The Advantages of Supply Chain Integration in Electric-vehicle Industry: Evidence from BYD

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Abstract. Contemporarily, with the increasingly serious problems of energy shortage and air pollution, many countries have taken new energy vehicles as their strategic industries. Exhaust emissions from conventional fuel vehicles contribute to the greenhouse effect and air pollution. Besides, the lack of energy supply due to the non-recycling of fossil fuels is also an increasing issue. Under the background of green innovation development, new energy vehicles have become an important development direction of the automobile industry. Governments around the world hope to use new energy vehicles to alleviate air pollution and energy shortages and achieve sustainable economic development. As a leader in China's new energy vehicle industry, BYD has not only achieved good results in China, but also has a certain share in foreign markets. As a leading enterprise in the new energy vehicle industry, BYD fully relies on its advantages in scale and actively explores the development mode of the whole industry chain of new energy vehicles. According to the analysis, BYD's market share is high and its sales volume has repeatedly hit record highs. Although its operating capacity has declined owing to the impact of the epidemic, it is still in a leading position in the industry. BYD has a large enterprise and a good momentum of development and its vertical supply chain system has also enhanced its competitive edges. Suggestions are proposed to reduce dependence on the government and improving product positioning. These results shed light on guiding further exploration of the further development of BYD.

Keywords: Supply Chain Integration, Electric-vehicle Industry, BYD.

1. Introduction

From the global insights, the problem of environmental pollution and energy shortage is serious. Therefore, one needs to explore some new energy use methods to replace the traditional energy, and the car should also use new energy as the basis for providing power. The traditional industry mainly uses oil as fuel, which has a bad effect on the air, which can lead to global warming. Other toxic gases will also lead to serious air pollution. Because of the drawbacks of traditional energy, some new energy sources, such as electric energy, solar energy, natural gas and water energy, have been widely developed. The development of new energy vehicles is an inevitable and general trend. New energy vehicles have encountered many challenges in the process of research and development and production, many problems need professional and technical personnel and solutions, and further breakthroughs are needed in key technical areas. At present, electric, hybrid and chemical fuel cell new energy vehicles have not been put into mass production, and it still needs the test of time. Among these three types of new energy vehicles, fuel cell vehicles have a fast development speed and occupied a certain market share.

The research and development and production costs of new energy vehicles are high, many new energy vehicles are still in the primary stage of research and development. Some technologies do not pass the standard, the system is very complex, and the efficiency of new energy use needs to be further improved, which makes it difficult for new energy vehicles to form industrial scale operation in a short time [1]. At the same time, reducing R&D and production cost is one of the important issues facing the automobile industry. New energy vehicles have not yet formed a large-scale industrial chain structure, which is not an easy task to replace oil as a vehicle fuel. Energy conversion needs to go through three stages, namely, the search for new energy, the production supply of new energy, and the efficient use of new energy.

According to the previous studies, the automobile industry can be divided into traditional automobile industry and new energy automobile industry. The traditional automobile industry chain includes four aspects. The first is the product technology, mainly refers to the product engineering development; the second is the procurement of parts; the third is the car manufacturers and the fourth are sales and service. Among the new energy vehicle components, the battery system accounts for the highest proportion, accounting for the vast majority of the new cost. Power batteries account for up to 60% of the cost of pure electric vehicles.

The core of the value chain of the new energy vehicle industry is mainly around batteries, motors and transmissions, and gradually extends to the fields of electronic control systems, complete vehicles (passenger and commercial vehicles) and upstream resources (lithium) [2]. The upstream of the new energy automobile industry chain is the raw material industry of motors and batteries. It includes battery cathode material, anode material, diaphragm, electrolyte and so on, motor rare earth, silicon steel material etc. The middle reaches are new energy vehicle products and their main components (power battery and its management system, motor and its control system, transmission, and electronic control system, etc.). Downstream are charging stations, supporting facilities of charging stations, sales of new energy vehicles, complete vehicles or rental services, etc.

