FIE402 summary

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FIE402 Corporate Finance

Contents

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0.1 General notes

- Start by writing down all the information we got in a structured manner.
- "Be super precise about dilution and value creation".
- "I'm a strong advocate of the APV method. It's often the best description of reality because you can always separate the value of the business from everything else."
- Black–Scholes exercises are almost always about plugging in the numbers.
- "A T year risk-free rate is r" means $\frac{1}{(1+r)^T}$

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Refresher

1.1 Notation

1.1.1 Chapter 4: The Time Value of Money (Topic: Capital budgeting)

Notation	Kind	What	Comments
r	percentage	interest rate	
g	percentage	growth rate	
C	amount	cash flow	
C_n	amount	cash flow at date n	
N	integer	date of the last cash flow in a stream of cash flows	
P	amount	initial principal or deposit, or equivalent present value	
PV_n	amount	Present value on date n	
FV_n	amount	future value on date n	
NPV	amount	net present value	
IRR	percentage	internal rate of return	
PV	Excel	present value	annuity for the initial amount
FV	Excel	future value	annuity for an extra final payment
$NPER$	Excel	periods	annuity for the number of periods or date of the last cash flow.
$RATE$	Excel	interest rate	annuity for interest rate
PMT	Excel	payment	annuity for cash flow

1.1.2 Chapter 5: Interest Rates (Topic: Capital budgeting)

Notation	Kind	What	Comments
EAR	percentage	effective annual rate	
r	percentage	(nominal) interest rate or discount rate	
PV	amount	present value	
FV	amount	future value	
C	amount	cash flow	
APR	percentage	annual percentage rate	
k	integer	number of compounding periods per year	
r_r	percentage	real interest rate	
i	percentage	rate of inflation	
NPV	amount	net present value	
C_n	amount	cash flow that arrives in period n	
n	integer	number of periods	
r_n	percentage	interest rate or discount rate for an n-year term	
τ	percentage	tax rate	

1.1.3 Chapter 7: Investment Decision Rules (Topic: Capital budgeting)

Notation	Kind	What	Comments
r	percentage	discount rate	
NPV	amount	net present value	
IRR	percentage	internal rate of return	
PV	amount	present value	
$NPER$	Excel	annuity for the number of periods or dates of the last cash flow	
$RATE$	Excel	annuity for interest rate	
PMT	Excel	annuity for cash flow	

1.1.4 Chapter 8: Fundamentals of Capital Budgeting (Topic: Capital budgeting)

Notation	Kind	What	Comments
τ_c	percentage	marginal corporate tax rate	
NPV	amount	net present value	
IRR	percentage	internal rate of return	
$EBIT$	amount	earnings before interest and taxes	
NWC_t	amount	net working capital in year t	
ΔNWC_t	amount	increase in net working capital between year t and year $t-1$	
$CapEx$	amount	capital expenditures	
FCF_t	amount	free cash flow in year t	
PV	amount	present value	
r	percentage	projected cost of capital	

1.1.5 Chapter 9: Valuing Stocks (Topic: The Dividend Discount Model)

Notation	Kind	What	Comments
r_E	percentage	equity cost of capital	
N	integer	terminal date or forecast horizon	
g	percentage	expected dividend growth rate	
Div_t	amount	dividends paid in year T	
EPS_t	amount	earnings per share on date t	
PV	amount	present value	
P_t	amount	stock price at the end of year t	
$EBIT$	amount	earnings before interest and taxes	
FCF_t	amount	free cash flow on date t	
V_t	amount	enterprise value on date t	
τ_c	percentage	corporate tax rate	
r_{wacc}	percentage	weighted average cost of capital	
g_{FCF}	percentage	expected free cash flow growth rate	
$EBITDA$	amount	earnings before interest, taxes, depreciation, and amortization	

1.1.6 Chapter 10: Capital Markets and the Pricing of Risk (Topic: Cost of Capital)

Notation	Kind	What	Comments
p_R	percentage	probability of return R R	
$Var[R]$	percentage	variance of return R	
$SD[R], \sigma[R]$	percentage	standard deviation of return R	
$E[R], \mathbb{E}[R]$	percentage	expectation of return R	
Div_t	amount	dividend paid on date t	
R_t	percentage	realized or total return of a security from date $t-1$ to t	
$\overline{R}$	percentage	average return	
β_s	decimal	beta of security s	
r_t	percentage	cost of capital of an investment opportunity	

1.1.7 Chapter 11: Optimal Portfolio Choice and the Capital Asset Pricing Model (Topic: Cost of Capital)

Notation	Kind	What	Comments
R_i		return of security/investment i	
x_i		fraction invested in security i	
$E[R_i], \mathbb{E}[R_i]$		expected return	
r_f		risk-free interest rate	
$\overline{R}_i$		aveage return of security/investment	
$Corr[R_i, R_j]$		correlation between return of i and j	
$Cov[R_i, R_j]$		covariance between returns of i and j	
$SD[R], \sigma[R]$		standard deviation (volatility) of return R	
$Var[R]$		variance of return R	
n		number of securities in a portfolio	
R_{xP}		return of portfolio with fraction x invested in portfolio P and $(1-x)$ investested in the risk-free security	
β_i^P		beta or sensitivity of the investment i to the fluctuations of the portfolio P	
β_i^P		beta of security i with respect to the market portfolio	
r_i		required return or cost of capital of security i	

1.1.8 Chapter 12: Estimating the Cost of Capital (Topic: Cost of Capital)

Notation	Kind	What	Comments
r_i		required return for security i	
$\mathbb{E}[R_i]$,		expected return of security i	
r_f		risk-free interest rate	
r_{wacc}		weighted-average cost of capital	
β_i		beta of investment i with respect to the market portfolio	
MV_i		total market capitalization of security i	
E		Value of Equity	
D		Value of Debt	
α_i		alpha of security i	
τ_c		corporate tax rate	
β_U		unlevered or asset beta	
β_E		equity beta	
β_D		debt beta	
r_E		equity cost of capital	
r_D		debt cost of capital	
r_u		unlevered cost of capital	

1.2 Topic notes

- Prices for $t > 0$ are expected values except if a deal is in place.
- I_0 is primo, CFs are ultimo.
- $FCF = (revenues - costs - depreciation)(1 - \tau_c) + depreciation - CapEx - \Delta NWC$
- $FCF = (revenues - costs)(1 - \tau_c) + depreciation \cdot \tau_c - CapEx - \Delta NWC$
- $(revenues - costs - depreciation)(1 - \tau_c)$ is also called *Net Operating Profit Less Adjusted Taxes* (NOPLAT). Also called unlevered net income.
- Free cash flows can be used for:

  - Retaining
    * Invest in new projects
    * Increase cash flows
  - Paying out
    * Repurchasing shares
    * Paying dividends

- The purpose of capital budgeting is to assess the quality of a project.
- Risk is calculated as the historical standard deviation (volatility) of return.
- An efficient portfolio cannot be diversified further
- YTM is like IRR, just for bonds. YTM is the highest expected return these bonds could have.
- The cost of debt is $r_d = \begin{pmatrix} pr(default) \\ 1 - pr(default) \end{pmatrix}^T \begin{pmatrix} y - L \\ y \end{pmatrix}$. y is the YTM and L is the loss rate if default. It's **crucial** to note that L is not the loss of the YTM but the actual loss rate. So assume the yield-to-maturity is 8% and the loss rate is 70%, then $y - L = 0.08 - 0.7 = -0.62$.
- $(1 + EAR) = (1 + \frac{APR}{k})^k$.
- The compound annual growth rate (CAGR) is better for long-run historical performance, while the arithmetic average is better when we try to estimate feature expected returns.
- WACC: the expected return the firm must pay to investors to compensate them for the risk of holding the firm's debt and equity together.
- Financial managers should evaluate an investment opportunity based on its cost of capital.
- Higher expected returns go with a greater risk of doing badly in great times. Beta is a measure of that.
- If you have a specific cash flow occurring from time N and you're looking at the cash flows from a different time period—usually time 0 but let's call it time M, then you need to 1) calculate the time N-present value of the cash flows, and then 2) calculate yourself back to time M: $PV_M = \frac{PV_N}{(1+r)^{N-M}}$.

