

# Investment and Financial Management

## Lecture Notes

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February 5, 2023

# 1 Introduction & Financial Analysis

**Corporate Finance:** Identifying profitable investment projects + Determining optimal financing + Liquidity planning => Maximizing firm / enterprise value

## 2 Financial Analysis

### 2.1 Firms's disclosure of financial information

**Purpose of financial statements:**

1. Firm-issued accounting reports with past performance info
2. Reliable source of info for shareholders and stakeholders<sup>1</sup> of the firm
3. Filed with relevant listing authority
4. Preparation under certain rules and standards (GAAP, IFRS)

**Main types of financial statements:**

1. Balance sheet / statement of financial position
2. Income Statement
3. Statement of cash flows
4. Statement of changes in shareholders' equity

### 2.2 Balance sheet / statement of financial position

**Balance sheet / financial position:** snapshot of firm's financial position (assets, liabilities, shareholder's equity) at a given point in time

**Balance sheet equation:** Two sides must be equal:  $Assets = Liabilities + Shareholder's Equity$

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<sup>1</sup>A **shareholder** is someone who owns stock in your company, while a **stakeholder** (*example: supplier, government*) focuses on the company's overall performance, how it treats customers, partners, and employees, and how it impacts the community, among other things.

| Balance Sheet                |                       |  |                       |                            |  |
|------------------------------|-----------------------|--|-----------------------|----------------------------|--|
| Assets                       |                       |  | Liabilities           |                            |  |
| Current Assets<br><12 months | Cash & Equivalents    | Cash, T-Bills<br><3 Month Maturity             | Current Liabilities   | Short-Term Debt            | Debt that is due<br><1 Year                                  |
|                              | Marketable Securities | Equity, Debt<br>(Liquid Financial Instruments) |                       | Payables                   | Interest, Wages,<br>Dividends, Taxes,<br>Accrued Liabilities |
|                              | Accounts Receivable   | Outstanding Payments<br>by customers           | Long-Term Liabilities | Long-Term Debt             | Interest &<br>Principal on Bonds<br>>1 Year                  |
|                              | Inventory             | Produced Goods ready<br>for sale               |                       | Deferred Taxes             | Taxes due >1 Year  |
|                              | Prepaid Expenses      | Rent, Insurance<br>Advanced Payments           |                       | Pension Liabilities        | Employee<br>Retirement                                       |
| Long-Term Assets             | Long Term Investments | Illiquid Securities<br><1 Year                 | Shareholder Equity    | Retained Earnings          | Profits kept by the<br>Company                               |
|                              | Fixed Assets          | Land, Machinery,<br>Equipment, Buildings       |                       | Treasury Stock             | Repurchased Stock  |
|                              | Intangible Assets     | Brands, Goodwill,<br>Patents, Trademarks       |                       | Additional Paid-In Capital | Shareholder<br>Investments beyond<br>par value price         |

### The Accounting Equation

$$\text{Assets} = \text{Liabilities} + \text{Shareholder's Equity}$$

- **Assets:** what the company owns
- **Liabilities:** what the company owes (debts, taxes etc.)
- **Shareholder's Equity:** difference between assets and liabilities
- **Assets**
  - **Current Assests:** cash or expected to be turned into cash in the next year (not all operational!) (*cash, marketable securities, accounts receivable, inventories*)
  - **Non-current Assets (Fixed assets):** assets for long-term use (operational, more than one year) (*net property, plant, equipment(PPE), goodwill and intangible assets*)
- **Liabilities**
  - **Current Liabilities:** due to be paid within one year (*accounts payable, short-term debt / notes payable, current maturities of non-current (long term) debt, taxes payable, wages payable*)
  - **Net working capital (NWC):**

$$NWC = \text{Current Assets} - \text{Current Liabilities}$$

- **Non-current Liabilities:** to be paid beyond one year (*long-term debt, capital leases, deferred taxes*)
- **Shareholder's Equity: Book value vs. Market value<sup>2</sup>**

<sup>2</sup>**Book value** is the net value of a firm's assets found on its balance sheet. **Market value** is the company's worth based on the total value of its outstanding shares in the market, which is its market capitalization.

- **Book value of equity:**

$$\text{Book value of equity} = \text{Book value of assets} - \text{Book value of liabilities}$$

- \* Could be negative
- \* Many of the valuable assets may not be captured on the balance sheet

- **Market value of equity (= Market capitalization, market cap):**

$$\text{Market value of equity} = \text{Market price per share} * \text{No. of shares outstanding}$$

- \* Cannot be negative
- \* Often differs substantially from book value

- **Market-to-book (M/B) ratio (= Price-to-book (P/B) ratio):**

$$M/B \text{ ratio} = \frac{\text{Market value of equity}}{\text{Book value of equity}}$$

- \* Successful firms have M/B ratio higher than 1
- \* Value Stocks<sup>3</sup>: Low M/B ratios
- \* Growth stocks<sup>4</sup>: High M/B ratios

- **Enterprise value (EV) (= Total enterprise value (TEV))**

- Value of firm's underlying business operations / assets
- Enterprise value  $\neq$  Equity value

$$\text{Enterprise value} = \text{Market value of equity} + \underbrace{\text{Debt} - \text{Cash}}_{\text{Net debt}}$$

- \* *Net debt = Total debt – Cash & short-term investments subs*

## 2.3 Income statement

**Income statement:** record of a firm's revenue, expense, and profit over a given period of time

<sup>3</sup>A **value stock** is trading at levels that are perceived to be below its fundamentals.

