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BASED ON HENGRUI PHARMACEUTICAL'S R&D INVESTMENT AND PERFORMANCE – RESEARCH ON THE DEVELOPMENT TREND OF THE PHARMACEUTICAL INDUSTRY

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INTRODUCTION

At the beginning of 2020, the Covid-19 Crown-19 epidemic swept the world. This public health incident not only had a huge negative impact on the global economy, but also put a huge test on the entire medical and health system. From viral gene sequencing to vaccine research and development, and finally to vaccines to comprehensive vaccination, every great progress is a test of innovation. Innovation is obvious the lifeblood of pharmaceutical companies, and innovation also gives companies a trend of upward development.

Looking at the post-epidemic era, the pharmaceutical industry ranks among the top ten industries in China. It is not only a rising industry, but also a people's livelihood economy. In the face of China's aging population, the development potential of the pharmaceutical industry is immeasurable, so Pharmaceutical companies have always been favored by investors in the capital market. However, both the favorable factors that promote the development of pharmaceutical companies and the unfavorable factors that hinder their development exist in the survival environment of pharmaceutical companies. Some pharmaceutical companies can use their core competitiveness to easily deal with these unfavorable factors and remain invincible in the market. The return on assets continues to increase; and some pharmaceutical companies often find it difficult to parry when faced with the test of unfavorable factors, and their revenues continue to decline. In particular, in 2019, when the science and technology version was implemented, the listing approval system for technologically innovative companies was transformed into a registration system. Looking at the current general trend of fully liberalizing the registration system of China's capital market in 2021, how to learn from the open market information and numerous listings the discovery of companies with investment value among pharmaceutical companies has become a topic of concern to many investors. This research paper is based on this, discusses the construction of the competitiveness evaluation system of listed companies in the pharmaceutical industry, and explores the development trend of the pharmaceutical industry and the lifeline of the enterprise.

Studying the innovative power of pharmaceutical companies is essential to improve and enhance their corporate competitiveness, and it also has important historical and practical significance for pharmaceutical companies in the development stage. This research paper starts with the discussion of R&D investment and new drug listing process, combined with the financial characteristics of pharmaceutical companies, and constructs a theoretical and specific indicator system for evaluating the innovation ability of pharmaceutical companies. The amount of R&D investment, R&D expenditure and R&D expenditure capital expenditure Data is used as an independent variable, and company performance indicators are used as dependent

variables. The asset-liability ratio, company size, operating income growth rate, and total asset turnover rate are used as control variables. Through correlation testing and multiple regression analysis, the R&D investment in China's pharmaceutical industry is obtained. The total amount has a positive correlation with the innovation ability of the enterprise. By selecting China's most innovative leading listed company Hengrui Pharmaceuticals as the research sample, after analysis, the conclusion of the empirical research on the innovation power of the sample companies is reached, and finally the problems existing in the innovation power of pharmaceutical companies at this stage are discovered. As well as the impact of R&D investment, it points out the extent of the impact of innovation on pharmaceutical companies, and then proposes corresponding solutions and suggestions for the problems of pharmaceutical companies' innovation. At the same time, it also points out the existence of this research paper in the empirical research. Shortcomings and prospects are also highlighted.

This researching is mainly divided into four chapters, and the research contents of each chapter are as follows:

Chapter One Theoretical aspects of investment in R&D. First, it explains the research background and significance of this researching; then it sorts out the research status of the concept, elements and evaluation of the profit model in the academic circle; finally, it explains the research content, methods and ideas of this article. An introduction to the concepts related to the profit model, the classification of the profit model of the pharmaceutical industry and other relevant theoretical foundations studied in this paper

The second chapter describes the current situation of the global pharmaceutical industry market in 2020. First, analyze the foreign pharmaceutical industry: global pharmaceutical market sales, global prescription drug sales, and global pharmaceutical industry R&D investment, and found that global pharmaceutical companies are facing the problem of patent exhaustion. Then analyze the status quo of China's pharmaceutical industry: chemical and biopharmaceutical companies-only two R&D companies that keep up with international giants, medical device companies-"persist in" sales-driven development, traditional Chinese medicine companies rely on "exclusive secret recipes" to ensure revenue, and R&D investment is in Low globally.

Chapter 3, Hengrui Pharmaceutical's case profile and current profit model analysis. Introduce the background environment of the case; Overview of Hengrui Pharmaceutical: Including the basic company profile such as development history, management philosophy, and operating performance; Based on theoretical research, combined with the specific situation of the case company, first, an overall introduction to Hengrui Pharmaceutical's profit model; Secondly, starting from the elements of the profit model, we conducted an in-depth analysis of the profit model of Hengrui

Pharmaceuticals; finally, integrated DuPont analysis method, comparative analysis method and other financial evaluation methods to analyze the profitability and profit quality of Hengrui Pharmaceuticals. Inspection and evaluation.

Chapter 4 combines the R&D and innovation advantages of Hengrui Pharmaceuticals. Provide relevant suggestions on how to take measures to promote the growth of listed companies in the pharmaceutical industry, and effectively promote the transformation of Chinese pharmaceutical companies from "Made in China" to "Created in China".

The following methods were used in the study.

1. Literature research method. Sorting out the relevant literature on profit model and the relevant information of the pharmaceutical industry, fully understanding the current research status of corporate profit model and profit model evaluation, and have a general way to analyze and evaluate the profit model of pharmaceutical companies.

2. Case study method. This researching selects Hengrui Pharmaceutical as a research case, and analyzes its profit model and profitability in detail, and summarizes the enlightenment of Hengrui Pharmaceutical's profit model for the transformation and upgrading of my country's pharmaceutical companies in the same industry and improving profitability.

3. Comparative analysis method. The thesis uses comparative analysis to compare the financial data of Hengrui Pharmaceuticals in terms of profitability and profit quality with the financial data of pharmaceutical companies that adopt other profit models to study the profitability and driving factors of Hengrui Pharmaceuticals under the current profit model.

4. AHP and fuzzy comprehensive evaluation method. Based on the descriptive analysis of the components of the profit model, this article combines the characteristics of the profit model and the characteristics of the pharmaceutical industry, and uses the analytic hierarchy process to construct an evaluation system for the profit model of Hengrui Pharmaceuticals from the four components of the profit model. And apply the fuzzy evaluation method to determine the final evaluation result of the profit model.

GENERAL DESCRIPTION

Keywords: R&D investment, pharmaceutical market, R&D Innovation, Pharmaceutical companies, Hengrui Pharmaceutical.

The aim, objectives, object and subject matter of the research.

The aim of the study is to identify directions for the development of the pharmaceutical industry.

To achieve this goal, it is necessary to solve the following tasks:

– to study the theoretical aspects of investment in research and development in the field of pharmaceuticals;

– to analyze the current state and challenges of the global pharmaceutical industrial market;

– suggest directions for the development of the pharmaceutical industry using the example of Hengrui Pharmaceutical.

Object of study – Hengrui Pharmaceutical/

The subject of the research is investments in scientific developments in the pharmaceutical industry.

Choice of object and subject of research is due to the relevance and practical significance of the issue of R&D investments and innovations in modern conditions.

The author presents the following points that have been defended:

1. The author systematizes the theoretical aspects of research in the field of scientific and technical research and development and their role in the development of enterprises and organizations in various industries. The author studied the essence of investment in R&D, from the impact on the activities of corporations, including the efficiency and value of companies. The relationship between corporate investment in R&D and productivity is shown. The insufficiency of Chinese research in the field of scientific and technological research and development was noted.

2. Results of the analysis of the current state and problems of the world market of the pharmaceutical industry to improve the efficiency of enterprises in the field of pharmaceuticals, including through investment in R&D

3. The recommendations proposed by the author on the development of a set of measures to increase investment in R&D of pharmaceutical companies in China, including through - encouraging the development of traditional medicine;

- strengthening the disclosure of information on R&D of public companies;

- improving the construction of R&D cooperation policy between Chinese and foreign enterprises;

- raising awareness of scientific and technological innovations;

- strengthening cooperation with research institutes;

- strengthening the management of innovative projects.

CHAPTER 1 THEORETICAL ASPECTS OF INVESTMENT IN R&D

1.1 Research background and significance

1.1.1 Research background

In the face of the epidemic, the aging population, the new medical reform and many other pressures, what should the Chinese pharmaceutical industry do in 2021 and the following years?

(1) At the beginning of 2020, the new Covid-19 epidemic swept the world. This public health incident not only had a huge negative impact on the global economy, but also put a huge test on the entire medical and health system. From viral gene sequencing to vaccine research and development, and finally to vaccines to comprehensive vaccination, every great progress is a test of innovation. Innovation is precisely the lifeline of pharmaceutical companies, and innovation also gives companies a trend of upward development. [56]

The figure 1.1shows the Distribution of the number of patients diagnosed.

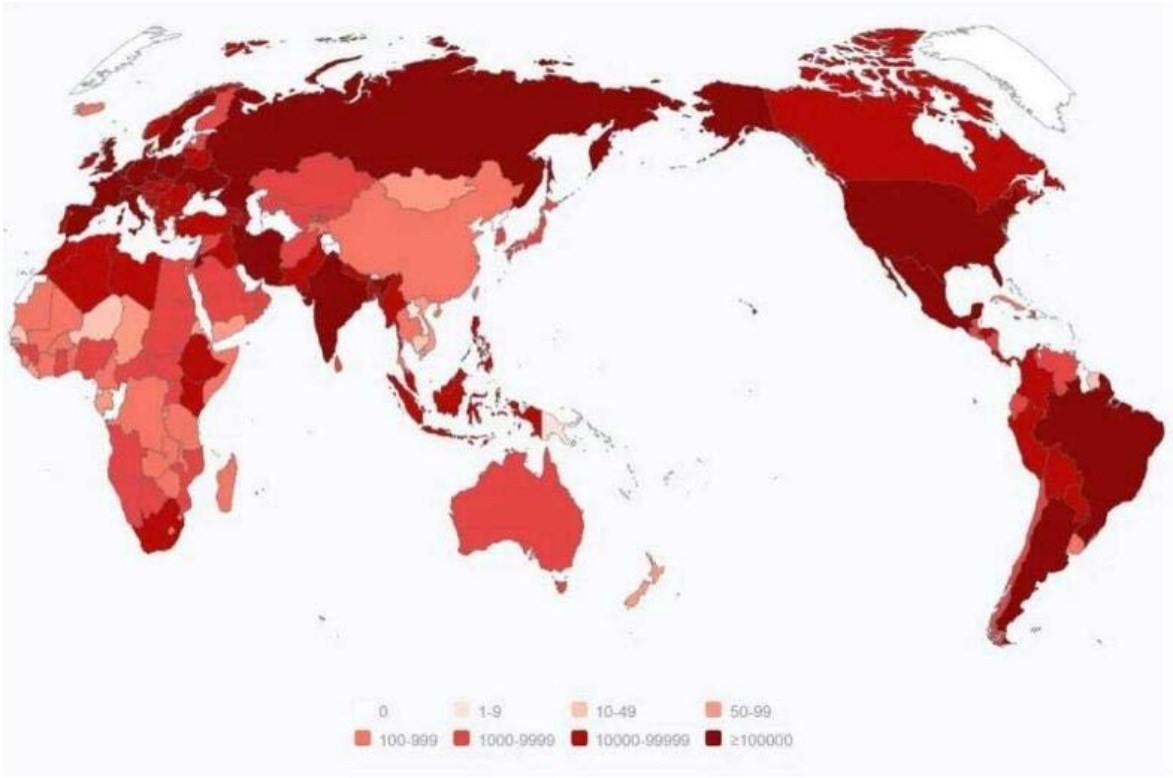

Figure 1.1 – Distribution of the number of patients diagnosed with new coronary pneumonia in the world (as of November 10, 2020)

Source: Compiled by the author based on data of the World Health Organization report [13]

March 16, "Starting": China and the United States took the lead in entering clinical trials simultaneously;

On August 6, "Sprint": A variety of vaccines worldwide entered clinical phase III;

On September 8, "Brake": Serious adverse reactions occurred, and the development of a Phase III clinical vaccine was suspended;

On November 9th, "crossing the line": Before the second wave of epidemic peaks hit, 90% effective vaccines were born.

(2) China has a population of 1.3 billion and is a country with a large population. It is even more important factor for the development of the pharmaceutical industry in such a populous country. However, a problem of a large population is not the only important factor for China's pharmaceutical industry. The pace of aging is obviously accelerating, and the problem of aging in China is getting worse. The population of people over 65 years old in China is on the rise. Data from WIND shows that as of 2016, the number of people over 65 years old has reached 149 million. It is this population background that has further promoted the development of my country's pharmaceutical industry [56]. Figure 1.2 draws up the China's population aging trend.

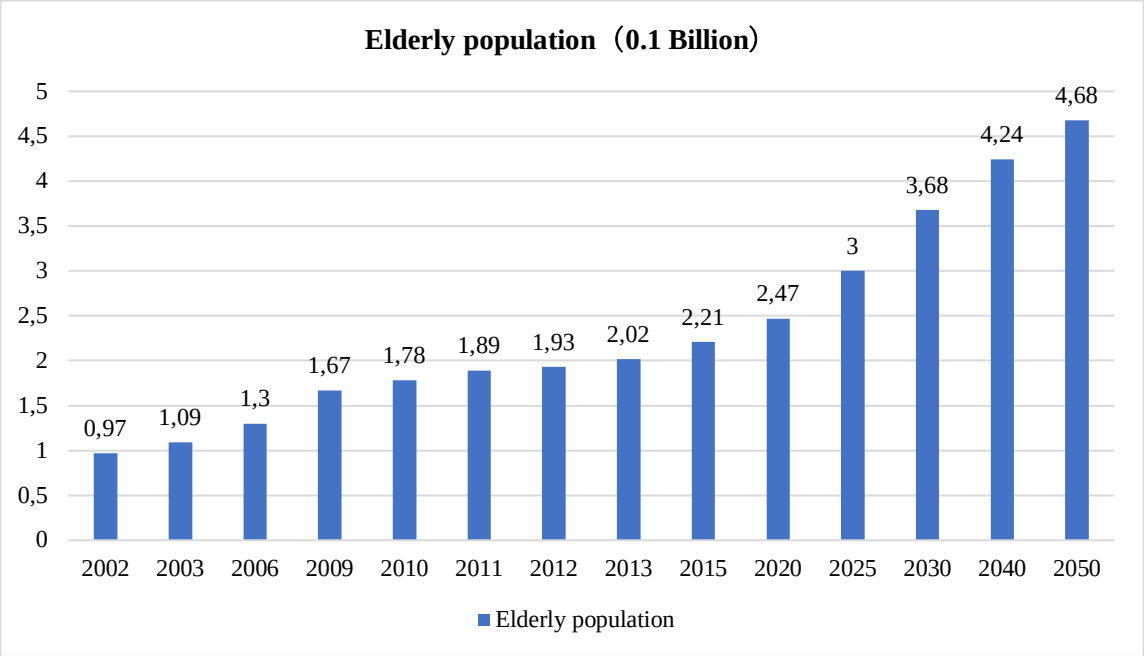

Figure 1.2 – China's population aging trend

Source: Compiled by the author based on data of the Ministry of Human Resources and Social Security of the People's Republic of China report from 2002 to 2050 [13]

It can be seen from the chart (Figure 1.2) that the number of elderly people over 65 increased in a large span in 2002, and has been increasing every year since 2003. By 2016, the number had reached 149 million. Faced with such a population structure, the state is also formulating corresponding countermeasures. The most important measure is to carry out medical reforms and provide preferential policies for pharmaceutical companies.

