Research on the Influence of R&D Expenses Super Deduction Policy on Enterprise Performance

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Abstract: The original intention of the R&D Expenses Super Deduction Policy is to promote the transformation of economic growth mode and the improvement of economic benefits of enterprises. Most of the existing research focuses on R&D investment and innovation of enterprises, ignoring the promotion effect of this policy on enterprise performance. This paper uses the data of A-share listed companies from 2013 to 2018 as a sample, and uses the PSM-DID method to study the influence of the R&D expense super deduction policy on enterprise performance. The results show that the R&D Expenses Super Deduction Policy can effectively promote the improvement of enterprise performance, and the effect of the policy shows obvious differences due to the differences in the life cycle of enterprises and the degree of regional marketization; The research conclusion of this paper provides empirical evidence on how the R&D expense super deduction policy affects enterprise performance, and also provides a useful reference for the further optimization of the R&D expense super deduction policy. This paper takes this change as a quasi-natural experiment, taking the data of A-share listed companies from 2013 to 2018 as a sample, and taking the enterprises that enjoyed the policy before 2016 and still enjoy it after that as the control group, and the companies that did not enjoy the policy before 2016 and only enjoy it after that as the treatment group, and the PSM-DID method is used to systematically study the influence, heterogeneity effect of the R&D Expenses Super Deduction Policy on enterprise performance.

Key word: tax incentives, R&D expenses super deduction policy, enterprise performance, PSM-DID model

1.Introduction

At present, China's economy is undergoing a transformation from high-speed growth to high-quality development, and technological innovation has become an important part of the national strategic system. However, the R&D and technological innovation activities of enterprises have the characteristics of high cost, high risk, and positive externalities, which affect the enthusiasm of enterprises for innovation. Therefore, it is necessary for the government to compensate enterprises through a series of means. The R&D Expenses Super Deduction Policy is one of the important measures. The original intention of the policy is to promote the transformation of economic growth mode and improve the economic efficiency of enterprises.

Since its launch in 1996, the policy has undergone several adjustments and has gradually become a policy with complete systems, standardized procedures, and strong inclusiveness, and

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its effects have also attracted extensive attention from scholars. Judging from the existing literature, the positive role of the R&D expense super deduction policy in encouraging enterprises to invest in R&D and improving innovation capabilities and innovation efficiency has been confirmed by many studies [1] [4], but the ultimate goal of the China to encourage innovation is to transform scientific and technological achievements into productivity, promote high-quality development of enterprises, and promote stable and healthy economic development [2]. Therefore, whether R&D expense super deduction policy can improve enterprise performance is also a question worthy of attention. At present, there are few researches on the influence of R&D expense super deduction policy on enterprise performance, and there are certain limitations.

2. Research hypothesis

Hypothesis 1: The R&D expense super deduction policy has a positive influence on enterprise performance.

As a tax incentives policy, the R&D expense super deduction policy needs to go through three links: policy formulation, policy information transmission and management, and enterprise behavior response. In addition to policy makers and government departments, the super deduction policy is also related to the target enterprise and implementation environment of the policy [6]. Therefore, the effect of policy implementation is also affected by the characteristics of the enterprise itself and the external market environment. Heterogeneity analysis is divided into two aspects.

The first is the difference in policy effects caused by the different life cycles of enterprises. According to the theory of enterprise life cycle, enterprises in different life cycle stages have different characteristics in terms of financial needs, development strategies, governance capabilities, and business risks [7], these factors will have an impact on the influence of the R&D expenses super deduction policy. Specifically, the cash flow combination method proposed by [8] Dickinson (2011) is used to divide enterprises into five stages: start-up stage, growth stage, mature stage, recession stage, and turbulent stage.

The second is the difference in policy effects caused by the degree of marketization in the region where the enterprise is located. A good market environment is an important condition for promoting the performance of enterprises. In areas with a high degree of marketization, firstly, the capital market is more mature, the financing channels of enterprises are more diversified, and information transmission smoother, more effective policy signals, and easier access to financial support for enterprises. Based on this, hypothesis 2 and hypothesis 3 are put forward.