<sup>4</sup>A **growth stock** is any share in a company that is anticipated to grow at a rate significantly above the average growth for the market (*example: TSLA*).

| Income statement of firm XY                          |  |
|--|--|
| Revenue / total sales                                |  |
| – Cost of sales / cost of goods sold (COGS)          |  |
| <b>= Gross profit</b>                                |  |
| – Operating expenses:                                |  |
| • Selling, general and administrative expenses (SGA) |  |
| • Depreciation and amortization expense (D&A)        |  |
| <b>= Operating income</b>                            |  |
| + / – Other income / expenses                        |  |
| <b>= Earnings before interest and taxes (EBIT)</b>   |  |
| + / – Interest income / expenses                     |  |
| <b>= Pre-tax income</b>                              |  |
| – Tax  |  |
| <b>= Net income</b>                                  |  |

- **Net Income = Total earnings of the firm's equity holders**
  - **Earnings per share (EPS):** how much money a company makes for each share of its stock

$$EPS = \frac{Net\ income}{Shares\ outstanding}$$

- **Diluted earnings per share (Diluted EPS):**<sup>5</sup> Future EPS could be diluted by in-the-money share (stock) options, convertible bonds or warrants. The diluted EPS takes these potential effects into account.

## 2.4 Statement of cash flows

- Record of sources and uses of the firm's cash over a given period of time
  - Sources of cash: activity that brings cash into firm (*example: sales*)
  - Uses of cash: causes cash to leave firm (*example: dividend payments*<sup>6</sup>)
- Derived from firm's income statement and changes in balance sheet
- Consists of:
  - Cash flows from **operating**, **investing** and **financing** activities

<sup>5</sup>**Dilution** occurs when a company issues new shares that result in a decrease in existing stockholders' ownership percentage of that company.

<sup>6</sup>A **dividend** is the distribution of a company's earnings to its shareholders and is determined by the company's board of directors.

## 2.5 Financial statement analysis

- **Financial ratios**

- Are used to:
  - \* Compare firm with itself over time
  - \* Compare firm to other similar firms
- Key financial ratios measure a firm's:
  - \* Profitability
  - \* Liquidity
  - \* Working Capital
  - \* Interest Covarage
  - \* Leverage (Gearing)
  - \* Valuation
  - \* Operating Returns

- **Profitability ratios**

- Measures of a firm's ability to generate profits as a percentage of the sales generated (margin ratios; margin = portion of sales that is a profit)
- Four levels of profitability ratios (resulting from income statement)

1.

$$\text{Gross margin} = \frac{\text{Gross profit}}{\text{Sales}}$$

2.

$$\text{Operating margin} = \frac{\text{Operating income}}{\text{Sales}}$$

3.

$$\text{EBIT margin} = \frac{\text{EBIT}}{\text{Sales}}$$

4.

$$\text{Net profit margin} = \frac{\text{Net income}}{\text{Sales}}$$

- **Liquidity ratios**

- Measures of a firm's ability to meet short-term debt obligations
- Help to assess firm's liquidity / financial solvency info of balance sheet / statement of financial position

1.

$$\text{Current ratio} = \frac{\text{Current assets}}{\text{Current liabilities}}$$

2.

$$\text{Quick ratio} = \frac{\text{Cash} + \text{Short-term investm.} + \text{Accounts receivables}}{\text{Current liabilities}}$$

3.

$$\text{Cash ratio} = \frac{\text{Cash}}{\text{Current liabilities}}$$

- **Interest coverage ratios**

- Measures of a firm's ability to meet its interest payments by comparing its earnings with its interest expenses
- Higher ratio = firm is earning much more than necessary to meet its obligations

1.

$$\text{EBIT/Interest coverage} = \frac{\text{EBIT}}{\text{Interest expense}}$$

2.

$$\text{EBITDA/Interest coverage} = \frac{\text{EBIT} + \text{Depreciation/Amortization}^7}{\text{Interest expense}}$$

- **Leverage / gearing ratios**

- Measures of a firm's reliance on debt as a source of financing
- Leverage ratios can be measured using book or market values!
- Important and common ratios:

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<sup>7</sup>**Amortization** is the method that is used to decrease the cost of the asset over time, while **depreciation** is the loss in value of the asset over time. Both of them are methods of calculating the value for business assets over time.

1.

$$\text{Debt-equity ratio} = \frac{\text{Total debt}}{\text{Total equity}}$$

2.

$$\text{Debt-to-capital ratio} = \frac{\text{Total debt}}{\text{Total equity} + \text{Total debt}}$$

3.

$$\text{Debt-to-EV ratio} = \frac{\text{Net debt}}{\text{Market value} + \text{Net debt}}$$

4.

$$\text{Equity multiplier} = \frac{\text{Total assets}}{\text{Book value of equity}}$$

- **Valuation ratios**

- Measures to help investors assess market value of a firm
- These ratios are intended to make intra-industry comparisons of firm valuations.