- $Div\_yield_t = \frac{Div_t}{P_{t-1}}$. The same goes with capital gain rate: $gain_t = \frac{P_t}{P_{t-1}} - 1$.
- The most money I could raise for a project is $I_0 + NPV$.
- Market cap $= MV(E) = E$
- Enterprise value $= MV(A) = A$

2

Capital Structure

2.1 Notation

2.1.1 Chapter 14: Capital Structure in a Perfect Market

Notation	Kind	What	Comments
PV		Present value	
NPV		Net present value	
E		Market value of levered equity	
D		Market value of debt	
U		Market value of unlevered equity	
A		Market value of firm assets	
R_D		Return on debt	
R_E		Return on levered equity	
R_U		Return on unlevered equity	
r_D		Expected return of debt	Cost of capital = expected return
r_E		Expected return of levered equity	
r_U		Expected return of unlevered equity	
r_A		Expected return of firm assets	
r_{wacc}		Weighted average cost of capital	
r_f		Risk-free rate of interest	
β_E		Beta of levered equity	
β_U		Beta of unlevered equity	
β_D		Beta of debt	
EPS		Earnings per share	

2.1.2 Chapter 15: Debt and Taxes

Notation	Kind	What	Comments
Int		Interest expense	
PV		Present value	
r_f		Risk-free interest rate	
D		Market value of equity	
r_E		Weighted average cost of capital	
τ_c		Debt cost of capital	
E		Value of the unlevered firm	
r_{wacc}		Value of the firm with leverage	
r_D		Marginal personal tax rate on income from debt	
V^U		Value of the unlevered firm	
V^L		Value of the firm with leverage	
τ_i		Marginal personal tax rate on income from debt	
τ_e		Marginal personal tax rate on income from equity	
τ^*		Effective tax advatage of debt	
τ^*_{ex}		Effective tax advantage on interest in excess of EBIT	

2.1.3 Chapter 16: Financial Distress, Managerial Incentives, and Information

Notation	Kind	What	Comments
E		Market value of equity	
D		Market value of debt	
PV		Present value	
β_E		Net present value	
β_D		Value of the unlevered firm	
I		Value of the firm with leverage	
NPV		Effective tax advantage of debt	
V^U			
V^L			
τ^*		Effective tax advantage of debt	

2.2 Topic notes

- Main assumptions of capital structure irrelevance:
  - With perfect capital markets, financial transactions neither add nor destroy value: instead, it repackages risk and therefore return.
  - That is, the law of one price implies that, in the perfect capital market setting, the choice of debt or equity financing will not affect the total value of a firm, its share price, or its cost of capital. Therefore, one will be indifferent to the financing.
- However, a firm can enhance its value by using leverage to minimize the taxes it (and its investors) pay.
- The tax shield is likely the most important market imperfection (except for personal taxes).
- Capital structure fallacies:
  - It's wrong to say that "higher leverage is beneficial because it increases EPS". First of all, leverage increases $\mathbb{E}[EPS]$ when $r_D(1-\tau_c) < \frac{\mathbb{E}[EPS]}{P}$, so it doesn't apply to every single case. Furthermore, higher leverage also increases the volatility and the riskiness of the EPS. So we cannot say that leverage is

beneficial for the EPS: it improves the average, but the distribution at large worsens.

  - It's wrong to say that "new equity issues are bad because they delete existing shareholder wealth".
  - It's wrong to say that "capital requirements are bad because equity is too expensive".

- Tax deductibility of interest is relevant for capital structure.
- Bankruptcy costs matter for the capital structure decision.
- The pecking order theory states that one should 1) use internal funds first, 2) then go for debt, and 3) finally get external equity.
- Fairly priced issues don't destroy value. For instance, when securities are fairly prices, the original shareholders of a firm pay the present value of the costs associated with bankruptcy and financial distress costs.
- How to evaluate the business risk of a firm:
  1. Find β_U with β_E under the old structure.
  2. Find the new β_E under the new structure by using β_U since that is unchanged.
- How to find a new stock price:
  1. Find r_u
  2. Find the required r_E after recapitalization
  3. Find the new stock price.
- D is net debt, which is debt minus excess cash or short-term investments.
- $\frac{D}{D+E} = \frac{\frac{D}{D}}{\frac{D}{D}+\frac{E}{D}} = \frac{1}{1+\frac{E}{D}} = \frac{1}{1+\frac{1}{(\frac{D}{E})}}$
- The key factors in the present value of the financial distress costs: 1) the probability of financial distress, 2) the magnitude (amount) if financial distress, and 3) the appropriate discount rate. Please note that the beta will be negative because financial distress increases when the firm is doing poorly (which we can assume is correlated with the market). Also, note that a negative beta reduced the cost of capital, which decreases the discount factor and ultimately increases the present

value of the financial distress costs. Therefore, **financial distress costs are higher for highly leveraged firms.**

- Asset substitution problem: replacing low-risk assets with riskier ones because of leverage.
- Cashing out: during financial distress, shareholders have an incentive to withdraw cash from the firm if possible because the cost of default will be borne by the debt holders.
- Debt overhand and under-investment: you can avoid projects with guaranteed positive-NPV if you have too much debt that you previously wasn't able to handle. Then creditors will take most of the cake in $t = 1$ so that the extra equity raised—the cost—will surpass the benefit the owners get because of this extra equity.
- Moral hazard: individuals will change their behavior if they're not fully exposed to its consequences.
- A firm owner's desire to sell equity may lead you to question how good an investment opportunity really is.
- Firms in the same industry may end with different, but all optimal, capital structures because of the market conditions that existed at the funding time.
- $\beta_E^{after} MV(E)^{after} = \beta_E^{before} MV(E)^{before} \iff \beta_E^{after} = \beta_E^{before} \frac{MV(E)^{before}}{MV(E)^{after}}$
- Forward P/E $= \frac{P_0}{EPS_1}$.
- High P/E: with leverage, you're expected to grow quickly.
- $V^L = A = E + D = \frac{FCF}{r_{WACC} - g}$. **It's crucial to note that it's note E on the left-hand side, it's the entire enterprise value that is equal to FCF**.
- $V^L = V^U + PV(TS)$
- $PV(TS) = V^L - V^U$. This is the way to calculate the present value of the tax shield. Doing it directly far increases the chances of getting it wrong. Can be rewritten as $PV(TS) = (D + E) - \sum_{t=1}^{T} \frac{FCF \cdot (1+g)^{t-1}}{(1+r_U)^t}$
- If constant debt levels, the tax shields will be permanent too (i.e. same amount forever). Another way to calculate the value of the tax shield, then, is $PV(TS) = \frac{TS}{r_D} = \frac{D \cdot r_D \cdot \tau_c}{r_D} = D \cdot \tau_c$.
- Cash is negative debt. Therefore, paying out cash, the firm is effectively increasing

leverage. Therefore, you can consider this as $PV_0(TS) = Payout_0 \cdot \tau_c$. Imagine this as a form of a tax cut.

