

Introduction to DCF Valuation and Cost of Capital Estimation

A Primer on DCF Valuation and Exploring the Cost of Capital Section of the Model

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- 2 Enterprise and Equity Value
- 3 Cost of Equity Estimation
- 4 Cost of Debt Estimation
- 5 Putting it All Together: Calculating the WACC

What is a DCF?

- A **discounted cash flow valuation (DCF)** is a method of determining the value of a stock.
- Other ways include the dividend discount model and approaches based on comparables
- The dividend discount model only works well for stable companies that pay dividends with constant growth.
- Comparable approaches can give a rough idea of a valuation but never take into account the specifics of the company
- DCF valuation can be applied to any company and is based on the particulars of the company

The DCF in One Picture



Motivating the DCF

Financial Asset Value

$$V = \sum_{t=0}^T \frac{CF^t}{(1+r)^t} \quad (1)$$

- The value of any financial asset is the present value of its future cash flows
- The cash flows for a stock are dividends. The dividend discount model takes the present value of future dividends.
- To find the value of a business, find the present value of its future free cash flows

Overview of Cost of Capital Estimation

- The goal of cost of capital estimation is to determine the **weighted average cost of capital (WACC)**
- This can broadly be broken down into two components: estimating the cost of equity and estimating the cost of debt
- Cost of equity is typically estimated using the Capital Asset Pricing Model (CAPM)
- Cost of debt is usually estimated from the interest payments and book value of debt



Overview of Free Cash Flow Estimation

- The goal of free cash flow estimation is to determine the historical and future free cash flows (FCF) for the company.
- Historical financial statements, including the income statement, balance sheet, and statement of cash flows are used to determine historical FCF
- It is the job of the analyst building the model to project those FCF into the future
- This is usually done by projecting the financial statements into the future

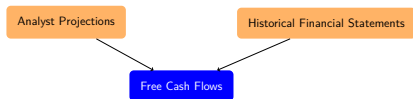


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Enterprise Value vs. Equity Value

- The enterprise value of the business is the asset value or the cost to purchase the entire company
- $\text{Enterprise Value} = \text{Equity Value} + \text{Debt Value} - \text{Cash}$
- A stock represents only the equity value or market capitalization of a business
- By determining the enterprise value, we can back into the equity value to get the stock price

Enterprise and Equity Value Lab, Level 1

Finding Enterprise and Equity Value Given FCF and WACC, Level 1

- 1 You are the CFO for a startup developing artificial intelligence technologies. There will be an initial research phase before making any money. Google is watching your development and will purchase the company after it is profitable.
- 2 For the first two years (years 0 and 1), the company loses \$20 million. Then there is one breakeven year, after which the profit is \$10 million for year 3. Finally in year 4, Google purchases the company for \$70 million.
- 3 The WACC for the company is 15% and it has 1 million shares outstanding. The company has \$5 million in debt and \$1 million in cash.
- 4 What is the enterprise value of the stock at year 5? What about the enterprise value today? What is the price of the stock today?

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Answers 1: Slide [34](#)

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How Can CAPM be used for Estimating the Cost of Equity?

Capital Asset Pricing Model (CAPM)

$$r_i = r_f + \beta(r_m - r_f) + \epsilon \quad (2)$$

- r_i : Return on stock i
 - r_f : Return on risk free asset
 - r_m : Return on market portfolio
 - β : Covariance of stock returns with market risk premium
 - ϵ : Idiosyncratic return, mean 0
-
- We will use historical stock price data along with CAPM to produce an estimate of the cost of equity.
 - Ultimately, r_i is the estimate of the cost of equity

Overview of Cost of Equity Estimation

Capital Asset Pricing Model (CAPM)

$$r_i = r_f + \beta(r_m - r_f) + \epsilon$$

- The three returns can all be estimated from historical data. Therefore β and ϵ are the unknowns. But ϵ has mean zero so we can ignore it for estimation.
- We will estimate the historical beta, then assume that the beta is still valid today to come up with the current r_i as the cost of equity.
- β can be estimated by regressing the historical stock returns of the company on the historical market risk premiums. The β is then the coefficient of the market risk premium in the regression.

