

THE IMPACT OF CHINA'S R&D EXPENSE SUPER DEDUCTION POLICY ON CORPORATE INNOVATION OUTPUT

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With the economic turmoil in the world and the intensification of the scientific and technological game between China and the United States, how to achieve the "low-end lock" in the technological leap is an urgent problem for the Chinese government to solve. As an inclusive R & D incentive policy, how does the R & D expense additional deduction policy affect enterprise innovation? Whether it can solve the innovation dilemma of Chinese enterprises has important theoretical and practical significance. From the two dimensions of "quality" and "quantity" of the enterprise innovation output, this paper focuses on the basic topic of "how the additional deduction of R & D expenses affects the enterprise innovation output" and brings the R & D manipulation into the research framework. Taking China's A-share manufacturing enterprises as the sample, the additional deduction of R & D expenses plays its "tax saving effect" and promotes the increase of the quantity and quality of enterprise innovation. The regulatory vacuum of the additional deduction policy and the advantage of R&D information will induce the self-interest behavior of the management, resulting in shortsighted decision-making by enterprises, which is not conducive to the innovation output of enterprises. With the increase in the proportion of additional deductions, the initiative and adaptability of enterprises to the policy are gradually enhanced.

Keywords: R&D expense super deduction; innovation quality; innovation quantity; R&D manipulation

Introduction

Scientific and technological innovation is an important way to enhance the core competitiveness and comprehensive strength of enterprises. In order to enhance the capacity for sustainable innovation and development, countries have launched development plans such as "reindustrialization" and "Industry 4.0".



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The Chinese government has also launched an innovation-driven development strategy, with initial incentive results. According to the Industrial R&D Investment Scorecard released by the European Union in 2022, among the top 2500 R&D enterprises in the world, China's selected enterprises rank second in the world in total number and growth rate, and the growth rate of R&D investment ranks first among the countries surveyed.

The World Intellectual Property Organization released the Global Innovation Index 2022 report, which shows China's steady improvement to rank 11th. Compared with R&D investment, the quality of innovation output patents and product technology content is not high, and some key core technologies are missing. The phenomenon of Chinese enterprises is still "emphasizing quantity and light quality" in innovation.

As the source of enterprise competitiveness, R&D activities make tax incentives related to R&D more popular among enterprises.

France, Italy, Britain, and other countries have formulated tax relief policies. According to the OECD data, 30 OECD countries and 21 EU countries provided R&D tax relief policies for enterprises in 2018 (Bloom et al., 2016).

Since the Chinese government proposed the preferential policy of additional deduction for R&D expenses in 1996, the intensity of preferential treatment, applicable industries, and collection scope of R&D expenses have been continuously standardized and improved, and the deduction proportion has been increased from 50% to 100%. Under the macroeconomic background of China's slowing economic growth and the gradual disappearance of demographic dividends, tax incentives will greatly play the role of institutional dividends (Sun et al., 2016).

Analyzing and evaluating the incentive effect of the preferential policies of additional deduction of R&D expenses is of great significance to improving the effectiveness of the policies and building an innovative country.

Objectives

As a preferential and inclusive tax policy, the incentive effect of the additional deduction policy for R&D expenses on enterprise innovation has attracted wide attention from the academic community. In recent years, research has gradually expanded from the relationship between it and innovation input to innovation output, and the relationship between the additional deduction policy of R&D expenses and enterprise innovation is mostly explained by quantitative growth.

In order to ensure the effectiveness and perfection of the policy, it is necessary to comprehensively consider the quantity and quality of the innovation of enterprises under the incentive of the additional deduction policy.

Taking the data of China's A-share manufacturing enterprises from 2012 to 2020 as a sample, this paper explores the relationship between the additional deduction policy and the innovation output of quantity growth and quality improvement from the two aspects of patent application and reference data.

In addition, the research and development manipulation of adjustment variables was introduced to deepen and promote the research on the development of additional deduction policies for innovation and development.

