Application and Feasibility Analysis of DCF Model in Corporate Valuation: A Case Study of Tesla, Inc.

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Abstract. Although in the past two years, the COVID-19 pandemic and the resulting rise in global raw materials and labor costs have had a more serious adverse impact on the entire automotive industry, the new energy vehicle industry has shown a strong momentum of development in the past two years, with significant improvement in both the scale and speed of development. Therefore, given the rapid growth of the electric vehicle industry in the past two years, it is necessary to evaluate companies in some related fields from the aspects of business scope and development policies in early 2022 to rejudge the value they can generate in the future. This paper adopts the Discounted Cash Flow (DCF) model, a classical capital pricing model, to discount all cash flows of Tesla in the future, thus obtaining the current corporate value of Tesla. It turns out that the final estimation of Tesla's enterprise value is about $900 billion. Compared with the public valuation of Tesla, there is a risk that the corporate value of Tesla may be overvalued by the public. Through analysis, it can be concluded that although the DCF valuation model has certain inevitable restrictions, it is still practical to evaluate large-scale companies. For the future development of new energy electric vehicles, although the far-reaching impact of the epidemic may continue for several more years, it can be argued that the development potential of the electric vehicle industry cannot be underrated, especially for new energy electric vehicle companies represented by Tesla.

Keywords: Tesla · Corporate Valuation · Capital · Discounted Cash Flow (DCF) · Weighted Average Cost of Capital (WACC) · Capital Asset Pricing Model (CAPM)

1 Introduction

The global automotive industry has already experienced a global economic recession, tax increases, a trade war between China and the United States, and strict environmental regulations until 2019. Nonetheless, the industry has been further hit by the worldwide outbreak of COVID-19 in 2020. For instance, many fields were negatively affected, such as the labor shortage, rising raw material prices, and fractured supply chains [1]. According to the data shown by International Energy Agency, due to the epidemic and

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other factors, global car sales declined by 16% from 2020 to 2021. However, against this backdrop, registrations of electric vehicles (EV) increased by 41%, so that by early 2021, the number of electric cars on the worldwide roads reached 10 million [2].

To sum up, the valuation methods of EV companies based on outmoded methods or statistics may not be suitable for today's post-epidemic era. Therefore, this paper will take Tesla, the leading company in the electric vehicle industry, as the research object, to estimate its corporate value by DCF methods. Then the final estimated result will be used to assess the strategies of new energy vehicle companies and show the relevant issues regarding DCF model in the process of corporate valuation.

2 Introduction of Discounted Cash Flow Methods and Tesla, Inc.

2.1 Theoretical Framework: Discounted Cash Flow (DCF) Methods

As a classical valuation method, the DCF model mentioned in this paper is still prevalent in current financial valuation and corporate management. This method involves estimating future cash flows and discounting them at a discount rate to produce the present value of future cash flows. It is used to compare the relative value of competing investment opportunities within companies and is a traditional way to determine the fundamental value of a company's assets, such as shares and debt [3].

DCF models are now often directly linked to evaluating economic activity to maximize the benefit of shareholders, since the sole purpose of a company is to maximize wealth for its owners while ensuring that the interests of creditors are fully protected. This idea has become particularly important in the 21st century. As the model has been expanded and developed, it has been used for making company management decisions and as a general method for valuing asset, from publicly traded stocks to acquiring companies and start-ups. The DCF model has become the basic but essential method in terms of general corporate management and corporate valuation.

2.2 Analytic Target: Tesla, Inc.

Tesla is an American electric vehicle and energy company headquartered in Austin, Texas. Production and marketing of electric vehicles, solar panels, energy storage equipment and related products and services. The company has the world's most significant sales of battery electric vehicles (BEV) and plug-in hybrid electric vehicles (PHEV), capturing 14% of the electric market in 2021 [4]. In terms of electric vehicle sales (mainly for the four models: Model Y, X, S and 3), Tesla sold 936,222 cars globally in 2021, and its cumulative sales reached 2.3 million by the end of 2021. In the energy business, Tesla is mainly responsible for two businesses: the solar generation business and the energy storage business. Tesla Energy, a subsidiary of Tesla, develops and installs photovoltaic systems in the United States. In 2021, energy storage deployment reached 3.992 GWh, up 32% YoY; Installed solar power capacity was 345 megawatts, up 68% YoY [5]. Tesla is constantly making breakthroughs in both electric generation and energy storage.

2.3 Data Sources

The primary data cited are mainly from: The annual report of Tesla, Inc. on Form 10-K published by United States securities and exchange commission [6], Quarterly Disclosure published by Tesla, Inc [5].

Some ancillary data are from: Statista, Iea, ValueInvesting, Finbox, Macrotrends, NYU Stern, Bloomberg, CSIMarket, Global Ranking, Social Security Administration, Mortgage, CNBC, WSJ|Market.

3 The Application of DCF

3.1 DCF Model Review

One of the meaning of using the Discounted Cash Flow (DCF) valuation model is that the value of a company can be derived from the expected discounted cash flow to reflect the opportunity cost of the investment and the risks associated with it at the present timeline [7]. In summary, the essence of valuing a company is to estimate its present value by presenting its future cash flows at a reliable discount rate.

