Valuation of Volkswagen Group: Forecast Using Discounted Cash Flow Method

Name: Selami Doğan Akansu Student No: 6315870

General Information About Volkswagen Group

This study focuses on Volkswagen AG (VW) and conducts a discounted cash flow (DCF) valuation, encompassing a three-year short-term forecast and a three-year medium-term outlook with a terminal value assumption extending to infinite lifetime. The valuation was conducted as of January 1, 2024, utilizing financial data spanning the past decade obtained from Investing Pro. Notably, Volkswagen AG encompasses a diverse portfolio of brands, including Porsche, Audi, Skoda, Lamborghini, and Bentley, alongside its subsidiary EV battery company, PowerCo.

Table 1 provides insight into the return distribution of the DAX index from 1995 to 2023, along with the log-returns of Volkswagen ordinary shares and the Germany bond yield spread.

Period	Market Prem.	Beta	Adj. Beta	Cost of Equity
1995-2023	0.0477	0.6049	0.8683	0.0678
Last 10 Years	0.0779	1.6080	1.2027	0.1220
Last 5 Years	0.0411	1.7282	1.2427	0.0775

Table 1. Company Market Beta Summary

The cost of equity is determined by combining the risk-free rate with the firm's beta and the market premium, as per the formula $k_S = r_f + \beta \times$ Market Premium. Bloomberg adjustment is applied in β estimation. Utilizing the Svensson method, the risk-free rate is calculated at 2.64%, based on the German bond yields. Figure 1 illustrates the yield curve of German bonds, highlighting an inversion at the onset, indicative of economic downturns, where short-term yields surpass long-term yields.

To validate the accuracy of our findings, VW's 2022 annual report provides crucial metrics: a beta factor of 1.55,computed using the MSCI World Index, a cost of debt of 5%, an after-tax cost of equity of 10.7%, and an after-tax cost of capital of 8.3%. Remarkably, our results closely align with the company's figures, considering discrepancies in currency and market index variations.

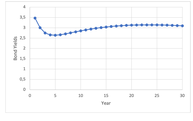

Figure 1. Firm Value and Debt Outlook

Figure 2. Peer Companies' Market Caps

Figure 3. VW Stock Returns and DAX Returns

Tax Rate Specification

The corporate tax rate in Germany applied to Volkswagen Group is 30% in aggregate, including trade tax and other taxes. However, since Volkswagen Group is an international enterprise, different tax rates are applied by other countries. Therefore, the overall tax rate of VW fluctuates over time. Being cautious, a 25% corporate tax rate is determined regarding the average tax rate of 23.45% for the last 10 years.

Parameter Name	Value	Parameter Name	Value
WACC	7.06%	Alternative WACC	7.21%
Cost of Equity	12.20%	Implicit Growth Rate	0.88%
Cost of Debt	4.84%	Sales Growth Rate	4.18%
Debt Ratio	60%	COGS, percent of Sales	82.51%
Tax Rate	25%	Fixed Assets Growth Rate	8.23%

Table 2. APV and WACC Model Parameters

Adjusted Present Value (APV) Approach

In the APV approach, Free Cash Flow (FCF) and tax shields are discounted separately. FCF is discounted using the unlevered cost of capital at 8.79%, resulting in a present value of €112.75 billion. The cost of debt, set at 4.84%, is utilized to compute the present value of the tax shield, amounting to €51.30 billion. Consequently, the total company value is determined as €164.05 billion when the total debt amount is subtracted. Surprisingly, the estimated total equity stands at -€41.14 billion. This discrepancy stems from the company's low market capitalization and predetermined book value of the total debt, leading to a lower valuation compared to the total debt volume.

WACC Approach

12.20% of the cost of equity and 4.84% of the cost of debt are used in the WACC calculation, resulting in 7.06%. Using WACC, the company's Free Cash Flow (FCF) is discounted to find the company value. As a result, VW's total value (TV) was determined to be €145.316 billion.

Alternative WACC

WACC with default probability (Koziol and Christian, 2014) provides a more realistic WACC rate. To find it, the bankruptcy cost is set at 10% of the company value, and the default probability is 1.42% over 5 years. With the default probability accounted for, the WACC increases from 7.06% to 7.21%. This results in a decrease of €3,566.82 million in the firm value.

