Study on Innovation Capability of Jiangsu Pharmaceutical Industry

—Based on the Comparative Analysis of Seven Provinces

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***Abstract*—Based on pharmaceutical industry data of seven provinces in 2011, the research is taken the perspectives of innovation inputs and innovation outputs. Through the comparative analysis of pharmaceutical industry innovation capabilities between Jiangsu provinces and the other six provinces, we find out that there are still some problems in the structure and the scale of Jiangsu pharmaceutical industry. And then we would offer suggestions on the improvement of Jiangsu pharmaceutical industry.**

Keywords-pharmaceutical industry; innovation capabilities; comparative analysis

I. INTRODUCTION

The pharmaceutical industry is one of four major high-tech industries in our country. The number of its transactions is on top worldwide with the development of global economic integration, China's pharmaceutical industry is faced with increasingly fierce competition both in domestic and overseas markets. Under the situation of severe challenges, we have to focus on innovation ability to maintain the improvement of Jiangsu pharmaceutical industry. From perspectives of the innovation input and output, we will compare the pharmaceutical industry of Jiangsu province with the other six provinces' to provide a basis for adaptive industry policies.)

II. LITERARURE REVIEW

Many foreign research literatures have focused on how to use specific technologies for pharmaceutical innovation. Esther F. Scmhdi (2002) divided the pharmaceutical industry innovation into innovative linear innovation (the logical innovation of outcome for achieving better, clear goals) and nonlinear Innovation (lots of leap innovation can not be predicted and the future is unsure) [1]. Jurgen Drews (1997) pointed out that the pharmaceutical industry only survive in the competition only by innovation and innovative strategies included short, medium and long-term three strategies; Short-term strategy is to corporate with research institutions for innovation; Medium-term strategy is to establish their own R & D center, resulting in an innovative consciousness and environment; Long-term strategy is the use advanced technology to innovate like gene technology [2]. Steven Casper and Catherine Matraves (1997) took English and German pharmaceutical industry for examples and discussed how to adapt the international and domestic changes in the competitive environment. In order to guide the United Kingdom and Germany for innovative strategies in the pharmaceutical industry，they stressed the important role of national innovation system in the management structure (decision-making, Organizations in R&D process etc.). In definition of innovative drugs of the pharmaceutical industry [3], Nick Davies, Tim Peakman and Steve Arlington (2004) proposed the standard of new drug should turn to the effect of the drug (Targeted treatment solutions) instead suit for everyone (one-Size-fitas-all) [4]. Aidan Hollis (2004) suggested to change the innovator's incentive mechanism. He said it's more practical to award according to the effect of the treatment instead of the patent [5].

Yan Jiuxing (2002) pointed out that the innovative features of the pharmaceutical industry are huge differences between products, strong sense of intellectual property protection, high barriers to entry and so on. Therefore medical innovation should start from products, processes, market, organization, management and several other aspects

[6]. Qu Fenghong (2005) analyzed the current situation of China's pharmaceutical industry and proposed to establish a technology innovation system with regional characteristics which was led by government corporate, took enterprises as main parts and based on research institutions and universities [7]. Li Jianmin (2002) discussed technological innovation strategies and pharmaceutical R&D model. He suggested that pharmaceutical companies must draft appropriate strategies according to their own situation. And companies should do research and development with their own strength [8].

III. COMPARATIVE ANALYSIS OF THE PHARMACEUTICAL INDUSTRY INNOVATION ABILITY BETWEEN JIANGSU PROVINCE AND SIX OTHER PROVINCES

The data of this paper are collected from China's high-tech industry statistics yearbook 2011. Based on that, we compared Jiangsu province with six other provinces according to the elements in the medicine industry innovation input and output. And it also will be used to analyze relative competitiveness of the pharmaceutical industry in Jiangsu [9].

A. The Investment Ability in Innovation Activities

1) The investment in scientific research personnel

The number of companies which have R&D activities in Jiangsu is 247 ranks first among seven provinces. Those of Shanghai, Shandong and other enterprises are followed behind and all of them exceed 140. The number of similar enterprises in Shanghai Beijing and Tianjin is less than 100. There are a little changes in the rankings of R&D staff Shandong surpassed Jiangsu and ranked first the first (See Figure1 below). At this point, the number of Jiangsu R&D enterprise and R&D staff is on top among seven provinces. But the average distribution of R&D stuff does not seem optimistic. Shandong ranks first with the average of 109 people, Jiangsu is the fourth of 59 people (Figure2). Compared with other provinces and cities, the quantity and the scale of R&D enterprise in Jiangsu are both small and immature. All of these are extremely unfavorable to the innovative activities of enterprises.

