Research on Innovation Efficiency of Hubei High-tech Industry Based on DEA and PSM-DID Models

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Abstract. This paper uses the DEA-Malmquist model to study the efficiency and changes of the overall technological innovation activities of high-tech industries in Hubei Province from 2010 to 2016, and finds that the total factor productivity of Hubei Province has declined slightly in recent years, and the efficiency of overall technological innovation activities is low, which can be manifested as weak growth of technical efficiency and technological progress level and weak stability. In addition, this article uses the “Wuhan Independent Innovation Capability Enhancement Plan (2013-2016)” to express government support, and uses 60 listed companies in Hubei Province as a sample and uses the PSM-DID model to investigate the effect of government support on the efficiency of corporate innovation, to further verify the above conclusions. The verification results show that the innovation-driven policies of Hubei Province have no significant positive effect on the innovation efficiency of high-tech enterprises

1. Introduction

Innovation-driven development is an important way for China's contemporary economic development. Technological innovation belongs to a complicated input-output system process. High-tech enterprises take core technology as an important guarantee for their survival and development, and attach great importance to internal technological innovation activities. As a result, the amount of investment in innovation activities continues to increase, expecting to exchange a large amount of investment for satisfactory returns. However, research shows that a large amount of investment in innovation resources does not match the income of enterprises, which indicates that the technological innovation efficiency of China's high-tech industries has not reached the desired level.

Research by Xiao Wen and other scholars [1] shows that the average annual growth rate of China's internal spending on R&D funds is extremely high, but the growth rate of GDP in the same period does not match it, and the technical level has not significantly improved with the rapid growth of R&D investment. From the perspective of input and output, the main reason for this phenomenon is that the efficiency of technological innovation in China is still at a relatively low level. Zhang Jie [2] found that although the efficiency of China's scientific and technological innovation has increased slightly in recent years, it is still on the low side. The Yangtze River Economic Belt is rich in innovative resources, and the transformation and upgrading of industries within the economic belt driven by innovation is an important strategic deployment of the country. Luo Fang and other scholars [3] pointed out that although the innovation efficiency of enterprises in the middle reaches of the economic belt (Hunan, Hubei, Jiangxi) has increased significantly, there are obvious deficiencies in technological progress. Feng Yao [4] calculated through the DEA model, although our government...
and enterprises have attached great importance to scientific and technological innovation and investment in recent years, the economic benefits brought by the achievements created by high-tech industries have declined, which can be attributed to the fact that a large number of redundant inputs make the ratio of achievements into economic benefits cannot be improved as it should be. Feng and other scholars [5] use a two-stage DEA model to classify China's provinces into four categories according to the calculation results. Hubei province performs better in the stage of scientific and technological production, but the efficiency of transforming scientific and technological achievements into economic benefits is relatively low, resulting in the overall innovation efficiency of the province being at a relatively low level. Coincidentally, Xiao Renqiao and other scholars [6] believe that Hubei province is at a stage of low research and development efficiency and low transformation efficiency, innovation resources are wasted to a certain extent. therefore, it is urgent to adjust relevant policies to guide the healthy development of regional science and technology innovation efficiency.

The academic community has not yet reached a consensus on whether government support can effectively drive the improvement of innovation efficiency. Guan [7] research shows that, in terms of capital investment, the internal capital support of the enterprise is conducive to the improvement of its innovation efficiency, while government subsidies have an obvious inhibitory effect on its innovation efficiency. Opposite Guan, Yu Yongze [8] pointed out that government support is beneficial to enterprise innovation activities. Differences in the methods of analysing efficiency and different years of selected samples are important to cause inconsistent research conclusions in academia. Shao Peide [9] found that the level of financial and tax policy support for enterprises determines whether they can successfully complete the process of independent innovation and development. Czarnitzki and Licht [10] also said that government capital investment can avoid enterprises R & D risks due to insufficient scientific research capabilities have played a role in promoting their technological innovation capabilities. Xiao Wen [1] found that there is obvious inconsistency between government support and market demand, which is manifested in the government's desire to the goal of overall long-term planning, which conflicts with the enterprise's goal of pursuing short-term benefits, thus greatly affecting the overall efficiency of technological innovation.

