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Article

The Influence of Technology Tax Policy on Technological Innovation Cost Input of A-Share Listed Enterprises

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Abstract: Technological innovation serves as a critical driver for enterprise competitiveness and economic growth, yet market mechanisms often fail to provide sufficient incentives due to high costs, risks, and long R&D cycles. Government intervention through science and technology tax policies has emerged as a pivotal tool to mitigate these challenges and stimulate corporate innovation. This study examines the impact of tax policies on R&D Expenditure among A-share listed enterprises in China, aiming to elucidate the role of fiscal incentives in fostering R&D investment. Utilizing data from 3,599 A-share listed firms between 2018 and 2023, sourced from the China Statistical Yearbook and CSMAR database, the research employs a multiple linear regression model to analyze the relationship between Income Tax Expense Ratio (ITER) (measured by the ratio of actual income tax paid to total profit) and R&D intensity (measured by R&D expenditure relative to operating revenue). Control variables include sales margin (SM), asset-liability ratio (ALR), and Logarithm of Net Assets (LNA). The results reveal a significant negative correlation between ITER and R&D expenditure, confirming that tax incentives effectively promote innovation investment by alleviating financial pressures. Robustness tests further validate these findings, demonstrating that reduced ITER correlate with higher R&D spending. The study underscores the importance of targeted tax policies in enhancing corporate innovation capabilities and advancing China's high-quality economic development. By providing empirical evidence on the efficacy of tax incentives, this research contributes to policy design aimed at sustaining long-term technological progress and industrial upgrading.

Keywords: technological innovation; tax policy; R&D expenditure; a-share enterprises; fciscal incentives

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1. Introduction

Technological innovation has become a central engine of economic growth and corporate competitiveness in the context of global industrial transformation and upgrading. However, enterprises face considerable challenges in pursuing innovation, including high R&D costs, extended development cycles, and uncertain outcomes. These barriers often weaken firms' incentives to invest in innovation when relying solely on market mechanisms, which highlights the importance of government intervention. Among various policy instruments, fiscal and tax policies play a particularly vital role because they directly reduce financial burdens, improve liquidity, and create an enabling environment for sustained R&D investment. In China, A-share listed enterprises serve as a representative sample of the real economy and provide a valuable lens through which to examine the effectiveness of tax incentives in fostering innovation. Existing research has shown that preferential tax measures such as R&D super deductions, reductions in corporate income tax rates, and high-tech enterprise certification can enhance firms' innovation capacity.

Nevertheless, empirical evidence on the precise relationship between effective tax burdens and R&D expenditure remains relatively limited. This study addresses this gap by investigating the influence of technology-related tax policies on the R&D intensity of A-share listed firms. In doing so, it contributes both to the theoretical understanding of fiscal policy as a driver of innovation and to the practical design of policies aimed at promoting high-quality, innovation-led economic development.

2. Research Hypotheses

"Innovation is the primary driver of development," and technological innovation is crucial for enterprise development, influencing a company's competitiveness and market position in multiple aspects. Enterprise innovation is increasingly recognized as a key determinant of competitiveness and long-term viability in the market economy [1]. Technological innovation of private enterprises is an important condition for promoting high-quality development of China's economy.[2]. Through technological innovation, enterprises can develop new products and services, improve existing ones, and thereby gain a competitive edge in the market. Innovative products and services attract more consumers, helping businesses expand their market share. Aside from organizational learning ability and the use of advanced technology, corporate governance also plays an important role in the innovation practices of enterprises [3]. Technological innovation enhances production efficiency, reduces costs, and strengthens a company's advantage in price competition. It also enables enterprises to adopt more environmentally friendly production methods, minimize environmental impact, and achieve sustainable development. Green development is an important way for manufacturing companies to achieve strong economic and social performance [4]. Companies with strong innovation capabilities are more likely to attract investors and partners, securing financial and resource support. Continuous technological innovation helps enterprises reduce reliance on single products or markets, thereby diversifying risks. Furthermore, technological innovation facilitates the development of products tailored to different markets, promoting international expansion. With social development, scientific and technological innovation has become the foundational driver for enterprises in the equipment manufacturing industry [5].

