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Research on the Influence Effect of Government Subsidies on the Growth of High-Tech Enterprises

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Abstract

As China's innovation-driven development strategy is gradually deepened, industries are accelerating their transformation towards high-end development. Against this backdrop, high-tech enterprises, as important entities for fostering new quality productive forces and promoting the high-quality development of the real economy, have a development quality that is directly related to the effectiveness of industrial transformation and the cultivation of core scientific and technological competitiveness. As an important fiscal and tax support tool, government subsidies can directly alleviate the R&D funding pressure of scientific and technological innovation enterprises. However, existing studies still have divergences on the actual empowerment effect of government subsidies and their differentiated roles at the property right level. Therefore, this paper selects the panel data of A-share high-tech listed companies on the Shanghai and Shenzhen main boards from 2015 to 2024 to empirically test the impact effect of government subsidies on enterprise growth and the heterogeneity of property rights. The study finds that government subsidies can significantly improve the patent output and return on total assets of enterprises, and drive the growth of high-tech enterprises through the dual channels of improving innovation quality and increasing operational efficiency. Moreover, compared with state-owned high-tech enterprises, subsidies have a better positive incentive effect on the growth of private high-tech enterprises. On this basis, this paper puts forward countermeasures and suggestions such as implementing differentiated subsidy allocation, improving the whole-process performance supervision of subsidies, and establishing a long-term innovation support mechanism, in order to effectively improve the allocation efficiency of fiscal subsidy resources and facilitate the high-quality growth of high-tech enterprises.

Keywords

Government Subsidies; High-Tech Enterprises; Enterprise Growth; Influence Effects.

1. Introduction

At present, the innovation-driven development strategy has entered a stage of deep implementation. High-tech enterprises have built core competitive barriers through sustained investment in technology R&D and efficient achievement transformation mechanisms, and are the key to fostering new quality productive forces and promoting high-quality growth of the real economy[1]. Compared with traditional manufacturing enterprises, high-tech enterprises are characterized by high R&D intensity, short technology iteration cycles, and high uncertainty in innovation output[2], which make them face long-term dilemmas in the development process, such as mismatch between supply and demand of R&D funds, difficulties in internalizing the positive externalities of innovation achievements, and high external financing costs[3]. Simply relying on market-oriented financing is difficult to meet the capital needs of their long-term technological breakthroughs and scale expansion. As a core policy tool for fiscal intervention in

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the science and innovation market, government subsidies can directly supplement the R&D cash flow of enterprises, effectively share the cost of innovation trial and error, and reduce the risk of innovation activities of high-tech enterprises, thus becoming an important policy support to sustain their continuous growth. With the increase of the state's special financial subsidies for high-tech enterprises, the types of subsidies such as R&D grants, interest discounts for technological transformation, and rewards for achievement transformation are also increasingly abundant, and thousands of high-tech listed enterprises on the Shanghai and Shenzhen Main Boards have benefited. However, the academic community has not yet reached a consensus on the actual effect of the subsidy policy. Some scholars believe that inclusive subsidies can easily make enterprises dependent on policies, and even give rise to rent-seeking behaviors, which instead weakens the motivation of enterprises for independent innovation[4-6]. Others argue that targeted financial subsidies can alleviate the externality problem of enterprise innovation, lower the threshold of enterprise R&D investment, and ultimately increase innovation output and improve operating profits[7-9]. A review of the literature also finds that existing studies mostly take listed companies in all industries or the manufacturing industry as a whole as research samples, and rarely consider high-tech enterprises separately, especially conduct analysis in combination with the characteristics of high R&D investment and high operational risk of the high-tech industry itself; in addition, some analyses are insufficient in studying the difference in policy effects between state-owned and private high-tech enterprises. Therefore, this paper takes high-tech listed companies on the A-share market of the Shanghai and Shenzhen Main Boards from 2015 to 2024 as samples to analyze the direct impact of government subsidies on the growth of high-tech enterprises and explore the heterogeneity of property rights, so as to provide referable operational suggestions for optimizing the allocation of government subsidies for high-tech enterprises and supporting the development of science and technology enterprises in a classified and precise manner.

