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Competitiveness Analysis for China's Biopharmaceutical Industry based on Porter Diamond Model

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ABSTRACT

The competitiveness of China's biopharmaceutical industry is an approach to measure the capability of biopharmaceutical products, the capability of occupying the international market shares and the ability to obtain profits. It is the most important to analyze the competitiveness of biopharmaceutical filed in order to clearly confirm the position of international division and develop appropriate industrial policy. In this paper, four key elements and two factors were created as the analysis frame according to the characteristics of the biopharmaceutical industry with the porter diamond model. Six factor can affect the competitiveness of China's biopharmaceutical filed, i.e. the production elements, requirements elements, relevant and supportive elements, corporations' strategic architecture elements, government factor and competitive factor. In conclusion, biopharmaceutical industry in China is in translation stage from investment-driven to innovation-driven.

Key words: Biotechnology Industry; Competitiveness; Porter Diamond Model

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INTRODUCTION

Porter diamond model is one of the most important models in industrial competitiveness analysis which has its unique advantages on the aspect of analyzing both national and regional industry competitiveness. Porter diamond model is raised by Michael Eugene Porter, famous Harvard Business School management expert in 1990. It is only used to analyze how to form an overall advantage of a country or a region so as to evaluate the global competitive position of the country or region in the beginning phase [1]. Currently, the application of the porter diamond model is not limited to competitiveness analysis of a country or region, but extended to the application in the competitiveness analysis in regional area as a hot research topic. Wang and Zeng (2003) analyzed the industrial competitiveness of Singapore with porter diamond model [2]. Cheng (2003) analyzed the development of China's agricultural cluster with application of porter diamond model [3]. Guo (2004) analyzed the automotive manufacture industry with application of porter diamond model expanding the field of application of porter diamond model to the manufacture industry [4]. Wang (2006) analyzed the competitiveness of clothing industry cluster of Ningbo city with

application of porter diamond model expanding the field of application of porter diamond model to the industry cluster [5]. Gu and Zhang (2007) analyzed the relationship between service economy and national competitive advantage with application of porter diamond model [6]; Beilei Li(2008) analyzed the success factors of German convention and exhibition industry with application of porter diamond model [7]; Naserbakht(2008) successfully apply Porter's diamond model to analyze the Iranian technology parks competitiveness level [8]; Xiuyun Yang(2010) analyzed the international competitiveness for creative industry in China with application of porter diamond model [9]; Manying Huang and Xiaohong (2011) carried out empirical analysis for the effect factors of international competitiveness for China's financial services with application of porter diamond model [10]; Liang Zhao and Lu Jing(2012) analyzed the industrial competitiveness of publishing industry with porter diamond model [11]; Xiaoqi Zhan(2013) analyzed the international industrial competitiveness of China's animation industry with porter diamond model [12]. According to current literature, porter diamond model is widely used in various industrial filed competitiveness analysis in different regions. However, the investigation of application of porter diamond model in China's biopharmaceutical industry competitiveness is still blank. Biopharmaceutical industry is a knowledge-intensive strategic emerging industry which has very broad prospects. It grows rapidly in China in recent years. Lots of nations place special emphasis on it. In this paper, four key elements, the production element, requirements element, relevant and supportive element, corporations' strategic architecture element, are analyzed for China's biopharmaceutical industry based on the Porter diamond model, then draws the conclusion that biopharmaceutical industry in China is in translation phase from investment-driven to innovation-driven stage. This conclusion provides a reference for China and the corporations to create a development policy to promote the biopharmaceutical industry as a strategic emerging industry.

GLOBAL BIOPHARMACEUTICAL INDUSTRY DEVELOPMENT REVIEW

In recent years, the biopharmaceutical industry is in a period of rapid development, with characteristics of significantly accelerated industrialization, rapid expansion, high enthusiastic to develop new drugs and so. America, European Union, Japan, Germany, Britain, France, Italy, Sweden and so on countries or regions have higher levels of global biopharmaceutical industry development. While China, Brazil, South Korea, Singapore, Russia, South Africa and so on countries have been committed to the research and development of biopharmaceutical development. The biopharmaceutical industry of emerging market countries, represented in China, is rapid promoted because of a large population base and increasing health effects of increased investment and other factors. Two economical indexes are used to measure the development level of biopharmaceutical: net value of pharmaceutical fields and export value. Table 1 shows net value of pharmaceutical fields and export value of these countries from 2000-2010.

