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Study on the Economies of Scale Effect of Biomedical Industry Agglomeration in the Yanatze River Delta

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Abstract: As one of the most active areas in China's economic development, the biomedical industry gathers and develops here, and gradually forms a competitive industrial cluster. As one of the important characteristics of industrial agglomeration, economies of scale effect is of great significance for enhancing industrial competitiveness and promoting regional economic development. This study conducted an in-depth analysis of the economies of scale effect of the biomedical industry agglomeration in the Yangtze River Delta, explored the specific manifestation and causes of the economies of scale effect by sorting out the current situation of industrial agglomeration, and further analyzed the impact of technological innovation, cost saving, market expansion, brand effect, industrial chain synergy and policy support on industrial agglomeration. It is found that the agglomeration of biomedicine industry in the Yangtze River Delta has significantly promoted the expansion of industrial scale and the improvement of efficiency, and has a positive effect on regional economic development.

Keywords: Yangtze River Delta; Biomedical industry; Industrial agglomeration; Economies of scale.

1. Introduction

As an important part of high-tech industry, biomedicine industry has the characteristics of high technology, high investment, high risk and high return. Relying on its strong industrial foundation and scientific research strength, the Yangtze River Delta region has made remarkable achievements in the field of biomedical development, such as enterprise scale and competitiveness, regional distribution characteristics, innovation and research and development investment, new drug approval, scientific research parks and talents, government policies and support, and industrial collaborative development, etc, showing a good development trend [1]. In 2023, the scale of Shanghai's biomedical industry will reach 933.732 billion yuan, an increase of 4.9%, of which the total industrial output value will increase to 185.975 billion yuan, and the high-end manufacturing industry in therapeutic biological products, implant interventional devices, medical imaging equipment and other subsectors will grow rapidly. Among the top 20 international pharmaceutical equipment companies, 90% of them have their China headquarters or R&D production headquarters in Shanghai; So far, there are 30 enterprises listed on the science and technology board, accounting for about 1/4 of the country. As one of the effective ways to improve industrial competitiveness, industrial agglomeration can bring many advantages such as economies of scale, technological innovation, brand effect, etc. At the same time, with the continuous deepening of scientific and technological innovation and the continuous expansion of market demand, the biomedical industry will usher in more development opportunities. However, the biopharmaceutical industry in the Yangtze River Delta is also facing some challenges, such as intensifying market competition and increasing risks of new drug research and development. In order to cope with these challenges, biomedical enterprises in the Yangtze River Delta region need to further strengthen innovation capacity building, improve product quality and added value, while strengthening industrial synergy and regional cooperation to jointly promote the healthy development of the biomedical industry. The purpose of this study is to analyze the current situation of the biomedical industry agglomeration in the Yangtze River Delta, explore the specific manifestation and causes of its economies of scale effect, and provide theoretical support for further improving the level of industrial agglomeration and optimizing the industrial structure.

2. Definition of Economies of Scale Effect

Economies of scale effect, also known as "scale effect", refers to the economic phenomenon that the average cost of a unit of product decreases when the production scale of an enterprise expands, thereby increasing the total revenue. This effect is mainly due to fixed cost allocation, specialization, technical efficiency improvement and management cost optimization. The essence of scale economy effect is that with the expansion of production scale, the utilization efficiency of production factors will be improved, and the production cost will be reduced and the economic benefit will be improved [2]. There are various reasons for economies of scale effect, mainly including the following points: First, fixed cost allocation, with the expansion of production scale, fixed costs (such as equipment investment, management costs, etc.) can be shared on more products, thereby reducing the fixed cost per unit product. The second is specialized division of labor. Large-scale production makes specialized division of labor possible and improves labor productivity and production efficiency. Third, technical efficiency improvement, large-scale production is conducive to the use of advanced technology and equipment, improve production efficiency and quality. Fourth, management cost optimization, with the expansion of production scale, management costs can be more effectively controlled and optimized. Economies of scale apply to many industries and sectors, including manufacturing, services, and high-tech industries. At different industrial levels, economies of scale effects are also reflected, such as the scale expansion at the enterprise level, the integration and optimization of the industrial chain level, and the industrial agglomeration at the regional level. In the

economies of scale effect, there is a negative correlation between cost and benefit. With the expansion of production scale, the cost per unit of product gradually decreases, while the total revenue gradually rises. This change in the relationship between cost and benefit is the core embodiment of economies of scale, and is also an important driving force for enterprises to pursue scale expansion. In short, economies of scale effect are a complex concept involving many factors. Its definition and connotation, causes and mechanisms, scope and level of application, advantages and characteristics, cost-benefit relationship, resource allocation efficiency and promotion of technological innovation together constitute its complete conceptual system [3].

