Proceedings of the 7th International Conference on Economic Management and Green Development
DOI: 10.54254/2754-1169/35/20231749

Valuation Analysis of Innovative Pharmaceutical Companies on STAR Market: Evidence from Zhifei Biological

Yuchen Bai [1,†], Tianyu Liu [2,†], and Ziyue Qin [3,a,*,†]

[1]*Department of Finance, Southwestern University of Finance and Economics, Chengdu, 611130, China*
[2]*International Economy and Trade, Shanghai University of Finance and Economy, Shang-hai, 200433, China*
[3]*Department of Bigdata and Finance, East China University of Political Science and Law, Shanghai 201620, China*
a. 210529010064@ecupl.edu.cn
**corresponding author*
[†]*These authors contributed equally.*

Abstract: The bio-pharmaceutical industry has gained great opportunities of develop-ment under the COVID-19 epidemic. In order to fit the current market situa-tion better in the post-epidemic era, the valuation analysis of the innovative pharmaceutical industry is conducted, using a model with Zhifei Biological as an example. Based on the assumption that new drugs under the develop-ment phase can also be viewed as assets in the valuation of the company, the DCF and pipeline models are used in the process of valuation. The outbreak of the COVID-19 epidemic has caused considerable changes in the valuation system of innovative pharmaceutical companies in the STAR market, which requires further research and adjustment. This paper uses the method of pipeline valuation based on the DCF model to valuate the specific case, di-viding the companies' products already on the market and in different stage of development into four different pipelines. The method is expected to have a higher applicability to the valuation of innovative pharmaceutical high-tech companies. These results shed light on guiding further exploration of valuation analysis.

Keywords: pipeline model, DCF model, Bio-pharmaceuticals, corona virus , valuation analysis

1. Introduction

The domestic New Coronavirus pneumonia epidemic is currently in a low state, but the transmission and the threat of the virus in the population persists, and vaccination remains the most effective means of preventing New Coronavirus infection at present. Recently, the State Council's Joint Prevention and Control Mechanism Integrated Group issued the Notice on the Issuance of Vaccination Work Plan to Respond to the Recent New Coronavirus Infection Epidemic [1] and people who have not completed the established vaccination program will gradually complete vaccination. In this context, a reasonable valuation of the biopharmaceutical industry, especially innovative drug development companies, is beneficial to the level of research and development and profitability of the companies'

DOI: 10.54254/2754-1169/35/20231749

innovative pharmaceuticals, and is important for the innovation and sustainable development of China's pharmaceuticals [2,3].

Banerjee studied Indian pharmaceutical companies as an example and found that the traditional static discounted cash flow valuation models generally under-valued pharmaceutical companies. He proposed that option pricing models could consider the value of new drug development in the valuation process [4]. Zhao, Chu and Wu proposed that a reasonable valuation relationship for innovative drugs is relevant to the sustainable development of drug innovation in China [3]. Zhuo proposed that the traditional valuation approach could not reflect the un-certainty in the commercialization process of R&D products of innovative pharmaceutical companies [5]. Li emphasized that the new crown epidemic has a catalytic effect on the pharmaceutical innovation industry and the urgent need to improve the valuation of pharmaceutical innovation companies [2]. Ye and Li proposed the applicability of the pipeline valuation method in the valuation of innovative pharmaceutical companies [6]. Wu, Bi and Chen conducted a simulated valuation of four different states of drug pipelines through a sample of innovative drug companies, reflecting that the pipeline valuation method can better represent the product cycle characteristics of multi-stage R&D states [7].

This paper applies the DCF and pipeline valuation models to study them valuation of China's biopharmaceutical industry, using the first private vaccine company listed on the Science and Technology Innovation Board, i.e., Zhifei Bio as an example. Starting from the analysis of the current market situation and development trend of the biopharmaceutical industry, and summarizing the valuation characteristics of the industry, by comparing the applicability of different valuation methods. Under the background assumptions that the intrinsic value of a company is discounted by future cash flows, a combination of DCF model and pipeline model is selected for valuation and its actual fit is verified. It is expected that the conclusion that the pipeline model based on the traditional DCF model is more appropriate for the valuation of innovative drugs on the science and technology board, and a valuation model with higher applicability for the valuation of innovative high-tech companies is found.