Therefore, calculating the free cash flow (FCF) and the company's discount rate plays a vital role in DCF valuation. According to the study of Copeland, Koller, and Murrin [8], the cash flow structure is defined as:

Revenue (net sales) - Cost of sales = Gross profit - Depreciation-Operating expenses = Operating income ± Other income(expense) = EBIT (Earnings before interest and taxes) - Income tax on operating income = NOPLAT (Net Operating Profit Less adjusted Taxes) + Depreciation = Operating cash flow ± CAPEX (Capital Expenditure) ± △WC (Working Capital Variation) = Free Cash Flow of the Company.

When a company's free cash flow (FCF) is obtained, the Weighted Average Cost of Capital (WACC) should be used as a discount rate to calculate the present value of cash flows. The formula for estimating the present value of the company is as follows:

$$\text{Company Value} = \sum_{t=0}^{t=n} \frac{FCF_{(t)}}{(1 + WACC)^t} \tag{1}$$

t: future period; $FCF_{(t)}$: The company's free cash flow at time t; WACC: weighted average cost of capital

The DCF method is used to forecast the operating results of a company over a discrete multi-year period. The discrete cash flow projection is then converted into a single present value. Therefore, the concept of perpetuity is introduced here, representing the ultimate value of the company's cash flows at the end [9]. The "long-term growth rate," which represents the company's predicted growth, should then be introduced.

$$\text{Perpetuity} = \frac{FCF_{(t)} \times (1 + g)}{WACC - g} \tag{2}$$

g: company growth rate

The weighted average cost of capital (WACC) formally appears in the above formula, which mainly considers how changes in bond and stock portfolio affect the company's

cost of capital and the valuation result of the whole company. The WACC formula is as follows:

$$WACC = \frac{D}{V} \times r_{debt} \times (1 - T_c) + \frac{E}{V} \times r_{equity} \tag{3}$$

V: enterprise value; E: equity cost of capital; D: debt cost of the capital; r_{equity}: cost of equity; required rate of return; r_{debt}: cost of debt; T_c: marginal tax rate of the firm.

In particular, the cost of equity presented in the WACC formula represents the minimum rate of return reasonably required by investors for an asset, which is mainly determined by the market risk-free rate of return, leverage-free beta and market risk premium. The Capital Asset Pricing Model (CAPM) can abstractly express the relationship among the three elements, which is defined as follows:

$$r_{equity} = r_f + \beta \times [E(R_m) - r_f] \tag{4}$$

r_f: risk-free return; β: security beta, the regression coefficient; $E(R_m)$: expected market return.

In summary, corporate value is measured by the present value discounted from the future free cash flow of the enterprise. The rough method is to obtain the current FCF of the enterprise through the accounting income data and finally estimate the present value represented by the discounted FFCF through the weighted average treatment based on the current state. When it comes to estimating the final value estimation, it is highlighted that the final result is sensitive to the expected long-term growth rate (LTG) and WACC because a slight change in LTG and weighted average rate can significantly impact the value of the company, so the business growth rates should be carefully assessed [10].

This paper will conduct a specific scenario analysis of Tesla's commercial data in 2021 and then to show the application and credibility of the DCF model in real business valuation practice with possible issues.

3.2 Data Input and Numerical Analysis

For the valuation of Tesla through DCF, the first step is using data sources, such as the annual report mentioned above and the disclosed data set, to input primary data to calculate and evaluate the total revenue and costs of Tesla in 2021. In addition, reasonable assumptions are put forward to predict Tesla's development in the next five years. This section will explain some of the relevant figures involved in "total revenue" and "free cash flow" and highlight some vital assumptions that were artificially referred in the calculation.

The revenue and costs analysis of Tesla needs to clarify its main business scope. According to the investigation, Tesla's business is mainly simplified and divided into electric vehicle sales, energy business, and other essential support services (Fig. 1).

First, the relevant expenses and revenue brought by "automotive sales" with the largest proportion among all the business can be obtained through the sales and delivery quantity statistics of four classic Tesla Models (Model Y, X, S, and 3) and their corresponding average selling price and costs. At the same time, some ancillary services such as Full Self-Driving (FSD) system and insurance contract services should also be

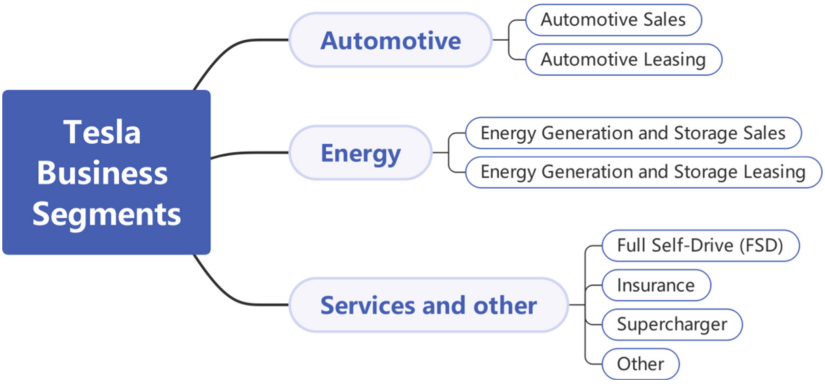

Fig. 1. Tesla Business Scope

Table 1. Tesla Annual Revenue & Cost: 2021–2027

Revenue & Expenses		2,021	2,022	2,023	2,024	2,025	2,026	2,027
Total Revenue	$	55,391,489,361	68,700,882,334	96,113,950,565	141,626,451,090	182,567,877,249	238,086,299,384	298,649,726,253
Total Expense	$	37,270,704,713	42,718,618,685	57,197,255,875	76,983,963,333	97,136,253,760	118,077,607,178	144,753,354,065

taken into account. The revenue and costs generated by the energy business mainly come from the value created by the energy generated or stored by setting relevant hardware (Table 1).

