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R&D Expense Add-on Deduction Policy, Financing Constraints and R&D Investment of High Technology Enterprises

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Abstract

The article explores the incentive effect of the R&D expense deduction policy on the R&D investment of high-tech enterprises by using a double difference model, and explores the heterogeneity of the R&D expense deduction on R&D investment based on the marketization level and financing constraints.

Keywords

R&D Expense Deduction Policy; R&D Investment; Financing Constraints.

1. Introduction

In the 2015 Government Work Report, Premier Li Keqiang put forward the concept of "mass entrepreneurship and innovation" and proposed a top-level system design based on financial, tax, legal and social aspects, raising innovation and entrepreneurship to the level of national strategy for the first time. High-tech enterprises are the main driving force of China's innovation development, and as the most innovative social body, they play an extremely important role in promoting the development of society's overall innovation capacity. According to modern economic theory, R&D activities have positive externalities, and their social returns are much higher than the company's earnings, and there is a knowledge spillover phenomenon[1]. Enterprises have limited short-term benefits and uncertain long-term benefits from R&D activities, and face many risks such as technical barriers and capital shortage, etc. The investment in R&D is not proportional to the return, and enterprises cannot achieve effective allocation of resources in R&D activities, and have insufficient motivation in R&D[2]. In a market economy, the government plays the role of macro regulation and resource allocation, and reasonable policy incentives are an important means to improve the internal driving force of enterprises to conduct R&D activities[3]. In order to optimize the effectiveness of allocating resources such as capital, facilities and intellectual property in the R&D process of high-tech enterprises, the Ministry of Finance, the State Administration of Taxation and the Securities and Futures Commission have proposed specific operational plans for companies of different sizes and industries. Fiscal policy is the main means of incentivizing listed companies in China, including fiscal decentralization incentives and tax incentives, among which, tax incentives are highly targeted and precise, and are a widely adopted policy incentive worldwide. Since 2008, China has introduced a number of tax incentive policies such as income tax reduction by half policy, accelerated depreciation policy for fixed assets and R&D expense deduction policy for various listed companies, small and medium-sized enterprises, especially high-tech enterprises, to continuously strengthen policy support and encourage R&D innovation of high-tech enterprises. Among them, the policy of deducting R&D expenses has the longest history and reduces corporate income tax, which is a more direct way of tax incentives. China's R&D expense deduction policy began in 1996 for state-owned enterprises with a 50% deduction rate, and in 2015, the Ministry of Finance, together with the State Administration of Taxation and the Ministry of Science and Technology, issued a policy on R&D expense deduction, covering all enterprises except for six industries such as tobacco manufacturing and entertainment, and in

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2017, further increased the percentage of R&D expense deduction for science and technology-based SMEs from 50% to 75%.

In recent years, the effect of the implementation of the R&D expense deduction policy has emerged, and its effect has been tested in many academic literature. On the one hand, the policy of deducting R&D expenses is a direct way to reduce corporate income tax and belongs to the category of tax incentives, thus to a certain extent, it compensates the cost of R&D investment made by enterprises, thus achieving the purpose of encouraging innovation and improving the innovation ability of enterprises[4]. The promotion of the policy also reduces the liquidity risk faced by companies conducting R&D and innovation, stabilizes the level of risk-taking, and has a significant pulling effect on the financial performance of companies[5]. On the other hand, as the R&D expense deduction policy has only really been implemented on a large scale in China since 2015, the overall application rate of the policy is currently more limited and the incentive effect varies among different types of markets. Due to the different characteristics of each industry, the policy has had different degrees and depths of impact on different industries. The R&D expense deduction policy has had a significant incentive effect on R&D investment of high-tech enterprises. Compared with the general income tax deduction policy, the policy of R&D expense deduction has a more obvious pulling effect on R&D investment of high-tech enterprises [6][7][8].

