WHICH IS BETTER INNOVATIVE INVESTMENT
An Empirical Analysis of Statistics from Chinese Industrial Undertakings

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Abstract: The analysis of this paper proves that, due to the differences in terms of characteristics of technology and economy between the developing countries or less-developed regions and the developed countries, and the industrial structure in these regions is located in the non-frontier, so the effects of various innovative investment modes in technological innovation differ from that in the developed countries. The significant relation, i.e. the effects of current venture investment in US is three times of the R&D investment effects, turns out to be the fact that the R&D investment produces four times effects than the venture investment effects in China. Therefore, as to current industry system of China, venture investment is definitely not the best innovative financing method, while the R&D investment may be much better.

1 INTRODUCTION

Technology innovation is the major source of technology advancement, which plays significant guiding and supporting role in the formation of national competitiveness in the long run. Among the various factors affecting the efficiency of technology innovation, innovation investment occupies a crucial position. A popular notion holds theoretically that among various innovation investment forms, the stimulus from venture investment to technology innovation is much profounder than that of other investment forms. For example, the research results of the scholars, Tykvova (2000), Ueda and Hirukawa (2003), which explores in the angle of resources supplementation, show that venture investment can adapted better to the characteristics and demands of technology innovation, while traditional financing modes can not be the major sources of corporation's technology innovation investment. Gebhardt's study aiming at the angle of curbing budget found that, as to the financing of innovative projects, venture investment is much more effective than traditional financing methods and is able to promote technology innovation better. (Gebhardt, 2000; 2006), Keuschning applied general equilibrium in his study and found that the services including capital and management provided by venture investment can effectively raise the success probability of running business, and guarantee the smooth advancement of technology innovation under the conditions of general equilibrium. (Keuschning, 2004), Lv Wei proposed that venture investment mechanism is a breakthrough of original technology innovation, causing the lifting of corporate ability of technology innovation, and as a result can accelerate greatly technology innovation (Lv Wei, 2002).

Empirical statistics from some developed countries like USA and EU give strong support to the above statements. For example, Kortum and Lerner carried out empirical analysis on the relationship between venture investment and technology innovation according to the statistics from the USA. The result indicates that the stimulus of venture investment is approximately three times of that of R&D. (Kortum, Lerner, 2000) Engel and Keilbach conducted their study taking German statistics as samples and they studied the effects of venture investment on small and medium sized high-tech businesses, and the result illustrates that the total number of patents from the businesses with venture investment is much more than from those without (Engel, Keilbach, 2007).

Due to the modeling effects of the developed countries, the above notions and experiences are opt to become the policy models of industrial

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technology innovation in the developing countries and less-developed regions, and produce significant effects. However, indiscriminate acceptance of these notions may contain potential dangers: the decision makers might ignore the real situation of that nation and region, and over-react to these new innovative investment modes like venture investment and reduce their attention to tradition innovation investment and relative administration, which results in damages to technology innovation practices in that nation and region. Until now, some crucial problems haven't gained adequate attention and research: for the developing countries and less-developed regions whose technology and economy are relatively lagging behind, is venture investment the best innovation investment mode in their technology innovation? In the technology innovation movement in the developing countries and less-developed regions, if there exists a relation that the stimulus of venture investment to patent innovation is larger or times of the effects of R&D[①]?

2 THE THEORETICAL EXPLANATION MODEL OF THE FUNCTIONAL PRINCIPLES OF INNOVATIVE INVESTMENT IN TECHNOLOGY INNOVATION

2.1 Theoretical Model

In order to answer these questions, first we need to establish a model about how innovative investment functions in technology innovation practice, and clearly elaborate the functional mechanism and movement principles of innovative investment in technology innovation practices theoretically. According to the Theory of Six Forces of Essential Factors of Production of academician Xu ShouBo, any economy and production are executed on the basis of six fundamental production factors, namely labor force, financial force, physical force, natural force, transport force and time force (Xu Shoubo, 2006). As an important technology production activity of human society, technology innovation cannot be isolated from the six Essential production factors. Innovative investment is one of these important factors-financial force and R&D investment and venture investment are two significant modes of innovative investment. Therefore, the explanation model of how innovative investment functions in technology innovation practice actually is an innovative model proposed by the writer on the basis of six production factors principle[②].