(3) New medical reform (centralized procurement of medicines) and anti-monopoly policy

Chinese pharmaceutical industry often faces the problem of drug supply cutoffs and sharp rises in drug prices. The frequent monopolistic behaviors in the industry have severely affected the vital interests of the people, and the central government has paid great attention. On February 9, 2015, the General Office of the State Council issued the "Guiding Opinions on Improving the Centralized Procurement of Drugs in Public Hospitals", implementing a classified drug procurement system, and implementing "centralized online and direct drug procurement" for some drugs, including commonly used cheap drugs. "Management Department Policy. On May 4, 2015, the National Development and Reform Commission issued the "Opinions on Promoting the Reform of Drug Prices", stipulating that, with the exception of narcotics and Class I psychotropic drugs, government pricing of drugs should be cancelled. On January 24, 2017, the General Office of the State Council issued the "How to Further Reform and Improve the Policy on Drug Production, Distribution and Use".

On April 18 of the same year, the Central Leading Group for Comprehensively Deepening Reforms held its 34th meeting, focusing on the shortage of cheap medicines. Since 2018, the central and local governments have respectively introduced reforms to the pharmaceutical retail system. It is imperative to promote competition in the commonly used drug market and maintain stable drug prices. The state is committed to breaking the traditional monopoly of the drug industry through institutional reforms and reducing drug prices.

Secondly, the patent protection period of a large number of multinational companies is about to expire. As a big country of generic drugs, our country is beginning to face a series of methods for multinational companies to maintain their intellectual property advantages. At the same time, our country is also striving to transform from a big country of generic drugs to a big country of original research drugs with independent intellectual property rights. It can be seen that my country's pharmaceutical industry will encounter more abuses of intellectual property monopoly behavior. The government has expressed its importance to the increasing monopoly of intellectual property rights. In 2015, the Anti-Monopoly Committee of the State Council issued the "Guidelines for Anti-Monopoly on Abuse of Intellectual Property Rights" (draft for comments), which clarified the criteria for determining monopolistic

behavior in the field of intellectual property rights and strengthened the supervision of intellectual property monopoly. The State Administration for Industry and Commerce implemented Decree № 74 "Provisions on Prohibition of Abuse of Intellectual Property Rights to Exclude and Restrict Competition" in August 2015, which gave specific explanations on the prohibition of intellectual property monopoly in the Anti-Monopoly Law.

1.1.2 Research significance

In the face of the impact of the Covid-19 epidemic in 2020 and the increasing impact of the aging population in the late stage of China's industrialization, as the economic development speed continues to decline, in the face of the rapid changes in global science and technology, our country is paying more and more attention to scientific research and encouraging companies Innovation. The pharmaceutical industry, which is closely related to people's lives, is also developing rapidly. In view of China's development potential and huge market, many multinational companies have been attracted to enter China, and production and R&D have been brought into China, which has promoted the development of my country's pharmaceutical industry, drove the development of our country's economy and the development of R&D capabilities in our country's pharmaceutical industry. R&D capabilities are the core force for pharmaceutical companies.

Sun Pharmaceuticals is the largest pharmaceutical company in India and Teva Pharmaceuticals is the world's largest generic drug company. These two companies had a patent infringement case with Pfizer in the United States and lasted for up to 10 years. Finally, they received a patent of US$2.15 billion. Infringement damages ended the case. This is the first case of infringement that resulted from the production and sale of generic drugs during the validity period of the branded drug patent, and the generic drug companies paid high compensation as a price.

The society is constantly innovating in the process of development. The pharmaceutical industry is a category of high-tech companies. Its R&D capabilities also determine the survival and development of the company. The R&D capabilities of the pharmaceutical industry not only affect the development of the company, but also affect the entire industry. With the improvement of industry R&D level, the development of the pharmaceutical industry in Europe, America and Japan started earlier than in China. Both R&D and operation are relatively mature. The development of China's pharmaceutical industry started late, and R&D capabilities are relatively backward. The current R&D model is backward. There is a shortage of R&D talents, and the development of enterprises is not deep enough in R&D. At present, China's pharmaceutical industry has a significant imitation. Most of the company's income

comes from generic drugs, because investments in generic drugs are low and the research and development time is short. The market does not have the advantage of survival and development, and it does not have the advantage in the fiercely competitive pharmaceutical market, which is not conducive to the long-term strategic development of the company. The United States is a major R&D country in Western countries as well as a global R&D country. Japan and USA are both the world's largest pharmaceutical R&D country. More than 60% of the new drug R&D in the global market comes from the United States. The US investment in the pharmaceutical industry is second only to the US defense expenditure. In the United States, its investment in pharmaceutical research and development accounts for the largest proportion of all civilian scientific research in the United States. Japan is a strong R&D country in Asia, and Japan is also an important base for new drug research and development. The development of the Japanese pharmaceutical industry is inseparable from the support and investment of its government. The development of the Japanese pharmaceutical industry also experienced scientific and technological policy formulation and advanced technology. The introduction of new technologies, imitating and absorbing the most cutting-edge new technologies have strengthened Japan's pharmaceutical R&D capabilities and promoted the development of the entire industry.

Therefore, in today's fierce international competition, if companies want to maintain their market share and have a leading position in the industry, they must pay more attention to their R&D and innovation capabilities. The investment in R&D funds will promote the continued healthy and upward development of my country's pharmaceutical industry. Development, and enable my country's pharmaceutical companies to occupy more market shares in the global market.

1.2 Related concepts

1.2.1 Concept of R&D Expenditure

The full English name of R&D is Research and Development, abbreviated as R&D. R&D expenditure refers to the R&D funds invested by enterprises in technological innovation and project research and development in the process of production and operation. It also refers to the investment in research institutions made by various countries or governments at all levels, in order to encourage the creation of new knowledge and new technology. These new technologies can encourage the creation of more new technologies and new knowledge, and can be applied in practice. The new intangible assets accounting standard divides R&D investment into two parts, one part is expensed and the other part is capitalized when the conditions are met. Research activities are the previous preparation activities for development activities

and the collection of data for development activities. Whether each R&D activity can form intangible assets after entering R&D is still uncertain. Accounting includes the capital investment at this stage into the current expenses. The development stage is to confirm that further development is possible after the completion of the research stage. Accounting standards include this part of the capital investment into the development expenditure item in the balance sheet.

1.2.2 Concepts related to R&D activities

R&D activities are activities where enterprises update and improve existing technologies, create more new technologies and new knowledge, and provide core technology support for the development of enterprises. It usually takes more than ten years for a new drug to come out from the initial research to the successful clinical trials and the final marketing. Therefore, every research and development activity has the characteristics of long time and high risk. Our country’s R&D and innovation capabilities have been constantly increasing. By 2016, R&D investment in China has ranked second in the world, and the investment in R&D activities is close to the sum of all R&D investment in the entire EU.

Based on the weak foundation of our country’s research and development capabilities and the overall development needs of the industry, the state encourages enterprises to conduct independent research and development, and make improvements on this basis through research on existing patented drugs on the market. This kind of imitation innovation has low research and development costs. The time is short, and companies can get the drugs on the market as soon as possible to bring benefits to the company, but this kind of imitative innovation and research and development of original drugs is not conducive to the improvement of the company's independent innovation ability. China puts forward higher requirements for generic drugs in the "National Drug Safety "Twelfth" Five-Year Plan", that is, the quality and efficacy of generic drugs and the original research drugs are consistent, and the approval of generic drugs is carried out in accordance with this requirement. New drug research and development is a complicated process, which involves medicine, pharmacy, biology and other disciplines, and the research and development of new drugs is also cumulative. The results of research and development and innovation are lagging, but successful new drugs can be occupied after they are recognized in the market.

The development of the pharmaceutical industry is inseparable from every R&D innovation activity. Although the new drug R&D process in the pharmaceutical industry takes a long time and has high risks, the new drugs after successful R&D can bring considerable profits to enterprises under the protection of drug patents. The profit is distributed and then invested in the research and development of the next new drug.

This process not only provides a guarantee for the survival and development of the company, but also continuously improves the company's market position, core competitiveness and scientific research capabilities of the entire industry in the process of original research drugs.

1.3 Innovation and deficiencies

1.3.1 Insufficient research

This researching only selects China's benchmark pharmaceutical company-Hengrui Pharmaceuticals as the sample, so there are certain limitations in the selection of sample companies; the comprehensive scores for the evaluation of the sample companies are mostly analyzed from the perspective of quantitative indicators, and some are ignored. Consideration of qualitative indicators that have a significant impact on the competitiveness of listed companies in the pharmaceutical industry.

Due to the limited research level of the author, no further research has been carried out on many deeper issues. The breadth and depth of the research need to be expanded. The future research direction can consider the scientific and reasonable quantification of qualitative indicators when designing a specific indicator system. This is also the direction that the author and scholars should further try in-depth research in the future, so when evaluating the financial competitiveness of enterprises, we should use objective thinking and viewpoints to deal with it.

1.3.2 Research Outlook

The pharmaceutical industry is one of the country's ten major industries, and it plays an indispensable role in all aspects of human life. For our country, the great opportunities during the "14th Five-Year Plan" period will further boost the development and growth of the pharmaceutical industry. Therefore, while the pharmaceutical industry is facing broad prospects, how to improve and abroad Competitiveness in the market and overcoming the shortcomings of the enterprise show the urgency and necessity. Based on this, with the support of related theories, this article collects and organizes information and data on the financial competitiveness of pharmaceutical companies, and uses empirical methods to verify them, so as to promote the sustainable development of pharmaceutical companies. Finally, analyze and solve the problems exposed by pharmaceutical companies from the main factors and comprehensive scores, and put forward constructive countermeasures.

From the empirical analysis in this researching, we can draw some problems in the current financial competitiveness of pharmaceutical companies, such as: uneven

solvency; poor management profitability, but there is a lot of room for improvement; overall performance of operating capabilities is average ; Lack of growth ability and severely polarized profitability, etc. Therefore, we can put forward corresponding improvement suggestions from four aspects, such as: creating a good financial management environment; integrating the industrial chain to improve profitability; flexibly controlling corporate investment and financing conditions to meet capital needs; focusing on improving scientific research capabilities and helping Promote the sustainable development of pharmaceutical companies, etc.

To sum up, under the general trend of the transformation of the enterprise listing approval system to the registration system, this researching is based on improving the financial competitiveness system of pharmaceutical companies. While enabling pharmaceutical companies to overcome their own developmental disadvantages, it provides investors with access to many listed pharmaceutical companies. To explore companies with investment value in the field to provide certain reference and reference.

1.4 Literature review in China and abroad

Scientific and technological capabilities represent the national strength of a country. In the competition between countries and enterprises, the survival and development of high-tech enterprises will inevitably be inseparable from their core competitiveness, that is, independent research and development capabilities, and foreign industrial development. R&D innovation is much earlier than China; so many foreign scholars have studied the influence of R&D investment before this century. In view of the development of scientific research in China and the promulgation of new intangible assets accounting standards, some domestic scholars have also begun to invest in R&D. Generate interest and conduct research on the relationship with corporate performance.

1.4.1 Review of foreign literature

Chinese research on scientific and technological research and development is held much later than abroad. The main reason is that our country's scientific research capabilities are still relatively young compared to advanced countries in Europe and the United States. The following is the research conducted by foreign scholars on the R&D investment in different industries in different periods. The impact of investment in corporate R&D activities on corporate performance or value.

Bart Los and Bart Verspagen (2000) chose to study the R&D investment of listed pharmaceutical companies, to study the relationship between corporate R&D investment and productivity. Different companies have different levels of R&D

investment. The intensity of R&D investment is related to the management's business strategy. Different managements have different attitudes towards R&D investment, but the research results show that the level of R&D investment, regardless of size, directly affects the production efficiency of operating companies. In the process of production and operation, enterprises should make full use of the impact of R&D intensity on the enterprise as a reference for enterprise development planning. Subrahmanya (2011) selected India's small-scale manufacturing industry as the research object, and selected 300 companies from the auto parts industry, electronic manufacturing industry and other manufacturing companies as samples. India is also a typical developing country. The conclusion is that investing in research can improve the profitability of the company and increase operating income. The above research results provide a signal that small-scale companies can still increase their R&D investment so as to better promote their development.

Chan (2001) used US manufacturing companies as the research object, and selected data from manufacturing companies in 1975-1995 as the data source to study the impact of their R&D investment intensity on the company. The research results show that, based on the selected data, the medical industry and the electronics industry invest more in R&D than other industries, and have a positive effect on enterprises. The United States is a powerful country in scientific research, which pays great attention to R&D and innovation. Its investment in R&D is even higher than its investment in national defense. Chambers & Jennings (1998), American scholars, choose high-tech companies closely related to R&D as the research objects, because high-tech companies are more representative, through the research of high-tech enterprises' R&D and performance. It is concluded that the R&D investment of high-tech enterprises can positively promote the benefits of enterprises and has a lag. (Rachel Griffith) (1999). Rachel selected financial data of manufacturing companies listed in London for more than 9 years as the research object, and conducted research on the relationship between R&D investment and the company’s innovation capability, monopoly level, and corporate performance. The results found that R&D investment are following: There is a correlation between manpower input and knowledge output patent right in, and it is positively correlated. The biggest feature of patent right is that it has monopoly, which positively affects the profitability of enterprises. Ballot and Erol Taymaz (2012) selected the R&D investment of large-scale enterprises in France and Sweden as the research object, and studied whether the investment of enterprise R&D activities can have an impact on the performance of the enterprise. What kind of impact and the extent of the impact, the results show that R&D investment has an impact on the innovation capability and corporate performance of the enterprise, that is, it can promote the improvement of the R&D and innovation ability of the enterprise, and it can also increase the profitability of the enterprise?

