# The Influence of Government Subsidy on Technological Innovation of Enterprises -- Based on The Empirical Analysis of Industrial Enterprises Above The Scale

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**ABSTRACT**

With the arrival of the new generation of scientific and technological revolution, innovation has become an important starting point for each country and region to seize a strong position. Technological innovation has become an important driving force for China's economic transformation and upgrading. The government usually adopts the way of providing R&D subsidies to improve the innovation level of enterprises. Based on China's large and medium-sized industrial enterprises as the breakthrough point, this paper USES the panel data of 2017-2019, 3 years, study the effect of government subsidy effect to the enterprise technology innovation, and using correlation analysis and multiple regression analysis of empirical model to explore the technological innovation of the national 31 provinces, the results show that the government subsidies has positive influence to the enterprise technology r&d, government subsidies will encourage technology innovation investment. Based on the results of this paper, some suggestions are put forward to improve the efficiency of technological innovation of enterprises and provide references for evaluating the performance of the current government R&D support policy and adjusting and improving the government R&D subsidy policy.

***Keywords:*** *Government subsidy; Technological innovation; R&D investment; Correlation analysis; Regression analysis*

## 1. INTRODUCTION

The party's 19 emphasize innovation is the first driving force of development, put forward the important content of the construction of innovative country, innovation has always been a hot topic of scholars research, is an important way for Chinese enterprises to pursue profit growth, but due to the innovation activities has the nature of public goods, under the complete market mechanism, need the government for the necessary intervention of technology enterprises, financial subsidies is an important way for the government to encourage enterprise innovation. The scientific and technological reserves supporting industrial upgrading and leading future development need to be strengthened; to adapt to innovation-driven system and the economic development has not really turned to the track of innovation; the scientific and technological talents lack leading and highly skilled talents, innovative entrepreneurs urgently need to develop; and the market environment and social atmosphere to encourage innovation still need to be further cultivated and optimized for (Du Junyi, Feng Gang 2020) [1].The relationship between government innovation subsidy and enterprise innovation behavior is one of the important issues in the field of innovation management [11].

In recent years, China has continuously increased its support for scientific and technological innovation, and directly funded enterprises through the establishment of innovation funds and small giant funds. In 2018, the state fiscal expenditure on science and technology reached 832.2 billion yuan, up 14.5% year on year. In order to improve the efficiency of government funding, optimize the allocation of public resources. This paper analyzes the influence of the government input on the enterprise technological innovation, and further analyzes the efficiency of the enterprise's own technological innovation. Lu Dong, Lin Gao and Yang Dan (2012)


S. A. R. Khan et al. (Eds.): ICMSSE 2022, AHCS 12, pp. 893–899, 2023.
https://doi.org/10.2991/978-94-6463-056-5_129

found that the government subsidies received by enterprises will not help improve the level of research and development level, especially for enterprises with political relations, and excessive government subsidies are not conducive to the research and development of (Lu Dong, Lin Gao and Yang Dan, 2012). [5] Existing literature has conducted theoretical research and empirical discussion on the relationship between government support and enterprise innovation decision-making, and the influence mechanism between government subsidies and enterprise innovation behavior has been deeply explored in (Zhao Zhonghua and Ju Xiaofeng 2013; Yue Guo 2018; Yang Yun and Ning xiangdong 2018) [10-12], but few people make in-depth analysis and distinction on the policy objectives of innovation subsidies. In this context, this paper aims to explore the influence of government subsidies on enterprise innovation decision-making, and to combine the industrial characteristics of enterprises with different properties.

## 2. LITERATURE REVIEW AND RESEARCH HYPOTHESIS

At present, technological innovation mainly includes three main modes: independent innovation, imitation innovation and cooperative innovation. The meaning of independent innovation is the mode that enterprises carry on research and development relying on their own strength and achieve the established strategic goals. This mode requires enterprises to spend great efforts to develop the core technology. Once successfully developed, the enterprise can obtain considerable commercial benefits with the monopoly advantage of the technology [3] [4] [7].