2. Valuation Model Selection

In view of the different applicability of different valuation models to the industry, we choose the DCF valuation method, also known as the discounted cash flow model, based on the unique characteristics of the biopharmaceutical industry, in order to reflect the profitability and investment value of enterprises by cash flow, and select the valuation of ZHIFEI BIOLOGICAL in this segment of the biopharmaceutical industry. In order to improve the applicability of the model, the latest data for the last three years are used. In order to improve the applicability of the model, the latest data from the last three years are used. For the bio-pharmaceutical industry, which is relatively volatile in terms of cash flow predictability, the valuation method of the pipeline model is added to compensate for the inaccuracy of the competent parameters of the DCF model, with a view to forming a quantitative grasp of the long-term development of the enterprise, taking into account the financial situation, business situation and product structure of the enterprise in multiple directions.

3. Pipeline Valuation

This paper assumes that the target company is a normal going concern and assesses its future profitability and investment value by analyzing its future cash flows. Given the reliance on existing financial reports and historical data, and excluding the possibility of falsification of financial reports, the assessment is conducted against the theoretical background that the intrinsic value of a company is derived from discounted future cash flows. As an innovative drug company in the KCI, the different drug pipelines are an important part of the enterprise value [4]. Traditional valuation methods cannot

DOI: 10.54254/2754-1169/35/20231749

adequately consider the value that drugs in development may bring to an innovative drug company in the future [5]. In this paper, we choose to adopt the pipeline valuation method to divide the drug pipelines according to the different stages of research and development, and conduct probabilistic risk-adjusted DCF valuation for each drug pipeline to obtain the value of each drug pipeline under the condition of drug development success rate, and then sum up to obtain the overall valuation of the company [6].

In this paper, Zhifei Biologica's products are divided into the following four segments. (1) Marketed innovative drugs, which are divided into proprietary and agency products, i.e., the company's current revenue sources. Influenced by fac-tors such as the end of the epidemic and competition from similar drugs, the cash flow from this segment is under pressure to slow down [7]. Future cash flows from this part of the drug can be forecast based on the company's historical financial data. (2) New drug pipeline that has completed clinical trials. After passing the Phase III clinical trials, the drugs will enter the marketing phase, and the commercialisation of this pipeline has a high degree of certainty, which will bring a high degree of predictability of future cash flows [8]. (3) New drug pipeline in the clinical trial stage. As clinical trials carry a high degree of risk, forecasts of future cash flows for this drug pipeline need a fully consideration to the possibility of clinical trial failure [9]. (4) New drug pipeline in the pre-clinical research stage. This part of the new drug pipeline has not yet entered clinical trials, it is highly uncertain, and its commercialization requires long-term preparation and therefore does not create market value for the company in the short term. Due to the use of a probabilistic risk-adjusted DCF valuation model, this part of the drug is not considered in the calculation of the current valuation of the company.

The comparative approach is one of the most important tools for forecasting future cash flows for a drug pipeline [10]. As the drug under development has not yet been marketed and historical sales data is not available, the future sales of the new drug can be predicted by referring to similar drugs that have already been marketed, with suitable adjustments. Take the lyophilized human rabies vaccine (MRC-5 cells) as an example, Jiffy has completed clinical trials for this vaccine and its commercialization has a high success rate. Rabies vaccines can be divided into three generations depending on the stromal cells. Jiffy's lyophilized human rabies vaccine (MRC-5 cells) and Kang Hua's lyophilized human rabies vaccine (human diploid cells) are both third generation vaccines with similar efficacy. Therefore, a comparison of the sales of the lyophilized human rabies vaccine (human diploid cells) with those of Kanghua can be used to forecast the future cash flows of the lyophilized human rabies vaccine (MRC-5 cells) of Zhifei Biological.

4. Financial Projections

The future cash flows of the company can be obtained by forecasting and summing up the future sales and costs of the marketed drugs and pipeline under development based on historical data and comparative method respectively as follows. Firstly, one needs to forecast of revenue from main business. Operating income from marketed drugs is expected to slow down significantly due to the impact of the new crown epidemic situation and competitive pressure from simi-lar drugs. In contrast, completed clinical and in-process clinical drugs are expected to achieve increased revenue in the future. Over the next 10 years, the company's overall main business revenue is expected to grow at a relatively stable rate. The results are listed in Table. 1.