Hypothesis 2: Keeping other conditions constant, the R&D expense super deduction policy has the strongest impact on the performance of growth and mature companies, followed by recession and turbulent companies, and the weakest impact on start-up companies.

Hypothesis 3: Keeping other conditions constant, in areas with a higher degree of marketization, the R&D expenses super deduction policy has a better effect on promoting enterprise performance.

3.. Research design

3.1 Sample selection and data sources

This paper selects the data of A-share listed companies in Shanghai and Shenzhen stock markets from 2013 to 2018 as a sample. The data comes from Guotaian and Wande databases (https://business.ustc.edu.cn/2013/1230/c2144a23805/page.htm), and the data processing is carried out according to the following steps: first, remove the tobacco industry, manufacturing industry, accommodation and catering industry, wholesale and retail industry, real estate industry, leasing and business service industry, and entertainment industry that are not applicable to the R&D expenses super deduction policy; secondly, eliminate samples of financial industry enterprises and samples with missing values; thirdly, divide samples into control group and treatment group, according to the regulations, before 2016, enterprise activities applicable to the R&D expenses super deduction policy should belong to the "High-tech Fields Supported by China" and "Guidelines for Key Fields of High-tech Industrialization with Priority Development". This paper draws on [9] Li Xin et al. (2019), identified companies that had enjoyed the R&D expenses super deduction policy before 2016 through the identification of relevant enterprise qualifications in the Guotaian database, and used them as a control group, and finally obtained 7401 observations of 1278 listed companies .

3.2 Research method and model setting

In 2016, the expansion of the subjects applicable to the R&D expenses super deduction policy is a quasi-natural experiment for enterprises affected by the policy adjustment, and the double difference model (Difference-in-Differences, DID) can be used to evaluate the policy effect. Considering the heterogeneity among enterprises, this paper uses Propensity Score Matching (PSM) before DID estimation to ensure the comparability between the control group and the treatment group, and to improve the problem of sample selection deviation. The equation of PSM for:

$$\mathrm{Treat}_i=\alpha_0+\alpha_1\mathrm{Controls}_i+\varepsilon_i \quad (1)$$

Model (1) is a binary dummy variable regression model, with whether enjoying the policy as the explained variable, and the control variable representing the individual characteristics of the enterprise as the explanatory variable to calculate the propensity score value, and according to the propensity score value, select the companies with the closest matching scores, so that the difference between the paired companies is mainly caused by whether they enjoy the R&D expenses super deduction policy.

In order to investigate the influence of R&D expenses super deduction policy on enterprise performance, a DID model is constructed:

$$\mathrm{Tobin\ Q}_{i.t}=\beta_0+\beta_1\mathrm{Treat}_{i.t} * \mathrm{Period}_{i.t}+\beta_2\mathrm{Controls}_{i.t}+\mathrm{Industry}_i+\mathrm{Year}_t+\Phi_{i.t} \quad (2)$$

$\mathrm{Tobin\ Q}_{i.t}$ is the explained variable, that is, the Tobin's Q value of the enterprise, which is used to measure the performance of the enterprise; ; $\mathrm{Treat}_{i.t}$: group dummy variable, if enterprise i did not enjoy the R&D expense super deduction policy before 2016, it is the treatment group, $\mathrm{Treat}_{i.t}$ takes the value of 1, otherwise it is 0; $\mathrm{Period}_{i.t}$:period dummy variable, if t is 2016 and later years, then $\mathrm{Period}_{i.t}$ takes the value 1, otherwise it is 0; The product of the two is the

core explanatory variable of this paper, and its estimated coefficient β_1 measures the policy effect that this paper focuses on; $Industry_i$ represents the industry fixed effect, $Year_t$ represents period fixed effects, $\Phi_{i.t}$ indicates the error term; Subscripts i and t denote enterprise and year, respectively.

3.3 Variable specification

The explained variable in this paper is enterprise performance. By using Tobin's Q value as an indicator to measure enterprise performance [3], this indicator can objectively and truly reflect the actual performance of listed companies. As mentioned above, the core explanatory variable is a group dummy variable interaction term with period dummy variable $Treat_{i.t} * Period_{i.t}$.