2.2.1 Modigliani & Miller

1. $E + D = U = A$. That is, $MV(securities) = MV(assets)$ regardless of whether the firm is levered ($D > 0$) or not ($D = 0$).
2. $r_e = r_U + \frac{D}{E}(r_U - r_D)$

- The **value of a firm** is independent of its capital structure.

2.2.2 Example

- Details:
  - Shares outstanding: 100 million
  - Market cap: 4 billion
  - Debt: 2 billion
- Management wants to delever the firm by issuing new equity to reply all outstanding debt.
- *How many shares to issue?*
  - Well, it's important look at the company's balance sheet and see that $E = 4bn$, $D = 2bn$, and thus $A = 6bn$. This gives $P_{now} = \frac{4bn}{100mn} = 40$
  - The management wants to get rid of debt, and the value of the total assets should remain the same. So $D = 0$ and $A = 6bn \iff E = 6bn$. With the current price of 40, this means they have to issue an additional $\frac{6bn-4bn}{40} = 50mn$ shares. The price after is the same as before, $P_{after} = \frac{6bn}{150mn} = 40$
- *But you as a shareholder disagree. Assume you hold 100 shares. In a perfect capital market, what can you do to undo the situation?*
  - Let's look at the balance sheet again, but this time scaled to the investor's ownership in the business. Before deleveraging and issuing more equity, it looked like this: $A = 6000, D = 2000, E = 4000$. After deleveraging, the shareholders has two options if it wants to remain a shareholder:

* Don't buy anything: this gives us $A = 4000, D = 0, E = 4000$ for the investor since the asset value per share is diluted and the price per share remains the same.

* Buy using own cash: this gives us $A = 6000, D = 0, E = 6000$ for the investor.

* Buy using debt: this gives us $A = 6000, D = 2000, E = 4000$ for the investor: $A = 4000, D = 0, E = 4000$ before the purchase, then $cash = 2000, D = 2000$ from raising private debt, then using that cash to buy more shares. So the share ownership plus the private debt gives $A = 4000 + 2000 = 6000, D = 0 + 2000 = 2000, E = 4000$.

3

Payout Policy

3.1 Notation

3.1.1 Chapter 17: Payout Policy

Notation	Kind	What	Comments
PV		Present value	
P_{cum}		Cum-dividend stock price	
P_{ex}		Ex-dividend stock price	
P_{rep}		Effective divident tax rate	
τ_d		Corporate tax rate	
τ_g		Stock price if excess cash is retained	
τ_d^*		Tax rate on interest income	
τ_c		Effective tax rate on retained cash	
P_{retain}		Dividend	
τ_i		Tax rate on interest income	
τ_{retain}^*		Effective tax rate on retained cash	
Div		Dividend	
r_f		Risk-free rate	

3.2 Topic notes

- Dividend policy matters for firm value only in imperfect capital markets because of taxes, flexibility, and signalling.
- Terminology (illustrated through an example):
    1. 20/07 is the *declaration date*. This is the date that the board declares the amount.
    2. 15/11 is the *ex-dividend date*. Buyers *on* or after this date doesn't receive the dividend.
    3. 17/11 is the *record date*. Always two days after the ex-dividend date. Since it takes three days for purchases to get on the record of owners, this record up until the last trading time the day before the ex-dividend date.

4. 02/12 is the *payable date*. This is the date when eligible shareholders receive their dividend.

- When $\tau_{div} > \tau_c$, the optimal dividend policy is to pay no dividends at all.
- Firms may attract different groups of investors depending on their dividend policy.
- MM's payout/dividend irrelevance: in perfect capital markets, if a firm invests excess CFs in financial securities, the firm's choice of payout versus retention is irrelevant and does not affect the initial value of the firm. So it is market imperfections that has an effect.
- Firms should retain cash to preserve financial slack for future growth opportunities and avoid financial distress costs.
- Share repurchases: a credible signal that management believes its shares are underpriced.
- Stock splits: stock dividends of $50+\%$ (no cash are paid out. Therefore, the market value is unchanged).
- Spin-off: disitrubte shares of a subsidiary (WWASA, Treasure)
- *cum-dividend* means "before dividend".
- Assuming perfect capital markets, price should drop by exactly the dividend payment.

4

Payout Policy

4.1 Notation

4.1.1 Chapter 23: Raising Equity Capital

None

4.1.2 Chapter 24: Debt Financing

Notation	Kind	What	Comments
YTC		Yield to call on a callable bond	
YTM		Yield to maturity on a bond	
PV		Present value	

4.2 Topic notes

- IPO terminology:
  - *Underwriter*: investment bank(s) helping out. Can be separated into *lead* (responsible) and *syndicate* (participating).
  - *Primary offering*: new shares available in a public offering.
  - *Secondary offering*: shares sold by existing shareholders in an equity offering
  - *Registration statement*: legal document before registration
  - *Preliminary prospectus*: circulated to investors before stock is offered.
  - *Final prospectus*: contains all details of the offering, including number of shares offeerd and the offer price
  - *Liquidation preference*: a minimum amount to pay to security holders, before paying anyone else, in the event of a liquidation, sale, or merger (usually 1–3 times the investment).
  - *Book building*: the process of coming up with the offer price based on customers' expressions of interest.

  - *Seasoned equity offering*: like an IPO but without the price-setting. However a discount is typically necessary to be given because of the informational asymmetry (according to the pecking order theory).
    * *Cash offer* (US): offer the new shares to new and existing investors at a discount price
    * *Rights offer* (EU): offer new shares to existing shareholders at a discount price. It's good if everyone participates because it protects existing shareholders from underpricing. This means that you give the discount to yourself so only those who does not exercise this right is losing out. If everyone's in, you gain what you lose.
- There are three types of underwriting processes:
  - Best effort
  - Firm commitment—common but expensive, usually 7 %
  - Auction
- The intuition of the greenshoe provision: the underwriter can issue more stock (usually up to 15 %). Then, if the issue is successful, they also sell the provision. If it's unsuccessful, then repurchase the allotment.
- The phenomenon of IPO underpricing.
  - Those who benefited from underpricing: investors who bought shares at the IPO price (plus the investment bank indirectly from future business)
  - Those who lost on underpricing: the owners of the shares that was sold during the IPO because they sold shares at a lower price than what the market was willing to pay.
- Pros and cons with IPOs:
  - Pros:
    * Creates liquidity
    * Better access to capital
    * Monitored by capital markets
  - Cons:

    * Dispersion: more owners means more free-riding
    * Regulatory requirements

- IPO puzzles:
  - On average, IPOs appear to be underpriced.
  - The number of IPOs are highly cyclical.
  - The costs of an IPO are very high.
  - The 3–5 year performance is poor.
- The key in determining the investment/duration is the timing of when the project generates CFs:
  - *line of credit*: short-term private debt.
  - *commercial paper*: short-term public debt.
  - *bank loan*: long-term private debt.
  - *bonds*: long-term public debt.
- The *underinvestment problem*: when close to bankruptcy, you reject positive-NPV projects because the value goes primarily to bondholders.
- The *overinvestment problem*: when close to bankruptcy, you may gamble that increasing the risk could give a profit because they would go broke if not.
- A *bond call provision* let the issuer repurchase before time T at a pre-determined price.
- *Convertible bonds* let bonds be converted to equity at a pre-determined time period and price. These are always priced higher than the non-convertible equivalent.
- Bonds payment: $\frac{\langle coupon\_rate\rangle/yr}{\langle \#payments\rangle payments/yr} \cdot \$\langle FV\rangle \cdot \langle CPI\_appreciation\rangle = \$\langle\rangle/payment$
- Yield to maturity, $YTM : P = \sum_{t=1}^{T} \frac{C+FV\cdot\mathbb{1}_{t=T}}{(1+YTM)^t}$
- Alternatively, $YTM = \left(\frac{FV}{\text{current value}}\right)^{\frac{periods/years}{periods}} - 1$
- Yield to call, $YTC : P = \sum_{t=1}^{T'} \frac{C+FV\cdot\mathbb{1}_{t=T'}}{(1+YTC)^t}$ (the yield of a bond or note if you were to buy and hold the security until the first callable date.)

