

Application of WACC in Automobile Enterprises

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Abstract: With the global promotion of energy conservation and emission reduction in recent years, some new energy vehicle enterprises are emerging in the market. To avoid potential risks in the new energy vehicle market with over-investment, the paper selects Tesla, BYD, and Toyota as examples, and uses CAPM and WACC to calculate and analyze the risks of three automobile enterprises based on the financial data in 2022. The result shows that Tesla owned the largest WACC and risks due to the calculation, and Toyota had the smallest WACC and risks. According to the analysis of data combined with the market situation of three companies, the author finds unique risks for each enterprise and provides a feasible direction for the development of three enterprises. It shows that the development of electric vehicles, guarantee of production, good product quality, and reasonable allocation of funds can help automobile enterprises avoid risks in the future.

Keywords: WACC, CAPM, NEV enterprises, automobile enterprises, risk analysis

1. Introduction

1.1. Background

In recent years, people pay more and more attention to the protection of the environment. To reduce the pollution caused by vehicle fuel emissions, some new energy vehicle enterprises are emerging in the market. And it causes hot investment in many new energy vehicle enterprises. Though some fuel vehicle enterprises like Toyota still dominate the market. Tesla has been the largest electric vehicle enterprise in the world and sold more than 1.3 million electric cars in 2022, while many other new energy vehicle enterprises like BYD have also seen rapid growth in recent years. As we know, over-investment often makes investors ignore the potential risks in the future. Risks are also related to the future development of enterprises. And WACC is considered a good way to determine enterprise risk by calculating financing costs. It is necessary to use WACC to analyze potential risks in the field.

1.2. Related Research

Nowadays, many scholars focus on the relationship between technology and innovation. The science and technology of manufacturing industry is closely related to its development. For example, improvements in performance and speed or innovations in technology are bound to make a car company grow. Han et al. conducted in-depth analysis and research on 63 listed NEV firms from

2008 to 2020 in China, assumed R&D investment and the amount of invention patent applications as the innovation of enterprises, and used empirical model, baseline model, Robustness tests, Heterogeneity test, and intermediary model to analyze the impact of intelligent transformation on innovation in NEV enterprises in China. The authors found intelligent transformation can encourage innovation in those enterprises [1]. Wu et al. analyzed panel data from 127 listed enterprises in the Chinese automotive industry between 2009 and 2018 and used descriptive statistics, econometric models, and Robustness checks to consider the firms' technological capability in the R&D of NEVs. The authors found that the technological capability of enterprises is positively correlated to the development of NEVs. In addition, government subsidies can also make up for the lack of technological capability [2].

Besides the effect of enterprises' technological progress, some scholars have noticed that government policies also have an important impact on the development of new energy vehicle enterprises. Lin and Liu collected the data of 28 listed NEV enterprises from 2012 to 2022 used the panel threshold model to analyze how environmental regulations and government subsidies work on the innovation and development of the firms and selected green patent applications to represent the extent of the innovation. The authors found that environmental regulations can help develop green innovation, and when the regulations are effective and proper, the government subsidies can create the biggest economic benefit to innovation [3]. Zhao et al. did some research on the impact of government subsidies on the NEV market, focus on the closed-loop supply chain, used game theory, and constructed 5 different models to compare the sales, recycling amount, and profit among the manufacturers, retailers, and recyclers. The authors found that these indexes all increase when the government offers subsidies, but the distribution of profits stays the same in the supply chain. In this case, the manufacturers own the maximum profit while the recyclers own the minimum [4].

Technology and policies provide support for the development of enterprises, but whether a new energy vehicle enterprise is popular among consumers depends on its performance in the market. Therefore, some scholars have conducted surveys on the sales of some new energy vehicles and consumer demand in the market. Hu and Yuan focused on policy, market, technologies, charging, electricity efficiencies comparison, and a case study of premium NEV activity heat map in Beijing to analyze the performance of German NEV automakers in China market, and used Mercedes and BMW as representatives. The authors built a hexagonal framework from the six factors above and found that some low-end NEV is more popular among Chinese customers. It is predicted that markets in China will develop well due to government subsidies and policies [5]. Wang et al. aimed to understand the purchasing intentions of Chinese citizens on new energy vehicles. The authors integrate the potential influence of government subsidies and consumer demand to offer suggestions to manufacturers. A scale and structural equation model were built based on data collected from 22 provinces. The result showed that citizens mainly concentrated on financial benefits, infrastructure readiness, environmental concerns, and policy privileges to make decisions and these factors can make positive effect on purchase behavior [6].

