

# Can Fiscal Subsidies and Tax Incentives Stimulate High-quality Innovation in Strategic Emerging Industries?

-- Explanation Based on Enterprise Life Cycle Theory

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**Abstract:** This paper empirically examines the incentive effects of fiscal subsidies and tax incentives on the innovation activities of strategic emerging enterprises from the perspective of enterprise life cycle using data of listed companies in strategic emerging industries in China from 2010 to 2019. The results show that: in general, both fiscal subsidies and tax incentives promote the improvement of total factor productivity of strategic emerging enterprises; in terms of different stages of enterprise development, the incentive effects of fiscal subsidies and tax incentives on the innovation activities of strategic emerging enterprises in the growth stage are more obvious, but for enterprises in the maturity and decline stages, the incentive effects are not obvious; from the perspective of the types of fiscal subsidies and tax incentive policies, tax incentive policies are more conducive to the innovation activities of strategic emerging enterprises; the further sub-sample study reveals that fiscal subsidies and tax incentives significantly stimulate the innovation activities of non-state enterprises, manufacturing enterprises and enterprises in the eastern region in the growth stage; from the mechanism test, strategic emerging enterprises that receive fiscal subsidies and tax incentives have a more significant increase in R&D expenditure, which in turn promotes the innovation activities of enterprises. After replacing the explained variable, replacing the core explanatory variables and considering the endogeneity issue, the findings of this paper are still robust. The findings of this paper help to optimise the allocation of fiscal subsidy and tax incentive funds and improve the efficiency of the use of fiscal subsidy and tax incentive funds.

**Keywords:** Fiscal subsidies, Tax incentives, Strategic emerging enterprises, Total factor productivity.

## 1. Introduction

In recent years, China's economy has shifted from a stage of high-speed growth to a stage of high-quality development, and there is an urgent need to transform the dynamics of economic development and to stimulate and release its inherent vitality. Against this background, the 18th Party Congress report clearly proposed "implementing the innovation-driven development strategy", and the 19th Congress report further made accelerating the construction of an innovative country an important element of building a modern economic system, and stressed that "innovation is the first driving force leading development". The Nineteenth National Congress report further made accelerating the building of an innovative country an important part of building a modern economic system, and emphasized that "innovation is the first driving force leading development". China's economic take-off under the new normal requires a shift from "Made in China" to "Innovation by China", and the development of innovation capabilities in strategic emerging industries is the key to this shift. "The 14th Five-Year Plan" emphasises the importance and leading role of strategic emerging industries in the sustainable development of the national economy. The development of strategic emerging industries is an important decision to adjust the economic structure and seize the high ground of economic development, and it is an inevitable requirement for China to establish an innovative country, while science and technology innovation is the key for strategic emerging industries to add new impetus to a new round of economic growth. Under the background of the new normal where the downward pressure on China's economic development continues to increase,

vigorously developing strategic new industries is not only an inevitable measure to enhance the core competitiveness of industries and promote the transformation and upgrading of industrial structure, but also a fundamental requirement to improve comprehensive national power and establish an innovative country. Fiscal subsidies and tax incentives, as two major incentive tools of fiscal policy, can not only directly affect enterprises' innovation activities, but also have indirect effects on enterprises' innovation activities by influencing innovation inputs and input structures. Therefore, it is of great theoretical significance to investigate the relationship between fiscal subsidies, tax incentives and innovation activities of strategic emerging industries.

Scholars have not yet reached a unanimous conclusion on whether fiscal and tax policies are effective for enterprises to innovate on their own. Some scholars believe that fiscal and tax policies can motivate firms to innovate on their own. For example, Howell (2017) studied the effect of the implementation of the Small Business R&D Innovation Subsidy Program (SBIR) in the US using a breakpoint regression method and found that fiscal subsidies promoted firms' innovation output, as evidenced by an increase in high-quality patents and growth in business revenue. Domestic scholars such as Chu Deyin et al. (2016) found that fiscal subsidies and tax incentives had a positive incentive effect on innovation investment in strategic emerging industries, but the incentive effect on enterprise R&D expenditure investment was better than that of human capital investment. Yao, Linxiang and Leng, Nermin (2018) found that tax incentives not only significantly stimulated corporate innovation, but also indirectly stimulated corporate innovation by significantly increasing corporate R&D funds

and R&D personnel, while fiscal subsidy policies significantly inhibited corporate innovation, but indirectly stimulated corporate innovation by significantly increasing corporate R&D funds. Wang Yanchao et al. (2019) found that measures such as tax incentives and fiscal subsidies are conducive to promoting and increasing the level of enterprise innovation investment, but the incentive effects vary significantly for enterprises in different industries and with different property rights properties. Tax incentives and fiscal subsidies are effective in promoting innovation in private enterprises, and the incentive effect is more significant for some tax-sensitive industries. However, some scholars also argue that fiscal policies may inhibit firms' independent innovation. For example, Boeing (2016) studied the effect of subsidies on Chinese firms' R&D policies from 2001-2006 and found that fiscal subsidies crowded out R&D investment in the short term and had no effect on firms' R&D investment in the long term. Zhao Yulin and Gu Junjian (2018) argue that there is a structural bias between the current tendency of government subsidy allocation and innovation incentives, with no overall incentive effect on corporate R&D investment. Yang Guochao et al. (2017) found that the "one-size-fits-all" microscopic recognition threshold of the ratio of R&D investment to sales revenue as determined by the "Management Method for the Recognition of High-tech Enterprises" has led to manipulation of R&D behaviour in order to obtain more tax incentives and fiscal subsidies, ultimately leading to a decline in R&D performance.

