Google's Three-Year Stock Price Deviation Analysis Based on DCF Model

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Abstract. This study evaluates Google's enterprise value over three years (2021–2023) using the Free Cash Flow (FCF) discount method, aiming to provide actionable insights for investors and management. By applying the Discounted Cash Flow (DCF) model, the analysis quantifies Google's theoretical stock value and compares it with market prices, revealing significant valuation discrepancies: overvaluation by 24.56% in 2021, undervaluation by 5.83% in 2022 amid macroeconomic turbulence, and overvaluation by 19.17% in 2023 driven by AI-driven optimism. Key drivers include macroeconomic shifts (e.g., Fed rate hikes), industry competition (e.g., OpenAI's breakthroughs), and strategic pivots (e.g., AI product launches). While the DCF model demonstrates strengths in valuing high-growth tech firms through cash flow projections, limitations persist, such as reliance on historical data and exclusion of non-financial factors (e.g., innovation ecosystems, political risks). The findings underscore the necessity of blending quantitative metrics with qualitative assessments of technological trends and market dynamics. For investors, this highlights the importance of balancing short-term valuations with long-term growth potential in AI and cloud computing. For management, optimizing R&D investments and capital allocation is critical to sustaining market confidence. Future research should integrate non-financial indicators, employ scenario analysis, and extend forecast horizons to enhance valuation accuracy.

Keywords: Enterprise Valuation, Stock Price, Free Cash Flow (FCF), Discounted Cash Flow (DCF) Model, Google Inc.

1 Introduction

In recent years, the global technology industry has developed rapidly, and new technology companies have sprung up like mushrooms [1]. Take Tesla and BYD for example, these companies focus on the development of intelligent driving technology and have launched many eye-catching high-tech car products. At the same time, companies like Unitree, which focuses on the research and development of robotics, have also made remarkable achievements. In addition, tech giants such as Google, Microsoft and Apple, whose research and innovation in the field of artificial intelligence continue to push the boundaries of science and technology. as AI-driven business models reshape

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competitive dynamics [2]. These companies, which are deeply engaged in AI, Intelligent Drive and other cutting-edge technologies, continue to introduce innovative products and services, leading the development direction of the industry. Among these tech giants, Google undoubtedly occupies a very important position. As one of the world's leading technology companies, Google has shown excellent performance in technological innovation, market leadership and business value creation. Therefore, Google's valuation has become the focus of attention of many investors and investment institutions. Based on this background, this paper aims to analyze the financial report data of Google in the past three years by Free Cash Flow (FCF) method and further explore and study the company valuation of Google, to provide more detailed and in-depth analysis for investors. Through this analytical framework, investors can more accurately assess the market value of Google's stock, determine whether its fair value is undervalued or overvalued and make more informed investment decisions. At the same time, this paper also has important reference value for the management of Google, because it can help them better understand the market's expectations and evaluation of the company, to make more reasonable decisions on resource allocation and further enhance the value of the company. In addition, this paper can also provide reference and reference for the value assessment of the entire technology industry companies. Through the in-depth analysis of Google's financial statements, this paper provides specific case support for the practical application of the FCF method, and provides suggestions for investors and enterprise management. This effectively improves their ability in investment decision making and strategic planning.

2 Method

2.1 Discounted Cash Flow (DCF) Model

The discounted cash flow (DCF) model is a widely used valuation method that estimates the value of a business by predicting a company's future free cash flow (FCF) and discounting it to present value [3]. This approach assumes that the value of a business is determined by its ability to generate cash flow for stakeholders in the future. Therefore, for technology companies such as Google with significant growth potential and stable cash flow, DCF model provides a powerful help in evaluating enterprise value [4].

2.2 Calculation of Free Cash Flow (FCF)

Free Cash Flow (FCF), as defined in corporate finance literature [5], is calculated as operating cash flow minus capital expenditures, reflecting cash available to investors. It is a critical metric for valuation as it reflects the actual cash available to investors, debt holders, and the company itself.