The common feature of the action plans of various countries is that the government directly intervened, organized the joint efforts of energy, transportation, manufacturing and other departments, combined R&D investment, industrial layout, and preferential policies. In this case, it promoted the cross-integration and comprehensive development of new-energy vehicles, power batteries, new-energy power generation, smart grid, and other industries, so as to create an emerging strategic industrial chain. Since 2008, the United States, Japan and the European Union have successively issued and implemented new development strategies for new energy vehicles, further clarifying the direction of industry development and significantly increasing policy support [3].

By comparing and analyzing the market share of BYD, the relevant financial data can fully understand the competitive advantages of BYD as the industry leader, and clarify its shortcomings, to further put forward reasonable suggestions. It can play a good demonstration role in improving the overall development level of China's new energy automobile industry and the development of other enterprises in the industry. The rest part of the paper is organized as follows. The second part is the case study, including a brief introduction of BYD, its market share, SWOT, financial data analysis and analysis of the characteristics and advantages of the industry chain. The third part puts forward relevant development suggestions based on the above analysis. The fourth part analyzes the limitations of this paper and the prospects for future research and industry development.

2. Case analysis

2.1. Description of BYD

Established in February 1995, BYD Co., LTD. is a private high-tech enterprise committed to meet people's yearning for a better life with technological innovation and promote the sustainable development of human society [4]. It is dedicated to the acquisition, storage, and application of energy. It will build comprehensive zero-emission new energy solutions to help achieve the goal of carbon peaking and carbon neutrality. Headquartered in Shenzhen, Guangdong Province, BYD is a listed company in Hong Kong and Shenzhen. In the international market, BYD has a remarkable record. In 2020, it ranked 832nd on the Forbes Global 2000 List, and in 2021, it rose to 458th [5]. In 2015, she was ranked No. 15 on Fortune's Change the World list and again in 2019 at No. 3. In 2020, BYD won the "Most Innovative Product Brand, New Energy Powertrain" Award on behalf of Chinese auto brands, becoming the first and the only Chinese auto brand to win this award.

The CSRC industry of the company is "automobile manufacturing", and the Wind industry is "optional consumption - automobile parts - automobile - automobile manufacturing [6]. The main products are BYD cars, chargers, electro-acoustic products, photoelectronic products, lithium

batteries and energy products, nickel batteries, solar cells, microelectronics and so on. In the last decade, the proportion of the main business income of automobiles has stabilized at more than 50%.

2.2. Market and financial analysis

BYD is the earliest enterprise involved in the field of new energy vehicles in China. As shown in Figure 1, after years of development, BYD is in the leading position in the industry, with market share of 19.73%, 18.08%, 11.93% and 17.1% from 2018 to 2021. BYD's market share decline in 2020 is mainly due to the trend of high-end market, NIO, Xiaopeng and Wuling Hongguang have launched new products, while some of BYD's old products are not competitive enough. Meanwhile, BYD's main products, Qin and Han, did not start to sell well until the fourth quarter, which also affected the market share. However, in the domestic market, BYD has topped the market share of NEVs for four consecutive years. In the meantime, it sold 641,400 NEVs in the first half of 2022, surpassing the 603,800 sold in the whole of last year. From the past performance, its sales in the second half of the year will generally exceed the first half of the year, which means that BYD's annual sales of new energy vehicles this year may exceed 1.2 million. BYD's sales of new energy vehicles have a strong growth momentum, repeatedly hitting a record high, and its market share is far ahead, which can greatly improve its profits and form economies of scale [7]. Nevertheless, BYD is not carefree, because BYD's product positioning is still mainly for the sinking market, more focused on the number one competitor Tesla's coverage is less than the third and fourth tier cities, there is still a long way to go before it can attack the high-end and pursue higher profit margin.