It can be learned from the innovative model based on the Theory of Six Forces of Essential Factors of Production, technology innovation system is a complex adaptive system, whose subject is an adjuster that take the initiative in trying to adapt well to circumstances, possessing limited rationale and opportunism. The innovation result is the outcome of the mutual function of the system subject under the certain system structure and circumstances, and then the rules of the system are very significant. Thus, as an important fundamental production factor, in what way does the innovation investment participate in technology innovation? How does it adjust to and influence the other factors? And what about the function mechanism of various innovation investments like venture investment and R&D investment?

The writer holds that there are several basic points to be grasped. Firstly, in the innovation activities, the action and decision system of various subjects is a "Target-oriented Self-adjusting process", whose target is to realize the maximum of its own benefits and the minimum of comprehensive cost (including cost of transaction and management). Secondly, the subjects of various factors have both limited rationale and the features of opportunism, so their action principles are continuously repeated and evolved towards the adjustment to the external environment and reaction to the feedback cha ains, integrating the features of nonlinearity, complexity and dynamic evolvement. Therefore, in terms of decision making methods, the subjects of various factors all abide by "convention", and their response principles are adjusted dynamically on that basis, and this is a conventional study process and accumulation process of technology experience (Nelson and Wentt, 1982).

If satisfactory returns could be achieved when the subjects of these factors function conventionally, the conventions will be continued and strengthened; Otherwise, if abnormity occurs when the factors function conventionally and the return is lower than a certain level, the subjects of the factors will need to adjust the convention, namely seeking a new convention suitable for itself among the existing technology and conventions, or by innovation discovering a new emerging convention which had never been found before. Then what are the dimensions consisting of the conventions? The writer holds that essentially the convention is a kind of technology program when the subject faces and settles problems, so its dimensions are characteristics of technology and economy.

Based on the above analysis, the writer proposed a coupling relationship model integrating the innovation investment and technology characteristics (with tokens to display technology complexity), and the economy characteristics. As illustrated by Graph 1, this model actually is evolved from the K Model by Mr. Herbert (Kitschelt·Herbert, 1991)[③]. According to this model, the coupling relationship cross-functioned by various innovation investment and technology characteristics and the economy characteristics could be summed up as follows:

(1) In those industries with more mature technology and fierce market competition such as textile industry, light industry, machinery industry etc., because the market structures are closer to perfect competition market, so the technology innovation have its uniqueness in the following three aspects: first, the demand of technology innovation is strong and diversified; second, the assets specificity is low during the process of innovation, and the results of innovation can hardly lead to considerable monopoly profits; third, the technology of the industries are relatively mature, less complex, and the uncertainty of innovation is relatively low. The compare analysis of the returns of innovation subjects and the comprehensive cost indicates that R&D investment by the corporations in this industry and private innovation investment might produce relatively high profits and low comprehensive cost, while venture investment and national R&D investment may lead to the problems of low profits and high comprehensive cost. Therefore, corporate R&D investment and private innovation investment are more suitable for this kind of industry, as illustrated by Graph 1 Section 1.

(2) In those industries whose technologies are relatively mature and whose market structures tend to be monopolized, such as fundamental chemistry, steel and railway transportation, there are limited corporations to be chosen from to expand innovation results. The innovation results turn up in the manner of Know-How and the asset specificity and cost of innovation are both very high, so the corporate center laboratory is more suitable, as illustrated by Section Ⅱ of Graph 1.

(3) In those industries whose technologies are highly complex, market structures tend to be monopoly, the innovation demands are concentrated and the asset specificity of innovation are very high, such as nuclear technology, aviation industry, huge aircrafts manufacture and telecommunication, there are considerable risk during the innovation process and it requires the national and corporate R&D investment, as illustrated by Section Ⅲ of Graph 1.

(4) In those industries whose technologies are highly complex but whose market positions are still in the infant phase, whose market structures tend to be competitive, and at many times the dominant industry design and stand haven't come into shape, such as IT, software, artificial intelligence, genetic engineering and pharmaceuticals etc., the technology innovation corporations are mostly newly start-ups which demand a large sum of investment in technology R&D and market development, possessing high uncertainty and risk of innovation. However, once the innovation succeeds, a vast market prospect and great returns will be enjoyed. Judging from the experience of developed countries, prior to the technology innovation in this kind of industry, national R&D investment are needed, and in the commercialized innovation phase, the venture capital will be very influential, as illustrated by Section Ⅳ Graph 1.