Using Price Data to Estimate Cost of Equity in Python

Python CAPM Estimation

- Go to Canvas and download "Determining the Cost of Equity.ipynb" and "price data.xlsx" from Examples > DCF > Cost of Equity > Python
- Make sure that you place these two in the same folder
- We are using historical prices to calculate the cost of equity using CAPM
- We will use a risk free rate of 3% for the exercise

Using Price Data to Estimate Cost of Equity in Excel

Excel CAPM Estimation

- Go to Canvas and download "DCF Cost of Equity.xlsx" from Examples > DCF > Cost of Equity > Excel
- We are using historical prices to calculate the cost of equity using CAPM
- We will use a risk free rate of 3% for the exercise

DCF Cost of Equity Lab

Finding Cost of Equity Given Historical Prices

- 1 Download "prices.xlsx" from the course site
- 2 Assume the risk free rate is 2%
- 3 What is the beta and the cost of equity for this company?
- 4 If you thought there was going to be a recession, such that the average market return would be 3% lower, then what would you expect the cost of equity to be?
- 5 Complete this exercise with the tool of your choice.

Answers: Slide [37](#)

Resources: Slide [38](#)

Market Value of Equity

- As we will cover in more detail when we get to WACC, we need to have the market values of both equity and debt along with the costs to be able to calculate the WACC.
- The market value of equity for a publicly traded company is straightforward. Just calculate the **market capitalization** as the number of shares outstanding multiplied by the current share price.
- The market capitalization can be used directly as the market value of equity.

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Overview of Estimating the Cost of Debt

- We want to estimate the cost of debt for the company, which more specifically should be the marginal interest cost of raising one additional dollar via debt.
- There are two general approaches to estimating this: the financial statements approach and the market value of bonds approach
- The market value of bonds approach is better able to capture the current rate when it has changed substantially over time, but it requires price, coupon, and maturity information on a bond.
- The financial statements approach uses only the income statement and balance sheet, and represents a weighted average historical cost of debt.

The Financial Statements Approach to Cost of Debt

- The financial statements approach uses interest expense from the income statement and total debt from the balance sheet to estimate the cost of debt
- With this approach, we can estimate the cost of debt by a very simple formula
- $$r_d = \frac{\text{Interest Expense}}{\text{Total Debt}}$$
- Calculate this for the most recent data available and use this as the cost of debt

The Market Value of Bonds Approach to Cost of Debt

- The cost of debt is about raising new debt, so it is more accurate to look at the market to determine how much the company would have to pay for new debt.
- The yield to maturity (YTM) of the company's bonds can be calculated. A weighted average of the YTMs can be used as an estimate of the cost of debt.
- The YTM is representing the required rate of return on the bond for the investor, which is equivalent to the cost of the bond for the company
- The YTM is simply the IRR of the bond, considering the current market price of the bond

After-Tax Cost of Debt

- Debt has an interesting feature in our tax system: debt is tax deductible.
- The amount a company has to pay in income tax is taken as a percentage of earnings before tax (EBT).
- As interest is taken out while calculating EBT, it lowers the tax payment.
- Think about two hypothetical companies with the exact same operations, revenues, costs, etc. One is financed completely with equity and the other with 50% debt. They will both have the same EBIT but the EBT will be lower for the debt firm and so the taxes will be lower for the debt firm, likely giving the debt firm a higher value than the equity firm.
- What this means for cost of capital estimation is that all our calculations will be based on pre-tax numbers, then we multiply by $(1 - \text{tax rate})$ to get the after-tax cost of debt to use in the WACC.

