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The Impact of Technological Iteration Capability on the Long-term Returns of the New Energy Vehicle Industry

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Abstract. The development core of the new energy vehicle industry has shifted from policy-driven to technology-driven. This paper is expected to explore systematically how technological iteration capability impacts the new energy vehicle industry's long-term return. In this regard, an extensive literature review coupled with case analyses is used to identify the related mechanisms through which emerging technologies, such as batteries, high-voltage platforms, and intelligent driving, may affect industry profits by reducing costs and improving performance or even creating premiums. Secondly, taking BYD Company as a case study, an absolute valuation model based on technology-driven assumptions was constructed to empirically analyze the contribution of technological iteration to its financial forecasting and intrinsic value. The research results indicate that technological iteration not only directly constructs enterprise profits through product differentiation strategies, but also indirectly enhances the overall competitiveness of the industry through innovation efficiency. Finally, this article provides targeted recommendations for corporate strategy formulation, policy guidance, and investment direction, and points out the limitations of current research and future research directions.

Keywords: New energy vehicle industry, Technical iteration capability, Long-term returns, DCF valuation, Product differentiation

1. Introduction

Under the influence of the global energy structure transformation and the "dual carbon" goal, the new energy vehicle industry has shifted from policy dependence to a new stage of technology-driven development. Data shows that in 2023, the sales volume of new energy vehicles in China reached 9.495 million units, and the production volume was 9.587 million units. The sales penetration rate has risen to 31.6%, while the new energy vehicle sales in China account for 61.98% of the global total [1]. Behind this explosive growth, technological iteration has always been the core driving force - the continuous updates of power batteries from lithium manganese oxide batteries and lithium iron phosphate batteries to high energy density lithium-ion power batteries, and China's independently developed electric drive system technology, such as permanent magnet synchronous motors and AC asynchronous motors [2]. The speed of technological iteration directly determines a company's market position and long-term profitability.

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Existing research has confirmed the crucial role of technological innovation in the new energy vehicle industry: some literature focuses on cost-benefit analysis of core technologies such as batteries and motors, pointing out that the purchase cost of lithium batteries is nearly 70 yuan higher than that of lead-acid batteries per unit mileage, but the difference between the two does not change significantly with driving mileage [3]. However, existing achievements still have limitations: there is insufficient research on the impact and correlation of technological iteration towards long-term benefits, a lack of full chain analysis from "emerging technology breakthroughs —differentiated product landing—industrial efficiency optimization", and a lack of systematic exploration from the perspective of innovation efficiency (IE).

Based on this, this paper conducts a review in three parts: firstly, outlining the impact of emerging technologies (such as batteries, intelligent driving, etc.) on industry returns, and summarizes the core conclusions of previous studies which about technological economics and risk assessment; Secondly, analyze how the product differentiation strategy driven by technological iteration can build benefits, and reveal the logic of value transformation by combining typical car model cases; Finally, through IE analysis, analyze the impact of technological iteration on the competitiveness of enterprises in the market. This study aims to clarify the intrinsic relationship between technological iteration capability and long-term returns and provide theoretical references for industry development.

2. The impact of emerging technologies on the revenue of the new energy vehicle industry and research review

2.1. The profit transmission path of core technology iteration

The iteration of battery technology is the key to industry revenue growth, mainly reflected in the improvement of energy density, cost reduction, and extension of cycle life. The breakthrough in solid-state battery technology has reconstructed the value distribution pattern of the industrial chain. Firstly, a new generation of lithium-ion power batteries with a high energy density cylindrical lithium iron phosphate battery that can achieve a single energy density of 170W/h/kg-1; There are also the leader who from Tianjin Lishen Company, together with other companies, developed a high specific energy density lithium-ion power battery with a single energy density of up to 260W/h/kg-1 [2]. Previous studies have shown that the economic benefits of battery technology are reflected in economies of scale and learning curves, with a cost reduction of 18-22% for every doubling of production capacity [4]. Finally, intelligent driving technology expands revenue space through functional value-added, enhances safety and user experience, and creates differentiated benefits. Literature shows that intelligent driving systems can reduce accident rates by 30-40% and generate additional revenue streams through data services such as OTA updates [5].

2.2. Product differentiation strategy driven by technological iteration: taking BYD as an example

The ability to iterate on technology builds revenue through product differentiation strategies, mainly reflected in performance improvement, cost control, and brand premium. Taking BYD as an example, BYD's blade battery technology achieves a balance between safety and energy density through structural innovation. Lithium iron phosphate batteries (especially BYD's blade batteries) have significant advantages in safety and cycle life, and continue to reduce costs through structural innovation (CTB/CTC). The long-term expectation of solid-state batteries will further optimize

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energy density and safety. There is also a high-voltage platform that supports 800V fast charging, achieving a range of over 600 kilometers and fast charging (up to 80% in 30 minutes) on the Han Enterprise Value (EV) model, which directly attracts high-end market users and brings premium income. Meanwhile, DM-i hybrid technology has achieved low-cost operation on models such as the Qin PLUS by optimizing fuel efficiency, expanding its mid-range market share. This differentiation strategy is based on technological iteration, constructing a value chain of "technology—product—market" to enhance long-term returns.

