Tax Incentives and Corporate Innovation Efficiency: A Moderated Mediating Effect Model

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Abstract

In the context of innovation-driven development strategy, science and technology innovation contributes to the improvement of enterprise productivity and comprehensive capability, and enterprise innovation is mainly realized through their R&D activities. Based on the strategic direction of science and technology innovation and industrial development, strategic emerging industries with long-term development and growth potential are highly valued. Using panel data of listed companies in strategic emerging industries in China from 2013 to 2019, a theoretical model is constructed using resource-based theory to test the mechanism of the effect of tax incentives on innovation efficiency. The relationship between tax incentives and innovation efficiency is analyzed by incorporating R&D investment and property rights nature into the study. It is found that tax incentives positively affect the innovation efficiency of enterprises and R&D investment has a mediating role, while the nature of state-owned enterprises plays a negative moderating role. Finally, the theoretical analysis and research findings are relied on to propose suggestions for improving the innovation efficiency of strategic emerging industries, which provide references for the improvement of innovation efficiency of strategic emerging industries.

Keywords-component; Tax incentives; innovation efficiency; R&D investment; nature of property rights

1. INTRODUCTION

The technological revolution is further unfolding all over the world, and high-quality innovation is the main form of development, and innovation activities become an important support for economic development in the "new normal" period. With the growing problem of technological necking, the government provides support for enterprises' innovation activities through effective allocation of resources, and tax incentives are widely adopted as the main R&D incentives. Innovation-driven development strategy came into being under the pressure of increasingly severe competition, and scientific and technological innovation, which is at the core of China's modernization, has risen to an unprecedented height. In the environment of innovation-driven development, enhancing independent innovation capability and building an innovative country are major strategic tasks in the new era of China, and fiscal policies encourage enterprises to conduct R&D, which is of great significance to the development of an innovative country. Relevant data from the National Bureau of Statistics show that China's R&D investment intensity has reached

2.108% in 2016, even exceeding some developed countries, with an average growth rate of 11.1% in four years from 13 years, up to 2.19% as of 2018, and steadily increasing. China's R&D personnel increased to 1.86 million in 2018, an increase of 61.9% over the decade. 1.4 million patent applications were accepted by the State Intellectual Property Office in 2019, with China leading the world in the number of patent applications and about 2.7 million valid patents but with an average life span of only 7.6 years. It shows that while R&D investment has received focused attention, the quality of innovation has been neglected and no attention has been paid to the level of innovation efficiency of firms. Regarding the impact of tax incentives on enterprise innovation, the results of existing studies are inconsistent, and some studies indicate that tax incentives increase enterprises' R&D investment and have an incentive effect on innovation investment [1-2]. However, some scholars have argued that tax incentives do not significantly affect firms' R&D output and do not significantly promote firms' technological innovation, and further, they do not significantly promote the efficiency of invention-based innovation, which is more representative of substantive

innovation. Both the patent counterfeiting behavior of enterprises and the government's performance assessment pressure distort the government's resource allocation, and whether tax incentives truly promote enterprise innovation deserves further exploration.

To study the impact of tax incentives on innovation efficiency, this paper takes listed companies in strategic emerging industries from 2013 to 2019 as the research object and analyzes its intrinsic mechanism of action from the perspective of R&D investment and the nature of property rights. The main contributions include the following three aspects: first, this paper expands the research scope of tax incentives on innovation from the perspective of efficiency and investigates its impact on enterprise innovation from the perspective of innovation input. Secondly, compared with traditional industries, the rapid development of strategic emerging industries can get more policy support, and this paper analyzes them as the research object. Third, this paper establishes a theoretical model with mediation and regulation based on resource-based theory to further analyze the internal transmission mechanism of tax incentives on innovation efficiency.

2. THEORETICAL ANALYSIS AND HYPOTHESIS

2.1 The impact of tax incentives on innovation

The government's macro-control provides development direction and financial support for the industry's development, with the dual role of a supporting hand and a predatory hand. As patent application makes technology information public, external enterprises can easily understand the R&D results of innovative enterprises and obtain R&D convenience at low cost, while innovative enterprises invest a lot of R&D capital, R&D personnel, and R&D time and bear huge R&D risks in the process of R&D innovation, but they cannot obtain the full benefit of innovation output. This mismatch between the costs and benefits of innovation can weaken the incentive to innovate. In the case of market failure, the benefits of innovation for enterprises are much lower than the social benefits for enterprises, and the government can compensate for the loss of innovation due to positive externalities using tax incentives as a regulating instrument, thus enhancing enterprises' willingness and ability to innovate. When enterprises carry out innovation activities, there are significant problems such as a large amount of R&D capital investment, the uncertainty of R&D risks, and long payback period. Relying solely on enterprises' innovation capital investment will affect the sustainability of innovation capability. Based on the resource dependence theory, companies usually rely on the government to alleviate the pressure of R&D funding in the R&D process, to promote R&D, and thus improve corporate

