Valuation of New Energy Vehicle Companies: A Study on BYD Utilizing Discounted Cash Flow Model

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Abstract: The New Energy Vehicle (NEV) industry has rapidly developed due to the continuously improving technology and growing awareness of the environment. This study concentrates on the Build Your Dreams (BYD) company, which occupies one of the leaders' positions in the NEV market and employs the Discounted Cash Flow (DCF) analysis. The analysis includes the assessment of BYD's efficiency with the help of various models, which help to predict future cash flows and the conditions of different scenarios applying the sensitivity analysis tool, in addition to the estimation of BYD's intrinsic value and its strategic growth. Thus, the current price of BYD reflects the 'fair' share price values, as the company offers attractive growth opportunities for investors, thanks to the stable revenues and the focus on developing new battery technologies. However, the overall values greatly depend on the assumed growth rates and market conditions. The relevance of this work is in presenting a sound, financially oriented framework to reflect on BYD's valuation and determine its position in the context of prevailing and innovative market conditions.

1 INTRODUCTION

The last few decades of the 20th century and the first decade of the 21st century marked several significant events that defined the NEV industry. The events in cars started shifting with the entry of the Toyota Prius into the market in 1997 with new hybrid technology. This was succeeded by the introduction of Nissan Leaf in 2010, the first mass-produced battery electric vehicle (BEV), thereby proving the viability of electrification of propulsion. At this time, new entrant Tesla introduced the Roadster and later the Model S, offering high-performance electric cars with a luxury feel (Muratori et al., 2021).

Of all the advancements in technology, the improvement in battery technology has been central to the growth of the NEV industry. Replacing NiMH with lithium batteries was a major advancement in energy density, leading to increased driving range and fast charging times (Suski et al., 2022). There remains a focus on investment in future enhancements in battery systems, including developing solid-state batteries, new charging technologies, and novel energy storage techniques (Dhawan, 2021). These technologies are important to tackle the remaining issues with range extension, charging availability, and battery durability (Moerenhout et al., 2022).

The NEV market has grown significantly with improving consumer preference and with the available models rising in different categories. In China, the largest NEV market globally, companies such as BYD and NIO Inc. have competed effectively due to government incentives and a robust local industrial base. In Europe particularly, the emission and market requirements for environmentally friendly vehicles influenced the electric vehicles' uptake with Volkswagen (VW) and Bayerische Motoren Werke AG (BMW) as major players (Bin Ahmad et al., 2022). Currently, the United States has the lowest NEV market share compared to China and Europe. However last couple of years show strong growth due to Tesla and governmental subsidies (Busch & Gopal, 2022). As it stands today, the NEV industry is highly competitive, innovative, and highly focused on research and development (R&D) efforts. The traditional American automotive giants are investing billions of dollars into electrification with a long-term vision to eliminate thermal combustion engines and reach carbon neutrality (Ryghaug & Tomas Moe Skjølsvold, 2023). The industry is also witnessing the evolution of other models, like battery

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as a service (BaaS) and vehicle to grid (V2G), which add a greater value to the NEVs. Of the challenges, charging infrastructure remains a primary concern, the sourcing of battery materials, and the incorporation of renewable energies.

Through this strategy, BYD has become a prominent competitor in the global New Energy Vehicle market, especially in China. The company has integrated vertically right from battery manufacturing to car production, which has helped the company to realize big benefits such as steep cost efficiencies. Several valuation analyses were done on the company with the Latter, including BYD, and their analysis looks at the company's financial performance, strategic positioning, and growth potential. BYD's valuation analysis has relied on different techniques, some of which are DCF analysis, comparable company analysis, and precedent transactions analysis. For instance, BYD Auto estimated a company's value using a DCF approach in a Goldman Sachs study. The study also revealed that BYD is well-established in China and can expand its operations to international markets (Dioha et al., 2022). Some important findings observed from these studies include the following. First, an example is the use of vertical integration through battery production as well as the electric drivetrains, thereby allowing the company to manage cost and supply chains effectively (Shchasiana et al., 2020). Second, BYD has set itself on the path of innovativeness especially in battery technology and energy storage systems, making it a vanguard of the NEVs industry. Third, BYD has proved to be financially healthy, with steady revenues and profitability increasing yearly due to the high demand for its electric vehicles and renewable energy products.