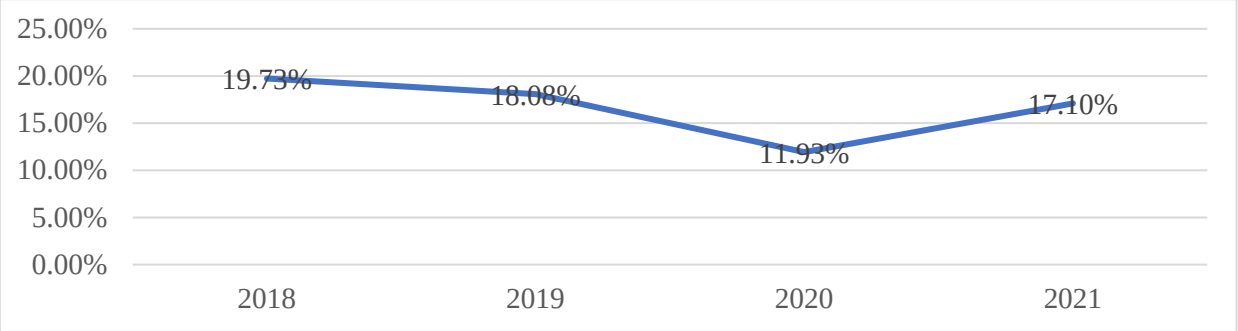

Figure 1. Market Share of BYD

2.3. SWOT analysis

The car sales market is a typical channel is king, which controls the sales network (to a large extent master the lifeblood of the car sales market). In reality, BYD's biggest advantage in the car market is its channel. It follows a new sales network model of 'different models' under the same brand, as opposed to the new sales network model of joint ventures divided by brand [8]. At present, in the Zhengzhou market alone, there are more than ten companies, such as Zhengzhou Yushun, Henan Fuaoxin, Henan Yuyuan, Henan Jinhong, Henan Yazhijie, Zhengzhou Meide, Henan Jiali, Henan Huada, Henan Tianshi, Henan Nanguang, operating the BYD brand. The newly built BYD dealers in Zhengzhou are increasing day by day. BYD so expand sales channels, to a large extent control the lifeblood of the sales market, sales performance is undoubtedly rising. BYD, meanwhile, collects deposits on cars before they arrive at dealerships, which not only helps its own internal financing but also helps reduce its inventory. So, its advantage in the market is its distribution channel.

However, BYD's market competition risks are relatively large. It is known that competition in the automobile industry is quite fierce, and BYD also faces many competitors. In the comparable price of the brand. In order to stay in a competitive position among brands with similar price points, one must do something better than the competitors [9]. Its ongoing efforts to improve its performance come as other car brands are trying to do the same. Although BYD can be basically self-sufficient, battery, mobile phone contract manufacturing and automobiles are all fully competitive industries and the company does not have the initiative. Current lithium battery, nickel battery business decline

trend, industry competitiveness. Mobile phone parts and OEM also in the intensifying competition, the gross profit rate is in a downward trend year by year. In the field of new energy vehicles, BYD's main market is still China's domestic market, which has not actively expanded the foreign market. Tesla, by contrast, is not overly dependent on its home market. It has a global market. BYD also faces problems in China, where many parts of the country do not have enough charging stations to meet the requirements of new-energy vehicles. These factors also hurt BYD's market.

Regarding to opportunities, with the gradual deterioration of the global environment, the globalization of new energy vehicles has become a predictable trend. In other words, with the increase of people's income, more and more people will choose to buy new energy vehicles, coupled with government support and subsidies, the future market of new energy vehicles will be more and more broad. China has clearly included the automobile industry in its development plan, and the new-energy automobile industry can receive policy support. Under the current subsidy policy, the combined subsidy of the central and local governments can reach 60,000 yuan per car, making the cost of buying a car almost the same as that of an ordinary gas-guzzler [10]. If such a policy can be enforced, it is very good for BYD.