Considering that the new energy vehicle industry is one of the emerging industries in recent years, is currently a hot investment, but the future development is still unknown. Some scholars have discussed the potential risks that new energy vehicle enterprises may face in the future, and put forward suggestions on risk avoidance. Guo studied how to assess the potential risks in the NEV supply chain, and she used AHP and Fuzzy comprehension evaluation method to construct a supply-chain operation reference model. The author focused on 5 procedures: planning, purchasing, producing, delivery, and return. Through the model, the author provided a reference for enterprises to avoid risks [7]. Wang pointed out the issues in the development of NEV industries in China from technology and industrialization. The author advised that enterprises need to build a risk avoidance

system. In the process, the government should formulate policies to guide the market and industry itself needs to improve the system [8].

Some scholars have concentrated on the prediction of future development of new energy vehicle enterprises, and they have conducted research on future stock prices, sales, and some other sections. Wang et al. did some research on the stock price of NEV companies and collected various stock price data as research material. The authors tried to integrate the time series and cloud models to seek a new method to predict the stock price. As the mainstream that new energy vehicles will replace fuel vehicles, the article provided suggestions for investors to build a portfolio from the aspect of future stock price [9]. Zeng et al. gave an analysis of the NEV market in China. Due to the overheated investment in China's NEV market nowadays, there are potential risks in the future. Therefore, the authors based on a new variable-structure grey model to study and predict the sales of new energy vehicles, and used different data sequences to test the model. The authors found that sales will keep rising before 2030 though the growth will slow down. Thus, the government should timely adjust policies for the NEV market in China [10].

1.3. Objective

To analyze the potential risks among new energy vehicle enterprises, the paper takes the financial situation of BYD and Tesla in 2022 as examples, and also selected that of Toyota to compare with NEV enterprises, calculates and analyzes the potential risks of three companies through CAPM and WACC, and provides a feasible direction of future development prospects for enterprises.

2. Method

2.1. CAPM

CAPM is Capital Asset Pricing Model, it is based on an efficient market with rational investors making diversified portfolios in an efficient frontier. The model is used to study the relationship between expected return rate and risk assets. As shown in Equation (1).

$$r_E = r_f + \beta_i \times (r_m - r_f) \quad (1)$$

r_E is the expected cost of equity capital needed in WACC, r_f is the risk-free interest rate, r_m is the expected market rate of return, $(r_m - r_f)$ is the market risk premium, β_i is a risk coefficient.

For a long time, the accuracy of the model was questioned by the academic community and many scholars found that β_i could not adequately explain the rate of return. But CAPM is still widely used nowadays and is regarded as an index to identify the fluctuation of a stock compared to the market. For example, if the β_i of a stock is large, the value of the stock will increase faster when the market value increases. On the contrary, the value of the stock will drop faster when the market value decreases.

In reality, β_i is hard to find because manufacturers usually operate multiple production lines in a firm. For example, Coca-Cola owns various divisions such as Coke and packaging production. In this case, the calculation of β_i needs to calculate different β_i according to the proportion of funds of each division. Then calculate the average to get the β_i of Coca-Cola. In the essay below, β_i of each auto enterprise is collected from the book data of each enterprise to avoid complicated calculations.

2.2. WACC

WACC is the Weighted Average Cost of Capital, it is a price index to measure enterprise financing cost. As it can be used to calculate the opportunity cost of risks the investors invest in a company, WACC can not only reflect how large the potential risks may happen but also can reflect the

expected rate of return on investment. For example, WACC can be regarded as a kind of discount rate to show the predicted income in the future when the investors aim to acquire a company. In the essay below, WACC is mainly used as an index to represent financing costs and related to the potential risks some listed auto companies may face in the future. As shown in Equation (2).

$$WACC=(E/V) \times r_E+(D/V) \times (1-T) \times r_D \quad (2)$$

E is the market value of equity, D is the market value of debt, V is the sum of E and D , r_E is the expected cost of equity capital, r_D is the expected cost of debt capital, and T is the marginal corporate tax rate.

To simplify Equation (2) for calculation, let $L=D/V$, Equation (2) can be converted to Equation (3):

$$WACC=(1-L)r_E+L(1-T)r_D \quad (3)$$

For Equation (3), it is obvious that the value of WACC depends on the expected cost of equity capital and the expected cost of debt capital. Therefore, the arrangement of equity and debt plays an important role in a company's future market valuation. If WACC is large, it means that it takes a large financing cost to invest in the company, and investors are more easily to face risks in investment.