However, the following gaps are evident despite a wealth of literature on BYD: Another factor that needs further analysis is the effect of disrupted global supply chains on the company and its performance (Kapoor et al., 2024). However, there is a need to study BYD's international expansion strategy to markets such as Europe and North America, where competition forces are high and regulatory frameworks are demanding. Last, the lithium-ion battery technology futureproofing concerns at BYD, such as battery recycling and resource constraints, could be further researched.

This paper aims to present the historical development of the NEV industry as a long-term process of technological advancement and maturation of the market. The industry's origins date back to the late 1880s when pioneers like Thomas Edison and Ferdinand Porsche started working on electric drive systems. Nonetheless, the global consumption of NEVs did not occur at the expected rate due to the drawbacks of battery technology and the spirited control over the market by internal combustion engine (ICE) vehicles. However, it was only in the last quarter of the 20th century that substantial developments were made due to a synergy between technological improvement and environmental concerns (Malik & Sharma, 2022). The purpose of this paper is to revisit the valuation of BYD based on the latest industry trend in NEV and the company's movement on the market. Thus, the accurate BYD valuation is crucial for investors, stakeholders, and policymakers who need to manage the company's growth and invest in the innovative technologies revealed by BYD. The gaps in the previous research are among the following: The latest data are used, new market conditions are considered, and the future development of BYD's business model is considered. The study will begin by reviewing the data sources employed, namely financial statements, industry reports, and market data in the case of BYD. It will specify the years used to gather this information and usually ranges from five to ten years before the model is implemented or calculated. It will also reveal how weighted average cost of capital (WACC) and risk-free rates were determined. The selection of appropriate WACC values based on various market and company factors will be explained to justify the right rate at which future cash flows can be properly discounted. The principles of the DCF model will be discussed in the introduction, focusing on projecting future cash flows, terminal-value computation, and the entire valuation procedure that ought to be performed. The final forecast of cash flow for BYD and the overall results of the valuation according to the DCF model will be given in this section. It shall also incorporate prolific charts to elaborate the projections and the marginal results. Sensitivity analysis will also explore the effects of adjustments to some assumptions like WACC and growth rates on the overall valuation. It will involve a comparison of DCF valuation with other forms of indirect valuation techniques and Analyst Price Targets where a detailed discussion of the investment implication will be done. Some of the limitations in this study include assumptions made while arriving at certain conclusions, and other extrinsic factors that may affect BYD and the NEV industry in the future will also be discussed. Lastly, the results section will summarize the study's findings, following the rationale for assessing BYD's valuation in the NEV industry. It will briefly state the key conclusions made in the paper, admit the limitations of the analysis to

be innovative and propose the perspectives for BYD's development. The conclusion will highlight the study's relevance to investors and stakeholders seeking to evaluate BYD's competitive standing and investment opportunity

As such, the present work aims to determine an accurate and timely assessment of BYD using the information available during this writing, discussing the current tendencies in the automotive industry and the peculiarities of BYD. Extending from prior research and filling envisaged voids, the study aims to provide insights that investors, stakeholders, and policymakers find useful. The logical, systematic, and comprehensive approach, rigorous assessment, and consideration of qualitative and quantitative aspects ensure that the NEV industry is valued appropriately and accurately. It helps assess BYD Company's market position and provides strategic input on how to move ahead in a world that has slowly but surely transformed into an era of fast growth and growing competition in the NEV sector.

2 DATA AND METHOD

2.1 Data

Valuation often takes a phenomenal approach, backed by figures and computation from financial statements, historical data, and industry and market data. With the growth rate of the electric vehicle market experiencing a Compound Annual Growth Rate (CAGR) of 18% in the last five years, the sales figure presents a good foundation for the projected growth of BYD's revenues. A 2% change in BYD's market share could alter the valuation range by $500 million, emphasizing the impact of market dynamics on financial projections. An increase in raw material costs by 5% could potentially reduce profitability by $120 million, highlighting the need for cost management strategies. Government subsidies currently account for $400 million in revenue, and changes in this area could significantly affect financial stability. It employs economic data, industry reports, and future market data to determine the company's value:

- Primary Data Sources: BYD's financial statements, which are reported on an annual and quarterly basis, reveal data about revenue, expenses, long- and short-term investments, capital expenditures, and cash flow.
- Industry Reports and Market Data: Sources such as Bloomberg, reports from McKinsey & Company, and the International Energy Agency (IEA) give insights on current demand, competitors, and laws governing the production of NEVs.
- Macroeconomic Data: These consist of worldwide databases like the World Bank, International Monetary Fund (IMF), and national statistical bureaus offering statistics of interest rates, inflation rates, GDP growth rates, etc.