Based on the primary data, the total revenue and the costs can be obtained, so that future free cash flow can be estimated. Therefore, the following content will analyze some specific parts involved in the charts shown above.

3.2.1 Sales of the Automotive

According to Tesla's annual report, Tesla's electric vehicle sales are basically in balance with supply and demand. Thus, the number of cars produced is assumed to be roughly equal to the number of vehicles sold and delivered. It will help determine the production volume for each model and facilitate subsequent cost analysis. Meanwhile, based on the sales status of the four Models in recent years and the adjustment of Tesla's internal sales plan, it is assumed that Model 3/Y will grow at a growth rate of 20% and Model S/X at a growth rate of 6%. For Cybertruck, which has not yet been officially launched, it is assumed that it will debut at an average price of $55,000 in 2023 and grow at a rate of 25% in the first two years, 35% in 2026, and 40% in 2027 (Tables 2 and 3).

Table 2. Average Sale Price of Models

Average Sale Price of Models		
Model 3	$/car	46,000
Model Y	$/car	60,000
Model S	$/car	80,000
Model X	$/car	95,000
CyberTruck	$/car	55,000

Table 3. Production Yield of Models: 2021–2027

Production Yield of Models		2021	2022	2023	2024	2025	2026	2027
Model 3	cars	600,000	720,000	864,000	1,036,800	1,244,160	1,492,992	1,791,590
Model Y	cars	306,000	367,200	422,280	485,622	607,028	758,784	948,480
Model S	cars	12,000	15,600	20,280	23,322	25,654	26,937	28,284
Model X	cars	12,390	14,868	18,585	21,373	23,724	24,910	26,155
Cyber Truck	cars			150,000	187,500	234,375	316,406	442,969
		930,390	1,117,668	1,475,145	1,754,617	2,134,940	2,620,029	3,237,479

3.2.2 Cost Structure

In terms of cost structure, Tesla plans to fully operate gigafactories in the U.S, Shanghai and Berlin to increase production capacity. Therefore, it is reasonable to believe that Tesla's production of Model 3/Y can achieve economies of scale in recent three years under scientific arrangements. However, with the rise of global inflation and labour and raw material prices, its costs will inevitably increase. Because of that, the production cost rate will reach a steady state from 2024. Therefore, the following model is established (Table 4).

Due to the lack of information about Model S, Model X, and Cybertruck, The estimates are based on the forecast performance of Model 3 and Model Y.

Table 4. Production Cost of Models: 2021–2027

Production Cost of Models		2021	2022	2023	2024	2025	2026	2027
Model 3	% of price	73%	71%	70%	69%	69%	69%	69%
Model Y	% of price	74%	72%	70%	70%	70%	70%	70%
Model S	% of price	78%	78%	78%	78%	78%	78%	78%
Model X	% of price	77%	77%	77%	77%	77%	77%	77%
CyberTruck	% of price			79%	78%	77%	76%	75%

3.2.3 FSD and Other Services Related to Automotives

Tesla's Full Self-drive (FSD) system has two main payment methods: one is a one-time payment plan, and the second is a monthly payment plan. The one-time payment plan accounts for the majority of FSD system revenue.

3.2.3.1 *One-Time Payment Model*

It is worth noting that when calculating the lump-sum payment, deferred income is involved, i.e. the current FSD fee may be paid in the next 2–3 years. The calculation formula is as follows:

$$\begin{aligned}\text{FSD annual revenue} &= \text{FSD current deferred revenue} + \text{early deferred revenue confirmed} \\ &= \frac{\text{Tesla current sales} \times \text{FSD current installation rate} \times \text{FSD current unit price}}{2} \\ &+ \text{early deferred revenue confirmed}\end{aligned} \tag{5}$$

3.2.3.2 *The Monthly Payment Model*

The annual revenue generated by monthly FSD payments is easier to calculate. The terms of payment are as follows:

Year-end holdings × FSD adoption rate × monthly revenue per user × 12.

As the number of Tesla vehicles delivered increases, FSD monthly payment revenue increases. But at the same time, although a one-time payment is a more economical way of payment, more car owners say they prefer to pay for a monthly subscription because the price of one-time payment has risen too fast in recent years. Many car owners do not have the habit using a car all the time [11]. Therefore, it is reasonable to assume that the number of monthly paying FSD users will increase from 7% in 2021 to 10% in 2027. By 2027, monthly payments are projected to reach $1.1 billion (Table 5).

3.2.4 Energy Business

Tesla energy business is divided into solar generation (residential and commercial solar roofs) and energy storage (Powerwall, Powerpack, Megapack).

