Research and analysis of BYD, a Chinese new energy vehicle manufacturing enterprise

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Abstract. BYD Auto is a Chinese automaker founded in 2003 and belongs to BYD Company Ltd. As a company that originated in battery manufacturing, BYD Auto has gradually developed into one of the most influential new energy vehicle manufacturers in China and even in the world by virtue of its leading battery technology. Based on the development history of BYD, this paper summarizes the layout of BYD in various industrial chains. Through the valuation analysis of BYD, it is concluded that BYD is an excellent listed enterprise with value of long-term holding in the secondary market so as to Provide reference for enterprise investors.

Keywords: BYD, Chinese automaker, valuation analysis, battery technology, new energy vehicle.

1. Introduction

Since the emergence of electric vehicles in the 19th century, until the 20th century, the commercial operation of early electric vehicles has been a niche field. Later, Ford invented the automatic start technology of the internal combustion engine, which greatly reduced the production cost of gasoline vehicles, and electric vehicles were almost replaced by internal combustion engine vehicles. Until the end of the 20th century, the shortage of oil resources led to the revival of new energy vehicles, and after Tesla planned to launch an electric vehicle with a cruising range of 200 miles in 2006, electric vehicles began to truly flourish.

2. Yardi's development history in the past 20 years

(1) Start-up period (2003-2008)

In 2003, BYD Group founded BYD Auto, marking the official entry of the battery manufacturer into the automotive market. In 2005, BYD launched its first car - F3. With the advantages of high cost performance, energy saving and environmental protection, F3 quickly became a hot-selling model in the market. In 2008, BYD successfully developed the world's first dual-mode electric vehicle F3DM. Its launch made BYD the first company in the world to put plug-in hybrid vehicles into mass production.

(2) Investment and strategic cooperation (2008-2015)

In 2008, the famous American investor Warren Buffett showed great interest in BYD Auto, and invested in BYD through his subsidiary Berkshire Hathaway, enabling BYD to further expand globally Influence. In addition, BYD has strategically cooperated with many well-known companies around the world, such as establishing a new energy vehicle company in a joint venture with Volkswagen.

(3) Leader of new energy vehicles (2015-present)

BYD Auto has always regarded technological innovation as the core competitiveness of the enterprise. In the field of new energy vehicles, BYD has successfully developed a number of breakthrough technologies, such as independent electric drive technology, battery management system, energy recovery system, etc. The application of these technologies gives BYD's new energy vehicles a high competitive advantage in terms of

cruising range, charging speed, and safety. In 2015, BYD launched its first pure electric vehicle e6, which broke the record for the cruising range of pure electric vehicles in China. Since then, BYD

has launched a series of pure electric, plug-in hybrid and fuel cell vehicles, such as Qin, Tang, Song, Yuan and other models, injecting strong vitality into the global new energy vehicle market.

On a global scale, BYD has also established partnerships with public transportation systems in many countries and regions to provide them with new energy vehicle solutions. For example, BYD provides pure electric buses and pure electric taxis for local public transportation systems in cities in the United States, Europe, and South America. In addition, BYD is also actively participating in the construction of global new energy vehicle infrastructure, such as the establishment of BYD Americas in the United States, investing in the construction of charging piles, charging stations and other infrastructure.

3. Overview of BYD's upstream and downstream industrial chains

3.1 The new energy-related industrial chain includes three parts: upstream materials, midstream components, and downstream terminals.

3.1.1. Upstream materials

The core component of new energy vehicles is the battery, and the battery material used to make the battery is divided into four parts: electrolyte, positive electrode material, negative electrode material and separator. Their upstream resources are lithium, cobalt mineral resources and other metals. At present, new energy vehicles mainly use lithium batteries, which are mainly composed of four parts: positive electrode, negative electrode, diaphragm and electrolyte. During discharge, lithium ions and electrons come out from the negative electrode, electrons reach the positive electrode through an external circuit, and lithium ions enter through the electrolyte. positive electrode. Lithium ions, positive electrode materials, and electrons recombine at the positive electrode to complete current conduction, and the separator mainly isolates the positive and negative electrodes to prevent short circuits.

