Tax Reduction and Fee Reduction, R&D Innovation and Financial Performance of High-Tech Enterprises-Test Based on the Difference-in-Differences Model

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Abstract. As the first of the five new development concepts, innovation is an important underpinning for building a modernized economy. As the leader of innovation-oriented enterprises, high-tech enterprises have great impetus to the national comprehensive innovation capability. Therefore, this paper constructs difference-in-difference model, and adds the robust standard error to study the correlation between tax reduction and fee reduction, R&D innovation and financial performance of high-tech enterprises, and finally carries on the robustness test. The model test results show that: (1) both the policy of increasing the additional deduction ratio of R&D expenses and the preferential policy of low tax rate can significantly improve R&D investment and financial performance of high-tech enterprises, but the latter has a stronger significance; (2) The impact of R&D investment on financial performance has a lag; (3) Compared with the policy of increasing the proportion of additional deduction, R&D investment has a more significant mediating effect on the preferential policy of low tax rate and financial performance.

Keywords: Tax and Fee Cuts · High-tech Enterprises · R&D Investment · Financial Performance · Difference-in-differences Model · Robustness Test

1 Introduction

As the leader of innovation-oriented enterprises, high-tech enterprises have a two-way incentive effect on technological innovation and regional economy [1]. Therefore, the government not only established the Beijing Stock Exchange and the science and technology Innovation Board from the financing side to expand financing channels, but also adopted preferential policies of tax and fee reduction to reduce enterprise costs and R&D risks from the cost side. The enterprise income tax law of the People's Republic of China stipulates in Article 20 of the Enterprise Income Tax Law of the People's Republic of China that the high and new technology enterprises which need to be supported by the State shall be levied enterprise income tax at a reduced rate of 15% (hereinafter referred to as the "preferential policy of low Tax rate"). Notice of Finance and Taxation (2018) No.

D. Qiu et al. (Eds.): ICBBEM 2022, AHIS 5, pp. 827–836, 2023.
https://doi.org/10.2991/978-94-6463-030-5_81

99 on Increasing the Proportion of Additional Tax Deduction for RESEARCH and Development Expenses increases the proportion of additional tax deduction for RESEARCH and Development Expenses to 75% (hereinafter referred to as the "Proportion Increase Policy").

2 Theoretical Background and Research Hypothesis

2.1 Tax and Fee Cuts and R&D Investment

The preferential policy of additional deduction for R&D expenses not only has a positive incentive effect on R&D investment of enterprises, but also has universality [2, 3]. Low tax incentives also have an incentive effect on R&D investment of high-tech enterprises and help enterprises to carry out independent innovation [4, 5]. However, compared with the tax base preferential policy, the tax rate preferential policy with low tax rate has more direct tax reduction effect and more incentive effect on enterprise R&D activities. Based on this, the following hypotheses are proposed:

Hypothesis 1: The proportion increase policy has a significantly higher effect on enterprise R&D investment than the preferential policy of low tax rate.

2.2 Tax and Fee Cuts and Enterprise Performance

Due to the positive externality of technological innovation, the activities carried out by R&D subjects will be imitated by other enterprises, resulting in profit dilution and market failure. Therefore, the government must intervene and adjust, and tax incentives are the starting point for the government to promote innovation. There is a significant positive correlation between income tax reduction and profit level of high-tech enterprises [6]. Based on this, the following hypotheses are proposed:

Hypothesis 2: Proportion increase policies and low tax incentives can significantly improve corporate financial performance, but the latter is more relevant.

2.3 R&D Investment and Financial Performance

Most enterprises improve their competitiveness through R&D to improve their financial performance. Therefore, R&D investment has a significant role in promoting financial performance [7–9]. However, from R&D investment to financial performance, it needs to go through a certain cycle, so there is a lag effect. Based on this, the following hypotheses are proposed:

Hypothesis 3: R&D investment has a significant positive correlation with financial performance.

2.4 The Mediating Effect of R&D Investment on Tax and Fee Reduction and Financial Performance

Tax and fee reduction preferential policies will reduce external risks and capital pressure of enterprises, thus promoting the improvement of financial performance. Preferential policies of low tax rate have a positive impact on financial performance [6, 8], and R&D investment has a mediating effect between the two [10]. And the preferential policy of low tax rate is more direct, and its mediating effect is more obvious. Based on this, the following hypotheses are proposed:

Hypothesis 4: Compared with the proportional increase policy, R&D investment has a more significant mediating effect on the preferential policy of low tax rate and financial performance.

