Impact of Tax and Fee Reduction on Enterprise Technological Innovation in Yangtze River Delta: An Empirical Study Based on DID Model

Ziyang Li

Anhui University, Hefei, China

Email: Philipplzy@163.com

Abstract. This study examines the policy effects of tax reduction and fee reduction measures on technological innovation of enterprises in Anhui Province, Shanghai, Jiangsu Province, and Zhejiang Province. The analysis utilizes data from a total of 594 listed companies in the Shanghai and Shenzhen stock markets, spanning the period from 2012 to 2021. Employing the rigorous Difference-in-Differences (DID) method, the study focuses on the policy implications of these measures since 2016. The findings reveal significant but divergent impacts of the tax reduction and fee reduction policies on the technological innovation of enterprises across the aforementioned provinces. Notably, there are substantial inter-provincial disparities in the effects observed. Specifically, the policies exhibit an overall stimulating effect on innovation within Shanghai and Zhejiang Province, while they manifest an overall inhibitory effect on innovation within Anhui Province and Jiangsu Province. Furthermore, the study uncovers a lagging pattern in the policy effects, as they are not immediately discernible in the year of implementation but gradually intensify in subsequent years.

Keywords: Tax reduction, fee reduction, technological innovation, DID

1 Introduction

The 19th National Congress has identified innovation as the strategic cornerstone for building a modernized economic system and expediting the development of an innovative nation. Subsequently, the 20th National Congress has introduced new requirements to comprehensively design supportive measures for tax reduction and fee reduction, aiming to deepen the implementation of these policies. In response to the challenges posed by the pandemic, China has taken proactive measures to alleviate enterprise difficulties, stimulate economic growth, and further expand the scope of tax reduction and fee reduction. In 2021, China witnessed a substantial increase of 1.1 trillion yuan in the scale of tax reduction and fee reduction, surpassing the remarkable figure of 2.5 trillion yuan achieved in 2020. Within the context of China's economic transition from high-speed growth to high-quality growth, the extensive implementation of tax reduction and

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fee reduction measures has played a pivotal role in fostering enterprise innovation and facilitating the transformation towards a high-quality development paradigm.

Research on the impact of taxation on corporate innovation can be broadly categorized into two main types: studies focusing on the influence of tax incentives for research and development (R&D) on corporate innovation, and studies examining the effects of changes in the tax burden on corporate innovation. The majority of studies suggest that tax incentives for R&D have a positive impact on corporate innovation. For instance, Li Chuanxian and Li Qihang argue that tax reduction and fee reduction measures effectively stimulate overall innovation activities in enterprises (2022). Li et al. further contends that increasing the intensity of tax reduction and fee reduction by the government significantly enhances innovation output within regions, with greater incentives for strategic innovation compared to substantive innovation. However, these measures may have short-term effects on government public investment and consequently inhibit corporate innovation[1](Li Zhen and Li Maolin, 2021).

Moreover, some studies highlight variations in the incentive effects of tax reduction and fee reduction policies on technological innovation among different tax types, with value-added tax exhibiting a relatively stronger incentive effect on R&D investment[2](He et al., 2021). Additionally, researchers have proposed that for every 1% decrease in the tax rate, there is an approximate increase of 0.783 patent applications by enterprises[3](Gao et al., 2020). Chen et al. suggest that government subsidies are more conducive to stimulating development-oriented innovation activities in manufacturing and service companies during their growth stage, while tax incentives are more suitable for supporting development-oriented and exploratory innovation activities in mature manufacturing companies [4] (Chen et al., 2019). Furthermore, Chen et al. find that fiscal subsidies and tax incentives have a positive impact on the number of granted patents, with tax incentives having a greater positive influence on patent output [5] (Chen et al., 2018). These measures also exhibit a positive effect on R&D expenditure, reducing the marginal cost of R&D for enterprises[6](Hu Kai and Wu Qing, 2018). Zhang et al. discover that enterprises benefiting from tax incentives demonstrate a higher number of patents, new products, and technology awards[7](Zhang et al., 2014).