3. Comparison

Table 1 presents the data in 2022 among BYD, Tesla, and Toyota. The first two lines show two different kinds of market value. In three companies, Tesla owned the largest market value of equity which reached 388.97 billion dollars. And due to the minimum market size of BYD among the three companies, it owned both the smallest market value of equity and that of debt, 93.89 billion dollars and 3.17 billion dollars, respectively. As for Toyota, it had the largest market value of debt as an established company, which reached 217.14 billion dollars, and it was larger than Toyota's market value of equity. The third line shows three different marginal corporate tax rates due to the different policies in different countries. BYD is a Chinese company so it should comply with China's tax policy in the market. And in 2022, the marginal corporate tax rate in China was 25%. Similarly, Tesla and Toyota should comply with policy in America and Japan, separately. At the fourth line, it performs the equity beta of three companies. Tesla owned the largest one which reached 2. And Toyota had the smallest equity beta and it was only 0.54. The equity beta of BYD was 0.65, ranked second among the three companies. The selection of the risk-free rate follows the general practice and is determined according to the 10-year US Treasury bond, whose value is 3.72%, as of December 31, 2022. And the determination of the market risk premium varies from country to country. For Tesla, the market risk premium was 5.9%, while for BYD and Toyota, the index was 7.2%.

Through the calculation of CAPM, it is obvious that Tesla owned the largest expected cost of equity capital, which reached 15.52%. And Toyota had the smallest one, the expected cost of equity capital was 7.61%. As for BYD, its expected cost of equity capital ranked middle among the three companies and it was 8.40%. When it comes to the expected cost of debt capital, the situation becomes different. BYD had the largest expected cost of debt capital and it reached 5.00%. While for Toyota, it owned the smallest expected cost of debt capital, which was only 1.10%. And Tesla's expected cost of debt capital was 3.32%, ranked second. The second line from the bottom shows the L of three companies. And the L has no practical significance, it is just used to refer to D/V to make it easier to calculate WACC. The method has been introduced in part two above. The last line performs the WACC of three companies. Tesla had the largest WACC, which reached 0.1533. And Toyota owned the smallest WACC and it was only 0.0396. BYD ranked middle among the three

companies and its WACC was 0.0936. The detailed analysis of the data above will be mentioned in part four.

Table 1: Comparison of three enterprises in 2022.

	BYD	Tesla	Toyota
Market value of equity	93.89B	388.97B	186.35B
Market value of debt	3.17B	5.74B	217.14B
Marginal corporate tax rate	25.0%	21.0%	23.2%
Equity beta	0.65	2.00	0.54
Risk free rate	3.72%		
Market risk premium	7.2%	5.9%	7.2%
Expected cost of equity capital (r_E)	8.40%	15.52%	7.61%
Expected cost of debt capital (r_D)	5.00%	3.32%	1.10%
L	3.27%	1.45%	53.82%
WACC	0.0936	0.1533	0.0396

4. Discussion

4.1. Market Situation and Analysis of Data

According to the data from Table 1, Tesla owned the largest equity beta and WACC in 2022. It means that Tesla has the largest potential risks to invest in the future. On the contrary, Toyota had the smallest equity beta and WACC, so it and its investors may face minimal risk of future losses. And the equity beta and WACC of BYD ranked second among the three companies, which means BYD has little future risk.

The results are caused by policies, markets, and companies themselves. From the view of market sales in 2022, the three companies have many differences. For Toyota, it has topped the global annual total vehicle sales for three years in a row. In 2022, its total sales volume reached 10.38 million, and sales outside Japan accounted for 76.6%. As an established vehicle enterprise, its business has covered the world and its main product is fuel vehicles. Although Toyota's fuel vehicles are limited in the market due to government policies, and Toyota also has a competitive disadvantage in battery electric vehicles (BEVs), Toyota's hybrid electric vehicles (HEVs) still has some market share in Europe. This mainly reflects in its sales of HEVs in Europe, which accounted for 66% of its total sales of HEVs in 2022. And it is related to the poor charging infrastructures in Eastern Europe. On the other hand, the advantage of HEVs in fuel saving will continue to attract consumers due to the rising oil prices caused by the Russia-Ukraine conflict. Therefore, Toyota's huge advantage in the global market is difficult to be replaced by other enterprises in a period of future. And it also explains the reasons why Toyota may face minimal risk in the future compared to the other two enterprises.

For Tesla, it is the largest BEV enterprise in the world and its total sales volume in 2022 reached 1.31 million, the year-over-year sales volume even grew 40%. And the gross profit margin of 2022 reached 25.6%, which has been the highest level in the past five years for Tesla. As for its market distribution, Tesla's major markets are America, Europe, and China. The Model Y (a type of BEV of Tesla) sold 20,000 units in Europe in November 2022, even surpassing Audi. Tesla also focused on its production and in 2022 it put three gigafactories in Texas, Berlin, and Shanghai into the production line. It is obvious that Tesla operated well in 2022, but strangely, it still has the largest

potential risks in the future according to WACC. This is mainly caused by the supply chains and the quality of vehicles. The explanation will be introduced in 4.2.