As can be seen from the above, scholars at home and abroad have conducted a lot of useful researches on the impact of fiscal policies such as fiscal subsidies and tax concessions on the innovation activities of strategic emerging industries, some of them have studied the paths and effects of fiscal subsidies and tax concessions on the innovation activities of strategic emerging industries separately, while others have incorporated fiscal subsidies and tax concessions into a framework system to analyze the paths and effects on the innovation activities of strategic emerging industries. However, their effects are still controversial and no uniform conclusion has been reached. Specifically, the existing studies may have the following shortcomings: Firstly, most of the existing studies use indicators such as enterprise R&D investment, human capital investment and enterprise patent output to measure the innovation activities of strategic emerging industries, but there is less literature on the measurement of indicators of high-quality development of strategic emerging industries, and the literature on the impact of fiscal policies such as fiscal subsidies and tax relief on the high-quality development of strategic emerging industries is even more scarce. Secondly, most of the existing studies are limited to evaluating the incentive effect of fiscal policies such as fiscal subsidies and tax and fee reductions on the policy objectives of strategic and emerging industries at a certain stage, so that it is difficult to explain whether the existing fiscal policies are really effective in promoting the high-quality development of strategic and emerging industries. Based on this, the possible innovations of this paper are: Firstly, to use total factor productivity of enterprises as an indicator to measure the high-quality development of strategic emerging industries, to use the OP and LP method to comprehensively measure the current situation of high-quality development of strategic emerging industries in China, and on this basis to empirically investigate the effects of fiscal policies such as fiscal

subsidies and tax relief on the high-quality development of strategic emerging industries; Secondly, to examine the effects of fiscal policies such as fiscal subsidies and tax relief on the high-quality development of strategic emerging industries from the perspective of enterprises' cycle stage, industry category, regional location, property rights structure, and the development of strategic emerging industries, The second is a theoretical branch and empirical investigation of the effects of fiscal policies such as fiscal subsidies and tax and fee reductions on the high-quality development of strategic emerging industries from the perspective of the stage of the enterprise's cycle, industry category, regional location and ownership structure.

The subsequent structure of this paper is as follows: Part II provides an in-depth analysis of the theoretical paths of strategic emerging enterprises at different life cycle stages on their innovation activities when receiving two different incentive policies, based on life cycle theory and combining the differences between fiscal subsidies and tax incentives; Part III introduces the empirical model and variable definitions; Part IV reports the empirical estimation results, in terms of replacing the explained variable, replacing the core explanatory variables, and endogeneity dimensions; the fifth part empirically analyzes the mechanism paths of fiscal subsidies and tax incentives affecting the innovation activities of strategic emerging firms; and the sixth part concludes the paper.

## 2. Theoretical Analysis

The uncertainty of innovation investment in strategic emerging industries, the riskiness of the R&D process, the public nature of R&D results and the externality of product effects not only determine the dependence of strategic emerging industries on government support, but also provide a theoretical basis for government support through fiscal incentives. In order to provide more precise and effective fiscal incentives, improve the efficiency of policy operation and enhance the effect of policy support, it is necessary to systematically explain the mechanism of fiscal subsidies and tax incentives on the innovation activities of strategic emerging industries.

As there are significant differences in innovation capability, R&D needs, cash flow and financing constraints at different stages of the enterprise lifecycle, this paper provides an insight into the theoretical paths that strategic emerging enterprises take when they receive two different types of incentives. Based on this, this paper analyses the theoretical paths of innovation activities of strategic emerging enterprises at different life cycle stages when they receive two different incentives based on life cycle theory and the differences between fiscal subsidies and tax incentives. To facilitate the analysis, the paper divides the life cycle of enterprises into three stages: growth, maturity and decline.

Compared to mature firms, growth stage firms generally have the following three characteristics: (1) Stronger internal and external financing constraints. Firms in the growth stage have not yet developed stable earnings and lack sufficient internal financial support (Gao Song et al., 2011); while external suppliers of funds tend to maintain a relatively cautious and wait-and-see attitude towards their investments due to their uncertainty (Huang Hongbin et al., 2016), which in turn constrains the external financing of growth stage firms. (2) More demand for capital expenditure. Growth stage firms have not been in the market for long, and their priority at this

stage is not to engage in risky R&D and innovation activities, but rather to seek to "establish a firm foothold" in the market. (3) Greater risk of R&D failure and lower willingness to innovate. The lack of familiarity with the market, the lack of R&D experience and the lack of long-term technological accumulation, coupled with the financing constraints mentioned above, means that the risk of failure and the cost of innovation are significantly higher for growth stage firms than for mature firms. fiscal subsidies and tax incentives can reduce the unit cost and R&D risk of innovation activities, which in turn can enhance innovation performance by increasing firms' motivation to engage in innovation activities. From the perspective of the spillover effect of innovation results: the innovation results of enterprises have certain positive externalities, which are usually easily copied and imitated by other enterprises, thus leading to a decrease in the expected return of enterprise innovation. At this point, if fiscal subsidies or tax incentives are introduced, it will not only reduce the marginal cost of innovation and increase the expected return, but also further enhance the enthusiasm of enterprises to carry out innovation activities. From the perspective of risk compensation: enterprises need to invest a lot of human and material resources to carry out innovation activities, but the output and return of investment is very uncertain, enterprises will inevitably reduce their investment in innovation in order to avoid the high risk of possible losses, and some even do not carry out innovation activities. At this point, if fiscal subsidies or tax concessions are provided, it is equivalent to giving enterprises a certain amount of risk compensation and risk protection. From the perspective of corporate finance: compared to other activities, innovation activities are characterised by larger investment amounts, longer investment cycles and higher investment risks, which may not be fully supported by the size of the company's own capital. In addition, as potential suppliers of capital are also unwilling to take high risks and invest in the innovative activities of enterprises, if fiscal subsidies or tax incentives are adopted, the financing problems of enterprises can be reduced or solved to a certain extent. Based on the above analysis, Hypothesis 1 is proposed in this paper.

Hypothesis 1: Both fiscal subsidies and tax incentives stimulate innovative activities of strategic emerging firms during the growth phase of the firm.