International Accounting Standards divide R&D expenditures into expense expenditures generated in the research phase and capitalized expenditures generated in the development phase. The accounting treatment of these two parts of expenditures is different, so the impact on the profits of the enterprise is also different. Garner, Nam, and Ottoot (2002) studied whether the R&D investment of a company is related to corporate performance, and enabled the innovation speed as an intermediate variable. The speed of innovation influences each other and positively affects corporate performance. The capitalization expenditure will form the intangible assets of the enterprise when the conditions are met. For the pharmaceutical industry, the most important form of knowledge output is the patent right. The research and development of new drugs takes a long time, the risk is high, and the investment is large. The patent protection period can bring huge benefits to enterprises. Ernst (2001) selected 50 machine tool manufacturing companies in Germany for data from 1984 to 1992. The results show that the number of patents generated by R&D can drive sales growth, and it proves that R&D investment is lagging in the R&D process. Hsieh, Gobeli, and Smishra (2003) conducted empirical research on the fixed assets and R&D investment data of the US pharmaceutical and chemical industry in the past 21 years. The analysis results show that R&D investment can drive the sales growth of enterprises and the growth of operating income and profits, thus proving that R&D investment is effective. Corporate performance can play a positive role in promoting.

1.4.2 Review of domestic literature

Our country’s development of high-tech R&D started later than the United States and Europe, but the speed of development is accelerating with the encouragement and support of the country. Correspondingly, some scholars have begun to study the R&D capabilities of enterprises one after another. He Wei (2003), using Griliches’ Cobb-Douglas production function method to conduct research on the data of large and medium-sized industrial enterprises in my country from 1990 to 2000. The research results show that R&D investment can have an impact on corporate performance, but the number of years of impact is 3 years. Liang Laixin and Zhang Huanfeng (2005) conducted research on R&D investment in high-tech enterprises with concentrated R&D and innovation activities in my country. The results show that R&D investment is conducive to the improvement of enterprises in independent innovation, and is significantly related to the profitability of enterprises, and the same is true. It proves that R&D investment is lagging, which is consistent with the conclusions of American scholar Chambers & Jennings on high-tech enterprises. Later, some scholars selected longer continuous data for research. Yue Jingui (2007) studied the R&D situation from 1978 to 2005, and took the 28-year R&D investment and GDP data as the research

objects, and analyzed in empirical research. In the process, the time series dynamic equilibrium relationship analysis method was used to conduct research, and the results proved that R&D investment can promote economic growth, and this is a long-term stable relationship. Tu Wenjuan (2008) conducted research and development on high-tech enterprises in Jiangsu Province using the grey relational analysis method. The research conclusions are consistent with Yue Jingui, that is, R&D investment (personnel investment and funding investment) is significantly correlated with enterprise output. Ye Yingping (2013) research stated that there are certain differences between regions in China. In order to understand the R&D investment and results of more regions, they selected 30 regions and collected the data of industrial enterprises in these 30 regions for research. This study covers many areas. From the perspective of regional development, the study is comprehensive. Through the analysis of R&D data in 2012, the results show that R&D investment can promote the growth of output value and promote the healthy development of enterprises. Guo Yan, Liu Yibo (2011) and Jin Ying (2011) also chose to study the relationship between R&D investment and corporate performance of high-tech companies. The results of the research are basically consistent with those of Liang Laixin and Zhang Huanfeng, which fully demonstrates R&D investment. Later the performance of the enterprise can promote the increase of R&D investment, and the further improvement of R&D capabilities can drive the performance of the enterprise. Huang Jing, Wu Hecheng, and Li Hui (2010) conducted research on R&D investment in five industries. The results show that R&D investment has a significant role in promoting the performance of the five industries. Among them, it has an the largest and positive impact on the aerospace industry with relatively high technical requirements, while the impact on computers and office equipment is the smallest.

The capital market is a channel for companies to raise development funds. Listed companies can make full use of the funds raised in the capital market to invest in corporate development, especially in R&D and innovation. Cheng Hongwei, Zhang Yonghai, and Chang Yong (2006) selected 96 listed companies to conduct research on R&D investment. The results show that the intensity of R&D investment is positively correlated with the performance of listed companies and can drive the improvement of corporate efficiency. Ren Haiyun and Shi Ping (2009) used the data of 71 newly listed pharmaceutical companies from 2001 to 2004 to conduct research, and the results showed that the correlation between R&D investment intensity and main business profit rate is significantly positive. The growth ability of the pharmaceutical industry is relatively good. Zhou Jiangyan (2012) conducted a study on 71 listed manufacturing companies, and the results showed that the investment in the company's R&D activities in the current period is that the investment in the current period promotes the current

gross profit margin, and still has a significant impact on the operating gross profit margin of the lagging period.

1.5 Review of domestic and foreign literature

By reviewing the above-mentioned research literature of domestic and foreign R&D expenditures on corporate performance, corporate value, and corporate growth, we can see the beginning of research on R&D expenditures and corporate performance, corporate value, and corporate growth abroad. Much earlier than in China, foreign accounting standards and disclosure requirements for listed companies are different from those in China. Foreign capital markets are more mature, and it is more convenient for scholars to obtain data for research. Most scholars' research conclusions are research and development. The research results of expenditure on corporate performance, – Value or growth have a positive impact. Since international accounting is expected to divide R&D activities into research and development phases earlier than our country, the impact of foreign R&D expenditures and capitalization on companies The research is also earlier than domestic, because the R&D and innovation ability of an enterprise runs through the survival and development of an enterprise, which is very important for the enterprise, especially for high-tech enterprises, the R&D and innovation ability is its core competitiveness, so many foreign countries Scholars are keen to research and explore research and development expenditures. There are relatively few empirical research documents on R&D expenditure in my country. There are two reasons for this. First, the development of scientific research capabilities in China started late, and secondly, it is difficult to obtain data, and there is no way to conduct effective empirical research. The promulgation of China's new intangible asset accounting standards and the updated requirements for the disclosure of listed companies will help scholars better obtain data for empirical research. The more detailed the disclosure of R&D expenditures in financial reports, the better it will be for investors, creditors, etc. to pass financial The report obtains useful information, which is beneficial to enterprises to attract investment. After the promulgation of the new intangible asset accounting standards, it has attracted some domestic scholars to conduct research on the R&D investment and corporate performance of Chinese enterprises. The results of R&D are positively correlated and influential. There are also conclusions with weak correlation. Therefore, the current research conclusions on R&D investment and corporate performance are not completely consistent.

CHAPTER 2 THE CURRENT SITUATION AND PROBLEMS OF THE GLOBAL PHARMACEUTICAL INDUSTRY MARKET

2.1 Status quo of foreign pharmaceutical industry

2.1.1 Global pharmaceutical market sales

In recent years, the rapid development of the global pharmaceutical market has mainly benefited from two aspects: on the one hand, the patents of some major drugs will expire one after another, allowing more generic drugs to enter the market; on the other hand, the rapid economic growth of emerging countries Growth has stimulated the demand for medicines in these countries [56]. Figure 2.1 shows the 2003-2020 global sales of pharmaceuticals.

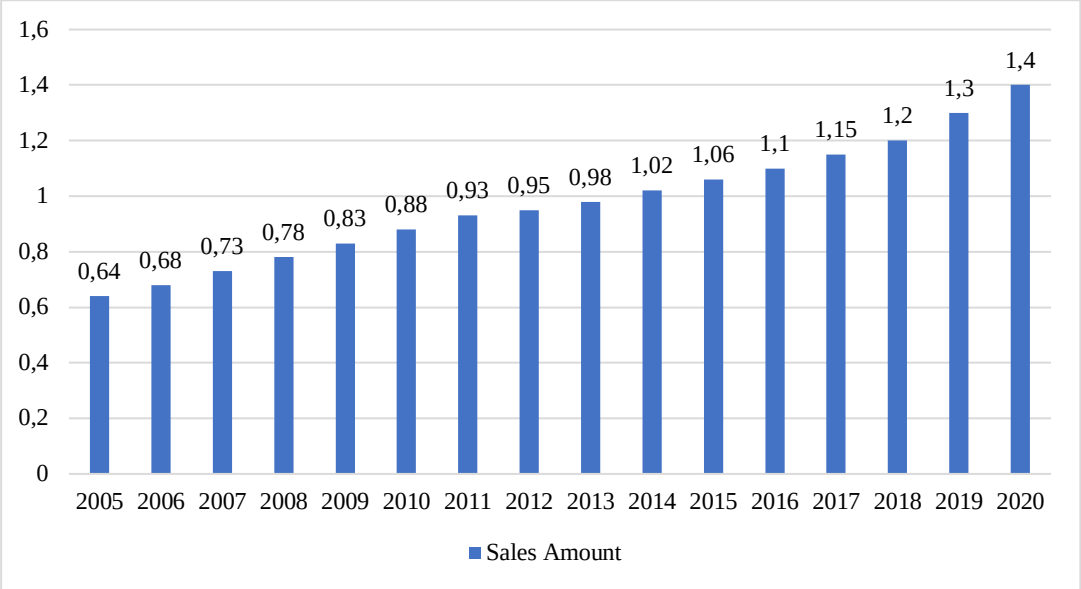

Figure 2.1 – 2003-2020 global sales of pharmaceuticals (US$ trillion)

Source: Compiled by the author based on data of the IMS Foresight Industry Research Institute report from 2005 to 2020 [34]

Before the global financial crisis, with the development of global economic integration and the continuous increase of global population aging, global pharmaceutical sales continued to increase. From 2003 to 2009, global pharmaceutical sales maintained a growth rate of more than 7%;

Since 2012, the deep impact of the international financial crisis has continued, and the global economic recovery has not improved significantly. However, the entry of financial capital has promoted the growth of drug demand and the improvement of medical channels, and global drug sales have begun to achieve recovery growth. As

the number of drugs with expired patents has dropped sharply, innovative drugs have emerged one after another and their prices have risen. As of 2019, global drug sales are expected to reach 1.30 trillion U.S. dollars, an increase of 4.8% compared to 2018. According to IMS's forecast, global drug sales will reach 1.4 trillion US dollars in 2020, a year-on-year increase of 7.7%.

2.1.2 Global sales of prescription drugs

According to a report released by EvaluatePharma in June 2020, global prescription drug sales in 2019 will reach 872 billion U.S. dollars, and will subsequently rise at a CAGR of 7.4% to 1,390 billion U.S. dollars in 2026. [56] The figure 2.2 draws 2012-2026 global prescription drug sales amount.

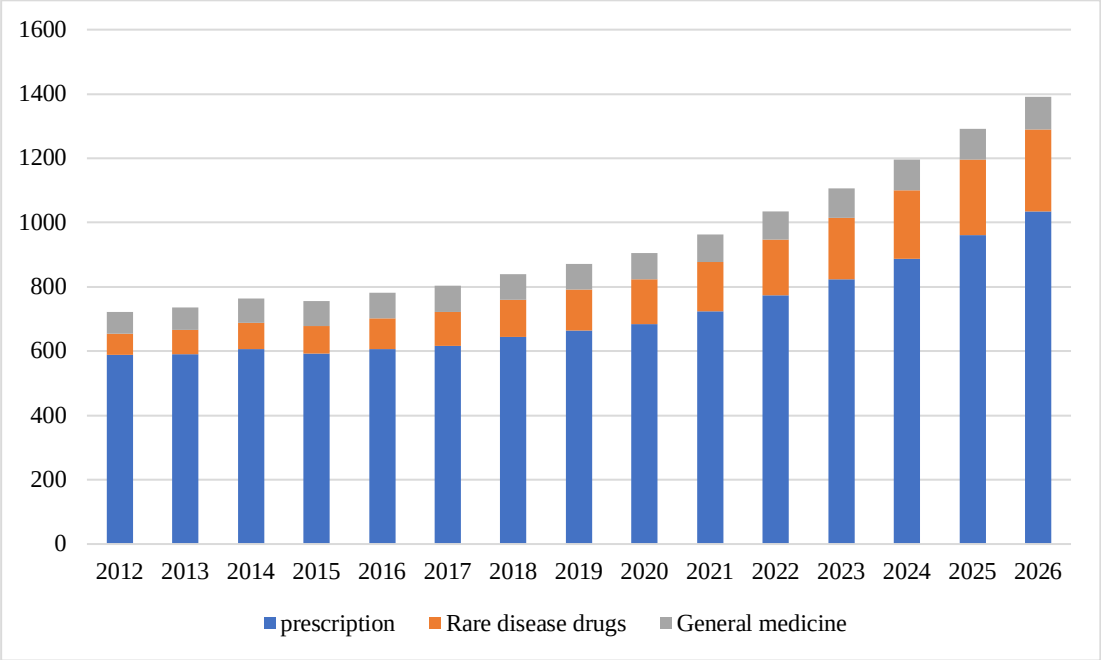

Figure 2.2 – 2012-2026 Global Prescription Drug Sales Amount (Billion dollars)

Source: Compiled by the author based on data of the EvaluatePharma Foresight Industry Research Institute report from 2012 to 2026 [9]

From the above chart we can see that the global sales amount of prescription drugs from 2012-2026 has been showing an upward growth trend, prescription drugs have been growing insignificantly from 2012 to 2016 and significantly since 2017; rare disease drugs have been rising insignificantly; general medicine has been growing significantly since 2019.

2.1.3 R&D investment in the global pharmaceutical industry

For the pharmaceutical industry, R&D investment is one of the main factors affecting the output of pharmaceutical R&D. According to Evaluate Pharma's statistics, global pharmaceutical R&D expenditures reached US$186 billion in 2019, a year-on-year increase of 1.6%. Especially in recent years, with the continuous progress of basic frontier disciplines, major pharmaceutical companies have increased their R&D investment in new drugs (ADC, PD-1, etc.) and new treatment technologies (CAR-T, etc.). In addition, Evaluate Pharma predicts that the CAGR will rise to USD 233 billion in 2026 with a CAGR of 3.2% from 2019 to 2026.