Scholars have not reached a unified conclusion on the relationship between government investment and enterprise technological innovation. The results of (Lu Guoqing, Wang Zhou and Zhang Chunyu 2014) [6] by Lu Guoqing et al. show that government innovation subsidies do not have much effect on the output performance of individual enterprises; and Zhuang Wanting believe that government subsidies have a significant positive impact on enterprise performance [13]. Although the relevant literature in the relevant definition, influencing factors related research is more detailed, but there are still three aspects: one is the research conclusion, a large number of literature points out that government R & D subsidies on enterprise technology innovation level, but is positive or negative influence, due to the selection of data, region, industry, nature, enterprise size, etc, the academic community has not reached a general consensus. Second, the current research on large and medium-sized industrial enterprises is relatively small, which play an important role in the current economic growth, and the data is relatively old and the research perspective mainly focuses on the lack of national perspective; third, the theoretical analysis. However, the existing research lacks mechanism analysis as a support, and often only conducts empirical tests but lacks the analysis of relevant mechanisms.

Based on the above research results, this study believes that government subsidies have a dual effect of inhibiting and promoting enterprise performance. Yang Ye and Wang Peng et al. (2015) found that financial subsidies are not conducive to enterprise R & D input, and the impact on r & d output has a certain lag. The government should adopt a variety of subsidies to make up for the lack of a single subsidy method [9]. Therefore, this paper puts forward the hypothesis: hypothesis 1: government subsidies will promote technological innovation investment. Hypothesis 2: Government subsidies will curb investment in technological innovation.

Wang Suikun and Hao Jiwei (2014) [8] believe that the government financial subsidies and tax incentives have played a positive role in promoting the R & D and innovation of smes, including. Feng Zongxian, Wang Qing and Hou Xiaohui (2011) [2] believe that the government subsidy investment will limit the innovation activities of enterprises to a certain extent, resulting in the loss of innovation efficiency.

Based on the above analysis, this paper puts forward the following assumptions: Hypothesis 3: Government subsidies will stimulate technological innovation output. Hypothesis 4: Government subsidies will curb the output of technological innovation.

## 3. MODEL BUILDING

### *3.1 Dependent Variable*

In essence, to evaluate the effect of enterprise technological innovation, we can examine the performance after technological innovation, and the performance can be measured by designing the input and output indicators of technological innovation. Enterprises invest certain innovative resources in innovative production, and the production process can be divided into two stages, one is the knowledge production stage of transforming innovative resources into new knowledge and new technologies, and the other is the stage of marketization of innovative achievements such as new knowledge and new technologies, so as to obtain commercial value. In reality, when the patent number as the output of technological innovation, the value is the number of patent applications rather than patent authorization, the reason is mainly lies in: on the one hand, a patent application to approval in China takes about 1~2 years, so the patent authorization in the current innovation level may have defects, and patent application number can reflect the current innovation output, and not all patent applications can be authorized, so the output of

enterprise technology innovation index set to the number of patent applications.

### *3.2 Independent Variable*

R & D investment is the enterprise in r & d innovation activities when the most direct investment, so R & D investment is the most direct embodiment of enterprise innovation activities, is also an important measure of enterprise innovation ability. Enterprise investment in technology innovation can be measured from two aspects: R & D expenditure and R & D personnel. R & D personnel full-time equivalent is the indicator used to measure science and technology manpower investment, the internal expenditure of R & D expenditure and new product development expenditure are the indicators used to measure capital investment. Therefore, this paper uses government subsidies, enterprise R & D expenditure and R & D personnel as independent variables.

### *3.3 Intervening Variable*

In this paper, enterprises' R&D investment intensity is taken as a mediator variable, and the reasons is:in order to realize the needs of development strategy, the government and private sector need to make a large amount of investment in technological innovation, and the investment related to technological innovation is inevitably reflected in the fixed assets investment of the whole society. Therefore, it is speculated that the technological innovation of enterprises can affect the economic growth by affecting the fixed assets investment.