Internationally, scholars suggest that an increase in corporate cash flow has a positive impact on internal R&D activities [8] (Brown et al., 2011). Consequently, tax reduction and fee reduction policies have a significant positive effect on increasing corporate cash flow. Conversely, if enterprises face severe cash flow pressure, an increase in rent-seeking behavior and financing constraints significantly inhibit corporate innovation[9](Zhang et al., 2017). Bloom et al., after analyzing new data on tax changes and R&D expenditures in 19 OECD countries over a 19-year period (1979-1997), conclude that tax incentives are effective in increasing corporate R&D intensity.

Regarding the impact of the tax burden on corporate innovation, some scholars argue that the tax burden not only affects patents and R&D investments but also influences the output of new products[10](Singh et al., 2014). The reduction in income tax rates, to a certain extent, stimulates the intensity of R&D expenditure and the number of patents[11](Xia Li, 2012). However, some scholars find that the decrease in the tax burden has no significant impact on R&D investment by enterprises, potentially attributed to

initial uncertainties surrounding policy implementation, leading to a wait-and-see approach by enterprises[12][13](Tian et al., 2017; Shao et al., 2019).

In terms of the impact of tax reduction and fee reduction policies on different types of ownership enterprises, some researchers argue that state-owned enterprises are more sensitive to these policies compared to non-state-owned enterprises[14](Zhang Shiming and Gao Wenliang, 2022). They suggest that tax reduction and fee reduction policies have a more pronounced impact on the innovation input and performance of state-owned enterprises[15](Li Chuanxian and Li Qihang, 2022). However, other studies find that tax reduction and fee reduction measures significantly stimulate R&D investment in private and foreign-funded enterprises, while their effects on state-owned enterprises are not significant [16] (Shen Si and Liu Wenlong, 2021). Zhu et al. discover that compared to state-owned enterprises, tax incentives have a greater stimulating effect on R&D investment in private enterprises [17] (Zhu et al., 2019).

2 Theoretical and Policy Basis and Assumptions

The high cost, long R&D cycles, and substantial risks associated with technological innovation activities make it challenging for enterprises to invest in such endeavors. Additionally, the output and conversion rates of innovation activities are often unstable. Moreover, China's intellectual property rights and patent protection system are still imperfect at present, which further discourages enterprises from investing in technology R&D due to cash flow pressures and long-term risks. In response to this, the government has implemented a package of tax reduction policies to encourage corporate innovation. The objectives of these policies are to alleviate the tax burden on enterprises and stimulate innovation. The measures include continuous reduction of value-added tax rates, additional deductions for R&D expenses, and preferential tax rates for high-tech enterprises. In 2022, China further intensified its efforts in tax reduction.

Regarding value-added tax incentives, the government has expanded the scope of VAT carry-forward and refund policies, accelerated the refund process, and broadened the range of eligible industries for full refund of VAT. This expansion now includes the ‘wholesale and retail trade’, ‘agriculture, forestry, animal husbandry, and fishing’, ‘accommodation and catering services’, ‘residential services, repair, and other services’, ‘education’, ‘health and social work’, and ‘culture, sports, and entertainment’ sectors. Additionally, in 2022, the prepayment of value-added tax was temporarily suspended for branch organizations of aviation and railway transportation enterprises throughout the year. Public transportation service enterprises and express delivery service enterprises were exempted from the additional VAT increase.

In terms of pre-tax deductions for corporate income tax, the government has increased the policy support for pre-tax deductions of equipment and instruments for small and micro enterprises, expanded the income tax preferential treatment for small and micro enterprises, and further raised the pre-tax additional deduction ratio for R&D expenses of technology-based small and medium-sized enterprises.

Furthermore, in other tax areas, the government has implemented the "six tax and two fee" reduction policy for small and micro enterprises (Table 1). In terms of fee

reduction, the government has further implemented policies to defer corporate social insurance contributions and expanded the scope of industries eligible for deferred payments (Table 2).