2. Theoretical Basis and Research Hypotheses

Stiglitz's government intervention theory holds that innovation itself has externalities, while defects inherent in the market economy, such as information asymmetry in the capital market and the high risk of innovation investment, will further break the balance of optimal factor allocation, thereby triggering market failure [10]. This is actually the fundamental reason why the government introduces fiscal support policies to actively intervene in the innovation activities of high-tech enterprises and make up for market deficiencies. Existing studies mainly have two views on the role of government subsidies, namely the grabbing hand and the helping hand [11]. The grabbing hand view holds that local governments are sometimes influenced by performance indicators such as short-term GDP, employment, and tax revenue, and will attach policy requirements when issuing subsidies to enterprises [12]. Inclusive subsidies with wider coverage will induce enterprises to spend a lot of energy and social connections to compete for them. Therefore, after receiving inclusive subsidies, enterprises tend to invest the money in projects that can generate profits quickly rather than long-term R&D with long return cycles and higher risks [13], which will eventually squeeze out R&D activities that are more in need of investment and affect the long-term development of enterprises. This view is more applicable to traditional industries without strict assessment standards, where industry constraints are weak and the control over the use of funds is more lenient. However, China's high-tech enterprises need to obtain government qualification certification, with strong industry constraints. Most subsidies for high-tech enterprises are special R&D grants, interest discounts for technological transformation, rewards for achievement transformation, etc., which are matched with rigid assessment requirements such as high-tech qualification, R&D intensity, and patent output [10], and the use of funds is strictly restricted. This greatly weakens the rent-seeking behavior and policy burdens caused by the grabbing hand, so the grabbing hand view

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is not very applicable. Therefore, this paper mainly draws on the helping hand view of government subsidies, and combines the industrial support policies for high-tech enterprises to explore the positive impact effect of government subsidies on high-tech enterprises.

The high-tech industry has the characteristics of large R&D investment, rapid technological updating, and difficulty in judging innovation returns [9], which makes the social industrial benefits brought by technological innovation far higher than the benefits that enterprises themselves can obtain. At this time, if we only rely on the automatic adjustment of the market, high-tech enterprises tend to actively reduce long-term R&D investment for their own short-term profits and to avoid innovation risks, and they also dare not easily carry out industrial expansion investment [11], which eventually leads to insufficient innovation capacity and limited development of the entire industry. The helping hand of government subsidies can make up for the deficiencies of market regulation to a certain extent [11]. Subsidy funds can directly meet the R&D capital needs of enterprises, share the costs of enterprises such as the procurement of R&D equipment and the salaries of R&D personnel, and play a certain positive role in diversifying the operational risks brought by R&D failures, encouraging enterprises to carry out R&D activities, and increasing innovation achievements; sufficient funds can also improve the working capital portfolio of enterprises, enabling enterprises to reasonably arrange the use of funds, improve the effectiveness of business activities, improve the profitability of enterprise assets, and promote the improvement of enterprise operating performance. The growth of high-tech enterprises includes the improvement of innovation capability and the growth of operating benefits [12]. The increase in innovation achievements and the improvement of operating performance brought by government subsidies jointly promote high-tech enterprises to achieve long-term and stable growth. Based on the above analysis, this paper proposes:

H1: Government subsidies can significantly promote the growth of high-tech enterprises.

H1a: Government subsidies can significantly improve the innovation performance of high-tech enterprises and promote the growth of high-tech enterprises;

H1b: Government subsidies can significantly improve the operating performance of high-tech enterprises and promote the growth of high-tech enterprises.

Differences in the inherent characteristics and nature of property rights lead to variations in property right attributes in terms of right ownership, exercise boundaries, transfer characteristics and other aspects. In terms of ownership subjects, Chinese enterprises have the distinguishing feature of being divided into state-owned and private ones. Enterprises with different property right natures have certain differences in obtaining external resources[13]. State-owned high-tech enterprises, relying on their identity as state-owned capital, have certain credit advantages[10]. They have relatively easy access to bank loans in terms of both channels and amounts, their own capital reserves are also relatively sufficient, and the external capital gap is not large, which makes the marginal effect of the new funds brought by government subsidies in promoting the innovation and business activities of enterprises limited. Private high-tech enterprises, however, lack the endorsement of state-owned credit, so they usually face greater difficulties in external financing[8], with higher financing costs and more obvious capital constraints. Under such circumstances, government subsidies can not only directly make up for the capital shortage of enterprises, but also send positive signals of policy support to the capital market and financial institutions, amplifying the incentive effect on the innovation and business activities of enterprises, and thus playing a greater role in promoting the growth of enterprises. Accordingly, this paper proposes:

H2: Government subsidies have a stronger positive promoting effect on the growth of private high-tech enterprises than on that of state-owned high-tech enterprises.

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3. Research Design

3.1. Sample Selection and Data Sources

This paper takes high-tech listed companies on the Shanghai and Shenzhen Main Board A-share markets from 2015 to 2024 as samples, and collates and collects data in accordance with the Administrative Measures for the Identification of High-Tech Enterprises and in combination with the annual high-tech enterprise qualification identification marks of the CSMAR (China Stock Market & Accounting Research) Database. The original financial data, patent data, government subsidy data and property right data involved in the paper are mainly from the CSMAR(China Stock Market & Accounting Research) Database and the CNRDS (Chinese Research Data Services) Platform. All data are cleaned as follows. First, listed companies with abnormal financial data such as ST, *ST and PT are excluded to avoid the interference of continuous losses and data distortion on the results; second, high-tech enterprises in the financial industry are excluded, as the accounting standards and business models of the financial industry are significantly different from those of real science and innovation enterprises, making it inappropriate to compare them together; then, the sample data of the year when enterprises are listed are removed to avoid the impact of incomplete data of listed enterprises in the initial stage; observation samples with missing values are removed; finally, all continuous variables are winsorized bidirectionally at the 1% and 99% quantiles to eliminate the impact of extreme outliers on the regression results, and 18,726 observation samples are finally obtained.