	WACC	Alt. WACC	APV	Adj. APV
PV FCF (1-6)	€ 41,174	€ 40,969	€ 38,931	€ 38,931
PV Horizon	€ 103,987	€ 100,626	€ 73,822	€ 73,822
PV of Tax Shield			€ 51,296	€ 19,728
PV of company	€ 145,161	€ 141,595	€ 112,753	€ 112,753

Table 3. APV and WACC Approach Summary, in millions

Model Comparison

The APV and WACC approaches yield divergent company valuations primarily due to differing debt assumptions. Volkswagen Group's debt structure, with a 60% debt ratio, exhibits relative stability over time compared to its peers, owing to its international footprint and consistent production and sales history. Given this stability, the WACC approach, which employs a constant debt ratio, is deemed more appropriate for valuing Volkswagen Group.

However, in the APV approach, continuously adjusting the debt ratio over time should theoretically converge to the same result as the WACC approach when all other parameters remain constant. In the valuation of Volkswagen Group, employing the adjusted APV approach yields a superior result of €53.05 billion, a significant improvement over the previous APV result of -€41.14 billion, as depicted in Table 3. This positive adjustment is attributed to the optimization of the debt structure over time to maintain a constant debt ratio, enhancing the overall valuation outcome.

Real Option

A real option to wait for VW is created using 8-year historical FCFs. This option entails acquiring the entire VW Group at its market capitalization of €58 billion, with the cost of capital set as the WACC. The interest rate is derived from the 1-Year Germany bond yield, currently at 3.47%. The "good" state averages the four highest FCFs to €11,659.81 million, while the "bad" state averages the four lowest FCFs to €(11,816.06) million. This balanced empirical approach results in a DCF valuation of € 62,739.38 million, higher 4.12% than the market capitalization that is the initial investment. Therefore, choosing the option to wait is a better strategy to buy the whole firm now.

Comparative Analysis of Volkswagen

In comparing the results of the APV and WACC valuation approaches, it is expected that APV, with a constant debt volume, would yield a lower company valuation compared to WACC with a constant debt ratio due to the diminishing tax shield over time. However, surprisingly, the APV approach resulted in a higher company value, likely attributed to the substantial total debt in relation to the estimated present value of the company. Moreover, Volkswagen (VW) exhibits a notably low price-to-book ratio compared to its industry counterparts, as illustrated in Table 4. This discrepancy is primarily influenced by factors such as free cash flow (FCF), debt ratio, and other financial metrics sourced from the company's financial statements, culminating in a negative equity value. Nevertheless, employing the APV method with a target debt ratio helps rectify this anomaly by aligning total equity with the specified debt ratio.

In terms of revenue and market capitalization comparisons with peer companies, VW's market cap appears notably lower than that of Stellantis, BMW, and Mercedes Benz. However, considering net incomes and market caps collectively, Volkswagen and its peers exhibit closer alignment in their financial metrics.

Company	Revenue	Net Income	Price/Book	Price/EPS	Market Cap
Volkswagen	€ 279,232	€ 15,443	0.35	3.99	€ 58,128
Porsche AG	€ 37,630	€ 4,950	3.90	13.84	€ 36,395
Stellantis	€ 179,592	€ 16,799	0.78	3.53	€ 66,944
BMW AG	€ 142,610	€ 17,941	0.71	5.50	€ 63,865
Mercedes B.	€ 150,017	€ 14,501	0.73	4.85	€ 66,918

Table 4. VW Peer Company Comparison, (revenue, net income, market cap in millions)

Volkswagen's NOx Emission Scandal

The depicted in Figure 2, Volkswagen faces a difficult market landscape due to the burgeoning presence of electric vehicle enterprises. Particularly noteworthy is the enduring impact of the NOx emission controversy in 2015, which may have affected the company's trajectory over subsequent years. This scandal led to substantial penalties and fines for Volkswagen, causing a significant erosion in its market value. As a consequence, the company's price-to-book ratios may have suffered, partly due to the lingering effects of the scandal, which contributed to a low market capitalization.