China has highest yearly increasing rate of net value of pharmaceutical fields in the world during 2000 to 2010 from table 1. America can also have the yearly increasing rate of 72%, while some other countries have higher yearly increasing rate: Russia is 359%, Israel is 278%, and Singapore is 274%. Furthermore, the export value for America is also not high. The export value for Israel is highest with up to 1409.9%, and subsequently Ireland is 547.5%, Singapore is 503.1%, China is 497.6% and Brazil is 412.1%. Another important factor for evaluation of a country's biopharmaceutical industry development is pharmaceutical innovation capability. Innovation capacity is mainly reflected in: circulation of pharmaceutical research publications, quantity of drugs patents authorized by WIPO and venture capital funds for biopharmaceutical drug patents. For details refer to Table 2.

Tab. 1: Economic index of pharmaceutical fields for major countries

Countries or region	Net value		Export value		Countries or region	Net value		Export value	
	2010 / million dollars	2000-2010 yearly aver. /%	2010 / million dollars	2000-2010yearly aver. /%		2010/ million dollars	2000-2010 yearly aver. /%	2010 / million dollars	2000-2010 yearly aver. /%
America	91,903	72.3	44,582.9	239.8	Singapore	6,510	274.4	6,097.4	503.1
EU	90,418	95.6	295,144.4	326.1	Sweden	5,687	86.9	9,191.6	134.6
China	63,316	718.5	10,688.8	497.6	Ireland	5,035	151.1	32,178.1	547.5
Japan	30,015	-3.4	4,324.0	58.3	Canada	4,215	138.8	5,703.6	364.6
Germany	19,546	129.7	66,937.7	386.7	Australia	2,597	191.1	3,584.0	207.4
England	14,744	84.6	34,340.0	218.9	Russia	1,784	358.6	583.0	289.2
Brazil	11,683	191.6	1,360.4	412.1	S. Africa	1,439	196.7	167.6	55.4
France	11,324	49.7	34,479.8	229.6	Israel	949	278.1	6,475.1	1409.9
Italy	9,379	52.2	17,675.8	177	Chile	370	70.5	128.3	258.5
Korea	6,813	113.9	1,215.0	260.6	Saudi Arabia	73	82.5	47.7	113.8

Source of data: U. S. National Science Foundation

Tab. 2: Innovation level of pharmaceutical fields for major countries

Countries or region	Circulation of pharmaceutical research publications		Quantity of drugs patents authorized by WIPO		Venture capital funds / million dollars	
	2010	2000-2010 yearly aver. rate /%	2010	2000-2010 yearly aver. rate /%	2010	2000-2010 yearly aver. rate /%
America	58664	10.6	15932	54.1	8229	5
EU	61774	4	10518	47.7	1710	-9
China	7429	373	856	48.9	491	6649
Japan	10666	-20.1	2729	106.3	7	-50
Germany	11779	-0.2	3014	31.7	339	-50
England	12518	-10.6	1897	-2	370	108
Brazil	3131	167.4	186	353.7	189	57103
France	6100	-12.5	1939	73.9	370	108
Italy	7698	22.1	881	75.8	---	-100
Korea	546	7.4	1232	592.1	48	-53
Singapore	521	14.1	162	800	8	---
Sweden	2959	-10.4	534	0.3	2	---
Ireland	614	41.5	199	41.4	54	889
Canada	7356	25	843	1.8	862	87
Australia	4960	29.9	493	44.6	98	-31
Russia	153	-25.1	157	-10.8	---	---
S. Africa	4227	226.5	76	46.2	89	21
Israel	1602	-7.8	1037	141.2	197	8
Chile	403	29.2	26	44.4	---	-100
Saudi Arabia	503	51.5	16	1500	12	-65

Source of data: U. S. National Science Foundation

The venture capital investigation in biotechnology industry in America take up to 66% share in the world which means that America has a great advantage in terms of capital market development and infrastructure construction; China, Brazil and South Africa have taken the leading position in the past decade in the aspect of circulation of pharmaceutical research publications; South Korea and Israel have taken the leading position in the aspect of quantity of drugs patents.

In general, America takes the leading position in global biopharmaceutical industry, but other countries are not far behind. The competition becomes more and more hyper-competitive. The pharmaceutical industry in some emerging countries such as China, Singapore, Brazil, South Korea, South Africa is growing rapidly and biopharmaceutical industry developed rapidly meantime. Their growth capability is very attractive. The emerging countries have pay more and more attention on the following three aspects for biopharmaceutical industry development:

- Establishment research and development advantages and accelerate the transformation of scientific and technology achievements.
- Enforce the capability to obtain venture capital funds support.
- Attract and cultivate talented people for the research and development team.