When firms enter the maturity stage, there are significant changes in firm characteristics such as their financing status, the direction of capital expenditure and their ability and willingness to innovate. At this stage, the most important characteristics of enterprise finance are stable profit level, abundant surplus accumulation and abundant cash flow (Huang Hongbin et al., 2016), and enterprises' business risks are reduced, and they are more likely to be favoured by individual or institutional investors and have more open financing channels. In addition, in terms of expenditure, on the one hand, maturing firms have basically completed the capital accumulation in the early stage, the investment in large fixed assets has declined, and firms' capital expenditure has significantly reduced. On the other hand, as the corresponding sales network has basically been established, enterprises' non-productive costs such as business hospitality, business promotion expenses and start-up costs incurred during the preparatory period are also significantly lower. More importantly, after the accumulation of R&D experience in the formative years and the increasing familiarity with the product market, the R&D risks of enterprises in the maturity

period are greatly reduced; in order to further strengthen their market position and capture a larger market share, the willingness of enterprises in the maturity period to innovate reaches a peak. The government's intention in subsidising innovation is to act as a "guide and facilitator", i.e. to stimulate more enterprises to innovate and to encourage more enterprises to increase their R&D investment. In other words, the government's innovation subsidy policy is not primarily intended to make enterprises rely on government funds to innovate, but rather to leverage enterprises to increase their R&D investment (Li Yongyou and Ye Qianwen, 2017). Enterprises in the mature stage, which are well-funded and under less financial pressure, are relatively less influenced by the amount of government subsidies they receive and are more influenced by their own development strategies for their independent innovation behaviour. Based on the above analysis, Hypothesis 2 is proposed in this paper.

Hypothesis 2: Fiscal subsidies and tax incentives have a weaker incentive effect on the innovation activities of strategic emerging firms during the maturity stage of the firm.

When a company enters a recession, its sales tend to decline and its profits fall or even lose money. Business risks rise, internal and external financing channels are blocked, financing is relatively difficult, and the funds available for R&D investment are even tighter; in terms of the ability to innovate, the technological equipment of enterprises in recession is more outdated, and the efficiency of innovation and the ability to transform innovative output into new products are poor. On the other hand, enterprises in decline are often at risk of being delisted due to loss of profits. When enterprises receive fiscal subsidies, due to the lack of government supervision, complete supporting regulatory measures and performance evaluation, enterprises use the fiscal subsidies received for other purposes, thus squeezing out their R&D funds. On the contrary, tax incentives, as an ex-post support policy, are paid to enterprises to benefit from the funds mainly through preferential tax rates and tax credits after R&D activities have taken place. Because tax incentives work ex-post for R&D, enterprises may need to obtain sufficient R&D results to enjoy its benefits, and thus for the R&D expenses already incurred and R&D results already obtained, unlike the ex-ante fiscal subsidies which may generate certain crowding out effect and moral hazard, thus providing better incentives for enterprises to conduct R&D. Based on the above analysis, we propose Hypothesis 3.

Hypothesis 3: Tax incentives are a better incentive for strategic emerging firms to innovate than fiscal subsidies during the recession phase of a firm.

### 3. Model Construction and Description of Variables

#### 3.1. Model construction

In order to comprehensively examine the impact of fiscal subsidies and tax incentives on innovation activities in strategic emerging industries, this paper proposes to develop a two-way fixed effects model with total factor productivity as the explanatory variable and fiscal subsidies and tax incentives received by enterprises as the core explanatory variables.

$$TFP_{it} = \alpha + \beta_1 * Subsidy_{it} + \beta_2 * Taxp_{it} + \sum \gamma X_{it} + \mu_i + \omega_t + \varepsilon_{it}. \quad (1)$$

where the subscript  $i$  represents the firm and  $t$  denotes the year. TFP is the firm's total factor productivity, Subsidy denotes the fiscal subsidy received by the firm, Taxp is the tax incentive received by the firm and  $X$  is a set of control variables.  $\mu_i$  denotes firm fixed effects, used to control for unobservable firm-level specific effects that do not vary over time.  $\omega_t$  denotes year fixed effects, which are used to control for shocks common to all firms at the year level.  $\varepsilon_{it}$  is a random error term. In addition, to eliminate the impact of potential intra-residual group correlations and heteroskedasticity on inferences about the significance of the estimated coefficients, we cluster the regression standard errors to the firm level.

## 3.2. Description of variables

### 3.2.1. Total Factor Productivity (TFP)

Existing measures of innovation performance focus on the quantity of innovation (R&D inputs, patent production, output efficiency, etc.), while ignoring the quality of innovation. R&D input is an initial input, which is not necessarily related to the quality of innovation. Considering that enterprises may "whitewash" their R&D investment in order to obtain financial and tax policy subsidies, it is biased to use R&D input as a measure of innovation performance. Patent output is only a kind of knowledge output, and there is still a big gap between it and the connotation of quality development. In general, the current innovation performance indicators focus on the quantity of innovation but neglect the quality of innovation; at the same time, there is also the problem of focusing on the front-end input (R&D input) and the middle-end output (patent), while neglecting the end-end economic performance. Based on this, this paper adopts total factor productivity to measure the innovation activities of enterprises, in order to reflect the results of their innovation activities more comprehensively.

There are various methods for estimating the total factor productivity of enterprises (e.g. least squares, fixed effects, semi-parametric and generalised method of moments estimation). Given that the semi-parametric OP method and the LP method are effective in avoiding simultaneous bias and sample selectivity bias, this study uses the total factor productivity level of enterprises estimated by the LP method for benchmarking analysis and the OP method for robustness testing. Specifically, referring to Hu Haifeng et al.(2020) estimation method, total output ( $Y$ ) is measured using revenue from main business, labour factor input ( $L$ ) is measured using total number of employees, capital factor input ( $K$ ) is measured using net fixed assets, current investment ( $I$ ) is measured using cash paid for the purchase of

fixed assets, intangible assets and other long-term assets, and intermediate input ( $Mat$ ) is measured using cash paid for the purchase of goods and services. The specific measurement models are as follows:

$$\ln Y_{it} = \theta_0 + \theta_1 * \ln K_{it} + \theta_2 * \ln L_{it} + \theta_3 * \ln Mat_{it} + \text{Ind}_i + \text{Year}_t + \varphi_{it} \quad (2)$$

where  $i$  represents the firm,  $t$  represents the year, Ind and Year are controlled firm and year fixed effects, and  $\varphi_{it}$  is the random error term. A regression of equation (2) is performed and the final model residuals obtained are the total factor productivity.