As a matter of fact, much of BYD's growth has also depended on government policies, tax breaks and financial subsidies. According to statistics, the subsidy in the past ten years is more than 10 billion yuan, much more than the average level of the industry, and provides corresponding tax reduction policies. If these preferential policies change, BYD will have to bear the corresponding risk. Taxes and subsidies have accounted for a large portion of BYD's profits in recent years, causing the company's net earnings to fluctuate wildly. With the development and changes of the industry, policy subsidies are being compressed year by year, and the price advantage of self-owned brand-new energy models will be reduced. Meanwhile, with the gradual development of joint venture brands and new forces, self-owned brand-new energy business led by BYD will also face risks.

2.4. Analysis of financial indicators

Profitability refers to a company's ability to make profits [11]. This paper makes a comprehensive analysis of BYD's profitability through four financial indicators: operating profit rate, net profit rate on sales, return on equity and return on total assets. As illustrated in Figure 2, the overall trend of these four financial indicators is a significant decline in 2019, an increase in 2020 and then a certain decline in 2021. The main reason for this situation of BYD is that new energy vehicles are the main business of the company. Since March 2019, the government has lowered the subsidies for new energy vehicles in stages, and the specific policy is to pay 0.6 times of the subsidy standard in 2018, and then gradually cancel the direct financial subsidies of local governments for new energy vehicles. From 2016 to 2019, BYD received state subsidies of nearly 4 billion Yuan, accounting for 12% of the total subsidies for new energy vehicles and ranking the first among the enterprises developing new energy vehicles. Therefore, the adjustment of the subsidy policy for new energy vehicles has impacted BYD's profitability in the short term. At the same time, more and more automobile enterprises began to pay attention to the new energy automobile sector and launched new energy automobile products at this stage, leading to intensified market competition, which also affected BYD's profit in that year.

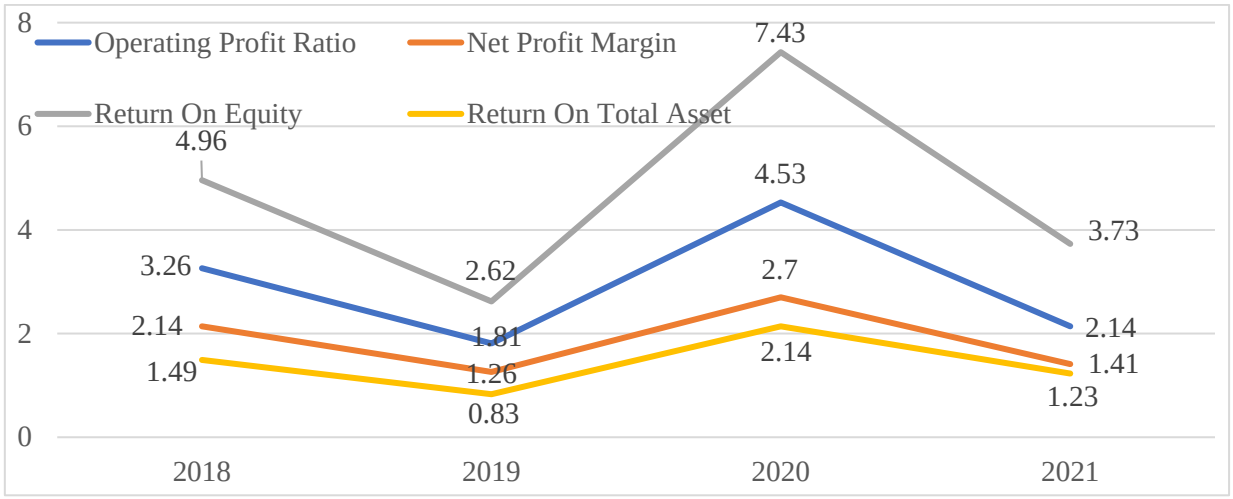

Figure 2. Profitability

Despite the impact of the novel coronavirus outbreak at the beginning of the year, China's reasonable and effective control of the novel coronavirus outbreak, coupled with a large backlog of orders in the early stage, BYD's production and sales volume increased rapidly in the fourth quarter, which directly promoted the growth of various indicators. In 2021, the new energy vehicle business was affected by chip shortage and skyrocketing prices of upstream raw materials, with operating costs rising 48.91% year on year, while its current relatively low pricing also affected BYD's profit. Overall, BYD's profitability is on a downward trend.