1.

$$\begin{aligned} \text{Price-to-earnings (P/E) ratio} &= \frac{\text{Market capitalization}}{\text{Net income}} \\ &= \frac{\text{Share price}}{\text{Earnings per share}} \end{aligned}$$

2.

$$\text{EV to EBIT} = \frac{\text{Market value of equity} + \text{Debt} - \text{Cash}}{\text{EBIT}}$$

3.

$$\text{EV to Sales} = \frac{\text{Market value of equity} + \text{Debt} - \text{Cash}}{\text{Sales}}$$

- **Operating returns / investment returns**

- Measures of a firm's returns on investment



- Compare its income to its investment using financial information from balance sheet / statement of financial position

1.

$$\text{Return on equity (ROE)} = \frac{\text{Net income}}{\text{Book value of equity}}$$

2.

$$\text{Return on assets (ROA)} = \frac{\text{Net income} + \text{Interest expense}}{\text{Total assets}}$$

3.

$$\text{Return on invested capital (ROIC)} = \frac{\text{EBIT} * (1 - \text{Tax rate})}{\text{Book value of equity} + \text{Net debt}}$$

4.

$$\text{Asset turnover} = \frac{\text{Sales}}{\text{Total assets}}$$

- **DuPont identity**

- DuPont identity further decomposes return on equity (ROE) into three components:

- \* Profitability (= Net profit margin)
- \* Asset efficiency (= Asset turnover)
- \* Leverage (= Equity multiplier)

$$\text{ROE} = \underbrace{\left(\frac{\text{Net income}}{\text{Sales}}\right)}_{\text{Net profit margin}} * \underbrace{\left(\frac{\text{Sales}}{\text{Total assets}}\right)}_{\text{Asset turnover}} * \underbrace{\left(\frac{\text{Total assets}}{\text{Book value of equity}}\right)}_{\text{Equity multiplier}}$$

### 3 Investment Analysis

#### 3.1 Net present value (NPV)

- **NPV (of a project or investment):** difference between present value of its benefits (cash inflow) and present value of its costs (cash outflow)

$$\text{NPV} = \text{PV}(\text{Benefits}) - \text{PV}(\text{Costs}) = \text{PV}(\text{All project cash flows})$$

$$NPV = \sum_{t=0}^T \frac{CF_t}{(1+r)^t}$$

With:

- NPV = Net present value, PV = Present Value,  $CF_t$  = cash flow in period t, r = Appropriate discount rate

- **NPV rule:**

- **NPV decision rule:** When making an investment decision, take the alternative with the highest NPV.
- **Accepting or rejecting a project:**
  - \* Accept, if positive NPV, expected profit => equivalent to receiving its NPV cash today
  - \* Reject, if negative NPV, expected net loss => would reduce the wealth of investors
- **Alternative rules versus NPV rule:**
  - \* Sometimes alternative investment rules give the same answer as the NPV rule, but at other times they disagree. If rules conflict, follow NPV decision rule.
  - \* Equivalent rules: Economic value added (EVA), Annuity-rule

### 3.2 Internal rate of return (IRR)

- **IRR:** discount rate that makes NPV equal to zero (at which  $PV(\text{Costs}) = PV(\text{Benefits})$ )

$$NPV = \sum_{t=0}^N \frac{CF_t}{(1+IRR)^t} = 0$$

With:

- NPV = Net present value,  $CF_t$  = cash flow in period t, IRR = Internal rate of return

- **IRR rule:**

- **IRR investment rule:**
  - \* Take any investment, if its IRR exceeds cost of capital<sup>8</sup>

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<sup>8</sup>Cost of capital is the minimum rate of return or profit a company must earn before generating value (e.g. undertaking a project, such as building new factory).

- \* Turn any down investment, if its IRR is less than cost of capital
- **Application of IRR rule: IRR vs. NPV**
  - \* IRR rule works for a stand-alone project if all of the project's **negative cash flows**<sup>9</sup> precede **positive cash flows**<sup>10</sup>. In other cases, IRR rule may disagree with NPV rule thus be incorrect!
  - Example: If market conditions change over the years, project A can have multiple IRRs. Thus, IRR cannot be used. Instead, use NPV for comparison of projects.*
- **Pitfalls of IRR rule:** Situations where IRR and NPV rules may conflict:
  1. Delayed investments
  2. Multiple IRRs
  3. Nonexistent IRR
- **IRR vs. IRR rule:**
  - While IRR rule has shortcomings for making investment decisions, IRR itself remains useful.
  - **But:**
    - \* IRR measures average return of investment => exact measure for average ROIC of a project over its lifetime.
    - \* IRR can be used to check the sensitivity of NPV to any estimation error in the cost capital.
- **Mutually exclusive projects:**
  - When you must choose only one project among several possible projects, the choice is mutually exclusive<sup>11</sup>.
    - \* **NPV rule:** Select the project with highest NPV.
    - \* **IRR rule:** Selecting the project with the highest IRR may lead to mistakes.
- **IRR rule and mutually exclusive investment with project ranking with different scales:**
  - If a project's size is doubled, its NPV will double. This is not the case with IRR. Thus, IRR rule cannot be used to compare projects of different scales.
- **Project ranking with timing of cash flows:**

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<sup>9</sup>outgoing > incoming

<sup>10</sup>outgoing < incoming

<sup>11</sup>If two or more events are **mutually exclusive**, they cannot happen simultaneously.

