

Investment and Financial Management

Lecture Notes

Efe Kamasoglu

February 4, 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 stakeholders¹ 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: $Assets = Liabilities + Shareholder's Equity$

¹A **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 <12 months	Cash & Equivalents	Cash, T-Bills <3 Month Maturity	Current Liabilities	Short-Term Debt	Debt that is due <1 Year
	Marketable Securities	Equity, Debt (Liquid Financial Instruments)		Payables	Interest, Wages, Dividends, Taxes, Accrued Liabilities
	Accounts Receivable	Outstanding Payments by customers	Long-Term Liabilities	Long-Term Debt	Interest & Principal on Bonds >1 Year
	Inventory	Produced Goods ready for sale		Deferred Taxes	Taxes due >1 Year
	Prepaid Expenses	Rent, Insurance Advanced Payments		Pension Liabilities	Employee Retirement
Long-Term Assets	Long Term Investments	Illiquid Securities <1 Year	Shareholder Equity	Retained Earnings	Profits kept by the Company
	Fixed Assets	Land, Machinery, Equipment, Buildings		Treasury Stock	Repurchased Stock
	Intangible Assets	Brands/names, Goodwill, Patents, Trademarks		Additional Paid-In Capital	Shareholder Investments beyond 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 value²**

²**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 Stocks³: Low M/B ratios
- * Growth stocks⁴: 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

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

⁴A **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)	
= Gross profit	
– Operating expenses:	
• Selling, general and administrative expenses (SGA)	
• Depreciation and amortization expense (D&A)	
= Operating income	
+ / – Other income / expenses	
= Earnings before interest and taxes (EBIT)	
+ / – Interest income / expenses	
= Pre-tax income	
– Tax	
= Net income	

- **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):**⁵ 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*⁶)
- Derived from firm's income statement and changes in balance sheet
- Consists of:
 - Cash flows from **operating**, **investing** and **financing** activities

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

⁶A **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:

⁷**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 capital⁸

⁸Cost 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**⁹ precede **positive cash flows**¹⁰. 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 exclusive¹¹.
 - * **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:**

⁹outgoing > incoming

¹⁰outgoing < incoming

¹¹If 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 ¹²
 - * 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.

¹²**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
= Cash flow from operations
+ Cash flow from investments (capital expenditures)
= Free (project) cash flow

- **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**¹³ 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 credit¹⁴.

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

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

¹⁴**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**¹⁵ 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 carryforward¹⁶ 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.*

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

¹⁶A **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 expense¹⁷ -> 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:**

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

¹⁷**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 beta¹⁸.
- **Methods of estimating the equity cost of capital:**

¹⁸**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 premium¹⁹

- **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, β_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 portfolio²⁰ 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 β_i = sensitivity to the market portfolio

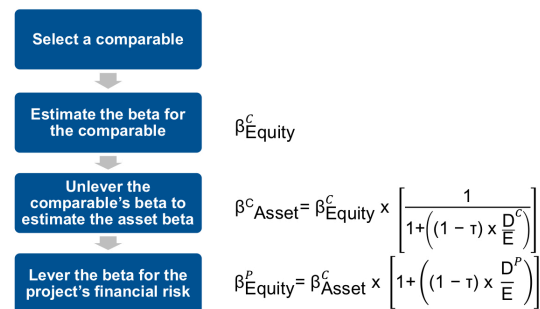
- **Estimating beta from historical returns:**

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

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

²⁰**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 maturity²¹ 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.

²¹**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

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