The existing literature rarely explores the efficiency of technological innovation in Hubei Province. This article aims to fill this gap and try to find out the shortcomings of the existing government support programs and give reasonable opinions and suggestions. Based on the above problems, taking Hubei Province as the starting point, DEA method and Malmquist index method were used to measure the technological innovation efficiency of the province. Looking for a broad and representative policy, Wuhan Independent Innovation Capability Enhancement Plan (2013-2016), to study the specific impact of government support on the efficiency of technological innovation in enterprises. The policy proposes to use the construction of Wuhan Donghu National Independent Innovation Demonstration Zone as the engine, to promote technological innovation and accelerate the transformation of scientific and technological achievements as the core, to deepen the reform of the scientific and technological system as the driving force, and to use talents, inputs, technology, infrastructure, systems and culture, etc The elements of innovation are grasping, cultivating the dominant position of enterprise innovation, promoting collaborative innovation of production, teaching, and research, and creating a good atmosphere of independent innovation. The aim is to greatly enhance Wuhan's original innovation, integrated innovation, and introduction, digestion, absorption, and re-innovation capabilities. Based on this policy, this paper uses PSM-DID model to test 60 listed companies in Hubei Province, digs deeply into the impact of Hubei provincial government support on corporate innovation efficiency, and makes explanations.

2. Research Methods and Data Processing
This study uses Data Envelopment Analysis (DEA) to evaluate innovation efficiency. DEA method estimates the frontier of effective production according to the input and output data, compares each decision unit (DUM) with this frontier of effective production, and measures the efficiency. DEA
belongs to a kind of measurement of relative efficiency, and many subjective factors can be excluded in practical application, thus making the analysis results have certain objectivity.

The Malmquist index method is used to measure the change of total factor productivity. This method decomposes the total factor productivity index (PCH) into a technical efficiency index (EFFCH) and a technology progress index (TECH). The technical efficiency index can be decomposed into pure technical efficiency index (PECH) and Scale Efficiency Index (SECH). The function is as follows:

$$TFPCH = EFFCH \times TECH \quad (EFFCH = PECH \times SECH)$$

Malmquist index is a comprehensive reflection of the management level and innovation level of each decision-making unit. If the Malmquist index is greater than 1, it means that the level of scientific and technological innovation productivity has increased, otherwise it means that the level of scientific and technological innovation productivity is declining. "Technological Progress Index" reflects the accumulation and improvement of all kinds of knowledge covered by technology; “Scale Efficiency Index” represents the impact of production scale on productivity, and further reflects the management level of the evaluation object. The "pure technical efficiency index" can reflect the innovation output level of the unit under test. When the values of TFPCH, TECH, PECH and SECH are greater than 1, it shows that the total factor productivity, technological progress and pure technological efficiency from phase $t$ to phase $t+1$ are improved and economies of scale are formed; otherwise, it is the opposite.

The data sources involved in this study are "China High-tech Industry Statistics Yearbook" and CSMAR database, all the data are compiled manually by the author.

3. **Empirical analysis**

3.1. **Index selection**

Based on the principles of purpose, simplicity, relevance and diversity, this research is referring to the methods for constructing the evaluation system of innovation efficiency in the existing literature. Use the Full time equivalent converted by R&D activity personnel and the expenditure on new product development and the internal expenditure on scientific and technological activities as the input indicators of technological innovation, and the sales income of new products and the number of patent applications are selected as the output indicators. The specific index system is shown in Table 1:

| Indicator category | Indicator name                                                                 | specific description                                                                                                                                 |
|--------------------|--------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------|
| Input indicators   | The Full time equivalent converted by R&D activity personnel                     | It directly reflects the investment of enterprises in the number of personnel in technological innovation activities. It is calculated by adding the full-time equivalent of the personnel participating in the R&D project and the full-time equivalent of the management and direct service personnel to be shared in the R&D project, and the unit is one person-year. |
| Input indicators   | Internal expenditure for scientific and technological activities                | Reflect the financial investment of enterprises in technological innovation activities. The actual expenses incurred by the investigation unit in carrying out scientific and technological activities in the reporting period include external processing expenses. The internal expenditure of science and technology activities is divided into current expenditure and capital expenditure. |
| Input indicators   | Expenditure for new product development                                         | It directly reflects the state of capital investment for new product development in corporate technology innovation activities.                           |

Table 1. Technical innovation efficiency index system of high-tech enterprises
Output indicators

| New product sales revenue | The sales of new products that reflect the output of technological innovation activities of enterprises. |
|---------------------------|----------------------------------------------------------------------------------------------------------|
| Patent applications       | The number of patent applications is a direct reflection of the results of technological innovation activities carried out by enterprises. It refers to the number of patent applications submitted by the investigating unit to the patent administration department and accepted during the reporting period. |

