works analyzed the tax incentive and R&D subsidiary in different perspectives.

With respect to the issue whether the R&D expenses tax super deduction policy can promote R&D activities or not,foreign pertinent literature is abundant. Some argue that it does has a positive impact on R&D and innovation activities.Robot (2007)pointed out that direct financial subsidies for R&D and the R&D expenses tax super deduction are all effective ways to promote R&D activities, and the latter has proved to be effective in the empirical test;Dirk et al.(2011)empirical evaluated the impact of theR&D expenses tax super deduction policy on R&D investment of 3,562 companiesthrough non-parametric match method. The results showed that the implementation of the R&D expenses tax super deduction policy can prompt companies to increase R&D expenditures.Yang (2012) investigated the impact of tax incentives on R&D activities of Taiwanese manufacturing companies and found that the use of either PSM or IV or GMM models indicates that R&D tax credit policies have a positive incentive for R&D spending by companies, especially in the electronics industry. However, the closer it is to the policy deadline, the weaker its effect will be.Others argue that the R&D expenses tax super deduction policy does not

promote the R&D activities of companies.Eisner et al.(1984) concluded that there is no substantial evidence to show that the R&D expenses tax super deduction policy will stimulate overall company R&D investment;Wallsten (2001) surveyed R&D and innovation activities of small businesses in the United States and proved the preferential tax policy have crowding out effect.

In recent years, some domestic scholars have also studied the incentive effects of the R&D expenses tax super deduction policy on corporate R&D activities.Liqing Li (2008) conducted a questionnaire survey to collect data of executives or financial staff of 103 companies and then analyzed the databased on the classical regression model. She found that there are many constraints on the R&D expenses tax super deduction policy, which results in the statistically insignificant of the incentive effect to R&D.Xindong Zhang et al. (2014) took the listed companies in the enterprise technology center as a sample and found that companies who enjoy tax incentives often have more patents, new products and technology incentives, and there are significant incentive effects.Xianglai Bu (2014) used the corporate tax data of 146 companies from ZhongguancunHaidianScience Park in Beijing during the period of 2009-2012 to examine the impact of fiscal and tax incentive policies on corporate R&D investment from a micro perspective, and also proved that preferential corporate income tax policies can promote companies' R&D activities.

However, other scholars draw different conclusions from their studies.For

example,Xiao Xiaoping et al. (2008)examined the capital costs caused by the tax incentives for R&D through establishing standard capital cost model and found thatthe post-tax R&D incentives can increase R&D investment by lowering R&D capital costs.Ali Zhou (2010) chose 2007-2009 China's A-share listed company as a sample and found that lowering the corporate income tax burden can effectively promote companies to increase R&D investment.Yuhua Mei et al. (2010) used the B-index model to run relevant data on 9000 randomly selected companies and found that the government's tax deduction for each dollar does not increase the R&D input for the same amount. According to this, some current R&D tax incentives policies in China do not meet their purpose.

In general, most of the earlier foreign studies onthe R&D expenses tax super deduction policy show that the policy have no obvious effect on the promotion of R&D activities. The effects can be effective and there is crowding out effect. However, in recent years the results show just the opposite. Most studies of policies concluded that the R&D expenses tax super deduction policy can effectively promote R&D activities. Domestic scholars have different opinions on the effect of R&D tax incentive policies. Some people think that the R&D expenses tax super deduction policy play a significant role in promoting R&D activities. Others say that this policy does not encourage companies to conduct more R&D activities.