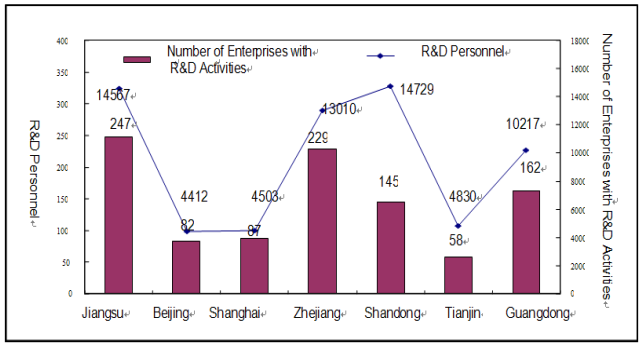


Figure1. The situation of pharmaceutical industry staff with R&D activities in seven provinces (city).

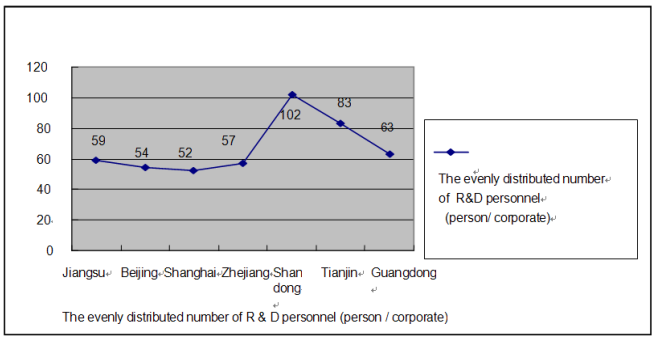


Figure 2. The comparison of R&D average distribution number in seven provinces (city)

2) The investment of innovation activities

The R&D internal expenditure of the medicine manufacturing enterprise in the seven provinces (cities) ranking from high to low are: Shandong, Jiangsu, Zhejiang, Guangdong, Shanghai, Tianjin, and Beijing. Thus, the pharmaceutical enterprise R & D funds of Jiangsu in the seven provinces (cities) are relatively more than the others, but the proportion of the R & D funds is relatively less and it is only higher than Beijing. The phenomenon that Jiangsu have much R & D funds and low proportion reveals that the pharmaceutical manufacturing enterprises have a certain scale, but the R & D investment is small and that paid attention to independent innovation is relatively low (Figure 3). In R&D funding structure, Jiangsu's pharmaceutical enterprises tend to be invested by internal funds and external loans. Compared with other cities, Jiangsu's pharmaceutical enterprises pressure is relatively low. However, the phenomenon that the government and financial institutions invest too little in medicine exists in all of the seven provinces (cities), which makes the financing structure becomes unreasonable and the way to obtain funds becomes narrow (Figure 4)

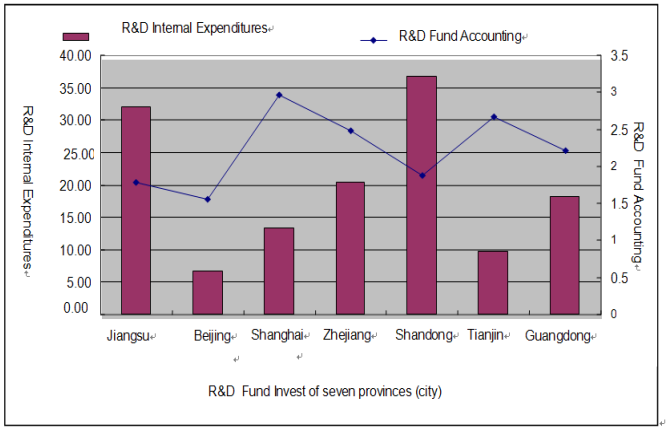


Figure3. R&D Fund Invest of seven provinces (city)