DCF Cost of Debt Lab, Level 1

Finding Cost of Debt Given Financial and Market Info, Level 1

- 1 A chemical manufacturer has a 7.0% coupon, annual pay 1000 par value bond outstanding, priced at \$1042.12 on 2020-10-27.
- 2 If the bond matures on 2023-10-27, what is the cost of debt for this company? The tax rate is 35%.

Level 2: Slide [39](#)

Answers 1: Slide [40](#)

Resources: Slide [42](#)

What is the Market Value of Debt?

- If you have taken the debt course, you should be familiar with the fact that bonds' values change over time.
- The value of a bond can be determined (just like any financial asset) by taking the present value of future cash flows (here, interest and principal payments).
- If the discount rate for the company changes, the value of the bonds change, as the interest payments are contracted and will remain the same
- The discount rate will change when the riskiness of the firm's debt changes, e.g. taking on additional debt, starting a new project, having a bad operating year, etc.

Why Should we Care about the Market Value of Debt?

- Say a company issues a 3-year bond with a 10% coupon. When issued, the riskiness of the firm implies it should have a 10% discount rate. In other words, the true cost of debt is 10%. The bond is at par (value 1,000).
- One year later, the firm has a bad year, and now lenders are requiring a 15% rate to lend to the company
- Due to this, the price of the existing bond has dropped to \$918.71.
- If we calculate the IRR on this \$918.71 bond, it comes to 15%, which is the true YTM or cost of debt
- The coupon rate on the bond is still 10%, and the book value of debt on the balance sheet is still 1,000 so based on the financial statements approach the cost of debt would still be 10%.

Approaches to Calculating the Market Value of Debt

- There are three main approaches to calculating the market value of debt for use in the WACC calculation, depending on what data you have available
- If all you have is financial statements, you must just assume the book value of debt equals the market value of debt.
- If you also have an estimate of the current cost of debt obtained from the market as well as an average maturity of debt, you can use the hypothetical bond approach.
- Finally, if you have all the individual debt instruments, you can calculate the market value of individual instruments.

Calculating the Market Value of Debt

MV Debt Example

- Go to Canvas and download "Market Value of Debt.ipynb" and "debt data.xlsx" from Examples > DCF > Cost of Debt
- Ensure you have the Jupyter notebook and the Excel spreadsheet in the same folder.
- We will go through the Jupyter notebook to show the three approaches to estimating the market value of debt.

Dealing with Seniority of Debt

- For the purposes of this class, we won't deal with seniority. But you should keep it in mind in the future when estimating the market value of debt.
- Seniority represents the payoff order during bankruptcy. The most senior loans will be paid first, and if there is still money left over, then the more junior loans will be paid.
- As there is a higher expected value in recovery, senior loans are less risky and so should have a lower rate associated with them.
- In the prior exercise, when valuing individual debt instruments, we assumed a single cost of debt, when in reality, it should be adjusted for the seniority.

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Calculating WACC

Weighted Average Cost of Capital (WACC)

$$\text{WACC} = r_e w_e + r_d(1 - t)w_d \quad (3)$$

- r_e : Cost of equity
 - w_e : Weight of equity
 - r_d : Pre-tax cost of debt
 - t : Tax rate
 - w_d : Weight of debt
-
- So now from the prior sections we have the cost of equity, market value of equity, cost of debt, and market value of debt.
 - The weights of debt and equity are found by dividing that market value by the sum of both market values.

What the Weighted Part of WACC Means



Lecture Resources

Lecture Resources

- ① [Slides - Introduction to DCF Valuation and Cost of Capital Estimation](#)
- ② [Lecture Notes - Introduction to DCF Valuation and Cost of Capital Estimation](#)
- ③ [Cost of Equity - Python](#)
- ④ [Price Data](#)
- ⑤ [Cost of Equity - Excel](#)
- ⑥ [Debt Data](#)
- ⑦ [Market Value of Debt](#)

Enterprise and Equity Value Lab, Level 2

Finding Enterprise and Equity Value Given FCF and WACC, Level 2

- ① A pharmaceutical company developed a new drug and has 4 years to sell it before the patent expires. It forms a new company to manufacture and sell the drug. After 4 years, the company will be sold to someone that wants to continue manufacturing at the lower price. The company is just about to pay a dividend.
- ② The new company pays a dividend of \$1 per share each year for years 0 to 3, before selling it for \$30 million in year 4.
- ③ There are 10 million shares outstanding, \$10 million of debt and \$1 million of cash throughout the life of the company. The WACC is 10% today.
- ④ What is the enterprise value at year 5 and today? What is the price of the stock today?