3. The Analysis of R&D Expenses Tax Super Deduction Policy

3.1 Theoretical Basis for R&D Expenses Tax Super Deduction PolicyPromoting R&D Activities

Classical economics believes that under perfect competition conditions, the results of production operations can automatically make the allocation of social resources achieve Pareto optimal, which is the effective operation of the market. However, in reality, perfect competition conditions are often difficult to meet, such as the existence of externalities, information asymmetry, etc., and thus market failure occurs (Arrow, 1962). Therefore, the government's relevant economic policies are needed to make up the market defects, and to some extent solve the problem of market failure so as to optimize resource allocation. The outcome of R&D activities, as knowledge asset,has the characteristics of externality, public product, and uncertainty, which leads to the failure of the R&D investment market:

1) Externality of R&D

   Externality is caused by inconsistencies between marginal private costs and marginal social costs, marginal private benefits, and marginal social benefits. For companies, the conditions for the implementation of R&D activities are that private expected benefits are greater than private expected costs. The capital and personnel input of R&D activities is large and the cost is high, but their transmission costs are low. Their externalities lead to the private benefits of the company being lower than the social benefits and inhibiting the company's R&D

activities.

2) Uncertainty of R&D

Uncertainty refers to the risk which company's R&D activities are accompanied by. There are a variety of risks, such as the risk of technology, the risk market, the risk of revenue, and the risk of institutional environment. The occurrence of risks can significantly increase the cost of R&D, and even leads to zero or negative returns. While most entrepreneurs in market are risk averse, this in turn results in insufficient investment in R&D.

3) Information asymmetry of R&D

R&D activities must keep confidential information in order to prevent technological spillovers, but this may lead potential investors to decide not to invest in the project because of lack of effective information. Eventually, promising R&D projects are forced to stop because of lack of funds. The existence of information asymmetry is not conducive to effective allocation of resources in the market and wastes resources, and then leads to market failure. At the same time, there may be another manifestation of information asymmetry. The company may wish to gain by allowing other companies to use the company's R&D output, such as the use of franchise rights, but choose not to disclose key information in order to prevent technological spillovers.

Based on the above theory, due to the characteristicsof R&D activities, the market cannot optimize the allocation of resources. Therefore, the government needs to make reasonable interventions and set certain mechanism to solve the market failure. For

instance, the implementation of R&D expenses tax super deduction policy optimizes the allocation of resources by encouraging positive externalities to intervene in the market.

3.2 International Comparison on R&D Expenses Tax Super Deduction Policy

3.2.1 Foreign R&D Expenses Tax Super Deduction Policy

Tax incentive policies are widely used by foreign governments as a major policy tool to encourage corporate R&D. In particular, developed countries have generally implemented tax credit or deduction policy earlier, and policy frameworks are more mature. Table 1 below outlines the preferential tax policy for R&D expenses in some typical foreign countries. Through sorting out, summarizing and analyzing these policies, it is helpful to test the effectiveness of the deduction policy for R&D expenses in China.

Table 1 Foreign R&D Expenses Tax Super Deduction Policy

Country	Main Content
Canada	1. Give a 20% tax credit to the company's for research and experimentation (R&E) expenses. 2. Give a 35% tax credit to a small-scale sole proprietorship's R&E expenses, allowable tax credit is up to a maximum of 3 million Canadian dollars, and the deductible portion of the company that year is refundable.

	3. Local governments also have the right to formulate tax incentives for corporate R&E expenses. [①]
U.K.	1. Large-scale companies (more than 500 employees or more than 100 million euros in annual revenue or more than 86 million euros in total assets): give a 130% super deduction on R&D expenses. 2. Small and medium-sized companies (with no more than 500 employees, annual income less than 100 million euros and total assets less than 86 million euros): give a 225% super deduction on R&D expenses.[②]
U.S.A.	1. Specify the basic part of the company's R&D expenses and give a 20% tax credit to the incremental part based on the basic part. 2. Calculation of the basic part of company's R&D expenses: the total R&D expenditures divide the total revenue in the first five years of the accounting and then multiply by the average income in the first four years of the accounting. [③]
India	1. Give a 100% super deduction on the R&D expenses incurred by domestic companies in India. 2. Give a 25%-100% super deduction on the R&D expenses incurred by a foreign company in India.[④]
Singapore	1. Give a super deduction on the R&D expenses incurred in Singapore; the part that does not exceed 400,000 US dollars will enjoy a 400% super deduction, and the part that exceeds 400,000 US dollars will enjoy a 150% super deduction. 2. Give a super deduction on the R&D expenses incurred outside Singapore;the part that does not exceed 400,000 US dollars will enjoy