3.2. Variable and Indicator Selection

3.2.1. Explained variable: Enterprise Growth (Eg)

According to the theory of enterprise growth, the growth of an enterprise is manifested on the one hand as the expansion of enterprise scale, that is, the growth in terms of quantity, and on the other hand, it should include the improvement in terms of quality brought about by technological progress[11]. At present, the academic circle's quantification of enterprise growth is mainly divided into two categories: single indicators and multi-dimensional composite indicators. Single indicators usually adopt financial indicators such as return on total assets and revenue growth rate, or innovation indicators such as patents and R&D intensity[13]. Although the single index measurement method is relatively simple to apply, it can only reflect the single financial situation of an enterprise or the innovation level of a single dimension, and cannot reflect the quantity and quality of the enterprise at the same time; while the multi-dimensional composite indicators include four methods: synthesizing a comprehensive index via the entropy method or principal component analysis, the balanced scorecard, weighting and scoring via the analytic hierarchy process, and dimension-wise independent regression[8]. Among them, the entropy method and the principal component method process innovation and operation together, which makes it difficult to distinguish the different impacts of government subsidies on the two levels of growth; the balanced scorecard requires a large amount of non-public data, which is difficult to obtain and not suitable for large-sample panel research; the weight setting of the analytic hierarchy process is highly susceptible to the influence of subjective operations; dimension-wise independent regression can take innovation performance and operating performance as two explained variables to conduct empirical research respectively[11]. This approach is not only consistent with the theory of enterprise growth, but also can intuitively compare the effects of government subsidies on enterprise innovation and business activities respectively, and there is no bias interference caused by information compression and subjective operations. Therefore, this paper uses the multi-dimensional composite index method to quantify enterprise growth from two aspects: innovation performance and operating performance.

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Combined with the characteristics of high-tech enterprises, the existing literature measurement indicators for innovation performance (Inpat) mainly include three types: R&D investment, operating income from new products, and invention patent output [6]. However, R&D investment can only reflect the scale of innovation input and cannot reflect the results of technology output; the disclosure standards for sales revenue of new products vary among enterprises, and relevant data are missing. Therefore, this paper selects the number of patent applications to measure the innovation performance of enterprises. Because the number of patent applications is the direct output of enterprise R&D activities and can be obtained from the CNRDS database. To eliminate the impact of existing zero values and skewed data distribution, this paper adds 1 to the total number of enterprise patent applications in the current year and then takes the natural logarithm for processing. Regarding the measurement of operating performance (ROA), the commonly used indicators in academia at present mainly include net profit, revenue growth rate, return on net assets, return on total assets, etc. . This paper mainly selects the indicator of return on total assets to measure the operating performance of enterprises. Because net profit is highly susceptible to the impact of enterprise asset scale and earnings management, while revenue growth rate can reflect the expansion speed of enterprise scale but ignores the efficiency of enterprise asset operation, and return on net assets can reflect the return on capital owned by enterprise shareholders but cannot cover all the operating resources of the enterprise. Return on total assets (net profit / total assets at the end of the period×100%) is less affected by the enterprise's equity structure and debt scale, can fairly reflect the profitability efficiency of the enterprise's overall assets, has certain comparability, and is a relatively suitable indicator for this paper to measure the operating performance of high-tech enterprises.

3.2.2. Explanatory Variable: Government Subsidy (Sub)

Referring to the commonly used measurement indicators in existing empirical analyses[4,8], the government subsidies in this paper are represented by the total amount of government subsidies disclosed in the annual income statements of high-tech enterprises. The total amount of government subsidies includes various fiscal support funds obtained by enterprises, such as special R&D subsidies, industrial development support funds, interest discounts for technological transformation, and scientific and technological innovation achievement awards, which can fully reflect the total scale of policy subsidies obtained by enterprises in the current period. To eliminate the impact of a large number of zero values in the original data caused by some enterprises not receiving any subsidies in the year, as well as the interference of extreme values, this paper adds 1 to the total amount of government subsidies and then takes the natural logarithm for processing.

3.2.3. Control Variables

To mitigate the interference of enterprises' individual characteristics on regression analysis, the control variables in this paper are enterprise size (Size), asset-liability ratio (Lev), institutional shareholding ratio (Ins), proportion of tangible assets (Tang), shareholding ratio of the largest shareholder (Top1), and proportion of operating cash flow (Cash). Among them, enterprise size (Size) is measured by taking the natural logarithm of total assets at the end of the period.