3 Empirical Study Design

3.1 Sample Selection and Data Sources

The data in this paper were obtained from CSMAR, Dongfang Fortune network and high-tech enterprise Identification network. This paper selects Chinese high-tech enterprises, high-tech industrial enterprises and six negative list industries from 2010 to 2020 as research samples. The samples with ST, *ST and missing major variables during the sample period were eliminated, finally 3150 initial data were obtained.

3.2 Variable Selection

3.2.1 Explained Variable

The explained variable selected in this paper is financial performance (ROE), namely return on equity, which makes up for the deficiency of tax profit per share index and has a strong comprehensiveness.

3.2.2 Explanatory Variables

The explanatory variable is the interaction term coefficient between policy and year. Policy represents whether the enterprise enjoys two preferential policies. If the policy is enjoyed, the value is 1; otherwise, the value is 0. Year represents the policy implementation process. For the two policies, 2018 and 2014 are respectively taken as the policy implementation years in this paper. The year after the policy implementation year is taken as 1 and the year before it is taken as 0. If both policy and year are set to 1, the cross product is set to 1; otherwise, the cross product is set to 0.

3.2.3 Intervening Variable

The mediating variable selected in this paper is R&D investment (II). Since the absolute amount of R&D investment varies greatly among different scales and industries, R&D investment/main business income is used to measure it.

Table 1. Variable definition and description

Variable types	Variable name	Variable to explain
Explained variable	ROE	Net profit/equity
Explanatory variables	policy	The value is 1 in the current year; otherwise, it is 0
	year	The value is 1 in 2014 or after 2018; otherwise, it is 0
Intervening variable	II	R&D investment/main business income
Control variables	Size	Ln (Total enterprise assets + 1)
	ROTA	Net profit/total assets
	NOI	Net profit/main business income
	PIA	Ending intangible assets/Ending total assets
	DAR	Total assets/total liabilities
	CI	Total assets/main business income

3.2.4 Control Variables

To avoid endogeneity among variables, Table 1 is the control variables added in this paper.

3.3 Model Design

To reduce endogeneity between variables, the DID model is adopted in this paper, as shown below:

$$\begin{aligned} II_{i,t} &= \alpha_0 + \alpha_1 * policy_i * year_t + \alpha_2 * policy_i \\ &+ \alpha_3 * year_t + \alpha_4 * X_t + \varepsilon_{i,t} \end{aligned} \tag{1}$$

$$\begin{aligned} ROE_{i,t+2} &= \alpha_5 + \alpha_6 * policy_i * year_{t+2} \\ &+ \alpha_7 * policy_i + \alpha_8 * year_{t+2} + \alpha_9 * X_t + \varepsilon_{i,t} \end{aligned} \tag{2}$$

$$\begin{aligned} ROE_{i,t} &= \beta_0 + \beta_1 * II_{i,t+2} + \beta_2 * policy_i * year_{t+2} \\ &+ \beta_3 * policy_i + \beta_4 * year_{t+2} + \beta_5 * X_t + \varepsilon_{i,t} \end{aligned} \tag{3}$$

Model (1) and model (2) correspond to the DID regression model of two preferential policies on R&D investment and financial performance with two lag periods respectively, $II_{i,t}$ respectively represent the R&D investment of the two preferential policies, $ROE_{i,t}$ respectively represents the financial performance of the two policies; Model (3) tests the mediating effect of R&D investment on two preferential policies and financial performance. Subscript i represents the ith firm, subscript t represents the t year. $II_{i,t+2}$ and $year_{t+2}$ respectively represent the R&D investment and year with two lag periods, variable $policy_i * year_t$ is the interaction term of the policy and year dummy variables. X_t is control variable; $\varepsilon_{i,t}$ is error term.

4 Empirical Test and Result Analysis

4.1 Descriptive Statistics

The two policy samples were 1,643 and 1,980 respectively; The maximum R&D investment is 25.06%, 74.29%, the minimum is 0%, the mean is 1.648%, 3.554%, indicating that there is a big difference in R&D investment intensity among enterprises. The maximum value of financial performance was 56.6% and 85%, and the mean value was 4.1% and 4.8%. Because the value obtained by some enterprises in some years is negative and large, the mean value is low.

4.2 Regression Analysis

This paper uses STATA software to test DID model, the regression results are shown in Table 2.