Then, one needs to forecast of main operating costs. Gross margins of market-ed drugs will show a declining trend. The gross margins of drugs in development that have completed clinical trials and are in clinical trials are expected to grow significantly after commercialization. Based on this judgement, the Company's main operating costs are forecasted as given in Table. 2.

Afterwards, we forecast of taxes and surcharges on main business. As the tax environment is not expected to change significantly in the coming years, the average ratio of taxes and surcharges to

DOI: 10.54254/2754-1169/35/20231749

revenue from main business for 2020-2022 is adopted in this paper and the following forecast is obtained (presented in Table. 3).

Table 1: Forecast of revenue from main business.

(Unit :100 million yuan)	2022A	2023E	2024E	2025E	2026E	2027E	2028E	2029E	2030E
pipeline 1	382.60	420.86	454.53	486.35	520.39	556.82	595.79	637.50	682.13
pipeline 2	0	38.26	87.23	130.85	157.02	188.42	226.11	271.33	325.59
pipeline 3	0	0	0	11.25	39.02	57.16	76.78	97.70	119.59
overall	382.60	459.12	541.76	628.44	716.43	802.40	898.68	1006.5	1127.31

Table 2: Forecast of main operating costs.

(Unit :100 million yuan)	2022A	2023E	2024E	2025E	2026E	2027E	2028E	2029E	2030E
pipeline 1	254.00	279.40	296.16	313.93	335.91	359.42	384.58	411.50	440.31
pipeline 2	0.00	41.98	72.23	87.61	93.74	112.49	134.99	161.99	194.38
pipeline 3	0.00	0.00	0.00	13.23	36.03	49.65	64.57	80.75	98.06
overall	254.00	321.38	368.40	414.77	465.68	521.56	584.14	654.24	732.75

Table 3: Forecast of taxes and surcharges on main business.

(Unit :100 million yuan)	2022A	2023E	2024E	2025E	2026E	2027E	2028E	2029E	2030E
taxes and surcharges on main business	1.77	2.10	2.46	2.88	3.27	3.66	4.10	4.59	5.14

Subsequently, we forecast of selling expenses, administrative expenses, re-search and development expenses and financial expenses. In terms of selling expenses, the ratio of selling expenses to cost of main business will decrease year by year from 2020 to 2022, and the ratio will be less than 1% in 2022. Considering that most of the drugs currently under development have some competition in the market, the selling expenses may increase, so the ratio is increased to 1% in the forecast.

In terms of administrative expenses, the ratio of administrative expenses to cost of main business will decrease year by year from 2020 to 2022. Considering that there is no obvious tendency to change the corporate management arrangement of ZHIFEI BIOLOGICAL, this article forecasts that the ratio of administrative expenses will remain at a low level in the next few years, so the expense ratio of

DOI: 10.54254/2754-1169/35/20231749

2022 will be used. In terms of financial expenses, the ratio of financial expenses to cost of main business from 2020 to 2022 shows a significant down-ward trend, and this paper predicts that the ratio of financial expenses will continue to decline slightly in the next few years to 0.04%. In terms of R&D expenses, the ratio of R&D expenses to cost of main business will fluctuate within the range of 3.2% to 3.5% from 2020 to 2022. As there are still a large number of drugs under development that have not entered the clinical stage, the ratio of R&D expenses is forecast to remain at around 3.4% in the next few years. In summary, the cash flow projections for each expense are detailed in Table 4 and the growth trend of each expense compared to operating profit is shown in Fig. 1.

Table 4: Forecast of expenses.