(5) In those industries, which are moderate complex and face moderate market competition, such as electronic equipment, household appliance, sophisticated chemistry, machinery and automobile manufacture, there is less demand of technology innovation, and relatively high asset specificity may be formed during the process of innovation. Meanwhile, the technology in this kind of industry may change drastically, requiring considerable input, imposing serious demand on market scale and producing high risk of innovation, therefore, they are more suitable for the innovative investment forms like R&D activities in the center laboratory of large corporations and innovation alliance, as illustrated by Section Ⅴ of Graph 1.

2.2 Theoretical Explanation of Technology Innovation Activities in the Developing Countries and the Less-developed Regions

Analysing the technology innovation activities in the developing countries and less-developed regions applying the above mentioned model, the writer came to an important conclusion: since the industry structure and characteristics of technology and economy in the developing countries and less-developed regions are different from that of the developed countries, therefore, as to the technology innovation in the developing countries and the less-developed regions, venture investment is not the best innovation investment method. The relation, namely the venture investment has much larger or times of stimulating influence on patent innovation than the effects of R&D, stands no ground.

First, according to the model, if two industries differ in characteristics of technology and economy, the innovation investment forms that they fit for will differ accordingly. For example, as to the rising industries with vast prospects, who have sophisticated technology and great uncertainty, and who face fierce competitive market without mature standard, such as IT, artificial intelligence, genetic pharmaceuticals, venture capital is an optimum innovation investment. However, as to the industries with relatively mature technology and serious competition such as textile and light industry, due to mature technology standards , specified market, and high level of marketization, the suitable innovation investment mode are corporate R&D input or private investment. The reason is that in this kind of industry, the growth margin is limited. If the venture investment enters this kind of industry, the rate of return will be very low. At the same time, since the cost of transaction and management is very high, the community income of society doesn't accord with personal income, and the rate of return of national R&D investment will be low too. As a result, for this kind of industry, these two kinds of innovation investment modes may not be suitable.

Then, for the developing countries and less-developed regions, what are the essential differences in terms of characteristics of industrial technology and economy between them and the developed countries? The writer maintains that the most distinctive difference between them lies in that the developed countries are in the leading edge of industrial technology and economy, while the developing countries and less-developed regions are mostly in the following edge. Just as Mr. Lin Yifu point out, because the developed counties occupy the leading positions in global industrial chain, in most of the cases enterprises have different views on the problem that which industry will come as next new and promising industry in the national economy, so they form no social consensus. Among various investment options, projects of few enterprises succeed, while projects from most enterprises would fail. The continual economic development relies on the choice of market. Later reality proves that the investment projects of a number of successful enterprises will promote next round of emerging of new industry, and drive the development of entire national economy. However, the industries of developing countries position low in the global chain of industry, the economic development of developing countries positions inside the global industrial chain, go through a process of upgrading along the track of the current industry with varied capital and technology intensity. The industrial upgrading during economic developing, the enterprises invest in the technology-mature, product-existing-market industries inside the global industrial chain. Which industry is new and which is promising? The enterprises inside the economy are opting to see eye to eye with one another, and swarm into it one by one and form "emergence". (Lin Yifu, 2007) This difference between the developing countries and the less-developed regions decides their essential differences in technology innovation: the technology innovation activities in the developed countries position mainly in the industries in Section Ⅲ, Ⅳ, and Ⅴ of the model; while the technology innovation activities in the developing countries and less-developed regions position mainly in the industries in the Section Ⅰ, Ⅱ, and Ⅲ of the model. That is to say, in the developing countries and less-developed regions, in terms of industrial structure, the industries with relative mature technology and high level of market competition dominate. This judgment could be proved by the proportion and changes of added value of Chinese high-tech industry in GDP since 1996. The statistics in Table 1 indicate that the proportion of added value of high-tech industry of China in GDP will rise from 1.81% in1996 to 4.48% of 2007, presenting an entire rising trend. Although it indicates a great advancement of high-tech industry of China over more than ten years, it, at the same time, also presents an important fact that the scale of the high-tech industry of China is still very small, and other traditional industries apart from high-tech industry still dominate the industrial structure of China.

Different sections maintain different characteristics of industrial technology and economy, so the suitable innovation investment mode should be different too. In terms of the characteristics of technology and economy, high-tech industry positions in the section Ⅳ of the model, and the suitable innovation investment mode in the rising phase is national public R&D input, and in the following phase is venture investment. However, the industrial system of the developing countries and less-developed regions is still dominated by the industries in Section Ⅰ, Ⅱ, and Ⅲ, so the innovation investment mode should be only and mainly the R&D investment from all aspects (including the nation, corporation and enterprises). In other words, for the developing countries like China, the optimal innovation investment modes haven't advanced to the phase of venture investment, therefore in the technology innovation, the relation that venture investment produces much larger or times of stimulating effects than the effects of R&D holds no ground either.