Table 1. Tax Reduction and Preferential Policies for Chinese Enterprises in 2022

Source	Tax type	Summary
CaiShui (Finance and Taxation)2022 No.14	Value-added Tax	Increased intensity of year-end VAT carry-forward and refund policies for small and micro enterprises and manufacturing enterprises.
CaiShui 2022 No.17	Value-added Tax	Accelerated progress and speed of year-end VAT carry-forward and refund.
CaiShui 2022 No.19	Value-added Tax	Value-added Tax | Early refund of accumulated VAT carry-forward for large-scale enterprises in the manufacturing industry and other sectors.
CaiShui 2022 No.21	Value-added Tax	Value-added Tax | Expanded industry coverage for full refund of VAT carry-forward.
CaiShui 2022 No.11	Value-added Tax	Value-added Tax | Continued implementation of VAT deduction policy for the service industry, exemption of value-added tax for public transportation services.
CaiShui 2022 No.15	Value-added Tax	Value-added Tax | Exemption of value-added tax for small-scale taxpayers.
CaiShui 2022 No.18	Value-added Tax	Exemption of value-added tax for express delivery and courier services.
CaiShui 2022 No.6	Corporate Income Tax	Deduction of taxable income for venture capital enterprises, angel investors, and qualifying start-up technology enterprises under certain conditions.
CaiShui 2022 No.12	Corporate Income Tax	Pre-tax deduction at a certain percentage for newly purchased equipment and appliances by small and micro enterprises meeting the specified criteria.
CaiShui 2022 No.13	Corporate Income Tax	Corporate Income Tax | Reduction of taxable income for small and low-profit enterprises by the portion exceeding 1 million yuan but not exceeding 3 million yuan annually.
CaiShui 2022 No.16	Corporate Income Tax	Corporate Income Tax | Further increase in the pre-tax deduction percentage for R&D expenses of technology-oriented small and medium-sized enterprises.
CaiShui 2022 No.10	Other	Local exemptions and reductions of "six taxes and two fees" for small and micro enterprises based on local conditions.
CaiShui (Finance and Taxation)2022 No.14	Value-added Tax	Increased intensity of year-end VAT carry-forward and refund policies for small and micro enterprises and manufacturing enterprises.

Source	Tax type	Summary
CaiShui 2022 No.17	Value-added Tax	Accelerated progress and speed of year-end VAT carry-forward and refund.
CaiShui 2022 No.19	Value-added Tax	Value-added Tax | Early refund of accumulated VAT carry-forward for large-scale enterprises in the manufacturing industry and other sectors.
CaiShui 2022 No.21	Value-added Tax	Value-added Tax | Expanded industry coverage for full refund of VAT carry-forward.
CaiShui 2022 No.11	Value-added Tax	Value-added Tax | Continued implementation of VAT deduction policy for the service industry, exemption of value-added tax for public transportation services.
CaiShui 2022 No.15	Value-added Tax	Value-added Tax | Exemption of value-added tax for small-scale taxpayers.
CaiShui 2022 No.18	Value-added Tax	Exemption of value-added tax for express delivery and courier services.

Table 2. Expense Reduction Policies for Chinese Enterprises in 2022

Source	Tax type	Summary
RenSheTingFa(Department of Human Resources and Social Security) [2022] No.16	Social Insurance Fees	Phase-wise implementation of deferred payment of enterprise social insurance fees for designated industries.
RenSheTingFa [2022] No.16	Social Insurance Fees	Expanded implementation scope of phase-wise deferred payment policy for social insurance fees.