2.3 Operating Cash Flow (OCF)

Derived from the cash flow statement, OCF is adjusted for non-cash expenses and changes in working capital. (Equation (1))

$$\text{OCF} = \text{Net Income} + \text{Non} - \text{Cash Exspense} - \text{Change in Working Capital} \quad (1)$$

2.4 Capital Expenditures (CapEx)

These are investments in physical assets such as data centers, servers, and office infrastructure. CapEx is subtracted from OCF to arrive at FCF. (Equation (2))

$$\text{FCF} = \text{OCF} - \text{CapEx} \quad (2)$$

For this study, Google's FCF will be calculated using its financial reports from the past three years. The analysis will explicitly account for cash flows from operating activities and investment activities, while fundraising activities will influence the capital structure and thus the discount rate rather than directly impacting FCF.

2.5 Discount Rate and Enterprise Value

The discount rate reflects the risk of future cash flows and is usually expressed as weighted average cost of capital (WACC). The WACC combines the cost of equity and the cost of debt after tax, weighted according to their proportion in the capital structure is presented in Equation (3) [6].

$$WACC = \left(\frac{E}{D+R} \times R_e\right) + \left(\frac{D}{E+D} \times R_d \times (1-T)\right) \quad (3)$$

Where,

E : Market value of equity

D : Market value of debt

R_e : Cost of equity (calculated using the Capital Asset Pricing Model, CAPM)

R_d: Cost of debt

T : Corporate tax rate

For Google, the cost of equity (R_e) is estimated using CAPM, which integrates market risk premiums and stock volatility [7]. (Equation (4))

$$R_e = R_f + \beta \times (R_m - R_f) \quad (4)$$

Where R_f is the risk-free rate, β measures Google's stock volatility relative to the market, and R_m is the expected market return.

After the discount rate is determined, the FCF and final values over the forecast period are discounted to present value. The enterprise value (EV) is the sum of these discounted cash flows as presented in Equation (5).

$$EV = \sum_{t=1}^{n} \frac{FCF_t}{(1+WACC)^t} + \frac{Terminal\ Value}{(1+WACC)^n} \tag{5}$$

The terminal value is calculated using the perpetuity growth model, which assumes a stable long-term growth rate [8]. (Equation (6))

$$Terminal\ Value = \frac{\mathrm{FCF_n} \times (1+\mathrm{g})}{WACC - g} \tag{6}$$

Where g is the assumed sustainable growth rate, usually consistent with the long-term economic growth rate.

2.6 Comparative Analysis with Market Price

Google's enterprise value is calculated by deducting net debt (total debt minus debt from cash and cash equivalents) to derive the equity value and dividing by the number of shares outstanding to estimate the value per share. Compare that value with Google's current market price to determine whether the stock is undervalued or overvalued.

3 Analysis

3.1 Data Sources

All data in this paper are strictly based on publicly available financial reports, market data and authoritative industry research to ensure transparency and credibility of the analysis. The following is a detailed explanation of the source of the data.

Google financial report. Annual reports and 10-K documents: Google's tax rates for 2021 to 2023 (16.20%, 15.92%, 13.91%) were calculated using data from its official annual report and 10-K filings with the U.S. Securities and Exchange Commission (SEC). Annual reports and 10-K documents are the core channels for public companies to disclose financial information and are subject to an independent audit and comply with General accounting standards (GAAP), so they are highly authoritative. Fluctuations in tax rates may reflect Google's tax optimization strategies around the world, such as distributing profits through subsidiaries in low-tax jurisdictions such as Ireland and Singapore.

Equity value calculation: Equity value is calculated by multiplying the number of outstanding shares with the closing price on the last trading day of the year. For example, with 1.285 billion shares outstanding in 2021 and a closing price of $144.85, the equity value is 1.285 billion x 144.85 = $186,132.25 million. This approach directly reflects the market's immediate valuation of Google.

Market and macroeconomic data. Risk-free rate: Use the 30-year US Treasury yield (4.6%) as an approximation of the risk-free rate. Long-term Treasury bonds are considered the benchmark of risk-free assets because they are backed by U.S. gov-

ernment credit, the risk of default is close to zero, and the maturity matches the assumption of corporate sustainability.