[①]Canada Income Tax Act，1985 ［Z］
[②]Finance Act，2011 ［Z］
[③]Internal Revenue Code，2013
[④]India Income Tax Act，1961

	a 400% super deduction, and the part that exceeds 400,000 US dollars will enjoy a 100% super deduction. 3. The policy is valid for the period of 2011-2018 (the period of the original plan was 5 years and it has been extended to 2018)[5]

By summing up and comparing, conclusion are as follows ：

1) With regard to the special preference for small and medium-sized enterprises (SMEs), Canada and the United Kingdom have a policy bias towards SMEs, and given them greater incentives. In addition, the United Kingdom has continuously increased the degree of its preferential treatment for SMEs in recent years, increasing the percentage ofsuper deduction on R&D expenses from 75%(original) to 100% (2011) to 125% (2012).
2) With regard to the validity of the policy, the policies in Canada and the United Kingdom are permanent, and the continuity of policies is strong, while India, the United States, and Singapore have stipulated a certain period of validity for the corresponding policies and will revise or extend them when the policy expires.
3) With regard to the happened place of the R&D expenses, in addition to India and Singapore, the rest of the countries have no requirement for R&D expenses incurred within or without the borders. India requires R&D expenses to occur in the country and to distinguish between domestic and foreign companies' preferential policies. Singapore differentiates between companies' R&D expenses incurred in Singapore and outside Singapore, and encourages companies to conduct R&D activities in Singapore. Considering that the developed countries, such as the United States, have a relatively developed economy and many

[5] Productivity and Innovation Credit, 2016

transnational corporations. Those transnational corporations can enjoy tax incentives for domestic and overseas R&D activities as long as they settle in the country.

3.2.1 R&D Expenses Tax Super Deduction Policyin China

The development of China's R&D expenses tax super deduction policy began in 1996 with the deduction of the company's technical development costs. Afterwards, through the further provisions of the relevant documents, the scope of the applicable companies is gradually expanded, and the range of deductible R&D expenses is expanded. As a result, the currentR&D expenses tax super deduction policy in China is formed.

Table 2 R&D Expenses Tax Super Deduction Policy in China

Release Time	Document Name	Department	Main Content
1996	《关于促进企业技术进步有关财务税收问题的通知》	MOF SAT	Give a 150% super deduction on R&D expenses for profitable companies that have increased their R&D expenses by more than 10% from the previous year
2003	《关于扩大企业技术开发费用加计扣除政策适用范围的通知》	MOF SAT	Extend the application scope of the super deduction policy to various ownership-based industrial enterprises with sound financial accounting

2006	《国家中长期科学和技术发展规划纲要（2006-2020）》	State Council	Give a 150% super deduction on the actual R&D expenses incurred in that year. The part which is more than taxable income can be carried forward for set-off in the following 5 years.
2008	《关于印发<企业研究开发费用税前扣除管理办法（试行）>的通知》	SAT	For the first time, detailed stipulations on the implementation rules for the R&D expenses tax super deduction policy
2013	《关于研究开发费用税前加计扣除有关政策问题的通知》	MOF SAT	Expand the scope of deductible R&D expenses, including the social insurance and housing fund of scientific research personnel
2015	《关于完善研究开发费用税前加计扣除政策的通知》	MOF SAT STM	Turn the company sector from a positive list to a negative list, industries not listed in the negative list can enjoy super deductions; Further expand the scope of deductible R&D expenses;Changesetting the R&D expense special ledger to setting subsidiary ledger; Streamline the examination and approval procedure, change to filing system
2017	《关于提高科技型中小企业研究开发费用税前加计扣除比例的通知》	MOF SAT STM	Increase the percentage of super deductions for R&D expenses of Sci-Tech-Typed SMEs
MOF: Ministry of FinanceSAT: State Administration of Tax STM: Science and Technology Ministry			

