Comparative Analysis of BYD's Valuation Based on Dividend Discount, Income Approach and Market Approach

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Abstract: As China's automobile manufacturing industry is in a critical period of transformation and upgrading, the company valuation in the new energy vehicle sector have attracted more and more attention from investors. The previous theories for the valuation of listed manufacturing companies mainly include dividend discount, cash flow discount and market relative valuation models, and each model have its own advantages. In this paper, the valuation level of BYD is calculated based on the market approach, return method and dividend discounting models, respectively. It can be seen that the calculation results of both the market method rate and the DDM model are much lower than the current market value of BYD. In comparison, the results of the free cash flow model based on the return method are closer to the market value of BYD. This may be because the level of BYD's dividend distribution is relatively low, and the business models of listed companies in the same industry are quite different from BYD's, which also causes the lack of comparability. Overall, the return method may be more applicable to the valuation of new energy vehicle listed companies, and the model parameter settings and estimation methods can also be further improved in future research.

1. Introduction

With the global Covid-19 epidemic in 2020, more and more families have demand for automobile purchase. Automobiles no longer belong to the luxury category, but will become a necessity for residents to travel outdoors in the future. According to the statistics of the automobile industry in 2020, the total annual sales of automobiles in China was 25.311 million units, a year-on-year decrease of 1.9%, while the new energy vehicles grew rapidly, with sales reaching 1.367 million units, a year-on-year increase of 10.9%, which reflects that the structure of China's automobile industry is on the track of transformation and upgrading, and that new energy vehicles will become the main driving force of the automobile industry.

At present, as China's automobile manufacturing industry is in a critical period of transformation and upgrading, the company valuation in the new energy vehicle sector have attracted more and more attention from investors. The previous theories for the valuation of listed manufacturing companies mainly include dividend discount, cash flow discount and market relative valuation models, and each model have its own advantages. For example, Cao Yingfan (2017) analyzed the investment value of BYD from a qualitative perspective on the basis of its basic financial statements. Chen Yaxin (2019) estimated the valuation of new energy vehicles based on the patent value of intellectual property, which was mainly applied to the pricing of core technologies. Lin Chao (2019) used Foton Motor as a research case, and chose a valuation method combining the cash flow method and the real option method. Sun Jianyang et al. (2021) also used industry environment and financial indicators to evaluate the investment value of BYD. Shen Yuqing (2021) commented on the different characteristics of new energy vehicle valuation and compared different valuation methods.

Although there have been many theoretical studies on the valuation of new energy vehicle companies in the past few years, fewer of them have used a specific company as a case study, and the valuation models used tend to have high limitations. Therefore, in this paper, three models,

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market approach, return method and dividend discounting, will be used to compare the applicability of different models to the valuation of BYD.

2. Theoretical Analysis of the Valuation of Listed Companies

2.1 Market Approach

The market approach, also known as the "relative value approach," is a method of selecting valuation metrics of listed companies in the same industry as the target and using them as a basis for valuing the company. The market approach requires that the market price of the listed company can reflect the intrinsic value, i.e. the market is effective and there are similar comparable companies in the market. In terms of specific calculation formulas, most of them have price-to-earnings ratio(PE), price-to-book ratio(PB) and price-to-sales ratio(PS), which are calculated as follows.

$$PE = \frac{MarketValue}{Net\ Profit} \tag{1}$$

$$PB = \frac{MarketValue}{NetAsset} \tag{2}$$

$$PS = \frac{MarketValue}{Gross\ Revenue} \tag{3}$$

PS is rarely mentioned in China's stock market, because it does not reflect the cost of enterprises, and is more suitable for enterprises with rapid growth and loss of profit. PE and PB are two relative valuation indicators that are often used. When the net profit and net asset scale of listed companies are relatively stable, these two indicators can better reflect the market value of the company under evaluation. The calculation method is also relatively simple, i.e., calculated by the ratio of market value to financial indicators. However, the effectiveness of PE and PB are easily affected by market shocks. Therefore, these two indicators are more suitable for large-scale manufacturing listed companies than start-up companies with negative net profit and unstable revenue, etc.

