Valuation of CATL Based on FCFF, Residual Income and Relative Valuation Model

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Abstract:

China's new energy vehicle industry is in a period of vigorous development: rapid expansion of market size, continuous progress of technology, strong policy support, gradual improvement of charging and power exchange infrastructure and positive benefits to the environment are gradually emerging. As an industry leader, the valuation of the CATL is of great significance to the value of the new energy vehicle industry. Based on FCFF model, residual income model and relative valuation model of P/E method, the author makes a valuation of CATL, and carries out sensitivity analysis of key parameters. By comparing the valuation results of the three models with the current stock price, it is concluded that the stock price in the CATL is undervalued and recommends buying. Based on the macro environment of the new energy battery industry and the competitiveness of CATL, it is best to hold for a long time and supplemented by a diversified investment strategy. These results not only serve the investment decisions of investors, but also reflect the development prospects of its industry, health and stability of the entire securities market.

Keywords: new energy vehicles; CATL; FCFF; sensitivity analysis.

1. Introduction

NEVs have experienced swift growth in China. From a modest total of 1,553 units sold in 2005, sales soared to over 330,000 by 2015, and further surged to more than 770,000 by 2017. In that year, China achieved the highest ownership of NEVs globally [1]. More importantly, it has maintained the highest position and reached 9.495 million units in 2023, reflecting the broad market and development prospects of China's new energy vehicle market. As a leader in energy conservation, electric vehicles possess the greatest development potential [2, 3]. New energy vehicles provide a solution for China to alleviate the energy crisis, improve air pollution, and reduce greenhouse gas emissions. Since the beginning of the 90s of the twentieth century, China's NEV industry has undergone four stages: research and development layout, preparation, extension, and industrialization development [4]. Different stages of development correspond to different development priorities, promoting the maturity and improvement of the new energy industry system. The rising NEV industry holds strategic significance in China. It supports the nation's efforts to achieve climate change goals, address energy issues, and maintain the vitality of both the automotive and transportation sectors through the provision of varied energy resources [5-7]. In April 2020, China issued

a purchase tax exemption policy and purchase subsidy policy for new energy vehicles. In January 2020, overseas markets officially implemented the "European Carbon Emission New Deal" proposed by the European Union, and governments have increased policy support for the acquisition of new energy vehicles and other subsidies, promoting the consumption of new energy vehicles [8]. With the surge in market demand for new energy vehicles, new energy batteries, as the core component of NEVs, have also ushered in a period of rapid development.

The cooling technology of new energy batteries, especially lithium-ion batteries used in electric vehicles, is crucial for the performance, safety, lifetime, and efficiency of the batteries. An efficient cooling system ensures that the battery operates within a safe temperature range, maximizing the battery's output performance and extending its service life. Owing to its high latent heat, excellent capabilities for thermal and cold storage, phase change materials are extensively employed across diverse sectors for energy storage and temperature regulation [9, 10].

To overcome the problems of long charging time, short service life and safety risks of new energy batteries, a number of professors at Tsinghua University jointly applied theoretical research and prototype tests to propose a cost-effective, fast and efficient battery pack replacement technology. Firstly, this approach is based on the central-

ized storage, charging, replacement and unified distribution of many batteries at charging stations. In addition, due to the speed and high degree of automation of battery replacement, the chassis replacement battery method is significantly better than the front/rear replacement or side wall replacement battery scheme. Finally, the use of floating connectors and fast-plug water pipes can realize the automatic plug when the battery pack is removed and assembled, saving time, and reducing the safety risks of manual disassembly [11, 12]. CATL has maintained a leading market share in China's power battery industry, with its market share reaching 41.6% in 2019, and has topped the world's first power battery enterprise for six consecutive years. Under the goal of carbon neutrality and carbon peak "dual carbon", CATL has launched a new product matrix and brand positioning (launching sodium batteries, entering the office to change power, cooperating with NIO, etc.), further enhancing its product competitiveness and brand influence.

Revenue growth, profit margin and cash flow status in the CATL are the key financial indicators to evaluate the value of the company. The valuation of the CATL is of great significance to the value of the new energy vehicle industry. As an industry leader, its valuation reflects the market's expectations for the future growth potential of new energy vehicles. At the same time, it can objectively evaluate the value of new energy enterprises, which can supplement the development research data of listed companies in the industry, and also have a reference role for investors to carry out corporate value research.