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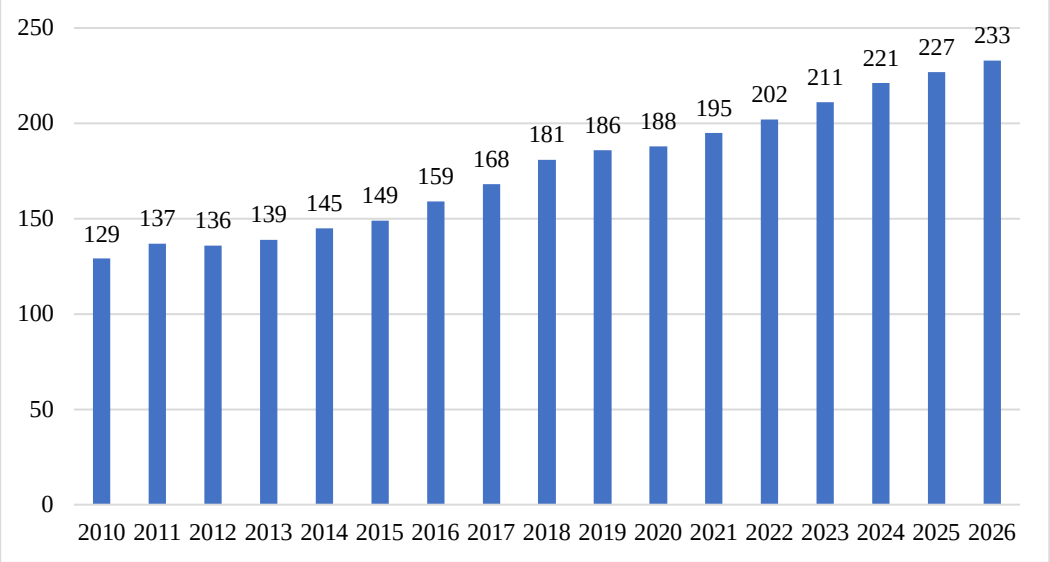

Figure 2.3 – Changes in global pharmaceutical R&D expenditures from 2010 to 2026 (US$ billion)

Source: Compiled by the author based on data of the EvaluatePharma Foresight Industry Research Institute report from 2010 to 2026 [10]

The global drug research and development is gradually heating up, which is mainly based on the emergence of some new molecular drugs in the treatment of diseases such as cancer, diabetes, cognitive impairment, and inflammation, the close integration and complementarity of diagnosis and treatment, and people's The traditional business model (emphasis on generic drugs rather than drugs for unknown rare diseases) dependence on the decline and other important factors.

The following table (Table 3.1) shows the top ten global pharmaceutical manufacturers with R&D investment in 2019-2026. The table 2.1 mainly describes the top 10 R&D investment of multinational companies from 2019.

Table 2.1 – Top 10 R&D investment of multinational companies from 2019 to 2026

Rank	Company	2019, US$ billion	2026, US$ billion	Proportion in 2019	Proportion in 2020	Growth rate
1	Roche	10.3	12.9	21.3%	21.2%	3.3%
2	Merck&co	8.7	11	21.3%	20.6%	3.3%
3	Johnson&johnson	8.8	10.7	22%	19.1%	2.8%
4	Novartis	8.1	9.7	18.2%	17.7%	2.1%
5	Pfizer	8	9.7	-	18.9%	2.7%
6	Bristol-Myers Squibb	5.9	9.4	23.4%	21%	6.9%
7	GlaxoSmithKline	5.5	7.6	17.7%	18.6%	4.6%
8	AstraZeneca	5.3	7.5	22.9%	18.3	5.1%
9	AbbVie	5	7.3	15.4%	13.9%	5.6%
10	Eli Lilly	5.6	7	27.9%	22.7%	3.3%

Source: Calculated by the author based on data of the EvaluatePharma Foresight Industry Research Institute report from 2019 to 2020 [27]

It can be seen that Roche has the largest R&D investment in 2019, with a total of 10.3 billion US dollars, accounting for 21.3% of sales; in 2026, Evaluate Pharma It is predicted that its research and development expenses will be 12.9 billion yuan, accounting for 21.2%.

In second place is Merck, with R&D expenses of US$8.7 billion, accounting for 21.3% of sales; in 2026, Merck's R&D expenses will rise to US$11 billion, accounting for 20.6%. In 2019, Johnson & Johnson ranked third in R&D expenses of US$8.8 billion, accounting for 22% of sales; in 2026, it was US$10.7 billion, accounting for 19.1%.

2.1.4 Pharmaceutical companies face the patent cliff

The "patent cliff" means that due to the expiration of exclusive patent protection for new drugs, pharmaceutical companies are facing fierce competition from generic

drugs, and there are not enough new products on the market to alleviate them. In the past, the turnover and profits obtained by relying on patent protection will plummet.

A new drug usually needs 10-15 years of research and development time from the drug discovery stage to the launching stage. The patent protection period of new drugs in major countries in the world is 20 years. After the new drug is launched, the effective patent protection period is basically only 6-10 years. year. Although 2012 has passed the peak of patented drug expiration, it is expected to usher in a new peak in 2023.

According to EvaluatePharma's statistics, in 2021-2026, patents for original drugs with sales of close to US$252 billion will expire. The expiration of patents of original drugs and the market impact of the introduction of generic drugs are expected to cause a loss of approximately US$125 billion in sales. [57] The figure 2.4 reflects the impact of patent cliffs on the sales of pharmaceutical companies from 2019 to 2026.

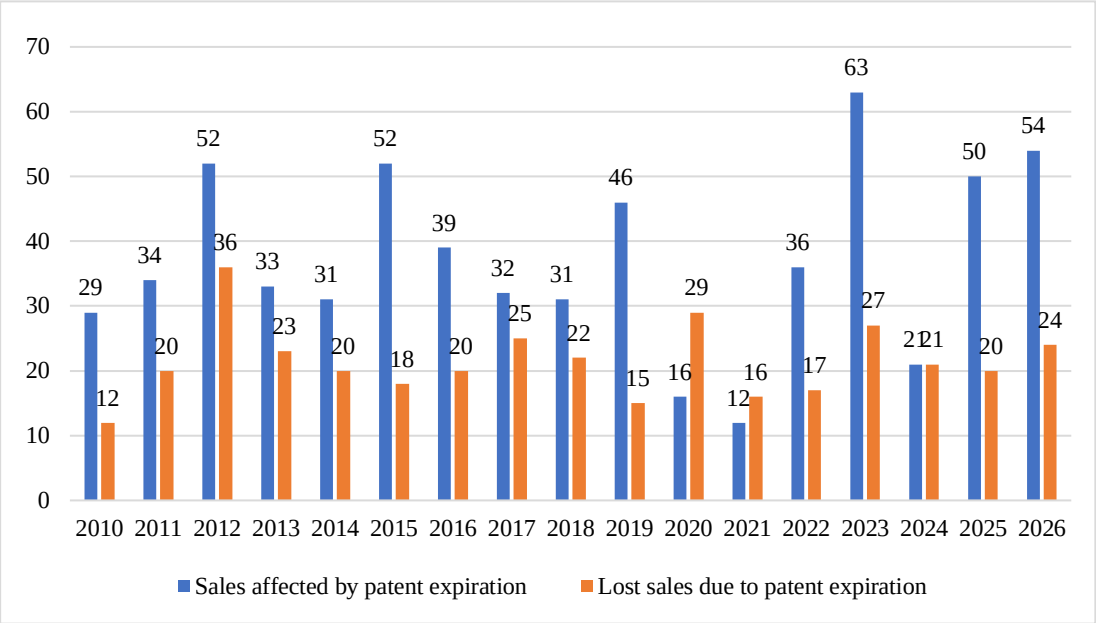

Figure 2.4 – The impact of patent cliffs on the sales of pharmaceutical companies from 2010 to 2026 (US$ billion)

Source: Compiled by the author based on data of the EvaluatePharma Foresight Industry Research Institute report from 2010 to 2026 [10]

In terms of pharmaceutical products, 2023 will be the year with the most patents expiring in recent years, and patents for many biological agents including Humira and Stelara will expire in 2023. In addition, there are many major drugs such as Perjeta, Prolia, Xgeva, Xeljanz, Farxiga and Yervoy that will expire in 2025 and 2025. Nevertheless, in 2026, Eliquis will become the top 10 best-selling drug. [57] The table 2.2 tells about seven pharmaceutical companies before global patent expiration in 2020.

Table 2.2 – Seven major pharmaceutical companies before global patent expiration in 2020

Company name	Number of patents expired	Details
NovartisAG	8	Among these eight, the North American sales of Afinitor / Votubia Exjade / Jadenu, and Zortress / Certican reached 2.188 billion U.S. dollars in 2020, and it is expected to only reach 315 million U.S. dollars in 2025; especially Afinitor / Votubia (everolimus), its sales in 2020 Global sales reached 1083 million U.S. dollars.
Merck&CoInc	5	
PfizerInc	4	Chantix (vareniclinetartrate)'s global sales will drop from US$1107 million in 2019 to only US$89 million in 2025.
AstraZenecaPlc	4	
AllerganPlc	3	
BauschHealthCompanieInc	3	
TakedaPharmaceuticalCoLtd	3	

Source: Calculated by the author based on data of the GlobalData Foresight Industry Research Institute [37]

As can be seen from Table 2.2, Swiss company Novartis will have 8 patents expiring in 2020; among them, sales of Afinitor/Votubia, Exjade/Jadenu and Zortress/Certican in North America will reach 2.188 billion US dollars in 2020, and they are expected to reach only 315 million US dollars in 2025; In particular, Afinitor/Votubia (everolimus) reached US$1,083 million in global sales in 2020.

2.2 Status Quo of China's Pharmaceutical Industry

The pharmaceutical industry is known as the "sunrise industry that never declines." With the increasing importance of people's own health and the acceleration of the domestic population's aging process, the biomedical industry has maintained a continuous growth trend in recent years. China has become the world's largest emerging market in the pharmaceutical industry. The total output value of my country's pharmaceutical industry has increased from 671.9 billion yuan in 2007 to 3.5699 billion yuan in 2017, with a compound annual growth rate of 18.2%.

New drug research and development is the source of innovation in the pharmaceutical industry. From 2010 to 2016, the number of new drugs under research

worldwide has grown steadily, from 9,737 to 13,718, with a compound annual growth rate of 5%. The overall global pharmaceutical R&D expenditure is on the rise, with a compound growth rate of 1.6% from 2011 to 2020. According to statistics, U.S. pharmaceutical companies with revenues of more than 20 billion U.S. dollars have a total operating income of 661 billion U.S. dollars in 2019 and R&D investment of 107.29 billion U.S. dollars, accounting for approximately 16.23%. (See Table 2.3).

Table 2.3 – R&D expenditures of US pharmaceutical companies with revenues exceeding US$20 billion

Company name	**2019 operating income (100 million U.S. dollars)**	**R&D expenditure in 2019 (US$100 million)**	**Ratio of R&D expenditure to operating income in 2019**
Novo Nordisk	1220.21	142.2	11.65
Johnson	820.59	113.55	13.84
Pfizer	517.5	86.5	16.71
Merck Group	486.77	94.02	19.32
Sanofi Aventis	468.4	98.72	21.08
GlaxoSmithKline	376.31	60.18	15.99
AbbVie	337.54	45.68	13.53
Abbott Pharmaceuticals	332.66	64.07	19.26
Medtronic	319.04	24.40	7.65
Bristol-Myers Squibb	289.13	23.31	8.06
Thermo Fisher Scientific	261.45	61.48	23.52
AstraZeneca	255.42	10.03	3.39
Amgen	243.84	60.59	24.85
Gilead Sciences	233.62	41.16	17.56
Eli Lilly and Company	224.49	91.06	40.56
Sanofi Aventis	223.2	55.95	25.07

Source: Calculated by the author based on data of the GlobalData Foresight Industry Research Institute [33]

As Table 2.3 shows, compared to pharmaceutical companies in the United States, Chinese pharmaceutical companies are clearly focused on sales rather than R&D.

2.2.1 Chemical and biopharmaceutical companies-only two R&D companies that keep up with international giants

There are currently 147 listed companies in the chemical pharmaceutical and biological products sub-industry of the A-share pharmaceutical industry. In 2019, the total operating income is 541.7 billion yuan, and the total R&D expenditure is 33.7 billion yuan, accounting for only 6.22%; the total sales expenses are 137 billion yuan. It accounts for 25.29%. Due to the large investment in research and development of new drugs, the longer cycle, and the higher risk of failure, pharmaceutical companies are not willing to invest too much in research and development. At the same time, the existing domestic drug intellectual property laws are not perfect and lack effective binding force on infringements. Therefore, most chemical drug companies in my country mainly focus on generic drugs, and the number of original research drugs is very small.

The data shows that among the 30 chemical pharmaceutical and biological products companies with revenues of more than 5 billion yuan, Hengrui Pharmaceuticals has the largest R&D investment. (See Table 2.4).

Table 2.4 – R&D expenditures of chemical pharmaceutical and biological products companies accounted for the top ten in revenue

Company name	2019 operating income (100 million RMB)	R&D expenditure in 2019 (100 million RMB)	Ratio of R&D expenditure to operating income in 2019 %	Sales expenses accounted for of operating income in 2019 %	Proportion of R&D personnel %	Proportion of sales staff %
Hengrui Medicine	232.89	38.96	16.76	36.61	14.09	60.11
Fosun Pharma	285.85	34.63	12.12	34.45	6.84	16.67
Huahai Pharmaceutical	53.88	5.47	10.16	17.83	21.59	2.94
East China Hospital	354.46	10.55	10.04	16.36	11.31	50.01
Yifan Bio	51.87	4.98	9.59	12.11	17.44	25.8
Health yuan	119.8	10.66	8.9	33.07	9.27	25.27
Livzon Group	93.85	8.28	8.82	32.96	8.08	28.93
Kelun Pharmaceutical	176.36	13.51	7.66	37.14	15.64	7.19
Hisun Pharmaceutical	110.72	8.14	7.35	26.09	8.47	28.05
Luoxin Pharmaceutical	75.89	4.86	6.4	42.8	6.99	44.29

Source: Calculated by the author based on data of the GlobalData Foresight Industry Research Institute [8]

Hengrui's 2019 revenue was 23.29 billion yuan, R&D expenditures were 3.896 billion yuan, accounting for 16.76% of revenue; sales expenses were 825 million yuan, accounting for 36.61% of revenue. Up to now, Hengrui has 6 innovative drugs on the market, 1 innovative drug has been declared for production, more than 30 innovative drugs are in the clinical development stage, a total of 44 national major new drug creation special projects, and more than 800 invention patents have been applied for, Including nearly 300 international patents. Hengrui is the largest listed pharmaceutical company by market capitalization in China. Years of high R&D investment has brought substantial returns to the company. The return on net assets in the past three years has been above 23%.

Fosun Pharmaceuticals ranked second in R&D investment. The company's 2019 revenue was 28.59 billion yuan, R&D expenditure was 3.463 billion yuan, accounting for 12.12% of revenue; sales expense expenditure was 9.847 billion yuan, accounting for 34.45% of revenue. The company has a total of 264 projects in research on innovative drugs, generic drugs, biosimilar drugs, and generic drugs consistency evaluation. 8 projects are applying for clinical trials, 32 projects are undergoing clinical trials, and 38 projects are waiting for approval for listing.