As shown in the Table 2, the first two columns respectively show that did in the current period of proportional increase policy affects R&D investment in the current period and the financial performance in the two lagging periods. It is found that the policy has a significant positive impact on current R&D investment at the level of 1%, with a correlation coefficient of 1.109. When the R&D investment base is large, the marginal effect will be large, let alone 175%. For the financial performance lagging two periods, although the R&D output of sample enterprises is low, their R&D capability will be reflected in the financial performance to some extent. Therefore, the policy implementation has a weak promotion effect on the financial performance at the significant level of 1%, with a correlation coefficient of 0.0765.

As for the preferential policy of low tax rate (the two columns in the middle), because it is equivalent to the enterprise tax rate of 60% discount directly, the preferential intensity is large, and compared with the enterprise that is not identified as successful, the high-tech enterprise that is identified as successful has much stronger innovation ability, and the enterprise economic benefit conversion rate is higher. Therefore, the policy has a positive promotion effect on R&D investment and financial performance at the significant level of 1%, with correlation coefficients of 1.448 and 0.291, respectively.

Table 2. DID regression results

Variable	II	ROE	II	ROE	ROE	ROE
llII					0.000281	−0.00232**
Time	0.159	−0.0335***	0.265	0.310***	−0.0335***	0.328***
treated	0.114	0.0190*	0.384	−0.460***	0.0189*	−0.437***
Did	1.109***		1.448***			
L2did		0.0765***		0.291***	0.0762***	0.314***

Note: ***, ** and * represent significant at 99%, 95% and 90% confidence levels respectively (the same below)

In conclusion, the regression coefficients of proportion increase policy and low tax incentive policy on R&D investment are 1.109 (1%) and 1.448 (1%), respectively, and the regression correlation coefficients of financial performance with two lag periods are 0.0765 (1%) and 0.291 (1%). By comparison, it can be found that both the R&D investment and the financial performance with two periods lag have a stronger positive incentive effect of the preferential tax policy. This conclusion verifies the hypothesis 1, 2 and 3.

For mediation effect (the last two columns), under the policy of the first R&D and lag period there was no significant correlation between financial performance, but in the intervening variable, the lag of policy implementation two issue of financial performance has a promoting effect on the level of 1%, show that R&D policy in proportion to improve and has a certain intermediary effect between financial performance, the coefficient is 0.0762.

As for the second policy, it is difficult to obtain invention patents, but to improve the core competitiveness of enterprises, they need to increase R&D investment. However, most of the funds will be itemized as R&D expenses before tax. In addition, high-tech enterprises have too much R&D investment in the early stage. For a year or two there will be no recovery in costs from the output of patents and the production and sale of products. Therefore, the correlation coefficient between R&D investment and financial performance of two periods behind is −0.0232 (5%), indicating that R&D investment inhibits financial performance of two periods behind. Under the influence of the mediating effect, the policy implementation also has a significant impact on the financial performance of the two lagging periods, with a correlation coefficient of 0.314 (1%).

To sum up, without mediating effect, the correlation coefficients of the impact of the two policies on financial performance are 0.0765 (1%) and 0.291 (1%) respectively. Under mediating effect, the correlation coefficients of the impact of the two policies on financial performance are 0.0762 (1%) and 0.314 (1%) respectively. It can be found that regardless of the mediating effect, low tax preferential policies have the most significant impact on financial performance. In addition, as for the mediating effect of R&D investment, R&D investment has the most significant impact on financial performance under the influence of preferential tax policies. Thus, hypothesis 4 is verified.

4.3 Robustness Test

To make the results more robust, robustness tests are carried out in this paper (Table 3).

For the proportion increase policy (column 2), the regression results are not significant and the coefficient is small in the three years before the implementation of the policy, but in the year the policy was implemented, the correlation coefficient rises sharply from −0.387, 0.098 and 0.206 to 1.127 (1%), and the correlation coefficient in the two years after the implementation of the policy is 1.125 and 1.016. The same conclusion can be drawn from the pattern of broken lines in Fig. 1.