4. Empirical Study Design

4.1. Study Hypothesis

Based on market failure theory, when market failure occurs, the market as a resource allocation tool cannot maximize the efficiency of resource allocation. At this time, government must take relevant measures to achieve optimal resource allocation. Through the process of technological innovation, companies have a large capital and personnel investment as the main players in innovation and R&D activities, yet have unstable output and high risks. As a result, the private benefits of the company are lower than the social benefits, which inhibits the company's R&D activities. The R&D expenses tax super deduction policy is one of the main methods for tax incentives, which will reduce R&D costs and provide more cash flow for companies, and thus promote R&D activities.

Based on the above theories and analysis, two hypotheses are proposed:

H1: The R&D expenses tax super deduction policy has a significant positive effect on the R&D input of China's GEM companies.

H2: The R&D expenses tax super deduction policy has a significant positive effect on the R&D output of China's GEM companies.

4.2. Data Sources

The company’s R&D expenditures, operating profit margins, asset-liability ratios,

internal cash flow, intangible assets, types of industries, size of companies, and whether it is a high-tech enterprise are from WIND; the number of companies' patent applications comes from "Patent Search and Analysis of SIPO".

In 2012 and 2013, listed companies in China disclosed whether they are entitled to the R&D expenses tax super deduction policy voluntarily. Therefore, this paper draws on the existing research method[6] and refers to the basic conditions for companies to enjoy the policies. For the sample companies in 2012 and 2013, firstly, if the relevant information of super deduction is disclosed in the annual report, then 1 is taken manually; if it is not disclosed but the company is a High And New Technology Enterprise in the same year, 1 is also taken; the rest is taken as 0. Since listed companies must disclose whether they are entitled to the R&D expenses tax super deduction policy in their annual reports since 2014, the sample companies in 2014 and later have adopted manual methods. If the relevant information of super deduction are disclosed in the annual report, take 1; otherwise, take 0.

After the above steps, 1,730 sample observation points from 346 GEM listed companies from 2012 to 2016 were finally obtained, and a balanced panel data was initially formed.

4.3. Variable Definition andEconometric Model

[6]刘圻，何钰，杨德伟. 研发支出加计扣除的实施效果——基于深市中小板上市公司的实证研究［J］. 宏观经济研究，2012（9）：87-92

Before constructing the model, explanatory variables, explained variables and control variables are defined as shown in Table 3.

Explanatory variable: the R&D expenses tax super deduction policy (JJKC) is adopted as the explanatory variable. If company enjoys the policy, take 1. Otherwise, take 0.

Explained variables :(1) take the natural logarithm of company R&D expenditure to measure the R&Dinput;(2) the natural logarithm of the number of company patent applications is adopted to measure the R&D output.

Control variables :(1) take the natural logarithm of the total assets of the company to measure the scale of the company;(2) take the operating profit margin of the company to measure the profitability of company;(3) take the asset-liability ratio of the company to measure the financial risks faced by the company;(4) take the natural log of cash and equivalent balance to measure internal cash flow;(5) the intangible asset ratio(6) take the company's industry type as the control variable, and the manufacturing industry and the technology industry take 1; otherwise, 0;(7) year.

Table 3 Variable Name and Definition

Variable Type	Variable	Definition
Explained Variable	R&DIN	The natural logarithm of company R&D expenditure
	R&DOUT	The natural logarithm of the number

		of company patent applications
Explanatory Variable	JJKC	If company enjoys the R&D expenses tax super deduction policy, take 1. Otherwise, take 0
Control Variable	SIZE	the natural logarithm of the total assets of the company
	YYLRL	the operating profit margin of the company
	ZCFZL	the asset-liability ratio of the company
	WXZC	Intangible assets than total assets
	XJL	the natural log of cash and equivalent balance
	IND	the manufacturing industry and the technology industry take 1; otherwise, 0
	YEAR	year