2.2 Return Method

The return method model is a valuation model that predicts the future cash flow of an enterprise by discounting and summing up. This method predicts the future profitability of the company, and predicts future net profit, working capital changes, depreciation and amortization through historical financial reports, industry reports and other information. At the same time, the weighted cost of capital (WACC) is calculated based on the equity capital and debt capital structure, and the discounted theoretical value is calculated based on the WACC as the discount rate. According to the following formula, *PV* represents the theoretical value of the valued company; *T* represents the length of forecast time (usually 3 years); *t* represents the year; $FCFF_t$ represents the expected free cash flow of the company being valued in *Year t*; WACC represents the discount rate calculated based on the weighted cost of capital; and *g* represents the expected free cash flow perpetual growth rate. The formula for calculating the weighted cost of capital (WACC) is expressed by the following formula (5), where *Kd* represents the interest rate on debt capital, *Ke* represents the annualized rate of return on equity capital, *Wd* represents the proportion of negative debt capital, *We* represents the proportion of equity capital, and *TAX* represents the tax rate on equity capital.

$$PV = \sum_{i=1}^{T} \frac{FCFF_t}{(1+r)^t} + \frac{FCFF_{T+1}}{(r-g)(1+r)^T} \tag{4}$$

$$WACC = W_d * K_d + W_e * K_e(1-TAX) \tag{5}$$

It can be seen that the calculation and derivation of the discounted cash flow (DCF) model is relatively more rigorous, which highlights the characteristics of the dynamic valuation of listed

companies and breaks through the valuation bubble problem in the market approach model. However, this model assumes that the valued company is sustainable. Therefore, it is applicable to the manufacturing industry with a stable business model and a traditional procurement and sales model.

2.3 Dividend Discount Model (DDM)

The dividend discount model (DDM) is the most classic valuation model for listed companies, which assumes that the stock of a listed company will pay dividends to investors every year, and the theoretical value of the stock is obtained by discounting and summing up the dividend amount. Dividend discount model (DDM) is a special model for discount calculation through dividend distribution, which is based on the discount and summation of dividends distributed by listed companies to obtain the value level of the stock. The specific calculation formula is as follows. V represents the intrinsic value of the stock, D represents the dividend in different Periods t, and k represents the discount rate. According to the dividend with a fixed growth rate g, a fixed growth dividend discount model can be obtained.

$$V = \frac{D}{(1+k)} + \frac{D(1+g)^2}{(1+k)^2} + \frac{D(1+g)^3}{(1+k)^3} + \ldots\ldots + \frac{D(1+g)^t}{(1+k)^t}$$
$$V = \frac{D}{k-g} \tag{6}$$

In China, not every listed company issues dividends annually. The dividend discount model (DDM) is more applicable to listed companies that pay dividends regularly, but not to list companies that do not pay dividends. China's auto manufacturing industry has a good historical record of paying dividends. In 2022, BYD's dividend payout ratio reached 10.07%, and the dividend distribution is relatively stable. However, the decision of dividend payout ratio of listed companies is highly subjective. If the listed company deliberately pays less or more dividends, the valuation results will be greatly deviated. Moreover, most investors buy stocks for short-term speculation, not for returns through dividend yields. Therefore, the applicability of this model may be insufficient

3. Case study of BYD’s valuation

3.1 Enterprise introduction

BYD's full name is "BYD Co., Ltd.". The company was established in Shenzhen in 1995. Its main business is automobile manufacturing, batteries, auto parts and other products for new energy vehicles. The company was listed on the Hong Kong Stock Exchange in 2007 and Shenzhen Stock Exchange in 2011. Its stock code on the Shenzhen Stock Exchange is 002594. BYD's market positioning has long been concentrated in the new energy vehicle industry. It has a new energy technology R&D team rarely found in China, with independent new energy battery technology, and acts as a battery supplier for most electric vehicle manufacturers. At present, BYD has launched its Qin, Han, Tang, Song, Yuan and other models of electric vehicles, which deeply integrated the cultural connotation of China's native peoples, and are committed to becoming a leader in the field of all-electric vehicles in China. From its historical financial information, BYD’s financial performance in 2018-2021 is relatively stable, and the company's net profit, net assets and other data have steady growth, which is suitable for valuation analysis.