3.1.2. Midstream components:

Mainly the three core components battery, motor and electronic control, as well as other components, such as circuit system, thermal management and lightweight. Among them, the battery is the core, including the battery cell and the battery management system BMS.

3.1.3. Downstream terminal:

Mainly vehicle passenger cars and commercial vehicles, the latter including passenger cars and special vehicles and charging facilities (charging piles and charging stations), and even derivative aftermarket services, such as car rental, finance, recycling, etc.

3.2 Depth Layout

BYD's comprehensive and vertically integrated layout of the new energy vehicle industry chain establishes a fully closed loop encompassing upstream raw materials, midstream components, and downstream complete vehicles. The remarkable synergy effect within this industry chain is evident. To further expedite the external supply of core components for new energy vehicles and expand growth opportunities, five subsidiaries have been established: Fudi Battery, Fudi Power, Fudi Vision, Fudi Technology, and Fudi Mold (Fudi Seiko). Additionally, strategic collaborations with external companies such as Faurecia, Huawei, Toyota, FAW Group Corporation (FAW), Horizon Robotics Inc., Momenta Inc., among others have been forged to comprehensively enhance cooperation in smart electric vehicles and continuously strengthen the company's industrial competitiveness. Furthermore, BYD's semiconductor business is on the verge of being spun off and listed independently with

an estimated valuation exceeding 10 billion yuan. Leveraging its foundation in BYD Auto while expanding its external supply business enables it to anticipate rapid development driven by both the widespread adoption of smart electric vehicles and domestic substitution of automotive-grade chips.

Thanks to BYD's integration of the vertical industrial chain and its comprehensive layout in the new energy vehicle industry, some key components of BYD's models, such as the three-electric system, thermal management, electronic appliances, and chassis systems, are self-developed and self-produced.

Sources: Company official website, OFweek, Battery China, First Electric, BYD Semiconductor Prospectus, Solar Electric Vehicle Network, Tianfeng Securities Research Institute

3.3 Comprehensive Industrial Chain Layout

Through a comprehensive industrial chain layout, the company has achieved significant synergies. With abundant new energy models and strong terminal demand, the market share of key components in the midstream has been driven up. The company's presence in the middle and upper reaches of the industrial chain also provides supply chain support for rapid sales growth, cost reduction, and improved competitiveness and profitability of end products. For example, as of May 2022, the company holds first place in China's new energy vehicle market share while its midstream Fudi battery ranks second in power battery cell (Cell) market share. Additionally, other three electric core components such as battery pack (Pack), electric drive system motors and electronic controls hold first place in China.

3.4 BYD in the fields of power batteries and semiconductors

3.4.1. Leading the new energy battery industry

The monthly installed capacity ofFudi Battery under BYD ranks second in China, and the domestic monthly installed capacity of Fudi Battery is second only to the leading company Ningde Times. At present, the total production capacity announced by Fudi Battery has reached 300GWh. According to the previous plan, the total production capacity of Fudi Battery in 2021 and 2022 can reach 75GWh and 100GWh respectively. Only Wuwei Fudi, Yancheng Fudi, Jinan Fudi, Shaoxing Fudi, Chuzhou Fudi and other companies established in 2021 will It will add about 90GWh of production capacity to BYD.

3.4.2. Breakthrough in semiconductor business, spin-off and listing will be imminent

The semiconductor business was spun off and listed, with a valuation exceeding 10 billion. On December 30, 2020, the company issued an announcement announcing that it is officially planning to spin off BYD Semiconductor Co., Ltd. for listing. As the head company of domestic automotive-grade semiconductors, BYD Semiconductor’s IPO plans to raise 2.686 billion yuan (after deducting issuance expenses).