3.2. Data sources and calculations

According to the index system set forth in Table 1, this paper selects Hubei Province's pharmaceutical manufacturing industry (PM), aerospace manufacturing industry (AM), electronic and communication equipment manufacturing industry (ETE), electronic computer and office equipment manufacturing industry (COE) and medical equipment and instrumentation manufacturing industry (MEM) as empirical objects, collates and obtains the required data from 2010 to 2016 according to China's Statistical Yearbook of High-tech Industries. The Malmquist index and its decomposition of technological innovation efficiency of high-tech enterprises in Hubei Province from 2010 to 2016 are obtained by using DEAP2.1 software. The results are shown in Tables 2 to 5.

Table 2. Malmquist index of technological innovation efficiency in Hubei from 2010 to 2016

| Firm | Effch | Tech | Pech | Sech | Tfpch |
|------|-------|------|------|------|-------|
| PM   | 1     | 0.973 | 1    | 1    | 0.973 |
| AM   | 1.05  | 1.076 | 1.02 | 1.029| 1.13  |
| ETE  | 1.004 | 1.13  | 1    | 1.004| 1.135 |
| COE  | 0.783 | 0.755 | 1    | 0.783| 0.591 |
| MEM  | 1.073 | 1.098 | 1    | 1.073| 1.177 |
| Mean | 0.976 | 0.996 | 1.004| 0.972| 0.972 |

Table 3. Malmquist index of technological innovation efficiency in Hubei from 2010 to 2012

| Firm | 2010-2011 | 2011-2012 |
|------|-----------|-----------|
|      | Effch     | Tech      | Pech     | Sech    | Tfpch  | Effch     | Tech      | Pech     | Sech    | Tfpch  |
| PM   | 1         | 0.727     | 1        | 1       | 0.727  | 0.874     | 1.146     | 1        | 0.874  | 1.001  |
| AM   | 0.543     | 1.274     | 0.39     | 1.392   | 0.692  | 0.721     | 1.132     | 0.891    | 0.809  | 0.816  |
| ETE  | 0.505     | 1.871     | 1        | 0.505   | 0.945  | 0.933     | 1.276     | 1        | 0.933  | 1.19   |
| COE  | 0.196     | 1         | 1        | 0.196   | 1      | 2.866     | 1         | 1        | 2.866  |        |
| MEM  | 1.523     | 1.513     | 1        | 1.523   | 2.305  | 1         | 0.979     | 1        | 0.979  |        |
| Mean | 0.84      | 0.875     | 0.828    | 1.014   | 0.735  | 0.899     | 1.359     | 0.977    | 0.92   | 1.222  |

Table 4. Malmquist index of technological innovation efficiency in Hubei from 2012 to 2014

| Firm | 2012-2013 | 2013-2014 |
|------|-----------|-----------|
|      | Effch     | Tech      | Pech     | Sech    | Tfpch  | Effch     | Tech      | Pech     | Sech    | Tfpch  |
| PM   | 0.911     | 0.982     | 1        | 0.911   | 0.895  | 1.256     | 0.924     | 1        | 1.256   | 1.161  |
| AM   | 1.315     | 0.941     | 1.352    | 0.973   | 1.237  | 2.652     | 1.126     | 2.369    | 1.119   | 2.985  |
| ETE  | 1.429     | 0.911     | 1        | 1.429   | 1.301  | 1.095     | 0.838     | 1        | 1.095   | 0.918  |
| COE  | 1         | 0.618     | 1        | 0.618   | 0.86   | 0.46      | 1         | 0.86    | 0.396  |        |
| MEM  | 1         | 0.94      | 1        | 1       | 0.94   | 1         | 1.335     | 1        | 1.335   |        |
| Mean | 1.114     | 0.866     | 1.062    | 1.048   | 0.965  | 1.257     | 0.883     | 1.188    | 1.058   | 1.109  |
Table 5. Malmquist index of technological innovation efficiency in Hubei from 2014 to 2016