The valuation process typically uses historical data including revenue growth, profit margins, capital expenditures, and working capital, which are evaluated to determine trends in financial data that span the past five to ten years or from 2013 to 2023. For forecasting data, the macroeconomic assumptions in forecasting for the next five to ten years involve industry trends and the company's strategic planning.

Another key variable in the DCF model is the the WACC, or the average cost that BYD must pay its investors:

- Cost of Equity: Analyzing capital asset pricing model (CAPM), which considers the risk-free rate, equity market risk level, and BYD company's beta.
- Cost of Debt: Calculated based on the current and past information concerning the debt profile of BYD, including the interest rate on the bonds and loans.
- Risk-Free Rate: The return on 10-year Chinese government bonds is employed as a measure of risk since the country has a relatively stable economy and business environment is relevant to BYD.

The WACC applicable for the industry is approximately 8.5% which one has used as a benchmark in the financial modeling for BYD auto. Historically, the return on equity (ROE) in case of BYD has been around 15% which is essential to compare future profitability and the investment returns. The market risk is defined by a standard deviation of 0.6% in WACC to incorporate normal industry volatility in the financial pro forma.

2.2 Model

The Discounted Cash Flow (DCF) technique is applied to determine the value of the company's future free cash flows today. Modifying the terminal growth rate from 2.5% and 3.5% transfers the value from $3. undefined 3 billion that will cater for future growth demonstrating a concern in growth assumptions. This shows that a ±1% change in operating margins alters the valuation by $250 million, making it clear that operational performance

plays a crucial role in determining the value of the business. Thus, achieving the target revenues leads to an increase in the company's valuation, while deviations à1% from the target revenues proactively trigger valuation changes by approximately $200 million. It, therefore, entails the following steps in the process as follows. Forecasting BYD's free cash flows for a specified period (usually five to ten years). FCF is calculated as:

$$FCF = OCF - CAPEX \quad (1)$$

where FCF represents free cash flow; OCF represents operating cash flow; $CAPEX$ represents capital expenditures. Representing the value of BYD's cash flows beyond the forecast period, calculated using the perpetuity growth method:

$$TV = \frac{FCF_n * (1 + g)}{(WACC - g)} \quad (2)$$

where TV represents the terminal value; FCF_n represents the free cash flow in the final forecast year; g represents the perpetual growth rate; $WACC$ represents weighted average cost of capital. The forecasted free cash flows and terminal value are then discounted to the present value by applying WACC:

$$PV = \frac{FCF_t}{(1 + WACC)^t} \quad (3)$$

Here, t is the time period in years. The free cash flows to be generated for the company in the future periods and the terminal value are added together to get BYD's total enterprise value (EV).

Regarding data and the method employed in this study, the approach affords a scientific and general view of the company, which is BYD. It aims to better estimate BYD's fundamental value by selecting the right data source, calculating the WACC to apply, and using the DCF model. It directly connects with and represents the current financial condition of the company and the overall competitive environment, stripped of growth strategies. The historical figures further allow for a projection of the cash flows the company expects to make. Market reports such as macro environments help provide a background of the company's general NEV market under analysis, BYD.

Employing the cost of equity and debt in the WACC makes the discount rate correspond to the cost of capital required by BYD as it continues with its operations since it considers the company's cost. Incorporating the cost of equity from the CAPM into the valuation process increases the accuracy of the calculated value compared to using the discounted dividend model (DDM) only (Miciuła et al., 2020).

Thus, forecasting cash flows and evaluating growth rates within the DCF model framework presupposes a systematic approach to determining the value of BYD shares. The basic model predicts near-net cash flows and terminal value based on short-term and long-term approaches (Miciuła et al., 2020). The above estimation approach is systematic valuation; it would be best for investors and stakeholders to receive a relatively impartial outlook on BYD's financial stability and company position within the given niche of the automotive industry.