2.2.2 Medical device company-"persist in" sales-driven development

At the same time, there are currently 89 listed companies in the medical device and medical service sub-industry. In 2019, the total operating income is 182.6 billion yuan, and the total R&D expenditure is 10.6 billion yuan, accounting for only 5.82% of the revenue; the total sales expenses are 27.4 billion yuan, accounting for Received 15.05%. (See Table 2.5).

Table 2.5 – Top ten medical equipment and medical service R&D expenditures as a percentage of revenue

Company name	2019 operating income (100 million RMB)	R&D expenditu-re in 2019 (100 million RMB)	Ratio of R&D expenditure to operating income in 2019 %	Sales expenses accounted for of operating income in 2019 %	Propor-tion of R&D personnel %	Proportion of sales staff %
Mindray Medical	165.56	16.49	9.36	21.78	25.54	32.21
Blue Sail Medical	34.76	2.97	8.54	16.16	13.25	7.92
Lepu Medical	77.96	6.31	8.09	27.86	22.48	30

End of Table 2.5

Chenxin Pharmaceutical	41.13	3.11	7.55	31.69	26.55	14.58
Golden Field Medical	52.69	3.24	6.15	15.27	10.27	21.58
Mike Biology	32.23	1.89	5.88	17.53	11.74	22.91
Diving Medical	46.36	2.35	5.07	13.59	13.14	11.8
WuXi AppTec	128.72	5.9	4.59	3.41	82.19	0.5
Meikang Biological	31.33	1.28	4.09	11.63	12.77	13.81
Dean Diagnosis	84.53	2.13	2.52	9	10.78	19.01

Source: Calculated by the author based on data of the Med Tech's 2019 R&D big spenders report [21]

Among the 15 medical equipment and medical service companies with revenues of more than 3 billion yuan, Mindray Medical ranks first in terms of R&D investment. The company's 2019 revenue was 16.56 billion yuan, R&D expenditure was 1.649 billion yuan, accounting for 9.36% of revenue; sales expense expenditure was 3.606 billion yuan, accounting for 21.78% of revenue. Among the company's 9819 employees, there are 2,508 R&D personnel, accounting for 25.5%. At present, the company's monitoring line monitors, anesthesia machines, defibrillators, ultrasound line products, in vitro diagnostic line biochemistry, blood cells and other products rank in the forefront of the domestic market, and it is the largest domestic medical device manufacturer.

Another thing worth mentioning is WuXi AppTec. In 2019, the company's revenue was 12.87 billion yuan, but R&D expenditure was only 590 million yuan, accounting for 4.59% of revenue; sales expenses were very low, only 439 million yuan, accounting for 3.4% of revenue. %. Among the company's current 21,744 employees, there are 17,872 R&D personnel, accounting for more than 82%. Among them, there are 6,450 masters and 1,022 doctors, making it the company with the largest number of doctors in listed pharmaceutical companies. There are only 109 sales staff in the company, accounting for only 0.5%. WuXi AppTec's main business is new drug R&D services for pharmaceutical companies, that is, R&D labor outsourcing. The main areas are small molecule chemical drug R&D services (CRO) and pharmaceutical services (CMO). Therefore, on the one hand, the company only needs very few sales personnel; on the other hand, the company’s R&D expenditure is mainly used for process upgrades in the CMO business and research on the yield of APIs, while the CRO business R&D expenditure is less. The reason is that according to the International Accounting Standards, the expenses related to R&D activities cannot be transferred to customers according to the contract.

2.2.3 Traditional Chinese medicine companies rely on "exclusive secret recipes" to ensure profits

Companies in the Chinese medicine sub-industry of the pharmaceutical industry have invested the least in R&D. The total operating income of 68 Chinese medicine companies in the two cities in 2019 was 317.6 billion yuan, but the total R&D expenditure was only 7.99 billion yuan, accounting for only 2.52%; the total sales expenses were 81.95 billion yuan Yuan, accounting for 25.81%. Among the 15 listed Chinese medicine companies with an operating income of more than 5 billion yuan, YiLing Pharmaceutical has the highest R&D investment. The company's revenue in 2019 was 5.83 billion yuan, and R&D expenditure was 515 million yuan, accounting for 8.84% of its revenue. The R&D investment of Chinese medicine companies outside Yiling does not exceed 5% of revenue. (See Table 2.6).

The phenomenon of traditional Chinese medicine companies taking their roots is very obvious. A typical example is Baiyun Mountain. The company's operating income in 2019 reached 64.95 billion yuan, and the expenditure on research and development was only 592 million yuan, accounting for only 0.91%. There is also Pien Tze Huang, whose core product Pien Tze Huang was invented in the mid-Ming Dynasty, more than 500 years ago, and the company still uses it as a moat to enjoy its profits.

Table 2.6 – Research and development expenditures of Chinese medicine companies with revenues exceeding 5 billion yuan

Company name	**2019 opera-ting income (100 million RMB)**	**R&D expenditure in 2019 (100 million RMB)**	**Ratio of R&D expenditure to operating income in 2019 %**	**Sales expenses accounted for of operating income in 2019 %**	**Proportion of R&D personnel %**	**Proportion of sales staff %**
Baiyun Mountain	649.52	5.92	0.91	9.83	2.27	56.36
Yunnan Baiyao	296.65	1.74	0.59	14.01	9.21	63.61
Tasly	189.98	8.1	4.26	14.55	13.64	56.91
China Resources Sanjiu	147.02	5.34	3.63	44.55	2.7	32
Buchang Pharmaceutical	142.55	6.39	4.48	56.68	10.5	21.89
Tongrentang	132.77	2.41	1.82	19.75	2.72	50.12
Tai Chi Group	116.43	1.76	1.52	32.21	5.6	26.79
Kunyao Group	81.2	1.27	1.56	36.68	4.29	33.54

End of Table 2.6

Zhongxin Pharmaceutical	69.94	1.4	2	26.15	14.72	43.39
Jichuan Pharmaceutical	69.4	2.31	3.1	49.70	8.51	51.45
Conbay	67.68	1.83	2.7	49.64	10.05	44.91
SINBON Pharmaceutical	66.55	0.37	0.55	6.5	2.97	8.9
Yiling Pharmaceutical	58.25	5.15	8.84	38.23	16.35	59.98
Pien Tsai Yellow	57.22	1.19	2.09	9.14	6.16	38.72
Hongri Pharmaceutical	50.03	2.38	4.75	42.10	15.71	26.31

Source: Calculated by the author based on data of the Med Tech's 2019 R&D big spenders report [21]

Data show that in the overseas Chinese medicine market, China owns only 0.3% of patent rights, while Japan and South Korea account for more than 70%. Japan and South Korea account for 80% of the overseas Chinese medicine market share, while China's exports of Chinese medicine account for only about 5%.

CHAPTER 3 HENGRUI PHARMACEUTICAL R&D INNOVATION AND MARKET VALUE ANALYSIS

3.1 The change of coaches ushered in a new era, professional managers took over to build a century-old Hengrui

The predecessor of Hengrui Medicine was the Lianyungang Pharmaceutical Factory, which was established in 1970. It completed the shareholding system transformation in 1997 and was listed on the Shanghai Stock Exchange in 2000. The company began to deploy innovative drugs at the beginning of its listing, and the first innovative drug, Irecoxib, was approved for listing in 2011. Since 2017, the company has gradually ushered in new drug development and internationalization. Innovative drug varieties 19K, pyrrotinib, PD-1 monoclonal antibody, etc. have been approved one after another. In January 2020, the former chairman of the company, Mr. Sun Piaoyang, stepped down, and Mr. Zhou Yunshu took over. As professional managers stepped forward, Hengrui Medicine entered a new stage of development [57]. The table 3.1 mainly draws up the memorabilia of Hengrui Pharmaceutical Development.

Table 3.1 – Memorabilia of Hengrui Pharmaceutical Development

Lianyungang Pharmaceutical Factory, the predecessor of Hengrui Pharmaceuticals, was established		Hengrui Medicine is listed on the Shanghai Stock Exchange		Methaliplatin API obtained CEP certification and Hengrui was established in the United States		Apatinib, the first innovative anti-tumor drug, approved for marketing		Sevochlorane for inhalation was successfully sold to the United States		Innovative drug 19k, pyrrotinib was launched, albumin paclitaxel was approved		The former chairman of the company, Mr. Sun Piaoyang, resigns, and Mr. Zhou Yunshu takes over
1970	1997	2000	2003	2005	2011	2014	2015	2016	2017	2018	2019	2020
	The company completes the shareholding system reform		The company's first innovative drug Irecoxib received SFDA clinical approval		Irecoxib was approved, Irinotecan injection was approved by FDA		The company sold its first overseas interest in PD-1 with independent intellectual property rights		The company's besylate, docetaxel, caspofungin, and dexmedetomidine have been approved by the FDA		Blockbuster product PD-1 was approved	

Source: Calculated by the author based on data of the PASC Research Institute official website [6]

The actual controller of the company is Mr. Sun Piaoyang, who indirectly holds 21.55% of Hengrui Pharmaceutical through Hengrui Group. The company has many subsidiaries, covering the entire pharmaceutical industry chain including R&D, production, sales, APIs, and import and export. [57] Table 3.2 shows the Hengrui Pharmaceutcal's shareholder structure and main subsidiaries.

Table 3.2 – Hengrui Pharmaceutical's shareholder structure and main subsidiaries

Sun Piaoyang													
89.22%													
Hengrui Group		Tibet Dayuan		Land Stock Connect		Hengrui Medicine		China Pharmaceutical Investment		other			
24.15%		14.96%		11.39%		4.87%		4.12%		40.51%			
Jiangsu Hengrui Pharmaceutical Co., Ltd.													
100%	90%	100%	100%	100%	96%	100%	100%	90%	100%	100%	100%	100%	100%
Shanghai Shengdi	Jiangsu original	Beijing Hengsen	United States Hengrui	Shanghai Hengrui	Chengdu Shengdi	Suzhou Shengdi	shandong Shengdi	Jiangsu Kexin	Jiangsu Xincheng	Japan Hengrui	Jiangsu Shengdi	Cadias	Ogilvy, Hong Kong
R & D				R&D and production				Sales			API	import and export	

Source: Calculated by the author based on data of the PASC Research Institute Company's first coverage report [19]

The company's performance has continued to grow steadily since its listing in 2000. In 2019, the company's revenue was 23.289 billion yuan, a year-on-year increase of 33.70%; net profit attributable to the parent was 5.328 billion yuan, a year-on-year increase of 31.05%. The CAGR of revenue from 2000 to 2019 was 22.61%, a cumulative increase of 47 times; the CAGR of net profit attributable to the parent was 26.07%, a cumulative increase of 81 times. [56] Figure 3.1 draws up Hengrui Pharmaceutical's revenue, net profit attributable to the parent and its growth rate.

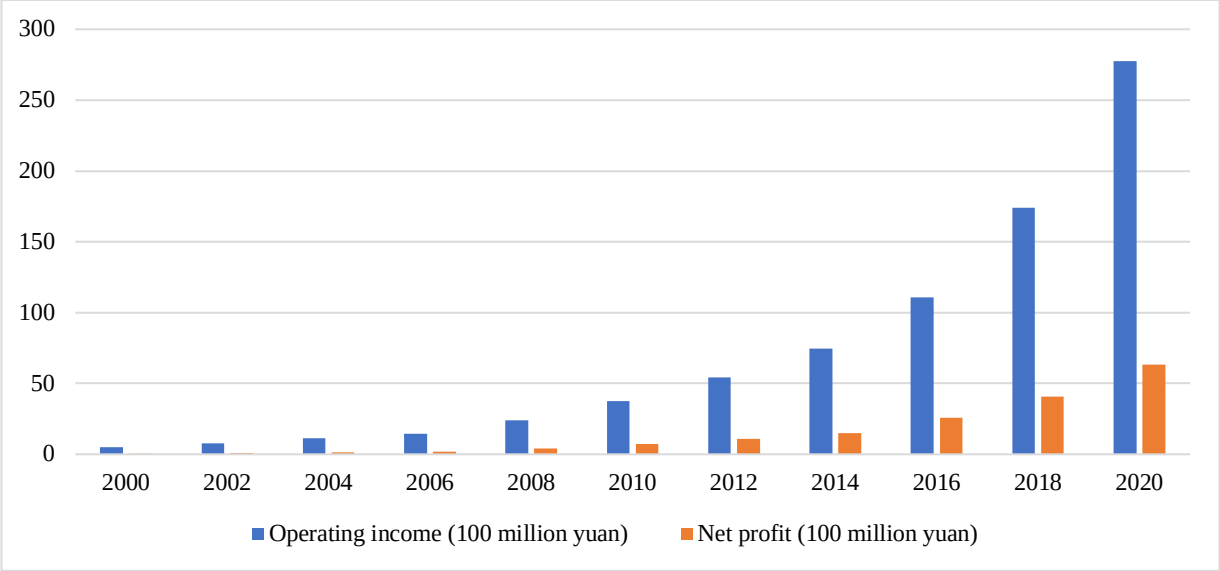

Figure 3.1 – Hengrui Pharmaceutical's revenue, net profit attributable to the parent and its growth rate

Source: Compiled by the author based on data of the PASC Research Institute [53]

The product structure is continuously optimized, and anti-tumor, anesthesia, and contrast agents are currently the three major business sectors. At the beginning of its listing in 2000, the company mainly focused on medicinal packaging materials, anti-tumor drugs, and anti-infective drugs. With the continuous optimization of the product structure, it has now formed its business mainly in the three major areas of anti-tumor, anesthesia and contrast agents. pattern. In 2019, anti-tumor, anesthesia, and contrast agent revenue accounted for 45%, 24%, and 14%, respectively [56] Figure 3.2 shows Hengrui Pharmaceutical’s revenue composition and changes in proportion.