3 EMPIRICAL ANALYSIS TAKING THE STATISTICS OF INDUSTRIES OF CHINA AS SAMPLE

In the following part, the paper will proceed to empirical analysis of the technology innovation statistics in industries of provinces, cities and autonomous regions in China, in order to test whether the above mentioned theoretical analysis result accord with the reality or not. As a developing country, technology innovation is an important strategy for both of the central government and the provinces, metropolis and autonomous regions. In fact, over the past three decades, the provinces, metropolis and autonomous regions all have devoted to upgrading their innovative ability, and accumulated a great many statistics and rich experience. The test taking these statistics as sample eventually is trustable.

3.1 Model Testing and Sample Description

3.1.1 Variable Selection

In order to make up the defects of the Time-series date, this paper chooses the Cross-sectional data of China between 2006 and 2008 and the Panel data to analyse this problem empirically. According to the nature and features of the problem to be tested, the following variables are chosen:

(1) Patent: This paper chooses the number of patent achieved as an index to measure corporate technology innovation. There has been a lasting dispute over the selection of technology innovation index. Previously, usually the indexes chosen included innovative intermediary products (such as patents), total factor productivity (TFP), and the terminal output of innovation (such as the number of innovation) etc. Since the obtaining patent is the major foundation of technology innovation result, and the statistics about patents have strong obtainability, this paper selects patent variables as the measurement index of technology innovation. The number of patent can be divided into two types: the number of patent applied and the number of patents authorized. This paper selects both of them as explaining variables to research the effects of technology innovation input and output.

(2) Venture investment: Researchers usually choose the total number of annual venture investment project to be the index to measure venture investment, and some may adopt the total volume of venture investment and the number of venture investor instead. The total number of annual venture investment project refers to the total number of real investment project of venture investment institution in that year. The annual volume of venture investment refers to the volume of real investment of venture investment institution in that year, indicating the real expenditure of one country in venture investment, so it has primly direct impact on technology innovation. This paper chooses the total number of annual venture investment project and the total volume of venture investment as measuring indexes, and select provincial statistics that are studied by the China Growth Enterprise Market Research Report published by China Venture.

(3) R&D investment: As the index of innovation input, R&D sheds obvious influence on innovation output, and is the principal explaining variable of patented output. This paper chooses respectively the R&D input of the whole society and the R&D of large and medium sized enterprises as the explaining variables, and studies their influences on technology innovation output.

3.1.2 Sample Description

The statistics of patents in this paper are adapted from China Statistical Yearbook of 2005-2009; R&D statistics are from China Statistics Yearbook of Science and Technology of 2005-2009; Statistics of venture investment are from the Research Report of China Growth Enterprise Market published between 2007 and 2009. Although related statistics of venture investment in provinces Henan, Gansu, Ningxia, Qinghai and Tibet are not included, the statistics of 25 provinces that are chosen have covered the major part of China, so the statistics are representative.

This paper selects two samples: one is the Cross-sectional data sample, including the statistics of various variables of 25 provinces, metropolis and autonomous regions in 2005; another is the Panel data sample, including the statistics of the year 2006, 2007, and 2008.

3.1.3 Model Testing

Based on the model mentioned above and its features of testing problem, this paper sets the model of analysis as follows:

$$\log(P) = \alpha + \beta \log(RD) + \gamma \log(VC) + \mu \qquad (1)$$

In this formula, P, RD, VC stands respectively for the number of patents applied, number of patents authorized, R&D input and venture investment, while μ stands for the random error.

3.2 Regressive Analysis of the Cross-sectional Data

The OLS estimation result of the statistics of the selected Cross-sectional data samples of the 25 provinces, metropolis and autonomous regions of China in 2005 can be referred to Table 3 and Table 4. The result indicates that: when the venture investment volume(VC1) and the R&D investment from large and medium-sized enterprises (RD2) serve as explaining variables, if the venture investment volume increases by 1%, the number of patent applied will increase approximately by 0.17% (Model 1), and the number of patent authorized increase by 0.16% (Model 6). This result proves that venture investment imposes obvious positive effects on patent output, complying with the conclusion of Kortum and Lerner (2000) and Tykvova (2000) essentially.