- Beware that $YTM \neq \mathbb{E}[r_D]$
- Amount raised in an IPO $= P \cdot \# \cdot (1 - fee\_rate)$
- By "Market value after the IPO" means the price after closing on the first day of trading.
- Rights issue: if all rights are exercised, the shareholders are indifferent between the different plans. So the questions is not about the shareholders preference for the plans, but whether they are likely to tender or not—and that's a point where they can differ between different plans. So analyze that.
- Some of the differences between a public debt offering and a private debt offering:
  - In a public debt offering, a prospectus is created with details of the offering and a formal contract between the bond issuer and the trust company is signed.
  - The trust company makes sure the terms of the contract are enforced.
  - In a private offering there's no need for a prospectus or a formal contract. Instead a promissory note can be enough. Moreover, the contract in a private placement does not have to be standard.
- An *unsecured* bond holder will be a residual claimant in case of bankruptcy after secured assets has been given.
- *Restrictive covenants*: restrictions on what management can do.
- The yield on a convertible bond is less than the yield on an identical bond without conversion because the option to convert the bond into stock is valuable, hence it's price will be higher and its yield lower.
- If you have a convertible bond, then the conversion price $P = \frac{FV}{\text{Conversion ratio}}$.
- But for regular bonds: $P = \sum_{t=1}^{T} \frac{c}{(1+YTM)^t} + \frac{FV}{(1+YTM)^T}$.
- A credit downgrade typically results in a higher interest rate for new debt. So there's an inverse relationship between the price of an outstanding bond and market interest rates.
- The greater the volatility of earnings, the lower the bond rating when everything else is held constant.

4.2.1 Example

- The firm is trying to raise (that is, after fees) just as much money as they did with underwriters. Assume fair market value (that is, equal to the post IPO value). Calculate the price and number of shares issued.
- Details:
  - $MV = 750mn$ after the IPO.
  - P^*: price without underwriters
  - Original shares outstanding was 10 million
  - We raised $93mn$—after fees—with the underwriters, so this is what we'll raise now as well.
  - We have two equations and two unknowns. 1) $750 = 10mn\ cdot P^* + 93mn \iff P^* = 65.7$. This equation says that the the market value should be equal to the number of original shares times the share price, and then add on the money raised. And 2) $93mn = \Delta \# P^*$. Plugging in P^*, we get $\Delta \# = 1.416mn$. That is, we are raising 1.416 million new shares. The key is in equation 1): put in the total sum after closing and calculate what the price must be out of the old number of shares.

5

Valuation

5.1 Notation

5.1.1 Chapter 18: Capital Budgeting and Valuation with Leverage

Notation	Kind	What	Comments
FCF_t		Free cah flow at date t	
r_{wacc}		Weighted average cost of capital	
r_E		Equity cost of capital	
r_D		Debt cost of capital	
r_D^*		Equity-equivalent debt cost of capital	
E		Market value of equity	
D		Market value of debt	Net of cash
τ_c		Marginal corporate tax rate	
D_t		Incremental debt of project on date t	
V_t^L		Value of a levered investment on date t	
d		Debt-to-value ratio	
r_U		Unlevered cost of capital	
V^U		Unlevered value of investment	
T^s		Value of predetermined tax shields	
k		Interest coverage ratio	
Int_t		Interest expense on date t	
D^s		Debt net of predetermined tax shields	
ϕ		Permanence of the debt level	
τ_e		Tax rate on equity income	
τ_i		Tax rate on interest income	
τ^*		Effective tax advantage of debt	

5.1.2 Chapter 19: Valuation and Financial Modeling—A Case Study

Notation	Kind	What	Comments
R_s		Return on security s	
r_f		Risk-free rate	
α_s		The alpha of security s	
β_s		The beta of security s	
R_{mkt}		Return of the market portfolio	
$\mathbb{E}[R_{mkt}]$		Expected return of the market portfolio	
ε_s		The regression error term	
β_U		The beta of an unlevered firm	
β_E		The beta of equity	
β_D		The beta of debt	
r_U		Unlevered cost of capital	
r_{wacc}		Weighted average cost of capital	
r_D		Debt cost of capital	
V_T^L		Continuing value of a project at date T	
V^U		Unlevered value	
FCF_t		Free cash flow at date t	
g		Growth rate	
T^s		Predetermined tax shield value	

5.2 Topic notes

Key: every valuation needs an intuitive understanding of the relevant input parameters—so you must be able to understand what of the given information is relevant and whether it affects the balance sheet, income statement, and/or cash flow statement.

- We are usually concerned with DCF analysis in this course (however, the dividend discount model is also used):

- Dividend discount model: $P = \sum_{t=1}^{T} \frac{DIV_t \cdot (1+g)^{t-1}}{(1+r_e)^t} = \frac{DIV_1}{r_e - g}$ if $T = \infty$. Note that the first payment don't contain growth.
- Discounted free cash flows model (DCF): $V_0^L = \sum_{t=1}^{T} \frac{FCF_t}{(1+r_{WACC})^t}$
- The impact on valuation is assessed by looking at the cash flows. Usually, you forecast earnings and from there forecast cash flows.
- It's crucial that you understand how to compute cash flows (i.e. what to add and deduct from and to net income).
- Debt capacity, d: the amount of debt at date t required to maintain the firm's target D/E. So $D_t = \mathbf{d} \cdot V_t^L = \frac{\mathbf{1}}{\mathbf{1}+\left(\frac{\mathbf{D}}{\mathbf{E}}\right)^{-\mathbf{1}}} V_t$
- The Law of One Price guarantees that the WACC, APV, and FTE gives the same assessed value.
- There are three key valuation methods, and it's important to think well through which method to use.
- WACC:
  - $r_E^{proj} = r_u^{proj} + \frac{D}{E}(r_u^{proj} - r_D = r_u^{proj} - d\tau_c r_D.$
  - $r_{WACC} = \begin{pmatrix} \frac{D}{D+E} \\ \frac{E}{D+E} \end{pmatrix}^T \begin{pmatrix} r_D(1-\tau_c) \\ r_E \end{pmatrix}$
  - While pre-tax WACC is $r_U = \begin{pmatrix} \frac{D}{D+E} \\ \frac{E}{D+E} \end{pmatrix}^T \begin{pmatrix} r_D \\ r_E \end{pmatrix}$
  - The expected return the firm must pay to investors to compensate them for the risk of holding the firm's debt and equity together.
  - **Easy to use when D/E is fixed.**
- APV:
  - $r_u^{proj} = \frac{1}{n}\sum_{i=1}^{n} r_u^{comparable\_i} = \frac{1}{n}\sum_{i=1}^{n} \begin{pmatrix} D_i/(D_i+E_i) \\ E_i/(D_i+E_i) \end{pmatrix}^T \begin{pmatrix} r_D^i \\ r_E^i \end{pmatrix}.$
  - Key: comparable companies has the same $\beta_{\mathbf{A}}$—that is, the same β_U. So find the asset beta from the competitors and then find the equity beta of the firm in question by plugging in the comparable asset beta.