- Problem with IRR: it can be affected by changing the timing of cash flows, even when the scale is the same.
- IRR is a return, but the dollar value of earning a given return depends on how long the return is earned.
- *Example: A project with lower IRR can have a much higher NPV due to its higher growth rate.*
- **Project ranking with differences in risk:**
  - An IRR, that is attractive for a safe project, need not to be attractive for a riskier project.
  - *Example: IRR of a project is higher than those of the other investment opportunities, yet has the lowest NPV.*
  - Higher cost of capital (e.g. due to size of the project) = Higher IRR

### 3.3 Other methods

- **Payback method:**
  - **Payback period:** amount of time it takes to recover or pay back the initial investment (initial cash outflow).
  - **Payback rule:** Accept project, if payback period is less than a pre-specified length of time. Otherwise reject.
  - **Applicability of payback rule:** Payback rule is used by many companies due to its simplicity. Maybe, firms often care more about the liquidity drain of a project rather than its profitability.
  - **Shortcomings of the payback rule:**
    - \* Ignores the project's cost of capital and time value of money <sup>12</sup>
    - \* Ignores cash flows after the payback period
    - \* Relies on an ad hoc decision criterion
- **Probability index (PI):** PI can be used to identify the optimal combination of projects to undertake. Companies use it for evaluation of projects with different resource constraints.

$$Profitability\ index = \frac{Value\ created}{Resource\ consumed} = \frac{NPV}{Resource\ consumed}$$

- **PI rule:** When choosing among projects competing for the same resource, pick the set of projects with the highest PIs that can still be undertaken given the limited resource.

<sup>12</sup>**Time value of money** means that a sum of money is worth more now than the same sum of money in the future. It can grow only through investing so a delayed investment is a lost opportunity.

- **Shortcomings of PI:**

- It does not take into account the size of the project, so it is not accurate in some cases.
- *Example: A large project with lower profit margins may have a lower profitability index than a smaller project with higher profit margins.*
- Different combinations must be enumerated in order to find out NPV maximizing combination.
- With multiple resource constraints, PI can break down completely.

## 4 Capital Budgeting

**Capital Budgeting:** A planning process used by a firm to determine if major projects or investments are worth the funding of cash capitalization structures (debt, equity or retained earnings)

### 4.1 Determining free cash flow (FCF) and NPV

- **FCF:** It is the cash a company generates after taking into consideration cash outflows that support its operations and maintain its capital assets. Thus, it is firm's extra cash after its operating expenses and other areas.
- **Methods of calculation of free cash flow:**
  - Direct calculation
  - Calculation from earnings
- **Two forms of free cash flow:**
  - **Free cash flow to the firm (FCFF):** FCF available to all providers of a firm's capital, including bondholders, shareholders and common stockholders.
  - **Free cash flow to the equity (FCFE):** FCF available to a firm's common (equity) stockholders
- **Direct calculation of FCF:**

$$FCF = \overbrace{(Revenue - Cost - Depreciation)}^{\text{Unlevered net income}} * (1 - t_C) + Depreciation - CapEx - \Delta NWC$$

$$FCF = (Revenue - Cost) * (1 - t_C) - CapEx - \Delta NWC + t_C * Depreciation$$

With:

- FCF = Free cash flow,  $t_C$  = Corporate tax rate,  $t_C$  \* Depreciation tax shield, CapEx = Capital expenditures, NWC = Net working capital

- **Calculation of FCF from earnings:**

| Free cash flow of firm XY                           |
|---|
| Earnings before interest and taxes (EBIT)           |
| – Adjusted tax expense                              |
| + Depreciation                                      |
| + / – Change in net operating working capital       |
| <b>= Cash flow from operations</b>                  |
| + Cash flow from investments (capital expenditures) |
| <b>= Free (project) cash flow</b>                   |

- **Forecasting earnings:**

- **Capital budget:** Lists the investments that a company plans to undertake
- **Capital budgeting:** Process used to analyze alternate investments and decide which ones to accept => using NPV to evaluate capital budgeting decisions
- **Incremental earnings:** Amount by which the firm's earnings are expected to change as a result of the investment decision

- **Interest expense:**

- In capital budgeting decisions, **interest expense**<sup>13</sup> is typically not included. Project should be judged on its own, not on how it will be financed.
- **Note:**
  - \* Interest expense is taken into account in cost of capital, i.e. discount rate used for calculating NPV.
  - \* Hence, if we considered interest payments as an expense, there would be a **double counting**.

- **Tax considerations:**

- **Marginal corporate tax rate:** The tax rate on the marginal or incremental dollar of pre-tax income. **Note:** A negative tax is equal to a tax credit<sup>14</sup>.

$$\text{Income tax} = EBIT * t_C$$

<sup>13</sup>An **interest expense** is the cost incurred by an entity for borrowed funds.

<sup>14</sup>**Tax credit** refers to an amount of money that taxpayers can subtract directly from the taxes they owe.

- **Note:**
  - \* Taxes paid by the company are lower as interest payment can be deducted from the tax base.
  - \* However, this **tax shield effect**<sup>15</sup> is taken into account in adjusting the cost of capital.
  - \* Tax shield effect while calculating project's cash flows => there would be double counting
- **Tax credit:**
  - **Rationale:** Typically, in a new project, EBIT may be negative over the first years.
  - **Profitable company:**
    - \* If the project takes place within an overall profitable company, we can calculate with negative tax payments, i.e. company is granted a tax credit.
    - \* Reason: The loss in project can be balanced against profits made in other business segments.
  - **Non-profitable company:**
    - \* If the overall company is not profitable, we have to set-up a tax carryforward<sup>16</sup> or (if allowed) a carrybackward.
- **Opportunity cost:** It is the forgone benefit that would have been derived from an option not chosen.
- **Project externalities:** Indirect effects of the project that may affect the profits of other business activities of the firm. **Cannibalization** is when sales of a new product displaces sales of an existing product.
- **Sunk costs:** costs that have been or will be paid regardless of the decision whether or not the investment is undertaken -> not to be included in incremental earnings analysis!
  - **Overhead costs:** fixed and not incremental to the project
  - **Past research and development expenditures:** Money that has already been spent on R&D is a sunk cost.
  - *They are both irrelevant for incremental (earning) analysis!*
  - Reason: *The decision to continue or abandon a project should be based only on the incremental costs and benefits of the product going forward.*

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<sup>15</sup>**Interest Tax Shield** refers to the tax savings resulting from the tax-deductibility of the interest expense on debt borrowings.