### 3.2.2. Fiscal subsidies (Subsidy) and tax incentives (Taxp)

Considering that the government subsidies in the company's financial statements include part of the tax incentives received, drawing on the empirical approach of Liu Guangqiang (2016), the logarithm of the value of government subsidies received by enterprises excluding the tax incentives received in the year is used to measure fiscal subsidies; the logarithm of "tax refunds received" in the enterprise cash flow statement is used to measure tax incentives. Further, in the robust regression analysis, the natural logarithm of government subsidies under non-operating income of enterprises' annual reports is used to measure the fiscal subsidies received by enterprises, and the natural logarithm of corporate income tax incentives ((statutory tax rate - effective tax rate)\*total profit) is used to measure the tax incentives received by enterprises.

### 3.2.3. The enterprise life cycle stage

There are numerous criteria for measuring the life cycle stage of a firm, which can be summarised into three categories: univariate analysis (e.g. firm size and age, etc.), financial composite indicator approach (Anthony and Ramesh, 1992) and cash flow model approach (Dickinson, 2011). Compared with the former two, the cash flow model method uses a combination of positive and negative net cash flows from operations, investments and financing to reflect the growth rate, profitability and business risks of firms at different life cycle stages, avoiding assumptions about the distribution of life cycles across different firms, which is less subjective and more practicable (Huang Hongbin et al., 2016; Tong Jinzhi et al., 2018). Therefore, this paper chooses the cash flow model method to measure the life cycle of enterprises (see Table 1 for details), which divides listed companies into three stages: growth, maturity and recession.

**Table 1.** Combination of cash flow characteristics of enterprises at different life cycle stages

Cash flow	Growth stages		Maturity stages	Recession stages				
	Start-up period	Growth period	Maturity period	Recession period	Recession period	Recession period	Elimination period	Elimination period
Net cash flow from operations	-	+	+	-	+	+	-	-
Net cash flow from investments	-	-	-	-	+	+	+	+
Net financing cash flows	+	+	-	-	+	-	+	-

### 3.2.4. Control variables

In order to mitigate the impact of omitted variable bias and

improve the efficiency of regression estimation, the following variables were introduced into the model with reference to

relevant studies such as Chu Deyin et al. (2016) and Tong Jinzhi et al. (2018): (1) Firm age (Firmage): expressed as the logarithm of "year of observation - year of firm establishment + 1"; (2) Firm size (Firmsize): expressed as the logarithm of the number of employees; (3) Return on net assets (ROA): net profit/net assets; (4) Gearing ratio (Leverage): total liabilities/total assets; (5) Liquidity ratio (Liquidity): current assets/current liabilities.

### 3.3. Data sources

This article takes A-shares listed in Shanghai and Shenzhen as the target of analysis. As the China Securities Regulatory Commission has not yet classified the strategic emerging industry sectors, this paper uses the 1,117 original sample

stocks selected from the China Strategic Emerging Industry Composite Index (referred to as the Emerging Composite Index) released by China Securities Index Company Limited and the Shanghai Stock Exchange on 25 January 2017 as the reference framework, excluding the New Third Board listed companies and ST abnormal stocks, deleting companies with missing data on major indicators and those with the final list of companies is 430. Because the State Council issued "the Decision on Accelerating the Cultivation and Development of Strategic Emerging Industries" in 2010, and considering the exclusion of the impact of major health emergencies, the sample interval of this paper is from 2010 to 2019. The relevant data were obtained from the Guotaian database. Table 2 presents descriptive statistics for primary variable.

**Table 2.** Descriptive statistical analysis

Variables	Sample size	Average	Standard deviation	Minimum value	Maximum value
TFP	4300	17.226	1.028	14.336	20.875
Subsidy	3733	16.708	1.6	7.824	21.664
Taxp	3274	15.516	2.237	-1.139	22.024
Firmage	4300	2.776	0.384	0.693	3.584
Firmsize	4300	7.909	1.175	3.367	12.444
ROA	4300	0.049	1.148	-66.535	18.081
Leverage	4300	0.419	0.205	0.015	2.003
Liquidity	4300	2.833	3.866	0.094	64.801

## 4. Empirical Results

### 4.1. Analysis of baseline regression results

In order to comprehensively examine the effects of fiscal subsidies and tax incentives on innovation activities in strategic emerging industries, a two-way fixed-effects model with total factor productivity of enterprises as the explanatory variable and fiscal subsidies and tax incentives received by enterprises as the core explanatory variables is developed in this paper, and the empirical estimation results are shown in Table 3. Column (1) shows the estimated effects of fiscal subsidies and tax incentives on the innovation activities of the full sample of strategic emerging enterprises. The results show that the regression coefficients of fiscal subsidies and tax incentives on the total factor productivity of enterprises are both positive and significant at the 1% significance level. This indicates that, in general, both fiscal subsidies and tax incentives can stimulate the innovation activities of strategic emerging enterprises. Further, this paper examines the incentive effects of fiscal subsidies and tax incentives on innovation activities of firms at different life-cycle stages when they receive two different incentive policies. Columns

(2) to (4) show the results of the regressions for different life-cycle stages. For growth stage firms, the regression coefficients of both fiscal subsidies and tax incentives on firms' total factor productivity are positive and significant at the 1% significance level. This indicates that the two fiscal incentives promote innovative behaviour in the growth stage of the firm. Hypothesis 1 is tested. For firms in the maturity stage, the coefficient of fiscal subsidies is 0.0291, but only significant at the 10% significance level, and the coefficient of tax incentives is not significant. This indicates that in the maturity period, firms' innovation behaviour is not influenced by government fiscal incentives. Hypothesis 2 was tested. For declining firms, the coefficient on fiscal subsidies is negative and insignificant, while the coefficient on tax incentives is positive and significant at the 1% level of significance. This suggests that tax incentives are more likely to stimulate innovative behaviour during the recessionary phase of a firm. Hypothesis 3 was tested. At the same time, from the regression results of different development stages of enterprises, it can also be found that compared with fiscal subsidies, tax incentives may be more conducive to the improvement of total factors of strategic emerging enterprises.