3.2.4.1 *Analysis of Historical Data*

The chart Fig. 2 shows Tesla's total energy or solar revenue from 2017 to 2021 [12]. For the fiscal fourth quarter of 2021, Tesla's energy revenue was $688 million, down 15%

Table 5. FSD: One-time and Monthly Payment Plans

Full Self-drive (FSD)		2021	2022	2023	2024	2025	2026	2027
One-time Payment Plan								
Adoption rate	%	35%	40%	45%	50%	55%	60%	65%
Unit Price	$	10,500	11,025	11,576	12,155	12,763	110,884	116,428
Revenue	$	2,158,000,000	3,969,000,000	6,500,000,000	9,827,000,000	14,176,000,000	21,264,000,000	27,052,000,000
Monthly Payment Plan								
Year-end holding	cars	2,250,000	3,450,000	5,000,000	6,910,000	9,220,000	12,020,000	14,100,000
Adoption rate	%	7%	7%	9%	9%	9%	10%	10%
Revenue	$	272,000,000	422,000,000	556,000,000	776,000,000	1,046,000,000	1,072,000,000	1,109,000,000

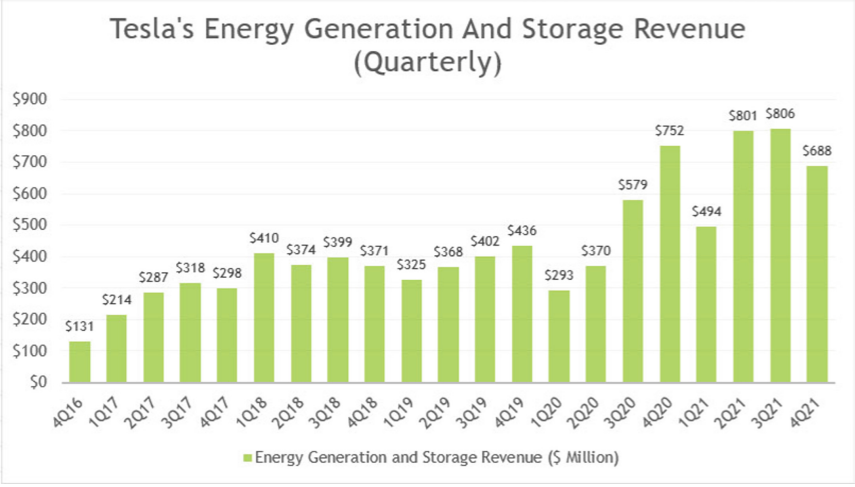

Fig. 2. 2016–2021 Tesla's Energy Generation and Storage Revenue

from the prior quarter and 9% from a year ago. While Tesla's energy revenue fell slightly last quarter, it was up 60% from fiscal 2019 and nearly double from fiscal 2018.

As a result, Tesla's energy revenue has been growing steadily over the long term.

3.2.4.2 *Assumption*

According to historical data [5], Tesla's solar and storage deployments continued to soar in the fourth quarter of 2021, reportedly at 345MW and 4GWh, respectively. It is observed that Tesla is expanding in the energy sector, which is reflected in decline in gross margins while revenue grows. Therefore, once the breakeven point is reached, Tesla's energy business will start making money. Thus, based on the average increase rate of solar generation and considering the risk of plummeting solar generation rates,

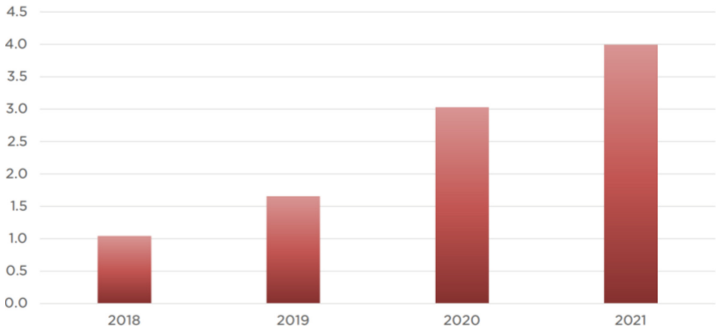

Fig. 3. 2018–2021 Total Energy storage deployments in GWh

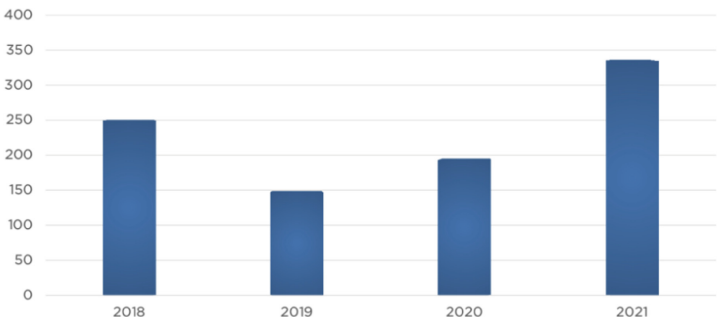

Fig. 4. 2018–2021 Residential solar deployed in MW

the solar deployment rate is assumed to keep at 15%. Relying on the general increasing trend of energy storage, the assumption is that the storage deployment rate will remain at 25% (Figs. 3, 4 and Table 6).

According to the previous analysis, the total revenue of the energy business of Tesla will increase from $2789 million in 2021 to $9428.654 million in 2027.