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Literature review

R&D expenses and enterprise innovation output

Scholars have extensively discussed whether the policy of additional deductions for R&D expenses is effective in encouraging enterprise innovation. Most studies show that the additional deduction policy has an incentive effect on enterprise innovation.

The Canadian government's tax credit leads to more product innovation and a higher share of sales of new products (Czarnitzki et al., 2011).

The Norwegian government's tax cuts in 2002 favor process innovation rather than product innovation (Cappelen et al., 2012; Dechezleprêtre et al., 2016).

The SME data in the UK verified the positive incentive effect of the tax credit policy on the number of patent application (Ivus et al., 2021). The crowding effect of R&D tax incentives was further tested and supported by innovation data from Indian private enterprises. Some scholars also object to the above views, believing that the additional deduction of R&D expenses does not significantly increase the number of enterprise innovations and will even have a certain inhibitory effect.

Tassey (2007) studied the impact of the US tax credit policy on corporate innovation and found that the impact of the policy was weak and failed to achieve the expected incentive effect.

Mukherjee et al. (2017) found that there is no obvious correlation between the decrease in the US corporate tax rate and the increase in the number of corporate patent applications.

Yang & Rui (2020) found that the tax reduction policies could not effectively promote the growth of the number of enterprise innovations due to the "rent-seeking" behavior of enterprises.

Driven by the global wave of innovation, the academic community began to realize the great disadvantages of evaluating innovation by the amount of innovation (Chen et al., 2020).

Innovation quality began to enter the research vision of scholars.

Zheng et al. (2020) built a measurement system of enterprise innovation quality with various indicators of the proportion of enterprise invention patents and found that the income tax reduction policy could significantly promote the improvement of enterprise innovation quality.

The empirical test results of Jiang et al. (2020) support that the additional deduction can optimize the innovation output of enterprises at both quantity and quality levels. Some scholars are also cautious about the above arguments and do not fully agree with the incentive effect of the tax reduction policy on the innovation quality of enterprises.

Chen et al. (2020) used official data from industrial enterprise invention patents to measure the quality of innovation. They looked at how "R&D additional deduction" affected the quality of innovation in businesses and found that the extra deduction only increased the number of innovations, but it didn't have a big effect on the quality of innovations.

Ding & Xie (2021) respectively studied the impact of government subsidies and tax reduction policies on the quality of enterprise innovation and found that only government subsidies can encourage enterprises to achieve high-quality innovation.

Li & Zheng (2016) believe that the enhancement of tax incentives significantly promotes the innovation output of enterprises but mainly encourages "strategic" innovation output rather than "substantive" innovation.

Researching and developing manipulative behavior

The existing research on the research and development of manipulation is carried out based on both the motivation and the economic consequences of manipulation.

In order to achieve the expected profit target, the management of the enterprise will artificially manipulate the amount of R&D expenses for earnings management (Roychowdhury, 2006).

In order to provide performance support for the high compensation, the management will also use the capitalization of development expenditure for earnings management (Huang & Deren, 2014).

Some scholars also explained the phenomena of "innovation for identification" and "identification for listing" by establishing an asymmetric information game model and found that enterprises would release false signals through R&D manipulation to obtain innovation subsidies (Sun et al., 2016).

Executives using development manipulation of regulatory vacuum (Chen et al., 2021) in order to short-term performance, give up big risk and regulatory difficult breakthrough innovation projects (Wu, 2012), or purchase machinery and equipment into use, inflated R&D spending (Sun et al., 2021), shortsighted enterprise decision-making behavior, weakening the R&D expenses for innovation incentive effect.

Countries and the government use macroeconomic regulation and control means to motivate enterprise innovation work. Its ultimate goal is not simply to increase the enterprise R&D or low-quality level of innovation output, but to expect enterprises to obtain high-quality innovation output, let Chinese enterprises have more say in the world, and realize the strategy of science and technology power.

So, what impact does China's innovation incentive and tax reduction policy, represented by the additional deduction of R&D expenses, have on the high-quality innovation of enterprises? Has the level of innovation output in enterprises improved? This question is worth further discussion.