In short, BYD is a company that started from battery manufacturing and has gradually developed into the most influential new energy vehicle manufacturer in China. Its cars are known for their high cost performance, energy saving and environmental protection. BYD develops electric drive, battery management, and energy recovery systems around battery technology, and is actively building global new energy vehicle infrastructure, such as charging piles and charging stations. It also has a deep layout of the new energy vehicle industry and fully grasps the entire industry chain of new energy vehicles. In February 2023, BYD will be the number one Chinese auto brand, surpassing Volkswagen and Porsche, and ranking eighth in the value of global auto brands.

4. Sales status of BYD's new energy vehicles

4.1 Current status of product strategy

Technology development is the most important thing for BYD, including "542" technology: 5 means that the acceleration time from 0 to 100 kilometers within 5 seconds is the performance benchmark; 4 means that the extremely fast electric four- wheel drive headed by control is the safety benchmark; 2 means that the fuel consumption of 100 kilometers is controlled within 2 liters, which is the fuel consumption standard. "542" is already an automotive standard in the automotive industry.

Iron battery technology is the ingenious technology that BYD is famous for, which can realize a power battery with a capacity of 18.5 degrees, thus providing a pure electric driving distance of 85 kilometers. In terms of coverage of new energy vehicle facilities, according to the "2019 China Electric Vehicle Charging Pile Industry Research Report", as of July 2019, China has built 447,000 public charging piles, and China's sales of new energy vehicles in 2019 are 915,000 vehicles.

4.2 Current status of sales strategy

BYD Song is the most important product line of BYD's new energy SUV. Its investment in technology research and development and sales of new energy vehicles rank first among its peers. According to data, the sales volume of BYD Song new energy vehicles reached 17,900 in 2019. , ranking first among new energy SUVs, although the gap with traditional power vehicles is still huge, but as a new car launched in 2019, the potential is very huge.

Figure 1 Comparison between BYD Song series and other brands of the same type

Manufacturer	Car series	Price （RMB）	Energy type	Sales volume
Great Wall Motor	Harvard H6	103000-141000 yuan	Conventional power	281343
Dongfeng Honda	Honda CR-V	169800-276800 yuan	Conventional power	223013
Dongfeng Nissan	X-Trail	188800-273300 yuan	Conventional power	214622
BYD	Song Dynasty	169800-219800 yuan	Hybrid, pure electric	17900
Weima Automobile	Weima EX5	139800-189800 yuan	Pure electric power	16670
XPeng	Xiaopeng G3	143800-196800 yuan	Pure electric power	14187
Geely Auto Automobile	Emgrand GS	109800 to 159900 yuan	Pure electric power	10292

4.3 Current status of price strategy

From the point of view of price strategy, the pricing of BYD's new energy vehicles is still relatively high. On the one hand, it has advantages in brand; The cost of the product and the market price are relatively high. BYD has made good use of its brand and technology advantages in its price strategy.

According to the above table, it can be seen that the price of BYD Song new energy vehicles is lower than that of traditional SUVs but higher than that of new energy vehicles of the same type, mainly between 160,000 and 220,000.

4.4 Status Quo of Channel Strategy

From the perspective of channel strategy, the automobile sales channel is mainly through dealers, and a series of assessments are required for the selection of dealers,

because the automobile brands are all unified. If individual dealers sell at ultra-low prices, It will bring a series of negative effects to other distributors, which is not conducive to the sales of the company's products. According to the theory of market segmentation, BYD divides the national market according to consumption level, population and other factors: the south has Guangdong, Zhejiang, Hunan, Shanghai, and Sichuan regions; while the north has Shandong, Shaanxi and other regions. Region, Beijing Region, and Jilin Region.