Development ability refers to the potential ability of an enterprise to expand scale and strength, also known as growth ability. This paper mainly through the total asset growth rate, operating income growth rate, net asset growth rate of three indicators, to make a comprehensive analysis of BYD's development ability. As exhibited in Figure 3, the overall trend for all three indicators has been upward after a sharp decline in 2019, with the growth rate of net assets in particular increasing by more than 300 times. In 2019, all indicators declined, and the growth rate of operating revenue was even negative. The reason is that the development slowed down due to changes in government subsidy policies and fierce competition. However, the subsequent rise reflects its strong vitality and strong development. Overall, BYD's development momentum is good, the growth rate is fast.

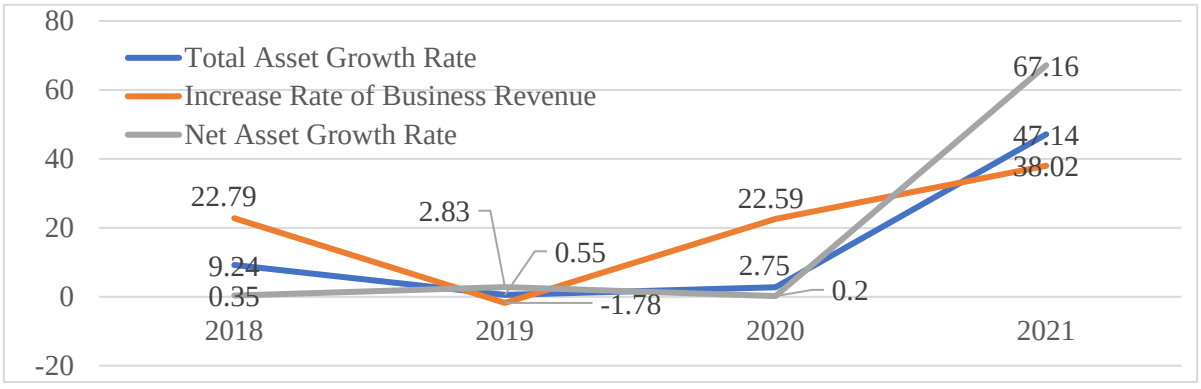

Figure 3. Development Ability

2.5. Supply chain features

A vertical supply chain system is BYD's hallmark. Founded in 1995 as a battery company, BYD didn't move into cars until 2003. After entering the automobile industry, BYD began to lay out the entire automobile industry chain and build a vertical supply chain system. In order to build its core competitiveness, it has focused on the research and development of core technologies. Make all the car parts you can. In the field of battery, BYD has firmly mastered the research and development technology of the three core components of new energy vehicles: battery, motor and electronic control,

and has a complete large-scale fully automated production line, with strong battery production capacity. In the field of chips, BYD established the Intelligent Control IC Division in 2002, and formally established BYD Semiconductor in 2020. Its main business is the research and development of various integrated chips, including automotive chips. In 2007, BYD independently developed Dilink automotive intelligent system, and actively laid out the development of automotive intelligent system with intelligent network system, intelligent cockpit, and autonomous driving system as the core [12]. Since December 2019, BYD has successively established Fordi Department companies, which are responsible for the research and development and manufacturing of power batteries, automotive lighting, automotive electronics, automotive powertrain and automotive molds and other components. The company, together with BYD Electronics and BYD Semiconductor, basically covers all aspects of self-research, production and sales of core components. Besides, BYD has invested heavily in the development of core components. Data from Founder Securities show that the company will invest 7.99 billion yuan in R&D in 2021, up 7.0% year on year. In 2021, the Company had 40,382 R&D personnel, representing a year-on-year increase of 12.9%; the number of patents of the company reached 29,777 in 2020, up 19.7% year on year.