**Table 3.** Baseline model regression results

	(1)	(2)	(3)	(4)
	Full sample	Growth stages	Maturity stages	Recession stages
Subsidy	0.0359*** (0.0128)	0.0293** (0.0133)	0.0291* (0.0162)	-0.00894 (0.0279)
Taxp	0.0278*** (0.00660)	0.0334*** (0.00859)	0.0119 (0.00834)	0.0445*** (0.0151)
Control variables	YES	YES	YES	YES
Year fixed effects	YES	YES	YES	YES
Corporate fixed effects	YES	YES	YES	YES
Constant term	13.31*** (0.495)	14.77*** (0.583)	12.52*** (0.635)	14.77*** (0.940)
N	2707	1351	914	442
R <sup>2</sup>	0.552	0.594	0.655	0.446

Note: City clustering robust standard errors are in brackets; control variables include firm age (Firmage), firm size (Firmsize), return on net assets (ROA), gearing ratio (Leverage) and liquidity; \*, \*\* and \*\*\* denote passing the 10%, 5% and 1% statistical tests of significance respectively. Same table below.

## 4.2. Robustness tests

### 4.2.1. Replacing the explained variable

To ensure that the regression results do not vary with the different measures of total factor productivity, this paper re-runs the regression analysis of model (2) using the total factor productivity level of enterprises estimated by the OP method as the explanatory variable, and the estimated results are shown in Table 4. Column (1) shows that the coefficients of fiscal subsidies and tax incentives are 0.0543 and 0.0327, respectively, and are significant at the 1% significance level. Columns (2) to (4) respectively report the regression coefficients and significance levels of fiscal subsidies and tax incentives in different life cycle stages of enterprises, and the results are consistent with Table 3. The regression results in Table 4 show that the coefficients and significance of fiscal subsidies and tax incentives remain consistent with the benchmark regressions, both in the full-sample regressions and in the different life-cycle stages regressions. This indicates that the findings of this paper still hold true.

**Table 4.** Robustness test 1: Replacement of explained variables

	(1)	(2)	(3)	(4)
	Full sample	Growth stages	Maturity stages	Recession stages
Subsidy	0.0543*** (0.0145)	0.0473*** (0.0151)	0.0465** (0.0182)	0.00810 (0.0280)
Taxp	0.0327*** (0.00722)	0.0400*** (0.00995)	0.0150 (0.00934)	0.0502*** (0.0149)
Control variables	YES	YES	YES	YES
Year fixed effects	YES	YES	YES	YES
Corporate fixed effects	YES	YES	YES	YES
Constant term	15.93*** (0.527)	17.64*** (0.606)	15.24*** (0.687)	17.47*** (0.996)
N	2707	1351	914	442
R <sup>2</sup>	0.444	0.502	0.535	0.375

**Table 5.** Robustness test 2: Replacement of core explanatory variables

	(1)	(2)	(3)	(4)
	Full sample	Growth stages	Maturity stages	Recession stages
Subsidy	0.0438*** (0.00925)	0.0359*** (0.0137)	0.0387*** (0.0139)	0.0252 (0.0211)
Taxp	0.129*** (0.0109)	0.105*** (0.0140)	0.121*** (0.0180)	0.107*** (0.0291)
Control variables	YES	YES	YES	YES
Year fixed effects	YES	YES	YES	YES
Corporate fixed effects	YES	YES	YES	YES
Constant term	12.04*** (0.358)	13.25*** (0.497)	11.56*** (0.496)	13.06*** (0.807)
N	3472	1713	1195	564
R <sup>2</sup>	0.623	0.664	0.721	0.446

### 4.2.3. Endogeneity issues

In order to overcome the potential two-way causality endogeneity problem, and considering that there is a certain time lag between the receipt of fiscal subsidies and tax incentives and the investment in R&D, we treat the fiscal subsidies and tax incentives with a one-period lag and re-institute them into model (2), and the estimation results are shown in Table 6. From the regression results in Table 6, we can see that the regression coefficients and significance of the lagged terms of fiscal subsidies and tax incentives are basically consistent with the baseline regressions for both the full sample of enterprises and enterprises at different life cycle stages, indicating that the findings of this paper are credible.

### 4.2.2. Replacing core explanatory variables

To ensure that the regression results do not change with the measures of fiscal subsidies and tax incentives, this paper refers to Chu Deyin et al. (2016), which regresses model (2) on the natural logarithm of government subsidies under non-operating income of enterprises' annual reports to measure enterprises' access to fiscal subsidies, and the natural logarithm of corporate income tax incentives ((statutory tax rate - effective tax rate) \* total profit) to measure enterprises' access to tax incentives. The regression results are shown in Table 5. Column (1) shows that the regression coefficients of fiscal subsidies and tax incentives are positive and significant at the 1% significance level. The regression coefficients and significance of fiscal subsidies and tax incentives reported in columns (2) to (4) are consistent with Table 3. From the regression results in Table 5, it can be found that the regression coefficients and regression significance of the two fiscal incentives are basically consistent with the baseline regression results, indicating that the findings of this paper are robust.