Due to the unevenness of China's economic development level, the level of financial marketization also shows an uneven phenomenon, and the existing literature mostly controls the internal factors of enterprises and ignores the influence of external environment on enterprises' R&D investment. Therefore, this paper focuses on the high-tech enterprises that are most favored by the policy, and explores the incentive effect of the R&D expense deduction policy on R&D investment of high-tech enterprises by using the double difference model, explores the heterogeneity of R&D expense deduction on R&D investment based on the marketization level and financing constraints, and further examines the path of the policy on R&D innovation of high-tech enterprises, based on which On the basis of this, we put forward targeted suggestions for policy optimization.

2. Literature References

2.1. R&D Expense Deduction Policy and Enterprise R&D Innovation

Tax incentives are an important external influencing factor for enterprises' R&D innovation, and reasonable tax incentives have good incentive effects on enterprises' R&D efficiency and innovation results[9][10]. Specifically, the role of R&D cost-plus deduction policy on firms' R&D investment and firm innovation has been fruitfully explored from multiple perspectives. Based on the perspective of the effect of the policy on enterprise R&D investment, Gan Xiaowu et al. (2020) examined the effect of R&D expense deduction on R&D revenue of high-tech enterprises and found that R&D expense deduction significantly stimulated R&D investment of high-tech enterprises[7]. Ren, Haiyun et al. (2017) examined the moderating role of firm heterogeneity between policy and R&D investment using a sample of manufacturing firms and found that the incentive effect of the policy was significantly influenced by the firm's life cycle, overall size, and characteristics of the industry in which it was located, and was also significantly related to macroeconomic development [11]. Cui Yaguang et al. (2020) used the PSM-DID method to examine the implementation effect of the R&D cost-added deduction policy in three major regions, namely Beijing, Tianjin, Hebei, Pearl River Delta, and Yangtze River Delta, and found that the policy had a more significant effect on promoting R&D of listed companies in Jiangsu, Zhejiang, and Shanghai [12]. Guo et al. (2020) found that R&D expense-plus deduction significantly improved total factor productivity of A-share listed companies in Shanghai and Shenzhen, China, based on the perspective of the effect of the policy on firm value, and the effect

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was more pronounced for capital-led companies [13]. Yao Weibao et al. (2020) used a sample of listed companies in the pharmaceutical industry in Shanghai and Shenzhen A-shares and found that the policy of R&D expense add-on deduction had an incentive effect on both technological innovation outcomes and financial value of enterprises [14].

2.2. Tax Incentives and Financing Constraints

The relationship between tax relief policies and corporate financing constraints has been less studied in academia. Jiang Xiaoyun et al. (2019) explored the impact of tax incentives on financing constraints of listed companies using the "dose-response" function, and found that tax incentives can motivate enterprises to increase the proportion of cash assets, thus alleviating the current financing constraints; at the same time At the same time, tax incentives to a certain extent make enterprises generate "rent-seeking behavior", i.e., to get tax relief to continuously increase the proportion of R&D expenditures and insufficient cash assets, resulting in inefficient over-investment and liquidity risk in the company's finance, thus aggravating the financing constraint [15]. Ma Dongmei et al. analyzed the impact of financing constraints on technological innovation from the perspective of government subsidies leading to R&D manipulation, and found that government subsidies have a strong intervention effect on the innovation motivation of high-tech firms, and the higher the degree of financing constraints, the greater the probability of "rent-seeking behavior" by policy intervention [16]. Although there are many differences between government subsidies and tax incentives, there are some analogies in the mechanism of their effects on firms' incentives for technological innovation [17].

Most of the literature confirms the incentive effects of R&D expense-plus deduction policy on firms' R&D inputs and innovation outputs, and further examines the effects of the policy on firms' market value, financial performance and innovation performance, but very little literature explores the incentive effects on firms' R&D motivation. Moreover, most of the literature is entirely based on micro perspective to examine the policy incentive effect, ignoring the impact of macroeconomic development level, and there is no clear conclusion on the intrinsic path of the impact of R&D cost-plus deduction on R&D investment. Therefore, this paper aims to find the external environmental influencing factors in the process of policy action based on the existing literature and further analyze the mechanism of policy influence on the internal financing structure of enterprises.

