

# An Empirical Study of Promoting Scientific and Technological Innovation by Intermediary Services: a Case of Wuhan of China\*

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**Abstract** Scientific and technological (sci-tech) intermediary services play the role of great significance to urban sci-tech innovation activities. In this paper, Wuhan, for example, based on the core of sci-tech intermediary service organization - the development of science and technology business incubators and the data of scientific and technological activities, respectively, from the human resources, financial, material and information platform of scientific and technological to analyze the intermediary services for the role of sci-tech innovation and the problems. Using multiple linear regression analysis method to explore the human and financial resources on the role of sci-tech output, to find effective ways to improve the sci-tech innovation, Then, make four suggestions: to make suitable laws and regulations; to enhance the professional; to expand the channels; to accelerate the building of information networks. It is of great significance to promote urban science and technology innovation, transformation and intermediary services development and planning.

**Key words** Sci-tech intermediary services; Sci-tech Innovation; Multiple linear regression

## 1 Introduction

In 1912, the Austrian economist Schumpeter was first put forward the concept of innovation - to build a new production function or supply function, his views have been quoted many researchers. Mid-20th century, upon Schumpeter's theory of institutional change, North proposed the concept of system innovation. In 1987, British economist Christopher-Freeman visited Japan and proposed the theory of national innovation systems theory, after that, scholars has in-depth studied of the formation of a national innovation system: macro, micro and integrated schools.

In the study of sci-tech intermediating organizations and technology Innovation, foreign scholars pay more attention to use the quantitative analysis and find exploration of innovative models (Hans Lofsten, 2005). Since the late nineties of last century, China access to high-speed development period, in which is popular to explore sci-tech intermediating organizations development and scientific and technological innovation-related problems. We can search 66 papers of PhD and excellent master thesis (1999-2010) in CNKI with the key word of sci-tech intermediary. These papers are mostly concerned about the role of intermediating organizations in sci-tech innovation and the ability of the process of research(Li Tinghui, 2010); status and problems; development of countermeasures and other aspects(Wang Fang, 2009).

## 2 Overview of Scientific and Technological Innovation in Wuhan

### 2.1 The reference value of Wuhan

The first high-tech innovation service center, "Wuhan East Lake new technical undertaking center ", was founded in June 1987. Since then, Wuhan East Lake has been the cradle land of incubator institution in China. In 1988, the East Lake Innovation Center took part in the drafting of "Self-regulating Mechanism of Enterprises in China Development Strategy Summary" in the national torch plan. From then on, China business incubator has kept developing and expanding under the flag of torch. And today it draws the attention of the world.

The business model created by Wuhan East Lake new technical undertaking center is applied by most of business incubators in all the country now. At the same time, business incubators have been the major subject of Wuhan science and technology service. Studying the problem of Wuhan science and technology service promoting scientific and technological innovation is meaningful to the development of the science and technology service, the urban science and technology innovation, and science and technology activities in our country.

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\* This paper is supported by Wuhan Science and Technology Bureau, No.201050333134.

**2.2 The overview of Wuhan**

The sci-tech intermediating organizations in Wuhan have three important sorts: science and technology business incubators, productivity organization; investment and financing service organization. The science and technology business incubator is called the High-tech Innovation Service Center. It is a science and technology innovation service institution whose aim is transforming the science and technology result and cultivating high-tech enterprises and enterprisers. While it is also the major parts of the state innovation system.

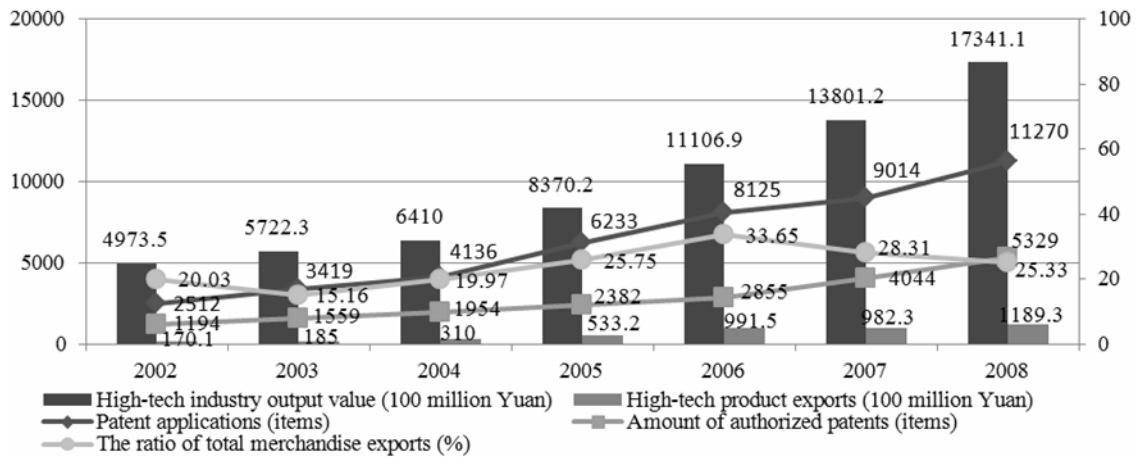
High-tech Innovation Service Center is one of the chief forms of science and technology business incubators. In order to reduce enterprise’s undertaking risk and cost, and improve the survival percent and successful percent of enterprises, it provides studying, producing and operating places ,and communal facilities about working for incubated enterprises ,it provides the services of policy, management, law, accountancy, financing, market promoting and training as well. There are something else, the business incubator for returned personnel, the international business incubator, and the national university science and technology park. The organization promoted by the productive forces is the institution which can take part in the process of technology for service. There are some similar institutions, such as, innovation service center, engineering research center, and so on. The service organizations of investment and circulating capital mainly rely on the institution of venture capital.