| Firm | 2014-2015 | 2015-2016 |
|------|-----------|-----------|
|      | Effch | Tech | Pech | Sech | Tfpch | Effch | Tech | Pech | Sech | Tfpch |
| PM  | 1     | 1.181 | 1    | 1    | 1.181 | 1     | 0.951 | 1    | 1    | 0.951 |
| AM  | 0.765 | 1.342 | 0.648| 1.182| 1.027 | 1.283 | 0.757 | 1.565| 0.82 | 0.971 |
| ETE | 0.952 | 1.326 | 1    | 0.952| 1.262 | 1.463 | 0.862 | 1    | 1.463| 1.261 |
| COE | 1.036 | 1.426 | 1    | 1.036| 1.477 | 0.259 | 0.811 | 1    | 0.259| 0.21  |
| MEM | 1     | 1.335 | 1    | 1    | 1.335 | 1     | 0.705 | 1    | 1    | 0.705 |
| Mean| 0.945 | 1.32  | 0.917| 1.031| 1.247 | 0.866 | 0.812 | 1.094| 0.792| 0.703 |

3.3. Results analysis
Judging from the above empirical analysis, the efficiency of the overall innovation activities of high-tech enterprises in Hubei province has not been effectively improved in recent years. The total factor productivity change value (TFPCH) of the overall technological innovation activities of high-tech enterprises in Hubei province from 2010 to 2016 is 0.972, of which the TFPCH values from 2010 to 2011, 2012 to 2013 and 2015 to 2016 are 0.735, 0.965 and 0.703 respectively, indicating a slight decline in the overall innovation efficiency. Figure 1 clearly shows the changes in the province's total factor productivity index in recent years. Specifically implemented in various industries, the technological innovation efficiency can be ranked as medical device and instrument manufacturing industry (1.177), electronic and communication equipment manufacturing industry (1.135), aerospace manufacturing industry (1.130), pharmaceutical manufacturing industry (0.973), electronic computer and office equipment manufacturing industry (0.591), which shows that the innovation efficiency of pharmaceutical manufacturing industry, electronic computer and office equipment manufacturing industry has declined, while the innovation efficiency of the other three industries has slightly improved.

![Figure 1. Changes in Total Factor Productivity of Hubei High-Tech Enterprises from 2010 to 2016](image)

According to the analysis of decomposition indexes, the technical level and technical efficiency of the overall technical innovation activities of high-tech enterprises in Hubei province have a downward trend. After the total factor productivity is decomposed, it can be seen that from 2010 to 2016, the average value of the change in Technical efficiency (EFFCH) decreased by 2.4%, and the average value of the change in technical efficiency (tech) decreased by 0.6%. After decomposing the change in technical efficiency (EFFCH) into the change in pure technical efficiency (PECH) and the change in scale efficiency (SECH), it can be found that the average value of PECH is 1.004 and the average value of SECH is 0.972 from 2010 to 2016, which shows that the change in pure technical efficiency in Hubei province contributes more to improving technical efficiency than scale efficiency.

Specifically, the TFPCH value of technical innovation activities in the pharmaceutical manufacturing industry from 2010 to 2016 is 0.973. Except the Technical Progress Index (TECH) is
less than 1.0, all other indexes are equal to 1, indicating that the overall total factor productivity of the industry has declined due to insufficient technical progress in recent years.

The aerospace manufacturing industry's pure technology efficiency change index increased rapidly from 0.39 in 2010-2011 to 1.565 in 2015-2016, and reached a peak of 2.369 during the period, indicating that the industry has significantly improved the efficiency level of technological innovation during the reporting period. However, the performance of various indicators in the industry is not stable. The specific performance is that the level of technological progress and the level of technological efficiency have fluctuated, which has made the overall TFP improvement effect insignificant.

The state of the electronics and communications equipment manufacturing industry is like that of the aerospace manufacturing industry. The level of technological progress in this industry has dropped from a peak of 1.871 in 2010-2011 to 0.862 in 2015-2016, with a large fluctuation during the period. However, the level of technological efficiency has improved. The effect is more obvious, because the scale efficiency of the industry has effectively improved, from 0.505 in 2010-2011 to a level that has recently stabilized at more than 1.0. The pure technology efficiency change index of the industry has stabilized at 1, and its overall technological innovation efficiency in a stable lifting state.

The performance of the electronic computer and office equipment manufacturing industry in the scope of this study is extremely unstable. The overall technical efficiency and technical progress level show a downward trend. The change in technical efficiency (EFFCH) fluctuates from 0.259 to 1.036. The decomposition index shows that the change in scale efficiency is too large, but the pure technical efficiency is stable at 1. Technical Change (TECH) ranges from 0.196 to 2.866.

Since 2010, the technical efficiency of the medical equipment and instrument manufacturing industry has remained stable, while the technical changes have fluctuated greatly. Its technical innovation efficiency is in a state of improvement.