Due to variations in tax reduction and fee reduction policies across different industries and regions, as well as differences in enterprise types, research and development capabilities, and levels of marketization in different areas, the impact of China's tax reduction and fee reduction policies on technological innovation may vary for enterprises in different regions. Relevant studies on the impact of tax reduction and fee reduction policies on different regions also indicate heterogeneity in the regional and marketization effects of these policies on innovation incentives for enterprises. Tax reduction and fee reduction policies have a greater stimulating effect on technological innovation for enterprises in the eastern region of China and for regions with higher levels of marketization [18] (Li Chuanxian and Li Qihang, 2022; He et al., 2021; Deng et al., 2020; Liang Junjiao and Jia Yuxi, 2019; Zhut al., 2019). Gao Yanrong found in their research that the combined use of tax incentives and government subsidy policies has a better effect on improving research and development efficiency in high-tech industries[19] (2020). They also found that tax incentives have a significantly higher stimulating effect on overall innovation efficiency in high-tech industries in the eastern region compared to the central and western regions, and the inhibitory effect of govern-

ment subsidy policies on overall innovation efficiency in the eastern region is also significantly lower[20](Gao Yanrong and Shu Ying, 2020). Therefore, it can be inferred that the impact of tax reduction and fee reduction policies on technological innovation for enterprises in the highly marketized Yangtze River Delta region of China should be more pronounced. Based on the above analysis, this study proposes the following hypotheses:

Hypothesis 1: Tax reduction and fee reduction have a significant impact on technological innovation for enterprises in Shanghai, Jiangsu, Zhejiang provinces, and Anhui region in the Yangtze River Delta.

Hypothesis 2: Tax reduction and fee reduction have a positive impact on technological innovation for enterprises in Shanghai, Jiangsu, Zhejiang provinces, and Anhui region in the Yangtze River Delta.

Hypothesis 3: The impact of tax reduction and fee reduction on technological innovation exhibits regional heterogeneity and marketization level heterogeneity, with a higher impact on enterprises in the provinces of the Yangtze River Delta compared to Anhui region.

3 Research Design and Empirical Analysis

3.1 Empirical Model

In this study, we consider the comprehensive implementation of the VAT reform since 2016 and the recent large-scale tax reduction and fee reduction policies. The DID (Difference in Difference) method is adopted to assess the policy effects, which is widely recognized for evaluating causal relationships between policies and outcomes. However, this method relies heavily on accurate policy implementation time and regional differences, and any deviation in these factors could affect the validity of the results. We construct the following difference-in-differences (DID) econometric model:

$$Innovation_{i,t}=\beta 1+\beta 2DIDi,t+\beta 3Xi,t+Vy+\varepsilon i,t$$

Here, $Innovation_{i,t}$ represents the technological innovation of enterprise i in period t. Following relevant scholars' studies, this paper uses the intensity of innovation inputs to measure the technological innovation of enterprises. We select the value of research and development (R&D) expenditure to revenue ratio from the financial statements of listed companies as the indicator of innovation input intensity [21] (Zhang Jiping, 2019). DIDi,t consists of a time component (Time) and the tax reduction and fee reduction policy (Treat). If enterprise i is included in the tax reduction and fee reduction policy after 2016 in period t, the value is set as 1; otherwise, it is set as 0. If the enterprise did not enjoy the tax reduction and fee reduction policy, DIDi,t is always 0. Since 2016, tax reduction and fee reduction policies for enterprises mainly include the "VAT reform," changes in VAT rates, preferential tax rates for high-tech enterprises, and changes in the ratio of employee education funds. Vy represents annual fixed effects. Xi,t represents control variables that affect technological innovation of enterprises, including return on assets (Roa), leverage ratio (Lev), firm size (Lnsize), firm age (Lnage), and equity concentration (TOP1)[22][23] (Wang Guijun and Cao Ping, 2018;

Deng et al, 2020; He et al, 2021). In this model, if β2 is significantly positive, it indicates that the tax reduction and fee reduction policies since 2016 have significantly increased the intensity of innovation inputs for enterprises. If β2 is significantly negative, it indicates that the tax reduction and fee reduction policies have a certain negative impact on the intensity of innovation inputs for enterprises. The variable descriptions are provided in Table 3.