However, the result of Table 3 and Table 4 also indicate that： when R&D investment from large and medium-sized enterprises increases by 1%, the number of patent applied will increase approximately by 0.72% (Model 1), and the number of patent authorized can increase by 0.69% (Model 6). Therefore, R&D investment is much larger than the effects that venture investment produces on the output of patent, almost 4.31 times of the stimulating effects that venture investment produces on the patent innovation. Obviously, this result is different from the Kortum and Lerner's (2000) conclusion which was drawn on the samples of American statistics. Because according to their conclusion, the stimulating effects that American venture investment produces on the patent innovation are three times of the R&D investment. It can be seen that in the technology innovation of China, the effect that R&D input and venture investment produce in the patent output is obviously different from that of America.

If the number of venture investment project (VC2), and R&D input of large and medium-sized enterprises (RD2) are taken as explaining variables, we can see that ： when the number of venture project increases by 1%, the number of patent applied will increase by 0.30% approximately (Model 3), and the number of patent authorized will increase by 0.26% (Model 8).

Moreover, if the lag terms in 1-2 period of VC and RD are inserted into the model, (see Model 4, 5, 9, 10). It can be seen that: The insertion of lag terms can improve the explanation ability of the model, but the statistical coefficients of the lag terms are not obvious and the model is not convincing. It proves that the expenditure of VC and RD largely coincide with the patent output, which accord with basically the conclusion of Hall, Griliches and Hausman (1986).

3.3 Regressive Analysis of Mixed Cross-sectional Data

3.3.1 Chow Testing of Mixed Cross-sectional data

Before the regressive analysis of mixed cross section, it is necessary to research whether there are distinctive structural changes between regressive coefficients of each year; therefore we need to carry out Stability Tests on the Model. This paper, by the approaches of Chow Tests, divides 59 observed values into three sub-samples of 2008, 2007, and 2006 in a view of testing them. The result is illustrated by Table 5.

Seen from the result of Chow Tests, there is no distinctive differences between the three sectional samples, namely there is no any obvious structural changes between 2006 ,2007and 2008, therefore, it is feasible to conduct regressive analysis on the cross sections by mixing up the statistics of the three years.

3.3.2 The Result of Regressive Analysis of Mixed Cross-sectional Data

The result of OLS estimation on the Mixed Cross-sectional data sample statistics from the year 2006 to 2008 is displayed in table 6 and table 7. The result indicates that venture investment has obvious positive effects on the patent output; when venture investment volume increases by 1%, the number of patent applied will increase by about 0.17% (Model 1), and the number of patent authorized will increase by 0.16% (Model 6); when R&D input from large and medium-sized enterprises increases by 1%, the number of patent applied will increase by about 0.75% (Model 1), and the number of patent authorized will increase by 0.72% (Model 6).

Herein, the effects that venture investment volume produces on patent output is far less than the effects R&D investment produces on patent, which is basically in line with the result of regression of Cross-section.

The result with the number of venture investment project (VC2), and the R&D investment from large and medium-sized enterprises (RD2)as explaining variables also indicates that ： when the number of venture investment project increases by 1%, the number of patent applied will increase by about 0.30% (Model 3), and the number of patent authorized will increase by 0.27% (Model 8), which accords highly with the regression result of Cross-section.

Moreover, the result of inserting the lag terms of 1-2 period into VC and RD (see Model 4, 5, 9, 10) also indicates that: although the insertion of the lag terms can improve the explaining ability of the model, the statistical coefficients of the lag terms are not obvious, which proves that the influences produced by venture investment and R&D expenditure coincident on the output of technology innovation, and there is not obvious hysteresis quality, which is completely in line with the regression result of the Cross-section analysis.