2.3. Absolute valuation analysis: taking BYD as an example

Using the DCF model to value BYD Company, the core assumption is based on financial forecasting driven by technical indicators. This article collects the annual reports of BYD Company from 2019 to 2023 [6]. From the perspective of business performance, as shown in Table 1, BYD Company's gross profit margin generally showed a low state from 2019 to 2021, but it has significantly improved since 2022 and has exceeded 20% by 2023. At the same time, the BYD's investment in developing emerging technologies has been increasing year by year, with a rapid increase from 2021 to 2023.

Table 1. BYD's business performance in the past five years

Year	2019	2020	2021	2022	2023
Sales volume (10000 units)	45.1	43.1	74.7	188.2	304.5
Operating revenue (billions of yuan)	1277	1566	2161	4241	6023
Gross profit margin	1.66%	1.64%	4.85%	17.0%	20.2%
R&D expenses (billions of yuan)	56.3	74.6	79.9	186.5	395.7

As shown in Figure 1, according to the Bloomberg NEF report, the average price of lithium-ion battery packs worldwide has decreased from \$151/kWh in 2022 to \$139/kWh in 2023, and is expected to drop to \$133/kWh in 2024 [7].

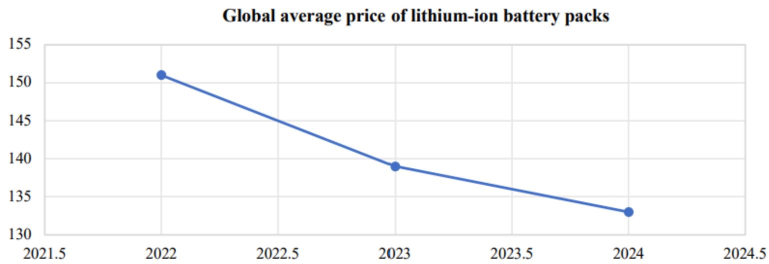

Figure 1. Global average price of lithium-ion battery packs

This article assumes that the average annual cost reduction of BYD batteries is 3%, which will directly contribute to the increase in gross profit. This paper assumes that the penetration rate of BYD's intelligent driving optional package will gradually increase from a lower level in 2024 to 30% in 2028, bringing additional contributions to Average Selling Price (ASP) and gross profit margin. Based on the above technology-driven logic and BYD Company's 2023 annual report data, this article constructs a financial forecast for the next five years. As shown in Table 2, the

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combination of technological leadership and cost advantage has steadily increased the market share, with the growth rate slowing down as the base increases. Assuming that the reduction in battery costs leads to a 0.8% increase in gross profit margin per year, and the optimization of product structure contributes to a 0.5% increase in gross profit margin per year. At the same time, the continuous investment in technology research and development and the continuous increase in brand marketing expenses have led to a synchronous increase in the operating expense ratio. Subtract the operating expense ratio from the gross profit margin to obtain the operating profit margin.

Table 2. BYD's financial forecast for the next five years

Project	2023	2024	2025	2026	2027	2028
Sales volume (10000 units)	304	360	410	460	500	535
Operating revenue (billions of yuan)	6023	6192	7216	8280	9150	9951
Gross profit margin	20.2%	21.0%	21.8%	22.5%	23.0%	23.5%
Opearting expense ratio	13.2%	13.5%	13.7%	14.0%	14.2%	14.5%
Operating profit margin	6.1%	6.5%	7.1%	7.5%	7.8%	8.0%

As shown in Table 3, EBIT is calculated using the obtained operating profit margin and operating revenue. Depreciation and amortization have steadily increased with capital expenditures, and after the peak period of expansion, the Capex/revenue ratio has been decreasing year by year. The change in working capital will occupy a huge amount in 2023, and the forecast period will return to normal levels. Substitute the data into the formula to calculate Free Cash Flow (FCFF).

Table 3. Calculate the free cash flow for the next five years

Project	2023	2024	2025	2026	2027	2028
EBIT	369	402	512	621	714	796
Tax rate	10.5%	11.0%	11.5%	12.0%	12.5%	13.0%
After tax operating profit	330	358	453	546	624	693
Discounts and Amortization	219	250	280	310	340	370
Capital expenditure	-832	-800	-750	-700	-650	-600
Changes in working capital	-1207	-200	-250	-200	-150	-100
Free cash flow	-1490	-392	-267	-44	164	363

As shown in Table 4, assuming the risk-free interest rate is 2.5% of the yield of China's 10-year treasury bond in 2023, the beta coefficient (β) is taken from Wind Financial Terminal, and the weekly beta of BYD relative to Shanghai and Shenzhen in the recent two years is 1.20. The equity risk premium is estimated by Professor Aswath Damodaran to be approximately 5.69% in the Chinese market [8]. The estimated cost of debt is 4.5%, capital structure: target debt/equity ratio is 20/80, and effective tax rate is expected to stabilize at 15% after the forecast period.