The control variables refer to the existing research, and select return on equity (ROE), enterprise size (Size), debt asset ratio (Leverage), company listing age (Age), director and supervisor salary (Salary), senior management shareholding ratio (Hold) to control, and set industry dummy variables (Industry) and year dummy variables (Year) to control the influence of industry and year. Table 1 shows the variable definition.

Table 1 Variable definition

variable nature	variable name	variable symbol	variable description
explained variable	Tobin's Q value	Tobin Q	Market value of total assets of the enterprise/replacement cost of total assets of the enterprise
core explanatory variable	policy processing	Treat * Period	Interaction term for period and treatment group
control variable	return on equity	ROE	Net profit/balance of shareholders' equity at the end of the period
	enterprise size	Size	ln (total assets)
	debt asset ratio	Leverage	Total debt/Total Assets
	company listing age	Age	ln (Current year - listing year +1)
	director and supervisor salary	Salary	ln (Total annual salary of directors, supervisors and senior management)
	senior management shareholding ratio	Hold	Number of shares held by senior management/number of common shares *100%

4. Analysis of empirical results

4.1 Analysis of PSM matching results

First, the PSM method is used to match the samples of the treatment group and the control group, and the dummy variable of whether the enterprise is treated is regressed to the control variable to obtain the propensity score value, and the nearest neighbor matching method is used for matching, and the matching results are tested for common values and matching balance test, from the kernel density distribution diagrams of the propensity scores of the treatment group

and the control group before and after the matching shown in Figure 1 and Figure 2, it can be seen that the probability densities of the propensity scores of the treatment group and the control group after matching are relatively close, indicating that the matching effect is good, which conforms to the common value assumption.

Comparing the changes of t and standard deviation before and after matching, the specific results are shown in Table 2. It is found that most of the control variables no longer have significant differences between the treatment group and the control group after matching, and the standard deviation after matching is significantly reduced. The absolute value of the standard deviation of each control variable is less than 10%, indicating that the matching basically satisfies the balance assumption, and also proves that the analysis using the PSM-DID method in this paper is reasonable.

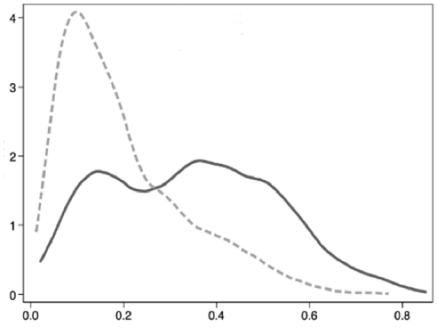

Figure 1 Propensity score density map before matching

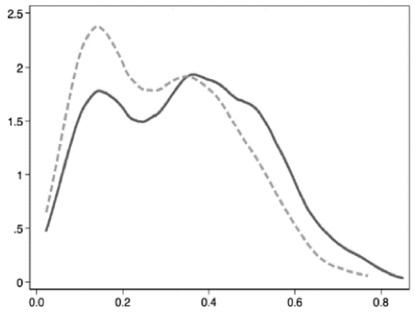

Figure 2 Propensity score density map after matching

Table 2 Comparison of sample features before and after PSM matching

variable	sample	average value		deviation	deviation reduction %	T test	
		treatment group	control group			T	P
ROE	before matching	0.0295	0.0396	-1.6	-128.1	-0.65	0.516
	after matching	0.0295	0.0526	-3.6		-1.17	0.242
Size	before matching	22.4800	22.0200	38.6	79.8	14.79	0.000
	after matching	22.4800	22.573	-7.8		-2.13	0.034
Leverage	before matching	0.4582	0.3776	39.6	87.3	15.00	0.000
	after matching	0.4582	0.4684	-5.0		-1.43	0.153
Age	before matching	2.4833	2.0813	71.2	97.7	25.94	0.000
	after matching	2.4833	2.4739	1.7		0.49	0.621
Salary	before matching	15.2160	15.3500	-19.6	86.4	-7.28	0.000

	after matching	15.2160	15.2340	-2.7		-0.78	0.448
Hold	before matching	3.0692	8.4717	-45.3	87.4	-14.89	0.000
	after matching	3.0692	3.7482	-5.7		-2.11	0.035