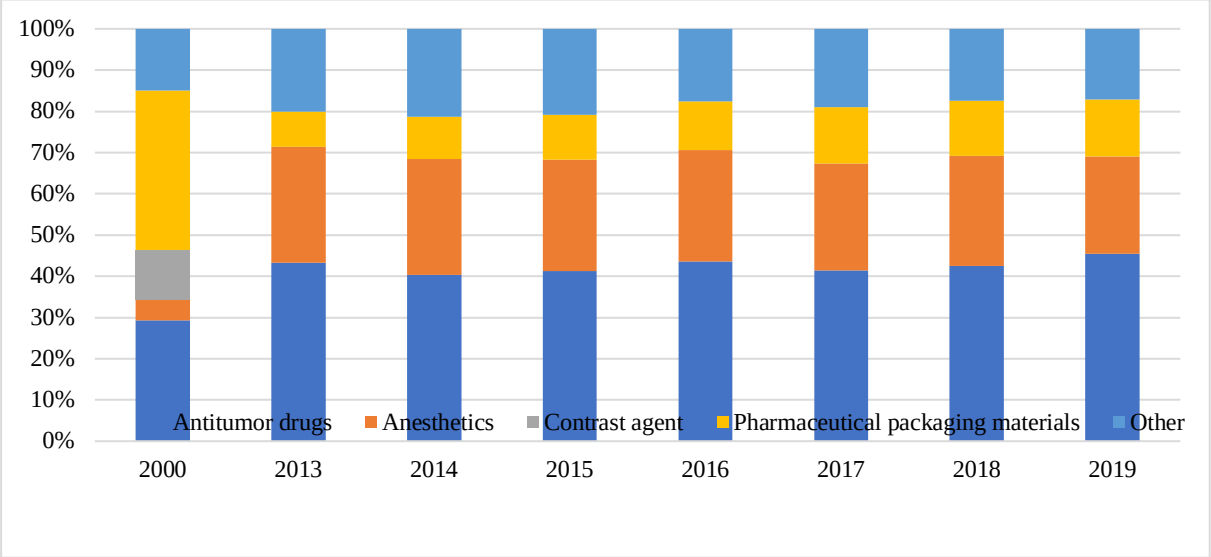

Figure 3.2 – Hengrui Pharmaceutical's revenue composition and changes in proportion

Source: Compiled by the author based on data of the PASC Research Institute [51]

3.2 Innovation is the company's core strategy, and Hengrui Pharmaceutical establishes its status as a "big brother"

Innovation is the current major trend in the domestic pharmaceutical industry. The era when the domestic drug market relied on traditional generic drugs to "eat fresh with one trick" has passed. As the medical reform continues to deepen, new medical reforms and drug policies are constantly being introduced, making my country's drug regulatory environment gradually integrate with mature markets such as the United States. The winning logic of the pharmaceutical industry has undergone major changes, and innovation has become the core driving force of the domestic pharmaceutical market. Companies must follow the changing trends of the industry, increase R&D investment, and maintain high-quality continuous growth by building a complete echelon of products under research. [57] Table 3.3 tells the comparison of the pharmaceutical market environment between China and the United States.

Table 3.3 – Comparison of the pharmaceutical market environment between China and the United States

	Past	**After improvement**	**right now**	**United States**
New drug listing progress	The progress of new drug review is slow, and the domestic launch of overseas new drugs is more than five years slower than abroad	Priority review and recognition of overseas clinical data	The speed of review of new drugs has been accelerated, and the time for overseas new drugs to be marketed in China has been shortened	One of the first countries to launch new drugs in the world
New drug release rate	New drugs are slow to increase their doses, and can only enter the medical insurance catalog 5 to 10 years after they are on the market	Medical insurance dynamic adjustment	Medical insurance is dynamically adjusted, new drugs are released quickly	Fast access to medical insurance, fast volume of innovative drugs
Generic drug market	Setting up approval barriers, the price of generic drugs is high, and the market for generic drugs is large	Consistency evaluation, purchase with quantity	The review backlog was lifted, generic drugs were launched quickly, prices fell sharply, and the market shrank	After the patent expired, generic drugs were quickly listed, and the price of generic drugs was about @0% of that of new drugs

End of Table 3.3

Auxiliary Drug Market	Auxiliary medication is popular	Medical insurance control fees, assessment of the proportion of medicines	Decline of adjuvant medication	Almost no adjuvant medication

Source: Calculated by the author based on data of the PASC Research Institute Company's report [11]

Hengrui Pharmaceutical's R&D continues to grow rapidly, and the proportion of R&D expenditure has reached the level of global pharmaceutical giants. Innovation is the company's core strategy. The company has attached importance to pharmaceutical research and development at the beginning of its listing, and its R&D expenditure has continued to grow rapidly, ranking first in China for many years. [56] Figure 3.3 reflected Hengrui Pharmaceutical's R&D investment.

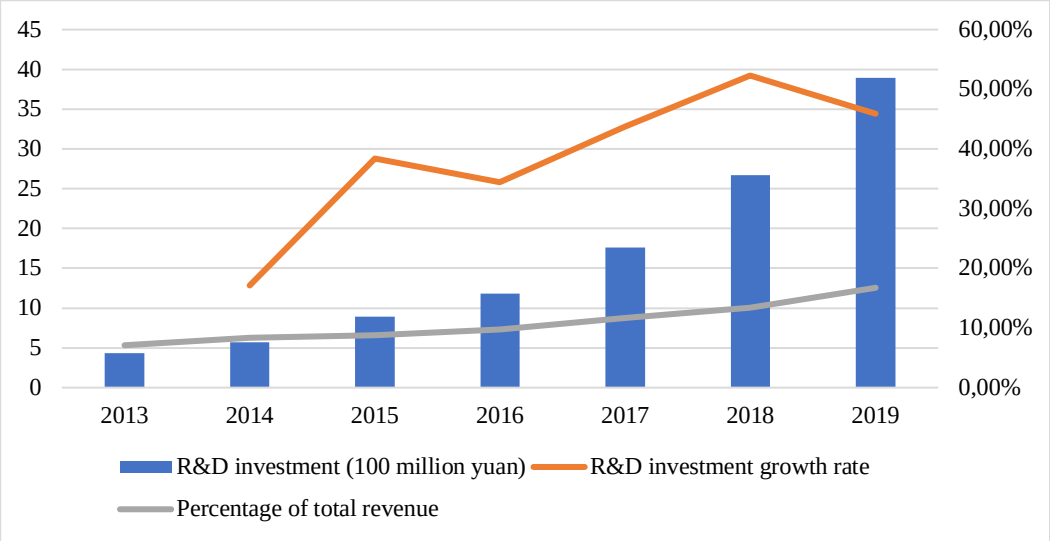

Figure 3.3 – Hengrui Pharmaceutical's R&D investment

Source: Compiled by the author based on data of the PASC Research Institute from 2013 to 2019 [19]

As seen from the Figure 3.3, In 2019, the company's R&D expenditure was 3.896 billion yuan, a year-on-year increase of 45.92%, accounting for 16.73% of revenue. Both the amount of investment and the proportion of revenue were far ahead of mainstream domestic pharmaceutical companies. In 2018, the top 10 global R&D investment companies had an average R&D expenditure of US$7.794 billion, and their average revenue accounted for 19.58%. At present, the proportion of Hengrui Pharmaceutical's R&D expenditure and revenue has reached the level of global pharmaceutical giants. [56] Figure 3.4 make the statistical analysis of top 10

pharmaceutical companies in global R&D investment in 2019.

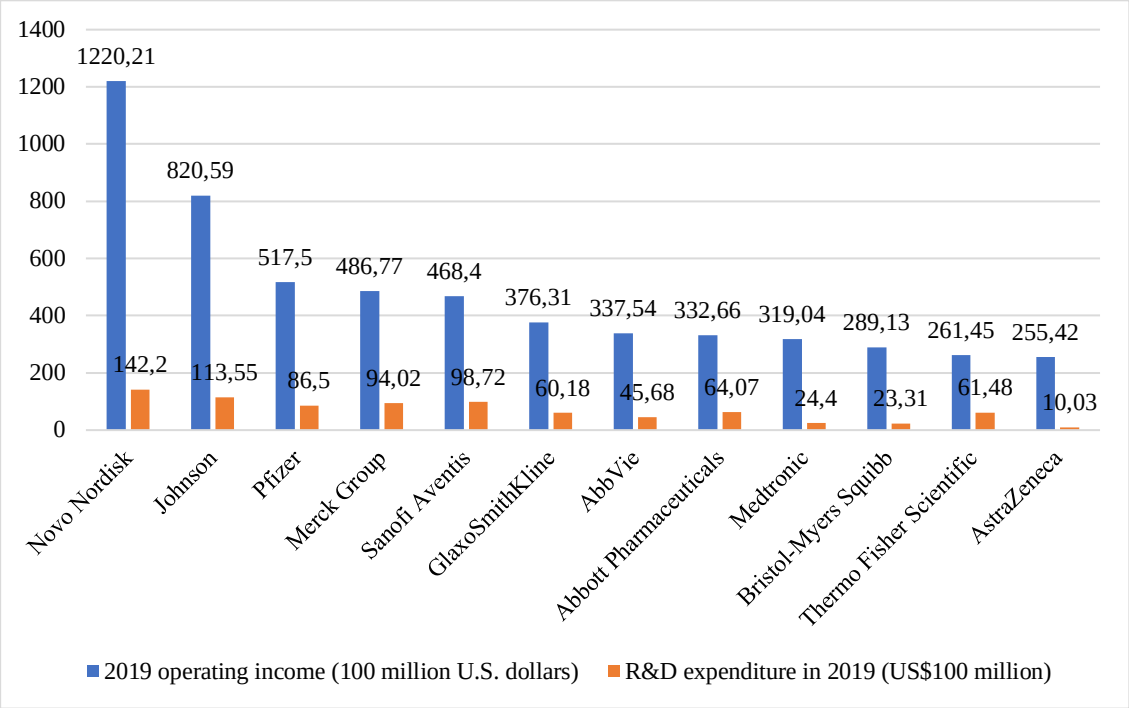

Figure 3.4 – Top 10 pharmaceutical companies in global R&D investment in 2019

Source: Compiled by the author based on data of the Annual reports of various companies, [13]

The company has an early deployment of innovative drugs, and Hengrui Pharmaceutical has been accumulating. The company submitted a listing application for Irecoxib as early as 2003. At that time, medical insurance was expanding, and generic drugs "layed down and made money." The courage to step out of the comfort zone, from the combination of imitation and innovation to independent innovation, the continuous layout of innovative drugs reflects the advanced strategic vision and strong courage of the company's leadership. As of the end of 2019, the company had applied for a total of about 54 innovative drug INDs, and R&D investment (US$100 million) as a percentage of revenue Hengrui Pharmaceuticals. The company's first coverage report included a significant increase in the number of declarations since 2017. At the same time, the company is gradually ushering in the harvest season. Since 2018, four major varieties of pyrrotinib, 19K, PD-1, and remazolam have been approved. It is expected that innovative drug varieties will be launched every year in the future [57].

Table 3.4 make the conclusion of Hengrui Pharmaceutical’s innovation drug IND application and approval status.

Table 3.4 – Hengrui Pharmaceutical's innovative drug IND application and approval status (as of the end of 2019)

2003	2005	2006	2008	2009	2011	2012	2013	2014	2015	2017	2018	2019
Irecoxib	Chlorincoxib	Apatinib	19k	Retagliptin	Hytrobopar	Henggliflozin	Umidji	SHR-1210	SHR-1210	SHR1459	SHR-1603	Fluzoparil
Cardofloxacin	Edostan ambroxol		Philotas		Pyrrotinib	Remazolam	HAO472	SHR-0814	SHR0814	SHR-1316	SHR-1701	DDO-3085
			Famitinib				Glipefan	SHR-6390	SHR1309	SHR-2042	SHR-1209	SHR-1704
							Ringmiddji	SHR1314		SHR8554	SHR-1902	SHR-1802
							SHR0302	SHR7390		SHR0532	SHR2285	SHR-1703
							M6G			SHR7280	SHR-1222	SHR5126
							SHR-A1201			SHR9146	SHR2150	
										SHR-A1403		
										SHR9549		
										SHR-1501		
										INS068		
										SHR0410		
										SHR2554		

Source: Calculated by the author based on data of the PASC Research Institute Company's announcement [24]

A variety of innovative drug products will be launched soon. In addition to the 6 innovative drug varieties that have been marketed, repagliptin (DPP-4 inhibitor), treropopag (TPOR agonist), famitinib (multi-target TKI), henggligliflozin (SGLT2)

Inhibitors), SHR3680 (AR receptor antagonist), SHR4640 (URAT1 inhibitor), SHR6390 (CDK4/6 inhibitor), SHR1316 (PD-L1) and many other heavy varieties are in the phase III clinical stage, and are expected to continue Listed. [57] Table 3.5 mainly draws up the summary of Hengrui Medicne's main innovaton drugs in the clinical stage.

Table 3.5 – Summary of Hengrui Medicine's main innovative drugs in the clinical stage (the latest progress is subject to the first indication)

	Name	**Mechanism of action**	**Indications**	**Latest progress**
1	Irecoxib	COX-2	Osteoarthritis	year 2011
2	Apatinib	VEGDFR-2	Advanced gastric cancer	year 2014
3	Thiopefilgrastim	G-CSF	Neutropenia	year 2018
4	Pyrrotinib	HER-2	Breast cancer	year 2018
5	Carrelizumab	PD-1	Hodgkin's Lymphoma	year 2019
6	Remazolam	GAB Aa	General anesthesia during surgery	year 2019
7	Fluzoparil	PARP	Tumor	Approval
8	Retagliptin	DPP-4	Type 2 diabetes	Clinical Phase 3
9	Hytrobopar	TPO-R	Aplastic anemia	Clinical Phase 3
10	Famitinib	TKI	Malignant tumor	Clinical Phase 3
11	Henggliflozin	SGLT2	Type 2 diabetes	Clinical Phase 3
12	SHR3680	AR	Prostate cancer	Clinical Phase 3
13	SHR4640	URAT1	gout	Clinical Phase 3
14	SHR6390	CDK4/6	Malignant tumor	Clinical Phase 2
15	SHR0302	JAK1	Ulcerative colitis Crohn's disease	Clinical Phase 2
16	SHR1316	PD-L1	Tumor	Clinical Phase 2
17	SHR1314	IL-17	psoriasis	Clinical Phase 2
18	DDO-3055	PHD	anemia	Clinical Phase 1
19	SHR8554	MOR	pain	Clinical Phase 1
20	SHR0532	ROMK	hypertension	Clinical Phase 1
21	SHR7390	MEK1/2	Colon cancer	Clinical Phase 1
22	SHR0410	KAPPA	Itching	Clinical Phase 1
23	SHR2554	EZH2	Malignant tumor	Clinical Phase 1
24	INS068		diabetes	Clinical Phase 1
25	SHR7280	GNRH	Estrogen dependence	Clinical Phase 1
26	SHR2285	FXIA	Venous thrombosis	Clinical Phase 1
27	SHR1209	PCSK9	High cholesterol blood cancer	Clinical Phase 2
28	SHR1701	PD-L1/TGF-b	Tumor	Clinical Phase 1

End of Table 3.5

29	SHR1702	TIM-3	Tumor	Clinical Phase 1
30	SHR1501	IL-15	Tumor	Clinical Phase 1
31	SHR2150	TLR7	Malignant tumor	Clinically approved

Source: Calculated by the author based on data of the PASC Research Institute Company's announcement [24]

At the same time, the company continues to expand the scope of indications around existing innovative drugs. For example, Carrelizumab, currently approved indications include classic Hodgkin's lymphoma, advanced hepatocellular carcinoma, advanced or metastatic non-squamous NSLCL, advanced or metastatic esophageal squamous cell carcinoma, which is already in stage III New indications in the clinical stage include advanced gastric cancer, squamous NSCLC, triple-negative breast cancer, nasopharyngeal carcinoma, etc. The continued expansion of indications around heavy varieties will fully release the patent value of innovative drugs and ensure the maximization of returns. [56] Figure 3.5 analysis the number of IND declarations for Class 1 new drugs of major domestic pharmaceutical companies.