<sup>16</sup>A **tax loss carryforward** allows taxpayers to use a taxable loss in the current period and apply it to a future tax period. *Result in the future:* decrease in taxable income (taxable income - carried taxable loss) => lower amount of tax

- **Unavoidable competitive effects:**

- When developing a product, firms may be concerned about the cannibalization of existing products.
- If sales are likely to decline in any case as a result of new products introduced by competitors => these lost sales are a **sunk cost**

- **Real-world complexities:**

Typically,

- sales will change from year to year
- average selling price will vary over time
- average cost per unit will change over time

- **Capital expenditures and depreciation:**

- **Capital expenditures:** Actual cash outflows when an asset is purchased -> included in calculating free cash flow
- **Depreciation:** Non-cash expense<sup>17</sup> -> free cash flow estimate is adjusted for this non-cash expense

- **Net (operating working capital (NWC):)**

- Most projects will require an investment in NWC.

$$NWC = \text{Current assets} - \text{Current liabilities}$$

$$NWC = \text{Cash} + \text{Inventory} + \underbrace{\text{Receivables} - \text{Payables}}_{\text{Trade credit}}$$

- Increase in NWC:

$$\Delta NWC_t = NWC_t - NWC_{t-1}$$

- **Calculation of NPV:**

$$PV(FCF_t) = \frac{FCF_t}{(1+r)^t} = FCF_t * \frac{1}{(1+r)^t}$$

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<sup>17</sup>**Non-cash expenses** are business expenses that do not require the expenditure of cash. They do not have an effect on cash flow!



## 4.2 Choosing among alternatives

- **Rules for choosing among alternative projects:**
  - **Choosing between mutually exclusive investment opportunities:** Pick the opportunity with highest NPV
  - **Choosing between alternatives:** Only include those components of free cash flow that differ among the alternatives.

## 4.3 Further adjustments to FCF

- **Adjustments to FCF:**
  - **Other non-cash items:** Amortization
  - **Timing of cash flows:** Cash flows are often spread throughout the year
  - **Accelerated depreciation:** Modified accelerated cost recovery system (MACRS) depreciation
  - **Liquidation or salvage value:** Include (after-tax) liquidation or salvage value of any assets that are disposed of any depreciation
  - **Terminal or continuation value:** Market value of FCF from the project at all future dates
  - **Tax loss carryforwards or tax carrybacks**

## 4.4 Risk analysis

- **Break-even analysis:** Computes the level of a parameter that makes the project's NPV equal to zero (*break-even point*, where total cost = total revenue)
- **Sensitivity analysis:** Shows how NPV varies with a change in one of the assumptions, holding the other assumptions constant
- **Scenario analysis:** Considers the effect on NPV of simultaneously changing multiple assumptions

# 5 Cost of Capital

## 5.1 Equity of cost of capital

- **Intuition:** The cost of capital of any investment opportunity (cost of equity) equals the expected return of available investments with same beta<sup>18</sup>.
- **Methods of estimating the equity cost of capital:**

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<sup>18</sup>Beta is a measure of risk calculated as a regression on the company's stock price.

- The Capital Asset Pricing Model (CAPM)
- Dividend discount model
- Bond yield plus risk premium<sup>19</sup>

- **CAPM:**

- CAPM states that the expected return on equity equals the sums of the risk-free interest rate and a premium for bearing the market risk.
- CAPM estimate / equation is provided by the security market line (SML) equation:

$$r_i = r_f + \underbrace{\beta_i * (E[r_{Mkt}] - r_f)}_{\text{Risk premium for security i (RP}_{Mkt})}$$

With:  $r_i$  = Equity cost of capital,  $r_f$  = Risk-free rate,  $\beta_i$  = Return sensitivity of stock i to changes in the market return,  $E[r_{Mkt}]$  = Expected return on the market,  $E[r_{Mkt}] - r_{Mkt}$  = Expected market risk premium or **equity risk premium** (ERP)

- Steps to implement CAPM and to calculate the equity cost of capital  $r_i$ :

a-) Construct the market portfolio<sup>20</sup> and determine its expected excess return  $E[r_{Mkt}] - r_{Mkt}$  of the (value-weighted) market portfolio

- **The fundamental market risk premium:**

- Two drawbacks of using historical data while estimating risk premium
  - (a) large standard errors of estimates
  - (b) backward looking => may not represent current expectations
- One alternative is to solve for discount rate that is consistent with the current level of index

$$r_{Mkt} = \frac{Div_1}{P_0} + g = \text{Dividend yield} + \text{Expected yield}$$

b-) Estimate the stock's beta  $\beta_i$  = sensitivity to the market portfolio

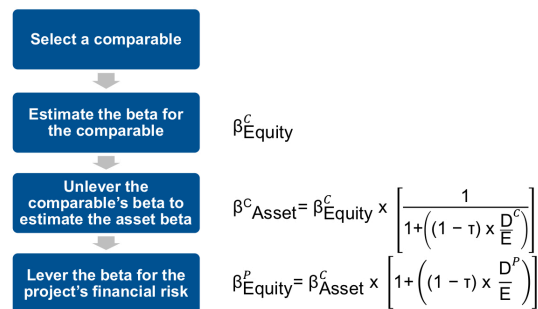
- **Estimating beta from historical returns:**

- Beta measures a security's "sensitivity to market" risk.