2. Data and Models

This study is prepared to use five to six years of CATL wealth data to make the forecast valuation. The data sources include iFinD, East Money Net, Choice financial terminal. Since the discounted cash flow method is an absolute valuation method, the value estimation of CATL is based on the company itself, which is closer to the real performance of the company. Moreover, CATL has positive annual earnings and relatively stable cash flow, and it can make reasonable and accurate prediction of future cash flow according to its historical cash flow situation First of all, the annual operating income of CATL in the next five years is calculated through business splitting, and then the proportion of various cost items in operating income is calculated by referring to the composition of its past income statement. Assuming that the future cost structure of the company is relatively stable, the average proportion of operating costs (excluding depreciation, amortization and interest expense) in revenue in the past six years is taken as the ratio of operating costs to rev-

enue in 2024 and maintained, so as to make a forecast of operating costs in the next five years and then obtain the forecast of EBITDA. Depreciation and amortization, capital expenditures, working capital, and EBIT are forecast based on historical data (i.e., the ratio of each item to operating income) for the past 6 years. Finally, free cash flow is calculated according to the following formula. The equation can be described as: FCFF=EBIT(EBIT)*(1-Tc) + Depreciation and amortization - Capital expenditure - Change in working capital. Based on the five-year Treasury bond yield in 2024, it is assumed that the risk-free interest rate is 2.5%. After calculating the compound annual return rate of Shenzhen Composite Index in the past 5 years, assume that the expected market return Rm=7.7%. Market risk premium = Rm-Rf=7.7%-2.5%=5.2%. With reference to the β coefficient of CATL from 2021 to 2023, the average value of 1.3 is used as the β coefficient for subsequent estimation. At the same time, it is assumed that the cash flow of CATL in the next 5 years conforms to the sustainable growth model and the fixed growth rate is 5%. The average bank interest rate on corporate loans is 4.4%, which is used as a company's cost of debt capital. According to the company's 2023 financial statement, the company's 2023 interest-bearing debt ratio is 35%, which is used as the company's debt ratio is 35%, and the equity ratio =1- debt ratio, that is, 65%. The effective tax rate is 11.5%. The cost of equity capital is calculated based on the capital asset pricing model as follows: Cost of equity capital = risk-free rate +ß* (market expected rate of return - risk-free rate)=2.5% +1.3 * (7.7%-2.5%) = 9.2%. The discount rate is calculated according to the weighted average Cost of Capital (WACC) formula as Discount rate = Cost of equity *Ratio of equity + Cost of debt * Ratio of debt * (1- tax rate)= 9.2%*65%+4.4%*35%* (1-11.5%) = 7.4%. Adding up the present value of all free cash flows to get the overall value of the business. Finally, the stock price valuation is calculated, and the calculation formula is as follows: Shareholder equity value = overall business value - financial liabilities + cash and cash equivalents; Stock price valuation = shareholder equity value/number of shares outstanding. The process considers a company's capital structure, debt and cash reserves, giving investors a more comprehensive way to value stock prices.

The residual income model, also known as the discounted abnormal earnings model, is a method used to assess the value of a business or project, based at its core on the present value of future residual earnings. The residual income model of valuation is widely used in the financial field, especially in stock investment, corporate mergers and acquisitions and valuation consulting. It provides a structured approach to assess the long-term value of a business, helping investors and decision makers to make

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rational investment and business decisions.

First, forecast the operating income of CATL in the next 5 years. By analyzing historical data, industry trends, and the company's future development plans, it is possible to estimate the future growth trend of operating revenue. Based on this, the average growth rate of operating income in the five years from 2019 to 2023 is calculated. Considering the increasing competition in the market and the expansion of the company size, this average growth rate may be a high initial estimate. However, it is also important to realize that rapid growth cannot be sustained indefinitely, so a decreasing trend can be adopted when adjusting the future revenue growth rate. This means that each future year's growth rate is likely to be slightly lower than the previous one. This adjustment considers the impact of market competition and the challenges brought about by the expansion of the size of the enterprise, so as to be more realistic. Finally, one can come up with a table that shows the projected growth rate of operating revenue over the five-year period from 2024 to 2028. These adjusted growth rates will be more in line with the underlying trend of the company's future development.