3.2.5 Supercharging Business and Insurance Business

3.2.5.1 *Supercharging Business*

As an essential part of expanding the use scene of electric vehicles, Tesla supercharging piles have the characteristics of high investment cost and fuzzy operation mode in the previous period, and their profit model has a significant correlation with the use frequency (equivalent to the vehicle ownership).

There are some assumptions used to estimate revenue in the supercharging business.

(i) Tesla's electric-only range will remain at 4 miles/KWh. It is also revealed that the average electricity per mile for Tesla is 0.25 KWh per mile.
(ii) Based on the trend analysis of sales and leasing of Tesla vehicles [13], the vehicle ownership will grow steadily

Table 6. Tesla's Energy Generation & Storage Business: 2022–2027 revenue estimation

Energy generation		2021	2022	2023	2024	2025	2026	2027
Solar deployment	MW	345	397	456	525	603	694	798
YoY-solar deployed	%	15%	15%	15%	15%	15%	15%	15%
Solar energy price	$/W	2	2	2	2	2	2	2
YoY-solar energy	%	1%	1%	1%	1%	1%	1%	1%
Revenue	$	517,500,000	601,076,250	698,150,064	810,901,300	941,861,860	1,093,972,550	1,270,649,117
Energy storage		2021	2022	2023	2024	2025	2026	2027
Enregy storage deployment	MWh	4,000	5,000	6,250	7,813	9,766	12,207	15,259
YoY-energy storage rate	%	25%	25%	25%	25%	25%	25%	25%
Energy storage price	$/MWh	568	562	557	551	545	540	535
YoY-energy storage price	%	−1%	−1%	−1%	−1%	−1%	−1%	−1%
Revenue	$	2,271,500,000	2,810,981,250	3,478,589,297	4,304,754,255	5,327,133,390	6,592,327,571	8,158,005,369
Total revenue	$	2,789,000,000	3,412,057,500	4,176,739,361	5,115,655,555	6,268,995,250	7,686,300,121	9,428,654,486

Table 7. Tesla Supercharging Business: 2022–2027 revenue estimation

Tesla Supercharging Business		2021	2022	2023	2024	2025	2026	2027
Annual average mileage	mile/car	8,500	10,000	11,000	12,000	13,000	14,000	15,000
Electric vehicle endurance	mile/KWh	4	4	4	4	4	4	4
Average annual charge	KWh/car	2,125	2,500	2,750	3,000	3,250	3,500	3,600
Charging fee	$/KWh	0.25	0.25	0.25	0.25	0.25	0.25	0.25
Annual charging fee	$/car	531.25	625.00	687.50	750.00	812.50	875.00	900.00
Vehicle owership	cars	2,250,000	3,450,000	5,000,000	6,910,000	9,220,000	12,020,000	14,000,000
Total charging revenue	$	1,195,312,500	2,156,250,000	3,437,500,000	5,182,500,000	7,491,250,000	10,517,500,000	12,818,000,900

(iii) The average mileage of Tesla vehicles worldwide is estimated to be 8,500 miles in 2021, which is expected to be increased to 15,000 miles in 2027 (Table 7).

3.2.5.2 *Insurance Business*

Since Tesla knows its cars best, the Tesla insurance business can ensure electric vehicles at a lower cost using advanced technology, safety, and serviceability. Therefore, Tesla's premiums are personalized and lower than those of traditional insurance companies.

There are some assumptions used to estimate revenue in the insurance business.

Table 8. Tesla Insurance Business: 2022–2027 revenue estimation

Tesla Insurance Business		2021	2022	2023	2024	2025	2026	2027
Insurance market Share	%	0.5%	1.0%	3.0%	5.0%	7.0%	8.5%	9.0%
Insured vehicles	cars	10,000	30,000	150,000	350,000	650,000	900,000	900,000
Premium per Policy	$/car	1,015	1,030	1,046	1,061	1,077	1,093	1,110
premium revenue	$	10,150,000	30,906,750	156,851,756	371,477,243	700,234,603	984,098,938	998,860,422
Insurance claims	%	75%	75%	75%	75%	75%	75%	75%
Revenue after settlement of claims	$	2,537,500	7,726,688	39,212,939	92,869,311	175,058,651	246,024,734	249,715,105

(i) Based on the insurance industry's average risk rate data, 75% is chosen as the average insurance claims, which means that annual claims account for 75% of insurance revenue.

(ii) The premium per policy will increase by 1.5% per year, from $1015 in 2021 to $1093 in 2027. According to a service conducted to indicate the average insurance payment for a Tesla [14], it was discovered that the minimum coverage is around $800 per year. Considering some vehicle owners choose full coverage insurance, the overall cost of insurance for Tesla is $1015/yr.

In the market, the average car insurance rate increases 2% per year. It is estimated that the premium per policy of Tesla will increase 1.5% per year due to the Tesla benefits policy (Table 8).

3.3 WACC and Corporate Valuation

When the total profit is calculated from the existing data, the operational goal is to determine the free cash flow and WACC separately (Fig. 5).