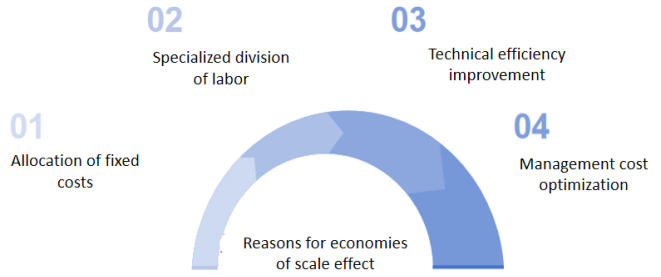

Figure 1. Reasons for economiesof scale effect

3. Current Situation of Biomedical Industry Agglomeration in Yangtze River Delta

3.1. Development Status of Biomedicine Industry in Yangtze River Delta

(1) Regional distribution characteristics

The biopharmaceutical industry in the Yangtze River Delta region shows obvious regional distribution characteristics. Among them, Shanghai, as the central city of the region, has the most mature bio-pharmaceutical industry, the largest number of enterprises and the most complete industrial chain. Jiangsu and Zhejiang provinces also have a certain number of biomedical enterprises, and formed their own distinctive industrial clusters. These industrial clusters are geographically close to each other, which is conducive to the formation of industrial synergies and promote the further development of the biomedical industry.

(2) Approval of new drugs

In recent years, the Yangtze River Delta biomedical industry has made remarkable achievements in the research and development of new drugs. From 2016 to 2023, the total number of drugs approved for listing in Shanghai, Nanjing, Suzhou, Hangzhou and Hefei was 388, 279, 201, 121 and 94, respectively [4]. A number of new drugs with independent intellectual property rights have been approved for listing, not only enriching the domestic pharmaceutical market, but also providing more treatment options for patients. The approval of these new drugs reflects the strength and achievements of the Yangtze River Delta region in biomedical innovation.

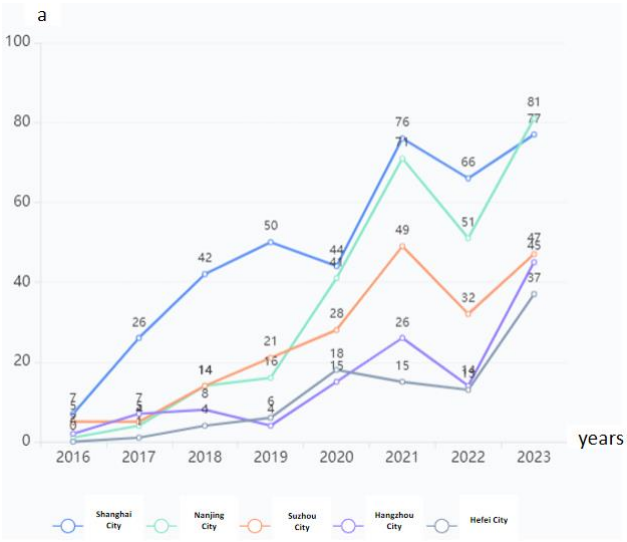

Figure 2. The number of approved drugs in major cities of Yangtze River Delta

(3) Enterprise scale and competitiveness

As an important gathering place of biomedicine industry in China, the Yangtze River Delta region has a number of large-scale and highly competitive biomedicine enterprises. These enterprises cover all aspects of the biomedical industry chain, from research and development, production to sales, forming a complete industrial chain. By the end of October 2023, there were 665, 215, 374, 397 and 136 high-tech enterprises in Shanghai, Nanjing, Suzhou, Hangzhou and Hefei respectively, and 402, 60, 86, 134 and 46 specialized and special new enterprises in the field of biomedicine industry [5]. Among them, there are many well-known pharmaceutical enterprises at home and abroad, which have significant influence and competitiveness in the industry, providing strong support for the development of the Yangtze River Delta biomedical industry.