<sup>19</sup>A **risk premium** is a measure of excess return that is required by an individual to compensate being subjected to an increased level of risk.

<sup>20</sup>**Market portfolio** is a value-weighted portfolio of all the securities traded in the market. Thus, it is used as a proxy, a market index. **Market indexes** report the value of a particular portfolio of securities.

- Beta is expected percent change in excess return of security for a 1% change in excess return of market portfolio
- **Method 1:** Beta is the slope of the best-fitting line in the plot of a security's excess returns vs. market's excess returns  
-> regression analysis
- **Method 2:** Beta is calculated as the covariance of a stock with the market divided by the variance of the market:
  - (a) Stock beta > 1.0: Stock is riskier than the overall market and has higher expected returns.
  - (b) Stock beta < 1.0: Stock is less risky than the overall market and is expected to have lower returns.
- **Issues in estimating beta from historical returns:**
  - Judgement regarding estimation period, appropriate market index, use of a smoothing technique and adjustments for non-public or small company stocks
  - **For non-public companies**, we need to use comparable companies (with similar risk, size, etc.) to estimate beta:



## 5.2 Debt of cost of capital

- **Definition:** It is the effective interest rate that a company pays on its debts, such as bonds and loans.
- **Methods of calculating the debt cost of capital:**
  - **Yield-to-maturity approach:** Debt cost of capital = Yield to maturity on a firm's outstanding debt
  - **Debt-rating approach:** Debt cost of capital = Yield based on similarly rated debt (bonds) with similar maturity
  - **Beta-CAPM approach:** Debt cost of capital = Expected return for debt based on its beta using CAPM
- **Yield-to-maturity approach (YTM):**

- **Definition:** It is the IRR an investor will earn from holding the bond to maturity<sup>21</sup> and receiving its promised payments.
- **The accuracy of the estimate depends on the risk of firm default!**
  - \* **Low risk of firm default:** YTM is a reasonable estimate of investors' expected rate of return.
  - \* **High risk of firm default:** YTM will overstate investors' expected return.
- **Beta-CAPM approach:**
  - Debt betas are difficult to estimate because corporate bonds are traded infrequently.
  - One approximation is to use estimates of betas of bond indices by rating category.

### 5.3 A project's cost of capital

- **Should we undertake a given project?**
  - **Assumptions:**
    - \* All-equity financing of the project separate from any financing decision
    - \* Ignoring financing risk
  - **Answer: It depends, especially on project's cost of capital!**
    - \* To calculate project's cost of capital, we need to find a comparable company and estimate the cost of capital of assets as a proxy.
      - All-equity firm comparables (company operating by using its equity)
      - Levered firm comparables (company operating by taking out loans)
- **All-equity financing: Asset (unlevered) beta**

$$\beta_U = \beta_E * \frac{E}{E + D} + \beta_D * \frac{D}{E + D}$$

- **Levered firms as comparables: Asset cost of capital / unlevered cost of capital**
  - Expected return required by investors to hold firm's underlying assets.

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<sup>21</sup>**Maturity** is a date on which a financial agreement ends, triggering the payment of principal with interest or repayment of a loan with interest.

- Weighted average of firm's equity and debt costs of capital

$$r_U = r_E * \frac{E}{E + D} + r_D * \frac{D}{E + D}$$

- **Cash and net debt:**

- Some items maintain high cash balances.
- Cash is a risk-free asset that reduces the average risk of the firm's assets.
- Since the risk of the firm's enterprise value is what we are concerned with, leverage should be measured in terms of net debt:

$$D = \text{Net debt} = \text{Debt} - \text{Excess cash and short-term investments}$$

- **Industry asset beta (unlevered beta):**

- After adjusting for the leverage of different firms to determine their asset betas, we can combine estimates of asset betas for multiple firms in same industry.
- Doing this will reduce estimation error of estimated beat for the project.

## 5.4 Project risk characteristics and financing

- **Differences in project risk:**

- Firm asset betas reflect market risk of the average project in a firm.
- Individual projects may be more or less sensitive to market risk.
- Financial managers in multi-divisional firms should evaluate projects based on asset betas of firms in a similar line of business.
- Another factor that can affect market risk of a project is its degree of operating leverage:
  - \* Operating leverage is relative proportion of fixed vs. variable costs.
  - \* A higher proportion of fixed costs increases sensitivity of the project's cash flows to market risk.
    - Project's beta will be higher.
    - A higher cost of capital should be assigned.

- **Weighted average of cost of capital (WACC):**

- **Perfect capital markets:** where, the choice of financing does not affect cost of capital or project NPV, no trader has the power to change the price of goods or services

- **Taxes – A big imperfection:** When interest payments on debt are tax deductible, net cost to the firm is given by:

$$\boxed{\text{Effective after-tax interest rate} = r * (1 - t_C)}$$

- **WACC Formula:**

$$\boxed{r_{WACC} = r_E * \frac{E}{E + D} + r_D * \frac{D}{E + D} * (1 - t_C)}$$

- **Given a target leverage ratio:**

$$\boxed{r_{WACC} = r_U - \frac{D}{E + D} * t_C * r_D}$$

- **r<sub>WACC</sub> vs. r<sub>U</sub>:**

- Unlevered cost of capital (or pre-tax WACC) = r<sub>U</sub>
  - \* Expected return investors will earn by holding firm's assets.
  - \* In a world with taxes, it can be used to evaluate an all-equity with the same risk as the firm.
- In a world with taxes, WACC is less than the expected return of firm's assets.
  - \* With taxes, WACC can be used to evaluate a project with the same risk and the same financing as the firm.