4 CONCLUSIONS

In the developed countries, the effects made by venture investment on the technology innovation output are generally superior to R&D investment. In the USA, it exists that the effects made by venture investment on the output of technology innovation is three times of that made by R&D investment. Therefore, in terms of raising the efficiency of technology innovation, venture investment is surely a better innovation investment mode. However, this paper proves theoretically that: because the industry structure of the developing countries and less-developed regions, as a whole, is not in the leading edge of the world in technology and economy, and their industries characteristics of technology and economy are different from the developer countries, so as a result, in the developing countries, the influences produced by the innovation investment in various forms are different from that of the developed countries, so that significant relation, i.e. in the technology innovation the effect caused by venture investment should be times of that caused by R&D investment, holds no ground. The empirical analysis with statistical samples of Chinese industrial enterprises advocates this important conclusion: in China, though venture investment produces obvious positive effects on the patent output, for example, when the venture investment volume increases by 1%, the number of patent applied will increase by 0.17%, and the number of patent authorized will increase by 0.16%. However, the relation, namely the effects produced by venture investment on the technology innovation should be three times of that produced by R&D investment, is not true in the technology innovation of Chinese industrial enterprises. Instead, it occurs that the R&D investment produces effects on technology innovation, which is several times of that produced by venture investment. The fact fully elaborates that currently in the industrial technology innovation of China; venture investment is not the best innovation financing method. On the contrary, R&D investment may be more suitable.

This conclusion could offer plenty helpful enlightenment to the developing countries and the less-developed regions in terms of the policies about technology innovation and decision-making. First, the policies about technology innovation should be rooted in the actual situation of current industrial system of that country or region. The experiences and conclusions of the developed countries should not be copied blindly. For example, in the traditional industries, if the venture investment is unilaterally stressed and the functions of R&D investment are ignored, the policies about technology innovation may take a wrong road and produce harmful influences on technology innovation. Second, since the R&D investment has not a single form, instead it has various forms and levels, at the present stage the effects of technology innovation made by R&D investment in different forms at different levels should be stressed, be studied profoundly about its principles and be innovated continuously. For example, the systematization, modularization and integration innovation mode has come into the automobile industry; it requires us to conduct researches on the new modes of these innovation institutions, as well as the developing trends and the suitable R&D investment. Demanding more attention, the research of this paper also proves that the industry system of China is still relatively backward, lagging greatly behind the developed countries, and being kept away from the phase where the new innovation investments like venture investment are utilized efficiently. In fact, the practices of the developed countries have proved that venture investment can produce tremendous prompting effects on the development of new industries. Therefore, how to realize the adjustment and upgrading of industrial structure system of China and get it used to the new trend of industry development globally as soon as possible, are still significant problems requiring further studies.

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①The answer to this question is very crucial. If the answer is negative, there should be a necessity of reflection on certain policies and actions in terms of technology innovation. In fact, this question has alerted some researchers. For example, Kortum and Lerner pointed out that what they used in their researches was the statistics of the USA, and the empirical analysis they conducted was about the situation of the USA, so they didn't answer the question that whether venture investments in other countries could promote technology innovation or not.

②Referring to Huang Zongyuan. Systematic Analysis Principle of Industry Development in Less-developed Regions [M].Beijing: Economic Science Press，2008,P 201-202.

③This model is evolved on the basis of H Model proposed by the writer previously, and the H Model is rooted in the K Model of Mr. Kitschelt, referring to Huang Zongyuan. Systematic Analysis Principle of Industry Development in Less-developed Regions [M].Beijing: Economic Science Press，2008, P215.