Beta and market expected return. Beta (β): Google has a beta of 1.02, taken from historical Yahoo Finance data [9]. A beta of just above 1 indicates that its stock price volatility is broadly in line with the market (S&P 500) but is slightly riskier than the market average due to the high-growth nature of the technology sector.

Market Expected Return (R_m): Set at 9.8%, it is based on the long-term average return of the S&P 500 index and reflects investors' expect ions for the overall return of the equity market.

Stock price data. Closing price of $144.85, $88.23 and $139.69 on the last trading day of 2021 through 2023, respectively, according to Yahoo Finance [9].

Industry growth forecast. Long-term Growth (g): Set at 5.1%, as cited in the International Data Corporation (IDC) [10]. According to the report, while global services revenue growth will be moderate in 2023, demand for cloud computing, artificial intelligence (AI) and digital services will remain stable over the next five years. As the world's leading IT market research institution, IDC's forecast is based on quantitative modeling and expert analysis of industry trends, which has high reference value.

3.2 Data Analysis

In this part, we will calculate the Operating Cash Flow (OCF) and Free Cash Flow (FCF)

OCF calculation. According to Google's financial data, the OCF in year 2021 to 2023 can be calculated. In year 2021, OCF was $96,033 million, reflecting strong advertising and cloud revenue for the year. In year 2022, OCF fell to $86,972 million, down 9.4% year on year, due to higher hardware business costs due to global supply chain disruptions, and increased AI R&D spending (such as the capitalized spending on the DeepMind project). And in year 2023, OCF rebounds to $101,795 million, a record high, thanks to a recovery in advertising and scaling of cloud computing services.

FCF calculation. The calculation results are as follows in Equation (7).

$$\mathrm{FCF} = \mathrm{OCF} - \mathrm{CapEx} \tag{7}$$

In year 2021, $71,393 million in FCF and $24,640 million in CapEx, primarily for data center expansions and server purchases. As for 2022, FCF drops to $55,487 million and CapEx surges to $31,485 million, reflecting huge investments in AI infrastructure (such as TPU chips) and quantum computing LABS. In year 2023, FCF recovers to $69,544 million and CapEx stabilizes at $32,251 million, with 65% of that going to generative AI-related hardware.

3.2.1 Weighted Average Cost of Capital (WACC).

Cost of Debt ($\boldsymbol{R_d}$). Debt costs for 2021 to 2023 are 7.542%, 8.58% and 9.25%, respectively, calculated by dividing interest expense by total debt. The rise in debt costs is mainly due to the Fed's rate hike cycle, with the coupon rate of $5 billion of new corporate bonds issued in 2023 reaching 5.25%.

Cost of equity (R_e). Calculated by the Capital Asset Pricing Model (CAPM) in Equation (8).

$$R_e = R_f + \beta \times (R_m - R_f) \tag{8}$$

After plugging in the data, the three-year R_e is:
2021:4.6% + 1.02 × (9.8%-4.6%) = 9.89%
2022:4.6% + 1.02 × (9.8% - 4.6%) = 9.89%
2023:4.6% + 1.02 × (9.8% - 4.6%) = 9.90%

WACC results. Since Google's capital structure is dominated by equity and debt accounts for only 15%, WACC has stabilized at about 9.89% in three years, indicating that its financing costs are less affected by interest rate fluctuations.

DCF model calculation. Adopting the sustainable growth model, the formula is as follows in Equation (9).

$$EV = \sum_{t=1}^{n} \frac{FCF_t}{(1+WACC)^t} + \frac{Terminal\ Value}{(1+WACC)^n} \tag{9}$$

The sustainable growth rate (g) is 5.1% and the forecast period (n) is set at 5 years. The calculation results are as follows:

2021: Terminal value of $1,488,650 million, enterprise value of $1,494,453 million.
2022: Terminal value of $1,163,337 million, enterprise value of $1,167,515 million.
2023: Terminal value of $1,449,851 million, enterprise value of $1,460,646 million.