4.5 SWOT Analysis

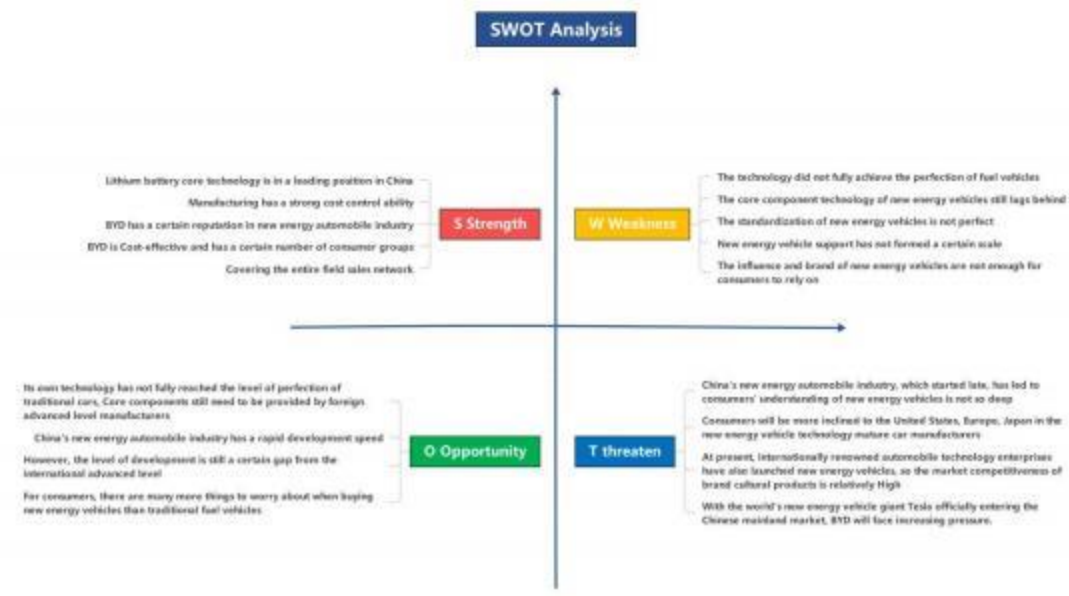

Figure 2 SWOT Analysis of BYD

5. BYD financial analysis and stock price analysis

5.1 Analysis of Financial Situation in the First Quarter of 2023

4.1.1. Operating income

BYD's financial report for the first quarter of 2023 shows that the operating income for the reporting period was 120,173,608,000.00 yuan, an increase of 79.83% compared to 66,825,185,000.00 yuan in the same period last year. This shows that the company's main business income is growing rapidly, and its market share may increase.

4.1.2. Profit Analysis

The net profit attributable to shareholders of listed companies was 4,130,063,000.00 yuan, an increase of 410.89% compared to 808,408,000.00 yuan in the same period last year. This shows that the company's profitability has improved significantly. At the same time, the net profit attributable to shareholders of listed companies after deduction of non-recurring gains and losses was 3,565,127,000.00 yuan, an increase of 593.68% compared with 513,943,000.00 yuan in the same period of the previous year, which further confirmed that the improvement of the company's profitability was not caused by non-recurring gains and losses. cause.

4.1.3. Cash flow analysis

Net cash flow from operating activities was RMB 14,465,699,000.00, an increase of 21.22% compared to RMB 11,933,340,000.00 in the same period of the previous year. This shows that the cash flow generated by the company's operating activities is stable, which is conducive to the company's daily operations and development.

4.1.4. Asset Analysis

The total assets at the end of the reporting period were RMB 547,102,961,000.00, an increase of 10.78% compared with RMB 493,860,646,000.00 at the end of the previous year. This shows that the company's asset scale is expanding, which is conducive to the company's long-term development.

4.1.5. Owner's Equity

At the end of the reporting period, the owner's equity attributable to shareholders of listed companies was RMB 115,576,583,000.00, an increase of 4.10% compared with RMB 111,029,299,000.00 at the end of the previous year. This shows that the company's net asset scale is expanding, which is conducive to the company's long-term development.