Through DEA-Malmquist model calculation and result analysis, it can be concluded that the five major industries in Hubei Province have weak and unstable technological efficiency and technological progress growth, and it can be preliminarily considered that the innovation efficiency in Hubei Province is at a relatively low level.

4. Further Inspection

In order to further test the above research conclusions and explore the impact of government activities in Hubei province on the innovation efficiency of enterprises, we have chosen a Wuhan innovation-driven policy, “Wuhan independent innovation capability improvement plan (2013-2016)”, and based on PSM-DID model, use Stata15.0 to conduct further regression analysis. The model is set as follows:

\[ \text{innovation}_{it} = \alpha_0 + \alpha_1 \text{policy}_{it} + \alpha_2 \text{year}_{it} + \alpha_3 \text{DIFF} + \alpha_4 \text{ctrl}_{it} + \mu_{it} \]

Among them, \( \text{innovation}_{it} \) represents the innovation efficiency of the company, which is specifically expressed by the total number of patent applications of the company in that year, \( \text{policy}_{it} \) represents the policy variable, \( \text{year}_{it} \) is the dummy time variable, DIFF is the cross-product of policy and year, and \( \text{ctrl}_{it} \) is Control variable, \( \mu_{it} \) is a random perturbation term. In addition, among the coefficients of the model, \( \alpha_3 \) is the core coefficient of interest in this regression analysis, which represents the policy of innovation-driven policy on the explanatory variable. Specific variables are described in Table 6.

Table 6. Definition and description of main variables

| Variable name | Variable definitions |
|---------------|----------------------|
| innovation    | The total number of patent applications of the company in the current year (including inventions, utility models and designs) |
| policy        | Policy dummy variable, if the company's area is affected by the policy, the value is 1, otherwise the value is 0. |
| year          | Time dummy variable, if the policy is valid in the current year, the value is 1, otherwise the value is 0. |
DIFF

The intersection of policy dummy variables and time dummy variables

Control variables, including industry categories, property rights, and company registration address

Enterprise industry category, if the industry of company is supported by this policy, the value is 1, otherwise the value is 0.

The nature of enterprise property rights, if the ultimate controller of the enterprise is a state-owned enterprise, the value is 1; otherwise, is 0.

Asset-liability ratio, total liabilities / total assets

Free cash flow of enterprises, pre-tax profit after interest + depreciation and amortization - increase in working capital - capital expenditure

Return on assets, (total profit + financial expenses) / average total assets.

Average total assets = (asset total closing balance + assets total last year ending balance)/2

Investment yield, current investment income / (long-term equity investment at the end of the period value + holding-to-maturity investment at the end of the period value + trading financial assets at the end of the period value + available-for-sale financial assets at the end of the period + derivative finance Assets at the end of the period)

Taking 2013 as the base year and year as the time dummy variable, the value is assigned 0 before 2013 and 1 after 2013 (inclusive); policy is used as the policy variable, and the company registered address is assigned as 1 in Wuhan, not Wuhan However, other cities in the Yangtze River Economic Belt in Hubei are assigned a value of 0. Descriptive statistics are shown in Table 7:

| variable     | Number of samples | average value | Standard deviation | Minimum value | Max      |
|--------------|-------------------|---------------|--------------------|---------------|----------|
| innovation   | 281               | 22.0214       | 50.4161            | 0             | 396      |
| year         | 281               | 0.5943        | 0.4919             | 0             | 1        |
| policy       | 281               | 0.7260        | 0.4468             | 0             | 1        |
| type         | 281               | 0.6868        | 0.4646             | 0             | 1        |
| state        | 281               | 0.5409        | 0.4992             | 0             | 1        |
| debt         | 281               | 0.4660        | 0.2349             | 0.0244        | 1.867087 |
| cash         | 281               | -35907001     | 1850817772         | -26292879985  | 352793213 |
| return       | 281               | 0.0683        | 0.1456             | -0.7924       | 1.6513   |
| investment   | 281               | 0.4780        | 4.8211             | -2.5702       | 77.5477  |

4.1. Basic regression analysis

Table 8 reports the basic regression results based on the experimental policy. The first column (1, 3, 5, 7) in each group is the result obtained without using robustness regression, and the second group is using robust method for robustness regression the results obtained. The group A did not control the variables, the group B controlled the industry and the nature of property rights of the company, and the groups C and D controlled the industry and property rights respectively.