Theoretical value per share. Enterprise value minus net debt (cash reserves minus total debt) divided by the number of shares outstanding:

2021: $116.29 (actual stock price of $144.85, undervalued by 24.56%).
2022: $93.69 (actual share price $88.23, overvalued by 5.83%).
2023: $117.22 (actual stock price of $139.69, undervalued by 19.17%).

3.3 Result Analysis

Stock price in 2021. Global liquidity eased in 2021, with the Nasdaq up 27% for the year. As well as investors' excessive optimism about the long-term growth potential of AI technology and cloud computing, Google, as a leader in the technology industry, has been favored by many investment institutions and investors, resulting in rising stock prices.

Stock price in 2022. The emergence of generative AI tools like ChatGPT directly threatened Google's dominance in search and AI, contributing to the 2022 undervaluation [11]. As a result, investment institutions and investors are not optimistic about Google's prospects. Coupled with aggressive interest rate hikes by the Federal Reserve (475 basis points accumulated throughout the year). soaring inflation (US CPI peaked at 9.1%) and the Russia-Ukraine conflict caused investors to panic. Shares in the technology sector sold off, with the Nasdaq index plunging 33 percent and Google's share price falling below its theoretical value.

Stock price in 2023. In 2023, Google AI new products were successfully listed [12], and major investment institutions and investors believe that the technology industry has great potential. Google is being touted as a leader in the tech industry. At the same time, the S&P 500 is up 24 per cent, making stock prices overpriced.

4 Conclusion

This paper systematically analyzes Google's financial data for the past three years by using the free cash flow (FCF) discount method, with the aim of evaluating its enterprise value and providing a reference for investors to make decisions. According to the results of the study, Google's stock valuation showed different fluctuations in different years: in 2021, the market price was overvalued by 24.56% compared to the theoretical value, in 2022, it was undervalued by 5.83% due to external shocks, and in 2023, it was overvalued by 19.17%. This fluctuation is closely related to the macroeconomic environment, industry competition pattern, and corporate strategy adjustment. For instance, in 2021, excessive optimism about artificial intelligence and cloud computing technology drove up stock prices, whereas in 2022, the Fed's aggressive interest rate hike and OpenAI's technological breakthrough caused market panic. By contrast, the successful launch of Google's AI products in 2023 restored investor confidence. The application of the DCF model in this study reflects its advantages in evaluating high-growth technology enterprises, as it quantifies future cash flow to reflect corporate value. However, like any research method, it has inherent limitations. Specifically, the analyzed data is based on Google's financial reports from 2020 to 2022, but the rapid iteration of the technology industry—such as AI breakthroughs or policy adjustments—may render historical data inadequate for predicting future cash flows. Additionally, key assumptions (e.g., sustainable growth rate, discount rate) depend on the current economic environment; sudden changes in macroeconomic factors (e.g., interest rates), industry regulations (e.g., data privacy laws), or competitive landscapes could distort results. Furthermore, the study acknowledges that Google's value encompasses non-financial elements such as technological innovation and user ecosystem, which the FCF method cannot quantify. Moreover, political risks and supply chain uncertainties—factors excluded from this analysis—could introduce significant valuation errors. For investors, these findings emphasize the need to combine quantitative analysis with qualitative judgment. That is, while financial indicators remain critical, dynamic assessments of technical barriers and market trends are equally vital. For example, although Google's stock appeared overvalued in 2023, its sustained investments in generative AI and cloud computing may justify future growth. For management, the research underscores the importance of balancing capital allocation between R&D and shareholder returns to foster market trust. Looking ahead, future research could expand in three directions: First, integrating non-financial indicators to refine valuation models; second, employing scenario analysis to simulate valuation ranges under diverse macroeconomic and competitive conditions; third, extending forecast periods to validate long-term assumptions. In summary, this paper not only offers methodological insights for valuing tech enterprises

but also highlights the complexity of aligning theory with practice, thereby providing a multifaceted perspective for investment decisions and strategic planning.

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