Research design and hypothesis formulation

Technological progress is an important source of a country's economic growth, and technological progress depends on enterprise innovation.

Innovation of public goods characteristics, externalities, and uncertainty (Arrow, 1962), make the enterprise face serious capital pressure, tax incentives will state income to the enterprise, effectively reduce the tax burden of the enterprise main body (Guo et al., 2020), claim additional deduction of R&D policy "interest-free loan effect", stimulate social capital into enterprise innovation (Liu et al., 2019), improve the enterprise endogenous financing ability, and alleviate the problem of R&D tension (Wang & Meng, 2020).

Corporate innovation activities bear a great risk of R&D failure (Greenwald & Stiglitz, 1986). The process of enterprise innovation is the process of risk selection (Solo, 1951), technology spillover prompted the enterprise to enter a certain period of risk aversion (Feng et al., 2015), the government as the enterprise research and development activities "partner" (Li et al., 2019), and claiming additional deductions before tax deductions can share the risk of innovation for the enterprise (Feng & Liu, 2017).

The higher the degree of innovation, the greater the range of expenses, and the more risk compensation can be obtained from the government's taxes (Zhu et al., 2019).

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The higher the degree of compensation, the stronger the innovation incentive effect (Feng & Liu, 2017).

In general, R&D claim additional deductions as the government makes up for the market failure, has a positive effect, can ease the pressure of funds, share the risk of development, improve the quality of enterprise innovation, and the higher the deduction of the intensity, the greater the role of the enterprise in the strategic decision and resource allocation to innovative projects, and enjoy the increase of new technology and other core intellectual property rights for the enterprise to bring lasting competitiveness.

Ha: There is a significant positive relationship between the preferential intensity of R&D expenses and the quality of enterprise innovation.

Hb: There is a significant positive relationship between the preferential intensity of R&D expenses and the number of enterprise innovations.

Influenced by the robustness of accounting information, tax collection, and management costs and the judgment of corporate accounting policies, enterprises will have cross-sectional differences in the capitalization and expense treatment of R&D expenditure (Wang, 2016), and microenterprises may have adaptive behaviors to macroindustrial policies (Du & Li, 2018).

When the company does not meet the profit benchmark, the manager will transfer the employee wages, depreciation, and amortization of machines and equipment, which are not originally R&D activities, to the R&D expenditure account to make excuses for the unrealized profit target (Skaife et al., 2013).

These costs are not related to R&D activities, which will lead to resource redundancy and increased innovation costs (Guo et al., 2019), which is detrimental to enterprise innovation. In addition to considering the sensitivity of investors to surplus information, Chinese enterprises also need to meet the mandatory regulatory requirements of the CSRC and other institutions (Roychowdhury, 2006).

When the enterprise is at the critical point of profit and loss or continuous growth, in order to avoid being examined, try to choose a relatively hidden surplus management mode to achieve the goal of "profit." Tends to capitalize on R&D spending (Wang Yan et al., 2011) or more directly cut R&D spending (Zhu et al., 2016).

The return rate of high-quality innovation is also highly uncertain, which is more likely to induce opportunistic behaviors in managers (Benner, 2010). In order to reach the surplus threshold, managers are more likely to reduce innovation projects that are risky and difficult to regulate (He et al., 2020), and such behavior is not conducive to the innovation output of enterprises.

Based on the above analysis, this paper makes the following assumptions:

Hc: The promotion effect of the negative adjustment of R&D manipulation behavior on the improvement of innovation quality.

Hd: The promotion effect of the negative adjustment of R&D manipulation behavior on increasing the number of innovations.

Research methods

The literature research method

Use R&D expenses, government subsidies, tax incentives, innovation ability, innovation efficiency, innovation performance, innovation quality, R&D manipulation, earnings management, and other databases to search relevant literature. The previous research results and conclusions are summarized, the research context and development frontier are sorted out, and the valuable research questions suitable for the research topic are refined in combination with the innovation practices of Chinese enterprises. Based on the logical deductions of tax incentive theory and information asymmetry theory, the research hypothesis of this paper is proposed to provide theoretical support for the latter text.