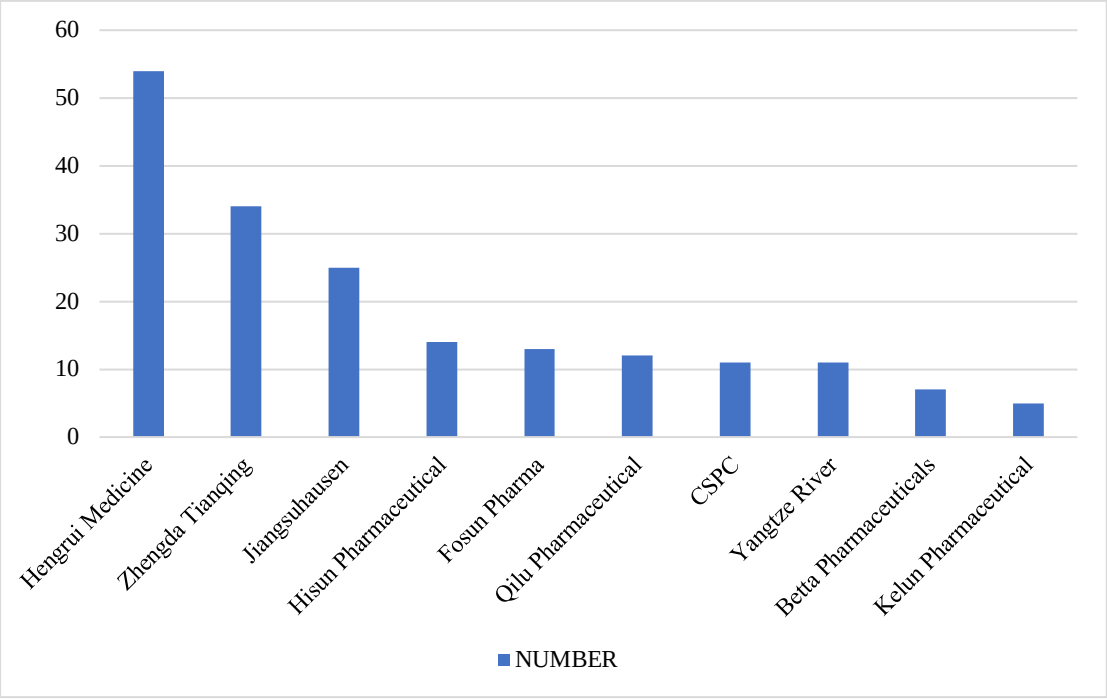

Figure 3.5 – Number of IND declarations for Class 1 new drugs of major domestic pharmaceutical companies (as of February 18, 2020)

Source: Compiled by the author based on data of the PASC Research Institute report [19]

Hengrui Pharmaceuticals is far ahead in the number of Class 1 new drug applications. According to our statistics, as of February 18, 2020, Hengrui Medicine

has declared a total of 54 Class 1 new drug INDs, much higher than other domestic companies. Zhengda Tianqing and Jiangsu Hausen ranked second and third with about 34 and 25 items respectively. The company is a veritable R&D "first brother" in China.

3.3 A strong marketing team to enhance product monetization capabilities

Division of business divisions increased focus, and a sales team of 15,000 people improved product monetization capabilities. In 2018, the company adjusted the sales team's organizational structure for branch sales and division system, and established three new divisions: tumor, imaging, and integration, plus the anesthesia line previously in charge of wholesale sales by Jiangsu Xinchen, a total of four divisions . The business unit system structure can significantly increase the concentration of sales staff, which in turn drives the improvement of sales capabilities. As of the end of 2019, the company had a total of 14,686 sales personnel, a year-on-year increase of 20.62%. The number of sales staff of the company is second to none among domestic enterprises [56]. Table 3.6 make the summary of Hengrui Pharmaceutical Marketing Team Structure. And in the following figure 3.6 draws up the tendy of sales personal and growth rate of Hengrui Pharmaceuticals.

Table 3.6 – Hengrui Pharmaceutical Marketing Team Structure

Sales team			
Oncology Division	Image Division	Integrated Business Department	Anesthesia Division
Jiangsu Kexin			Jiangsu Xinchen

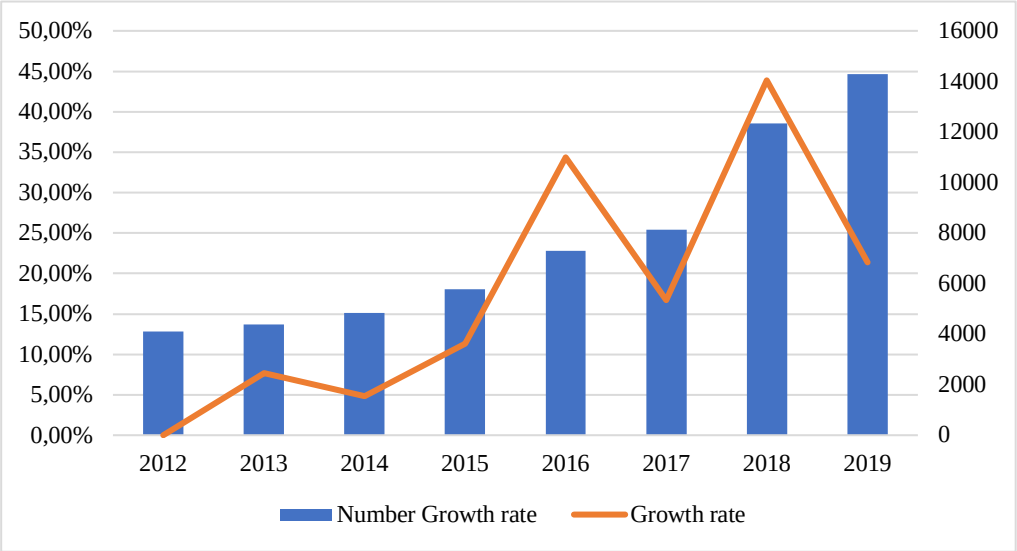

Figure 3.6 – Sales personnel and growth rate of Hengrui Pharmaceuticals

Source: Compiled by the author based on data of the PASC Research Institute report [19]

The company's main products have a leading market share, which is a manifestation of strong sales capabilities. From the point of view of sample hospitals, the market share of the top 20 varieties of Hengrui Pharmaceuticals sales in 2019 are both in the top two. Among the top 11 varieties, except for paclitaxel (albumin-bound), the market share is the first. In addition, the Top20 varieties accounted for 92% of the company's sample hospitals' total revenue, reflecting the company's strong sales capabilities [57]. Table 3.7 make amounts of data to show the details of the top 20 varieties of Hengrui Pharmaceutical’s sample hospital sales in 2019.

Table 3.7 – Details of the top 20 varieties of Hengrui Pharmaceutical's sample hospital sales in 2019

Name	Sales volume (100 million yuan)	Rate of increase	Market share	Market share Ranking	Number of the enterprise
Iodixanol	8.53	37%	58%	1	5
Cisatracurium benzenesulfonate	6.62	24%	76%	1	4
Docetaxel	6.19	-7%	46%	1	15
Dexmedetomidine	5.24	-25%	51%	1	7
Butofino	4.96	84%	exclusive	1	1
Sevochlorane	4.8	14%	66%	1	5
Irinotecan	4.72	8%	91%	1	2
Paclitaxel	4.35	13%	66%	1	5
Apatinib	3.63	-	30%	2	5
Calcium Sodium Magnesate Glucose	3.4	27%	exclusive	1	1
Sodium magnesium potassium calcium glucose	2.44	4%	exclusive	1	1
Tegafur	2.02	-6%	16%	2	5
Oxaliplatin	1.93	-14%	16%	2	18
letrozile	1.71	7%	30%	2	3
Caspofungin	1.7	158%	21%	2	3
Imrecoxib	1.67	68%	exclusive	1	1
Febuxostat Tablets	1.6	43%	35%	2	4
Xeloda	1.02	-10%	10%	2	4
Cefoselis	10.1	-34%	exclusive	1	1
Gadolinium gluconamide terate	0.99	100%	82%	1	2

Source: Calculated by the author based on data of the PASC Research Institute Company's report [45]

Sales ability is the guarantee for the high volume of new drugs. Taking Irecoxib and apatinib as examples, the two new drugs ushered in a rapid increase after their launch, and the CAGR reached 101% and 54% in 2019, respectively. The heavyweight PD-1 monoclonal antibody was only approved for marketing in 2019, but from the point of view of the sample hospitals, 2020Q2 sales have reached 77.18 million yuan. At present, under the influence of policies such as mass procurement, the sales link of generic drugs has been weakened. But for new drugs, the professionalism of the sales team and the degree of market coverage are still the key factors for their ability to quickly increase volume. [56] We will see the trendies from the following 3 figures (see figures 3.7-3.9) of “sales and growth rate of erycoxib sample hospitals”, “Apatinib sample hospital sales and growth rate”, “Sales of Hengrui Medicine Carrelizumab Sample Hospitals”.

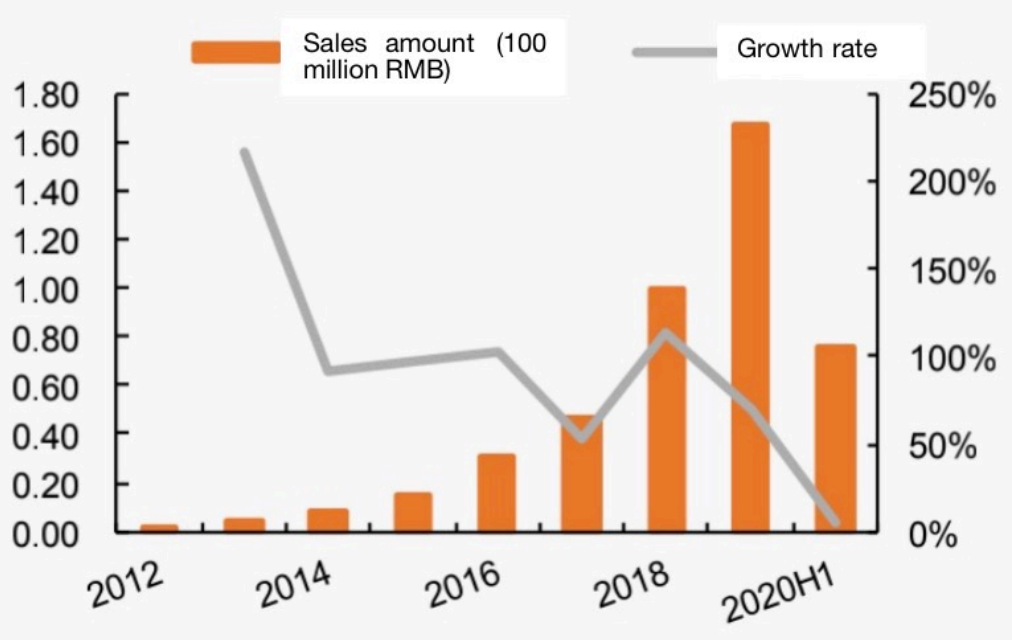

Figure 3.7 – Sales and growth rate of erycoxib sample hospitals

Source: Compiled by the author based on data of the PASC Research Institute company announcement [14]

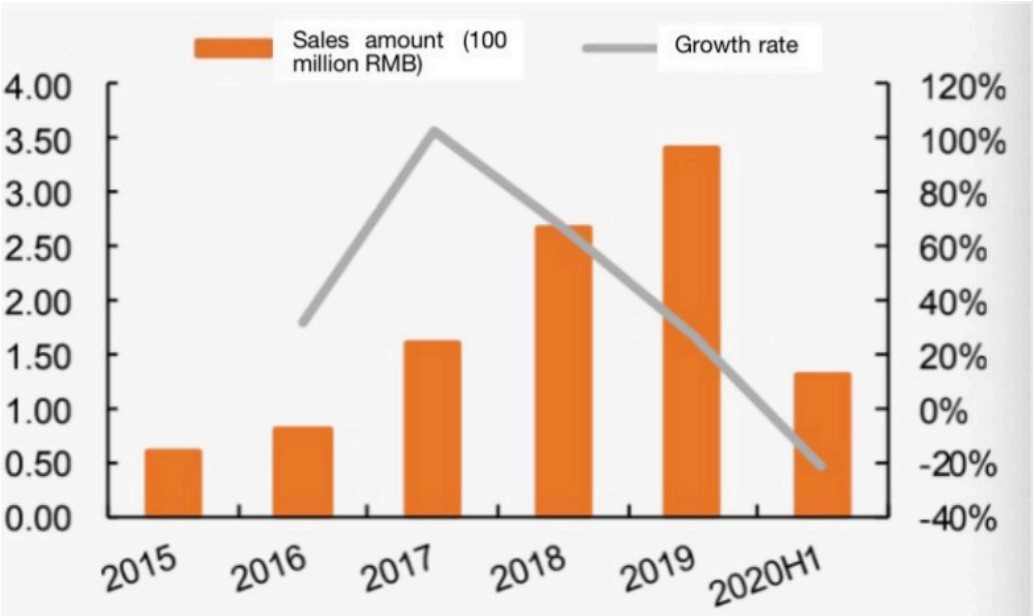

Figure 3.8 – Apatinib sample hospital sales and growth rate

Source: Compiled by the author based on data of the PASC Research Institute company announcement [14]