Referring to the existing literature, this paper adopts the R&D investment intensity of enterprises in 31 provinces and cities in China and the annual GDP of each region. Details are shown in the following table:

Table 1: Variable definition and description

| Type of variable | Variable name | Symbol | Declaration |
|---|---|---|---|
| Explained variable | Innovative performance | inn | Take the natural logarithm of the number of patents applied for in this year |
| Explanatory variable | Government subsidies | sub | The natural logarithm of government R & D subsidies this year |
| | Enterprise R&D expenditure | R&D | Industrial enterprises above the size of this year new product development expenditure naturally logarithm |
| | Technical level | level | The ratio of the total number of researchers and the total number of employees |
| Metavariable | Enterprise R&D investment intensity | rd | Enterprise R & D investment and regional GDP of the year |

### *3.4 Data source and processing*

The raw data used in this paper are derived from the China Statistical Yearbook of High-tech Industries, the Statistical Bulletin of National Economic and Social Development, the China Statistical Yearbook, and the China Science and Technology Statistical Yearbook, dated up to 2018-2020.

## 4. EMPIRICAL ANALYSIS AND THE RESULTS

### *4.1 Descriptive analysis*

In this paper, Stata15.0 is used to conduct descriptive statistics on the above variables, so as to explore the characteristics of data and research objects, so as to better understand the results of further statistical analysis, and the results are shown in Table 2.

Table 2: Descriptive analysis

| Index | Least value | Crest value | Mean | Std |
|---|---|---|---|---|
| Year | 2017 | 2019 | 2018 | 0.82092 |
| inn | 3 | 12.52 | 9.2683 | 1.74 |
| sub | 8.07 | 17.46 | 14.361 | 1.74822 |
| R&D | 0 | 0.21 | 0.0323 | 0.04663 |
| level | 8.09 | 17.47 | 14.3952 | 1.76491 |
| rd | 0.02 | 10.59 | 1.1321 | 1.14923 |

From Table 2, the mean value, standard deviation, minimum value and maximum value of technological innovation performance of enterprises are 3, 1.74, 3 and 12. There is a certain gap in the number of patent applications of different types of enterprises each year, the technological innovation level of different enterprises is different. The mean of government subsidies is 8.07, the standard deviation is 1.748, and the range is 9.39, indicating that there are certain differences in the degree of financial subsidies and policy support provided by the government to different types of enterprises. The mean value and standard deviation of r&d investment intensity of enterprises are 1.1321 and 1.14923, indicating that different enterprises attach different importance to their r&d investment. Based on this, we can draw a preliminary conclusion that increasing scientific research investment is conducive to improving the independent innovation ability of emerging industries, and thus can promote regional innovation.

### *4.2 Correlation analysis*

In order to ensure whether there is correlation between variables, correlation analysis should be carried out on each variable before regression analysis. Spass14.0 software was used in this paper. For the continuous variables in this paper, Pearson correlation analysis was used to explore the correlation between variables. The specific analysis results are shown in Table 3 below:

Table 3: Correlation analysis

| Variable | Avg | Std | inn | sub | R&D | level | rd |
|---|---|---|---|---|---|---|---|
| inn | 9.26 | 1.74 | 1 | | | | |
| sub | 14.36 | 1.74 | .972** | 1 | | | |
| R&D | 0.03 | 0.04 | .698** | .638** | 1 | | |
| level | 14.39 | 1.76 | .973** | .968** | .661** | 1 | |
| rd | 1.13 | 1.14 | .465** | .590** | .388** | .466** | 1 |
| ** was at level 0.01 (double tail) with significant correlation. | | | | | | | |

All Pearson correlation coefficients were greater than 0.3, However, the coefficient between innovation performance and enterprise input intensity, government subsidies and enterprise input intensity, technology level and enterprise input intensity and enterprise R & D expenditure and enterprise input intensity is between 0.3 and 0.6, It shows that they are of moderate correlation, The correlations between variables are all greater than 0.6, and correlation between enterprise r & d expenditure and innovation performance reached 0.973, So they are highly correlated. Therefore, in the real economic development environment, the government can provide appropriate support, to strengthen the protection of intellectual property rights and mobilize the enthusiasm of enterprises for innovation.

### *4.3 Regression analysis*

Analysis of the government subsidies and the technical-level construction of the regression equations was done using Stata15.0, and the results are shown in Tables 4 and 5.