innovation[3-4]. The government incentivizes firms to conduct R&D by implementing tax credits, a part of the R&D costs of firms is borne by the government, low rent-seeking risks improve the contribution of innovation factors, and overall tax incentives have a facilitating effect on firm innovation, and this incentive policy positively and significantly affects firm innovation inputs, while effective public support improves firm innovation output [5]. In addition, other studies have shown that the tax incentives enjoyed by firms do not have a significant incentive effect on innovation; Because of the above analysis, the hypothesis is proposed that. H1: Tax incentives have a positive effect on firms' innovation efficiency.

2.2 Impact of tax incentives on R&D investment

Based on the new economic growth theory, the increase in R&D investment can lead to sustainable economic growth, so the government tends to develop more subsidized policies to promote R&D investment. Signaling theory views tax benefits as a positive signal, and the government position that supports the development of enterprises reduces the perceived degree of risk faced by external investors and promotes the intensity of R&D investment by enterprises. Enterprises in a highly competitive market are conservative in disclosing R&D information to improve their competitive advantage, while the positive signal released by tax incentives to external investors recognizes the foreseeable of enterprises' innovation projects and eases the financial pressure to promote R&D activities. Tax credit as a policy support tool provides a suitable innovation environment for enterprise R&D, effectively mitigates the market role failure caused by asymmetric information, while tax credit has a positive incentive effect on R&D investment [6], and the preferential policies enjoyed by enterprises directly weaken the corporate tax burden, provide indirect financial support for investment activities. Tax incentives encourage enterprises to actively engage in R&D activities and promote the transformation of innovation input into innovation output，reduce the debt service risk of exogenous financing, increase enterprises motivation for R&D and promote R&D efficiency[7]. Another part of the research shows that the absence of tax policy in R&D makes the incentive effect of preferences on firms' innovation investment insignificant. In addition, some scholars argue that the positive effect of tax incentives on R&D investment is significant within a certain interval, and the incentive effect weakens when this threshold is exceeded. Given the above analysis, the hypothesis is proposed. H2: Tax incentives have a positive effect on firms' R&D investment.

2.3 The impact of R&D investment on innovation

When scholars research the correlation between R&D investment and innovation, the findings are inconsistent; some scholars believe that there is a significant positive relationship between the two, others believe that an increase in R&D investment raises the production cost of enterprises and is detrimental to their innovative activities, and there is a significant negative relationship between the two, while others believe that there is a non-linear relationship between the two. Corporate R&D is characterized by the uncertainty of the cycle, the lag of returns, and the spillover nature of the economy. The impact of R&D investment on industrial innovation varies among different industries. Corporate R&D activities are constrained by R&D funds, and it is usually believed that more R&D investment can effectively improve the innovation capability of enterprises. R&D investment enables enterprises to improve their innovation ability to a certain extent and gain competitive advantages in the market. For strategic emerging industries with high capital intensity, R&D investment plays a decisive role in the improvement of enterprises' independent innovation capability. In the theory of technological innovation, Schumpeter pointed out that enterprises can improve their competitiveness through R&D activities, and then promote innovation to make them more developmental advantages. The innovation activities of firms are constrained by R&D funds, and some research results show that there is a threshold effect on the promotion of innovation by in-house R&D, which has the advantage of knowledge accumulation for improving firm innovation within a certain interval. Most studies show that increasing R&D investment can improve competitive advantage through technology accumulation and that internal R&D is beneficial for enterprises to optimize production factors and positively affect their innovation dynamics and effectiveness [8]. Because of the above analysis, the hypothesis is proposed. H3: R&D investment has a positive impact on firms' innovation efficiency.