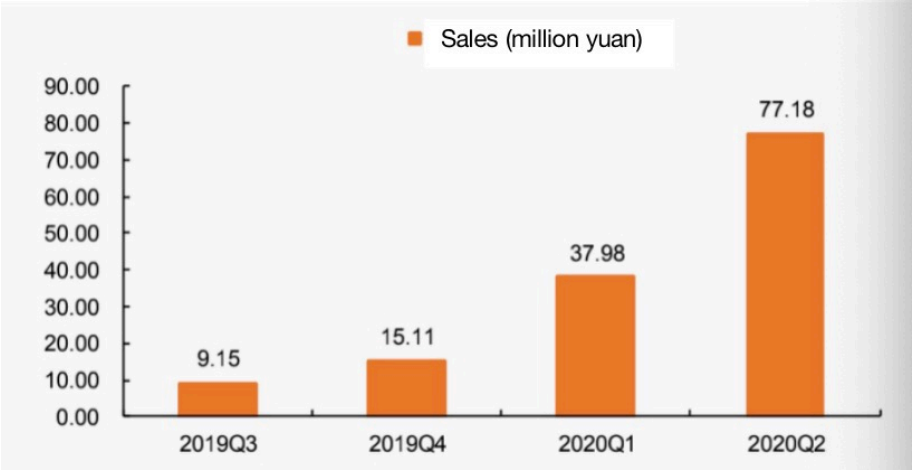

Figure 3.9 – Sales of Hengrui Medicine Carrelizumab Sample Hospitals

Source: Compiled by the author based on data of the PASC Research Institute company announcement [14]

3.4 Leading domestic export of preparations, with export varieties ranging from generic drugs to innovative drugs

The company is the first echelon of domestic preparation exports, mainly high-end injection formulations. In December 2011, the company's irinotecan injection was approved by the FDA, becoming the first injection product listed by a Chinese company in the United States. From 2010 to 2019, Hengrui Medicine obtained 14

ANDA varieties approved by the FDA, of which the number of approvals has increased significantly since 2017. From the perspective of the number of ANDAs of major domestic preparation export companies, Hengrui Medicine belongs to the first echelon in China. [56] Table 3.8 shows the Hengrui Medicine's ANDA varieties approved by the FDA. And figure 3.10 gives the trend of Approval status of U.S. ANDA of major domestic preparation export companies

Table 3.8 – Hengrui Medicine's ANDA varieties approved by the FDA

2019	Daptomycin
2018	Deschloroethane, thytepa, caspofungin
2017	Docetaxel, gabapentin, cisatracurium
2015	Sevochlorane
2014	Oxaliplatin
2013	Letrozole
2012	Irinotecan

Source: Calculated by the author based on data of the PASC Research Institute Company's report [45]

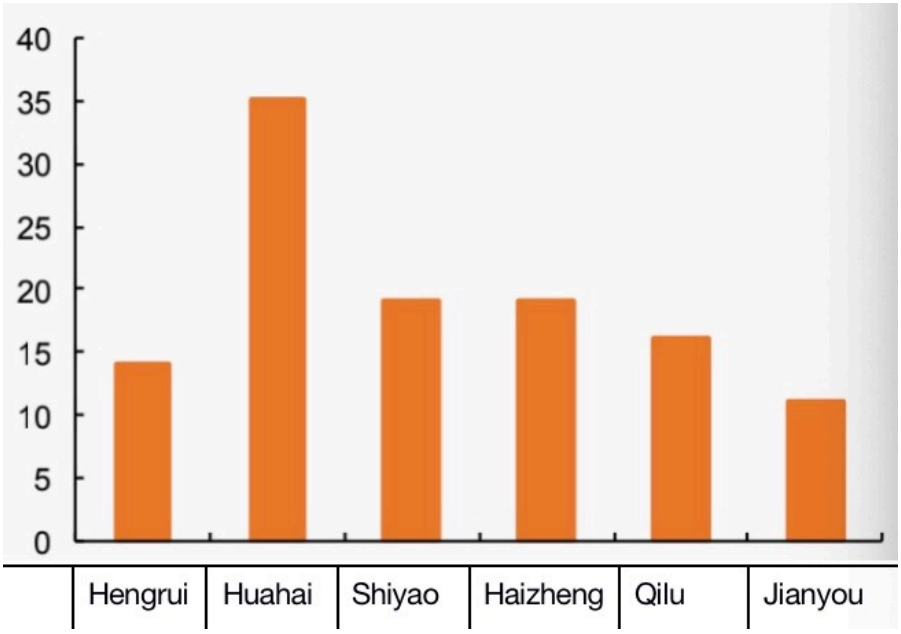

Figure 3.10 – Approval status of U.S. ANDA of major domestic preparation export companies

Source: Compiled by the author based on data of the Wind Medical Library report [51]

In 2019, Hengrui Medicine's overseas revenue was 632 million yuan, a slight decrease year-on-year. We believe that the main reason for the decline in growth is that the company's overseas revenue is still dominated by early approved varieties, and the number of new varieties approved since 2017 is still to be increased. [57] Specifical data and trend we can see from Figure 3.11 - Hengrui Pharmaceutical's overseas revenue and growth rate

Figure 3.11 – Hengrui Pharmaceutical's overseas revenue and growth rate
Source: Compiled by the author based on data of the PASC Research Institute report [19]

The company has abundant R&D pipeline reserves, and the export varieties are expected to upgrade from generic drugs to innovative drugs. In terms of innovative drugs, carrelizumab + apatinib for advanced hepatocellular carcinoma, pyrrotinib for HER2 + advanced NSCLC, and SHR3680 for prostate cancer have all entered the phase III clinical stage overseas and are expected to be launched in the short term. [56] Table 3.9 tells about the progress of Hengrui Medicine's main overseas clinical trials.

Table 3.9 – Progress of Hengrui Medicine's main overseas clinical trials

	Name	**Mechanism of action**	**Indications**	**Latest progress**
1	Carrelizumab, Apatinib	PD-1+VEGFR	Advanced liver cancer cells	Clinical Phase 3
2	Pyrrotinib	HER2	Advanced NSCLC	Clinical Phase 3
3	SHR3680	AR	Prostate cancer	Clinical Phase 3
4	INS068		diabetes	Clinical Phase 2
5	SHR1314	IL-17	psoriasis	Clinical Phase 2
6	SHR0302	JAK1	colitis	Clinical Phase 2
7	SHR8554	MOR	Itching	Clinical Phase 1
8	SHR0410	KAPPA	gout	Clinical Phase 1
9	SHR4640	UARAT1	Advanced liver cancer cells	Clinical Phase 1

Source: Calculated by the author based on data of the PASC Research Institute Company's report [19]

The export of preparations is the only way to become an international pharmaceutical giant, and Hengrui is expected to follow Big Pharma. The main logic of the export of preparations is to expand the scope of the market and raise the ceiling of varieties. Due to its patent protection characteristics, the incremental contribution of innovative drugs in the global market is even more obvious. Judging from the development history of overseas pharmaceutical giants, overseas expansion is the only way to go. Except for BMS, among the top 10 global pharmaceutical companies in 2019, their operating income was more than US$30 billion. As a leader in my country's pharmaceutical manufacturing industry, Hengrui Pharmaceuticals has revenue of only US$3.3 billion in 2019, which has at least 10 times the growth space compared with international giants.

License-out reflects innovative strength. As early as 2015, the company licensed the overseas rights and interests of PD-1 monoclonal antibody to Incyte of the United States (later the company believed that independent development would be more conducive to maximizing the benefits of the variety, and the license was terminated in 2018). Since 2018, the company has successively licensed externally. JAK1 inhibitors, BTK inhibitors, PD-1 monoclonal antibodies and pyrrotinib are developed and sold in specific markets. With many domestic pharmaceutical companies keen on license-in, Hengrui Pharmaceutical's normalized license-out shows that the company's innovative strength has gradually gained international recognition [56]. Table 3.10 tells about the progress of Hengrui Medicine’s main overseas clinical trials.

Table 3.10 – Main overseas licensing status of Hengrui Pharmaceutical's innovative drugs

	Name	**Mechanism of action**	**Company**	**Time**
1	SHR1210	PD-1	Incyle (US)	2015-9-1
2	SHR0302	JAK1	Arcutis (US)	2018-1-4
3	SHR1459/1266	BTK	TG Theerapeutics (US)	2018-1-8
4	Carrelizumab	PD-1	CrystalGenomsic (Korea)	2010-4-21
5	Pyrrotinib	EGFR/HER2/HER4	HLB Life Science (Korea)	2020-9-29

Source: Calculated by the author based on data of the PASC Research Institute Company's report [19]

3.5 Profit forecast and analysis

We believe that the company is the leader of domestic innovative drugs, and the successive listings and international layout of the products under research will continue to open up the market value space.

1. The anti-tumor segment is the company's main source of growth potential in

the future. In 2019, the medical insurance contract for apatinib and pegaspin was renewed. 19K and pyrrotinib passed the medical insurance negotiation for the first time, which is expected to usher in a rapid increase; PD-1 monoclonal antibody has classic Hodgkin lymphoma, advanced hepatocellular carcinoma, The four major indications for non-squamous NSCLC and esophageal squamous cell carcinoma were approved, and they came from behind, and sales continued to explode. We assume that the anti-tumor sector is expected to maintain growth rates of around 40.12%, 35.63% and 29.98% from 2020 to 2022.

2. The anesthesia sector 2020H1 is temporarily affected by the epidemic, and dexmedetomidine has not won the bid and is under certain pressure. However, with the launch of the blockbuster innovative drug remazolam, the anesthesia sector has great growth potential. We assume that the growth rates of the anesthesia sector from 2020 to 2022 are10.55%, 15.28% and 15.91%.

3. The contrast agent segment has benefited from the rapid development of the domestic imaging diagnosis industry, and the company has an obvious leading position. 2020H1 is also affected by the epidemic, but with the continuous enrichment of external cooperation and self-developed varieties, it will continue to maintain a rapid growth momentum in the future. Assume that the growth rate of the contrast medium sector in 2020-2022 will be 15.25%, 24.66% and 20.35%, respectively.

CHAPTER 4 RESEARCH CONCLUSIONS AND RECOMMENDATIONS

4.1 Research conclusion

Technological progress is inseparable from technological innovation. As the world's second largest economy, our country's economic development is gradually shifting from the previous imitation to today's independent innovation. Innovative research and development capabilities are the core capabilities of an enterprise. China's pharmaceutical companies continue to make progress and develop in recent years, and the country is also introducing policies to encourage the development of the pharmaceutical industry. However, the current R&D investment of my country's pharmaceutical companies is much lower than that of major international companies, and its share in the world market is small. Mainly produce and sell generic drugs. This paper conducts an empirical study on the total R&D investment in the pharmaceutical industry and corporate performance and conducts a robustness test. The two research conclusions are consistent, and the following conclusions are drawn: The R&D investment intensity of listed companies in the pharmaceutical industry in my country has a significant positive correlation with corporate performance. The innovative results of R&D activities can increase the profits of enterprises. The consistency evaluation of medicines and the "two-invoice system" being implemented in my country will have a great impact on enterprises in the future.

4.2 Recommendations to the government

4.2.1 Encourage the development of traditional medicine in China

The development of western medicine in China is later than that in Europe and the United States. Traditional medicine has not paid much attention, but the power of traditional Chinese medicine cannot be ignored. For example, in the SARS campaign in 2003, traditional medicine played a big role, and now some institutions are also beginning to study Therefore, the state and governments at all levels should also strongly support the effect of integrated western medicine treatment to create new varieties with resource characteristics and curative advantages. This will also make the development of China's pharmaceutical industry more comprehensive, novel, and more competitive.

4.2.2 Policy support

In this researching, the results of an empirical study on the R&D investment and corporate performance of the pharmaceutical industry show that there is a significant positive correlation between the intensity of corporate R&D investment and corporate performance. Therefore, the government should provide encouragement and support in terms of R&D expenses, such as tax incentives, demand for corporate loans, and financial support from the state. Innovate the methods of national financial support in terms of funds, using incentives and guidance, injecting corporate capital into investment shares, and granting subsidies for application demonstration projects.

4.2.3 Strengthen the disclosure of R&D information of listed companies

When reviewing the reports of listed companies in the sample, we found that the disclosure of R&D investment in annual reports before 2015 was different. Some would have a two-year comparison, some would have a three-year comparison, and some It only introduces the general situation of the R&D investment in the year, and some do not even disclose the R&D expenditure. However, the 2015 annual report will disclose the R&D investment, but the level of detail varies. The disclosure of R&D personnel is still confusing, and many companies have not elaborated on the personnel situation. Therefore, there is no way to compare and analyze the impact of R&D personnel on the company.

It is suggested that the Securities Regulatory Commission should make the disclosure requirements of listed companies' financial reports and notes more specific and clear, with a more uniform format, unified requirements for disclosure content, and consistent disclosure of results standards, which is conducive to R&D investment in high-tech industries for companies Follow-up research on performance or other impacts.

4.2.4 Improve the policy construction of R&D cooperation between Chinese enterprises and foreign enterprises

Although our country's economy and R&D capabilities are developing rapidly, R&D capabilities are still not as good as the United States, Asia's Japan, and Europe, where the pharmaceutical industry is well-developed. Therefore, our government can introduce some policies to help advanced foreign pharmaceutical companies to cooperate with the domestic pharmaceutical industry, thereby promoting my country's pharmaceutical research and development capabilities.

4.3 Suggestions for companies

4.3.1 Strengthen the awareness of scientific and technological innovation

If pharmaceutical companies want to survive and develop in this fierce market competition, they need to continuously improve their R&D capabilities and innovative R&D quality so as to improve their core competitiveness. The development of science and technology in the pharmaceutical industry is closely related to the survival of human beings. If a company wants to grow, it must first improve its core competitiveness. It cannot just stay in the imitation stage. If a pharmaceutical company only produces and sells generic drugs, it is not conducive to the long-term development of the company. The entry threshold of the company is relatively low and there is no protection of patent rights. This way, the number of companies producing generic drugs will increase. In the fierce market competition, if they want to have a market share, they will compete through price in a bad manner. In the long run, companies will have no profits. Space, development is difficult, and the possibility of bankruptcy is very high, so the management and other personnel of the company should be aware of the importance of R&D and innovation, which is an important factor to promote the development of the company.

4.3.2 Strengthen cooperation with research institutions

When studying the development status of our country's pharmaceutical industry, we found that with the development of my country's economy and the strengthening of science and technology, R&D institutions are also increasing year by year. This is also inseparable from the country's encouragement and support for science and technology. Policies have been introduced to attract high-tech talents to work in China. An enterprise's R&D capabilities are limited. With the aid of the existing results of the research institution's platform, the R&D capabilities of the enterprise can be improved through cooperation with professional research institutions, thereby promoting faster and better development of the enterprise.

4.3.3 Strengthen the management of innovative projects

R&D and innovation capabilities are the driving force for the pharmaceutical industry to support the development of enterprises. The management of R&D personnel and R&D funds is very important for enterprises. Enterprises should formulate the management of R&D teams, R&D funds and R&D innovation projects that are conducive to the company's normal production. Under the premise of operation, the R&D and innovation capabilities are guaranteed, which can better

promote the improvement of the core competitiveness of the enterprise, and at the same time, it can also increase the visibility of the enterprise in the market and obtain more market shares.

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