After defining the above-mentioned explained variable, core explanatory variables, and control variables, construct the following econometric model:

$$R\&D_{it} = \beta_0 + \beta_1 JJKC_{it} + \beta_2 SIZE_{it-1} + \beta_3 YYLRL_{it-1} + \beta_4 ZCFZL_{it-1} + \beta_5 WXZC_{it-1} + \beta_6 XJL_{it-1} + \beta_7 IND_{it} + \beta_8 YEAR_t + \varepsilon_{it}$$

5. Empirical Test Results and Analysis

5.1. Descriptive Statistics Analysis

The descriptive statistics of the main variables are shown in Table 4. From 2012 to 2016, companies in China's GEM listed companies which enjoyedthe R&D expenses tax super deduction policy showed a clear upward trend. The average value increased from 0.788 in 2012 to a peak value of 0.907 in 2015. This indicates that more and more China's GEM listed companiesenjoy the preferential policy. China's GEM listed companies' R&D input has also increased year by year. The average value has increased from 16.457 in 2012 to 17.608 in 2016. This shows that the R&D activities of China's GEM listed companies are increasingly active and corporate R&D expenditures are increasing. In addition, it can be seen from Table 4 that the R&D output of China's GEM listed companies also showed an upward trend. In general, from 2012 to 2016, the number of China's GEM listed companieswhich have enjoyed preferential deductions is on the rise. At the same time, the R&D input and output of China's GEM listed companies are also ever increasing.

Table 4 Descriptive Statistics of Major Variables for 2012-2016

Year	Variable	Mean	Max	Min	S.D.
2012	JJKC	0.788	1.000	0.000	0.409
	R&DIN	16.457	19.254	8.159	1.405
	R&DOUT	1.881	5.468	0.000	1.445
2013	JJKC	0.777	1.000	0.000	0.417
	R&DIN	16.865	19.729	8.198	1.136
	R&DOUT	2.098	6.146	0.000	1.421
2014	JJKC	0.832	1.000	0.000	0.375

	R&DIN	17.088	20.513	6.860	1.250
	R&DOUT	2.118	5.938	0.000	1.451
2015	JJKC	0.907	1.000	0.000	0.291
	R&DIN	17.461	20.906	12.380	0.978
	R&DOUT	2.268	6.250	0.000	1.340
2016	JJKC	0.887	1.000	0.000	0.317
	R&DIN	17.608	21.760	7.747	1.162
	R&DOUT	2.134	6.510	0.000	1.409
Overall	JJKC	0.838	1.000	0.000	0.368
	R&DIN	17.098	21.760	6.860	1.262
	R&DOUT	2.100	6.510	0.000	1.418

5.2. Regression Analysis Based on Model

5.2.1. Analysis of Regression Results Based on R&D Input

Regression (1) is the regression result that considers the impact of the R&D expenses tax super deduction policy on R&D input. As can be seen from Table 5, the coefficient for for the core explanatory variable JJKC is significantly positive, which indicates that the R&D expenses tax super deduction policy has a positive effect on the R&D investment of the company, incentivizes the R&D investment of GEM listed companies, and achieves the effect of motivation. Hypothesis H1 is supported by data from the GEM listed companies.

Focusing on regression coefficients in Regression (1), we conclude that: under the same conditions, the R&D input when the company enjoys the R&D expenses tax super deduction policy is 1.794% higher than the R&D input when theydo not enjoy the policy, and it is statistically significant at the 1% level.The R&D expenses tax super deduction policy has a significant positive effect on corporate R&D activities. It

achieves the desired policy effect, and promote the development of innovative R&D activities by GEM listed companies; the regression coefficient between company size and R&D input of the company is significantly positive, indicating that the larger the scale of the company, the more willing it is to increase R&D investment; the regression coefficient of the company's internal cash flow and R&D input of the company is significantly positive, indicating that the more net cash flow the company has, the more willing it is to increase R&D input; The regression coefficient of the industry type and R&D input of the company is significantly positive, indicating that the technology companies and manufacturing companies in GEM listed companies have more investment in R&D than companies in other industries.