4.1.6. Off-balance sheet income

From the perspective of financial expenses, the amount incurred in this period is 5,910,000.00 yuan. Compared with the data of the previous period, the financial expenses are well controlled, which is conducive to improving the company's profit level. The investment income is 245,494,000.00 yuan, and the investment income from joint ventures and joint ventures is 215,063,000.00 yuan, which shows that the company's investment activities have achieved certain income.

In general, BYD's operating conditions in the first quarter of 2023 are good, with substantial growth in operating income and net profit, stable cash flow, expansion of asset scale and net asset scale, and certain gains in investment activities. From the perspective of financial analysts, BYD's performance is strong, and its future development prospects are worth looking forward to.

5.2 BYD Valuation and Stock Price Analysis

4.2.1 Price-earnings Ratio Valuation

As a popular valuation method in the market, price-earnings ratio valuation has received extensive attention from the market. The specific formula of the price-earnings ratio valuation method is as follows:

Table 1 List of Rolling P/E Ratio Values of Some Car Companies from 2018 to 2021

date	BYD	Dongfeng Motor	GAC Group	SAIC	Great Wall Motor
2018-03-31	37.77	49.00	15.06	11.55	20.66
2018-06-30	36.51	31.49	10.32	11.40	17.39
2018-09-30	47.45	22.17	9.56	10.39	11.40
2018- 12-31	49.65	14.42	8.67	8.32	8.41
2019-03-31	52.49	16.72	10.97	8.46	13.72
2019-06-30	40.37	19.73	11.41	8.62	19.36
2019-09-30	35.43	17.81	14.10	9.02	23.21
2019- 12-31	45.99	19.41	16.21	9.57	19.24
2020-03-31	101.33	18.40	16.32	9.35	18.04
2020-06-30	200.39	26.97	23.28	10.75	23.11
2020-09-30	174.01	19.87	24.26	11.05	42.60
2020- 12-31	153.49	31.44	26.11	13.31	83.33
2021-03-31	105.99	22.65	17.72	11.25	51.56
2021-06-30	157.49	17.09	16.32	9.81	52.48
2021-09-30	184.43	19.13	19.54	8.79	62.90
2021- 12-31	232.18	23.59	25.09	9.99	58.13

Since 2018, BYD's P/E ratio has been at a high level in the industry. Such a high price- earnings ratio reflects the existence of a pair of possibilities: The high price-earnings ratio may reflect that BYD's current market value is too high, reflecting the existence of market risks; but to a certain extent, it also shows investors' interest in the company's growth potential. Agreed, investment opportunities exist.

In the face of these two possibilities, in order to further judge the strength of investment opportunities and investment risks, it is necessary to calculate the PEG index. The PEG index can take into account the current profitability and future growth of the company, and its formula is:

$$PEG = \frac{PE}{G}$$

Among them, G is the company's profit compound growth rate in the next three years.

In order to calculate the PEG index, the dynamic price-earnings ratio and the company's profit compound growth rate in the next three years are calculated mainly by collecting relevant data forecasted by securities companies. After data collection, more than 20 brokerages have collected the forecasts of relevant indicators for BYD from 2022 to 2024. We first averaged the earnings per share data forecasted by various securities companies, and calculated the dynamic price-earnings ratio of BYD from 2022 to 2024 based on the BYD stock price at the time point of April 13, 2022.

Table 2 Calculation of BYD's dynamic price-earnings ratio from 2022 to 2024

forecast year	Stock price (2022/4/13)	EPS Forecast	Dynamic price-earnings ratio
2022	237 Yuan	2.7779	85.3176
2023		4.6261	51.2316
2024		6.6209	35.7959

We also calculate the average value based on the net profit forecasted by the brokerage, and use BYD's report data in 2021 as the base period to calculate the company's profit compound growth rate G for the next three years to be 86.43%, and assume that BYD will continue to grow at this growth rate. The PEG data we then obtained are shown in Figure 4.

Table 3 PEG indicator estimation.