For BYD, it is a rapidly developing enterprise in recent years. In 2022, its total sales volume reached 1.86 million, surpassing Tesla. As for BEV, its sales volume reached 0.91 million, ranked second only to Tesla in the world. The major market of BYD is China and it is also the most popular NEV enterprise among consumers in China. Since China's NEV market accounts for 25.6% of the global NEV market, BYD naturally has a huge market share among NEV enterprises. For its business, BYD's business is very broad and varies from electric buses to saloon cars. The production line, from the manufacturing of batteries to the installation of vehicles, is all done by itself. BYD also supplies batteries to other NEV enterprises, including Tesla. It reduces the worries about potential problems in the supply chain. And due to the encouragement by the government, the prospect of BYD's future development looks good. But the limitation of the market size determines it has larger risks than Toyota.

4.2. Potential Risks

It is time to study the potential risks of three enterprises after a brief analysis of their market situations. For Toyota, although it has a great advantage in market size around the world, the poor development in BEV could be a problem. With the construction of charging infrastructure in Eastern Europe and the end of the Russia-Ukraine War in the future, Toyota may lose much of its market share in Europe. On the other hand, Toyota has paid attention to electric vehicles (EVs) in recent years, but its main product like HEV doesn't meet international emission standards for EVs. Reforming government emission policies in different countries may restrict Toyota's production and decrease consumer demands. And Toyota's research on BEV has lagged far behind that of many NEV enterprises. Besides, as a Japanese enterprise, its earnings and revenues are affected by changes in the yen exchange rate. The continued depreciation of the Japanese currency is also bad for Toyota's development.

When it comes to Tesla, its potential risks are mainly caused by two factors. First, Tesla relies on suppliers for some core technologies of manufacturing and hasn't achieved its independent production. For example, the battery is the core of an electric vehicle, but the supply of its battery is outsourced to other enterprises like BYD. If Tesla's cooperation with its suppliers ends, or if there are quality problems with the suppliers' products, it could have heavy losses on Tesla's entire production line. Second, Tesla faces potential losses due to its product quality and design. In America, Tesla faces some lawsuits due to accidents of brake failure and spontaneous combustion. If these lawsuits succeed, Tesla will pay substantial compensation and face a reputation crisis. And in May 2023, Tesla announced a recall of 1.1 million cars in China to upgrade its "single-pedal" model to reduce potential problems of brake failure. The large amount causes significant financial costs to Tesla although it could use OTA technology to upgrade cars online for car owners. This is where Tesla's negligence in design led to its current financial losses.

For BYD, its risks are mainly due to the expansion of business in the future. BYD is committed to building its independent production supply chain, so it has to expand its business to many fields like production of batteries and recycling. And the rapid expansion has left BYD with a rising debt-asset ratio. In the third quarter of 2022, the index even exceeded 70%. At the same time, shareholders didn't invest more in BYD. This may lead the capital chain of BYD to get tense in the future. On the other hand, BYD's rapid growth in recent years has been largely supported by government policies. In September 2022, China announced that consumers can be exempt from purchase taxes on electric vehicles until the end of 2023. But when the policy expires, the demand for electric vehicles may fall with the higher taxes. It may reduce BYD's profit.

4.3. Development Prospect

Based on the analysis of the potential risks of three enterprises from 4.2, here are some suggestions for the future development of the three enterprises. Toyota should pay more attention to the development of BEV and put more research funds into it. Though Toyota will not lose its competitive advantage in the market as its main product is fuel vehicles when compared to other NEV enterprises in the short term, the mainstream trend of energy conservation and emission reduction determines that the future market must be the world of NEV. As for Tesla, it may need to expand independent production of more products instead of relying on suppliers to ensure the stability of the supply chain and facilitate technological innovation. And it should also improve the product quality to reduce the risk of accidents. For BYD, it should weigh the balance between expanding the business and allocating the funds to reduce the worries from the shortage of funds.

5. Conclusion

The paper analyzes the potential risks of Tesla, BYD, and Toyota through the calculation of WACC, based on the financial data of three enterprises in 2022. The result shows that Tesla owned the largest WACC in 2022 and Toyota had the smallest one. BYD ranked middle among the three companies. It means that Tesla may face the largest risks in the future while Toyota has the smallest risks.

Combined with the market situation of the three enterprises, each company has its unique risks in the future. For Toyota, it is mainly caused by its poor development of battery electric vehicles, and for Tesla, it is majorly caused by worries of losing some suppliers, product quality and some lawsuits resulting from it. For BYD, it is due to the allocation of funds.

To avoid these potential risks as much as possible, the paper points out the feasible direction of development for three companies. For Toyota, it should attach importance to the development of battery electric vehicles. For Tesla, it should reduce dependence on suppliers and expand independent production, and pay more attention to the design and quality of products. BYD needs to allocate its funds in a more balanced way.

All in all, WACC can be used to analyze potential risks among automobile enterprises. And the development of electric vehicles, guarantee of production, good product quality, and reasonable allocation of funds can help automobile enterprises avoid risks in the future.

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