3.3. Model Design

This paper constructs a two-way fixed-effects panel regression model, using innovation performance (Inpat) and operating performance (ROA) as dependent variables respectively to test the main effect of government subsidies on the growth of high-tech enterprises; the model specification is as follows:

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$$Y_{it}=\beta_0+\beta_1 Sub_{it}+\sum \beta_j \, Controls_{it}+Firm_i+Year_t+\mu_{it} \tag{1}$$

Y_{it} represents the innovation performance Inpat and operating performance ROA of enterprise i in year t; Sub_{it} is the government subsidy received by enterprise i in year t; $Controls_{it}$ are all control variables; $Firm_i$ is the enterprise fixed effect, which controls the inherent heterogeneity of enterprises; $Year_t$ is the year fixed effect, which controls macro annual shocks; μ_{it} is the random disturbance term.

4. Empirical Analysis

4.1. Descriptive Statistics

Table 1. Descriptive Statistical Results

Variable	N	Mean	Std. Dev.	Min	Median	Max
Inpat	18726	2.412	1.864	0.000	2.303	7.113
ROA	18726	3.725	6.941	-28.632	3.617	24.581
Sub	18726	15.610	2.735	0.000	15.842	20.124
Size	18726	22.364	1.273	19.156	22.291	26.847
Lev	18726	0.416	0.197	0.039	0.405	0.864
Ins	18726	43.271	24.136	0.000	45.693	91.352
Tang	18726	0.234	0.162	0.002	0.201	0.758
Top1	18726	33.682	14.753	8.346	31.974	74.229
Cash	18726	0.058	0.076	-0.214	0.055	0.267

Average innovation performance is 2.412, with the minimum value being 0 and the maximum value being 7.113 indicating there are certain differences in innovation output among the sample data. Some high-tech enterprises have no patent output in some years, which is also consistent with the unbalanced innovation development among high-tech enterprises listed on the domestic main board. The operating performance shows that the sample enterprises are profitable on the whole, with an average value of 3.725, but the minimum value is negative. Considering the characteristics of science and innovation enterprises such as long R&D investment cycle and large profit fluctuation, it is understandable that some high-tech enterprises suffer from periodic operating losses caused by excessively high R&D costs in order to maintain technological iteration and promote enterprise R&D and innovation. The government subsidy data shows that government subsidy resources do not fully cover all high-tech enterprises, and there are differences in the distribution of subsidy resources among enterprises. The difference between the median and the average of the control variables is not significant. The sample high-tech enterprises are relatively balanced in terms of operation scale, capital structure, internal governance and cash flow status, and the relevant data can effectively support the subsequent empirical regression analysis.

4.2. Correlation and Multicollinearity Test

Correlation coefficients between government subsidies and innovation performance, and between government subsidies and operating performance are 0.326 and 0.115 respectively, both of which are significantly positive at the 1% statistical level, which is initially consistent with the previous analysis and hypotheses. Government subsidies can promote the growth of high-tech enterprises by improving their innovation and operating performance. Most control

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variables have a significant correlation with the explained variables, indicating that the selection of control variables in this paper is reasonable to a certain extent. The correlation coefficients of all variables are lower than 0.5, and there is no high linear correlation.

Table 2. Pearson Correlation Matrix

Variables	Inpat	ROA	Sub	Size	Lev	Ins	Tang	Top1	Cash
Inpat	1								
ROA	0.163***	1							
Sub	0.326***	0.115***	1						
Size	0.402***	0.087***	0.514***	1					
Lev	-0.072***	-0.356***	0.031***	0.438***	1				
Ins	0.134***	0.228***	0.169***	0.275***	-0.043***	1			
Tang	0.025***	-0.142***	0.061***	0.296***	0.384***	-0.076***	1		
Top1	0.047***	0.183***	0.094***	0.157***	0.018	-0.032***	0.165***	1	
Cash	0.091***	0.472***	0.078***	0.063***	-0.247***	0.141***	-0.093***	0.116***	1

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

Table 3. Variance Inflation Factor Test

Variables	VIF	1/VIF
Size	2.81	0.356
Sub	2.34	0.427
Lev	1.96	0.510
Tang	1.62	0.617
Ins	1.43	0.699
Top1	1.31	0.763
Cash	1.05	0.952
Mean VIF	1.79	—

The variance inflation factor test results show that the VIF values of each variable range from 1.05 to 2.81, with the maximum VIF value being 2.81 and the average VIF being 1.79, which is

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far below the critical value of 10 for severe multicollinearity, so the risk of multicollinearity is relatively low. Combined with the results of correlation analysis, the model as a whole has no serious multicollinearity problem, and subsequent regression analysis can be carried out.