To calculate the cost of equity capital, the interest rate of 5-year Treasury bonds in 2024 is risk-free yield, which is 2.5%. Next, Rm of market risk return is calculated. Taking the compound annual return rate of China's major market index (Shenzhen Composite Index) in the past 5 years as the expected return rate of market risk, Rm=7.7% can be obtained by calculation. Market risk premium =Rm-Rf=7.7%-3.2%=5.2%. The beta coefficient measures the non-systemic risk of the stock. With reference to the β coefficient of CATL in recent years, 1.3 is used as the β coefficient of CATL for subsequent estimation. In addition, it is assumed that the cash flow of CATL in the next five years conforms to the sustainable growth model and the fixed growth rate is 3%. The cost of equity capital is calculated based on the capital asset pricing model as follows: Cost of equity capital = risk-free rate +ß* (market expected rate of return - risk-free rate)=2.5% +1.3* (7.7%-3.2%) = 9.3%. Residual income calculation formula is as follows: Residual income=Net profit-investment amount (or amount of net assets occupied) * minimum investment rate of return specified or expected. Based on the above data, the residual income of CATL in the next 5 years is finally calculated as given in Table 1.

Table 1. The residual income of CATL in the next 5 years

Item	Historical data					Future prediction				
	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
Net profit	50	61	179	335	468	631	826	1056	1320	1617
Net assets	422	692	926	1769	2199	4116	5190	6231	7875	9814
Cost of equity capital	9.3%	9.3%	9.3%	9.3%	9.3%	9.3%	9.3%	9.3%	9.3%	9.3%
Residual income	11	-3	93	171	264	250	346	479	591	708

Imagining that after 2028, the company applies the sustainable growth model. One needs to calculate the future annual cash flow discount factor based on the discount rate and discount period. The present value of all future cash flows is then added up to get the equity value of the business. Through this step, we are able to derive the valuation of the stock price. This approach combines the time value of future cash flows with the potential value of the company's sustainable growth. This valuation method helps investors and decision makers better understand the long-term value of companies and provides a reliable framework for stock price forecasting. The P/E ratio method in the relative valuation method is to evaluate the relative value of the target asset by comparing its P/E ratio with the industry or market average. The advantage is simple to use, fast and effective. Based on the existing transaction data of the market, it reflects the consensus of the market on the value of the asset and applies to different assets and market types.

This paper will use PE ratio method to evaluate CATL, and the comparable companies are: PYLON, Camel Group Co., Ltd. and Guangzhou Great Power Energy and Technology Co., Ltd. Price-earnings ratio is the ratio of price per share to earnings per share, which is one of the basic indicators of stock valuation. The higher the price-earnings ratio, the better the future development prospects of the enterprise, but at the same time, there may be the possibility of overvaluation. Companies with more mature development are generally more inclined to choose the price-earnings ratio method for valuation. By comparing with the average of comparable companies, this paper analyzes the P/E ratio of CATL, and finally calculates the relative stock price of CATL.

3

3. Results and Discussion

3.1 Valuation Results

The Company's free cash flow is discounted and valued as given in Table 2. Adding the present value of all free cash flows to get the overall value of the enterprise, and further calculate the stock price valuation as given in Table 3. As of May 14, 2024, CATL's stock price stood at 199.01 RMB. Based on the valuation outcomes from the free cash flow method, it is determined that CATL's stock price is currently within a reasonable range. Investment recommendation: Suggest purchasing positions.

Table 2. Free cash flow.

Item	2024	2025	2026	2027	2028	After 2028
Corporate free cash flow	173	505	578	720	890	9,187.9
Discount period	1	2	3	4	5	5
Discount factor	0.93	0.87	0.81	0.75	0.70	0.70
Discount period	7.4%	7.4%	7.4%	7.4%	7.4%	7.4%
Present value of free cash flow	-47	147	144	148	145	6,441.6

Table 3. The overall value of the enterprise.

Enterprise overall value (100 million RMB)	6,978.83
Minus: Financial liabilities (100 million RMB)	1,178.67
Plus: Cash and cash equivalents(100 million RMB)	2,643.14
Shareholder equity value (100 million RMB)	8,443.30
Number of Shares outstanding (hundreds of millions)	43.96
Stock price valuation (RMB)	192.07

Residual income calculation formula is Residual income = Net profit - investment amount (or amount of net assets occupied) x minimum investment rate of return specified or expected. Based on the above data, the residual income of CATL in the next 5 years is finally calculated as given in Table 4. Assuming that the company complies with the sustainable growth model after 2028, the annual future cash flow discount coefficient is estimated according to the discount rate and discount period, and the residual income of the company is discounted and valued as given in Table 5. Adding up all the present values to get the eq-uity value of the enterprise, and further calculate the stock price valuation. The calculation formula is as follows. Stock price = Equity value/share capital= 923.814 billion yuan / 4.399 billion shares=210.01 yuan/share. In summary, based on the residual income model, CATL is valued at RMB 210.01 per share. However, as of May 14, 2024, the closing price of CATL was RMB 199.01 per share. This indicates that CATL is currently undervalued, suggesting potential growth in the future. It is recommended to buy/increase holdings.