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APPENDIX

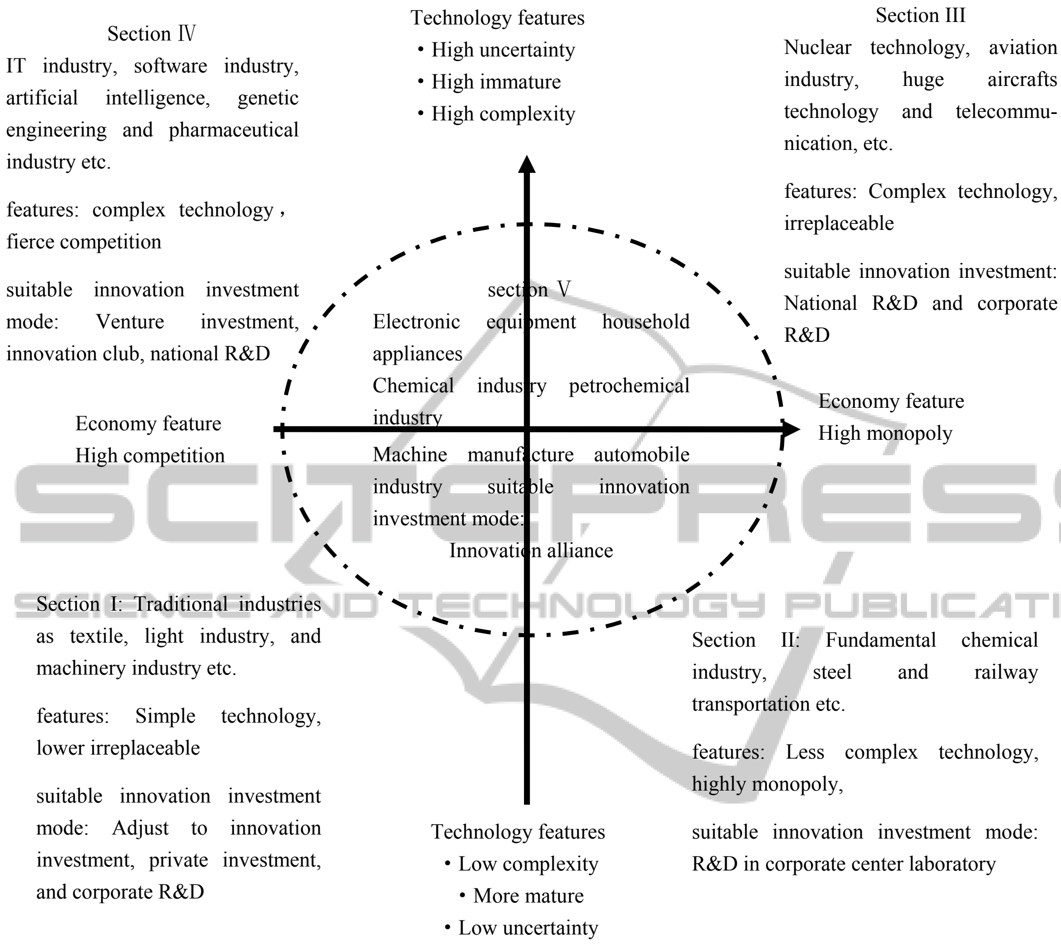

Figure 1: Coupling relationship model of the innovation investment and characteristics of technology and economy.

Table 1: The Proportion of Two Industries in GDP of China Since 1996.

Year	**High-tech industry Added Value (billion)**	**Gross national GDP (billion)**	**High-tech Industry proportion (%)**	**Other industries proportion (%)**	**Year**	**High-tech industry Added value (billion)**	**Gross national GDP (billion)**	**High-tech industry proportion (%)**	**Other industries proportion (%)**
1996	1271.95	70142.49	1.81	98.19	2002	3768.58	119095.69	3.16	96.84
1997	1539.96	78060.83	1.97	98.03	2003	5034.02	135173.98	3.72	96.28
1998	1785.33	83024.28	2.15	97.85	2004	6341.30	159586.75	3.97	96.03
1999	2107.12	88479.15	2.38	97.62	2005	8127.79	184088.60	4.42	95.58
2000	2758.75	98000.45	2.82	97.18	2006	10055.51	213131.70	4.72	95.28
2001	3094.81	108068.22	2.86	97.14	2007	11620.66	259258.90	4.48	95.52

sources: Adapted from China Statistical Yearbook and China High-tech Industry Statistical Yearbook between the year 1997 and 2008, published by China State Statistics Bureau.

Table 2: Definition and Elaboration of Variables.

Name of variable	Elaboration of Variable Index	Unit
P1	Variables explained： the number of patents applied	a
P2	Variables explained：the number of patents authorized	a
VC1	Variables explaining：volume of venture investment	Million USD
VC2	Variables explaining：the number of venture investment project	a
RD1	Variables explaining：R&D expenditure of the whole society	Billion RMB
RD2	Variables explaining: R&D expenditure of large and medium-sized enterprises	Billion RMB

Table 3: The Regressive Result of Cross-sectional data – Taking P1 as the Induced Variable.

	Model 1	Model 2	Model 3	Model 4	Model 5
Constant	6.030521*** (0.0000)	5.083878*** (0.0000)	6.262084*** (0.0000)	5.493210*** (0.0000)	5.642896*** （0.0000）
log(RD1)		0.899826*** (0.0000)			
log(RD2)	0.716225*** (0.0000)		0.684397*** (0.0000)	0.716391*** (0.0000)	0.712027*** （0.0000）
log(VC1)	0.174657** (0.0036)	0.069933 (0.2155)		0.171766* (0.0074)	0.188194** （0.0049）
log(VC2)			0.302276*** (0.0000)		
log(RD2(-1))				0.094017 (0.2231)	0.090564 （0.2406）
log(VC1(-1))				0.058048 (0.2712)	0.049550 （0.3939）
log(RD2(-2))					-0.113884 （0.1396）
log(VC1(-2))					0.090606 （0.0953）
R-squared	0.881717	0.898801	0.923015	0.904554	0.922629

Remarks: The numerals in （） correspond to the statistics of t ， ***, **, and * stand for respectively the statistical markedness at the level of 1%, 5%, and 10%.