4.3. Baseline Regression Test

Table 4. Baseline Regression Results

Variables	(1) Inpat	(2) ROA
Sub	0.076***	0.043***
	(9.36)	(6.82)
Size	0.412***	0.217***
	(16.74)	(7.95)
Lev	-0.328***	-0.461***
	(-8.15)	(-11.27)
Ins	0.005***	0.012***
	(4.63)	(7.41)
Tang	0.114*	-0.186***
	(1.72)	(-3.54)
Top1	0.002**	0.008***
	(2.35)	(5.16)
Cash	0.637***	12.642***
	(7.08)	(32.17)
_cons	-8.742***	-3.165***
	(-18.26)	(-6.31)
Year	Yes	Yes
Firm	Yes	Yes
N	18726	18726
R^2	0.713	0.648

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

Coefficient of the core explanatory variable government subsidy (Sub) is 0.076 in column (1), which is significantly positively correlated at the 1% level, indicating that government subsidies can effectively incentivize high-tech enterprises to carry out R&D activities and promote the increase of the number of enterprise patent outputs, thereby improving the innovation performance of enterprises, and Hypothesis H1a is preliminarily verified. The coefficient of government subsidy in column (2) also passes the 1% significance test, which is 0.043 and positively correlated. Government subsidies can help high-tech enterprises improve the profitability level of their total assets and enhance their operating performance, and Hypothesis

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H1b is preliminarily verified. In general, government subsidies can simultaneously improve the innovation performance and business performance of high-tech enterprises, thereby promoting the growth of high-tech enterprises, and Hypothesis H1 is preliminarily verified.

In terms of control variables, the coefficient of enterprise size (Size) shows a significant positive correlation. Larger high-tech enterprises have more R&D resources and excellent operational capabilities, so their performance in innovation and operation is better; the coefficient of asset-liability ratio (Lev) is significantly negative, and excessive liabilities will crowd out R&D investment and working capital, thereby inhibiting enterprise growth; the significantly positive coefficients of institutional shareholding ratio (Ins) and operating cash flow (Cash) indicate that the supervision of external institutions and sufficient internal funds can provide effective support for the innovation, production and operation of high-tech enterprises; the regression results of tangible asset ratio (Tang) and the shareholding ratio of the largest shareholder (Top1) are also consistent with theoretical expectations, which overall indicates that the selection of control variables in this paper is valid.

4.4. Property Rights Heterogeneity Analysis

Table 5. Heterogeneity Analysis by Ownership Nature

Variables	(1) SOE Inpat	(2) SOE ROA	(3) Non-SOE Inpat	(4) Non-SOE ROA
Sub	0.032**	0.018*	0.091***	0.056***
	(2.47)	(1.71)	(10.15)	(7.93)
Size	0.385***	0.204***	0.431***	0.228***
	(11.36)	(5.82)	(13.81)	(6.44)
Lev	-0.301***	-0.427***	-0.349***	-0.483***
	(-5.28)	(-7.46)	(-6.63)	(-9.75)
Ins	0.004**	0.010***	0.006***	0.014***
	(2.51)	(4.83)	(3.97)	(6.26)
Tang	0.103	-0.162**	0.127*	-0.204***
	(1.34)	(-2.41)	(1.76)	(-3.19)
Top1	0.002	0.006***	0.003**	0.009***
	(1.58)	(3.07)	(2.24)	(4.85)
Cash	0.582***	11.936***	0.685***	13.127***
	(4.73)	(21.46)	(5.94)	(26.78)
_cons	-8.326***	-2.974***	-9.153***	-3.381***
	(-12.74)	(-4.68)	(-14.92)	(-5.47)
Year	Yes	Yes	Yes	Yes
Firm	Yes	Yes	Yes	Yes
N	6142	6142	12584	12584
R^2	0.704	0.635	0.721	0.656

Notes:SOE denotes state-owned enterprises; Non-SOE denotes non-state-owned enterprises.*** p<0.01, ** p<0.05, * p<0.1

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To further explore whether there is property right heterogeneity in the impact of government subsidies on the growth of high-tech enterprises, this paper divides high-tech enterprises into two categories, state-owned high-tech enterprises（SOE）and non-state-owned high-tech enterprises (Non-SOE), according to the nature of property rights, and conducts a two-way fixed effects regression.