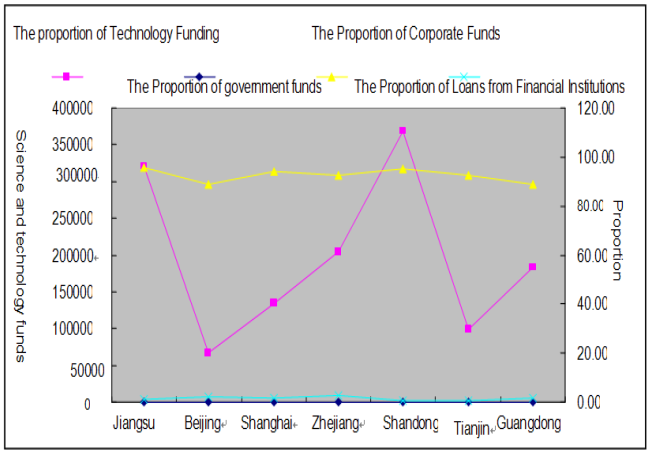
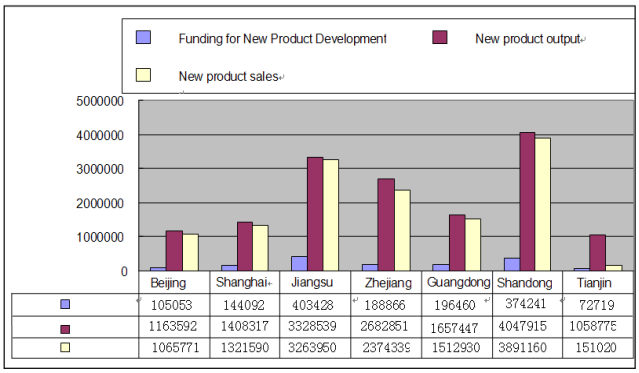


Figure 4. R & D Funding Structure of seven provinces (city)

B. *Innovation Output Capacity*

3) New product development and sales

New product development funds of the pharmaceutical industry in Jiangsu province in 2011 reached 4.03428 billion Yuan, which ranks first in seven provinces (municipalities) followed by Shandong, second and Guangzhou. Comparing new product production and new product sales income ， we find that the gap of the production and sales of new products is small in six provinces (municipalities), except Tianjin. The investment in pharmaceutical industry research and development in Jiangsu is bigger than Shandong， but in production value and sales ， it is lower than that of Shandong. It shows in the degree of product marketization, Jiangsu is inferior to Shandong. The miscommunication between market and production will lead to the situation (figure 5).



	Beijing	Shanghai	Jiangsu	Zhejiang	Guangdong	Shandong	Tianjin
	105053	144092	403428	188866	196460	374241	72719
	1163592	1408317	3328539	2682851	1657447	4047915	1058775
	1065771	1321590	3263950	2374339	1512930	3891160	151020

Figure 5. New product development and sales of seven provinces (city)

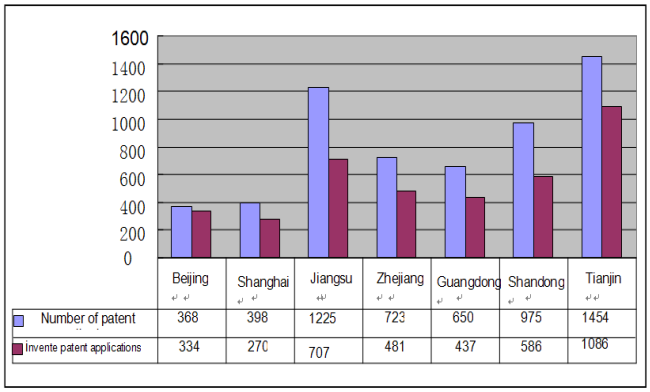


Figure 6.The number of patent applications and patents in seven provinces

4) Patent application and conditions

Among seven provinces (municipalities), Tianjin ranks first with 1454 patent applications followed by Jiangsu, Shandong, Zhejiang, Guangdong, Shanghai. Through statistical analysis the percentage of getting a patent for invention is respectively 90.7% in Beijing, 67.8% in Shanghai, 57.7% in Jiangsu, 66.5% in Zhejiang, 67.2% in Guangdong, 60% in Shandong, and 74.6% in Tianjin. Beijing ranks first with the highest percentage of patent application while that of Jiangsu ranks last. This proves that Jiangsu's medicine industry is relatively weak in independent innovation (figure 5).

5) Technology introduction, digestion, absorption and the case of re-creation

Based on the comparative analysis of the data，we can find that on the technical import, digestion and the spending of purchase, transformation of technology, the Jiangsu pharmaceutical industry spends more money horizontally. This shows that Jiangsu pharmaceutical industry depend too much on external technology. Compared to other provinces and cities, independent research and development capacity is not enough. A vertical analysis reveals that we can find that expenditure on technical import is far more than that on technology absorption, while in the other provinces, the gap between the two expenses is small. Even Shangdong , which spends less money on technical export ,does better in technology absorption.