3.2 Market approach valuation analysis

3.2.1 Comparative analysis of the same industry

The table below shows the horizontal comparison of BYD's price-earnings ratio (P/E), price-to-book ratio(P/B), earnings per share and other data during the closing price on April 21,

2022 and that of other listed companies in the same industry. As can be seen from the data, BYD's P/E ratio is 225.04, and the P/B ratio is 7.21, which is far behind other listed companies in the same industry. From the perspective of median, the industry's median earnings per share is 0.54 yuan, the median P/E ratio is 12.21, and the median P/B ratio is 2.47. Therefore, BYD's market value is overvalued based on the market average.

Table 1: P/E and P/B of BYD and other listed companies in the same industry

Sort	Short Name	Latest closing price (yuan)	Earnings per share (yuan)	P/E Ratio	P/B Ratio
Industry average (Global approach)		43.85	0.72	39.27	2.33
Industry median		13.91	0.54	12.21	2.47
1	BYD	235.40	1.05	225.04	7.21
2	Great Wall Motor	24.36	0.73	33.48	3.47
3	SAIC	16.21	2.07	7.85	0.70
4	GAC Group	11.61	0.70	16.56	1.35
5	Changan Auto	10.33	0.37	27.85	1.42
6	Sokon Group	41.39	-1.53	-26.98	7.77
7	BAIC Blue Park	6.52	-1.22	-5.33	2.51
8	FAWHaima Automobile	5.00	-0.77	-6.47	2.42

3.2.2 Analysis of Valuation Results

According to BYD's earnings per share of 1.05 yuan and the industry average and median, the corresponding intrinsic values are listed in Table 2. It can be seen that there is a large gap between this result and the closing price, which may be due to the existence of a "Matthew distribution" of the P/E or P/N ratio distribution in the new energy automotive industry, resulting in the median and average value does not represent the valuation level of individual enterprises, indicating that the market approach valuation results are not accurate. As shown in Figure 1, the P/E ratio and P/N ratio distribution of the auto manufacturing industry do not meet the normality.

Table 2: Theoretical valuation level of BYD

Index	Result	Theoretical stock price
Earnings per share (yuan)	1.05	
Net assets per share (yuan)	32.66	
Industry average PE ratio	39.27	41.23
Industry median PE ratio	12.21	12.82
Industry average PB ratio	2.33	76.10
Industry median PB ratio	2.47	80.67

Figure 1: P/E and P/B distributions of the auto manufacturing industry

3.3 Return method valuation analysis

3.3.1 Weighted cost of capital

Before the free cash flow valuation analysis, it is necessary to calculate the corresponding after-tax operating net profit, working capital changes, capital expenditures, depreciation and amortization disclosed by the company. In the calculation of cost of equity capital, the CAPM model is constructed by using BYD's 2018-2021 stock market performance GEM index. In the research and calculation, it is assumed that the risk-free rate of return is 0, then the relationship between the two can be calculated through univariate linear regression. Since the compound annual growth rate of the GEM Index from 2018 to 2021 is 18.25%, the cost of equity capital of BYD can be obtained by the following cost of equity capital formula, which is 18.20%.