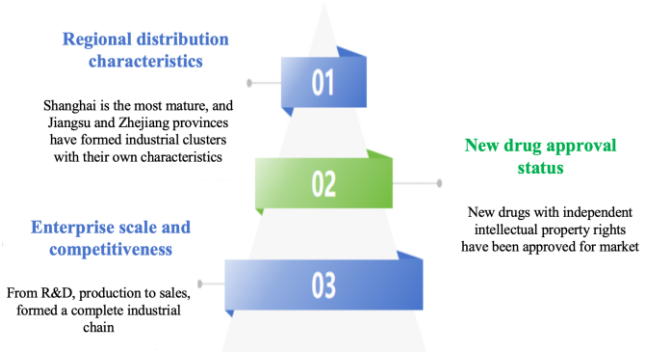

Figure 3. The status quo of bio-pharmaceutical industry agglomeration in the Yangtze River Delta

3.2. Existing Problems

(1) Small enterprise scale

There are many biomedical enterprises in the Yangtze River Delta, but most of them are small in scale and lack of large leading enterprises. This leads to the overall competitiveness of the industry is not strong, it is difficult to form a scale effect and brand effect, but also limits the investment and ability of enterprises in research and development, production and marketing. At the same time, although the biomedical industry in the Yangtze River Delta shows a trend of agglomeration on the whole, the degree of agglomeration varies greatly among different regions. There are a large number of enterprises in some areas, but the lack

of effective cooperation and resource integration leads to waste of resources and repetitive construction; Other regions are relatively backward and lack the core competitiveness of the biomedical industry.

(2) Lack of innovation ability

The biomedical industry is a typical technology-intensive industry with high requirements for innovation ability. However, at present, the innovation ability of biomedical enterprises in the Yangtze River Delta region is generally insufficient, lacking original technologies and products. Most companies are still stuck in the production stage of generic drugs and low-end medical devices, and it is difficult to gain a competitive advantage in the high-end market and the international market. In addition, the biomedical industry has a long industrial chain, including research and development, production, sales and other links. However, at present, the degree of coordination of the biomedical industry chain in the Yangtze River Delta region is not high, and the connection between various links is not close enough, resulting in the overall efficiency of the industrial chain is not high. At the same time, the cooperation and interaction between upstream and downstream enterprises also need to be strengthened.

(3) Financing challenges

On the one hand, with the rapid development of the biomedical industry, the market competition is becoming increasingly fierce. The biopharmaceutical enterprises in the Yangtze River Delta region are facing the competitive pressure from domestic and foreign counterparts and need to continuously improve their core competitiveness and market share. At the same time, with the gradual liberalization of policies and the gradual opening up of the market, the future market competition will be more intense. On the other hand, the biomedical industry is capital-intensive and requires a large amount of capital investment. However, due to the small scale of enterprises, limited profitability and other reasons, the Yangtze River Delta biomedicine enterprises face great challenges in financing. This restricts enterprises' research and development investment and market expansion, and affects the rapid development of the industry.

(4) Talent shortage becomes a bottleneck

The biomedical industry has a high demand for talents. However, at present, the shortage of talents in the biomedical industry in the Yangtze River Delta region is serious, especially high-end talents and compound talents. As a result, enterprises are limited in technology research and development and market expansion, and it is difficult to achieve sustainable development. At the same time, although governments at all levels in the Yangtze River Delta region have issued a series of policies and measures to support the development of the biomedical industry, there are still problems such as insufficient policy coverage, insufficient support, and inadequate policy implementation. This makes it difficult for enterprises to enjoy policy dividends, and also restricts the rapid development of the industry.