Table 4. The residual income of CATL in the next 5 years.

Item	Historical data					Future prediction				
	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
Net profit	50	61	179	335	468	631	826	1,056	1,320	1,617
Net assets	422	692	926	1,769	2,199	4,116	5,190	6,231	7,875	9,814
Cost of equity capital	9.3%	9.3%	9.3%	9.3%	9.3%	9.3%	9.3%	9.3%	9.3%	9.3%
Residual income	11	-3	93	171	264	250	346	479	591	708

Table 5. The residual income of the company is discounted and valued s.

	2024	2025	2026	2027	2028	After 2028
Residual income	250.20	345.64	478.85	590.64	708.16	11,651.85
Discount period	1.00	2.00	3.00	4.00	5.00	5.00
Discount rate	9.3%	9.3%	9.3%	9.3%	9.3%	9.3%
Discount coefficient	0.92	0.84	0.77	0.70	0.64	0.64
Present value of net cash flow	228.99	289.54	367.13	414.45	454.81	7,483.23
Cash flow present value sum	9,238.14					

Table 6. The P/E ratio of CATL analysis.

Company name	Price/Earnings Ratio
PYLON	28.37
Camel Group Co., Ltd.	16.34
Guangzhou Great Power Energy and Technology Co., Ltd.	29.56
Average	24.76
CATL	18.78

By comparing with the average of comparable companies, the author analyzes the P/E ratio of CATL, and the analysis results are shown in the Table 6. As can be seen from the results, the current price-to-earnings ratio of CATL is 18.78 times, lower than the average price-to-earnings ratio of comparable companies is 24.76. Based on the average comparable company price-to-earnings ratio of 24.76, the estimated value per share of CATL can be calculated to be 269.6 yuan (24.76*10.89, where 10.89 is the expected earnings per share of CATL in 2024), which is much higher than the current share price of 199.01 yuan. It shows that CATL's stock price is in an undervalued state, and there is certain room for growth in the future. One speculates that the market may not be fully reflecting its true value, which provides investors with a buying opportunity.

Based on the three valuation models, it can be found that the stock price of CATL is undervalued, and investors can consider buying the stock and holding it for a long time, provided that they have a deep understanding of the company's fundamentals and have confidence in its future development. At the same time, keep diversified investment, set stop loss, and stop profit points, and continue to pay attention to the market and company dynamics, in order to adjust the investment strategy according to the situation.

3.2 Sensitivity Analysis

The author used the sustainable growth rate and discount rate (WACC) as sensitivity factors to analyze the sensitivity of company valuation. Assume that the initial value of the sustainable growth rate is 5%, and increase or decrease by 0.5 percentage points respectively on this basis, to obtain the growth rate of 4.0%, 4.5%, 5.0%, 5.5%, and 6.0%. Similarly, if the initial discount rate is 7.4%, increase or decrease by 1 percentage point respectively to obtain the discount rates of 5.4%, 6.4%, 7.4%, 8.4%, and 9.4%. The following table can be obtained by plugging these values into the formula. As can be seen from the Table 7, when the change amplitude of discount rate and sustainable growth rate is similar, the sensitivity of company valuation to the change of discount rate is greater than that of the change of sustainable growth rate. This suggests that company valuations are more sensitive to changes in the discount rate. Therefore, the calculation of discount rate needs to be more careful and accurate when conducting company valuation. To assess the impact of sustainable growth rate and cost capital ratio on the valuation of the company. Sustainable growth rate from 2.0% to 4.0%, cost capital ratio of 7.3%, 8.3%, 9.3%, 10.3% and 11.3% respectively. Using a simplified valuation model (such as Gordon Growth Model) to calculate the valuation of the company under different sustainable growth rates and cost capital ratios. Based on the given sustainable growth rate and cost capital ratio, the corresponding company valuation can be calculated. Some useful conclusions can

be drawn by observing and comparing the changes in the corresponding values.

Table 7. Sensitive analysis of WACC.