2.4 The mediating role of R&D investment

Tax incentives as favorable signals can obtain more exogenous financing and relieve the pressure of the shortage of R&D funds for enterprises. The preferential policy alleviates the financing constraint of enterprises through indirect subsidies, which further influences enterprises' R&D investment and thus has an impact on innovation. As an internal tax credit, it has a certain substitution effect with enterprises' R&D investment, both of which help enterprises to carry out innovative activities; in addition, the market structure is further stimulated by the influence of tax policy on R&D investment, which has a facilitating effect on enterprise innovation. In summary, tax incentives help enterprises to conduct R&D and reduce innovation costs to improve their innovation capabilities. Both external government intervention and internal corporate R&D investment are the main sources of financial investment in corporate innovation, and the overlap between the two in the innovation field leads to a crowding-out effect. Sustainable financial support for R&D activities, as a key part of corporate innovation, can improve the innovation capability of firms. Tax incentives can alleviate the pressure of R&D funds for enterprises, and good relations and favorable investment signals help enterprises to obtain more external financing. In addition, corporate R&D investment in generating innovation results also interacts to influence corporate policy support. Given the above analysis, the hypothesis is proposed. H4: R&D investment plays a mediating role in the process of the influence of tax incentives on firms' innovation efficiency.

2.5 The regulatory role of the nature of property rights

Due to the long transformation path from R&D investment to innovation efficiency, the effect of R&D investment on innovation efficiency is influenced by the nature of property rights. Enterprise innovation is a long-term investment project with high risk and high return, and enterprises that receive more tax benefits due to the property rights advantage may not necessarily improve their innovation efficiency in the R&D process. State-owned enterprises receive more abundant innovation resources, while non-state-owned enterprises receive relatively less government support. At the current stage of strategy-driven development, state-owned enterprises by nature tend to be less efficient in innovation despite having high-quality resources, while non-state-owned enterprises are relatively more enthusiastic in independent innovation due to the lack of incentives. State-owned enterprises have more obvious advantages in terms of resource endowment, and the government gives financial support to enterprises in case of losses through direct subsidies or indirect reductions. State-owned enterprises are supervised and managed by the government, which will weaken the favorable signal of enhancing external financing, thus the efficiency of R&D funding subsidies for innovation becomes insignificant. The political background characteristics of SOEs bias the allocation of innovation resources, making them have a favorable innovation environment and pay more attention to rent-seeking activities, and the feedback on innovation activities is inert. Based on principal-agent theory, managers of non-SOEs face more competition and pressure in the market, which motivates management to invest in innovation to reduce the probability of innovation failure and gain future development advantages in the fierce market competition, tax incentives have an incentive effect on innovation in non-SOEs, and non-SOEs in factor-distorted regions are more influenced by the government. Enterprises with different

property rights have different preferences for redundant resource allocation, and non-state enterprises pay more attention to the way enterprises allocate resources while obtaining economic benefits, which is conducive to the operation of enterprises. State-owned enterprises have richer resources and R&D funds, but those with monopoly status have weaker innovation ability because they are less motivated to invest in R&D, non-state-owned enterprises are more innovative because of their better competitive market environment, their R&D investment is higher than that of state-owned enterprises, and their technological innovation efficiency is relatively higher. H5: The nature of property rights has a moderating effect, and the positive effect of R&D investment on innovation efficiency is more significant for non-SOEs.

3. RESEARCH DESIGN

3.1 Sample and Data Sources

This paper selects Shanghai and Shenzhen A-share listed companies that meet the nine industrial classifications of strategic emerging industries from 2013 to 2019 as the research sample. Sample data with the main business income of 50% or more are screened and further selected based on previous studies. (1) Excluding listed companies that were ST, *ST, financial, and insurance banks from 2013 to 2019. (2) Excluding listed companies with total assets and sales growth rate greater than 1. (3) Excluding listed companies that issued both B shares and H shares. (4) Excluding samples with outliers and omitted values. After screening the final sample of 3090 observations, Stata16 is used for empirical analysis. The data related to financial information of listed companies are obtained from the Wind database, CSMAR database, and Juchao information website. To reduce the influence of extreme values and ensure the reliability of the results, a 1% tailing process was applied to the data.

3.2 Variable Definition

3.2.1 Dependent variable

Innovation efficiency (IOEi, t+1). In this paper, the ratio of innovation output to innovation input is used to express the innovation efficiency of enterprises. The number of patent applications is more reflective of the true nature of innovation capability than the number of grants, and innovation output is expressed by the number of patents independently filed by the firm in the current year. Since there is a lag between innovation input and output, the logarithm of the number of patents in year t+1 of firm i is used as a ratio to the logarithm of R&D input in year t to measure the innovation efficiency of the firm in year t+1. Define $IOE_{i,t+1}=100* LN(1+PAT_{i,t+1})/LN(1+RD_{i,t})$. A larger value of this value indicates a

higher efficiency in transforming innovation output per unit of innovation input.