PORTER DIAMOND MODEL

Porter diamond model theory is raised by Michael Eugene Porter, famous Harvard Business School management expert. It was used to the evaluation of the competitiveness of a country or a region in the worldwide scope. Porter argued that only a particular industry or several industries in any country in the world have strong international competitiveness. Therefore, the study of international competitiveness between nations focuses on the reason that some countries have become strong in the competitiveness in some specific industries, but the others does not. Potter summarized the factors into six points and developed a far-reaching diamond model for international competitiveness evaluation.

3.1. Production Element

The element for production will impact the competitiveness of specific industry for one country. Potter divided the production element of into two categories: basic elements and senior production key elements. The basic elements include natural resources, climate, geography, geographical position, demographic characteristics etc.; The senior elements include communications infrastructure, skilled labors, technology institutions, research facilities and specialized technical knowledge and so on.

3.2. Requirements element

Requirements element means the type of demand for the product or the service provided for a specific industry in domestic market. Porter diamond theory emphasizes the role of domestic demand in stimulating domestic demand and improving the competitive advantage. The characteristics of domestic demand play an important role in shaping the characteristics of domestic products, resulting in technical innovation and improving the quality.

3.3. Relevant and supportive element

This item means that whether a nation has suppliers and related supporting industries with high international competitiveness. It is analyzed from the aspect of industry chain. Judging from upstream of industry chain, whether raw materials supply can be cost savings; Judging from downstream of industry chain, whether sales and logistics sectors can be cost saving in both marketing and transportation process. The joint action of complete industry chain has important impact to improve the industry competitiveness of whole industry chain.

3.4. Corporations' strategic architecture element

This item means that whether the strategy of the corporation harmonized with the advantages of competitiveness in its country and its industry. Porter pointed out that if the industry of one nation had very strong international competitiveness. There must have several competitive corporations in domestic market no matter how small the nation was.

These four elements are basic factor. Meanwhile, there are two other variables: government and opportunities. Porter pointed out that the impact of government policy can not been ignored. Porter's diamond model is a promotion mutually reinforcing system. The role played depends on the special position of any role.

CHINESE BIOPHARMACEUTICAL INDUSTRY COMPETITIVENESS ANALYSIS

Industrial competitiveness is an important branch of research in the field of competitiveness. It is one of the important factors to impact countries' or regions' economic development. The promotion of one nation's international industry competitiveness is directly related to improving the overall welfare of their people. If the development of international industries competitiveness is ignored in domestic, thus the survival and development space of country's national industry is lost. Finally, the welfare of their people will be inevitably hurt.

China is a developing country in the midst of a comprehensive government-led social transformation. This paper constructs a diamond model taking the features of biopharmaceutical industry and the situation of China into consideration.

4.1. Basic elements

4.1.1. Production elements

The production elements of biopharmaceutical industry mainly include: high-quality labor force, knowledge resources, natural resources, capital resources, industrial infrastructure and so on. The concentration of biomedical industry in China is generally raised in recent years. The profit of domestic biopharmaceutical industry is close to the 15% of average profit of the world's leading pharmaceutical enterprise. However, taking consideration from the aspect of technology innovation in China, the investment in the research and development aspect is lower than that of aboard generally. The investigation on China's quoted biopharmaceutical companies shows that the investment in the research intensity of quoted companies is at around 3% to 12% with an average of about 6% to 7%. Some companies are even less than 1%. There is a certain gap compared to international recognition of the research-based pharmaceutical companies with 15% research and development intensity. Furthermore, there is a certain gap for the aspects of human resources, information technology and brand resources compared to multinational companies.

4.1.2. Requirements elements

China's biopharmaceutical market is gradually growing. As the Chinese population rapid growth, the aging process, continuously improvement of health care system and the enhanced of residents ability to pay, people's health needs is gradually increasing. China has become one of the fastest growing drug consumption markets in the world. China has become world's third-largest pharmaceutical market after America and Japan. Chinese medicine quality control efforts have been strengthened gradually [13]. In terms of drugs quality and safety, China still have the problems that drug safety legal system is imperfect, technical support system is distempered, and so on. In recent years, some biopharmaceutical product safety incidents happened in China, such as vaccine safety incidents in Shanxi, Dalian, Jiangsu and other place which resulting in a broad social impact and affecting the public's confidence in the safety of medicines to a certain extent. In 2012, China promulgated National Drug Safety Twelfth Five-Year Plan, proposed

the development aim of greatly improving the quality of medicines, further improvement of drug regulatory system, standardizing the order of development, production and distribution process [14]. The requirements promotion for drug quality and safety from public and government result in the rise of threshold of entry of pharmaceutical industry, higher demands for corporations' quality management level. It can promote positive change in the industrial structure and finally meet the objectives of industrial competitiveness.