Equity capital cost = 0.9901 × GEM index compound annual growth rate + 0.13%

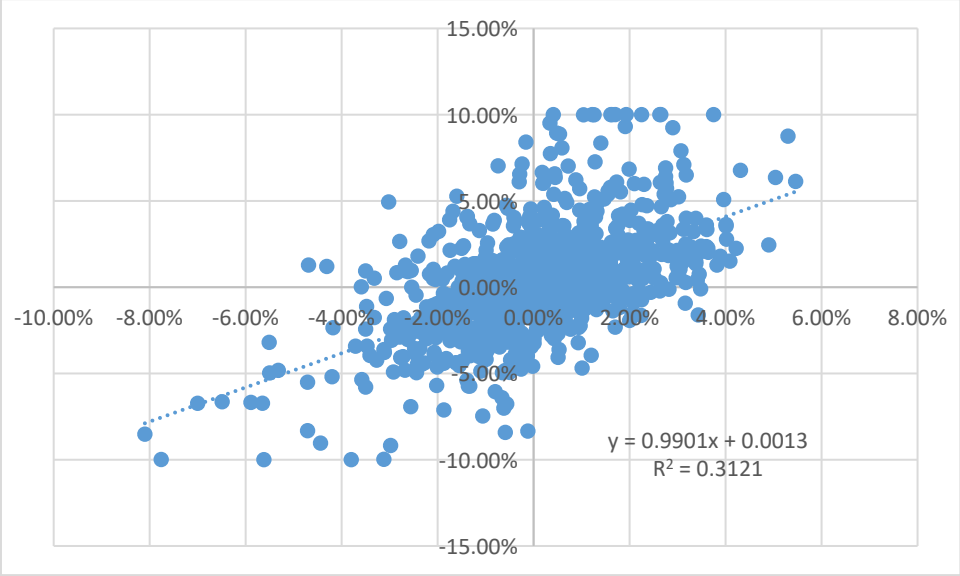

Figure 2: Regression Model Analysis

Further, the summation is calculated based on BYD's debt capital structure and equity capital structure. Among them, it is assumed that the average interest rate of BYD's short-term debt[1] is 1.5%, and the scale of long-term debt is 5.11%. The capital income tax rate is 25% based on the share of equity capital, then it can be calculated that the WACC discount rate of BYD is 10.47%.

Table 3: Discount Rate Calculation

Category	Amount (100 million yuan)	Proportion	Cost
Short-term debt	305.54	20.99%	1.50%
Long-term debt	107.9	7.41%	5.11%
Rights and interests	1,042.44	71.60%	18.20%
Tax rate			25%
WACC			10.47%

3.3.2 Forecast of tax profits

The following table presents BYD's income statement for 2018-2021. BYD's operating income did not have positive growth in 2018-2019, but it showed a rapid growth in 2020-2021, which is because the demand for new energy vehicle purchase gets a blowout in this period. Hence, it is assumed that the growth rate in 2021 will be maintained in 2022-2024. Meanwhile, BYD's operating cost rate is relatively stable, so the main business cost rate is assumed to be the average of

[1]short-term loans + notes payable + long-term loans due within one year

2018-2021. At the same time, due to the release of BYD's economies of scale in 2021, operating expenses are also eased, assuming that the 2021 level is maintained in 2022-2024. It is assumed in this article that BYD can still enjoy higher income tax incentives. Therefore, the proportion of income tax in 2022-2024 is the average in 2019-2021.

Table 4: After-tax operating profit for 2018-2021

Subject\Time	2018Annual Report	2019Annual Report	2020Annual Report	2021Annual Report
Operating income (100 million yuan)	1,300.55	1,277.39	1,565.98	2,161.42
Year-on-year growth	-	-1.78%	22.59%	38.02%
Operating cost (100 million yuan)	1,087.25	1,069.24	1,262.51	1,879.98
Proportion	83.60%	83.71%	80.62%	86.98%
Operating expenses	182.61	186.91	227.59	246.04
Proportion	16.80%	17.48%	18.03%	13.09%
Before-tax operating profit (100 million yuan)	30.69	21.24	75.88	35.4
Subtract: Income tax expense (100 million yuan)	8.29	3.12	8.69	5.51
Income tax share	27.01%	14.69%	11.45%	15.56%
After-tax operating profit(100 million yuan)	22.40	18.12	67.19	29.89

The forecast results in the table below show that from 2022 to 2024, BYD's after-tax operating profits for three consecutive years will be 8.185 billion, 11.297 and 15.592 billion yuan, respectively.

Table 5: Forecast of after-tax operating net profit for 2022E-2024E

Subject\time	2022E	2023E	2024E
Operating income (100 million yuan)	2983.27	4117.61	5683.27
Year-on-year growth	38.02%	38.02%	38.02%
Operating cost (100 million yuan)	2497.77	3447.51	4758.38
Proportion	83.73%	83.73%	83.73%
Operating expenses	390.43	538.89	743.79
Proportion	13.09%	13.09%	13.09%
Before-tax operating profit (100 million yuan	95.06	131.21	181.10
Subtract: Income tax expense (100 million yuan)	13.22	18.24	25.18
Income tax share	13.90%	13.90%	13.90%
After-tax operating profit(100 million yuan)	81.85	112.97	155.92

3.3.3 Forecast of Capital Expenditure

In terms of capital expenditures, according to the data in Choice database of East Money, BYD's capital expenditures, depreciation and amortization data for 2018-2021 are as follows in Table 6. All 3 sets of data have high instability, but the overall growth has shown trend. Therefore, assuming that the compound growth rate of 2018-2021 will be maintained in 2022-2024. The calculation result of year-on-year growth rate for 2022-2024 is 27.92%, 12.76% and 17.41%, respectively.