It is visible that Jiangsu medicine in the digestion and absorption of imported technology investment is still not enough. If external advanced technology can not absorb and digest internally, it is impossible to improve the capability of independent innovation.

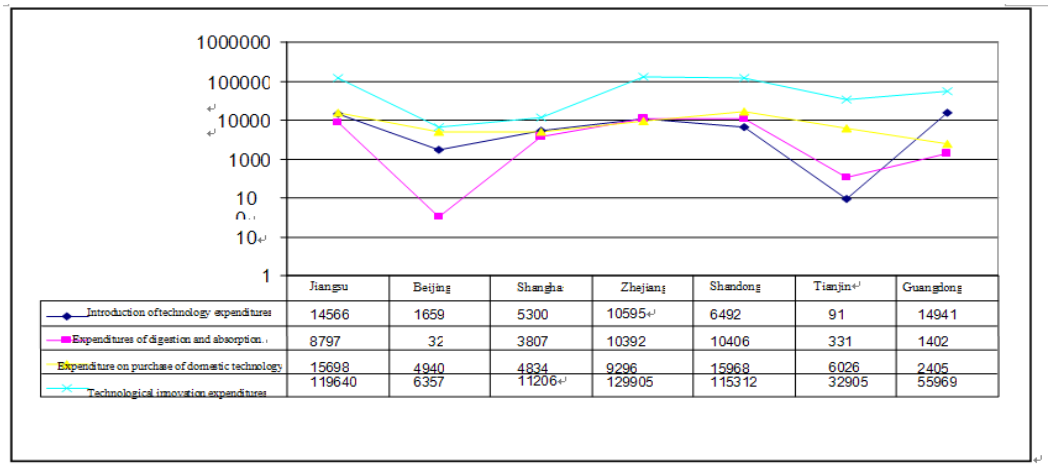


Figure7. Technological transformation of seven provinces (city)

IV. COUNTER MEASURES

Through the comparative analysis of Innovation in pharmaceutical industry between Jiangsu Province and the other six provinces，we found out that there are still some innovative capacity problems. Recommendations are as follows:

A. *Attract talent, Sstrengthen Personnel Training, Improve Personnel Structure*

First, the government can improve the level of urbanization through continuous improvement of infrastructure construction, and give some preferential policies to attract the talents outside. Enterprises should take advantage of good benefits, excellent work environment, reward options, and other means to attract and retain talent. Secondly, governments and enterprises should make use of rich educational resources of Jiangsu province, train original personnel and key personnel at different levels to improve medical research capacity in Jiangsu province. Finally, the government should focus on attracting and cultivating the talent.

B. *Increase Capital Investment, Broaden the Funding Sources, Adjust the Capital Structure*

As Jiangsu pharmaceutical industry lacks innovation investment funds, and the structure is irrational, enterprise funds occupies invested partly, which bring some pressure to pharmaceutical companies. Therefore, to increase investment should consider the introduction of external funding, broaden the sources of funds, and rationalize its structure. First, government should increase financial subsidies and give tax and other preferential policies to the lower input enterprise, give help on loan to the newly established pharmaceutical companies. Secondly, introduce the vibrant financial and investment institutions to pharmaceutical industry, and establish appropriate institute investors, so that the enterprise can avoid certain financial risks, relieve stress, and also take advantage of operating system in the investment institutions , improve the innovation output efficiency of pharmaceutical.

C. *Promote the Cooperation in Terms of Production , Study and Research Accelerate Transformation of Scientific and Technological Achievements.*

The degree of transformation of scientific and technological achievements into productivity is not high, this is due to blocked information and weak awareness of intellectual property. Therefore, the government in Jiangsu province should guide pharmaceutical industry, encourage the cooperation in terms of production, study and research in technological innovation , strengthen the pharmaceutical market research. Second, we must establish a special intermediary service organization. The role of intermediary service organizations in the communication technology and innovation can not be ignored. It can be used as the media to strengthen communication of enterprises and research institutes, feedback market information timely, and reduce the pressure on enterprises.

D. *Carry out Exchanges and Cooperation Actively, Introduce Absorption Technology Funding*

The pharmaceutical industry in Jiangsu Province should strengthen exchanges with other provinces, especially with large foreign pharmaceutical companies and research institutions. It is necessary to introduce external capital and technology, develop cooperatively and exchange talents. For the advanced technology and management tools, enterprises should not only introduce, but also digest and absorb, and then develop a suitable new technology and management methods. Therefore, strengthening the cooperation of other provinces, international companies and research institutions is helpful to innovation capacity of pharmaceutical industry in Jiangsu Province.

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