5.2.2. Analysis of Regression Results Based on R&D Output

Considering that the R&D activities include both R&D input and R&D output in the process, the regression (2) is the regression result that considers the R&D expenses tax super deduction policy on R&D output (this paper takes the number of patent applications to measure the R&D output). As illustrated in Table 5, the coefficient of the core explanatory variable JJKC is significantly positive, which shows that the R&D expenses tax super deduction policy has a positive effect on R&D output of the company, and that the implementation of the policy can increase the number of patent applications of GEM listed companies significantly.Hypothesis H2 is supported by the data of the GEM listed company.

Focusing on regression coefficients in Regression (2), we conclude that: under the same conditions, the R&D output when the company enjoys the R&D expenses tax super deduction policy is 0.858% higher than the R&D output when they do not enjoy the policy, and it is statistically significant at the 1% level. The R&D expenses tax super deduction policy has a significant positive effect on corporate R&D activities. It achieves the desired policy effect, and promote the development of innovative R&D activities by GEM listed companies; the regression coefficient between company size and R&D output of the company is significantly positive, suggesting that the larger the scale of the company, the more R&D output the company has;The regression coefficient of the industry type and R&D output of the company is significantly positive, suggesting that the technology companies and manufacturing companies in GEM listed companies have more patent applicationsthan companies in other industries.

By comparing the results in regression (1) and regression (2), we can find that although the regression coefficientsare also positive of corporate profitability, internal cash flow, financial risks, and intangible assets ratio on the R&D output of GEM listed companies in regression (2), they do not pass the significance test. This shows that the overall development and financial status of the company can also increase the R&D output of GEM listed companies, but this promotion effect is not obvious. Comparing the coefficients of the core explanatory variables in Regression (1) and

Regression (2), it can be found that GEM listed companies enjoying the R&D expenses tax super deduction policy can significantly increase their R&D input and R&D output, but the incentive effect on R&D input is more pronounced.

Table 5 Regression Analysis Based on Model

	(1)	(2)
	R&DIN	R&DOUT
JJKC	1.594***	0.858***
	-0.212	-0.123
YYLRL	0.520*	0.193
	-0.289	-0.171
ZCFZL	0.0147***	0.00318
	-0.00354	-0.00347
XJL	0.124***	0.0624
	-0.0431	-0.052
IND	0.452***	0.360***
	-0.0429	-0.0368
WXZC	1.551*	0.101
	-0.838	-1.01
SIZE	0.675***	0.0957**
	-0.036	-0.041
Constant	-2.901***	-0.940**
	-0.568	-0.446
Number of code	345	345
R-squared	0.45	0.19
Robust standard errors in parentheses		
*** p<0.01, ** p<0.05, * p<0.1		

5.3. Robustness Check

Due to the inconsistency in the way of gathering relevant information of super deduction, in order to further test the robustness of the regression results, the above-mentioned regression was performed on the sample companies' data before 2014 and since 2014. The regression results are shown in Table 6. In Table 6,

regression (1) and regression (2) are the regression of data since 2014; regression (3) and regression (4) are the regression of data before 2014.From the grouping regression results, it can be seen that: In 2014 and later, the impact of the R&D expenses tax super deduction policy on R&D output and input of the GEM listed company is significantly positive, and the regression coefficient is greater than the overall regression coefficient; before 2014, the impact of the R&D expenses tax super deduction policy on R&D output and input of the GEM listed company is also significantly positive. Although the coefficient of regression (3) and regression (4)is slightly lower than the overall regression coefficient, it does not affect the conclusion that the implementation of the R&D expenses tax super deduction policy has a statistically significant effect on listed companies on GEM's listed companies.