3. Theoretical Analysis and Hypotheses

For listed companies, especially high-tech companies, R&D innovation is an important means to create and integrate new technologies, produce technical achievements such as patents and construct the core competitiveness of the company, but the company is often troubled by financing constraints. On the one hand, the act of R&D itself requires a large amount of capital investment, and due to the low cost of endogenous financing and the easy availability of own funds, most high-tech companies will first choose to invest their own funds in R&D activities, which directly causes the reduction of internal cash flow of the company. On the other hand, R&D innovation is characterized by long-term and uncertain returns. Once a company invests in human and capital costs, it needs to bear liquidity risks for a long period of time in the future. The increased level of capital risk of listed companies signals to investors the inferiority of the company's financial position, which further affects the share price of listed companies, and the reduced scale of funds available through exogenous financing channels such as equity and debt further exacerbates the financing constraints faced by companies.

Endogenous growth theory shows that the knowledge spillover effect of R&D innovation is obvious and has a strong positive externality, the benefits of R&D innovation to society are much higher than their own benefits, and the motivation and input cost of R&D are constrained

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by this, thus causing the "failure" of the whole market self-regulation function. Government regulation at the macro level is an important tool to solve this phenomenon. Based on the above characteristics of R&D innovation, developed countries such as the UK and the US often use legal and economic measures to boost enterprise technological innovation. China is still in a period of stable economic development, and there is still a big gap between the protection of intellectual property rights in national laws and developed countries. Although the government has introduced many legal policies to improve the overall awareness of property rights in society, the effect of the policies is limited due to the uneven economic development and the complexity of the social level, therefore, economic policies have become an important tool for the government to encourage enterprise technological innovation.

There are two main channels for listed companies to obtain funds, one is the profits obtained from their own operations, and the other is external financing such as equity financing and debt financing. The proposed policy of R&D expense add-on deduction firstly directly reduces the taxable income of high-technology enterprises and increases their internal cash flow, releasing policy-level benefits to high-technology enterprises, alleviating the shortage of funds caused by high R&D investment, and helping to improve the company's risk-taking level in the long run for the purpose of promoting R&D innovation [18]. Secondly, the additional deduction of R&D expenses releases positive signals to the market and investors, indicating government-level support for corporate R&D investment, stimulating to some extent the liquidity of listed companies' stocks, which is beneficial in the long run to enhance the market value of companies, further alleviating liquidity risk, reducing the degree of financing constraints of companies, making it less difficult for companies to obtain exogenous financing, and strengthening R&D motivation[19].

In summary, this paper proposes hypothesis 1.

H1: The policy of R&D expense deduction promotes R&D investment of listed companies and has a more significant effect on R&D investment of listed companies with high degree of financing constraints.

The Chinese market as a whole is a financing system dominated by indirect financing led by commercial banks, and the uneven level of regional economic development has led to an obvious phenomenon of regional agglomeration in financial development. In Yangtze River Delta, Pearl River Delta and other eastern coastal regions, the financial market is more active, whether it is indirect financing dominated by loans from joint-stock banks or direct investment dominated by angel investment and strategic investment, which greatly broaden the financing channels of listed companies, and the social resources have a stronger supporting effect on the development of listed companies. In regions with high level of regional financial development, the number of high-tech enterprises is also higher, and the fierce competitive environment has given rise to high demand for R&D, and the subjective initiative of enterprises themselves to seek innovation is strengthened. Therefore, in a developed financial market, the developed market economy has a strong self-regulating ability, and listed companies will make R&D decisions according to their own development level and the degree of industry competition, and the role of policy intervention in company behavior is more limited.

Based on the above analysis, this paper proposes hypothesis 2.

H2: The effect of the policy is more and weaker in regions with a higher level of marketization compared to regions with a lower level of marketization.