## 6 Capital Structure

### 6.1 Equity vs. debt financing

- **Basic question of corporate finance = Capital structure decision:** After the decision whether or not to undertake an investment, which type of security should a firm sell to investors.
- **Definition:** The relative proportions of debt, equity, and other securities that a firm has outstanding. Two main types of capital structure:
  - **Financing a firm with equity** (= all-equity financing, unlevered firm)
  - **Financing a firm with equity and debt** (= levered firm)
  - **Is there a capital structure that shareholders prefer?**

## 6.2 Modigliani-Miller 1: Leverage and arbitrage

- **Capital structure decision:** The theory of capital structure was developed beginning with the capital structure theory of Merton Miller and Franco Modigliani (MM).
- **Assumptions of MM model:**
  - **Homogeneous expectations**
  - **Homogeneous business risk classes**
  - **Perpetual cash flows**
  - **Perfect capital markets:**
    - \* Investors and firms can trade the same set of securities at competitive market prices equal to the present value of their future cash flows.
    - \* No taxes, transaction costs, issuance costs or agency costs associated with security trading
    - \* A firm's financing decisions do not change the cash flows generated by its investments, nor do they reveal new info about them.
- **Modigliani and Miller argue:** In a perfect capital market, total value of a firm is equal to the market value of the total cash flows generated by its assets and is not affected by its choice of capital structure. Reasons:
  - Market value of any firm is independent of its capital structure.
  - If a company has a given set of assets, changing debt to equity will change the way net operating income is divided between lenders and shareholders, but will not change the value of the company.
- **MM proposition 1 (without taxes):** The market value of a company is not affected by the capital structure of the company.

$$E + D = U = A$$

With:

E = Market value of equity in a levered firm, D = Market value of debt in a levered firm, U = Market value of equity in an unlevered firm, A = Market value of the firm's assets

- **Proof of MM proposition 1:**
  - **Law of one price:** Firm's securities and its assets need to have the same total market value (whether the firm is unlevered or levered).
    - \* Otherwise, an arbitrage<sup>22</sup> opportunity would exist.

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<sup>22</sup>**Arbitrage** is the simultaneous purchase and sale of the same asset in different markets in order to profit from tiny differences in the asset's listed price.

- **Homemade leverage:** The investors use leverage in their own portfolios to adjust the leverage choice made by the firm.
  - \* Homemade leverage is a perfect substitute for corporate leverage
  - \* Substitutability between corporate debt and personal debt
- **A leveraged recapitalization: Application of MM proposition 1**
  - How do firms adjust their capital structure?
  - A firm can use borrowed funds to pay a large special dividend or repurchase a significant amount of outstanding shares.

### 6.3 Modigliani-Miller 2: Leverage and cost of capital

- **Basis of MM 2:** MM's first proposition can be used to derive an explicit relationship between leverage and the equity cost of capital.
- **MM proposition 2 (without taxes):** The cost of capital of levered equity is equal to the cost of capital of unlevered equity plus a premium that is proportional to the market value of debt-to-equity ratio.

$$r_E = r_U + \frac{D}{E} * (r_U - r_D)$$

With:

$r_E$  = Return on levered equity,  $r_U$  = Return on unlevered equity,  $r_D$  = Return on debt,  $D/E$  = Debt-to-equity ratio (market value)

- **Unlevered firm: Capital budgeting and WACC:**
  - If a firm is unlevered, all of the FCFs generated by its assets are paid out to its equity holders.
  - The market value, risk, and cost of capital for the firm's assets and its equity coincide. Therefore:

$$r_U = r_A$$

- **Levered firm: Capital budgeting and WACC:**
  - If a firm is levered, project  $r_A$  is equal to firm's  $r_{WACC}$ :

$$r_{WACC} = r_U = r_A$$

$$r_{WACC} = r_U = r_A = r_E * \frac{E}{D + E} + r_D * \frac{D}{D + E}$$



- With perfect capital markets, a firm's WACC is independent of its capital structure and is equal to its equity cost of capital if it is unlevered which matches the cost of capital of its assets.
- With no debt, WACC = unlevered equity cost of capital
- As firm borrows at the low cost of capital for debt, its equity cost of capital rises. Net effect is that firm's WACC is unchanged.

- **Computing WACC with multiple securities:**

- If the firm's capital structure is made up of multiple securities, then WACC is calculated by computing the WACC of all the firm's securities.

- **Unlevered and levered betas:**

- Effect of leverage on the risk of a firm's securities can also be expressed in terms of beta:

$$\beta_U = \beta_E * \frac{E}{E + D} \beta_D * \frac{D}{E + D}$$

=>  $\beta_U$ : A measure of the risk of a firm as if it did not have leverage which is equivalent to the beta of the firm's assets.

- Leverage amplifies the market risk of a firm's assets,  $\beta_U$ , raising the market risk of its equity  $\beta_E$ .

$$\beta_E = \beta_U + \frac{D}{E} * (\beta_U - \beta_D)$$

## 6.4 Capital structure fallacies

- **Equity issuances and dilution:**

- **Dilution:** An increase in the total of shares that will divide a fixed amount of earnings
- **Dilution vs. equity issuance:** It is sometimes (incorrectly) argued that issuing equity will dilute existing shareholders' ownership, so debt financing should be used instead.
- As long as firm sells new shares of equity at a fair price, there will be no gain or loss to shareholders associated with the equity itself.
- Any gain or loss associated with the transaction will result from NPV of the investments the firm makes with the funds raised.