3.3.1 From Total Revenue to FCF

The simplified free cash flow formula is as follows (Table 9):

$$\text{NOPLAT} = \text{Total Revenue} - \text{Cost} - \text{Operating Income Tax} \tag{6}$$

$$\text{Free Cash Flow} = \text{NOPLAT} + \text{Depreciation} - \text{Capital Expenditure} + \text{Change of Working Capital} \tag{7}$$

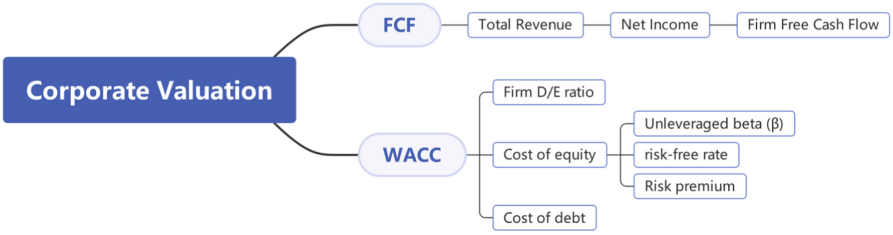

Fig. 5. The structure of Corporate Valuation

Table 9. Fixed Assets & Taxes

Fixed Assets			
Value of Fixed Assets at the end of 2021	$	18,884,000,000	Balance sheet
Depreciation Rate	% of Rev	3%	Estimated
CAPEX	% of Rev	15%	Valueinvesting
Taxes			
Payroll Tax	%	7.65%	Federal Insurance Contributions Act (FICA)
Profit Tax	%	17.15%	Discounted US Federal Tax rate
Property Tax	%	1.10%	US nationwide average rate (Mortgage)

Confirming fixed assets and income tax is the first issue to be solved from transferring the revenue to the final free cash flow of the company. According to the collected data from Valueinvesting [15], when dealing with fixed assets, it is assumed that Tesla adopts a 3% depreciation rate for fixed assets and a 15% capital expenditure rate for profits. In terms of the tax rate, relying on the general tax policies applied in the United States, it is stipulated that the individual payroll tax and property taxes are 7.65% and 1.10% respectively. The corporate income tax is based on the US federal tax rate, combined with the corporate income tax rate paid by foreign companies in China and Europe, and the final tax rate is assumed to be 17.15%. The last element is working capital, which is the net of total current assets minus total current liabilities of the enterprise. Namely, it is the net of current capital available for use and turnover in the operation of the enterprise. According to WSJ|Market [16], the change in working capital was worth $518,000,000, and the assumption is that the change rate is 10% because of the rapid expansion of Tesla.

Combined with the above assumptions and calculated gross income, the estimated cash flow of Tesla from 2021 to 2027 is obtained (Table 10).

Table 10. Cash Flow Estimation

	2021	2022	2023	2024	2025	2026	2027
Free Cash Flow	5,837,462,842	8,276,015,767	13,455,431,255	24,863,972,892	33,511,762,264	49,068,664,344	63,729,933,731

3.3.2 WACC Calculation

The most critical thing in estimating WACC is to understand the relationship between several important variables and adjust accordingly. The Table 11 shows the values of each related coefficient related to WACC, which are collected and processed from different credible data platform.

The majority of relevant coefficients could be obtained from data platforms. While the company beta of Tesla needs to be specifically explained how it is estimated. Beta is a pointer used to measure the systemic risk of an asset. According to CAPM, a suitable beta estimation method is to find the industry beta of electric vehicle and new energy industries similar to Tesla and deleverage the beta based on the average capital structure of the target industry. Then, the beta coefficient of Tesla is obtained by leveraging again relying on its capital structure. The specific operation formula is as follows:

$$\text{Industry Assets Beta} = \frac{\text{Industry Equity Beta}}{1 + \text{Target D/E Ratio}} \tag{8}$$

$$\text{Company Beta} = \frac{\text{Industry Assets Beta}}{1 + \text{Company D/E Ratio}} \tag{9}$$

Ultimately, the company's beta value of Tesla is estimated to be 0.9522.

The final step is corporate valuation. In order to minimize the error. Firstly, the net present value (2022–2027) could be estimated by formula (10). Then, using the perpetuity formula (11) based on the data in 2027, the continued corporate value after 2027 could be obtained. The estimated corporate value of Tesla equals $NPV_{2022–2027}$ plus NPV_{2027} continued (Table 12).

$$NPV_{2022-2027} = \frac{FCF_{2022}}{1 + WACC_{2022}} + \frac{FCF_{2023}}{(1 + WACC_{2023})^2} + \frac{FCF_{2024}}{(1 + WACC_{2024})^3}$$

Table 11. Vital coefficients in WACC evaluation

WACC related coefficients			
US risk-free	%	2.40%	10-year US Treasury
Market Premium	%	4.50%	Finbox
Beta		1.13	NYU Stern
Target D/E Ratio	%	19.86%	NYU Stern
Growth Rate	%	5.00%	Valueinvesting
Inflation in the base year	%	7.00%	Bloomberg
Company D/E Ratio	%	1.00%	Valueinvesting