Table 6: Capital Expenditure and Depreciation and Amortization 2018-2021

Subject\Time	2018Annual Report	2019Annual Report	2020Annual Report	2021Annual Report
Capital expenditure (100 million yuan)	178.42	206.27	117.74	373.44
Year-on-year growth	-	15.61%	-42.92%	217.17%
Depreciation of fixed assets and investment properties (100 million yuan)	75.89	81.07	92.45	108.8
Year-on-year growth	-	6.83%	14.04%	17.69%
Amortization of intangible assets (100 million yuan)	18.09	14.77	30.73	29.28
Year-on-year growth	-	-18.35%	108.06%	-4.72%

Table 7: Capital Expenditure and Depreciation and Amortization 2022E-2024E

Subject\Time	2022E	2023E	2024E
Capital expenditure (100 million yuan)	477.69	611.04	781.62
Year-on-year growth	27.92%	27.92%	27.92%
Depreciation of fixed assets and investment properties (100 million yuan)	122.68	138.33	155.98
Year-on-year growth	12.76%	12.76%	12.76%
Amortization of intangible assets (100 million yuan)	34.38	40.36	47.39
Year-on-year growth	17.41%	17.41%	17.41%

3.3.4 Forecast of net working capital

In this part, working capital is estimated by operating current assets and operating current liabilities, and net working capital changes are calculated from working capital changes. From the data results, the changes in BYD's operating assets and operating liabilities from 2018 to 2020 are large. It is likely that BYD will exert its efforts in operation and marketing during this period, filling the investment through debt, and the investment in working capital will also be drastically reduced. Therefore, this paper assumes that operating assets and operating liabilities will maintain the growth rate of 2021 during 2022-2024.

Table 8: Net Working Capital Calculations for 2018-2021

Subject\Time	2018Annual Report	2019Annual Report	2020Annual Report	2021Annual Report
Operating assets (100 million yuan)	1,152.11	1,069.67	1,116.05	1,661.10
Year-on-year growth rate	-	-7.16%	4.34%	48.84%
Operating liabilities (100 million yuan)	1,165.69	1,080.29	1,064.31	1,713.04
Year-on-year growth rate	-	-7.33%	-1.48%	60.95%
Increase in perating working capital (100 million yuan)	-	-82.44	46.38	545.05
Increase in operating current liabilities (100 million yuan)	-	-85.4	-15.98	648.73
Net working capital change (100 million yuan)	-	2.96	62.36	-103.68

Table 9: Net Working Capital Calculations for 2022E-2024E

Subject\Time	2022E	2023E	2024E
Operating assets (100 million yuan)	2472.34	3679.76	5476.87
Year-on-year growth rate	48.84%	48.84%	48.84%
Operating liabilities (100 million yuan)	2757.19	4437.78	7142.75
Year-on-year growth rate	60.95%	60.95%	60.95%
Increase in operating working capital (100 million yuan)	811.24	1207.43	1797.10
Increase in operating current liabilities (100 million yuan)	1044.15	1680.59	2704.97
Net working capital change (100 million yuan)	-232.91	-473.17	-907.87

3.3.5 FCFF measurement results

The following equation sets out the formula for the FCFF model respectively, by which the results of the BYD valuation model can be calculated, and the projected free cash flows for 2022-2024 are shown in Table 10.

$$\begin{aligned} FCFF = {} & EarningsBeforeInterestAndTax(1-\text{IncomeTaxRate}) \\ & -\text{ChangesInNetWorkingCapital} - CapitalExpenditures \\ & + DepreciationAndAmortization \end{aligned} \tag{7}$$

$$\begin{aligned} &\text{Operating Pr}ofitAfterInterestAndTax = MainBu\text{sin}ess\,\text{Re}venue \\ &-MainBu\text{sin}essCost - \text{OperatingExpenses} - \text{CorporateTax} \end{aligned} \tag{8}$$

$$CapitalExpenditure = CashPaidForPurchaseOfFixedAssets \tag{9}$$

$$\begin{aligned} &\text{Net}WorkingCapital = IncreaseInOperatingCurrentAssets \\ &-\text{IncreaseInOperatingCurrentLiabilities} \end{aligned} \tag{10}$$