  - **APV is especially common when D/E is fluctuating. That is, when 1) there's a fixed $\frac{int_t}{FCF_t} = k \iff int_t = k \cdot FCF_t$, which gives $V^L = V^U(1+\tau_c k)$ or 2) there are pre-determined debt levels.** When the debt levels moves with the cash flows—as they do when assuming a target leverage ratio—then the risk of the debt will be the same as the risk of the cash flows.
  - Disadvantage that we need to compute the project's debt capacity to determine interest and ΔD before making our capital budgeting decision.
- FTE:
  - Disadvantage that we need to compute the project's debt capacity to determine interest and ΔD before making our capital budgeting decision.
  - **Used in complicated settings where the capital structure or tax shield is hard to determine.**
- Safe cash flows can be 100% debt-financed. Therefore, risk is unchanged and the appropriate discount rate is $r_D(1-\tau_C)$
- Issuance costs: $NPV = -I_0 + V^L -$ (after-tax issuance costs) + PV(saved issuance costs on future projects if CF from this project is reinvested in another)
- "Safe" tax shields should be deducted from debt, like we do with cash, when evaluating the leverage: $D^S = D - T^S$
- If the WACC changes over time, the valuation formula is modified slightly to $V_t^L = \frac{FCF_{t+1}+V_{t+1}^L}{1-r_{WACC}(t)}$
- Although the r_E's for two projects may be wildly different, it's likely because of different D/E's. After unlevering, we'll likely see that the r_U's are really similar.
- Common multiples when using comparables for valuation: 1) P/E, 2) $EV/sales$, and 3) $EBITDA$. But they cannot be relied upon for a precise estimate.
- The CAPM is popular to use for estimating the cost of capital.
- $\beta_U = \begin{pmatrix} \text{equity value/enterprise value} \\ \text{debt value/enterprise value} \end{pmatrix}^T \begin{pmatrix} \beta_E \\ \beta_D \end{pmatrix}$.
- DCF: $EV(T) = V_T^L = \frac{FCF_{T+1}}{r_{WACC}-g}$
- DCF: $EV(t) = V_t^L = \sum_{i=1}^{t} \frac{FCF_i}{(1+r_{WACC})^i}$

- Note that it's the enterprise value we use in the discounted cash flow analysis. If we want to compute the equity value, we then weigh this enterprise value: $E = \frac{E}{D+E} V_t^L$.
- Use the cash multiple to compare deals with similar time horizons and risk only since the multiple doesn't account for them.
- $r_{WACC} < r_U < r_E$. Why?
  - $r_E > r_U$ because leverage makes the equity risk greater than the overall risk of the firm
  - $r_{WACC} < r_U$ because the WACC includes the benefit of the interest tax shield.
- If the exercise says that the D/E will be maintained (forever), then it's a clue that WACC will be used.
- Remember that if debt levels change, then r_E will change too because of changed risk.
- If we're asked to find the WACC for an expansion and we don't have much details, then remember that r_U and r_{WACC} are quite much alike. So you can calculate yourself down to $r_{WACC} - r_U = \frac{D/E}{1+D/E} \tau_c \cdot r_D$.

6

Options and Corporate Finance

6.1 Notation

6.1.1 Chapter 20: Financial Options

Notation	Kind	What	Comments
PV		Present value	
Div		Dividend	
C		Call option price	
PV		Put option price	
S		Stock price	
K		Strike price	
dis		Discount from face value	
NPV		Net present value	

6.1.2 Chapter 21: Option Valuation

Notation	Kind	What	Comments
Δ		Shares of stock in the replicating portfolio	Sensitivity of option price to stock price
B		Risk-free investment in the replicating portfolio	
S		Stock price	
r_f		Risk-free rate of interest	
C		Call option price	
T		Years until the exercise date of an option	
K		Strike price	
σ		Volatility of stock's return	
$N(d)$		Cumulative normal distribution	
ln		Natural logarithm	
PV		Present value	
PV		Put option price	
S^x		Value of stock excluding dividends	
q		Dividend yield	
ρ		Risk-neutral probability	
β_S		Beta of the stock	
β_B		Beta of the bond	
β_E		Beta of the levered equity	
β_D		Beta of the debt	
β_U		Beta of the firm's assets	Beta of unlevered equity
A		Market value of assets	
E		Market value of equity	
D		Market value of debt	

6.1.3 Chapter 22: Real Options

Notation	Kind	What	Comments
NPV		Net present value	
S^x		Value of stock exccluding dividends	
S		Stock price	
PV		Present value	
Div		Dividend	
K		Strike price	
ln		Natural logarithm	
T		Years until the exercise date of an option	
σ		Volatility of the return of the underlying asset	
C		Call option price	
$N(d)$		Cumulative normal distribution	
ρ		Risk-neutral probability	
r_f		Risk-free rate of interest	

6.2 Topic notes

- The two main uses of options in corporate finance is 1) relative valuation and 2) replicating a portfolio. The latter is enormously useful for understanding more advanced valuation methods.
- Call and put values at expiration (i.e. ignoring the time value):
  - Long call: $\max S - K; 0$
  - Short call: $-\max S - K; 0$
  - Long put: $\max K - S; 0$
  - Short put: $-\max K - S; 0$
- *Intrinsic value*: the option value of it expired immediately.

- *Time value*: current value minus the intrinsic value.
- The put–call parity: $C = P + S - PV(K)$. **This is not on the formula sheet, so remember it.** Modified versions with dividends:
  - $C = [S - K] + [dis(K) + P - PV(div)]$
  - $P = [K - S] + [C - dis(K) + PV(div)]$
  - The left-hand side is the current value, the first bracket is the intrinsic value, and the second bracket is the time value.
  - For the call option, the time value is *always* positive before $t = T$. Therefore, it's always optimal to wait with a call option. So with an American option, for instance, exercise only at $t = T$ or just before the ex-dividend date to maximize value.
  - For the put option, however, things are a little bit different. It's unlikely that a put holder will exercise the option early because (s)he benefits by waiting for the stock price to drop after the ex-dividend date.
- The option delta Δ is the change in the price of the option given a \$1 change in the price of the stock (always ≤ 1).
- Replicating portfolios with Black–Scholes:
  - $C = \begin{pmatrix} \Delta = N(d_1) \\ B = -PV(K)N(d_2) \end{pmatrix}^T \begin{pmatrix} S \\ 1 \end{pmatrix}$
  - $P = \begin{pmatrix} \Delta = -[1 - N(d_1)] \\ B = PV(K)(1 - N(d_2)) \end{pmatrix}^T \begin{pmatrix} S \\ 1 \end{pmatrix}$
  - The value of the replicating portfolio equals the value of the call for small changes in S. But for larger changes, we must update the portfolio to maintain the accuracy.
  - Note that $N(d)$ is the normal *cumulative* distribution function.
- We can price options by using the put–call parity and create replicating portfolios.
- If we are creating replicating portfolios using multiple time periods:
  1. Calculate the value of an option in time T (where there's no time value of the options) for every possible outcome.