Table 12. WACC Calculation & Enterprise Valuation

WACC & Corporate Valuation	2021	2022	2023	2024	2025	2026	2027
Industry Equity Beta	1.13						
Industry Assets Beta	0.9428						
Company Beta	0.9522	0.9522	0.9522	0.9522	0.9522	0.9522	0.9522
Cost of Equity	14.15%	10.42%	10.42%	9.99%	9.57%	9.46%	9.99%
Cost of Debt	4.50%	4.50%	4.50%	4.50%	4.50%	4.50%	4.50%
WACC	14.05%	10.35%	10.35%	9.93%	9.51%	9.40%	9.93%
Discounted CF	---	7,499,610,960	11,049,241,684	18,716,335,072	23,303,473,551	31,309,709,957	36,111,376,465
NPV Forecast Period from 2022–2027	127,989,747,688						
NPV Continuation Period	769,092,862,558						
Corporate Value	897,082,610,246						

$$+ \frac{\mathrm{FCF}_{2025}}{(1+\mathrm{WACC}_{2025})^4} + \frac{\mathrm{FCF}_{2026}}{(1+\mathrm{WACC}_{2026})^5} + \frac{\mathrm{FCF}_{2027}}{(1+\mathrm{WACC}_{2027})^6} \tag{10}$$

$$\mathrm{NPV}_{2027\ \mathrm{continued}} = \frac{\mathrm{FCF}_{2027} \times (1+g)}{\mathrm{WACC}_{2027} - \mathrm{g}} \tag{11}$$

Therefore, the estimated perpetual corporate value of Tesla is $ 897,082,610,246.

4 Discussion

This paper uses the DCF model to evaluate Tesla, the representative company of new energy auto vehicle enterprises. Furthermore, the application of the DCF model in corporate valuation is demonstrated. The final prediction results are used to adjust investors' views on the future development prospects of new energy enterprises in the epidemic era. Using the DCF model, Tesla was eventually valued at about $900 billion. This part will discuss the practical significance and rationality of this result.

4.1 The Practical Significance of DCF Model Valuation Results

According to Global Ranking [17], as of December 31, 2021, Tesla's valuation reached $1.06 trillion, slightly higher than the final valuation of $900 billion derived from the DCF model. With a valuation of more than $1 trillion, Tesla remains the sixth most

valuable company globally. As early as October 26, 2021, CNN Business reported that Tesla's valuation had officially broken through $100 billion [18].

Since the valuation data of Tesla by the DCF model combined with WACC is slightly less than that in the current market, it can also prove the practicability and feasibility of DCF in the process of corporate valuation. The reason for the slight difference between the estimated result from DCF and the market cap is that Tesla seemed to be overvalued at the end of 2021. According to the Global Ranking [17], the market cap of Tesla dropped dramatically from January 14 to January 21, when on January 17 the market cap decreased below $1 trillion and reached $947.92 billion on January 21. Then this statistic fluctuated around $900 trillion until March 20, 2022, when the market cap rose over $1 trillion again. The information delay could explain the decrease of the corporate valuation. It appears that when the fourth-quarter results were released, shareholders expressed distrust of Tesla's operations. Thus, the final estimation of DCF model shows a relatively accurate result. Meanwhile, this $900 billion valuation of Tesla also reflects the market's recognition of Tesla's sustainable, high-quality and rapid development prospects. It also reflects the vast development potential of new energy vehicle enterprises represented by Tesla in the epidemic period.

Therefore, combined with the auxiliary materials and the analysis of the above parts of Tesla's proprietary business, success factors that Tesla will emerge from the global new energy enterprises can be simply boiled down to the following several factors. For example, the expansion of the company's related business scope, the improvement of supporting facilities and production capacity, and the company's unique sophisticated technology and innovative products.

First of all, in addition to the company's main business - electric vehicles, Tesla has expanded into related energy production and storage businesses. Its main representative products are solar roofs and solar panels. According to the annual report [6] revealed by the United States Securities and Exchange Commission, the energy generation and storage segment revenue of Tesla has increased from $181.39 million in 2016 to $2789 million in 2021. At the same time, it was found that Tesla's energy business profit maintained 5% of the total profit after 2019. Compared with Tesla's electric vehicle sales, the energy business is a relatively small but stable part of Tesla's whole business. It is expected that, with the adjustment of the industrial structure, the energy business will become increasingly important to the company.

Second, Tesla's current factories worldwide are being planned and built at a rapid pace. By April 10, 2022, Tesla had built 6 gigafactories around the world, among which the latest two plants, Berlin Gigafactory and Texas Gigafactory, were officially put into operation on March 22, 2022 and April 7, 2022 respectively. Tesla is creating gigafactories to match its economies of scale as the market changes. It can be predicted that Tesla's EV business will increase output with increased production capacity and reduce relative profit before reaching the maximum profit point for Tesla, thus achieving the final economies of scale.

Finally, the introduction of high-tech components and innovative products with independent intellectual property rights guarantees the sustainable and efficient development of the company. The new 4680 cylindrical lithium-ion battery that Tesla is currently working on, according to Kazuo Tadanobu, CEO of Panasonic's Energy Division, which is

one of Tesla's major battery partners, could help the company grow its global business in the future because it can reduce the cost of electric vehicles while also ensuring the efficient and safe operation of vehicles [19]. In addition to industrial components similar to car batteries, Tesla is expected to launch the much-anticipated CyberTruck in 2023 officially. Elon Reeve Musk, CEO of Tesla, at the recent Tesla Gigafactory opening ceremony, said, "Sorry for the delay. But you're going to have [CyberTruck] next year, and it's really going to be great." [20] Tesla continues to launch new products, from the Model S, released in 2012, to the Cybertruck, released in 2023. The innovative pace led Tesla to its success, with an estimated valuation of $900 billion, making it the sixth most valuable company in the world.