Table 4: The Regressive Result of Cross-sectional data –Taking P2 as the Induced Variable.

	Model 6	Model 7	Model 8	Model 9	Model 10
Constant	5.550355*** （0.0000）	4.749733*** （0.0000）	5.759913*** （0.0000）	5.263685*** （0.0000）	5.248052*** （0.0000）
log(RD1)		0.829870*** （0.0000）			
log(RD2)	0.687432*** （0.0000）		0.667913*** （0.0000）	0.688779*** （0.0000）	0.680393*** （0.0000）

Table 4: The Regressive Result of Cross-sectional data –Taking P2 as the Induced Variable. (cont.)

log (VC1)	0.164902** （0.0021）	0.077226 （0.1923）		0.069328** （0.0074）	0.188337** （0.0016）
log (VC2)			0.264078*** （0.0001）		
log (RD2(-1))				0.166091 （0.3487）	0.058413 （0.3760）
log (VC1(-1))				0.004273 （0.9321）	0.008879 （0.8579）
log (RD2(-2))					-0.103049 （0.1227）
log (VC1(-2))					0.127898 （0.0105）
R-squared	0.897638	0.876635	0.924551	0.901270	0.936567

Remarks: The numerals in （） correspond to the statistics of t，***, **, and * stand for respectively the statistical markedness at the level of 1%, 5%, and 10%.

Table 5: Chow Test Result.

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F-statistic	0.490538	Probability	0.812323
Log likelihood ratio	3.374632	Probability	0.760568

Table 6: Result of Regressive Analysis of Panel data-Taking P1 as Induced Variable.

	Model 1	Model 2	Model 3	Model 4	Model 5
Constant	5.950044*** （0.0000）	5.079356*** （0.0000）	6.213828*** （0.0000）	5.574505*** （0.0000）	5.882852*** （0.0000）
log(RD1)		0.923259***（0.0000）			
log(RD2)	0.746766*** （0.0000）		0.698969***（0.0000）	0.727938*** （0.0000）	0.720048*** （0.0000）
log(VC1)	0.174491*** （0.0000）	0.052321 （0.1460）		0.146557*** （0.0003）	0.152016*** （0.0001）
log(VC2)			0.300614***（0.0000）		
log(RD2(-1))				0.074988 （0.1195）	0.044867 （0.4292）
log(VC1(-1))				0.068612 （0.0817）	0.061908 （0.1117）
log(RD2(-2))					-0.126244 （0.0260）
log(VC1(-2))					0.095440 （0.0128）
R-squared	0.856826	0.900252	0.898379	0.878299	0.893650

Remarks: the numerals in （） correspond to the statistics of t，***, **, and * stand for respectively the statistical markedness at the level of 1%, 5%, and 10%.

Table 7: Result of Regressive Analysis of Panel data-Taking P2 as Induced Variable.

	Model 6	Model 7	Model 8	Model 9	Model 10
Constant	5.425997*** （0.0000）	4.726168*** （0.0000）	5.661210*** （0.0000）	5.091773*** （0.0000）	5.353154*** （0.0000）
log(RD1)		0.845256*** （0.0000）			
log(RD2)	0.719684*** （0.0000）		0.681994*** （0.0000）	0.708854*** （0.0000）	0.695647*** （0.0000）
log(VC1)	0.160898*** （0.0000）	0.061134 （0.1256）		0.145119*** （0.0002）	0.147812*** （0.0001）
log(VC2)			0.267834*** （0.0000）		
log(RD2(-1))				0.079728 （0.1596）	0.041718 （0.4300）
log(VC1(-1))				0.032460 （0.3898）	0.019042 （0.5952）
log(RD2(-2))					-0.117535 （0.0261）
log(VC1(-2))					0.121967*** （0.0009）
R-squared	0.862644	0.864674	0.895622	0.874437	0.898560

Remarks: The numerals in （） correspond to the statistics of t，***, **, and * stand for respectively the statistical markedness at the level of 1%, 5%, and 10%.