2. Replicate the portfolio for the time periods T and $T-1$, and then find the option value in $T-1$.

3. Repeat step 2) all the way down to the first period and then find today's option value.

- We can use option pricing to think of equity and debt by:
  - Being an equity holder: the underlying is the assets and the strike price is the *face value* of the debt outstanding. As quickly as the debt is paid off, the equity holder gets the rest. $A = D + E \iff E = A - D$ (long call option on assets: $\max(A - FV(D); 0)$).
    * If you want to calculate with Black–Scholes, you can use these steps:
      1. Equity can be seen as a call option
      2. Use Black–Scholes to find the implied volatility of the assets
      3. $\Delta = N(d_1)$
      4. $\beta_E = \Delta\big(1 + \frac{D}{E}\big)\beta_U \iff \beta_U = \frac{\beta_E}{\Delta\left(1+\frac{D}{E}\right)}$
  - Being a debtholder:
    1. Be long in the firm/assets
    2. Short call the assets with strike price equal to the *face value* of the debt outstanding.
    3. So $A = D + E \iff D = A - E$ (long assets, short equity call)
  - Being a debtholder (this alternative is called a credit default swap—using an option to insure the firm's credit risk so that it becomes risk-free):
    1. *The key when looking at options is to draw the end result I want, write up the structure (for instance $E = A - D$) and then find the variant that's gives me the payoff I need.*
    2. Be long in risk-free debt
    3. Short put on the firm's assets with strike price equal to the *face value* of the debt oustanding.
    4. So $A = D + E \iff D = A - E$ (buy risk-free debt, short asset put).
- *Hedging*: using an option to reduce risk.

- Asset substitution problem: conflict of interest regarding risk—equity owners may benefit from investments that increase the risk of the firm while debt owners will not.
- Debt overhang problem: equity holders have less incentive to invest when more go to debt holders.
- Black–Scholes: if a dividend is paid out, S' replaces S with $S' = S - PV(div)$.
- Beta calculations:
  - β_E is straightforward to estimate (linear regression of the stock prices)
  - We can never estimate β_U, but we can deduce it from D and E. If we got many instruments, just weigh each of them.
  - β_D is difficult to estimate, so we make a compromise and assume that $\beta_D = 0$. This works well for relatively risk-less debt.
  - $\beta_{option} = \begin{pmatrix} \frac{S\Delta}{S\Delta+B} \\ \frac{B}{S\Delta+B} \end{pmatrix}^T \begin{pmatrix} \beta_S \\ \beta_B \end{pmatrix}$. $\frac{S\Delta}{S\Delta+B}$ is the leverage ratio: the amount of money we have in the stock versus the amount of money we have in the option. (so a weighted average of the securities in your portfolio). Furthermore, $\beta_B = 0$ is the debt is risk-less.
- Two ways to calculate implied volatility:
  1. Estimate from historical data
  2. Use current market price of options to deduce the volatility.
- Implied volatility of one option can be used on other options with the same underlying and expiration date.
- If you're asked to use option data to determine the rate for the junior debt, then follow these steps:
  1. Calculate first the rate for the senior debt by finding $FV^{senior} = \frac{D^{senior}}{\#}$. $D^{senior} = \frac{FV^{senior}}{(1+YTM^{senior})^T} \iff YTM^{senior} = \left(\frac{FV^{senior}}{D^{senior}}\right) - 1$
  2. Calculate then the rate for the senior and junior debt combined by finding $FV^{senior+junior} = \frac{D^{senior+junior}}{\#}$, then calculating $D^{junior} = \frac{FV^{junior}}{(1+YTM^{junior})^T} \iff YTM^{junior} = \left(\frac{FV^{junior}}{D^{junior}}\right) - 1$, with $D^{junior} = A - E - D^{senior}$.

6.2.1 Real options

The capital budgeting decision is the most important application of options in corporate finance.

- There's two main ways to value real options: 1) Black–Scholes and 2) Decision trees (with 2.1) binomial models and 2.2) risk-neutral probabilities).
- We got three main categories of real options:
  - *The option to delay*:
    - If waiting leads to increased competition, deduct from current market value of assets: $S^x = S - PV(\text{lost FCF}) - PV(\text{lost FCF from competitors})$
  - *The option to grow*
  - *The option to abandon*
- The value of the real option is the NPV with the option minus the NPV without the option.
- The way to understand decision trees:
  - Work yourself backwards.
  - If ■: *decision node*—calculate the present value and compare optimal choices.
  - If ● *chance node*—calculate the expected present value.
- The intuition of risk-neutral valuation: if all market participants were risk-neutral, then all financial assets would have the same cost of capital: r_f. You could also call the risk-neutral probabilities as "calibrated probabilities".
- When evaluating the risk, ask yourself: is the risk correlated with the state of the economy? If no, then risk can be diversified away and you can use r_f as the discount rate.
- We can use risk-neutral valuation when we don't know the true probabilities of each outcome. For instance, if $\vec{q} = (0.72, 0.18)$, with the first outcome being an increase, then it's required that there's a 72% risk-neutral probability that interest rates will rise for the annuity to have an expected return.
- When evaluating investments with different lives, a key is to consider reinvestment options of the shorter-lived project.

- If you can choose the order of investments, then first go for what is **the cheapest**, **the most risky**, and **the longest-lasting**. That way, things get easier down the line. Calculate as $cost_t = investment \cdot PV(success) = \frac{\left(\prod_i pr(\text{success in previous stages})_i\right) \cdot pr(\text{success in this stage})}{(1+CoC)^t}$
- If you're not sure if the project can handle interest increases, then use the *hurdle rate* as a discount rate og see if you still got $NPV > 0$. The optimal hurdle rate is $CoC \cdot \frac{\text{callable annuity rate}}{\text{risk-free rate}}$
- A patent is considered risk-free, so you can use risk-free instruments to replicate
- An out-of-the-money real option has value.
- An in-the-money real option need not be exercised immediately.
- Think about real options as decision tree analysis.
- If $V_0 > C$: enter today. If $V_0 < C$: wait.
- Pricing a model with a decision tree:
  1. Draw the tree for up until the point where the option expires
  2. Calculate the option values at the time the option expires, meaning time value is 0.
  3. Create a replicating portfolio as seen from time $t = T$. So if we have only one period, that would give $\begin{pmatrix} S(\omega_1) & (1+r_f) \\ S(\omega_2) & (1+r_f) \end{pmatrix}^T \begin{pmatrix} \Delta \\ B \end{pmatrix} = \begin{pmatrix} C_1(\omega_1) \\ C_1(\omega_2) \end{pmatrix}$
  4. Then find the call value: $C_0 = \begin{pmatrix} S_0 \\ 1 \end{pmatrix}^T \begin{pmatrix} \Delta \\ B \end{pmatrix}$

6.2.2 Example

- Use option data to determine the rate Google would have paid if it had issued \$128bn in zero-coupon debt in January 2011.
- $S = 422.27$
- Suppose $\# = 320mn$. That gives $MV(E) = 135.13mn$
- $r_f = 1.2\%$

- Assume perfect capital markets

The recipe to solve this:

1. Under perfect capital markets, $A^{\text{before recap}} = A^{\text{after recap}}$.
2. Calculate FV per share, which is K (**crucial point!**). Shareholders get all the value after this point, but nothing before.
3. Average bid and ask for this "strike price" $K = \frac{E}{\#}$, with $E = Avg \cdot \#$.
4. $A = D + E \iff D = A - E$. A is before recap while E is $Avg \cdot \#$.
5. $D = \frac{FV}{(1+YMT)^T} \iff YTM = \left(\frac{FV}{D}\right)^{1/T} - 1$
6. Credit spread $= YTM - r_f$.