3.2.2 Independent variable

Tax benefits (TAX). The tax benefit is measured by the corporate income tax rate instead, and the actual calculation is expressed as the ratio of the corporate current income tax expense to EBIT and is determined by taking the opposite of it. Define TAX = - income tax expense / EBIT. A larger value of this value indicates a greater degree of tax benefits for the enterprise.

3.2.3 Mediating and moderating variables

R&D input (RD). R&D investment includes R&D expenses and technology development expenses, etc., and is used to measure innovation investment, which is expressed as a relative number of R&D investment intensity in this paper. Define RD = R&D expenditure/main business revenue. A higher value indicates a higher intensity of R&D investment. Nature of property rights (STATE). The nature of property rights is represented by a dummy variable, with 0 assigned to state-owned enterprises, and 1 assigned if it is a non-state-owned enterprise.

3.2.4 Control variables

Concerning previous research results, firm size, firm age, return on assets, Tobin's Q, gearing ratio, product market competition, equity concentration, executive shareholding, capital intensity, financing constraints, and market capitalization-to-book ratio were selected as control variables. Industry and year were also controlled based on firm characteristics.

4. EMPIRICAL ANALYSIS AND RESULTS

4.1 Descriptive statistical analysis

Descriptive statistical analysis of the main variables of the full sample, as shown in Table 1, shows that innovation efficiency varies widely among listed companies in strategic emerging industries, while the overall level is low. Tax incentives show a minimum value of -0.655, a maximum value of 0.390, and a mean value of -0.118, indicating that the degree of difference in tax incentives among enterprises in different strategic emerging industries is large. R&D intensity is 6.6%, with a large gap between the maximum and minimum values and a low overall level of enterprises. The mean value of the nature of ownership variable is 0.724, indicating that 72.4% of the enterprises in the data are non-state enterprises. Non-state enterprises account for a relatively large share.

TABLE 1. VARIABLE DESCRIPTIVE STATISTICS

variable	N	mean	sd	min	max
IOE	3090	9.994	8.951	0	31.47
TAX	3090	-0.118	0.122	-0.655	0.390
RD	3090	0.0660	0.0570	0.00200	0.322
STATE	3090	0.724	0.447	0	1

4.2 Analysis of regression results

4.2.1 Regression analysis of main effects and mediating effects

The regression results of the main and mediating effects of tax incentives on innovation efficiency are shown in Table 2.

TABLE 2. MAIN AND MEDIATING EFFECTS MULTIPLE REGRESSION RESULTS

	M1	M2	M3	M4
	RD	IOE	IOE	IOE
TAX	0.019**	3.165**		2.629**
RD			29.280***	28.937***
_cons	-0.033	16.271*	16.970*	17.212*
Adjusted r2	0.381	0.118	0.137	0.138
IND	Y	Y	Y	Y
year	Y	Y	Y	Y

*** p<0.01, ** p<0.05, * p<0.1

In Table 2, Model 1 incorporates the control variables with the independent variable tax incentives and is studied with R&D input as the dependent variable. Model 3, model 4, and model 5 incorporate tax incentives, R&D inputs, tax incentives, and R&D inputs into the equation, respectively, with innovation efficiency as the dependent variable for the study. From model 2, it is known that tax incentives are significantly and positively correlated with innovation efficiency ($\beta=3.165$, $p<0.05$), indicating that tax incentives have a facilitating effect on innovation efficiency and hypothesis 1 holds. From model 1, R&D investment is significantly and positively correlated with tax incentives ($\beta=0.019$, $p<0.05$), indicating that tax incentives have a facilitating effect on R&D investment, and hypothesis 2 holds. From model 3, R&D investment is significantly and positively correlated with innovation efficiency ($\beta=29.280$, $p<0.01$), indicating that R&D investment has a facilitating effect on innovation efficiency, and hypothesis 3 holds. From model 2 and model 4, the total effect of tax incentives on innovation efficiency is 3.165, and the promotion effect is significant. The direct effect of R&D investment on tax incentives is 0.019, and the intermediary effect is 0.019*28.937=0.55, accounting for 17.37% of the total effect, and R&D investment plays a part in the intermediary effect, and hypothesis 4 holds.

4.2.2 Regression analysis of moderating effects

The regression results of the moderating effect of the nature of property rights in the process of the effect of R&D investment on innovation efficiency are shown in Table 3.