Market mechanisms may fail under certain circumstances, such as in the provision of public goods, externality issues, and information asymmetry. Technological innovation often exhibits characteristics of public goods, as its outcomes can be easily appropriated by others without compensation (free-rider problem), which reduces enterprises' incentives to invest in research and development (R&D). Technological innovation typically involves high risks, substantial investments, and prolonged R&D cycles with uncertain success rates. Technological innovation typically involves high risks, substantial investments, and long R&D cycles with uncertain returns on investment [6]. Under market mechanisms, firms may be reluctant to allocate resources to long-term, fundamental research due to perceived excessive risks. Market mechanisms prioritize short-term gains, whereas technological innovation, particularly disruptive innovation, requires sustained investment and patience. The disruptive innovation theory, proposed and developed by Christensen over 20 years ago, has been widely discussed and applied [7]. Innovation boosts economic growth. One of the most critical factors in innovation-driven growth is the role of disruptive innovation, which is widely recognized as a key driver by leaders of both small and large firms [8]. Faced with market pressures, enterprises may prioritize immediate returns at the expense of long-term innovation and R&D. In a globalized market environment, firms confront intense competition worldwide; without appropriate policy support, they may struggle to bear the costs and risks associated with innovation. Consequently, relying solely on market mechanisms cannot provide a stable environment for technological innovation in enterprise development, necessitating government intervention to offer supplemental support.

Through the implementation of tax incentive policies such as additional deductions for R&D expenses and tax reductions for high-tech enterprises, the government reduces corporate R&D costs and encourages enterprises to increase R&D activities, thereby promoting technological innovation. Tax incentives and fiscal subsidies directly alleviate the financial burden on enterprises, enabling them to allocate more funds to R&D activities, thereby enhancing their market competitiveness. By providing fiscal funding support and tax incentives, the government encourages enterprises to transform scientific research achievements into actual productivity, accelerating the commercialization and industrialization of technological outcomes. Technology commercialization mechanisms are important starting points for diffusing technologies in a given intellectual property regime of a region [9]. Government financial support and tax incentives assist enterprises in attracting and cultivating high-end talent required for technological innovation, thereby providing human resource guarantees for long-term development and innovation. The regulation of fiscal and tax policies is an imperative prerequisite for improving the regional innovation capability [10]. Through fiscal and tax policies, the government improves the external environment for corporate innovation, including better public services and stronger intellectual property protection, creating favorable conditions for technological innovation. Government fiscal and tax policies can guide social capital toward the field of scientific and technological innovation, leveraging government funds to promote greater investment of financial resources and social capital in high-tech innovation sectors. Technological innovation is widely regarded as a breakthrough strategy for achieving new drivers of economic and social development [11]. By supporting the R&D and industrialization of key core technologies, the government facilitates industrial structural upgrading toward more advanced, environmentally friendly, and sustainable development, achieving high-quality economic growth. Researchers have consistently studied the relationship between technological innovation and economic growth, and widely agree that it serves as a key driving force for economic development [12].

Based on this, the following hypothesis is proposed:

Hypothesis 1: Science and technology tax policies promote corporate investment in R&D Expenditures.

3. Research Design

3.1. Data Sources

The data in this study primarily originates from the China Statistical Yearbook and the CSMAR database, encompassing 3,682 A-share listed enterprises from 2018 to 2023. To meet the data requirements for empirical research, the following screening criteria were applied to eliminate outliers, resulting in a final valid sample of 3,599 observations. The empirical analysis will be conducted using Stata 16.0.

Data screening criteria:

Total profit greater than 0;

Taxable income greater than 0;

Actual corporate income tax paid greater than 0;

Revenue from new products (services) greater than 0;

Operating revenue greater than 0; (6) Total assets greater than 0.

3.2. Variable Selection and Model Specification

3.2.1. Explained Variable Enterprise

R&D Expenditure

Drawing on the research of Xu Fei (2019), this study adopts the ratio of R&D expenditure to operating revenue to measure enterprise R&D Expenditure, where a higher R&D intensity indicates more active innovation activities.

3.2.2. Explanatory Variable

Income Tax Expense Ratio (ITER)

Tax incentives promote enterprise investment in technological innovation through multiple channels, including reducing ITER, increasing R&D funds, and optimizing the tax environment. These measures play a significant role in enhancing corporate innovation capabilities and competitiveness. Classical economic theory and endogenous economic theory agree that technological innovation plays a vital role in the process of economic development. Therefore, the government has a motivation to seek the optimal allocation of resources by intervening and providing support to corporate R&D investment to promote enterprise technological innovation [13]. This paper uses the ratio of actual corporate income tax paid to total annual profit to measure the effective ITER. This ratio represents the amount of income tax payable per unit of profit earned by the enterprise in the current year.

3.2.3. Control Variables

Sales Margin (SM)

SM directly or indirectly influences enterprise technological innovation investment, as firms need to ensure profitability while rationally planning and allocating resources to promote technological innovation and long-term development.

Asset-Liability Ratio (ALR)

The ALR serves as a crucial indicator of corporate financial structure, reflecting the proportion of assets financed through debt. Higher debt levels indicate greater reliance on debt financing, which may influence technological innovation investment to some extent. The ALR is calculated as the ratio of total liabilities to total assets at the end of the period, reflecting the firm's debt level and its potential impact on innovation investment [14].

Logarithm of Net Assets (LNA)

The scale of corporate assets may impact technological innovation activities.

