

# The Analysis of Government R&D Investment to the Innovation Intention of Chinese Enterprises with Different Nature

## -----An Empirical Study Based on Zero-Inflated Model in Economics

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**Abstract.** When there are differences in environment and conditions of the enterprise, there will be differences in government R&D investment impacting on enterprise innovation intention. This paper is to analyze the effects of government subsidies on the innovation intention in the enterprise with nature difference. Analyze the panel data of 1590 high-tech enterprises in 2008-2011. Also use the zero inflated model to deal with the problem in patent application number of too much zero, distinguishing innovative intention with zero. The parameter estimation is more accurate, which leads to a more consistent with the actual conclusion: Government R&D investment and enterprise innovation will have a correlation; For state owned enterprises, Government R&D investment has inhibitory effect on enterprise innovation intention, non-state owned enterprises can be promoted, the Chinese Government R&D investment needs to be improved, rather than blindly input.

### Introduction

In China, the government's incentive for the economy is not negligible. For enterprises, innovation intention will not always exist. In the choice of innovation, the enterprise must weigh the results. First, after the choice of enterprise innovation, whether it will bring some revenue to the enterprise, the two is the risk of innovation can be avoided. For this consideration, the enterprise may not have the willingness to innovate, and the government as a representative of the social welfare, having the obligation to carry out the basic and public welfare of the enterprise R&D investment(Zuofeng Li, 2012)[1]. It should play its role, in which the Government R&D investment for enterprises is an indispensable incentive factors in R&D and development innovation.

However, the Government R&D investment to the enterprise's innovation intention not necessarily only has a positive relationship, but also has the potential to a negative effect (Hong Zhou, 2014)[2]. For example, when a high government subsidies, some enterprise would be appropriate to reduce the amount of potential investment in science and technology innovation. Of course, due to the information asymmetry of the market economy, the government cannot correctly distinguish the authenticity of information distributed by the enterprise, making the choice of R&D investment will be an error, cannot achieve the optimal allocation of resources. Then, the government R&D investment on enterprise technology research and development innovation how to motivate in the end, and from the micro level of enterprise, the government how to allocate the R&D investment on enterprise innovation, these need further discussion and research.

### Literature Review

As early as the middle of last century, foreign countries began to study the relationship between the Government R&D investment and the innovation intention. Between different research objects and estimation methods, the following conclusions can be obtained in general:

**Complementary Relationship.** Complementary relationship is the most common result of government R&D investment effect, that is, the government R&D investment has a great effect on the enterprise's innovation intention. For example Hamberg (1966) [3]. He is the first scholars to use enterprise cross section data to research government R&D investment and enterprise R&D

investment. On the one hand, he ruled out the sample heterogeneity, on the other hand by introducing a profits, sales, depreciation and R&D lag items and other control variables, and obtained four complementary relationship. After Busom (2000) [4] using different data and methods found similar results.

**Alternative Relationship.** The so-called alternative relationship means that the government R&D investment will have an inhibitory effect on the enterprise's innovation intention or that the government R&D investment will reduce investment of enterprises to increase investment in innovation. Such as Wallsten (1999) [5].

Compared with foreign research, domestic research started later, our country is mainly in 2000 to have this research results; secondly, most of the literature focuses on the complementary relationship between the two. The domestic research mainly studies the relationship between the two from different angles. Such as Ping Li (2010) [6], Ning Jiang (2010) [7] and You Wu (2013) [8] studied different nature of industries from different industries, the government R&D investment will have different effects. Yihui Wang (2013) [9] started from the perspective of enterprise environment. The results of the study showed that in state-owned enterprises government subsidies would lead to the decrease of innovation performance.

Through the above research, it can be seen that the result of Government R&D investment policy on enterprise's innovation intention relationship cannot be a uniform. The main purpose of this paper is to analyze Government R&D investment effect on the enterprise innovation intention from government investment and the enterprise nature, so as to effectively improve the Government R&D input efficiency.

## Model and Data

**Variable Setting.** According to previous research experience, the explanatory variables is patent application number , explanatory variables is Government R&D input , enterprise research investment , enterprise nature , firm size and enterprise's scientific research personnel(Yihui Wang, 2013)[10]. In order to simplify the calculation process, there will make some explanatory variables into dummy variables, if the enterprise is state-owned, the value is zero, or one.