TABLE 3. MODERATING EFFECT OF THE NATURE OF PROPERTY RIGHTS

	M1	M2
	IOE	IOE
RD	29.165***	44.311***
STATE	-0.234	1.151*
RD*STATE		-21.800***
_cons	17.363*	18.384**
Adjusted r2	0.137	0.141
IND	Y	Y
year	Y	Y

*** p<0.01, ** p<0.05, * p<0.1

Model 1 adds the mediating variable R&D input and the moderating variable property rights nature, and model 2 adds the interaction term of R&D input and property rights nature based on model 1. The regression results are shown in Table 3. The interaction term is significantly negatively correlated with innovation efficiency ($\beta=-21.800$, $p<0.01$), indicating that the nature of property rights plays a negative moderating role, and the positive effect of R&D investment on innovation efficiency is more significant in non-state enterprises, and hypothesis 5 holds.

5. ROBUSTNESS TEST

The accuracy of the results was further verified using the measurement of replacing mediating variables with innovation efficiency. To change the measurement of mediating variables, RD1=R&D expenditure/total assets was defined. Change the measurement of innovation efficiency by replacing the corresponding sum of patent applications with the sum of invention patents, utility model patents, and design patents independently granted by the enterprise in the current year. Define $IOE1_{i,t+1}= 100*LN(1+ PAT1\ t+1)/ LN(1+ RDt)$. As shown in Tables IV and V, the regression results show that the conclusions are robust.

TABLE 4. INTERMEDIATION EFFECT TEST

	M1	M2	M3	M4
	RD1	IOE1	IOE1	IOE1
TAX	0.014***	4.048***		3.287***
RD1			54.218***	52.518***
_cons	-0.026	15.203*	16.321*	16.591**
Adjusted r2	0.317	0.123	0.136	0.138
IND	Y	Y	Y	Y
year	Y	Y	Y	Y

*** p<0.01, ** p<0.05, * p<0.1

TABLE 5. MODERATING EFFECT TEST

	M1	M2
	IOE1	IOE1
RD1	54.422***	104.317***
STATE	0.276	2.703***
RD1*STATE		-76.728***
_cons	15.857*	17.204*
Adjusted r2	0.136	0.146
IND	Y	Y
year	Y	Y

*** p<0.01, ** p<0.05, * p<0.1

6. CONCLUSIONS AND RECOMMENDATIONS

6.1 Research Conclusion

Using the panel data of listed companies in strategic emerging industries from 2013-2019, the main findings are as follows: (1) Tax incentives positively promote the innovation efficiency of enterprises, and as an indirect incentive policy with higher autonomy alleviate the pressure of R&D and improve the innovation motivation of enterprises. (2) In the role of tax incentives on innovation efficiency, R&D input plays a mediating role, and tax incentives further improve the innovation efficiency of enterprises through the promotion of the mediating variable R&D input. (3) In the role of R&D investment on innovation efficiency, the nature of property rights plays a moderating role, and the promotion effect of R&D investment on innovation efficiency is reduced by the nature of state-owned property rights.

6.2 Suggestions for countermeasures

(1) Tax preferences have a facilitating role in the innovation activities of enterprises, positively influencing their R&D investment and innovation efficiency, but the overall level of innovation efficiency in strategic emerging enterprises is low, so the relevant departments should increase the preferences and strengthen the supervision mechanism to promote the transformation of enterprise innovation input into innovation output, and improve the enthusiasm and innovation efficiency of enterprises. (2) Enterprises' R&D investment has a catalytic effect on innovation efficiency, so they should increase their R&D capital investment to avoid crowding out the incentive effect of tax preferences and maximize its intermediary effect, to lay the foundation for continuous innovation. (3) State-owned enterprises negatively regulate the intermediary role of R&D investment compared with non-state-owned enterprises. From the perspective of fiscal policy, the rent-seeking activities and resource dependence of state-owned enterprises can be reduced through deepening reforms. Correspondingly, non-SOEs should be given appropriate resources to support their innovation activities. (4) Tax incentives can increase the R&D investment of enterprises and thus promote the innovation efficiency of enterprises. In the management of enterprises, the management does not pay enough attention to the importance of innovation efficiency, and strategic emerging enterprises should actively apply for tax incentives or innovation projects with preferences in the case of low innovation efficiency, to efficiently invest in innovation activities to realize enterprise optimization and upgrading and play the positive role of tax incentives to realize the improvement of enterprise innovation.

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