Regression coefficient of government subsidies on innovation performance is 0.032, which is significantly and positively correlated at the 5% statistical level, and the regression coefficient on operating performance is 0.018, which is significantly and positively correlated at the 10% level; while in the sample of non-state-owned enterprises, the coefficients are 0.091 and 0.056 respectively, both of which show a significant positive correlation at the 1% level, and the absolute values of the coefficients are approximately 2.8 to 3.1 times those of the state-owned enterprise sample group. This is mainly because state-owned high-tech enterprises have inherent resource advantages. With the endorsement of their state-owned status, they have more financing channels and relatively sufficient supporting resources, so the marginal promotion effect of government subsidies is relatively limited. In contrast, non-state-owned high-tech enterprises face more prominent financing constraints, higher financing costs, and larger gaps in R&D funds. The existence of government subsidies can directly alleviate the pressure of enterprises' capital demand, effectively mobilize their enthusiasm for innovation and R&D, and have a more obvious marginal promotion effect on the innovation and business activities of high-tech enterprises. To sum up, government subsidies have a significant positive promoting effect on the innovation performance and operating performance of high-tech enterprises with two different types of property rights, but the promoting effect is more obvious in the sample of non-state-owned high-tech enterprises. This result is consistent with the previous analysis and the expectations of theoretical hypotheses. Hypothesis H2 is valid and verified. In terms of control variables, the direction of effects of variables such as enterprise size, asset-liability ratio, shareholding ratio, proportion of tangible assets, and operating cash flow in the two sets of regression results is basically consistent with the benchmark regression results in the preceding text.

4.5. Robustness Test

4.5.1. Replace the Explanatory Variable

In the previous benchmark regression analysis, the government subsidy measurement indicator used in this paper was measured by taking the natural logarithm of the total amount of government subsidies. Here, in order to eliminate the interference caused by different variable processing methods on the analysis results, the proportion of government subsidies in operating revenue (Sub_ratio) is used to replace the original measurement indicator of the explained variable, and the two-way fixed effects regression is re-conducted.

After replacing the explained variable, the influence coefficient of Sub_ratio on the innovation performance of high-tech enterprises in the regression result is 0.427, showing a positive correlation at the 1% significance level. The promoting effect on the operating performance of high-tech enterprises is also positively correlated at the 1% significance level, with a coefficient of 0.215. This has no substantial difference from the data results obtained in the previous text in terms of sign and significance, and the goodness of fit is also within a reasonable range, indicating that government subsidies have a promoting effect on both the innovation performance and operating performance of high-tech enterprises. They can boost enterprise growth by improving the innovation and operating performance of high-tech enterprises, and this promoting effect will not change due to different processing methods of government subsidy indicators adopted in the paper, nor is it an accidental result brought about by indicator selection. The robustness of the conclusions of this paper has been preliminarily verified. The relevant regression coefficient results of the control variables are also basically consistent with

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the direction of the benchmark regression, which is generally in line with theoretical common sense.

Table 6. Robustness Test Results of Replacing the Explained Variable

Variables	(1) Inpat	(2) ROA
Sub_ratio	0.427***	0.215***
	(7.84)	(5.96)
Size	0.406***	0.212***
	(16.31)	(7.64)
Lev	-0.324***	-0.457***
	(-7.96)	(-11.03)
Ins	0.005***	0.012***
	(4.47)	(7.23)
Tang	0.111*	-0.182***
	(1.67)	(-3.46)
Top1	0.002**	0.008***
	(2.28)	(5.05)
Cash	0.629***	12.573***
	(6.95)	(31.86)
_cons	-8.663***	-3.128***
	(-17.89)	(-6.24)
Year	Yes	Yes
Firm	Yes	Yes
N	18726	18726
R^2	0.709	0.645

Notes:Sub_ratio denotes government subsidies as a proportion of operating revenue.*** p<0.01, ** p<0.05, * p<0.1

4.5.2. One-period Lag of Explanatory Variable

Based on the foregoing analysis, the impact of government subsidies on the innovation performance and operating performance of high-tech enterprises may have a certain time lag. Therefore, conducting a one-period lag effect test (L.Sub) on the explanatory variable government subsidies can, to a certain extent, mitigate the potential impact on the conclusions caused by the two-way causality problem.

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Table 7. One-Period Lag of Explanatory Variable

Variables	(1) Inpat	(2) ROA
L.Sub	0.068***	0.039***
	(8.61)	(6.35)
Size	0.401***	0.210***
	(15.87)	(7.42)
Lev	-0.319***	-0.448***
	(-7.72)	(-10.71)
Ins	0.005***	0.011***
	(4.31)	(6.95)
Tang	0.108*	-0.179***
	(1.62)	(-3.38)
Top1	0.002**	0.007***
	(2.19)	(4.91)
Cash	0.614***	12.416***
	(6.74)	(31.23)
_cons	-8.541***	-3.074***
	(-17.43)	(-6.11)
Year	Yes	Yes
Firm	Yes	Yes
N	16594	16594
R^2	0.706	0.641

Notes: L.Sub denotes the one-period lagged value of government subsidies.*** p<0.01, ** p<0.05, * p<0.1

As can be seen from the above table, after the one-period lag of government subsidies (L.Sub), the influence coefficients of government subsidies on the innovation performance and operating performance of high-tech enterprises are 0.068 and 0.039 respectively, and both show a positive correlation at the 1% significance level. This is consistent with the promotion effect results obtained in the previous benchmark regression analysis, and the goodness of fit of the one-period lag model also indicates the stability of the regression results. The direction and significance of the regression coefficients of the control variables have also basically not changed much. In general, government subsidies have a promoting effect on both the innovation performance and operating performance of high-tech enterprises, and can promote enterprise growth by improving enterprise innovation and operating performance, and the promoting effect is persistent. The above benchmark regression results are robust.