During the period from 2019 to 2021, BYD transformed its parts and components division into a subsidiary company, and each part and component company will operate independently, not only supplying parts to BYD, but also supplying parts and components to other automobile companies, collectively referred to as Fordi Parts and Components companies, and compete on a level playing field with other external suppliers. It has a relatively complete industrial chain, building most of its own supply chain, including batteries. In the current special environment, BYD has demonstrated its advantages in the industrial chain, mitigated the impact caused by the global chip shortage and raw material price increase, and at the same time, was able to better ensure the smooth production and sales of the company in the face of repeated epidemic difficulties. However, this kind of vertical integration is not perfect either. It is one of the reasons why BYD's gross profit margin has always been low, and when the market changes, the vertical integration model will not be able to adjust quickly according to the market changes, hence it is not easy to adapt to the market changes.

3. Suggestions

3.1. Reduce dependence on the government and build charging piles independently

China's new energy vehicle policy support system is relatively complete, supporting the development of new energy vehicle enterprises from various aspects such as capital subsidies, infrastructure support, research and development technology support. However, in the long run, it is conducive to optimizing the competition pattern of new energy vehicles, improving the product mix, promoting the marketization of the industry and promoting the steady and healthy development of the industry. Therefore, BYD should gradually reduce its dependence on direct government subsidies. Under limited conditions, rational use of government policy resources, especially infrastructure support and product research and development technical support. In terms of infrastructure support, the current infrastructure of China’s new energy automobile industry is not perfect, and many places cannot provide sufficient charging piles. Therefore, BYD can try to build self-owned charging piles to improve the coverage of its own charging piles, so as to further seize the market.

3.2. Improve product positioning and enter the high-end market

To some extent, BYD's low-profit business strategy is an active choice, because for enterprises in the growth stage, the value formed by user base, market share and word of mouth is far more important than short-term profit. If it wants to further expand its market share and make more profits, it should explore high-end electric vehicle users, improve its product positioning and enter the high-end market. The key to entering the high-end market is to produce more intelligent and differentiated products. Therefore, BYD should increase investment in intelligent research and development, from automobile chips, vehicle design to electric drive system, to get through all the core technologies, so

as to be unique in the future trend of intelligent new energy vehicles. The key to differentiation is to provide consumers with different products. At present, the main consumer groups of new energy vehicles are 20-35 years old, and a major feature of such consumer groups is the pursuit of differentiation and personalization. As a result, BYD can provide high-end services such as exterior modifications, customized car accessories and advanced beauty treatments. Besides, it can also carry out joint cooperation with brands favored by young people to reflect the differentiation of brands and attract more young consumers.

4. Conclusion

In summary, this paper discusses competitive advantages of new energy vehicles based on the case of BYD. Specifically, case analysis, data analysis and contrastive analysis methods are adopted for analysis. According to the evaluations, BYD's market share is high and its sales volume has repeatedly hit record highs. Although BYD's operating capacity has declined due to the impact of the epidemic, it is still in a leading position in the industry. In addition, it has a large enterprise and a good momentum of development; its vertical supply chain system has also enhanced its competitive edges. It is suggested to reduce the dependence on the government and improving product positioning. These results shed light on guiding further exploration of the further development of BYD.

Ascribed to the limited understanding of BYD and the fact that this paper only starts with BYD's industrial chain and analyzes its advantageous financial data, there is no detailed comparative analysis with other enterprises in the same industry, such as Tesla and NIO. Thus, the advantages analysis may be one-sided, leading to some incomplete analysis. It is hoped that in the future research process, one can have a deeper understanding of BYD's industrial chain, and join the comparative analysis of other enterprises in the same industry to make the whole analysis more complete. Overall, these results offer a guideline for development of BYD and other electric-vehicle companies.

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