4.2 Benchmark regression results

Columns (1) and (2) of Table 3 report the results of the benchmark regression. It can be seen that the coefficient signs and significance levels of the core explanatory variables have not changed significantly before and after adding control variables, indicating that the overall regression results are reliable. From the results of column (2), the coefficient of the variable $Treat_{i.t} * Period_{i.t}$ that this paper focuses on is 0.2726, which is significant at the 1% level, indicating that the implementation of the R&D expense super deduction policy can significantly improve enterprise performance by 0.2726 units, hypothesis 1 of this paper is verified.

Table 3 Benchmark regression and heterogeneity analysis results

variable	benchmark regression		enterprise life cycle heterogeneity			regional marketization heterogeneity	
	1	2	3 start-up period	4 mature period	5 recession period	6 high marketization	7 low marketization
Treat * Period	0.3201*** (0.0529)	0.2726*** (0.0521)	0.1009 (0.1950)	0.2905*** (0.0615)	0.4912* (0.2538)	0.2907*** (0.0623)	0.1581 (0.1112)
ROE		0.0287 (0.0209)	-0.1371 (0.2246)	0.0935*** (0.0316)	-0.0533 (0.0785)	0.0374 (0.0267)	0.0320 (0.0337)
Size		-1.0143*** (0.0400)	-0.9705*** (0.1639)	-0.8930*** (0.0516)	-1.6211*** (0.1785)	-1.0329*** (0.0458)	-1.1171*** (0.1013)
Leverage		0.3938*** (0.1276)	0.5017 (0.3568)	0.4537** (0.1777)	0.7128 (0.5166)	0.3133** (0.1422)	0.9624*** (0.3268)
Age		0.7497*** (0.1057)	0.4846 (0.4187)	0.7599*** (0.1251)	0.8534 (0.5238)	0.8137*** (0.1201)	0.3047 (0.2983)
Salary		0.2691*** (0.0436)	0.1761 (0.1800)	0.2423*** (0.0516)	0.5685** (0.2204)	0.2730*** (0.0510)	0.2022** (0.0917)
Hold		-0.000 (0.0018)	-0.0022(0.0055)	0.0016 (0.0022)	0.0009 (0.0094)	0.0003 (0.0020)	0.0018 (0.0066)
cons	1.1757 (1.0942)	17.6785*** (1.14190)	18.5499*** (4.0275)	15.5762*** (1.6510)	25.9354*** (4.6154)	17.6234*** (1.5297)	22.5559*** (2.4197)

Industry	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	7343	7330	945	5098	1287	6284	1046
R^2	0.315	0.383	0.420	0.387	0.420	0.385	0.419

4.3 Heterogeneity analysis

1. Heterogeneity of enterprise life cycle

According to the previous analysis, according to the positive or negative of the net operating cash flow, net investment cash flow and net financing cash flow of the enterprise, the enterprises are divided into three groups: the start-up period, the growth period and the mature period, the recession period and the turbulent period.

From column (3) of table 3, R&D Expenses Super Deduction Policy has a positive but not significant impact on the performance of start-up companies. It can be seen that although start-up companies have high innovation enthusiasm and large R&D investment scale, however, R&D innovation is uncertain, and large-scale R&D expenditure does not necessarily lead to more innovative results and profitable products. The premise of being able to actually enjoy the R&D Expenses Super Deduction Policy is that the taxable income is positive. Enterprises in the early stage may not be able to carry out super deduction in the year due to losses, so the R&D Expenses Super Deduction Policy does not have a significant effect on improving the performance of enterprises in the early stage.