All variables and their corresponding symbols are presented in Table 1.

Table 1. Variable Definition.

Indicator Type	Indicator Name	Symbol	Definition and Calculation Method
Explained Variable	R&D Expenditure	RD	R&D Expenditure / Main Business Income
Explanatory Variable	Income Tax Expense Ratio	ITER	Actual Income Tax Paid / Total Annual Profit
Control Variable	Sales Margin	SM	(Operating Income - Operating Cost) / Operating Income
	Logarithm of Net Assets	LNA	LN (Total Assets at the End of the Period)
	Asset - Liability Ratio	ALR	Total Liabilities at the End of the Period / Total Assets at the End of the Period

3.2.4. Model Specification

The study aims to construct the following multiple linear regression model:

$$RD = \beta_0 + \beta_1 ITER + \beta_2 SM + \beta_3 ALR + \beta_4 LNA + \varepsilon$$

In this model, the dependent variable is the firm's investment in R&D Expenditure, while the independent variable is the ITER. The control variables include SM, ALR, and LNA. The term ε represents the random error term.

4. Descriptive Statistics and Analysis

This paper conducts descriptive statistical analysis on the 3599 sample observations obtained. The means, standard deviations, maximum values, minimum values, and medians of the relevant variables are presented in Table 2.

Table 2. Descriptive statistics of variables.

VarName	Obs	Mean	SD	Min	Median	Max
RD	3599	0.0239	0.048	0.00001	0.00689	0.49526
ITER	3599	0.1604	0.079	0.00226	0.14624	0.39955
ALR	3599	0.4297	0.185	0.02970	0.42530	0.99030
SM	3599	0.3466	0.205	-0.25712	0.30523	0.96426
LNA	3599	22.9807	1.468	19.20702	22.76437	28.3026

As shown in the table above, the mean value of R&D Expenditure is 0.0239, indicating that enterprises invest 2.39% of their main business revenue annually in R&D and innovation activities. The small standard deviation suggests that R&D expenditure levels are relatively stable among enterprises, with minor differences. The average ITER of the sample enterprises is 16.04%, which means that a one-unit total profit incurs an ITER of 0.1604 units. The standard deviations of the ALR, SM, and LNA are 0.185, 0.205, and 1.468, respectively, indicating relatively small variations in these variables across enterprises.

5. Correlation Analysis

Table 3 presents the results of the correlation analysis for the main variables in the model. Each variable exhibits a high correlation with the explained variable, R&D Expenditure, suggesting that these variables have strong explanatory power for the level of corporate R&D expenditure. Among them, R&D Expenditure is significantly negatively correlated with the ITER at the 1% level, meaning that the higher the proportion of income tax paid relative to total profit, the lower the corporate expenditure on innovation and R&D, preliminarily validating Hypothesis 1: science and technology tax policies promote corporate investment in technological innovation. For the control variables, the ALR is significantly negatively correlated with R&D Expenditure at the 1% level, indicating that higher corporate leverage ratios lead to lower R&D expenditure levels. The high financing costs and debt pressure caused by a high leverage may destroy the firm's main business [15]. The SM is significantly positively correlated with R&D Expenditure at the 1% level, implying that higher corporate profitability is associated with greater investment in innovation and R&D. LNA is significantly negatively correlated with R&D Expenditure at the 1% level.

Table 3. Correlation Analysis Results.

	RD	ITER	ALR	SM	LNA
RD	1				
ITER	-0.2890***	1			
ALR	-0.2510***	0.2989***	1		
SM	0.3737***	-0.2839***	-0.5417***	1	
LNA	-0.1762***	0.2529***	0.5412***	-0.3613***	1

Note: * p< 0.1，** p<0.05，*** p<0.

6. Benchmark Regression Analysis

To further examine the relationship between R&D Expenditure and ITER, SM, LNA, and ALR, we conducted regression analysis on the model, with the results presented in Table 4.

Table 4. Benchmark Regression Results.

	(1) RD
ITER	-0.0201 *** (-3.1824)
ALR	-0.0167 *** (-3.0953)
SM	0.0782 *** (18.0645)
LNA	-0.0012 ** (-1.9782)
_cons	0.0284 ** (2.0909)
Individual fixed effect	No
Fixed effect of year	No
N	3599
adj. R2	0.147

Note: The values in parentheses represent the t-values, * indicates $p < 0.1$, ** indicates $p < 0.05$, and *** indicates $p < 0.01$.

The regression results indicate that the correlation coefficient between R&D Expenditure and ITER is -0.0201, showing a statistically significant negative relationship at the 1% level. This suggests that the ITER has a significant negative impact on R&D Expenditure, which aligns with expectations. A higher proportion of income tax paid relative to main business revenue implies fewer financial resources available for innovation and R&D investments.