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4. Study Design

4.1. Sample Selection and Data Source

The Ministry of Science and Technolog issued the "National Key Areas of High and New Technology Support" in 2010, which listed the fields of electronic information technology, biological and new pharmaceutical technology as the key areas of high-tech development . Therefore, based on this document and combined with the Guidelines on Industry Classification of Listed Companies issued by the Securities and Futures Commission, this paper manually screens out listed companies in eight secondary industries, such as electronic information industry and medical technology manufacturing industry in the manufacturing industry, among the A-share listed companies in Shanghai and Shenzhen, China , and eliminates the sample companies in the following order: firstly, eliminating ST and *ST companies; secondly, eliminating companies with three consecutive years thirdly, excluding companies with losses for three consecutive years; forthly, excluding companies with missing values of variables during 2012-2021. Finally, 1363 companies with 9561 observations were obtained. In addition, this paper uses a double difference model to investigate the effect of the policy, so the six industries mentioned in the "negative list of industries" in the policy document are used as the control group for the empirical study. The data of listed companies used in this paper are obtained from Guotaian CSMAR database and Wind database, and Stata16.0 is used for data processing and analysis.

4.2. Model Setting

Therefore, this paper constructs a double difference model (1) to test the effect of the policy on R&D motivation and R&D investment of high-tech enterprises.

$$RD_{i,t} = \alpha_0 + \alpha_1 DID + \alpha_2 Controls_{i,t} + \varepsilon_{i,t} \quad (1)$$

The coefficients of this variable $RD_{i,t}$ represent the effect of the policy on the motivation and investment in R&D of high-tech firms, $Controls_{i,t}$ includes a series of control variables such as gearing, cash flow, and firm size. The core explanatory variable is the interaction term of time and dummy variables in the experimental group, and the coefficient of this term represents the effect of the policy on R&D motivation and R&D investment of high-tech enterprises. If the policy has a positive incentive effect on R&D investment and R&D motivation of high-tech enterprises, it should be positive and significant.

In this paper, we apply model (1) to group regressions for groups with different levels of financing constraints and marketization.

For the measurement of financing constraints, there are different ways to measure financing constraints in the academic community[20][21][22][23][24]. The SA index uses two exogenous variables of enterprise size (Size) and enterprise age (Age), and the measure is simpler, therefore, this paper draws on the method of Ju (2013) to construct the SA index to measure financing constraints. The constructing equation is as follows:

$$SA\ Index = -0.737 Size + 0.043 Size^2 - 0.04 Age \quad (2)$$

Among them, total corporate assets (Size) are in millions, and corporate age (Age) represents the years of listed companies in years, and the SA index is calculated as a negative number, and for the simplicity of subsequent regressions, the absolute value is taken for the SA index, and the larger the absolute value of the index is, the more serious the financing constraint is for the company.

For the measurement of marketization level, this paper uses Fan Gang and Wang Xiaolu's China

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marketization index by province, and the data from 2017-2019 are obtained by linear interpolation.

5. Empirical Results and Analysis

5.1. Descriptive Statistics

The descriptive statistics of each variable are shown in Table 1. The mean value of the ratio of R&D to business revenue for high-tech enterprises is 0.066, while that for negative list enterprises is only 0.003, and there is a significant difference in the R&D investment intensity between them. In addition, the mean values of ROA and ROE of high-tech enterprises and negative list enterprises are less different, but the mean value of effective tax rate of high-tech enterprises is 13.2%, which is lower than the 15% stipulated in the income tax tax relief policy, while the mean value of effective tax rate of negative list enterprises is 24%, which initially indicates that high-tech enterprises enjoy policy benefits to a certain extent.