4.2 Possible Problems of the DCF Model in Valuation

In the above application of the DCF model, Tesla's final valuation is about $900 billion, and the practical significance is assessed. To further analyzing the feasibility of the DCF model, some valuation issues that may arise in the real world also need to be considered. In fact, there is a risk that the discounted corporate value may differ greatly from the actual situation. This section will analyze why this problem may occur from three potential pitfalls of the DCF valuation model [21].

The first potential pitfall comes in Tesla's cash flow estimation. When using the DCF model to value Tesla, the most important thing is to estimate the future cash flow, and the most common problem is that the company's annual forecast of cash flow growth is uncertain. Specifically, Tesla's past data can precisely predict 2021 and 2022 performance and cash flow, but it is uncertain to predict the business performance in the next few years, which will negatively impact the sustainable cash flow forecast. Based on the historical records of previous years, if the prediction of recent years differs significantly from the actual situation, the final valuation result will become wildly inaccurate. For instance, the 4 Models of electric vehicles are analyzed respectively in this paper. However, some crucial elements, such as the production and delivery situations of each Model, are not revealed by Tesla. The annual report combined Model S with X, Model 3 with Y, which made it hard to estimate the sales revenue and related costs. The possible solution is to estimate free cash flows rationally for the first five or even ten years based on existing data, and finally add aggregate discounted cash flow with the perpetuity cash flows afterwards. Based on this step, the final perpetual cash flow could be more precise.

The second pitfall is Tesla's CAPEX projections. According to the understanding of free cash flow, forecasting free cash flow requires a forecast of CAPEX for each model year. In this model, uncertainty about CAPEX increases with each additional year of valuation. However, capital expenditure is more discretionary. For example, when the company is in recession, the management will control and suppress capital expenditure, and vice versa. As a result, CAPEX projections are highly risky because even small changes in forecasts can significantly impact DCF's final valuation structure. In combination with the global deployment plan of Tesla's future gigafactor and the forecast of the increased company's fixed assets (e.g. supercharger) with the increase in electric vehicle sales, this DCF model assumes a CAPEX-to-revenue ratio of 15% using the sales ratio method. The ratio of 15% is close to the CAPEX-to-revenue ratio of Tesla

in 2021 and close to the ratio of Tesla's average sales from 2017 to 2021. Therefore, this data is used as Tesla's sustainable CAPEX-to-revenue ratio to estimate free cash flow to reduce errors.

The discount rate and forecasted sustainable growth rate are discussed in the final section. First of all, for the discount rate, the current widely used method is the Weighted Average Cost of Capital. However, estimating NPV through WACC is problematic because the cost of leverage of equity (from CAPM) is used throughout the project. However, in the future, the non-leverage cost of equity and the leverage cost of equity mainly depends on the strategic decision of the company, so it will change in a small range at any time. For example, if the company changes its capital structure, a variable WACC should be applied instead of keeping the original estimated WACC for NPV [22]. Therefore, there may be inevitable errors in calculating NPV, and the predicted results will often be conservative. In addition, the other part is the growth rate, which must be a permanent-growth rate forecast in the DCF model. It can be predicted that the sustainable management company's sustainable growth rate is affected by the long-term economic growth rate, and the company will eventually enter the mature low growth mode. However, it is too idealistic to assume that something is permanent, and the growth rate of a mature company is rarely constant from year to year. Therefore, based on the long-term historical data of the global economy and Tesla's rapid development in the recent five years, Tesla's sustainable growth rate is assumed to be 5% to minimize the prediction error, although the error is inevitable [15]. However, though some solutions exist to make the result accurate, the errors derived from the estimation of growth rate and discount rate are ineluctable. Because of the property of the DCF valuation model, this valuation result is sensitive to small changes in the discount rate and growth rate assumptions, and a difference of a few tenths of a decimal point can make the final result very different.

5 Conclusion

To explore the future corporate value of the new energy electric vehicle industry in the epidemic era, this report uses the DCF valuation model to conduct the company valuation for Tesla. The theoretical level of the DCF valuation model clarifies how to make a specific valuation of a company based on the company's total profit, capital structure, industry development status, and other factors. Finally, it clarifies the valuation scheme by FCF, WACC, CAPM, and different formulas. Then the DCF model is used to analyze and forecast the corporate valuation of Tesla. In the practical application of the DCF model at the commercial level, the main business fields of Tesla need to be clarified based on the investigation. The value brought to Tesla by electric vehicle sales, energy, and other businesses should be explored. With the data before 2021 reasonably estimated, the value of free cash flow from 2022 to 2027 can be obtained through the DCF valuation model. Then, the cost of equity can be estimated through CAPM, and WACC can be obtained. Finally, the company value of Tesla is estimated to be $900 billion. Although this figure is lower than the market cap of Tesla at the end of 2021, it still makes sense. During the epidemic period, as a new energy electric vehicle company, it can obtain a high company valuation, which revealed the huge development space of the new energy field in the future. At the same time, Tesla's development strategy, innovation ability,

and other advantages also inspire other electric vehicle companies. Finally, although the DCF valuation model may be inaccurate in estimating free cash flow, capital expenditure, or sustainable growth rate, it could also better adapt to the actual situation by studying more company data, market development status, and dynamic adjustment according to the company's development strategy, so as to obtain more accurate future valuation data.

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