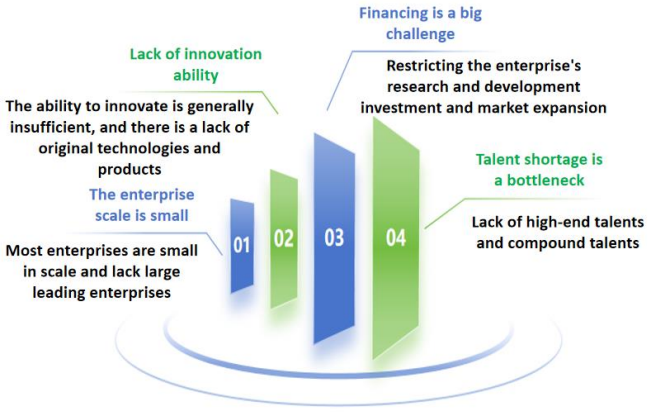

Figure 4. The agglomeration of biomedical industry in Yangtze River Delta

4. Analysis of Scale Economy Effect of Biomedical Industry Agglomeration in Yangtze River Delta

4.1. Advantages of Economies of Scale

The Yangtze River Delta region, as the core region of China's economy, has a significant trend of bio-pharmaceutical industry agglomeration in recent years, and has formed a number of large-scale bio-pharmaceutical industry clusters. These clusters not only gather a large number of biomedical enterprises, but also attract many scientific research institutions, universities, medical service institutions and other supporting industries, forming a complete biomedical industry chain. This clustering phenomenon makes the Yangtze River Delta biomedicine industry has a strong advantage of economies of scale. The advantage of scale economy is an important feature of the agglomeration of biomedical industry in Yangtze River Delta. Through industrial agglomeration, enterprises can share infrastructure, human resources and technical resources, reducing the production costs and transaction costs of individual enterprises. At the same time, industrial agglomeration can also bring knowledge spillover and technological innovation, and further improve the production efficiency and product quality of enterprises. This scale economy advantage makes the Yangtze River Delta biomedicine industry more advantageous in the market competition [6].

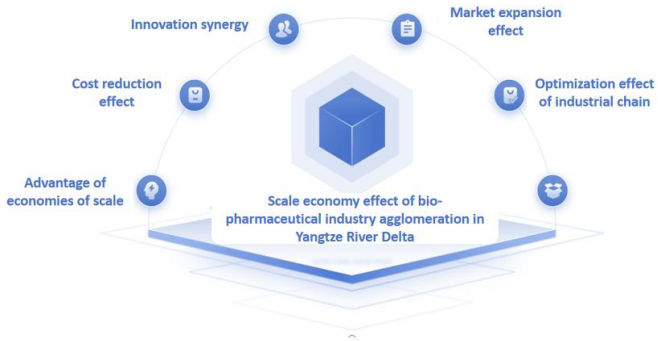

Figure 5. Scale economy effect of bio-pharmaceutical industry agglomeration in Yangtze River Delta

4.2. Cost Reduction Effect

The Yangtze River Delta region is one of the important engines of China's economic development, and the biomedicine industry, as one of its advantages, has shown a

rapid agglomeration trend in recent years. This agglomeration not only improves the overall competitiveness of the industry, but also brings significant economies of scale, in which the cost reduction effect is particularly prominent. The cost reduction effect is mainly reflected in several aspects. The first is the reduction of raw material procurement costs. The biomedical industry has a large demand for raw materials and high quality requirements. In the Yangtze River Delta region, with the agglomeration of biomedical enterprises, raw material suppliers have increased correspondingly, forming a relatively complete supply chain system. This makes it easier for companies to obtain the raw materials they need and reduce procurement costs through competition among suppliers. At the same time, agglomeration also promotes the scale of raw material supply and further reduces the raw material cost per unit of product. The second is lower production costs. The production of biomedical enterprises needs to invest a lot of equipment, technology and human resources. In the Yangtze River Delta biomedical industry cluster area, enterprises can share infrastructure, technical resources and human resources, thereby reducing production costs. For example, enterprises can jointly use research and development platforms, laboratories and other facilities to reduce the input cost of a single enterprise; At the same time, the agglomeration also promotes technical exchange and talent flow, and improves production efficiency and technical level. Finally, sales and marketing costs are reduced. With the gathering of biomedical enterprises, the Yangtze River Delta region has formed a relatively perfect sales network and marketing channels. Enterprises can reduce sales and marketing costs by sharing sales channels and participating in industry exhibitions. In addition, agglomeration also promotes the cooperation and alliance between enterprises, jointly explore the market and promote products, and further reduce the cost of market promotion.

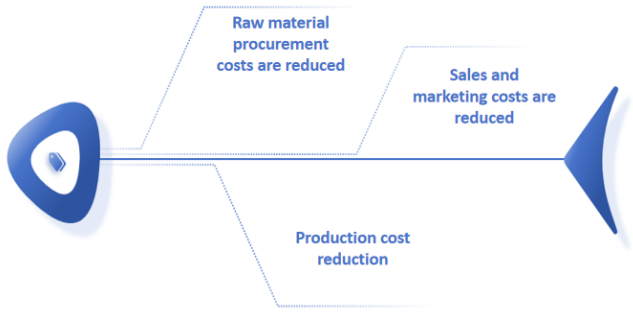

Figure 6. Performance of the cost reduction effect [7]