The estimation results in column (4) of table 3 show that the R&D expenses super deduction policy can significantly improve the performance of enterprises in the growth stage and mature stage. The investment scale is relatively large, so it can fully enjoy the benefits brought about by the R&D Expenses Super Deduction Policy. At the same time, enterprises at this stage have stronger technological innovation capabilities and resource utilization capabilities, are more familiar with the supply and demand of their industry, can give full play to their technological and resource advantages, accelerate the transformation of R&D investment into innovative results, and improve their market competition. It can bring actual economic benefits to the enterprise, and promote the improvement of enterprise performance.

The results in column (5) of Table 3 show that the R&D Expenses Super Deduction Policy can help improve the performance of enterprises in recession and turbulent periods, but its significance level is lower than that of enterprises in growth and maturity periods, which is consistent with hypothesis 2 of this paper , that is, during the recession and turbulent periods, enterprises pay less attention to R&D investment, and the influence of the R&D expense super deduction policy on their enterprise performance has weakened.

2. Heterogeneity of the degree of regional marketization

In this paper, the total marketization index score in the "Marketization Index Report by Province in China" is used to measure the degree of marketization of the provinces and cities where the enterprises are located [5], and the sample enterprises are divided into two groups based on the mean value. The estimated results are shown in the columns of table 3 column (6) and column (7).

The results show that the influence of the R&D expenses super deduction policy on enterprise performance is stronger in areas with a high degree of marketization. The policy adjustment in 2016 increased enterprise performance in high marketization areas by 0.2907 units, which was significant at the 1% level, enterprise performance in low marketization areas is also positively affected, but not significantly. We believe that highly marketization regions have better market mechanisms, more reasonable allocation of factors, and a more robust institutional environment, which provide a good foundation for the role of the R&D expense super deduction policy. Hypothesis 3 of this paper has been verified.

4.4 Robustness check

In this paper, the PSM-DID method is used to make the estimation results more reliable. In order to ensure the robustness of the regression results, the following robustness tests Table 4 are carried out.

Table 4 Robustness test results

variable	counterfactual test		replace the explained variable	manufacturing sample
	1	2	3	4
$Treat * Period$			0.1866*** (0.0361)	0.2493*** (0.0535)
$Treat * Period\_2014$	-0.0579 (0.0684)			
$Treat * Period\_2015$		-0.0474 (0.0551)		
cons	18.2800*** (1.4224)	18.2918*** (1.4233)	-8.1003*** (0.9831)	17.1554*** (1.0329)
Controls	Yes	Yes	Yes	Yes
Industry	Yes	Yes	Yes	Yes
Year	Yes	Yes	Yes	Yes
N	7330	7330	7330	5939
R^2	0.381	0.381	0.344	0.407

6. Conclusion

The research findings: (1) The full sample estimation results show that the R&D expense super deduction policy promotes the improvement of enterprise performance. (2) The heterogeneity analysis found that from the perspective of the enterprise life cycle, the R&D expense super deduction policy has the most significant positive influence on the performance of enterprises in the growth stage and mature stage, followed by enterprises in the recession stage and turbulent stage, and it is not significant in the start-up stage; from the perspective of regional marketization, in regions with a high degree of marketization, the R&D Expenses Super Deduction Policy has a stronger role in promoting enterprise performance.

The R&D expense super deduction policy is an effective policy tool to promote enterprise innovation and improve enterprise performance. The research conclusion of this paper has the following implications for the implementation and adjustment of the R&D expense super deduction policy: first, the R&D expense super deduction policy can be effective promote the

innovation output of enterprises and the improvement of enterprise performance, in the future, we should further play the role of the R&D expense super deduction policy, stimulate the enthusiasm of enterprises for innovation, and improve the economic efficiency of enterprises; It is one of the "twin engines" of China, which is of great significance to fostering economic growth. However, the R&D Expenses Super Deduction Policy plays a role by reducing the tax burden of enterprises. The start-up enterprises are not yet profitable, so they cannot enjoy policies in the current period of R&D investment, should consider adopting more effective means such as directly providing financial support to start-up enterprises to support enterprises through the start-up period; third, the market environment has a significant impact on the effect of the R&D Expenses Super Deduction Policy, and local governments should strengthen the improvement of the market system, to provide enterprises with a good environment for innovation and development, so as to better exert the effect of the R&D Expenses Super Deduction Policy.

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