Table 10: Forecast of FCFF of BYD

Subject\Time	2022E	2023E	2024E
Net profit after tax from continuing operations (100 million yuan)	81.85	112.97	155.92
Capital expenditure (100 million yuan)	477.69	611.04	781.62
Depreciation and amortization (100 million yuan)	122.68	138.33	155.98
	34.38	40.36	47.39
Net working capital change (100 million yuan)	-232.91	-473.17	-907.87
FCFF (100 million yuan)	-5.87	153.79	485.54

Based on this equation, this paper establishes valuation model for BYD, which includes two-stage increase results, of which *WACC* is 10.47% and the *g*-industry perpetual growth rate is assumed to be 2.5% due to the ideal development of the industry in the new energy vehicle industry. The calculation result of the perpetual growth rate of 2.5% is given in the following formula. According to the calculation, the theoretical market value of BYD is 511.3 billion yuan. The closing price on April 21, 2022 is 235.40, and the market value is 685.3 billion yuan. The two figures of market value are relatively close.

$$PV = \sum_{t=1}^{3} \frac{FCFF_t}{(1+WACC)^{t-1}} + \frac{FCFF_3 \times (1+g)}{(1+WACC)^3 \times (WACC - \text{g})}$$

$$PV = -5.87(1+10.47\%)^{1} + 153.79/(1+10.47\%)^{2} + 485.54/(1+10.47\%)^{3}$$
$$+ 485.54*(1+2.5\%)/(10.47\% - 2.5\%)/(1+10.47\%)^{3}$$
$$\approx 511.3(BillionYuan)$$

The following table presents the valuation results of different perpetual growth rates. It can be seen that when the perpetual growth rate is 5%, it is closer to the closing price of 235.40 on April 21, 2022.

Table 11: Sensitivity Analysis of FCFF Valuation of BYD

Sustainable growth rate	Valuation results (100 million yuan)	Share capital (100 million shares)	Theoretical stock price (yuan)
2.5%	5113	29.11	175.64
5.0%	7394	29.11	254.00
7.5%	13517	29.11	464.34
10.0%	84772	29.11	2912.13

3.4 Calculation results of the dividend discount model

The table below presents BYD's dividend data. It can be found that BYD's dividend growth rate has been negative for the last 5 years. However, the decline in dividend per share will naturally occur due to Covid-19 epidemic in China in 2021. Based on the weighted calculation of the last 6 years, it is calculated that the average dividend per share in 2019-2021 is 0.14 yuan. Then, it can be estimated based on different dividend growth rates. Considering that the equity capital discount rate calculated above is 18.20%, then the results in Table 13 can be obtained according to formula (6). It can be found that the valuation results of BYD with dividend discount model are lower under the assumption of any conditions, which is also caused by the lower dividend rate of BYD, indicating that DDM is not applicable to BYD valuation.

Table 12: Dividend Data of BYD

Annual Report	Dividends per share (yuan)	Dividend Yield (%)
2016	0.18	0.36
2017	0.14	0.25
2018	0.20	0.39
2019	0.06	0.10
2020	0.15	0.09
2021	0.11	0.04

Table 13: DDM Valuation Results of BYD

Dividend Growth Rate\Initial Dividend (yuan)	0.14	0.16	0.18	0.2	0.22	0.24
-15.00%	0.42	0.48	0.54	0.60	0.66	0.72
-10.00%	0.50	0.57	0.64	0.71	0.78	0.85
-5.00%	0.60	0.69	0.78	0.86	0.95	1.03
0.00%	0.77	0.88	0.99	1.10	1.21	1.32
5.00%	1.06	1.21	1.36	1.52	1.67	1.82
10.00%	1.71	1.95	2.20	2.44	2.68	2.93
15.00%	4.37	5.00	5.62	6.25	6.87	7.50

4. Conclusions

This paper calculates the valuation level of BYD based on the market approach, thereturn method and the dividend discounting model, respectively. It can be obtained that the calculation results of both the market approach and the DDM model are much lower than the current market

value of BYD. In contrast, the results of the free cash flow model with the income approach are closer to the market value of BYD. This may be due to the fact that BYD's dividend payout level is low and the business model of other listed companies in the same industry differs significantly from BYD's, which also contributes to the lack of comparability. Overall, the return method may be more applicable to the valuation of new energy vehicle listed companies, and the model parameter settings and estimation methods can also be further improved in future studies.

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