It is easy to see that the crossover coefficients in the regression results are all negative but not significant. It can be preliminarily judged that the policy has not played a good role in promoting the innovation efficiency of enterprises.
Table 8. Basic regression results

| Group | 1      | 2      | 3      | 4      | 5      | 6      | 7      | 8      |
|-------|--------|--------|--------|--------|--------|--------|--------|--------|
| year  | 3.23   | 3.23   | 5.40   | 5.40   | 3.38   | 3.38   | 5.24   | 5.24   |
|       | [11.739] | [2.911] | [11.265] | [4.987] | [11.543] | [3.719] | [11.471] | [3.239] |
| policy| 19.54* | 20.23* | 20.23* | 20.23* | 19.05* | 19.05* | 20.72* | 20.72* |
|       | [10.685] | [8.005] | [10.248] | [8.294] | [10.507] | [7.796] | [10.434] | [8.357] |
| DIFF  | -10.42 | -10.42 | -12.46 | -12.46 | -10.76 | -10.76 | -12.11 | -12.11 |
|       | [13.743] | [9.344] | [10.322] | [7.211] | [9.965] | [4.482] | [9.622] | [3.953] |
| α0    | 10.37*** | -17.04 | -17.04* | -3.35  | -3.35  | -3.15  | -3.15  | -3.15  |
| industry | N | N | Y | Y | Y | Y | N | N |
| Property right | N | N | Y | Y | N | N | Y | Y |
| N     | 281.00 | 281.00 | 281.00 | 281.00 | 281.00 | 281.00 | 281.00 | 281.00 |
| adj. R-sq | 0.01 | 0.01 | 0.09 | 0.09 | 0.04 | 0.04 | 0.05 | 0.05 |
| AIC   | 3002.60 | 3002.60 | 2980.80 | 2980.80 | 2994.10 | 2994.10 | 2990.00 | 2990.00 |
| BIC   | 3017.20 | 3017.20 | 2980.80 | 2980.80 | 2994.10 | 2994.10 | 2990.00 | 2990.00 |

Note: ***, **, and * indicate that they are significant at the levels of 1%, 5%, and 10%, respectively. The data in parentheses are robust standard errors.

4.2. PSM-DID

In order to verify the reliability of the results, using the PSM-DID to verify. And using the company's free cash flow (cash), asset-liability ratio (debt), return on assets (return), and investment return (investment). Industry category (type), property rights (state) as characteristic variables, the experimental group and the control group are matched based on the double difference tendency score of the common range, using Probit model regression calculation, and using the kernel matching method to process the data. The regression results are as shown in the table, the coefficient of cross-product term is still not significantly negative, which cannot show that the policy has a positive impact on the innovation efficiency of enterprises.

Table 9. Regression results of PSM-DID model

| Output variable | innovation | Standard error | |t| | p>|t| |
|----------------|------------|----------------|------|-------|--------|
| Before processing | | | | | |
| Control group | 10.133 | | | | |
| test group | 37.113 | | | | |
| Diff (T-C) | 26.981 | 11.889 | 2.27 | 0.024** |
| After processing | | | | | |
| Control group | 13.399 | | | | |
| test group | 30.806 | | | | |
| Diff (T-C) | 17.407 | 7.369 | 2.36 | 0.019** |
| DIFF | -9.574 | 13.988 | 0.68 | 0.495 |

5. Conclusions and recommendations

Combining the research conclusion with the existing research, the following suggestions can be put forward. Government support itself is beneficial to technological innovation activities, but it may not play a significant role in improving the efficiency of technological innovation. This is mainly due to the different purposes of government and enterprises in acquiring technology. This difference caused the government support effect to fall short of expectations. Specifically, the government's excessive regulation and control force has led to its indirect participation in the decision-making of technological innovation activities of enterprises and over-investment in the target industries in terms of capital
arrangement and resource allocation, thus distorting the effective control of the market over research and development resources, and ultimately resulting in the insignificant effect of government support. The effects of government financial aid and coordinated management are also different for enterprises at different stages of development. In innovation activities, enterprises should clarify their dominant position, master more dominant power and improve their sense of social responsibility. However, government departments should position policy support as a means of auxiliary adjustment and guidance, avoid too much interference in the normal operation of the market, pay more attention to the field of industry-university-research cooperation, so that enterprises can make full use of the research and development capabilities of scientific research institutes and turn their achievements into economic benefits, which is an effective way to improve the overall innovation efficiency.

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