7

Mergers and Acquisitions

7.1 Notation

7.1.1 Chapter 28: Mergers and Acquisitions

Notation	Kind	What	Comments
EPS		Earnings per share	
P/E		Price-earnings ratio	
A		Premerger total value of acquirer	
T		Premerger total value of target	
S		Value of all synergies	
N_A		Premerger number of shares of acquirer outstanding	
x		number of new shares issued by acquirer to pay for target	
P_T		Premerger share price of target	
P_A		Premerger share price of acquirer	
N_T		Premerger number of shares of target outstanding	

7.2 Topic notes

- Reasons for M&A's: primarily about synergies. These are usually 1) cost reductions and 2) revenue enhancements.
  - Saying that the acquirer will reduce risk is not a viable argument: shareholders can diversify by holding other investments. Since it's costly to merge, diversifying is often a cheaper way to reduce risk.
- Which party usually benefits from M&A's: the target because they have more bargaining power.
- Possible defense mechanisms in M&A's:
  - *Poison pills*
  - *Staggered boards*

  - *White knights*
  - *Golden parachutes*
  - *Recapitalization*
  - *Other*

- There's often a free-riding problem in M&A's. Three solutions:
  - *Toehold*
  - *Leveraged buyout*: instead of using own cash, acquirers borrows money through a shell company that pledges the shares as collateral on the loan—i.e. the money needed/used only if the deal goes through.
  - *Freezeout merger*

- The profitability condition that's required for the acquirer to proceed: $\frac{A+T+S}{N_A+x} > \frac{A}{N_A}$. That is, that the total pre-merger values $(A+T)$ plus the synergy (S) value divided by the after-merger number of shares outstanding with the acquirer $(N_A + x)$—that is, post-merge value per share—must be greater than the pre-merge value per share. x is the extra shares issued by the acquirer.

- The exchange ratio is how many shares per target share to offer, $\frac{x}{N_T}$. For acquirer to earn on this, we should have $\frac{x}{N_T} < \frac{T+S}{A} \cdot \frac{N_A}{N_T}$.

- From this we deduce that for the acquirer, a takeover is a $NPV > 0$ project if $PV(synergies) > premium$. But because of competition, premiums are pushed upwards and little value is therefore provided to the acquirer.

- Managers are wrong to claim that "an M&A is good since it increases EPS" because:
  - Well, by acquiring a company with low growth potential, a company with high growth potential can raise its EPS.
  - But note that no value has been created, it's only the multiple that changed.

- The acquirer only need the board of directors to approve the deal, while the target needs the board to approve the deal and the shareholders to vote on it.

- When the offer is a cash offer and shareholders of the acquirer think it's a bad deal, the stock price will go down and since the exchange ratio is set, the premium goes up.

- EPS goes down if the target has a higher P/E than your firm.

- When evaluating how much the other shareholders gain from a poison pill, compare the gain against the number of shares they had originally before the pill was triggered.
- Leverage buyout: if your deal is so nice that everyone wants to tender, then you'll buy everything instead of the originally planned amount.
- Horizontal mergers are more likely to create value for acquiring shareholders.
- Why mergers cluster in time, causing merger waves:
  1. It is clear that merger activity is much greater during economic expansions than during contractions and that merger activity strongly correlated with bull markets.
  2. Many of the same technological and economic conditions that lead to bull markets also motivate managers to reshuffle assets through merger and acquisitions.
  3. Generally, a combination of forces usually only present during strong economic expansions drive merger activity to peak levels.
  4. Merger mania is caused by the fear that only big companies survive in a time of increasing merger activity.
- Why shareholders from target companies enjoy an average gain when acquired while acquiring shareholders on average often do not gain anything:
  - The acquiring firm has to compete against other firms, thus reducing the gains it can obtain from the transaction.
  - Target shareholders benefit from this competition, as they obtain higher bids for the company.
  - In some cases the acquiring firm may present an initial offering price that is high enough to forestall a bidding war, effectively handing the gain form the offer to the shareholders of the target company.

8

Leasing

8.1 Notation

8.1.1 Chapter 25: Leasing

Notation	Kind	What	Comments
L		Lease payments	
PV		Present value	
r_D		Debt cost of capital	
τ_c		Marginal corporate income tax rate	
r_U		Unlevered cost of capital	
r_{wacc}		Weighted average cost of capital	

8.2 Topic notes

Key question: should we lease or purchase?

It's the market frictions that decide whether we should buy or lease

- *Lessor*: the one who buys the item
- *Lessee*: the one who leases the item from the lessor
- The cash flows of leasing: equal amounts from $t = 0$ to $t = T - 1$. So note that the first lease payment happens immediately.
- When leasing in a perfect capital market, the alternatives are just as good: 1) leasing now and then buying at the end of the leasing period, and 2) borrow now and purchase immediately. The only differnce is that we divide the firm's cash flows and risks in different ways.
- When leasing in an imperfect market, these alternatives are not just as good. Note that we are comparing the alternatives **leasing** and **borrowing**, not leasing and buying.
- The lease-equivalent loan: the loan that leads to the same level of fixed obligations that you'd have with the lease. This is an important concept for evaluating a lease correctly. Steps:

1. Study the leasing alternative
2. Study the buying alternative
3. Study leasing vs buying by calculating $lease - buy$ for each time period.
4. Calculate the present value of the $t = 1$ to $t = T$ cash flows to get the initial amount of the lease-equivalent loan. Look at how much must be paid out of your own pocket with each alternative.

- APR: multiply/divide by months. For instance, $APR = 12months/year \cdot 1\%/month = 12\%/year$
- APY (annual percentage yield): has months in the exponent. For instance, $APY = (1 + 0.01)^{12} - 1$
- *APR with monthly compounding* means $r^{month} = \frac{APR\%/year}{12months/year} = ...\%/month.$
- In a *true tax lease*, the **lessor** receives the depreciation deductions associated with the ownership of the asset. The *lessee* deducts the operating expense.
- In a *non-tax lease*, the *lessee* receives the depreciation deductions.
- Evaluating a true tax lease: the key is to compare to a purchase financed with equivalent leverage. So:
  1. Compute $\Delta FCFs$, including tax shields and deductibles.
  2. Compute NPV, discounted with after-tax r_D.
  3. $NPV > 0$: go for leasing. $NPV < 0$: go for borrowing.
- Evaluating a non-tax lease: this is directly comparable to a traditional loan. Thus, lease is attractive if it offers a better rate than the loan. So discount lease payments using the pretax borrowing rate.
- A big reason forleasing is tax gains by shifting the more valuable deductions to the party with the higher tax rate. That is, that the lessee gets more tax deductions from leasing then from depreciating the asset. Then both parties can benefit from the lease.
- By *annual lease rate*, we mean the leasing payment each year—it's not a reference to an interest rate of any sort.
- The *effective after-tax lease borrowing rate* is the IRR of $lease - buy$

- Recipe for leasing:
    1. Timeline: lease, buy, and lease–buy
    2. $D = PV(\text{lease–buy at } r_d(1 - \tau_c))$
    3. $C - D > L$ (go for leasing) or $< L$ (go for borrow and buy)? That is, which upfront investment is the greatest. Alternatively, and perhaps more intuitively, which alternative lets you put the least amount of money out of your pocket?
    4. IRR of $lease - buy$ is the effective lease rate after tax.

9

Working Capital Management

9.1 Notation

9.1.1 Chapter 26: Working Capital Management

Notation	Kind	What	Comments
CCC		Cash conversion cycle	
NPV		Net present value	
EAR		Effective annual rate	

9.2 Topic notes

Working capital: the invesntory, receivables, payables, and the cash portion needed to run the company on a day to day basis. It affects the FCFs and therefore the firm's value.