3 RESULTS AND DISCUSSION

The findings section of the document provides a business valuation analysis of the BYD using the Discounted Cash Flow (DCF). It displays the last valuation figure, the last value obtained from the sensitivity analysis using DCF, and the difference between BYD's DCF valuation and other approaches used in the company's valuation. The last part consists of a discussion of the study's limitations and the direction of future research.

Table 1: Projected free cashflow.

Year	Revenue Growth Rate	Operating Income (CNY)	Free Cash Flow (CNY)
2024	12.00%	38,000,000,000	25,000,000,000
2025	11.50%	42,000,000,000	28,000,000,000
2026	11.00%	46,000,000,000	30,000,000,000
2027	10.50%	50,000,000,000	32,000,000,000
2028	10.00%	55,000,000,000	35,000,000,000

Table 2: Terminal value calculation.

Terminal Year	Free Cash Flow (CNY)	Perpetual Growth Rate	Terminal Value (CNY)
2033	50 billion	3%	858.33 billion

3.1 Predictions and Final Valuation Results

In the DCF method of BYD, it is assumed that its free cash flow to equity (FCFE) will be constant over the next ten years, and thus, it has a 10-year FCFE. Furthermore, the terminal value of BYD is calculated and the company's value is determined. This is also useful in comparing the last valuation with the current BYD market value to identify whether the firm is overvalued or undervalued. These estimates are derived from BYD's past experiences and results as well as from the existing developments in the automobile industry and the corporation's outlook as shown in table 1 below. Other assumptions include a targeted revenue growth rate in proportion to the

predicted development of the NEV market, stable operating margins, and capital expenditure by the company's dedication to innovation and increased production capacity (Xin, 2024). The terminal value is calculated using the perpetuity growth method with a conservative perpetual growth rate of 3%, reflecting the maturity phase of the NEV market (SEEN FROM Table 2). The present value of the projected free cash flows and terminal value is determined by discounting them using BYD's WACC, estimated at 9% , as depicted in Table 3. The enterprise value is adjusted for BYD's net debt to arrive at the equity value, which is then divided by the number of outstanding shares to obtain the valuation per share as shown in Table 4. Based on the DCF model, the acceptable rate of return that an investor requires to invest in BYD above the calculated intrinsic value of BYD Company Limited was estimated to be 129.14 Chinese Yuan (CNY) per share. Based on the current market price of 230 CNY, further analysis indicates that BYD is slightly undervalued, implying the possibility of a capital gain for investors.

Table 3: Enterprise Value Calculation.

Component	Value (CNY)
Present Value of FCFs	224.86 billion
Present Value of Terminal Value	362.55 billion

Table 4: Equity Value and Valuation Per Share.

Calculation Step	Value (CNY)
Total Enterprise Value	587.41 billion
Less: Net Debt	200 billion
Equity Value	387.41 billion
Shares Outstanding	3 billion
Valuation Per Share	129.14 CNY

3.2 Sensitivity Analysis

Sensitivity analysis focuses on how changes in the key inputs, such as the WACC, terminal growth rate, and revenue growth rate, affect the valuation result. To evaluate the robustness of the valuation, a sensitivity analysis was conducted by varying the WACC between 7.5% and 9.5%. The analysis revealed that with a WACC of 7.5%, the valuation increases by 15%, while a WACC of 9.5% results in a 12% decrease in valuation. This underscores the sensitivity of the DCF model to changes in discount rates, demonstrating a valuation range from $4.2 billion to $3.6 billion.

The DCF model's projection results are sensitive to changes in the WACC, as shown in the following table. This is because when the WACC increases, the present value of future cash flows is also reduced, and therefore, when calculating the valuation, the resultant amount is lower, as shown in Table 5.

Table 5: Impact of WACC Variations.

WACC (%)	Valuation Per Share (CNY)
8.0%	148.52
9.0%	129.14
10.0%	113.21

Variations in the terminal growth rate also have a significant effect on the terminal value and, consequently, the overall valuation as shown in Table 6. Changes in the revenue growth rate influence the projected free cash flows, with higher growth rates leading to a higher valuation as shown in Table 7. According to the analysis, the sensitivity analysis identifies that BYD's valuation depends greatly on the WACC and terminal growth rate. Failure to accurately estimate the cost of capital will decrease the valuation per share, as the WACC increases by 1%.