Wuhan sci-tech intermediating organizations mainly rely on governments and the departments. It can provide required fixed assets, funds, consulting, trainings and foster support policies for sci-tech innovations. Regarding of the data of recent years, Wuhan intermediary service plays an apparent part at present. The results of Wuhan sci-tech innovations have been improved steadily. In order to adapt to the request of long-term development, Wuhan intermediary service perfects other systems of outfits incessantly in good condition, for example, information platforms, supporting funds.

**3 Technological Innovations and Factor Analysis**

**3.1 Output state of scientific and technological activities in Wuhan**

According to Figure 1, Wuhan City, the development of science and technology activities in recent years shows an obvious upward trend. High-tech product exports increased rapidly, indicating the momentum of promoting scientific and technological achievements into production is better, but the growth rate of exports of high-tech products is far less than the growth rate of high-tech industry output value and the increase in total merchandise exports. Patent applications have also increased year by year to accelerate, while the rate of authorized patents maintain at between 35% -47%.



**Figure 1 Wuhan S & T Activities Output Indicators (2002-2008)**

Since 2006, the high-tech products exports are increasing, but the ratio of total merchandise exports has declined. Taking into account the impact of financial crisis on exports, high-tech export still has very good economic benefit. Two trend lines, said patent applications and patents amount, rising year by year, nearly 50% increase in the ratio of momentum is very impressive.

**3.2 Factors affected by the sci-tech intermediating organizations**

In accordance with the functions involved in science and technology innovation, sci-tech innovation resources can be divided into the four categories of sci-tech human resources, sci-tech



### 3.2.3 Sci-tech information resources and material resources

Technological and material resources including the experimental platform, scientific equipment and all the tangible material resources help to carry out sci-tech innovation.

Scientific and technological information resource means the data and information which can promote sci-tech innovation: experiences, advisory information, historical data, information on scientific and technological achievements, Intellectual property information, relevant policy information, etc.

To 2008, Wuhan has the national and municipal engineering (technology) research centers 56, 72 R & D institutions, science and technology business incubators in 52, technology industry base 25, the productivity center 28, other types of communication platforms nearly ten. At the same time there is strong government support, fully capable of material resources in science and technology to meet the development requirements.

However, late start in building the information platform, database and information networking is not perfect, information mobility is small, all kinds of good information platform needed to be set up.

## 4 Correlation Analyses and Prediction

### 4.1 Based on multiple linear regression analysis of key factors of technology innovation

In this paper, to take the performance evaluation of scientific and technological innovation, the amount of patent authorization, this is the common evaluation. The perspective focused on the sci-tech human and financial resources in R & D activities, to explore the relationship between these two factors with the amount of patent authorization. Through analysis and testing, we find the existing problems and forecasting, planning advice.

With the calculation and test of SPSS and Excel, data from Figure 1, Table 1, Table 2; 2009 statistics slow, so use the data in 2008 to replace it, then we can get the linear regression analysis output:

**Table 3 Linear Regression Analysis Output**

Regression	
Multiple R	0.994317867
R Square	0.98866802
Adjusted R Square	0.984135228
Standard error	205.9858872
Observation	8

Analysis of variance

	df	SS	MS	F	Significance F
Regression analysis	2	18509284.57	9254642.286	218.1145836	1.36699E-05
Residual	5	212150.9285	42430.18571		
Total	7	18721435.5			

	Coefficients	Standard error	t Stat	P-value	Lower 95%	Upper 95%
Intercept	2054.34969	696.4530835	2.949731631	0.031895292	264.0600443	3844.639
$X_1$ Variable	-0.079691498	0.031497387	-2.530098712	0.05252365	-0.16065811	0.001275
$X_2$ Variable	59.50218845	3.469893151	17.14813277	1.2346E-05	50.58254415	68.42183