4.1.3 Relevant and supportive elements

China has basically formed a national drug innovation system, established a number of integrated drug research and development platforms with universities and research institutes as the main body, cell technology platform and new drugs' incubation base with enterprises as the main body. Universities and research institutes have extensive research base conditions and human resources, which are the main bearers of national research programs or projects, play the main role in the upstream research and development of drugs. With social and economic development, the main body of up stream research and development of drugs become diversified with the establishment of biomedical research companies, pharmaceutical research and development centers, drug research technology outsourcing companies, biotechnology industrial parks and so on research institutions. However, because research institutions and technology demand side are lack of awareness, poor infrastructure, limited technical innovation, and so on reasons, the technical achievements transformation is poor and the transformation rate is still low which hampers pharmaceutical companies innovation and development.

Pharmaceutical manufacturing industry downstream industries are health care industry and the pharmaceutical retail industry. The health expenditure per head is increased from 362 RMB per year to 1643 RMB per year from 2000 to 2011. The absolute figure of outpatient and inpatient medical expenses is also increased. Because of the establishment and promotion of various security systems and the increase of government investment, individuals proportion of health expenditure is decreased since 2001 compared to all kinds of health expenditure, from 60% in 2001 to 35.3% in 2010, which further stimulate the costs of medical and health expenses [15]. The China's pharmaceutical retail market develops rapid. The pharmaceutical retail market size reached 188.5 billion RMB. However, the concentration of the industry is not high with low efficiency. There are only ten pharmaceutical retail corporations with more than 20 billion sales figure with similar development mode [16].

4.1.4 Corporations' strategic architecture elements

The problem that the industry concentration is low, product is seriously similar and so on continually plagued China's pharmaceutical enterprises. The scale of enterprises biopharmaceutical companies is small. In recent years, Chinese biopharmaceutical companies have promoted the industry concentration in the manner of capital operation, mergers and acquisitions, development and innovation, high evolving business alliances. Furthermore, the multinational corporations with tremendous strength come into the Chinese market more and more. Chinese biotechnology corporations get stronger via cooperation with multinational corporations.

4.2 Effect factors

4.2.1 Opportunities

Biotechnology is one of the fastest growing technology currently, therefore, it is the preferred development field with higher priority in the world, and it is also one of Chinese vigorously development corporations high-tech in recent years. At the policy level, China promulgated Biotechnology Development Plan Twelfth Five-Year Plan to promote the development of biotechnology for the first time in 2011; At the investment level, China established "973" Plan, "863" Plan, National Science and Technology Support Program and other key projects to support the

development of pharmaceutical biotechnology fundamental research and technology development; At the talent team construction level, China has formed a preliminary technology talent team. The quantity of research and development staff in biotechnology field reached 25 million people [17].

Policy and prevalence of disease trends changing provide opportunities for the development of biotechnology industry. Affected by the global financial crisis, some international biopharmaceutical industry giants have financing gap to realize industrialization for some research achievements. Therefore, China's pharmaceutical corporations have more and more opportunity to participate in international cooperation to undertake research achievements, develop international cooperation as an opportunity for China's corporations to open up international markets.

4.2.2 Government

China government regulates the market and optimize corporations' competitive environment by the measure of promoting industrial restructuring and development of biopharmaceutical industry. In 2012, China has issued Pharmaceutical Industry Twelfth Five-Year Development Plan and Twelfth Five-Year National Strategic Emerging Industry Development Plan. Pharmaceutical Industry Twelfth Five-Year Development Plan put biopharmaceutical drugs as the first key development field. Twelfth Five-Year National Strategic Emerging Industry Development Plan sets biopharmaceutical industry as one of the strategic emerging industries, and made great efforts to develop biopharmaceutical technology, vaccines and specific diagnostic reagents. The release and implementation of these plans provides a good opportunity for the development of biopharmaceutical corporations [18].

In terms of policy, China increases the investment in basic scientific research and corporate scientific research, reduces the risk of corporate research and development. The guarantee is provided for the corporations to undertake independent research and development of innovative products. In terms of tax policy, the biopharmaceutical industry has been supported to in terms of value added tax, business tax, corporate income tax, personal income tax and so on. Export rebate rate of biopharmaceutical products is raised from 13% to 17% to encourage products export. The high-tech biopharmaceutical corporations major supported by the government can have the discount 15% of bio-tech enterprise focused on supporting corporate income tax rate of 15% corporate income tax.