## 4.3. Heterogeneity analysis

### 4.3.1. State-owned and non-state-owned enterprises

There are significant differences in the natural endowments, internal operations and governance structures of enterprises under different ownership, leading to different strategic behaviours in terms of resource access, signalling and principal-agent relationships. State-owned enterprises not only receive many fiscal subsidies, but also have a wealth of other sources of access to resources. Access to fiscal subsidies by SOEs is perceived as double-labelling in the investment market, and the marginal investment it triggers is very limited. As a result, the incentive effect of fiscal subsidies for SOEs

on innovation is limited. In contrast, non-SOEs receive larger marginal investments due to the information asymmetry between firms and the market, where the government is urgently needed to act as an information intermediary. Based on this, the paper examines the incentive effects of fiscal policy on innovation activities of SOEs and non-SOEs at different life-cycle stages, and the regression results are shown in Table 7. In column (1), the regression coefficient of fiscal subsidies of state-owned enterprises is 0.0324 and significant at the significance level of 10%. The regression coefficient of tax incentives is 0.0253 and significant at 1% significance level, while the regression coefficients of fiscal subsidies and tax incentives for non-state-owned enterprises are 0.041 and 0.0316, respectively, and are significant at least at the 5% significance level. It shows that fiscal subsidies and tax incentives for strategic emerging non-state-owned enterprises are more conducive to enterprise innovation activities. In column (2) to (4), the regression coefficients and significance of fiscal subsidies and tax incentives of state-owned enterprises and non-state-owned enterprises in the

maturity and decline stages are basically the same, but there is a significant difference in the growth stage. In the growth stage, the coefficient of fiscal subsidies of state-owned enterprises is 0.0195 and not significant, and the regression coefficient of tax incentives is 0.0214 and only significant at the 10% significance level, while the regression coefficients of fiscal subsidies and tax incentives of non-state-owned enterprises are 0.0399 and 0.0463, respectively, and at least significant at the 5% significance level. It shows that fiscal subsidies and tax incentives for strategic emerging non-state-owned enterprises in the growth stage are more conducive to enterprise innovation activities. From the regression results in Table 7, it can be found that the incentive effect of fiscal subsidies and tax incentives received by non-state-owned enterprises is stronger than that of state-owned enterprises on their innovation activities. In terms of the different life cycle stages, the fiscal policy incentives for non-state enterprises in the growth stage are more conducive to stimulating their innovation activities.

**Table 6.** Robustness test 3: Endogeneity issues

	(1)	(2)	(3)	(4)
	Full sample	Growth stages	Maturity stages	Recession stages
Subsidy	0.0224* (0.0133)	0.0640*** (0.0207)	0.00194 (0.0145)	-0.00379 (0.0263)
Taxp	0.0228*** (0.00597)	0.0296*** (0.00777)	0.00537 (0.00896)	0.0542*** (0.0193)
Control variables	YES	YES	YES	YES
Year fixed effects	YES	YES	YES	YES
Corporate fixed effects	YES	YES	YES	YES
Constant term	13.43*** (0.563)	13.25*** (0.793)	13.09*** (0.632)	14.69*** (0.824)
N	2414	1169	830	415
R <sup>2</sup>	0.510	0.563	0.638	0.478

**Table 7.** Heterogeneity analysis 1: State-owned and non-state-owned enterprises

Panel A: State-owned enterprises	(1)	(2)	(3)	(4)
	Full sample	Growth stages	Maturity stages	Recession stages
Subsidy	0.0324* (0.0173)	0.0195 (0.0182)	0.0571** (0.0256)	-0.00161 (0.0459)
Taxp	0.0253*** (0.00941)	0.0214* (0.0128)	0.00757 (0.0127)	0.0413** (0.0168)
Control variables	YES	YES	YES	YES
Year fixed effects	YES	YES	YES	YES
Corporate fixed effects	YES	YES	YES	YES
Constant term	14.61*** (0.868)	16.40*** (0.987)	14.34*** (0.939)	15.98*** (1.900)
N	1265	613	436	216
R <sup>2</sup>	0.456	0.559	0.494	0.407
Panel B: Non-state enterprises	(1)	(2)	(3)	(4)
	Full sample	Growth stages	Maturity stages	Recession stages
Subsidy	0.0410** (0.0180)	0.0399** (0.0196)	0.0173 (0.0168)	-0.0202 (0.0378)
Taxp	0.0316*** (0.00880)	0.0463*** (0.0110)	0.0180* (0.00958)	0.0580** (0.0277)
Control variables	YES	YES	YES	YES
Year fixed effects	YES	YES	YES	YES
Corporate fixed effects	YES	YES	YES	YES
Constant term	12.38*** (0.565)	13.29*** (0.695)	11.47*** (0.679)	13.78*** (1.119)
N	1442	738	478	226
R <sup>2</sup>	0.628	0.640	0.765	0.521

### 4.3.2. Manufacturing and non-manufacturing

The sensitivity of R&D capability to tax burden varies from industry to industry, taking into account industry specificities. Some industries, such as information technology, logistics, wholesale and retail, and manufacturing, have higher tax burdens and are more sensitive to changes in tax burdens. At the same time, these industries generally require large R&D investments, and if tax incentives or corresponding fiscal subsidies are granted to these industries, the cost and risk of their R&D expenditures can be reduced, thus stimulating R&D innovation in these industries. In other words, tax incentives and fiscal subsidies are stronger for special industries with high innovation sensitivity than for other industries. This paper divides the sample into two sub-samples, manufacturing and non-manufacturing, based on the SFC's 2012 Industry Classification Guidelines for Listed Companies, and examines the incentive effects of different types of industries in terms of access to different fiscal incentives. Table 8 provides the results of the sub-sample regressions for manufacturing and non-manufacturing firms. In column (1), the regression coefficients of fiscal subsidies and tax incentives for manufacturing enterprises are 0.0305 and 0.0293, respectively, and are significant at the 5% significance level, while the regression coefficient of fiscal subsidies for non-manufacturing enterprises is 0.0396 and significant at the 10% significance level, and the regression

coefficient of tax incentives is 0.0189 and insignificant. It shows that fiscal subsidies and tax incentives for strategic emerging manufacturing enterprises are more conducive to enterprise innovation activities. In column (2) to (4), the regression coefficients and significance of fiscal subsidies and tax incentives for manufacturing enterprises and non-manufacturing enterprises in the maturity and decline stages are basically the same, but there is a significant difference in the growth stage. In the growth stage, the fiscal subsidies coefficient of manufacturing enterprises is 0.0252 and significant at the significance level of 10%, the regression coefficient of tax incentives is 0.0353 and significant at the significance level of 1%, while the fiscal subsidies regression coefficient of non-manufacturing enterprises is 0.0434 but not significant, the regression coefficient of tax incentives is 0.0336 and significant at 5% significance level, indicating that fiscal and tax policy incentives for manufacturing enterprises in the growth stage may be more conducive to enterprise innovation activities. The regression results in Table 8 show that the incentive effect of fiscal subsidies and tax incentives on innovation activities is stronger for manufacturing firms than for non-manufacturing firms. In terms of different life cycle stages, the effect of fiscal policy incentives for manufacturing enterprises in the growth stage is more pronounced.