The regression equation is:

$$Y = 2043.4437 - 0.0797X_1 + 59.5022X_2 \tag{1}$$

$Y$ : annual amount of patent authorization (items)

$X_1$ : annual R&D personnel (full-time workload, people)

$X_2$ : annual R&D expenditures (100 million Yuan)

### 4.2 The development of scientific and technological innovation Inspiration

According to linear regression analysis, the amount authorized by the patent as an index reflects the relationship with the human and financial resource of R&D activities. Where the coefficient of  $X_1$  is negative, while the  $X_2$  coefficient is positive, the coefficient absolute value of  $X_1$  is much larger than  $X_2$ . So we can see that, in promoting measures to increase the amount of granted patents, the increase in investment funds and proper control of the workload is the key. It can increase the use of funds of unit

work in R&D activities, further improve the scientific and technological achievements of the effective output, this study is same with foreign scholars.

Using the regression equations derived above,  $Y = 2043.4437 - 0.0797X_1 + 59.5022 X_2(1)$ , to predict the output of scientific and technological innovation.

R&D personnel in the balanced case, when R&D expenditures within the 10 billion, the amount of granted patents may reach 5800 or so; when 12 billion, authorized patents are likely to reach 7000.

In the case of R&D personnel is under control, through performance appraisal, etc. the staff decrease 5%. At this point, the internal expenditures 10 billion, authorized patents are likely to reach 5950; 12 billion in the case of granted patents are likely to reach 7100.

From this analysis we can see that science and technology intermediary in promoting innovation, should pay attention to expanding funding channels and increasing investment, control the number of R & D staff, to ensure sufficient funds per capita usage rate, so the output of scientific and technological innovation can promote further improvement.

## 5 Problems and Proposals

### 5.1 The issues of Wuhan science and technology intermediary services

#### 5.1.1 Investment and financing channels are not wide

Financial resources are the most important key of science and technology innovation activities. Wuhan has not yet appeared by the scarcity of resources is the result of the strong support by government policies in early development, while government funds may still meet the requirements of financial resources. With the expansion, the demand for financial resources should follow the growth in the future, and it may become a bottleneck of accelerated development of Wuhan in sci-tech innovation and activities.

#### 5.1.2 Information platform construction not complete

Information platform is an important part to improve the efficiency. Good information platform is the base of sci-tech innovation, exchanging information and the financial investment channels. Wuhan, the construction of various types of information platform is the slowest compared with other organizations. Status information platform can't meet the existing technology, financial investment activities.

### 5.2 Development view

#### 5.2.1 Improve the laws and regulations

Development of specific laws and regulations; norms of conduct scientific and technological intermediary; improve the information disclosure system; form a good policy environment. Let all kinds of sci-tech intermediating organizations can develop and compete in a good policy environment, obtain information on the fair and equitable.

#### 5.2.2 Enhance professional

From the earliest incubators to provide integrated services developed to various professional bodies, indicating that the sci-tech intermediary service in Wuhan is more and more professional. This trend needs to be promoted; more and better professional intermediary service organizations will bring competition and dynamism into the industry.

The industry once into the plight of low quality of employees, not only to conduct training and assessment, should also organize the appropriate qualification to ensure the professional quality of employees. Also related education sector should be strengthened in this area of higher education and continuing education to ensure the talent pool.

#### 5.2.3 Expand the channels and increase vitality

In China, sci-tech intermediary services are mainly based on domestic technology policy-oriented, activities depend on the plan of government departments not the market. With the development of expanded sci-tech intermediary service industries should also open their markets to investment, financing channels and competition. They need a substantial innovation, making sci-tech intermediary services to meet the needs of sci-tech innovation and activities.

#### 5.2.4 To speed up construction of information network

As an important infrastructure, information network and information platform play an effecting role of sci-tech intermediary services and sci-tech innovation. They can speed up the flow of scientific and technological resources, to make up for technology, human resources, technology market functions, and institutions at all levels to optimize resource allocation.

## 6 Conclusions

Sci-tech intermediary service plays a powerful promoting role in the innovation system. To seize the key factors--financial resources, to control R & D personnel in a proper size, to avoid the massive, energy and financial resource utilization is not high, to avoid the massive, low energy, low utilization of funds issue, we can improve the ability of technological innovation and transformation. China's innovation system is still under development, improve the legal system, information platform, while improving the quality of personnel, those are what should be paid more attention to. In addition, the policy and the role of relationship has been studied for many years, but the specific sci-tech intermediary agencies of innovation method and exploring innovation key factors have not yet achieved very good research, these may be Chinese scholars to study new problems.

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