CONCLUSION

Michael Eugene Porter proposed four development stages for evaluation of the competitiveness, based on the elements analysis:

- Elements pushing stage: industry has advantages in production elements, namely, to have cheap labor and abundant natural resources. It is resource-intensive elements industry.
- Investment-driven stage: Industrial competitiveness depends on the willing of the national and enterprise development and investment capacity. It is capital-and technology-intensive industry.
- Innovation-driven stage: Industrial competitiveness mainly comes from the country's technological innovation and enterprise desire and ability.
- Wealth pushing stage: Industrial competitiveness mainly relies on the accumulated wealth of a country or region in the past. Corporations' innovation capability and competitiveness began to decline.

According to Porter diamond model, each basic elements and factors affecting the competitiveness of Chinese biopharmaceutical industry are summarized in Figure 1.

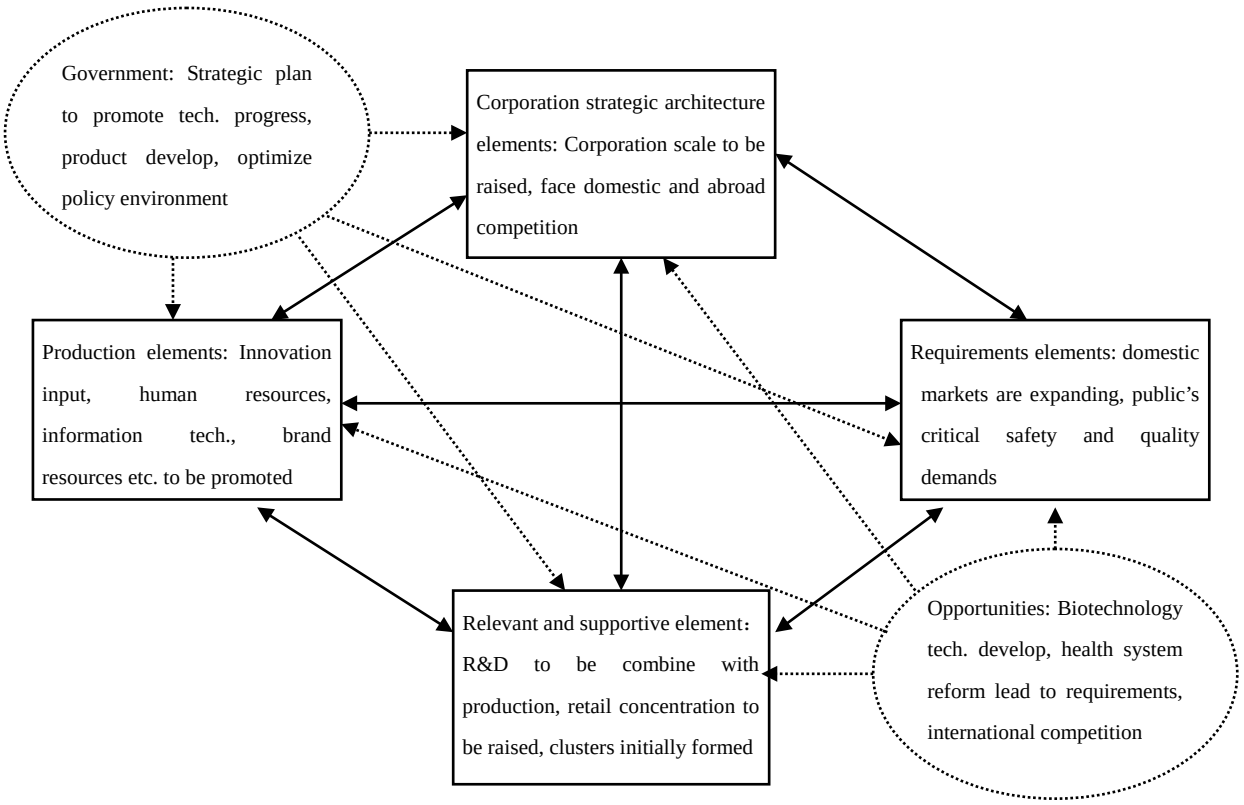

Fig. 1: Diamond model for competitiveness of China's biotechnology field

Based on the above analysis and the definition of four stage of Porter's competitive advantage, biopharmaceutical industry in China is in translation phase from investment-driven to innovation-driven stage currently. The industrial competitiveness advantages reply on nation's and enterprise's development desire and investment ability. Therefore, it will take time to gain a competitive advantage in high-tech products as the main pattern of industrial competitiveness.

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