6,979	6,979	Sustainable growth rate%				
		4.0%	4.5%	5.0%	5.5%	6.0%
WACC	5.4%	12,738	19,898	46,928	-119,615	-25,787
	6.4%	7,242	9,080	12,268	19,163	45,191
	7.4%	5,019	5,828	6,979	8,749	11,820
	8.4%	3,816	4,261	4,839	5,618	6,727
	9.4%	3,063	3,341	3,681	4,110	4,667

Table 8. Sensitive analysis of COE.

0		Sustainable growth rate%				
		2.0%	2.5%	3.0%	3.5%	4.0%
COE	7.3%	11,539.72	12,608.18	13,927.45	15,597.59	17,780.05
	8.3%	9,568.81	10,283.69	11,134.48	12,164.00	13,435.20
	9.3%	8,144.75	8,651.01	9,238.14	9,927.21	10,747.27
	10.3%	7,068.77	7,442.52	7,867.76	8,355.90	8,922.02
	11.3%	6,227.96	6,512.82	6,832.17	7,192.67	7,602.82

Seen from Table 8, when the Cost of Equity increases from 7.3% to 11.3%, using a sustainable growth rate of 2.0%, the valuation of the company decreases from 11,539.72 to 6,227.96, a change of 46%. It can be seen that company valuation is very sensitive to changes in Cost of Equity. For every 1 percentage point increase in the cost capital ratio, the valuation of the company decreases by about 25% to 35%, showing a high sensitivity to the cost capital ratio. With a COE of 7.3%, for example, when the sustainable growth rate increases from 2.0% to 4.0%, the company valuation increases from 11,539.72 to 17,780.05, a change of 54%. In contrast, company valuations are relatively unresponsive to changes in sustainable growth rates. For every 0.5 percentage point increase in sustainable growth, the valuation change is about 5 to 10 percent. In conclusion, when evaluating a company, it is not only necessary to pay attention to and accurately calculate the cost capital ratio, but also to consider the cost capital ratio and the sustainable growth rate. Although the impact of sustainable growth rate is relatively small, it is still one of the important factors affecting the valuation of a company. Therefore, when conducting sensitivity analysis, it is necessary to consider the impact of changes in these two factors on the company's valuation.

All in all, sensitivity analysis can better understand the degree of influence of different factors on the valuation of a company, so as to provide important references when making investment decisions and determining valuation models. Analyzing this data can help companies better understand their financial situation under different scenarios and inform future decisions. For example, financial strategies can be adjusted based on the results of these analyses to address possible risks and uncertainties.

4. Conclusion

Based on the analysis of three valuation models, as well as the current prospects of the new energy vehicle and battery industries, and the operating performance of CATL, the author has concluded that the current stock price of CATL is undervalued. Therefore, the author recommends buying shares of CATL now. Additionally, the author is optimistic about the future growth potential of CATL, suggesting that it should be held for the long term. The following are some limitations of this study. As an external person, the author cannot obtain the detailed and real information inside the enterprise, and can only rely on the publicly released annual statements of the enterprise as the basis for predicting the future operation of the enterprise. At the same time, due to the lag of the statement and the possibility of tampering, it means that these data cannot reflect the actual business conditions of the enterprise in time, resulting in a great deviation of the

final valuation data. As a leader in the new energy battery industry, CATL belongs to the high-tech industry. The development and growth of such industries often rely on advanced intellectual property rights and continuous technological innovation. Once the technological revolution occurs in the industry, the impact on enterprise value will be disruptive, and the author did not consider this factor in the valuation. If the enterprise can seize the opportunities brought by the technological revolution, its future profitability and growth space will gain a leap growth; On the contrary, the innovation ability and profitability of enterprises will suffer a devastating blow, and even directly lead to bankruptcy delisting. When determining key parameters such as beta coefficients, discount rates, perpetual growth rates, and the cost of equity (COE), there is a stringent time constraint, and these processes are highly subjective. Even small changes in parameters can cause significant changes in the calculated results, resulting in valuation results deviating from the true value. The value of high-tech enterprises is often affected by technological innovation. The author's next step is to research how to quantify and consider the impact of technological innovation on enterprise value in valuation models, to assess the company's future development potential and profitability more accurately. Moreover, the authors consider using some algorithms to optimize the model, which can determine these key parameters more accurately. The valuation of CATL is an estimate of the potential and profitability of the company's future development. It not only serves the investment decisions of investors, but also reflects the development prospects of its industry and the health and stability of the entire securities market.

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