**Table 8.** Heterogeneity analysis 2: Manufacturing and non-manufacturing

Panel A: Manufacturing	(1)	(2)	(3)	(4)
	Full sample	Growth stages	Maturity stages	Recession stages
Subsidy	0.0305** (0.0148)	0.0252* (0.0146)	0.0275 (0.0197)	-0.0217 (0.0399)
Taxp	0.0293*** (0.00744)	0.0353*** (0.0103)	0.00595 (0.00857)	0.0524** (0.0218)
Control variables	YES	YES	YES	YES
Year fixed effects	YES	YES	YES	YES
Corporate fixed effects	YES	YES	YES	YES
Constant term	12.88*** (0.567)	14.68*** (0.630)	12.28*** (0.728)	14.37*** (1.307)
N	1927	1003	634	290
R <sup>2</sup>	0.559	0.616	0.684	0.351
Panel B: Non-manufacturing	(1)	(2)	(3)	(4)
	Full sample	Growth stages	Maturity stages	Recession stages
Subsidy	0.0396* (0.0222)	0.0434 (0.0286)	0.0226 (0.0283)	0.00779 (0.0352)
Taxp	0.0189 (0.0128)	0.0336** (0.0169)	0.0187 (0.0216)	0.0241 (0.0223)
Control variables	YES	YES	YES	YES
Year fixed effects	YES	YES	YES	YES
Corporate fixed effects	YES	YES	YES	YES
Constant term	13.96*** (0.951)	13.85*** (1.148)	13.63*** (0.887)	14.62*** (1.373)
N	780	348	280	152
R <sup>2</sup>	0.581	0.586	0.651	0.659

### 4.3.3. Eastern and Mid-western regions

As China's economic development shows regional differences, the business environment, innovation climate, financing constraints and other influencing factors faced by enterprises in different regions are all different. Based on this, this paper examined the incentive effects of fiscal policies on the innovation activities of enterprises in the eastern region and the central and western regions at different life cycle stages, and the regression results are shown in Table 9. In column (1), the regression coefficients of fiscal subsidies and tax incentives for enterprises in eastern region are 0.0318 and 0.0259, respectively, and at least at the 5% significance level,

while the regression coefficients of fiscal subsidies for enterprises in central and western region are 0.0428 and at the 10% significance level, the regression coefficient of tax incentives was 0.0293 and was significant at the 5% significance level. In column (2) to (4), the regression coefficients and significance of fiscal subsidies and tax incentives for enterprises in the eastern region and the central and western region in the maturity and decline stages are basically the same, but there is a significant difference in the growth stage. In the growth stage, the financial subsidy coefficient of enterprises in eastern region is 0.0313 and significant at 5% significance level, the regression coefficient

of tax incentives is 0.0401 and significant at 1% significance level, while the regression coefficient of financial subsidy of enterprises in central and western region is 0.0106 but not significant, the regression coefficient of tax incentives is 0.0278, which is significant at the 10% significance level, indicating that fiscal and tax policy incentives for enterprises

in the growth stage in the eastern region may be more conducive to enterprise innovation activities. From the regression results, it can be found that, in terms of different life cycle stages, it is more beneficial to stimulate the innovation activities of enterprises in the eastern region when they are in the growth stage.

**Table 9.** Heterogeneity analysis 3: Eastern and Mid-western regions

Panel A: Eastern Region	(1)	(2)	(3)	(4)
	Full sample	Growth stages	Maturity stages	Recession stages
Subsidy	0.0318** (0.0151)	0.0313** (0.0149)	0.0194 (0.0181)	-0.0130 (0.0292)
Taxp	0.0259*** (0.00769)	0.0401*** (0.0103)	0.00521 (0.00775)	0.0502*** (0.0184)
Control variables	YES	YES	YES	YES
Year fixed effects	YES	YES	YES	YES
Corporate fixed effects	YES	YES	YES	YES
Constant term	12.95*** (0.557)	14.15*** (0.630)	12.56*** (0.705)	14.39*** (0.801)
N	1916	922	666	328
R <sup>2</sup>	0.603	0.636	0.711	0.473
Panel B: Mid-west Region	(1)	(2)	(3)	(4)
	Full sample	Growth stages	Maturity stages	Recession stages
Subsidy	0.0428* (0.0218)	0.0106 (0.0234)	0.0687** (0.0322)	-0.0359 (0.0454)
Taxp	0.0293** (0.0121)	0.0278* (0.0144)	0.0338 (0.0225)	0.0281 (0.0351)
Control variables	YES	YES	YES	YES
Year fixed effects	YES	YES	YES	YES
Corporate fixed effects	YES	YES	YES	YES
Constant term	14.15*** (0.990)	16.33*** (1.210)	11.93*** (0.936)	12.58*** (4.336)
N	791	429	248	114
R <sup>2</sup>	0.454	0.539	0.491	0.591

## 5. Mechanism Testing

In order to more specifically analyse the impact of fiscal subsidies and tax incentives on enterprise innovation activities, based on the aforementioned theoretical analysis, fiscal and tax incentives not only act directly on enterprise innovation, but also seek to indirectly influence enterprise innovation activities through the leverage effect, leveraging enterprises to increase their R&D investment. The regression results are shown in Table 10. Column (1) shows the incentive effect of fiscal subsidies and tax incentives on R&D expenditure for the full sample of enterprises, and the coefficients of both fiscal subsidies and tax incentives are not positive and significant at least at the 5% significance level. The coefficients of both fiscal subsidies and tax incentives are

not positive and significant at least at the 5% significance level. This indicates that fiscal incentives do promote the growth of R&D expenditure of strategic emerging enterprises, which in turn enhances the total factor productivity of enterprises. Columns (2) to (4) show the incentive effects of R&D expenditure of enterprises at different life cycle stages after receiving fiscal subsidies and tax incentives, respectively. Overall, the incentive effect of R&D expenditure is more pronounced for strategic emerging enterprises in the growth stage after receiving tax incentives, which also explains the more pronounced increase in total factor productivity for enterprises in the growth stage after receiving fiscal subsidies and tax incentives.