(Unit :100 million yuan)	2022 A	2023 E	2024 E	2025 E	2026 E	2027 E	2028 E	2029 E	2030 E
selling expenses	22.35	32.13	36.84	41.48	46.57	52.16	58.41	65.42	73.28
administrative expenses	3.74	4.73	5.43	6.11	6.86	7.68	8.60	9.64	10.79
financial expenses	0.14	0.17	0.18	0.18	0.19	0.21	0.23	0.26	0.29
R&D expenses	8.54	10.93	12.53	14.10	15.83	17.73	19.86	22.24	24.91

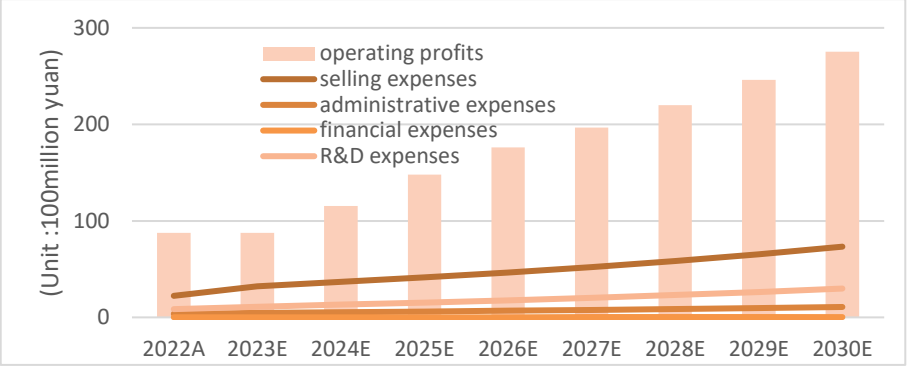

Figure 1: Forecast of expenses and profits.

Table 5: Forecast of after-tax profits.

(Unit:100 million yuan)	2022 A	2023 E	2024E	2025E	2026E	2027E	2028E	2029E	2030E
operating profits	87.58	87.466	115.320	147.783	176.242	196.802	220.070	246.094	275.183
total profits	87.18	87.067	114.793	147.108	175.437	195.903	219.064	244.970	273.926
minus: tax	11.79	13.120	17.298	22.167	26.436	29.520	33.010	36.914	41.277
after-tax profits	75.39	73.947	97.495	124.941	149.001	166.383	186.054	208.056	232.649

DOI: 10.54254/2754-1169/35/20231749

Considering that China's tax rate for innovative drug companies will remain in a stable range, the following cash flow projections were obtained after calculation (as listed in Table 5). Eventually, we will forecast the free cash flow. This paper predicts that in the next few years, Zhifei Biological's depreciation and amortization, working capital increase and capital expenditure will not face large fluctuations, and with the expansion of the enterprise scale, the above items will maintain a more stable growth. The specific forecast results are shown in Table 6, and the forecast growth trend is shown in Fig. 2.

Table 6: Forecast of free cash flow.

(Unit :100 million yuan)	2022A	2023E	2024E	2025E	2026E	2027E	2028E	2029E	2030E
depreciation and amortization	3.208	4.499	5.158	5.807	6.519	7.302	8.178	9.159	10.259
working capital increase	53.000	54.540	56.733	49.282	48.166	46.254	43.111	41.260	39.187
capital expenditure	14.530	14.952	15.553	13.511	13.205	12.681	11.819	11.311	10.743
free cash flow	11.068	8.954	30.367	67.955	94.149	114.749	139.302	164.644	192.977

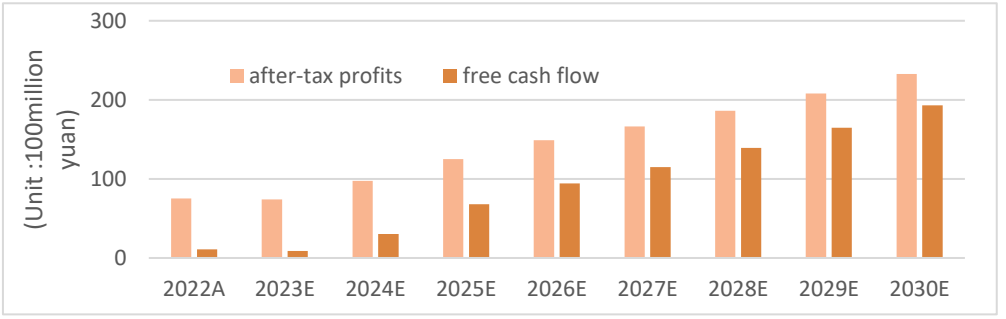

Figure 2: Forecast of free cash flow.