- **Conservation of value principle for financial markets:**

- With perfect capital markets, financial transactions neither add nor destroy value, but instead represent a repackaging of risk (and therefore return).
- This implies that any financial transaction that appears to be a good deal may be exploiting some type of market imperfection.

## 7 Capital Structure and Taxes

### 7.1 Interest tax deduction

- **Intuition:** Corporations pay taxes on their profits after interest payments are deducted. Thus, interest expense reduces amount of corporate taxes.
- **Definition of interest tax shield:** It is the reduction in taxes paid due to the tax deductibility of interest.
- **Formula of interest tax shield:**

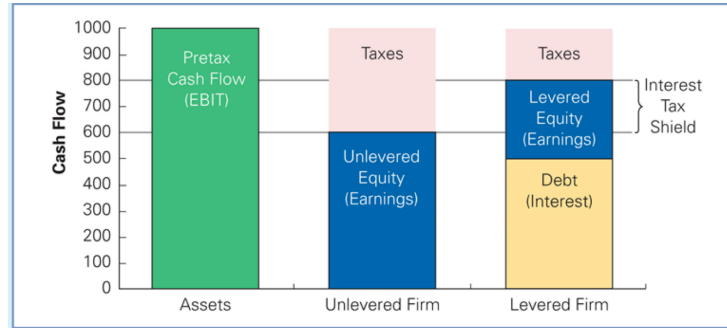
$$\text{Interest tax shield} = \text{Corporate tax rate} * \text{Interest payments}$$

### 7.2 Valuing the tax shield

- **Valuation of the interest tax shield:**
  - When a firm uses debt, interest tax shield provides a corporate tax benefit each year.
  - This benefit is computed as the present value of the stream of future interest tax shields the firm will receive.
  - The cash flows a levered firm pays to investors will be higher than they would be without leverage by the amount of the interest tax shield:

$$\text{Cash flows to investors with leverage} = \text{Cash flows to investors without leverage} + \text{Interest tax shield}$$

- **Valuation of the interest tax shield: Unlevered vs. levered firm**



- **MM proposition 1 (with taxes):** The total value of the levered firm exceeds the value of the firm without leverage due to the present value of the tax savings from debt.

$$V^L = V^U + PV(\text{Interest tax shield})$$

With:

$V^L$  = Market value of a levered firm,  $V^U$  = Market value of an unlevered firm,  $PV(\text{Interest tax shield})$  = Present value of interest tax shield

- **The interest tax shield with permanent debt:** Typically, the level of future interest payments is uncertain due to changes in:
  - marginal tax rate
  - amount of debt outstanding
  - interest rate on that debt
  - risk of the firm

For simplicity, we will consider the special case in which the above variables are kept constant.

- **The interest tax shield with permanent debt:**

- Suppose a firm borrows debt  $D$  and keeps the debt permanently. If the firm's marginal tax rate is  $t_C$ , and if the debt is riskless with a risk-free interest rate  $r_f$ , then the interest tax shield each year is  $t_C * r_f * D$ , and the tax shield can be valued as a perpetuity.

$$PV(\text{Interest tax shield}) = \frac{t_C * \text{Interest}}{r_f} = \frac{t_C * r_f * D}{r_f} = t_C * D$$

- **WACC with taxes:** With tax-deductible interest, the effective after-tax borrowing rate is  $r_D * (1 - t_C)$  and WACC becomes:

$$r_{WACC} = \frac{E}{E + D} * r_E + \frac{D}{E + D} * r_D * (1 - t_C)$$

$$r_{WACC} = \underbrace{\frac{E}{E + D} * r_E + \frac{D}{E + D} * r_D}_{\text{Pre-tax WACC}} - \underbrace{\frac{D}{E + D} * r_D * t_C}_{\text{Reduction due to interest tax shield}}$$

- Pre-tax WACC = The firm's unlevered cost of capital
  - \* Is constant, reflecting the required return of the firm's investors based on the risk of the firm's assets
- Effective after-tax WACC = The firm's after-tax cost to the firm
  - \* Declines with leverage as the interest tax shield grows
- **Interest tax shield with a target debt-to-equity ratio:**
  - When a firm adjusts its leverage to maintain a target debt-to-equity ratio, we can compute its value with leverage,  $V^L$ , by discounting its FCF using WACC.
  - The value of the interest tax shield can be found by comparing the value of the levered firm,  $V^L$ , to the unlevered value,  $V^U$ , of the FCF discounted at the firm's unlevered cost of capital, the pre-tax WACC.

### 7.3 Optimal capital structure

- **Optimal level of leverage:** The optimal level of leverage from a tax saving perspective is the level such that interest equals EBIT. At the optimal level of leverage, the firm shield all of its taxable income and it does not have any tax-disadvantage excess interest.
- **Limitations to the optimal level of leverage:**
  - However, it is unlikely that a firm can predict its future EBIT (and the optimal level of debt) precisely.
  - If there is uncertainty regarding EBIT, then there will be a risk that interest will exceed EBIT. As a result, tax savings for high levels of interest falls, possibly reducing the optimal level of the interest payment.
  - In general, as a firm's interest expense approaches its expected taxable earnings, marginal tax advantage of debt declines, limiting the amount of debt the firm should use.