Table 1. Descriptive statistics of each variable

	High-tech enterprises				Negative list of enterprises				All			
	Mean	Std	Min	Max	Mean	Std	Min	Max	Mean	Std	Min	Max
R&D	0.066	0.058	0.000	0.317	0.003	0.009	0.000	0.049	0.061	0.057	0.000	0.317
DID	0.520	0.500	0.000	1.000	0.000	0.000	0.000	0.000	0.393	0.489	0.000	1.000
Incen	0.001	0.002	-0.004	0.010	-	-	-	-	0.001	0.002	-0.004	0.010
lever	0.350	0.193	0.040	0.861	0.563	0.206	0.086	0.929	0.402	0.217	0.044	0.898
Size	21.680	1.097	19.619	25.069	22.639	1.451	19.222	26.497	21.913	1.257	19.574	25.728
Income	20.923	1.266	18.265	25.181	21.959	1.564	18.265	25.181	21.174	1.416	18.264	25.181
Growth	0.181	0.376	-0.480	2.276	0.282	0.962	-0.720	7.399	0.196	0.467	-0.569	3.133
Tax	0.132	0.144	-0.554	0.749	0.240	0.170	-0.464	0.862	0.159	0.157	-0.512	0.792
Age	15.677	5.746	1.000	61.000	19.243	5.602	1.000	40.000	16.542	5.912	1.000	61.000
Cash	0.043	0.064	-0.139	0.220	0.021	0.092	-0.282	0.267	0.038	0.072	-0.196	0.230
Fixed	0.170	0.120	0.004	0.545	0.113	0.137	0.000	0.593	0.156	0.127	0.001	0.561
IR	0.040	0.035	0.000	0.199	0.031	0.046	0.000	0.242	0.038	0.038	0.000	0.209
ROA	0.046	0.066	-0.298	0.207	0.032	0.044	-0.197	0.166	0.042	0.062	-0.278	0.202
ROE	0.065	0.112	-0.597	0.299	0.076	0.115	-0.634	0.355	0.068	0.113	-0.610	0.308
Larhold	0.324	0.137	0.083	0.702	0.367	0.155	0.083	0.702	0.334	0.142	0.083	0.702
Market	8.564	1.834	-0.230	11.518	8.363	1.837	-0.230	11.518	8.515	1.836	-0.230	11.518

5.2. Difference-in-difference Results

Columns (1) and (2) of Table 2 report the results of the full sample benchmark regressions, which are robust estimates after eliminating heteroskedasticity. The regression coefficient on R&D investment is 0.007 and is significant at the 1% statistical level. The results in Table 3 show that the sign and significance of the coefficient of the policy effect variable DID do not change significantly before and after the inclusion of the control variables, indicating that the regression results have some reliability. The policy of R&D expense deduction has a significant promotion effect on R&D investment.

In this paper, the study sample is divided into high financing constraint group and low financing constraint group according to the median of financing constraint SA index for group regression. Columns (3) and (4) of Table 3 report the regression results of the financing constraint grouping. The results show that in the high financing constraint group, the regression coefficient of policy on R&D investment is 0.0095, which is positive and significant at the 1% statistical level. In the low financing constraint group, the regression coefficient of policy on R&D investment is not significant. This indicates that the policy of R&D expenses plus deduction promotes R&D innovation significantly for listed companies with high financing constraints, and has no significant promotion effect on R&D investment for companies with low financing

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constraints. According to the previous analysis, enterprises facing greater financing constraints have a stronger need for the policy and are more dependent on it, so the beneficial effect of the policy is more obvious.

In this paper, the study sample is divided into high marketability level group and low marketability level group according to the median of marketability index for group regression. Columns (5) and (6) of Table 3 report the results of the regressions grouped by marketization level. The results show that in the high marketization level group, the regression coefficient of policy on R&D investment is 0.002, which is not significant. In the low marketization level, the regression coefficient of policy on R&D input is 0.010 and is significant at the 1% statistical level. This indicates that the policy of R&D cost addition deduction has a significant effect on promoting R&D of listed companies in regions with high marketization level, and has no significant effect on promoting R&D investment of companies with low marketization level. In regions with high marketization level, the external environment is more complex, and the policy change is only part of the environmental change factors, and the R&D investment of listed companies is still influenced by the degree of industry competition, the level of financial development, and the economic environment, and the policy has a more limited impact on the R&D investment of listed companies.

To sum up, hypothesis 1 and hypothesis 2 of this paper are fully verified.