Table 3. Variable Descriptions

	Variable	Symbol	Description
Dependent Variable	Technological Innovation	rd	Research and development (R&D) expenditure to revenue ratio
Explanatory Variable	Policy Dummy Variable	DID	Firms affected by policies after 2016 are assigned to the treatment group, with a value of 1, otherwise 0
Control Variables	Return on Assets	Roa	(Net Income + Financial Expenses) / Total Assets
	Leverage Ratio	Lev	End-of-year total liabilities / End-of-year total assets
	Firm Size	Lnsize	Natural logarithm of total assets of the firm
	Firm Age	Lnage	Natural logarithm of the difference between the examination year and the year of the company's listing
	Equity Concentration	Top1	Percentage of shareholdings held by the largest shareholder
	Year Fixed Effects	Vy	Controls for annual fixed effects

3.2 Sample Selection and Data Sources

The Yangtze River Delta is selected as the research region, which represents one of the most economically dynamic regions in China. However, the selection of these provinces, while representative of eastern China's economic development, may limit the generalizability of the findings to other regions, especially those with different economic structures and levels of development. This study selects data from 2012 to 2021 for companies listed on the Shanghai and Shenzhen A-share stock markets. The data is obtained from the CSMAR database and the WIND database. The original data is carefully screened by excluding companies with ST or PT status for one year or more during the research period, removing financial abnormal data, eliminating samples with incomplete indicator data, and conducting winsorization at the 1% level for variables. The final sample consists of 64 listed companies, yielding a panel dataset of 640 observations for Anhui province; 153 listed companies, yielding 1530 observations for Shanghai city; 180 listed companies, yielding 1800 observations for Jiangsu province;

and 197 listed companies, yielding 1970 observations for Zhejiang province. The empirical analysis is conducted using StataMP16 software.

3.3 Descriptive Statistics

From the descriptive statistics presented in Table 4, it can be observed that the mean values of the policy dummy variable (DID) for each province are around 0.5. This indicates that approximately 50% of the companies in the four provinces have benefited from the tax reduction and fee reduction policies after 2016. Among them, Shanghai has the lowest proportion, while Zhejiang has the highest. The research also reveals that R&D expenditure as a percentage of revenue for listed companies in the four provinces ranges from 3% to 4%, with Shanghai having the lowest proportion and Zhejiang the highest.

Table 4. Descriptive Statistics of Main Variables

Variable	Province	Sample Size	Mean	Standard Deviation
rd	Anhui Province	640	0.0337	0.0349
	Shanghai Municipality	1530	0.0300	0.0390
	Jiangsu Province	1800	0.0368	0.0355
	Zhejiang Province	1970	0.0406	0.0415
did	Anhui Province	640	0.4922	0.5003
	Shanghai Municipality	1530	0.4478	0.4974
	Jiangsu Province	1800	0.5189	0.4998
	Zhejiang Province	1970	0.5431	0.4983

3.4 Empirical Analysis

3.4.1 DID Analysis Results.

As shown in Table 5, the impact of tax reduction and fee reduction policies on the innovation intensity of companies in each province is significant. Specifically, the effect is significant at the 1% level for Anhui Province, at the 5% level for Shanghai and Zhejiang Province, and at the 10% level for Jiangsu Province. However, the impact of tax reduction and fee reduction policies on the innovation intensity of listed companies varies greatly among the provinces. It is observed that the policy has a negative effect on the innovation intensity of listed companies in Anhui Province and Jiangsu Province, while it has a positive effect on the innovation intensity of listed companies in Shanghai and Zhejiang Province. These findings suggest that the effects of tax reduction and fee reduction policies differ significantly among provinces, and the negative impact is more pronounced in the provinces where it occurs. Therefore, the statistical analysis supports Hypothesis 1 and Hypothesis 2 for Shanghai and Zhejiang Province, while rejecting Hypothesis 3.