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4.5.3. Shorten the Sample Interval

This paper removes the sample data from 2015, selects the sub-sample data of high-tech enterprises from 2016 to 2024 to conduct the two-way fixed effects regression test again, so as to discuss whether the benchmark regression results above are interfered by the sample data of the initial year 2015.

Table 8. Shorten the Sample Interval

Variables	(1) Inpat	(2) ROA
Sub	0.073***	0.041***
	(9.02)	(6.64)
Size	0.410***	0.215***
	(16.48)	(7.79)
Lev	-0.326***	-0.459***
	(-8.04)	(-11.15)
Ins	0.005***	0.012***
	(4.54)	(7.30)
Tang	0.113*	-0.184***
	(1.69)	(-3.49)
Top1	0.002**	0.008***
	(2.31)	(5.10)
Cash	0.633***	12.604***
	(7.01)	(31.98)
_cons	-8.705***	-3.147***
	(-18.04)	(-6.27)
Year	Yes	Yes
Firm	Yes	Yes
N	16913	16913
R^2	0.711	0.646

Notes: The sample period is restricted to 2016–2024.The one-period lag approach not only excludes the year 2015 but is also affected by the panel's non-stationary nature, which results in the exclusion of some enterprise-year observation data; as a consequence, the sample size is slightly smaller than that obtained by directly removing the 2015 subsample (16,913 observations).*** p<0.01, ** p<0.05, * p<0.1

After excluding the sample data of the initial year 2015, the regression result shows that the regression coefficient of government subsidies on the innovation performance of high-tech

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enterprises is significantly positive at the 1% level, with a value of 0.073. The regression coefficient on the operating performance of enterprises is 0.041, which also has a significant positive correlation at the 1% level. In addition, the sign directions of the correlation coefficients of all control variables are also consistent with the benchmark regression in the previous text, with no inconsistency or opposite situations, and the goodness of fit of the model also seems to be relatively good. The conclusion drawn in the previous text that government subsidies can promote the improvement of the innovation performance and operating performance of high-tech enterprises, thereby achieving the long-term growth of enterprises, will not be interfered by the particularity of the data sample of the initial year 2015, and the conclusion is robust.

In summary, under the above robustness tests, no matter whether we adopt the method of replacing explanatory variables, lagging explanatory variables by one period, or shortening the sample interval, the positive impact of government subsidies on the innovation performance and operating performance of high-tech enterprises in the regression results remains unchanged, and both can improve the growth of enterprises.

4.6. Endogeneity Test

After verifying the robustness of the conclusions of this paper, considering the possible interference caused by endogeneity, this paper further adopts the instrumental variable method to conduct endogeneity tests. The possible endogeneity of the conclusions of this paper mainly comes from two aspects. On the one hand, government subsidies can affect the innovation performance and operating performance of high-tech enterprises, while high-tech enterprises with high innovation levels and good operations are more likely to win the government's favor and receive government support, and reverse causality bias will arise in this two-way causality; on the other hand, affected by the circumstances that some factors cannot be quantified or the relevant data are unavailable, omitted variables may cause bias in model estimation. Although the lagged one-period effect test of explanatory variables has been carried out in the previous robustness test, which initially alleviated the reverse causality bias, the endogeneity interference caused by omitted variables still needs to be addressed. Therefore, this paper selects the firm-year average government subsidy (IV_Sub) as the instrumental variable for the explanatory variable government subsidy (Sub), and adopts the two-stage least squares method to conduct the endogeneity test. In the first stage, the enterprise government subsidy Sub is taken as the explained variable, and the instrumental variable IV_Sub, all control variables, enterprise fixed effects and year fixed effects are taken as explanatory variables to obtain the fitted value of government subsidies. In the second stage, the fitted value of subsidies obtained in the first stage is used to regress the explained variables, namely innovation performance and operating performance. The results are as follows:

After replacing the explained variable, the influence coefficient of Sub_ratio on the innovation performance of high-tech enterprises in the regression result is 0.427, showing a positive correlation at the 1% significance level. The promoting effect on the operating performance of high-tech enterprises is also positively correlated at the 1% significance level, with a coefficient of 0.215. This has no substantial difference from the data results obtained in the previous text in terms of sign and significance, and the goodness of fit is also within a reasonable range, indicating that government subsidies have a promoting effect on both the innovation performance and operating performance of high-tech enterprises. They can boost enterprise growth by improving the innovation and operating performance of high-tech enterprises, and this promoting effect will not change due to different processing methods of government subsidy indicators adopted in the paper, nor is it an accidental result brought about by indicator selection. The robustness of the conclusions of this paper has been preliminarily verified. The relevant regression coefficient results of the control variables are also basically consistent with

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the direction of the benchmark regression, which is generally in line with theoretical common sense.