Table 2. Baseline Regression

	(1)	(2)	(3)	(4)	(5)	(6)
	Basic Regression		Divided by SA		Divided by marketing	
			High	Low	High	Low
	R&D	R&D	R&D	R&D	R&D	R&D
DID	0.009***	0.007***	0.0095***	0.004	0.002	0.010***
	(4.67)	(3.45)	(4.27)	(1.06)	(0.69)	(3.39)
Lever		-0.013*	-0.0109	-0.00707	-0.011	-0.007
		(-2.11)	(-1.03)	(-0.78)	(-1.35)	(-0.85)
Size		0.020***	0.00992*	0.022***	0.023***	0.015***
		(7.39)	(2.44)	(5.92)	(6.10)	(4.14)
Income		-0.025***	-0.0160***	-0.029***	-0.029***	-0.020***
		(-9.10)	(-5.03)	(-6.49)	(-7.12)	(-6.69)
Growth		-0.003***	-0.00235*	-0.004**	-0.002	-0.004***
		(-3.59)	(-2.16)	(-2.99)	(-1.55)	(-3.47)
Tax		-0.007**	-0.00722*	-0.003	-0.0050	-0.006
		(-2.92)	(-2.17)	(-0.87)	(-1.81)	(-1.56)
Age		0.004***	0.0039***	0.003***	0.003***	0.004***
		(9.10)	(5.23)	(5.78)	(4.88)	(6.51)
Cash		-0.016*	-0.0179*	-0.010	-0.003	-0.029**
		(-2.33)	(-2.14)	(-1.01)	(-0.40)	(-2.86)
IR		0.079**	0.0707	0.134***	0.099**	0.055
		(2.80)	(1.91)	(3.48)	(2.66)	(1.21)
ROA		-0.043***	-0.0355*	-0.067***	-0.054***	-0.045*
		(-3.79)	(-2.38)	(-3.74)	(-3.95)	(-2.42)
Year	YES	YES	YES	YES	YES	YES
Industry	YES	YES	YES	YES	YES	YES
N	9561	9560	4406	5154	5193	4367
Adj-R^2	0.119	0.217	0.215	0.218	0.220	0.224

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5.3. Robustness Tests

Figure 1 shows the results of the dynamic trend test, and adding all variables will result in a multicollinearity situation, so removing the ex ante one-period results show that before the implementation of the policy in 2016, none of the confidence intervals of the estimated coefficients are significantly different from zero, indicating that there is no significant difference in the time-varying trend of R&D investment between the treatment group and the control group of non-pilot enterprises before the implementation of the R&D expense-added policy. In contrast, after the implementation of the policy, the estimated coefficients are significantly greater than 0 and increase with the increase of the year, indicating that there is a sustained and enhanced promotion effect of the R&D expense-plus-deduction policy on R&D investment of high-tech enterprises within a certain period of time (2017-2019) when there is no critical change in external conditions.

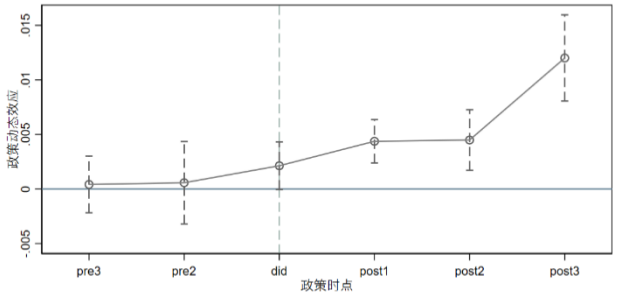

Figure 1. Parallel trend test results

6. Conclusion

In this paper, we focus our research on high-tech enterprises that are most favored by the policy, and use a double difference model to explore the incentive effect of the R&D expense-added deduction policy on R&D investment of high-tech enterprises, explore the heterogeneity of R&D expense-added deduction on R&D investment based on the marketization level and financing constraint perspective, and further examine the path of the policy's effect on R&D innovation of high-tech enterprises. The main findings are as follows: (1) The policy of R&D cost-plus deduction has a significant incentive effect on the R&D motivation and R&D investment of high-technology enterprises. (2) The R&D expense-plus-deduction policy has a significant promotion effect on the R&D investment of high-tech enterprises facing higher financing constraints. (3) The R&D expense deduction policy has a significant incentive effect on R&D investment of high-tech enterprises in regions with lower marketization level. Based on the above findings, this paper puts forward the following policy recommendations. According to the degree of competition and enterprise characteristics of each industry, the strength of different R&D expense deduction policies should be clarified, and greater support should be given to key industries. For regions with a high degree of marketization, the policy freedom can be appropriately increased to give full play to the market's own regulatory role. For regions with a lower degree of marketization, it should further strengthen the publicity and popularize the actual usage of the policy in order to achieve the expected incentive effect.

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