4.3. Synergy of R&D and Innovation

Innovation is the core competitiveness of biomedicine industry. The cluster of biomedical industry in the Yangtze River Delta provides a good environment for innovative activities. In the industrial agglomeration zone, close cooperative relations have been formed between enterprises and between enterprises and scientific research institutions to jointly carry out research and development activities and share innovation results. This innovation synergy will help accelerate the promotion and application of new technologies and enhance the innovation capacity and competitiveness of the entire industry. On the one hand, in the Yangtze River Delta biomedical industry cluster area, many enterprises, universities and scientific research institutions have formed a close cooperation network. This network structure promotes the collaboration of technology development and knowledge creation. Enterprises can share research and development resources, technical achievements and expertise to accelerate the development and market process of new products. At the same time, universities and scientific research institutions provide a steady stream of talents and technical support for the industry, and promote the continuous innovation of the industry. On the other hand, the Yangtze River Delta biomedical industry cluster covers enterprises from raw material supply, production and manufacturing to sales and service. These enterprises realize the sharing and optimization of value activities through the collaborative cooperation of the industrial chain. For example, enterprises can jointly purchase raw materials to reduce procurement costs; Share production equipment and processes to improve production efficiency; Jointly carry out market promotion and brand building to enhance market competitiveness. This collaborative cooperation not only reduces the operating costs of enterprises, but also improves the competitiveness and innovation capacity of the entire industrial chain. Finally, the enterprises in the Yangtze River Delta biomedical industry cluster have formed a common cultural concept and value in the long-term cooperation and development process. This kind of cultural synergy helps to enhance the trust and cooperation willingness among enterprises and promote the in-depth development of innovative activities. At the same time, by jointly building regional brands, the visibility and influence of the entire biomedical industry has been enhanced, attracting more investment and talent resources.

4.4. Market Expansion Effect

Industrial agglomeration contributes to the formation of brand effect and cluster effect, and enhances the overall image and visibility of the Yangtze River Delta biomedical industry. This will help attract more customers and investment, further expand the market, and by 2025, the scale of Shanghai's biomedical industry will reach 1.2 trillion yuan [8], and basically become a source of technological innovation in the biomedical industry with international influence. At the same time, industrial agglomeration can also promote the cooperation and exchange of upstream and downstream enterprises in the industrial chain, promote the improvement and upgrading of the industrial chain, and provide more opportunities and space for market expansion. By forming economies of scale, industrial agglomeration reduces production costs and improves production efficiency, thus enhancing the market competitiveness of products. In the Yangtze River Delta biomedical industry, many enterprises gather together to share resources, information and technology, forming a strong industrial synergy. This synergy makes the biomedical products in the Yangtze River Delta more competitive, able to better meet the market demand, and then expand the market share. At the same time, the cluster of biomedical industry in the Yangtze River Delta enables the biomedical enterprises in the region to more conveniently obtain market information and understand market demand, so as to develop new products and expand new markets in a targeted manner.

4.5. Industrial Chain Optimization Effect

The cluster of biomedical industry in the Yangtze River Delta has promoted the optimization and upgrading of the industrial chain. Through industrial agglomeration, enterprises can better realize resource sharing and complementary advantages, and form a close industrial chain

cooperation. This helps to improve the overall efficiency and stability of the industrial chain, and promote the development of the industry in the direction of high-end and intelligent. In the process of industrial chain optimization, governments at all levels in the Yangtze River Delta region attach great importance to the development of the biomedical industry and have introduced a series of policies and measures to support industrial agglomeration. These policies include tax incentives, financial support, talent introduction and other aspects, which provide a strong policy guarantee for industrial agglomeration. At the same time, the government also actively promotes industry-university-research cooperation and the transformation of scientific and technological achievements, providing a strong impetus for innovation for industrial agglomeration.

5. Conclusion

The Yangtze River Delta biomedical industry agglomeration has significant economies of scale effect, with obvious industrial agglomeration advantages, cost reduction effect, innovation synergy effect, market expansion effect, industrial chain optimization effect, etc. In the future, with the increasing policy support and market demand, the Yangtze River Delta biomedical industry cluster will continue to give play to the advantages of economies of scale and promote the sustainable and healthy development of the entire industry. In the future, the Yangtze River Delta biomedical industry cluster will continue to deepen development. With the continuous deepening of scientific and technological innovation and the continuous expansion of market demand, the biomedical industry will usher in more development opportunities. At the same time, the Yangtze River Delta region will further strengthen cooperation and exchanges with other regions to promote the cross-regional coordinated development of the biomedical industry. Under the dual promotion of policy support and market demand, the scale economy effect of the Yangtze River Delta biomedical industry agglomeration will further appear, injecting new impetus to the development of the entire industry.

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