Regarding the control variables, the ALR exhibits a correlation coefficient of -0.0167 with R&D Expenditure, demonstrating a significant negative relationship at the 1% level. This implies that a higher ALR significantly reduces R&D expenditure, likely because firms with elevated debt levels face greater financial risks, leading to more conservative operational decisions that discourage technological innovation. Highly leveraged firms may prioritize short-term financial stability over long-term, uncertain R&D projects.

Conversely, the SM shows a positive correlation coefficient of 0.0782 with R&D expenditure, significant at the 1% level, indicating a strong positive influence. A higher SM reflects greater retained profits from sales, providing firms with more financial flexibility to cover operational costs and allocate resources to R&D and market expansion. Enhanced profitability thus enables firms to engage more actively in technological innovation.

The regression results show a correlation coefficient of -0.0012 between LNA and R&D Expenditure, indicating a negative impact of LNA on R&D investment. Smaller firms typically have more compact organizational structures and faster decision-making processes. This allows them to respond more swiftly to market changes and emerging technologies, leading to greater engagement in technological innovation. Although small enterprises may have limited total resources, they can concentrate their constrained resources on specific innovation projects, achieving breakthroughs in certain domains. Small firms may also demonstrate higher risk tolerance in innovation, as they often possess stronger growth aspirations and motivation to break through existing market constraints, whereas larger corporations tend to adopt more conservative strategies due to considerations of scale and existing market share.

The empirical results confirm Hypothesis 1. The significant negative correlation between ITER and R&D expenditure suggests that tax incentives received by A-share listed companies effectively stimulate R&D investment. These tax incentives promote innovation expenditure through multiple mechanisms: reducing ITER, increasing R&D budgets, enhancing returns on innovation investments, encouraging long-term capital allocation,

strengthening innovation motivation, attracting talent and external funding, aligning with policy guidance, and facilitating risk-sharing. Such policies not only improve short-term financial conditions but also significantly enhance long-term innovation capabilities and market competitiveness of enterprises.

7. Robustness Test

To verify the robustness of the aforementioned regression results, this study conducted robustness checks. The degree of tax incentives granted to A-share listed companies, measured by the reduction in ITER (ΔITER), was used as the main explanatory variable in the regression analysis to examine their technological innovation capability. The proportion of reduced ITER (ΔITER) was calculated as (nominal ITER - actual ITER) / total profit, where nominal ITER equals taxable profit multiplied by the nominal income tax rate.

Table 5 presents the regression results of the impact of tax incentives on R&D Expenditure in A-share listed companies. The results indicate a significantly positive correlation between the amount of tax incentives and corporate R&D Expenditure, which is consistent with the previous empirical findings, thereby confirming the robustness of the empirical results.

Table 5. Robustness Test.

	(1) **RD**
ΔITER	0.0921*** (11.9380)
ALR	-0.0064 (-1.2209)
SM	0.0708*** (16.4940)
LNA	-0.0004 (-0.6391)
_cons	0.0264 (1.9750)
Individual fixed effect	No
Fixed effect of year	No
N	3599
adj. R2	0.147

Note: The values in parentheses represent the t-values, * indicates $p < 0.1$, ** indicates $p < 0.05$, and *** indicates $p < 0.01$.

8. Conclusion

The findings of this study demonstrate a significant negative correlation between ITER and corporate R&D expenditure among A-share listed enterprises in China, confirming the efficacy of science and technology tax policies in promoting investment in technological innovation. The empirical analysis reveals that tax incentives alleviate financial pressures on firms, enabling them to allocate greater resources to innovation activities, which aligns with the broader objective of fostering high-quality economic development. The robustness of these results is further validated through supplementary tests, reinforcing the conclusion that a reduction in ITER positively influences R&D intensity. Additionally, the control variables provide nuanced insights into the determinants of R&D investment. Higher profitability, as measured by SM, correlates with increased R&D investment, reflecting the role of retained earnings in financing innovation. Conversely,

elevated leverage ratios and larger LNA exhibit inhibitory effects, suggesting that financial constraints and organizational inertia may impede innovation efforts. These findings underscore the importance of targeted fiscal policies in addressing market failures inherent in technological innovation, particularly the challenges of high costs, long cycles, and uncertain returns. By mitigating ITER, governments can create a conducive environment for sustained R&D investment, thereby enhancing corporate competitiveness and facilitating industrial upgrading. The study contributes to the existing literature by providing empirical evidence on the relationship between tax policies and innovation in emerging economies, offering actionable insights for policymakers seeking to optimize fiscal incentives. Future research could explore the heterogeneous effects of tax incentives across different industries and ownership structures. It could also examine the long-term impact of such policies on technological breakthroughs and sustained economic growth. Ultimately, this study highlights the pivotal role of tax policy as a strategic tool for stimulating innovation and advancing national economic objectives.

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