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Table 4. Weighted average cost of capital

Risk-free rate	2.5%
Beta coefficient	1.20
Equity risk premium	5.69
Cost of debt	4.5%
Capital structure	20/80
Effective tax rate	15%

Calculate the cost of equity as 2.5%+1.20 5.69%=9.33%. WACC= (80%9.33%)+ (20%4.5% (1-15%))≈8.2%. Discounting the FCFF calculated in Table 3 at 8.2%, the PV is approximately -14.3 billion yuan. Assuming that the dividends of technological iteration are digested and enter a stable growth period, the sustainable growth rate is g=2.5%. The final value TV=[FCFF2028 (1+g)]/(WACC-g) ≈ 653 billion yuan. Enterprise value EV=-143+4390=42.47 billion yuan. According to the 2023 annual report, monetary funds far exceed interest-bearing liabilities, with a net debt of -120 billion yuan. Subtracting the net interest-bearing debt from the enterprise value equals the equity value of 4247- (-1200)=54.47 billion yuan, and the total share capital of BYD A-shares is 2.911 billion yuan [9]. Therefore, the intrinsic value per share is 5447/29.11 ≈ 187.1 yuan/share. Considering the critical impact of WACC and perpetual growth rate, conducted sensitivity testing as shown in Table 5. Under the current assumption (WACC=8.2%, g=2.5%), the valuation center is 187.1 yuan.

Table 5. Sensitivity analysis

WACC/g	2.0%	2.5%	3.0%
7.7%	208.5	225.8	247.5
8.2%	173.2	187.1	204.5
8.7%	145.5	156.8	170.7

According to Dongfang Wealth Network, the stock market data of BYD Company provided by Dongfang Wealth Securities shows that BYD Company's A-shares are priced at 104 yuan per share, which is estimated to be higher than the current market value. This may indicate that the cost reduction and efficiency improvement created by technological iteration capabilities have underestimated the benefits brought to BYD Company. The continuous increase in gross profit margin brought about by technological cost reduction is the biggest driving force. However, the investment in technology research and development is enormous, and if the results are not as expected, it will erode profits. The intense industry price war may offset some of the gross profit improvement brought about by technology cost reduction.

3. The competitiveness of enterprises in technological iteration from the perspective of Innovation Efficiency (IE)

Continuous innovation is the main means for new energy vehicle companies to enhance their competitiveness, and technological innovation is essential for the industry to gain long-term development advantages. Innovation efficiency is an excellent indicator for measuring the modernization investment of enterprises. If enterprises can improve innovation efficiency, the return on innovation results will be greater, and the cost and investment of innovation resources will also

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decrease. Research has found that the average IE of the new energy vehicle industry in the Pearl River Delta, Yangtze River Delta, and Southwest regions is the highest, about 0.05 higher than that in Central China, while the lowest is in Northeast China, less than 0.5. At the same time, under the pressure of the European debt crisis and the overall economic environment in China, SAIC Group still maintains an IE index greater than 0.85, and has a clear and appropriate innovation model for the rational use of innovative resources, which is one of the reasons why it has become a leading company [10].

4. Conclusion

This study systematically analyzed the impact mechanism of technological iteration capability on the long-term returns of the new energy vehicle industry and found that technological iteration is one of the fundamental driving forces for the industry's long-term returns. Therefore, for enterprises, they should increase research and development investment, focus on battery recycling and intelligent driving, to reduce technological risks. At the same time, enterprises need to pay attention to the balance between their own innovation achievements and innovation resources, and improve innovation efficiency. What's more, subsidies and related policy support need to be provided to policymakers. The ability to iterate on technology is the cornerstone of long-term returns for the new energy vehicle industry, and companies need to build innovation capabilities to respond to market changes. This study is based on publicly available data and literature, and there may be a data lag (such as data not updated after 2022). The literature citation focuses on highly cited papers, which may overlook emerging research. In addition, the uncertainty of the speed of technological iteration may affect the universality of conclusions. At the same time, absolute valuation analysis heavily relies on the assumption chain of 'technical success being transformed into commercial success'. The model does not take into account the explosive growth potential of overseas markets, which may pose significant risks. Investors should view this model as a dynamic analysis framework and continuously adjust assumptions based on subsequent financial reports and industry trends. Future research can combine big data analysis to track in real-time the impact of technological iterations on returns. In the long run, technological iteration will drive the new energy vehicle industry towards carbon neutrality goals, with enormous potential for returns.

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