This paper selects the panel data of 1590 high-tech enterprises in 2008-2011. After exploration of preliminary data, finding that the frequency of the zero number in Chinese companies' innovation intention for accounted for is obviously higher than the other values (in order to highlight the value of zero, intercept the patent application number in less than 10). Show a skewed distribution, there is zero expansion.

**Model Building.** The basic idea of Zero inflated count model is the number of events occur as two possible processes, first corresponds to a null event occurs is assumed to follow a binary probability distribution, the number in the patent application can only be zero, this process generating zero explains that the reason of data existing excessive zero. Second, it is assumed that the number of patent applications is subject to the general counting process, in which the value can be zero or positive. Zero inflated count model establishes mixed probability distribution of zero count and non-zero count:

$$y_i \sim \begin{cases} 0, p_i \\ g(y_i), 1 - p_i \end{cases} \quad (1)$$

$p_i$  indicates the probability that an individual is derived from the first process. The  $g(y_i)$  obey Poisson or Negative binomial distribution, so the probability density of  $Y_i=y_i$  is,

$$\begin{cases} P(y_i = 0|x_i) = p_i + (1 - p_i)g(0) \\ P(y_i|x_i) = (1 - p_i)g(y_i), y_i > 0 \end{cases} \quad (2)$$

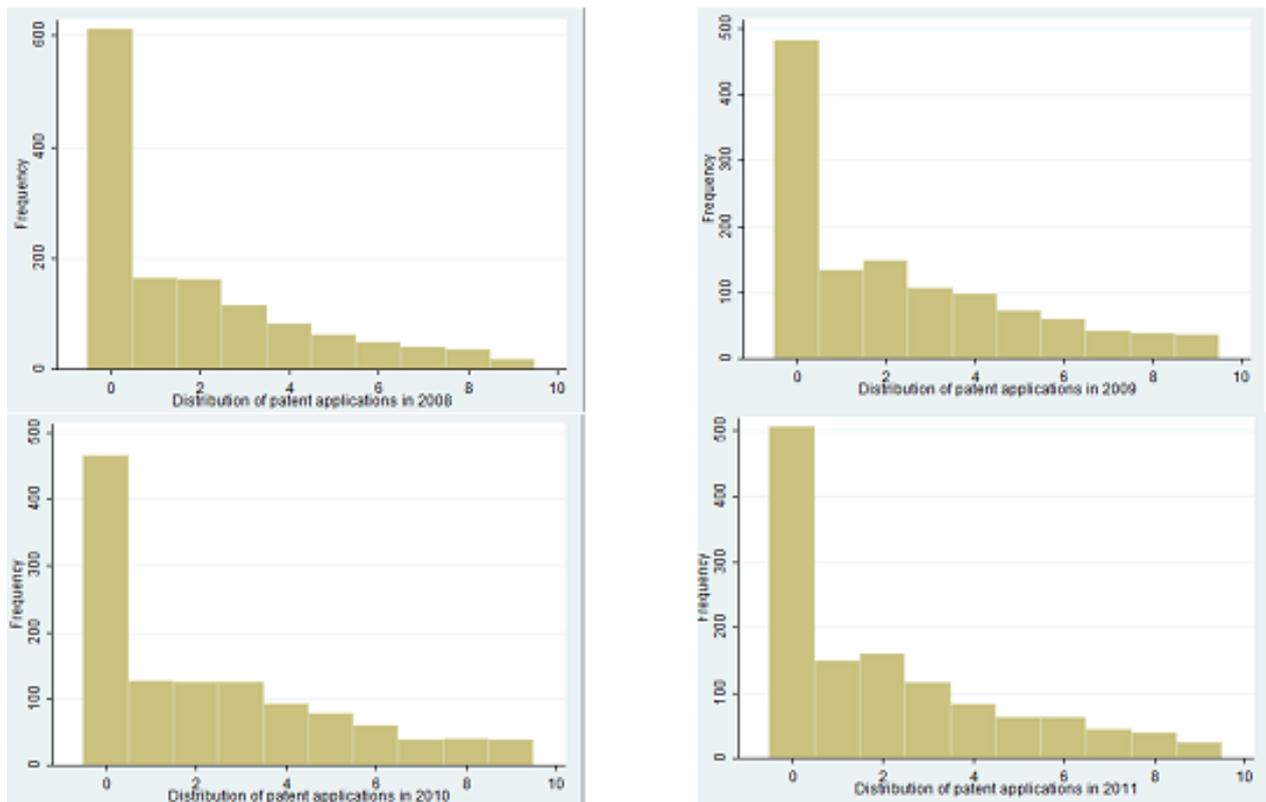


Figure 1. The number of patent applications in 2008-2011

**Model Analysis.** The selected model is mainly used for reference in the study of the influence factors of induced abortion in China (Cuntong Wang, 2010) [11]. From patent application number in 2008, the average number of patent applications is 5.98, variance is 23.02, variance significantly more than the average, which is the discrete data, so the simple least-squares method cannot solve the problem, model selection by the Vuong test, Vuong statistic is 10.13, far greater than 1.96, rejecting the null hypothesis. Should be use Zero-inflated Poisson model.