	Dynamic price- earnings ratio	PEG
2022	85.31756	0.98718
2023	51.23161	0.592783
2024	35.79592	0.414182

It is not difficult to see through calculation that BYD's long-term PEG index data will be lower than 1, which is undervalued and has investment value.

4.2.2. Residual income valuation

This paper assumes that the required rate of return required by shareholders is r, and adopts the CAPM model, namely:

$$R_s = R_f + \beta \times (R_m - R_f)$$

Among them: Rs is the required rate of return required by shareholders, Rf is the risk- free rate, Rm is the rate of return expected by the market portfolio, and β is the sensitivity coefficient, which reflects the sensitivity of the stock to the overall market trend. β × (Rm-RF) is the risk premium.

Figure 3: Five-year k-line chart:

For the risk-free interest rate, we selected the one-year treasury bond rate of 1.9918% as of April 16, 2023. For the expected return rate of the market investment portfolio, we selected the five-year period from 2018 to 2023 using data from relevant databases. The mean value of the weighted average market annual rate of return of the circulating market capitalization is 9.852%; for the β coefficient, we selected the β value of the 24- month rolling monthly return, which is 0.7888; from this we calculated the required shareholder return rate Rs to be 8.19%.

So far, all the parameters of the forecast period have been prepared and can be included in the calculation; after calculation, the value of BYD in the ten-year forecast period from 2022 to 2031 is 55.22584199 yuan.

Next, we need to calculate the final value, mainly in the determination of the growth rate g. We regard the growth rate g as the average growth rate of residual income in the forecast period from 2022 to 2031, and obtain a growth rate of 6.3911%. Since our determination of the growth rate g is subjective, in order to ensure the fairness of the valuation, this paper sets the upper and lower limits, taking the growth rate g as 7% and 4% as the growth rate under optimistic and pessimistic market conditions respectively. We can calculate the final value of the sustainable growth period and combine it with the value of the forecast period to obtain the valuation of BYD's stock price per share at the beginning of 2022 (see Table 4).

Table 4 Valuation results under the residual income valuation method

	Growth Rate	Future Value (yuan)	Forecast period value	Stock valuation (yuan)
Pessimistic	4%	119.8676827	55.22584199	175.0935247
Generally	6.3911%	285.4366622		340.6625042
Optimism	7%	433.7274657		488.9533077

In summary, the author still believes that BYD's stock price is undervalued and there is room for growth, and believes that the target price can break through at least 320 yuan per share.

6. Summary

Considering BYD's advantages in the electric vehicle industry chain, new technology innovations and continuous expansion of overseas markets, we can see that BYD's future development is very bright. It is foreseeable that under the competition pattern of new car companies, state-owned car groups and independent car companies in the future, BYD will continue to obtain more development opportunities and become a benchmark in the industry.

In short, 1. BYD's product strength continues to rise, and the sales of new energy vehicles are strong. The company's sales of new energy vehicles have been increasing. It continues to lead the development of the industry in the field of electric vehicles, and has taken the lead in high-end self-owned brands, making rapid progress. 2. BYD Blade Battery has six technological innovations of super safety, super life, super battery life, super strength, super power and super low temperature performance, skipping modules, compared with traditional battery packs, the volume utilization rate is increased by 50%, and the cost is low. There are also obvious advantages. 3. BYD's industrial chain layout has been continuously expanded to promote the spin-off and listing of semiconductors as much as possible, and has successively invested in Huada Beidou (high-precision navigation), Canadian Solar (photovoltaic), Hunan Yuneng (cathode materials) and other core companies in the industrial chain . The author believes that BYD relies on the delicate layout of the product chain, which has significantly promoted the ability to control core technology and supply chain risks, and played a leading role. All in all, BYD is a domestic giant of new energy vehicles, and it is possible to usher in prosperity and development with such impressive industry development. By analyzing BYD's financial statements, BYD is valued. Judging from the final valuation results, within the respective valuation time points, the trend of BYD's stock price change is basically in line with the corresponding valuation results. Therefore, investing in BYD within the corresponding time point will be profitable.

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