Table 5. Did Analysis Results of Each Province

Variable	rd			
	Anhui province	Shanghai Municipality	Jiangsu province	Zhejiang province
did	−.0139***	.0042**	−.0051*	.0040**
	(-3.69)	(2.38)	(-1.65)	(1.99)
Lnsize	.0045	.0037***	.0086***	.0036***
	(2.05)	(3.62)	(5.11)	(4.56)
Lev	−.0053	−.0285***	−.0274***	−.0273***
	(-0.50)	(-6.29)	(-4.06)	(-8.51)
Roa	−.0289	−.0955***	−.0698***	−.0693***
	(-1.64)	(-11.40)	(-5.34)	(-11.87)
Top1	.0042	−.0123*	−.0113	−.0072
	(0.29)	(-1.74)	(-1.14)	(-1.26)
Lnage	.0031	.0047***	.0022	.0027***
	(0.80)	(4.00)	(0.89)	(3.12)
cons	−.0736*	−.0290	−.1432***	−.0285*
	(-1.69)	(-1.33)	(-4.10)	(-1.71)

Note: The values in parentheses represent the t-statistics for individual explanatory variables. ***, **, and * denote significance at the 1%, 5%, and 10% confidence levels, respectively. The same notation applies below.

4 Conclusion and Policy Recommendations

4.1 Conclusion

This study utilized data from listed companies on the Shanghai and Shenzhen stock exchanges from 2012 to 2021. By employing the difference-in-differences (DID) method, we investigated the incentive effects of tax reduction and fee reduction policies on the technological innovation of companies in Anhui Province, Shanghai, Jiangsu Province, and Zhejiang Province. The empirical findings are as follows: The incentive effects of tax reduction and fee reduction policies on innovation intensity differ significantly among different regions. Specifically, the overall effect is negative for companies in Anhui Province and Jiangsu Province, while it is positive for companies in Shanghai and Zhejiang Province. This implies that tax reduction and fee reduction policies lead to a decrease in innovation intensity for companies in Anhui Province and Jiangsu Province, while they stimulate an increase in innovation intensity for companies in Shanghai and Zhejiang Province. Furthermore, the incentive effects and inhibitory effects of these policies on innovation intensity exhibit a certain time lag, with no significant impact observed on innovation intensity in the year of policy implementation but gradually increasing effects in subsequent years. The effects of tax and fee reductions are not uniform across different regions, with significant variation observed. This disparity can be attributed to factors such as regional economic development levels, enterprise size, and industrial structure. For instance, enterprises in more developed

coastal areas may benefit more due to greater access to resources for innovation, while inland regions may experience less pronounced effects.

4.2 Policy Recommendations

Given the asymmetry of information between the government and enterprises, the varying degrees of marketization, the incomplete patent protection system, and the uneven development among provinces, tax policies demonstrate different outcomes across provinces. Under government intervention, tax relief policies may also lead to crowding-out effects on innovation in enterprises. Decision-makers in companies may allocate more resources to projects that are conducive to gaining market competitive advantages or projects that are more likely to receive government support. Moreover, the information asymmetry between the government and enterprises may result in misallocation and redundancy of research and development (R&D) funds and personnel, leading to decreased output efficiency. Consequently, tax reduction and fee reduction policies may not effectively enhance the innovation output of enterprises and may ultimately hinder their innovation development. Additionally, in the context of the COVID-19 pandemic, most companies have faced financial constraints and reduced operating income in recent years. Innovation and research and development have been generally scaled back during the pandemic due to the long R&D cycles, high investment requirements, and uncertain outcomes. Therefore, the tax incentives provided by the government for innovation and R&D also face challenges in effectively offsetting R&D costs and mitigating business risks. Thus, this study contributes to assessing the current state of innovation investment and policy effects in different provinces and regions, and provides the following policy recommendations:

a. The central government and local governments should continuously monitor the multifaceted effects of tax reduction and fee reduction policies, assess the problems faced by local enterprises, conduct research on their needs, and stimulate their innovation vitality. As tax reduction and fee reduction policies increase fiscal risks and burdens, governments should implement tax reduction policies for companies in different regions and sectors with greater precision, enhance policy guidance, effectively enhance the innovation capacity of enterprises, and truly reduce the economic pressure on innovation, thereby fostering a virtuous cycle between government taxation and enterprise innovation.

b. When formulating policies, the government should consider the regional differences and design policy combinations that are suitable for different regions based on their specific characteristics and levels of marketization. This approach will ensure that policies align with the real situations and development needs of local enterprises.

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