5. Valuation Results

Considering the higher risk of new drug development, the weighted average cost of capital for innovative drug companies under a risk-adjusted DCF-based model is generally in the range of 10%-14%, and the perpetual growth rate is generally in the range of 0%-4% [11]. In this paper, the WACC is set at 10% and the perpetual growth rate is set at 2%, taking into account the analysis of the financial reports of ZHIFEI BIOLOGICAL. Hence, one can obtain final FCFF value after the forecast period FCFF(t)*(1+g)/(WACC-g)=2460.45. According to the formula $EV=\sum_{i=To}^{T} FCF/(1+WACC)^{i}$, the final overall valuation of ZHIFEI BIOLOGICAL is ¥151,647 million, with a market capitalization of ¥134,448 million as at 24 April 2023.Based on the above valuation, we believe that the company is currently undervalued by the market.

DOI: 10.54254/2754-1169/35/20231749

6. Conclusion

To sum up, the Science and Technology Innovation Board provides development momentum for companies with science and technology innovation as their core driver. Among them, the innovative drug industry has a large R&D demand and a long product cycle, and the applicability of traditional valuation models to innovative drug companies is low. In contrast, the DCF valuation based on a pipeline model with probabilistic risk adjustment can not only include drugs under development by innovative drug companies in the valuation, but also take into account the risk of drug development. This paper applies this valuation method to the leading domestic innovative drug company, i.e., Zhifei Biological, and the overall valuation results are broadly in line with the market capitalization, but there is still uncertainty about the risk of drug development and the sales data of the drugs in development after they are launched, and more data is needed to verify this. It is hoped that the valuation system for high-tech companies will be further improved in the future to take full account of their valuation characteristics. A better valuation system will further facilitate the market to form reasonable expectations for the companies on the STB and promote the development of high-tech companies. Overall, these results offer a guideline for valuation of biological corporation.

References

[1] *The State Council Joint Prevention and Control Mechanism for New Coronavirus Infections. Notice on the issuance of the vaccination program for the recent outbreak of novel coronavirus infection, https://www.samr.gov.cn/ltb/tzgg/202304/t20230420_354745.html, last accessed 2023/5/1.*

[2] *Li, Q.: Research on the Value Evaluation of Innovative pharmaceutical Enterprises, Master's Thesis, Qingdao University of Technology (2020).*

[3] *Zhao, Z., Chu, S., Wu, J.: Evaluation of innovative drugs based on DCF model: A case study of Puyouke. Modern Commerce and Industry 13, 71-72 (2018).*

[4] *Banerjee, A.: Real Option Valuation of a Pharmaceutical Company. Vikalpa, 28(2), 61–73 (2003).*

[5] *Zhuo, F.: Discussion on investment, financing and valuation of technological innovation enterprises. Chinese Journal of Management Accounting 2, 48-63 (2019).*

[6] *Ye, X., Li, Y.: Valuation analysis of innovative drug companies on the science and technology innovation board: the case of Microchip Bio. Finance and Accounting, 620(20), 51-54 (2020).*

[7] *Wu, H., Bi, Q., Chen, S., Han, Y., Yang, H.: Research on the valuation method of high-tech companies on the Science and Technology Innovation Board -- A case study of innovative pharmaceutical high-tech companies. Modern Marketing (Academy Edition) 10, 28-30 (2021).*

[8] *Meng, D.: Research on the selection of valuation methods for innovative drug companies on Science and Technology Innovation Board. Chinese market 22, 99-101 (2022).*

[9] *Zhu, J.: Wisdom fly biological enterprise valuation case studies, master's degree thesis, huazhong university of science and technology (2021).*

[10] *Liu, J.: Based on the improved FCFF model and real option method of pharmaceutical enterprise value evaluation research, Master's degree thesis, southwestern university of finance and economics (2021).*

[11] *Pharmaceutical Group, CICC Securities Research Institute 2019 Discussion of innovative drug valuation methods, www.zhitongcaijing.com/content/detail/215216.html last accessed 2023/5/1.*