Table 6GroupRegression Resultsby Year

	(1)	(2)	(3)	(4)
	R&DIN	R&DOUT	R&DIN	R&DOUT
JJKC	1.736***	1.032***	1.291***	0.504**
	-0.258	-0.147	-0.279	-0.2
YYLRL	0.501*	0.162	0.255	0.14
	-0.287	-0.227	-0.218	-0.135
ZCFZL	0.00868**	-0.00221	0.0129**	0.00227
	-0.00382	-0.00425	-0.00576	-0.00595
XJL	0.0851**	0.0354	0.122	0.167*
	-0.035	-0.0568	-0.0822	-0.0915
WXZC	0.919	0.0892	4.342**	5.548**
	-0.617	-1.367	-1.683	-2.225
Constant	13.67***	0.61	12.58***	-2.014
	-0.798	-1.11	-1.825	-1.904
Number of code	346	346	346	346
R-squared	0.43	0.1	0.27	0.1
Robust standard errors in parentheses				
*** p<0.01, ** p<0.05, * p<0.1				

6. Conclusion and Suggestions

6.1. Conclusion

In this paper, a research question is raised that whether the implementation of he R&D expenses tax super deduction policy can promote the R&D activities. To answer this question, the panel data based on the R&D expenditures and patent applications of China's GEM listed companies is exploited by constructing the econometric model.

On the whole, the implementation ofthe R&D expenses tax super deduction policy has a statistically significant effect on listed companies on GEM's listed companies. In particular, firstly, the implementation of the R&D expenses tax super deduction policyhas an incentive effect on the R&D input and achieved the expected policy effect.The increase in the R&D output when the company enjoys the R&D expenses tax super deduction policy is 1.954% higher than the R&D investment when they do not enjoy the policy; secondly,the R&D expenses tax super deduction policy can significantly increase the number of patent applications for GEM's listed companies. The company's R&D input has increased by 0.858% compared to the input in R&D when it does not enjoy the policy.In general, there is strong evidence that the implementation of the R&D expenses tax super deduction policy has indeed a statistically significant positive effect on R&D activities.

6.2. Related Suggestions

Although this paper empirically proves that the implementation of the R&D expenses tax super deduction policy has indeed a statistically significant positive effect on R&D activities, there are still problems at various aspects in the implementation of the policy and numerous influencing factors.

First, the policy itself has a certain degree of complexity. Therefore, it is more difficult to carry out in practice, which includes the identification of R&D projects, the identification of R&D field, the evaluation of R&D achievements and so on. Second, there are still certain ambiguities at practical level in the current R&D expenses tax super deduction policy, such as the qualifying standard of new products and new processes, which increase the confusion of implementation for companies and policy enforcement departments. Finally, other than policy itself, regional development level, market structure and other factors also have a strong impact on the implementation of the policy.

The main bodies of the policy execution are the government and companies. Therefore, this paper will put forward concrete suggestions from these two aspects.

6.2.1. Suggestion for Government

The government and related departments should make the following adjustments:

1) Streamline the examination and approval procedure of the R&D expenses tax super

deduction policy, and lower the application costs for the company so that companies can truly enjoy the preferential policy;

2) Increase the publicity on the R&D expenses tax super deduction policy and offer free training, lectures, and seminars etc. to related target companies so that companies can further understand the policy;

3) Taxation department should clarify related concepts such as the definition of R&D activities and various R&D expenses that can be deducted, and refine the actual operation methods to reduce the confusion in implementation;

4) strengthen the linkage between the taxation department and the science &technology department to help define some professional issues about scientific and technology, and at the same time strengthen communication with the company to promote the implementation of this policy.

6.2.2. Suggestion for Company

Companies should give full play to their own initiative and should make the following adjustments:

1) Regulate the company's financial management, improve the accounting system and clearly define the relevant accounts of R&D activities so as to meet the conditions of the R&D expenses tax super deduction policy;

2)Reinforce the R&D management of the company, and strengthen the linkage between the R&D department and financial department, enhancing information sharing and communication, to solve some technical issues that are difficult for

certain financial departments to determine

3) Develop contacts with taxation and science & technology departments to understand the latest developments in policy implementation and deepen the understanding of the R&D expenses tax super deduction policy so that companies can make full use of this policy to improve their own R&D level. If necessary, they can seek the help of an external consulting agency.

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