Merton Model

Merton model is constructed using unlevered cost of capital of 0.078, cost of debt of 0.048 and cost of equity of 0.122. The model outputs d1 of 0.651 and d2 of -0.160, representing the equity position of N(d1) as 0.743 units of the asset value long and N(d2) as 0.437 units of zero bonds with face value F short. Conversely, the debt position corresponds to N(-d1), with 0.257 units of the asset value long, and N(d2), with 0.437 units of zero bonds with face value F long. Consequently, the firm's replication can be achieved by scaling these factors, resulting in S0 and D0 values of €153,579.53 million and €229,933.47 million respectively.

To obtain these outcomes, the second approach was employed, wherein the firm value (V0) is normalized to 100, and D0 and S0 are determined based on a debt ratio of 60%. Additionally, F is set at 100, while T is initially taken as 5.42 years. The input for stock return volatility (σS) is derived as 0.34, utilizing the last five years of stock return data.

To get these results, the second approach was used. The firm value (V_0) is normalized to 100. D_0 and S_0 are set by the debt ratio, 60%. F is taken as 100 and T as 5.42 years initially. Stock return volatility (σ_S) is inputted as 0.34 obtained using the last 5 years of stock return data.

Sensitivity Analysis

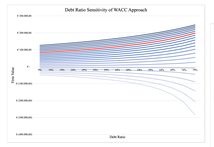

Figure 4. Debt Ratio Sensitivity of WACC Approach

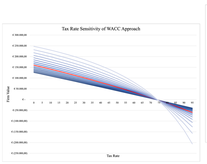

Figure 5. Tax Rate Sensitivity of WACC Approach

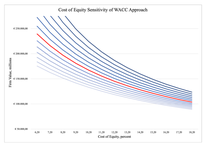

Figure 6. Cost of Equity Sensitivity of WACC Approach

In Figure 4, the debt ratio is plotted on the x-axis with iso-tax-rate curves, whereas in Figure 5, this relationship is reversed. The red curve in Figure 4 signifies the scenario with actual parameters in the iso-curves. Notably, an increase in the debt ratio amplifies the firm value, with subsequent increments having a disproportionate impact due to the convex nature of the line. As the blue curves get whiter, tax rate increases, so the firm value, too. Although, a higher tax rate exceeding 75% results in a negative firm value, albeit being an extreme and unrealistic scenario.

In Figure 5, the red curve illustrates the impact of the tax rate on firm value, demonstrating a near-linear decrease as the tax rate increases. However, this linear trend is disrupted by changes in the debt ratio. With higher leverage (lighter blue curves), an elevated tax rate leads to greater losses in firm value, highlighting the risk-increasing effect of higher leverage.

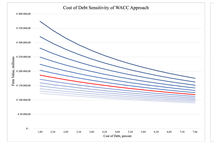

Figure 7. Cost of Debt Sensitivity of WACC Approach

Figure 8. Long Term Growth Rate Sensitivity of WACC Approach

Figure 9. Fixed Asset and Sales Growth Sensitivity of WACC Approach

Moving to Figures 6 and 7, these depict sensitivity analyses of the cost of debt and equity with respect to firm value. A darker blue curve has a lower cost of debt in Figure 6 and a lower cost of equity in Figure 7. In Figure 6, the negative effect of the cost of equity on firm value is evident, particularly pronounced for lower values. Increasing it 100 basis points, leads to € 9 billion decrease in the firm value. Regarding Figure 7, an 100 basis point increase in the cost of debt results € 5 billion decrease in the firm value.

Figure 8 focuses on the long-term perspective, with darker blue lines representing higher starting values of the long-term FCF. The red curve reflects the actual value of €9,730 million. Assuming no growth, the firm value stabilizes at €104 billion. However, changing the long-term growth rate to 2.5%, creates € 51.15 billion increase in the firm value.

Figure 9 reflects the sensitivity of empirically calculated parameters of WACC approach which are fixed asset and sales growth rate. Those parameters have an effect on the FCF forecasting. Increasing sales growth rate by 100 basis points affects the firm value by € 5.60 billion. Furthermore, increasing the fixed asset growth rate by 100 basis points, causes a huge loss in the firm value by € 45.70 billion. Obviously, investing in the fixed assets, such as factories, land, machinery decreases the firm's FCF, also, decreases the overall firm value. Rather than investing in the current asset, working on new projects and increasing efficiency of the firm can be a better strategy considering the firm's low profit margin than its peers.