Net working capital: currents assets minus current liabilities

- Cash Conversion Cycle:
  - CCC = inventory days + accounts receivable days - accounts payables days
  - CCC = $\frac{\text{inventory}}{\text{average daily COGS}} + \frac{\text{accounts receivables}}{\text{average daily sales}} + \frac{\text{accounts payables}}{\text{average daily COGS}}$
  - So cash conversion cycle: plus on assets, minus on liabilities.
- Trade credit vs standard loans: Consider the trade credit as a loan, so calculate the interest rate the customer is effectively paying:
  $EAR = \left(\frac{\text{full amount}}{\text{discounted amount}}\right)^{365/\text{net days–discount days}} - 1$
- It's optimal to pay either at the day the discount expires or the day the invoice expires—not at any other date. When evaluating these alternatives, calculate implicit EAR and compare it with a bank loan—if you could get a cheaper loan in the bank, the take a loan and pay the invoice early.
- Remember to consider opportunity costs.
- NWCs are recovered at the end of the project's life. Important if doing a cash flow analysis.
- There are two ways to monitor accounts receivables:

  - *Accounts receivable days*:
    * Compare against net days
    * Look for trends and seasonality
  - *Aging schedule*: categorize accounts by the number of days they've been on the firm's books.

- Use accounts payable days outstanding and ompare against your credit terms to see if you're paying too early.

- Reasons to hold cash:
  - *transaction balance*: meet day-to-day needs
  - *precautionary balance*: compensate for uncertainty
  - *compensating balance*: satisfy bank requirements

- Evaluating whether a billing firm should take over the invoicing. If it's a perpetuity, think about it this way:
  - Think about it as how much we could have earned in perpetuity by investing the amount we pay the billing firm.
  - Our benefit will therefore not be the actual amount we're investing right now.
  - But we're studying the opportunity cost. If you're paying \$250 per month means that we cannot invest a similar amount each month and therefore loses out on the capital gain there.
  - Example:
    * Outsourcing will reduce the collection float by 20 days. Since average daily collections are 1200, this means that we're getting a benefit of \$24,000. We should calculate $PV(benefits)$ but it's unnecessary here since all the benefit comes in $t = 0$.
    * What's the costs? It's the opportunity costs: we're losing out on capital gains: $PV(costs) = \frac{250}{0.08/12} = 45,000$.
    * Since the costs surpasses the benefits, we shouldn't go for this.

10

Risk Management

10.1 Notation

10.1.1 Chapter 30: Risk Management

Notation	Kind	What	Comments
r_f		Risk-free interest rate	
r_f		Current interest rate	
r_L		Cost of capital for an insured loss	
β_L		Beta of an insured loss	
$r_\$$		Dollar interest rate	
r_e		Euro interest rate	
S		Spot exchange rate	
F		One-year forward exchange rate	
F_T		T-year forward exchange rate	
K		Option strike price	
σ		Exchange rate volatility	
T		Option (or forward) expiration date	
$N()$		Normal distribution function	
C_t		Cash flow on date t	
P		Price of a security	
ε		Change in interest rate	
k		Compounding periods per year	
A		Market value of assets	
L		Market value of liabilities	
E		Market value of equity	
D_P		Duration of security/portfolio P	
$\tilde{r}_t$		Floating interest rate on date t	
δ_t		Credit spread on date t	
N		Notational principal of a swap contract	
NPV		Net present value	

10.2 Topic notes

In FIE402, risk management is about 1) knowing why and when public corporations would want to hedge, and 2) knowing how sensitive equity value is to changes in interest rates.

- When to hedge: currency options callow firms to insure themselves against the exchange rate moving beyond a certain level (i.e. capping the cost). The value of the option is $C = \begin{pmatrix} N(d_1) \\ N(d_2) \end{pmatrix}^T \begin{pmatrix} S/(1+r_{foreign}^T) \\ -K/(1+r_{local})^T \end{pmatrix}$
- Interest rate risk can be described through the concept of *duration*: %change in value $\approx$ $(-Duration \cdot \frac{\varepsilon}{1+r_appr.} \cdot 100\%$
- Duration is the sensitivity of a bond's price or an asset's value to changes in interest rates. For bonds, duration indicates the years it takes to receive a bond's true cost, weighing in the present value of all future coupon and principal payments.
- Duration and corporate finance: by restructuring the balance sheet to reduce duration, we can hedge the firm's interest rate risk.
- Swap-based hedging: on interest rates, contract with the bank about exchanging the coupons from two different types of loans (for instance fixed interest rate against floating or vice versa).
- Good investments create corporate value
- The key to making food investments is generating enough cash internally
- CFs may be disrupted by external factors, potentially compromising the ability to invest.
- Insurance affects:
  - Bankruptcy and financial distress costs
  - Issuance costs
  - Tax rate fluctuations
  - Debt capacity
  - Managerial incentives
  - Risk assessment

- Fair premium $= pr(loss) \cdot PV(\mathbb{E}[loss]$. Or, not really loss, but what of the loss that will be covered.
- So we should calculate $r_L = r_f + \beta_L(\mathbb{E}[R_{MKT}] - r_f)$
- Firms that are riskier choose higher insurance coverage
- Covered interest parity: $F = S \cdot \frac{1+r_\$}{1+r_€}$. That is, we get $\frac{\$_1}{€_1} = \frac{\$_0}{€_0} \cdot \frac{\frac{\$_1}{\$_0}}{\frac{€_1}{€_0}}$.
- There's two ways to handle currency over time: 1) buy forwards or 2) cash-and-carry.
- The cash-and-carry method if exchanging from euros to dollars:
    1. Borrow €today for one year at rate $r_€$.
    2. Exchange today at rate $S\$/€$
    3. Invest the dollars for one year at rate $r_\$$.
- Key when you got two differnt tax levels: think about in which time period they come in. For instance, if you an "invest" in an insurance today and get 40 % tax deduction on this operating expense, and then the tax rate is lowered and you get repaid the coverage (extraordinary income) at this lower tax rate, then you can gain on having an insurance although the insurance is actuarially fair
- LIBOR: London InterBank Offered Rate. It's a benchmark rate that represents the interest rate at which banks offer to lend funds to one another in the international interbank market for short-term loans. So it serves as a first step in calculating interest rates.

10.2.1 Example

- You need to raise 100mn
- You can borrow short-term at 1 % spread over LIBOR (LIBOR+1%) *or* issue a ten-year fixed-rate bonds at a spread of 2.5 % over ten-year treasuries (which is at 7.6 %).
- Current ten-year interest rate swaps are quoted at LIBOR versus the 8 % fixed rate.
- Management believes the firm is "underrated" and that its credit rating is likely to improve in the next year or two.

- But management are not comfortable with the interest rate risk associated with using short-term debt.
- Suggest a strategy for borrowing the 100mn. What is your effective borrowing rate?
  - If management believes their situation will improve, they should borrow short-term. So step 1) is borrow 100mn on a short-term loan and pay $LIBOR + 1\%$. But they have two options here: 1.1) Borrow short-term at $LIBOR + 1\%$, or 1.2) issue fixed-rate bonds at the ten-year treasury bonds plus spread.
  - Then one can use this loan and enter into an interest rate swap
  - "Quoted at LIBOR versus the 8 % fixed rate" means that you *receive* the LIBOR and *pay* the 8 % fixed rate.
  - Step 2) is to calculate the effective borrowing rate, which is original rate *minus* the rate you receive *plus* the rate you pay. So $(LIBOR+1\%)-LIBOR+8\% = 9\%$.
- Suppose then that the credit rating improves after 3 years. It can now borrow at the treasury yeild (currently 9.10 % for a seven-year period) plus 0.5 % (spread has fallen because of the better rating).
- To lock in the new credit quality for the next seven years, refinance the 100mn short-term loan into a long-term loan at the treasury yield plus the spread. **Then you *unwind*** your current swap by entering a new swap.
- The effective borrowing rate is now $(9.10\% + 0.5\%) + (LIBOR + 8\%) + (LIBOR - 9.5\%)$