Table 4: Parametric test

| R | $R^2$ | Adj.R | Err. | Change statistics | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | | $\triangle R^2$ | $\triangle F$ | df1 | df2 | Sig F |
| .977a | 0.954 | 0.953 | 0.37577 | 0.954 | 941.288 | 2 | 90 | 0 |
| a predictor variables: (constant), technical level, and government subsidies | | | | | | | | |
| b dependent variable: Innovation performance | | | | | | | | |

Visible from table 4, the P value of F test is 0, the model is statistically significant, shows that the model is good, R square value slightly 95.4%, that the model of high fit, the model is very practical and variable selection is appropriate, so the combination of model and variables for real economic and social enterprise technology innovation research has great reference value.

Table 5: Regression model

| | Bi | | Beta | T | Sig | Collinearity | |
|---|---|---|---|---|---|---|---|
| | B | Std err | Beta | | | 1/VIF | VIF |
| const | -3.574 | 0.398 | | -8.975 | 0 | | |
| sub | 0.883 | 0.029 | 0.887 | 30.351 | 0 | 0.593 | 1.686 |
| level | 4.926 | 1.091 | 0.132 | 4.516 | 0 | 0.593 | 1.686 |
| a dependent variable: Innovation performance | | | | | | | |

It can be seen from Table 5 that the VIF of government subsidy and technical level is not greater than 2, indicating that the collinearity of independent variables is acceptable, and the significance is less than 0.05, which shows that the impact of government subsidy and technical level as independent variables on technological innovation is very significant. Government subsidies standardization coefficient of 0.887, significance is 0.00, technical level is technical innovation personnel input standardization coefficient is 0.132, significance is 0.00, in terms of standardization coefficient, government subsidies compared to enterprise R & D personnel investment, greater influence on enterprise technology innovation, therefore, in the regression analysis, should increase government subsidies to promote enterprise technology innovation.

## 5. CONCLUSION AND REVELATION

### *5.1 Conclusion*

This paper takes the industrial enterprises above designated size from 2017 to 2019, and first makes descriptive statistics on the government innovation subsidies, enterprise R & D investment strength and enterprise innovation performance, to explore the role path of government innovation subsidies obtained by strategic emerging enterprises on enterprise innovation performance, and test the intermediary effect of R & D investment intensity of enterprises. This paper for above-scale industrial enterprises using quantitative method research, mainly from the government subsidies will stimulate enterprise R & D investment, government subsidies will squeeze enterprise R & D investment two aspects comb and summarize the relevant research results, according to the panel data to establish individual and time double fixed effect model, empirical analysis of the influence of government subsidies on industrial enterprises technology innovation in China.

Despite the time lag, government subsidies can still enhance the innovation strength of enterprises. The government's R & D subsidies is conducive to making up for market failure and ultimately improving the technological innovation level of enterprises. The more government subsidies large enterprises and state-owned enterprises receive, the easier it is to trigger the government capital extrusion effect of small and medium-sized enterprises and private enterprises, which is not conducive to bring higher enterprise technological innovation effect; the more high-tech enterprises receive government subsidies, the more significant the direct

capital effect and risk sharing effect, and will bring better technological innovation effect.

### *5.2 Deficiencies and prospects*

Although this study deeply explores government subsidies, there are still some limitations. Due to direct data of large and medium-sized industrial enterprises, This paper draws on previous literature, Studies were conducted with data from the subregions, With the availability of future data, More accurate analysis can be done; at the same time, Due to the diversity of ways government R & D subsidies, Different forms have differences in the level of enterprise innovation, This paper focuses on the main form of patent applications, More detailed research on other methods is needed in the future; besides, Because the internal mechanism of government subsidies affecting enterprise innovation is more complex, There are many influencing factors, This paper stays on the overall effect of government subsidies on enterprises, Factors of different ways and different enterprises should be expanded in the future research.

Under the background of deepening economic reform, strategic emerging industries are the key objects of cultivation. Increasing the investment in scientific research is conducive to improving the independent innovation ability of emerging industries. We should establish diversified technology incubator, emerging industries and research institutions to provide technology, so as to provide the appropriate environment for enterprise research and development and improve the conversion rate of scientific and technological achievements.

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