Table 1 OLS Regression results

Variable	OLS (1)	OLS (2)	OLS (3)
Enterprise research Input	0.000072 (***)	0.000068 (***)	0.000067 (***)
Enterprise researchers	0.013 (***)	0.014 (***)	0.014 (***)
Enterprise size	4.204 (***)	3.759 (***)	3.787 (***)
The Government R&D Input		0.00023 (***)	0.000232 (***)
Nature of enterprise			0.881 (Not significant)

(In brackets, the \*,\*\*,\*\*\* express they are significant in the levels of 10%, 5%, 1%)

As can be seen from Table 1, by comparing two models, the government R&D investment coefficient is positive, so it has a positive role in promoting enterprise innovation. The nature of enterprise is an essential factor for enterprise innovation, but the nature of the enterprise is not obvious in the simple OLS regression model by comparing the model 2 and model 3.

Table 2 Zero-inflated Poisson Regression results

Variable	Zero-inflated Poisson ( 3 )	Zero-inflated Poisson ( 4 )
Enterprise research	1.15e-06 ( *** )	-2.48e-07 ( ** )
Enterprise researchers	0.00014 ( *** )	0.00022 ( ** )
Enterprise size	0.417 ( *** )	0.408 ( *** )
The Government R&D Input	4.83e-06 ( *** )	9.80e-07 ( *** )
Nature of enterprise	-0.068 ( *** )	-0.165 ( *** )
The Government R&D Input*Nature of enterprise		0.0000359 ( *** )

Comparing model 3 and model 4 from Table 2, when introducing the interaction term of Government R&D into the enterprise nature (the different nature of the enterprise, the Government R&D investment will have difference), the coefficient of enterprise scientific investment become negative. Government R&D investment will be affected differently because of the different nature of the enterprise, then it will affect the enterprise internal research investment, so it can be seen a negative investment in scientific research in the model 4. Now 1590 high-tech enterprises are divided into two groups in 2008, a group of state-owned enterprises, a total of 155. The other group for the non-state owned enterprises, a total of 1435 companies. With the same method regression, it can be seen Government R&D investment coefficient is negative in state-owned enterprises, and the coefficient of non-state-owned enterprises is positive. This result illustrates that in state-owned enterprises, Government R&D investment to enterprise innovation will inhibit, the investment increase, on the contrary, will lead enterprises to lower the willingness to innovate.

## Conclusions

This paper is on the basis of the existing literature research, analysing the relationship between China's enterprise innovation intention and the Government R&D investment by Zero-inflated model, drawing the following conclusions:

First, the enterprise scale and R&D personnel of enterprise will have significant impact, the size of enterprises is lager, enterprises will have motivation through innovation to get greater profit, in order to obtain a competitive advantage; at the same time, the larger scale enterprises can also take the risk of innovations fail. Enterprise R&D personnel has a very significant role in enterprise innovation, showing that the talent factor is an important force to promote enterprise innovation in today, China should vigorously develop talents.

Second, the Government R&D investment to the enterprise's innovation intention have a negligible effect. In state-owned enterprises, government subsidies will have significant negative regulatory role between R&D investment and enterprise innovation. For the state-owned enterprises, it should be appropriate to reduce the Government R&D input and avoid the state-owned enterprises "unearned". The Government R&D investment is transferred to the non-state owned enterprises, and incentive their willingness to innovate, so as to promote the research and development of the enterprise.

In short, the Government R&D investment impacting on innovation intention is related to the nature of enterprise, so the government providing funding to the enterprise research needs more targeted, providing to high-tech enterprises with larger scale and more personnel in addition to state-owned enterprises. And reasonable allocate Government R&D investment to improve Government R&D investment efficiency. At the same time, strengthen the government's supervision of the enterprise. The government should perfect and strengthen the supervision and administration in the use of the subsidy funds, to ensure the use of subsidy funds to achieve tangible results.

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