For the preferential policies of low tax rate (column 3), the regression results are also not significant in the two years before the implementation of the policies, and the correlation coefficients in the first three years remain negative, which are −1.272, −0.841 and −0.229, respectively. In the three years after the implementation of the policies, the

Table 3. Parallel trend test

Variable	II	II
Before3	−0.387	−1.272**
Before2	0.0980	−0.841
Before1	0.206	−0.229
Current	1.127***	0.359
After1	1.125***	1.162**
After2	1.016***	1117*
After3	–	0.156

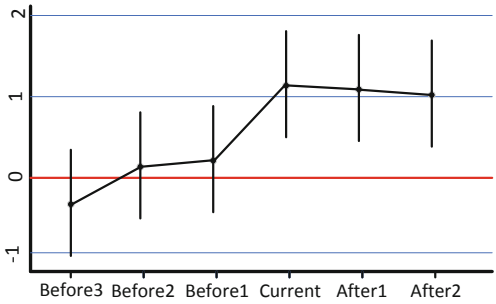

Fig. 1. Parallel trend test of proportional increase policy

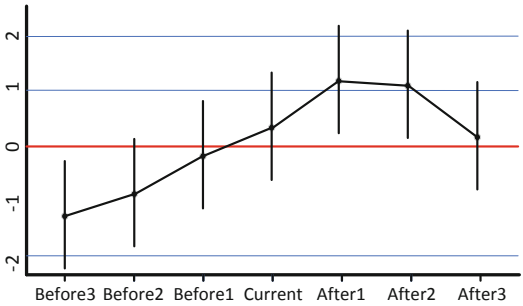

Fig. 2. Parallel trend test of preferential policies of low tax rate

coefficients become 0.359, 1.162 (5%) and 1.117 (10%). This indicates not only that the preferential policy has significantly promoted the r&d investment of enterprises, but also that the policy lasts for only three years, but the coefficient remains positive. The same conclusion can be drawn from Fig. 2.

5 Conclusions and Recommendations

Based on the above analysis, the following conclusions can be drawn: first, the proportion increase policy and the preferential tax policy have a positive correlation with the R&D investment and the two-year lag financial performance at the level of 1%, and the latter policy has a stronger effect; Second, R&D investment has a lag effect on financial performance; Third, R&D investment has the most obvious mediating effect on low tax incentives and financial performance. Based on this, this paper suggest the following:

5.1 Government Level

5.1.1 Strengthen Mechanisms for Protecting Intellectual Property Rights

To promote the R&D investment of enterprises and protect the R&D achievements from infringement, it is particularly important to improve the intellectual property protection mechanism. If R&D patents and other achievements can't be effectively protected, the business performance of enterprises will suffer a huge loss. So the intellectual property protection mechanism should be strengthened to reduce the risk of enterprise R&D and operation.

5.1.2 Increase Support for Preferential Tax Policies

In order to promote technological innovation of enterprises, China should enhance the support of tax incentives, especially for high-tech enterprises. Compared with 65% tax deduction in the United States, the innovation support of 10% tax rate for high-tech enterprises in China is still low. Therefore, China should appropriately enhance the intensity of tax incentives, which is more conducive to stimulate the enthusiasm of enterprises to improve the scientific research level of all enterprises in the whole industry.

5.1.3 Deepen the Development of Platforms for Industry-University-Research Cooperation

The combination of large amount of working capital of enterprises, patent technology of scientific research institutes and scientific research talents and scientific research projects of colleges and universities can save a lot of labor research and development costs of enterprises, indirectly reduce the tax burden of enterprises, and then improve enterprise performance. At the same time, scientific research institutes and universities can also get what they need, to achieve win-win results for all.

5.2 Corporate Level

5.2.1 Accelerate the Improvement of the Evaluation System for Enterprise

The process of technological innovation activities lasts for a long time. To ensure that enterprises get the final benefit output from R&D input, it is necessary to establish an effective evaluation system. First, enterprises need to establish a clear budget system for budget control, and strictly control the research expenditure and development expenditure in the process of R&D. Second, enterprises are also required to follow up the

real-time progress of each research and development project, and record detailed capital expenditure details.

5.2.2 Accelerate the Efficiency with Which R&D Investment is Converted

For the research results obtained by the enterprise, it is necessary to timely apply for patents, and design transformation schemes, so that the results can be transformed into products or competitive technical services as soon as possible to improve enterprise benefits. As mentioned above, the R&D investment has a low conversion rate to corporate financial performance. Therefore, it is necessary to strengthen the tracking and supervision of project implementation, shorten the transformation time of project R&D investment, and turn it into an achievable profit return as soon as possible.

5.2.3 Accelerate the Realization of Research and Development Cooperation Projects

To improve the enterprise's technological innovation ability and research and development transformation level, it is necessary to establish a horizontal cross-enterprise innovation and research platform, so as to better improve the research and development level of China's high-tech enterprises and even the whole high-tech industry. At the same time, enterprises share research results, to achieve win-win results for all.

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