Table 9. 2SLS Regression

Variables	(1) First-stage Sub	(2) Second-stage Inpat	(3) Second-stage ROA
IV_Sub	0.724***	—	—
	(13.57)		
Sub(fitted)	—	0.081***	0.047***
		(8.94)	(7.16)
Size	0.376***	0.418***	0.223***
	(14.28)	(16.93)	(8.11)
Lev	-0.341***	-0.334***	-0.468***
	(-7.43)	(-8.27)	(-11.42)
Ins	0.004***	0.005***	0.012***
	(3.86)	(4.72)	(7.54)
Tang	0.132*	0.119*	-0.191***
	(1.84)	(1.78)	(-3.62)
Top1	0.002**	0.002**	0.008***
	(2.21)	(2.42)	(5.28)
Cash	0.652***	0.644***	12.713***
	(6.49)	(7.16)	(32.44)
_cons	-7.935***	-8.861***	-3.248***
	(-15.32)	(-18.47)	(-6.45)
Year	Yes	Yes	Yes
Firm	Yes	Yes	Yes
N	18726	18726	18726
First-stage F-statistic	146.32	—	—

Notes: IV_Sub denotes firm-year average government subsidies. Sub(fitted) is the fitted value of government subsidies derived from the first-stage regression. The first-stage F-statistic is well above the empirical critical value of 10, which excludes the threat of weak instruments.*** p<0.01, ** p<0.05, * p<0.1

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5. Conclusion and Policy Recommendations

5.1. Conclusion

This paper selects the panel data of domestic A-share listed high-tech enterprises from 2015 to 2024 to explore the effect of government subsidies on the growth of high-tech enterprises. The study finds that government subsidies can indeed promote the growth of high-tech enterprises. As the innovation activities of high-tech enterprises require large upfront investment and have a long return cycle, high-tech enterprises generally face the problem of insufficient funds. Government subsidies can not only directly supplement the disposable funds of enterprises, but also share the cost of innovation trial and error and reduce R&D risks for enterprises. They play a certain role in helping enterprises produce more patent achievements and improving their operating profitability. Government subsidies can promote the long-term growth of high-tech enterprises by improving their innovation performance and operating performance. Although government subsidies can promote the growth of high-tech enterprises, their effect on the growth of high-tech enterprises is affected by the property right attribute, and is different between state-owned high-tech enterprises and non-state-owned high-tech enterprises. The marginal effect of government subsidies on improving the innovation performance and operating performance of state-owned high-tech enterprises is far smaller than their promoting effect on non-state-owned high-tech enterprises. This is because private enterprises generally face more prominent funding constraint problems. After the subsidies are in place, they can effectively revitalize the innovation and operating resources of enterprises, so the improvement effect on growth is significantly better than that of state-owned enterprises.All hypotheses of this paper have been verified and established, which are robust and reliable.

5.2. Recommendations

At the government level, we should continue to make good use of the policy tool of government subsidies. The high-tech industry itself has the industry characteristics of high risk and high input, so it is difficult to fully solve various problems in the innovation stage solely relying on market forces. The government should reasonably arrange the allocation of subsidies in light of the actual situation of industrial development, help enterprises improve the level of patent output, and enhance their actual operating benefits. The formulation of subsidy policies should not adopt a one-size-fits-all approach, and the actual differences among enterprises with different types of property rights should be taken into account. For state-owned enterprises, we should not blindly allocate subsidy funds. After the subsidies are issued, we should conduct follow-up verification, focus on the actual flow of subsidy funds, prevent some enterprises from engaging in rent-seeking behavior to obtain subsidies, ensure that fiscal subsidies are truly invested in technology research and development as well as production and operation, and improve the overall use efficiency of fiscal funds.

For enterprises, high-tech enterprises should objectively understand the role of government subsidies. After receiving the subsidy funds, they should not regard subsidies as a simple profit supplement, but try to allocate the funds to core links such as technology research and development and product iteration. Enterprises with different property right backgrounds should adjust their ideas on the utilization of subsidy resources according to their own characteristics. Private enterprises can use subsidies to ease capital pressure and seize the opportunity to deploy innovative projects; state-owned enterprises should take the initiative to get rid of their dependence on policy funds, tap internal potential, and rely on their own capabilities to achieve technological iteration and performance growth. Enterprises should also pay attention to optimizing their own capital structure and controlling the scale of liabilities within a reasonable range. They should attach importance to the accumulation of internal cash

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flow, coordinate their own funds with policy subsidies, provide stable resource support for R&D innovation and daily operation, and consolidate the foundation for their own growth.

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