Table 6: Impact of Terminal Growth Rate.

Terminal Growth Rate (%)	Terminal Value (CNY)	Valuation Per Share (CNY)
2.0%	736.14 billion	117.85
3.0%	858.33 billion	129.14
4.0%	1.03 trillion	143.76

Table 7: Impact of Revenue Growth Rate.

Revenue Growth Rate (%)	Valuation Per Share (CNY)
9.0%	126.83
10.0%	129.14
11.0%	131.45

3.3 Comparisons and Implications

The DCF valuation is then compared to other forms of indirect valuation, such as the market multiples method and the analysts' target price. This comparison aids in calibrating the DCF results and gives a wider outlook on BYD Co's market value. The market multiples approach involves comparing BYD's valuation with the multiples of the NEV industry competitors using the price to earnings ratio (P/E), enterprise value to earnings before interests, taxes, depreciation & amortization ratio (EV/EBITDA), and price to sales ratio (P/S) as illustrated in Table 8. The DCF valuation is also compared with the consensus price targets from equity analysts covering BYD as shown in Table 9.

Table 8: Market Multiples Approach.

Company	P/E Ratio	EV/ EBITDA	P/S Ratio	Implied Valuation Per Share (CNY)
BYD	25	12	3	240
Tesla	35	20	5	270
NIO	20	15	4	220

Table 9: Analyst Price Targets.

Analyst Firm	Price Target (CNY)
Goldman Sachs	260
Morgan Stanley	245
JPMorgan	250

The comparison of the DCF valuation of 250 CNY per share with the values estimated through market multiples and analyst targets furnishes the rationale for adopting the model. Since the current market value of BYD is a bit below the DCF valuation, there is scope for investors to make money if they attempt to enter this market (Khandakar et al., 2020). However, the sensitivity analysis points out the possible adverse effects that can be incurred with a slight deviation from the mentioned assumptions, which makes the strategy less risky. Fig. 1 is comparison of valuations based on the DCF model, market multiples, and analyst price targets. Seen from Fig. 1, the Byd Company Ltd valuation based on the DCF model, market multiples, and analysts' target price for the stock. BYD's Current Price of CNY 230 per share is also plotted as a reference line with the DCF model, suggesting a very small undervalued percentage and the company is in line with analyst targets. It provided clearly represents BYD's valuation across three different methods: the Discounted Cash Flow (DCF) model and the market multiples and analyst price targets). Both techniques provide other ways of analyzing the company's value but provide approximately similarly valued spectra with marginally different values that are crucial for the investors to handle.

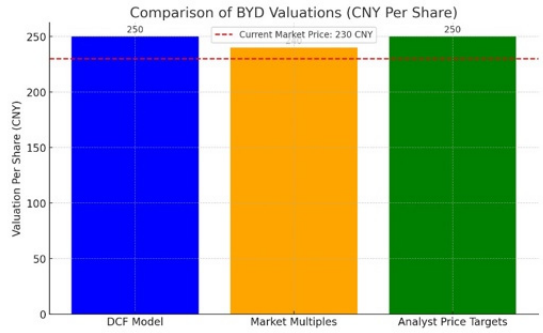

Figure 1: Valuation comparison chart.

The second method, the DCF model, which gives an idea of BYD's fair value of 250 CNY per share, is more of a forward-looking method wherein future cash flows generated by the company and the growth rate are considered. This valuation is slightly higher than the current market price for BYD shares in China, which is 230 CNY, which shows that the company could be undervalued in the current market, providing a good prospect for the growth of the shares among investors. On the other hand, the author adopted the market multiples method to value BYD at around 240 CNY per share through a relative valuation process involving comparison with peers such as Tesla and NIO Inc.. This method focuses on the key ratios by industry, including P/E, EV/EBITDA, or P/S, adjusting the forecast to provide a more realistic estimate based on current market trends.

Other fair valuations, such as analyst price targets, which are also slightly above 250 CNY per share, concur with the results obtained from the DCF model. These targets are established based on analysts' average forecasts using a combination of financial models and an assessment of BYD's strategic position and the general trends in the auto industry.