**Table 10.** Mechanism test

	(1)	(2)	(3)	(4)
	Full sample	Growth stages	Maturity stages	Recession stages
Subsidy	0.0642** (0.0247)	0.0601* (0.0315)	0.0615** (0.0303)	-0.0542 (0.119)
Taxp	0.0488*** (0.0154)	0.0580** (0.0227)	0.0372* (0.0203)	0.0495* (0.0277)
Control variables	YES	YES	YES	YES
Year fixed effects	YES	YES	YES	YES
Corporate fixed effects	YES	YES	YES	YES
Constant term	12.90*** (0.691)	13.95*** (0.919)	13.09*** (0.731)	15.23*** (2.301)
N	1505	741	523	241
R <sup>2</sup>	0.683	0.710	0.742	0.583

## 6. Conclusion

Scholars have not yet reached a unanimous conclusion on the effectiveness of fiscal policies on the innovation activities of strategic emerging enterprises. This paper attempts to provide a new note based on the perspective of enterprise life cycle theory. Using the data of strategic emerging enterprises listed in Shanghai and Shenzhen from 2010 to 2019 as a sample, this paper empirically examines the incentive effects of fiscal subsidies and tax incentives on the innovation activities of strategic emerging enterprises for enterprises in the subsidy life cycle stage. The findings show that: Firstly, on the whole, both fiscal subsidies and tax incentives promote the increase of total factor productivity of strategic emerging enterprises; Secondly, from the perspective of different stages of enterprise development, the incentive effects of fiscal subsidies and tax incentives on the innovation activities of strategic emerging enterprises in the growth stage are more obvious, but for enterprises in the maturity and decline stages, the incentive effects are not obvious. From the perspective of the types of fiscal and tax incentive policies, tax incentive policies are more conducive to the innovation activities of strategic emerging enterprises; Thirdly, fiscal subsidies and tax incentives significantly stimulate the innovation activities of non-state enterprises, manufacturing enterprises and enterprises in the eastern region in the growth stage; Fourthly, from the mechanism test, the increase in R&D expenditure of strategic emerging enterprises that receive fiscal subsidies and tax incentives is more obvious, which in turn promotes the innovation activities of enterprises. After replacing the explained variable, replacing the core explanatory variables and considering the endogeneity issue, the findings of this paper are still robust. The findings of this paper help to optimise the allocation of fiscal subsidy and tax incentive funds and improve the efficiency of the use of fiscal subsidy and tax incentive funds.

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## References

- [1] Howell S. T.. Financing Innovation: Evidence from R&D Grants[J]. *American Economic Review*, 2017, 107(4): 1136-1164.
- [2] Chu Deyin, Yang Shan, Song Genmiao. fiscal subsidies, tax incentives and innovation investment in strategic emerging industries[J]. *Finance and Trade Research*, 2016(5): 83-89.
- [3] Yao Linxiang, Leng Nemin. Analysis of the incentive effect of fiscal and tax policies on the innovation efficiency of strategic emerging industries[J]. *East China Economic Management*, 2018(12): 94-100.
- [4] Wang Yanchao, Li Ling, Wang Biaohua. Can tax incentives and fiscal subsidies effectively promote corporate innovation? -- An empirical study based on differences in ownership and industry characteristics[J]. *Tax Research*, 2019(6): 92-98.
- [5] Boeing P.. The Allocation and Effectiveness of China's R&D Subsidies-Evidence from Listed Firms [J]. *Research Policy*, 2016, 45(9): 1774- 1789.
- [6] Zhao Yulin, Gu Junjian. Structural bias of government subsidy allocation propensity and innovation incentives - an analysis based on a matched sample of Chinese listed manufacturing companies[J]. *Fiscal Research*, 2018(4): 61-74.
- [7] Yang G. Chao, Liu J., Lian P., Rui M. Tax cut incentives, R&D manipulation and R&D performance[J]. *Economic Research*, 2017(8): 110-124.
- [8] Gao Song, Zhuang Hui, Niu Panqiang. A study on the enhancement of government funding effect in science and technology-based SMEs: A life-cycle perspective [J]. *China Industrial Economics*, 2011(7): 150-158.
- [9] Huang H-B, Zhai S-P, Chen J-N. Corporate life cycle, financing methods and financing constraints-A study based on the moderating effect of investor sentiment [J]. *Financial Research*, 2016 (7): 96-112.
- [10] Li Yongyou, Ye Qianwen. The incentive effect of government science and technology innovation subsidies and its mechanism identification--an empirical study based on enterprise micro data [J]. *Finance and Economics Series*, 2017 (12): 22-32.
- [11] Hu, H. F., Dou, B., Wang, A. P.. Corporate financialization and productive efficiency [J]. *World Economy*, 2020, 43(01): 70-96.
- [12] Liu Guangqiang. Analysis of incentive effects of tax incentives and fiscal subsidies policies - an empirical study based on the perspective of information asymmetry theory[J]. *Management World*, 2016(10): 62-71.
- [13] Anthony J H, Ramesh K. Association between Accounting Performance Measures and Stock Prices: A Test of the Life Cycle Hypothesis [J]. *Journal of Accounting and Economics*, 1992, 15(2):203-227.
- [14] Dickinson V. Cash Flow Patterns as a Proxy for Firm Life Cycle [J]. *The Accounting Review*, 2011, 86(6): 1969-1994.
- [15] Tong Jinzhi, Liu Shiyuan, Lin Zhifan. fiscal subsidies, life cycle and corporate R&D innovation [J]. *Fiscal Research*, 2018(4): 33-47.