Level 1: Slide [10](#)

Answers 2: Slide [35](#)

Resources: Slide [36](#)

Enterprise and Equity Value Lab, Answers for Level 1

Finding Enterprise and Equity Value Given FCF and WACC, Answers for Level 1

- ① The enterprise value at year 5 is \$70 million
- ② The enterprise value at year 0 is \$9.2 million
- ③ The equity value at year 0 is \$5.21 million so the share price is \$5.21

Level 1: Slide [10](#)

Level 2: Slide [33](#)

Resources: Slide [36](#)

Enterprise and Equity Value Lab, Answers for Level 2

Finding Enterprise and Equity Value Given FCF and WACC, Answers for Level 2

- 1 The enterprise value at year 5 is \$30 million
- 2 The equity value at year 0 is \$49.2 million so the share price is \$4.92
- 3 The enterprise value at year 0 is \$58.2 million

Level 1: Slide [10](#)

Level 2: Slide [33](#)

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Enterprise and Equity Value Lab Resources

Finding Enterprise and Equity Value Given FCF and WACC Resources

① [Slides - Introduction to DCF Valuation and Cost of Capital Estimation](#)

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Level 2: Slide [33](#)

Answers 1: Slide [34](#)

Answers 2: Slide [35](#)

DCF Cost of Equity Lab, Answers

Finding Cost of Equity Given Historical Prices, Answers

- ① The beta is 0.848
- ② The cost of equity is 6.53%
- ③ The cost of equity in the recession is 3.98%

Exercise: Slide [16](#)

Resources: Slide [38](#)

DCF Cost of Equity Lab Resources

Finding Cost of Equity Given Historical Prices Resources

- ① [Slides - Introduction to DCF Valuation and Cost of Capital Estimation](#)
- ② [Prices](#)

Exercise: Slide [16](#)

Answers: Slide [37](#)

DCF Cost of Debt Lab, Level 2

Finding Cost of Debt Given Financial and Market Info, Level 2

- 1 Go to <https://stockrow.com> and search for WMT to get Walmart's financials. Calculate the cost of debt for 2019-07-31 using the financial statements approach. Note that you will also need to determine the effective tax rate using actual tax paid and EBT.

Level 1: Slide [23](#)

Answers 2: Slide [41](#)

Resources: Slide [42](#)

DCF Cost of Debt Lab, Answers for Level 1

Finding Cost of Debt Given Financial and Market Info, Answers for Level 1

- 1 The pre-tax cost of debt for the chemical manufacturer is 5.44%
- 2 The after-tax cost of debt for the chemical manufacturer is 3.54%

Level 1: Slide [23](#)

Level 2: Slide [39](#)

Resources: Slide [42](#)

DCF Cost of Debt Lab, Answers for Level 2

Finding Cost of Debt Given Financial and Market Info, Answers for Level 2

- 1 The pre-tax cost of debt for Walmart in 2019-07-31 is 0.86%
- 2 The after-tax cost of debt for Walmart in 2019-07-31 is 0.64%

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Level 2: Slide [39](#)

Resources: Slide [42](#)

DCF Cost of Debt Lab Resources

Finding Cost of Debt Given Financial and Market Info Resources

① [Slides - Introduction to DCF Valuation and Cost of Capital Estimation](#)

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Answers 2: Slide [41](#)

Answers 1: Slide [40](#)