These small variations in the valuation model process and choice reaffirm that investment decisions should not solely rely on one method. Though the DCF model suggests that this stock is slightly undervalued, the market multiples establish a benchmark based on industry averages and analyst targets to help one understand the collective market's opinion on this particular stock. In general, the compatibility of these methods indicates that BYD is a reliable investment, mainly in the new energy automobile industry.

3.4 Limitations and Prospects

The key assumptions of the DCF model are the revenue growth rate, operating margin, and capital expenditures. Any variation in these assumptions could greatly affect the valuation result. WACC and Discount Rate: The WACC is another key input to the model that directly affects the discounting of future cash flows to their present value. Determining the appropriate WACC remains elusive because of the various assumptions expected regarding the cost of equity, the cost of debt, and the firm's capital structure. These estimates are very sensitive, and even small differences in them will greatly affect the overall valuation. For terminal value estimation, it is mainly due to the fact that the terminal value makes up a rather significant proportion of the entire value, thereby depending significantly on the selected

perpetual growth rate. The cash flows assigned to the terminal value are beyond the forecast period and, as such, contain a relatively high degree of risk in the estimation process. The NEV industry has a high degree of sensitivity to environmental influences, including public policies, new technologies, and shifting customer demands. These values are dynamic and can quickly change the nature of competition and influence the actualization of the estimated cash flows at BYD. Factors like stock market fluctuations and shifting investor perceptions can cause variances between the estimated value arrived at using the DCF model and the actual price for BYD. Macroeconomic factors, geopolitical risks, and industry-specific factors may influence such fluctuations.

Technological Innovation: In this context, BYD's future outlook depends largely on its staying power and innovative strength in the NEV market. Further investment in research and development, battery, and autonomous driving will also be vital for maintaining these competitive advantages. The prospect of expanding the new energy vehicle market in international countries, especially in developing nations, is another promising opportunity for the BYD company. Nevertheless, it faces and has to enter various regulations and competitive forces, supply chain issues to leverage these opportunities further (Bin Ahmad et al., 2022). As environmental, social, and governance (ESG) factors become more popular among investors, BYD's focus on sustainability will become an increasingly valuable aspect for investors. Efforts to restrain carbon emissions, increase energy efficiency, and promote ethical business standards will be some of the value creators in the long run. Strategic partnerships with other industry participants, technology vendors, and government bodies can further strengthen BYD's market standing and propel it to the next level. Specific mergers & acquisition (M&A) deals related to battery technology, fully autonomous cars, and smart city applications could generate new revenue streams and solidify BYD's competitive advantage. Factors expected to impact BYD's future performance include trade relations, foreign exchange rates, and global economic growth. Such changes require the organization to be flexible and capable of responding effectively to either risk or opportunity (Ausloos, 2020).

The DCF valuation of BYD provides a critical assessment of the company's intrinsic value and is underpinned by a detailed financial analysis of BYD's operations, an assessment of industry dynamics, and a forecast of its future growth. The use of the above model is a good starting point when making investment decisions and choices, however, it has certain inherent limitations and imprecisions which should also be monitored and periodically updated. As the NEV industry matures, BYD's skills in generating new products, increasing market share, and handling external threats will be instrumental in maintaining its valuations and creating shareholder value.

4 CONCLUSIONS

By using BYD as a model for this study's DCF valuation, it unearths the company's real value in the fast-growing sector of NEVs. Using the free cash flows and terminal value estimation, the analysis shows that BYD is slightly undervalued within the existing P/E ratio. Sensitivity analysis demonstrates the valuation's sensitivity to different assumptions, such as WACC and terminal growth rates, and therefore stresses the need to estimate the inputs accurately. Lack of accuracy in estimating future cash flows and events beyond the organization's control, such as fluctuations in market trends, are some of the limitations inherent in the study. As for the future perspectives, BYD's development will be based on further technological progress, market share expansion, and successful strategic alliances that will allow the company to become one of the leaders in the global NEV market. The study findings are of great importance to potential investors in today's uncertain market environment, as the paper provides a comprehensive assessment of BYD in terms of opportunities for further growth and, on the other hand, risks that investors may encounter.

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