Empirical research method

Chinese A-share manufacturing enterprises in 2012–2020 were selected as the research sample, and the secondary data was obtained through Taian and other databases. On the basis of a literature review and research assumptions, the STATA16.0 software and multiple linear regression methods were used to test the impact of additional deductions from R&D expenses, the quantity of innovation, and the quality of innovation.

Sample selection and data sources

Selecting the sample and identifying the data source

This paper takes a sample of China's A-share manufacturing enterprises due to the incomplete data disclosure before 2012 (Long & Lin, 2018). In order to ensure the reference of the sample data, the sample period is determined to be 2012–2020.

The enterprise data comes from the Guotai Taian Database (CSMAR) and Juchao Information Network, and the patent data comes from the China Intellectual Property Office (SIPO) and IncoPat. In order to meet the research needs, financial enterprises and enterprises processed by ST, *ST, and PT, enterprises with missing data values, and enterprises without continuous observation values for three years or listed for less than three years were excluded, and finally, 8,285 valid observation values of 1,678 companies were obtained.

Variable definition and measurement

We divide the explained variables into two dimensions: quality and quantity. Taking into account the policy effect's time lag and the dispersion of patent data, Cao & Zhang (2020) experience suggests measuring the innovation quality (LnCit) by calculating the total number of patent applications in the subsequent year using a logarithmic scale. At the quantitative level, the number of innovations (patents) is measured by the total number of applications for invention patents, utility models, and design patents plus 1 log. The preferential intensity of additional deductions for R&D expenses is taken as the explanatory variable, and the proportion of the annual tax reduction enjoyed by the enterprise is calculated with the help of the B index method (Ren & Song, 2017).

R&D manipulation as a regulatory variable, referring to Gunny's method and the practice of Hu et al. (2016), the following model is constructed:

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$$\frac{R\&D_{i,t}}{TA_{i,t-1}} = \alpha_0 + \alpha_1 \frac{1}{TA_{i,t-1}} + \alpha_2 MV_{i,t} + \alpha_3 TQ_{i,t} + \alpha_4 \frac{INT_{i,t}}{TA_{i,t-1}} + \alpha_5 \frac{R\&D_{i,t-1}}{TA_{i,t-1}} + \varepsilon_{i,t} \quad (1)$$

$$NMRD_{i,t} = \hat{\alpha}_0 + \hat{\alpha}_1 \frac{1}{TA_{i,t-1}} + \hat{\alpha}_2 MV_{i,t} + \hat{\alpha}_3 TQ_{i,t} + \hat{\alpha}_4 \frac{INT_{i,t}}{TA_{i,t-1}} + \hat{\alpha}_5 \frac{R\&D_{i,t-1}}{TA_{i,t-1}} + \varepsilon_{i,t} \quad (2)$$

$$ABRD_{i,t} = \frac{R\&D_{i,t}}{TA_{i,t-1}} - Normal_R\&D_{i,t} \quad (3)$$

Among them, R&D is R & D expenses; MV is the logarithm of total market value; TQ is Tobin Q value; INT is operating profit; TA is total assets; NMRD is the estimated normal R&D expenses; ABRD is the abnormal R&D expenses of the enterprise; this paper constructs the absolute value

Learn from existing studies (Ju, 2022; He et al., 2022) to control the impact of corporate governance and finance. The enterprise size, the asset-liability ratio, the years of establishment of the company, the nature of the enterprise, the management shareholding ratio, the top five shareholders, the return on equity, and the government subsidies are set as the control variables.

Creating the model

In order to verify the impact of R&D expense additional deduction discounts on innovation output, the following benchmark models are constructed according to the method of Chen et al. (2020):

$$Inov_{i,t} = \delta_0 + \delta_1 Ded_{i,t} + \delta_2 Controls_{i,t} + \varepsilon_{i,t} \quad (4)$$

The following regulation effect model was made using the literature method (Yuan et al., 2020) to check the effect of R&D manipulation on the relationship between the extra deduction for R&D costs and the output of new products by businesses.

$$Inov_{i,t} = \gamma_0 + \gamma_1 Ded_{i,t} + \gamma_2 RDIN_{i,t} + \gamma_3 Ded_{i,t} RDIN_{i,t} + \gamma_4 Controls_{i,t} + \varepsilon_{i,t} \quad (5)$$

Research result

Descriptive statistics

Tab. 1 reports the descriptive statistical results of the main variables. According to the results, there are great differences in innovation quality and innovation quantity, and the number of innovations in most enterprises has reached the average level.

From the perspective of the scale effect, the innovation quantity of most enterprises is above the sample average. Strategic innovation has a higher standard deviation than substantive innovation, indicating an imbalance in the structural development of innovation quality in the sample enterprises.

In the correlation analysis, the intensity of R&D expenses and preferential deduction was significantly positively correlated with the quantity and quality of enterprise innovation, which preliminary verified the assumptions Ha and Hb.

Table 1 - The descriptive statistics of the variables
(made by the author)

variable	N	mean	p50	sd	min	max
LnCit	8285	3.1750	3.0910	1.5110	0.0000	7.5720
Patent	8285	3.3180	3.3670	1.4960	0.0000	7.1840
Patent1	8285	2.3940	2.3980	1.4430	0.0000	6.7460
Patent2	8285	2.7190	2.8330	1.5710	0.0000	6.6620
Ded	8285	0.8380	0.7250	0.6110	0.0075	4.2890
RDIN	8285	0.0055	0.0036	0.0060	0.0000	0.0541

Multiple regression analysis

Tab. 2 reports the regression results of the impact of the additional deduction of R&D expenses on the innovation quantity and innovation quality of enterprises. The results of model M1 showed that the regression coefficient of the quality of innovation was 0.965, significant at the 1% level. The results of model M2 showed that the regression coefficient of the preferential intensity on the number of innovations was 0.785, which was significant at the 1% level. It shows that the additional deduction of R&D expenses has a positive effect on promoting the quality and quantity of enterprise innovation, and the above results support Ha and Hb.

The results of model M3 show that the regression coefficient of the preferential intensity on substantive innovation output is 0.870 and is significant at the 1% level. The results of model M4 show that the regression coefficient of the preferential intensity on the strategic innovation output is 0.620 and is significant at the 1% level.

The response coefficient of substantial innovation to additional deductions of R&D expenses is 0.870 higher than that of strategic innovation output to R&D expenses, which is 0.620. Combined with M1 and M2, it further shows that the policy of additional deductions for R&D expenses can guide enterprises to carry out more high-quality R&D innovation.

Table 2 - The preferential intensity of R&D expenses affects the regression results of enterprise innovation output
(made by the author)

variable	M 1	M 2	M 3	M 4
	LnCit	Patent	Patent1	Patent2
Ded	0.965*** (0.049)	0.785*** (0.048)	0.870*** (0.045)	0.620*** (0.055)
Constant	-13.88*** (0.700)	-10.90*** (0.685)	-11.97*** (0.678)	-10.38*** (0.774)
Control Variables	Yes	Yes	Yes	Yes
Year	Yes	Yes	Yes	Yes
F price	144.75	86.94	90.55	65.58
N	8285	8285	8285	8285
R-sq	0.450	0.352	0.383	0.276

Note: *, **, *** indicate that the regression coefficients are significant at 10%, 5%, and 1% confidence levels, respectively, with a robust standard error in parentheses.

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Tab. 3 reports the regulatory role of R&D manipulation in the relationship between innovation quantity and innovation quality improvement in enterprises. According to the fiscal [2018] 99 provisions from 2018 to 2020, the additional deduction ratio increased to 75%, and the sample is divided into two categories: 50% (2012–2017) and 75% (2018–2020).

Model M1 shows that the regression coefficient of the interaction term of R & D manipulation and additional deduction is 22.97, which is significant at the 1% level, indicating that R & D manipulation has a negative adjustment effect on the improvement of the innovation quality of additional deduction for R&D expenses.

Model M4 showed that the regression coefficient for the interaction term between R & D manipulation and additional strength was 25.74, which was significant at the 1% level. It shows that R & D manipulation has a negative adjustment effect on the increase in R & D expenses. The above results support the hypothesis that both Hc and Hd.

From the sub-sample regression results, compared with the comparison models M2 and M3, when the additional deduction ratio is 50%, the regression coefficient of the interaction item of R&D manipulation and additional deduction is 16.43, which is lower than the regression coefficient of 26.64 when the additional deduction ratio is 75%, both of which are significant at the level of 1%. It shows that the self-interest behavior of enterprise management increases with the increase in the proportion of additional deductions, which is not conducive to the improvement of the innovation quality of enterprises.

The above results further support the hypothesis that both Hc and Hd. From the perspective of the number of innovations, in the comparison models M5 and M6, with the increase in the proportion of additional deduction, the regression coefficient of the R&D manipulation and the adjustment items of additional deduction also increase, which further proves that the self-interest behavior of the enterprise management is not conducive to the incentive effect of the additional deduction policy of R&D expenses.

Table 3 - Results of the regression of the RD manipulation
(made by the author)

variable	LnCit			Patent		
	M1	M2	M3	M4	M5	M6
	Full sample	An additional 50%	An additional 75%	Full sample	An additional 50%	An additional 75%
Ded	1.178*** (0.055)	1.209*** (0.073)	1.068*** (0.059)	1.008*** (0.056)	1.039*** (0.071)	0.894*** (0.066)
RDIN	19.78*** (5.442)	11.09* (5.940)	27.81*** (9.013)	26.44*** (4.885)	19.64*** (5.486)	31.48*** (8.283)
Ded × RDIN	-22.97*** (3.638)	-16.43*** (4.104)	-26.64*** (4.639)	-25.74*** (3.377)	-20.81*** (3.884)	-27.37*** (4.635)
Constant	-14.05*** (0.688)	-13.29*** (0.783)	-15.53*** (0.825)	-11.11*** (0.672)	-10.52*** (0.758)	-11.55*** (0.841)
Control Variables	Yes	Yes	Yes	Yes	Control Variables	Yes
Year	Yes	Yes	Yes	Yes	Yes	Yes
N	8,285	6,102	2,183	8,285	6,102	2,183
R-sq	0.458	0.427	0.543	0.361	0.320	0.423

Note: *, **, *** indicate that the regression coefficients are significant at 10%, 5%, and 1%, respectively, with a robust standard error in parentheses

Robustness test

In order to ensure the robustness of the results, reference Yuan et al. (2020) and right small Feng & Liu (2017) adopt the method of replacement, which is explained as variable measurement, with the proportion of invention patent applications and patent application instead of innovation quality, with invention patent, utility model, and design patents according to the 3:2:1 weight allocation, with the sum of the weighted application to add 1 logarithmic instead of innovation quantity. Re-regression: the results are basically consistent with the previous conclusion.

Summary and discussion

R&D claims additional deductions as a Chinese government supports enterprise innovation as a fiscal policy, plays its tax effect by improving the enterprise endogenous financing ability, shares the innovation risk, etc., effectively making up for the "market failure", and from the "quantity" and "quality" two dimensions play the role of R&D incentives, namely in increasing the number of enterprise innovations while at the same time promoting the quality of enterprise innovation.

At the same time, the regulatory vacuum of R&D expenses and the advantage of R&D information will induce the management's self-interest behavior, resulting in shortsighted decision-making by enterprises.

The managers may induce R&D manipulation due to motives such as tax saving or salary self-defense, which are not conducive to the innovation output of enterprises. With the increase in the proportion of additional deductions, the regression coefficient of the adjustment items for the intensity of R&D manipulation and R&D expenses also increases, reflecting the active adaptability of enterprises to the policy. It further proves that the self-interest behavior of enterprise management is not conducive to the incentive effect of the additional deduction policy for R&D expenses.

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