Capital investment policy

Part 1: Investment analysis – investing or not?

1.1 CIP definition

A "Capital Investment Policy" specifies criteria to compare investment alternatives and rules to select those that serve the financial objectives of the corporation.

1.2 Financial goal of a corporation

Assumption: all shareholders have equal access to well-functioning, competitive financial markets

Goal = to **maximize** the current market **value** of shareholders' investments in the firm

1.3 NPV rule

Assumption: perfect capital markets

Invest if NPV = PV – C_0 > 0

→ Firm **value increases by NPV**

	Perpetuities	Annuities
Level	$PV = \dfrac{C}{r}$	$PV = \dfrac{C}{r}\left[1-\left(\dfrac{1}{1+r}\right)^T\right]$
Growing	$PV = \dfrac{C}{r-g}$	$PV = \dfrac{C}{r-g}\left[1-\left(\dfrac{1+g}{1+r}\right)^T\right]$

- Equal to: invest if return > r = discount rate = **opportunity cost of capital**/hurdle rate
- Choosing among projects: choose highest NPV

1.4 Alternative decision rules

IRR rule: invest if IRR > r

- $0 = C_0 + \dfrac{C_1}{(1+IRR)} + \dfrac{C_2}{(1+IRR)^2} + \cdots$
- (IRR – r) gives an indication of how sensitive the investment is to uncertainty in estimated r
- Pitfalls:
  - Lending or borrowing
  - Multiple IRR values if signs of cash flows change
  - Ignores scale of projects when comparing
  - Time varying interest rates
  - No real solutions might exist

Payback Period

1.5 Interest rates

Effective Annual Rate **EAR** ↔ Annual Percentage Rate **APR**

- $1 + EAR = (1 + \dfrac{APR}{k})^k$
- Effective rate for the horizon $\dfrac{1}{k}$: $\dfrac{APR}{k}$

Nominal cash flow (what you actually pay/receive) ↔ **Real cash flow** (adjusted for inflation)

- Real cash flow = $\dfrac{\text{Nominal cash flow}}{(1+\text{inflation rate})^t}$
- $(1+r_{real})(1+i) = 1+r$
- Rule: discount real cash flows with r_{real} and nominal cash flows with $r_{nominal}$

2.1 Capital rationing

Assumption: informational frictions (i.e. imperfect capital markets)

→ Agency problems: outside **financing constraints** under moral hazard

→ Use **Profitability Index** = $\dfrac{NPV}{Resources\ consumed}$ instead of NPV for choosing among projects

2.2 Capital budgeting

Sales
- Cost of goods sold
= Gross profit
- General costs
- R&D
- Depreciation
= EBIT
- Taxes
= Unlevered net income
+ Depreciation
- Investments
- Δ NWC
= unlevered FCF

Incremental earnings
> → Opportunity costs
> → Project externalities
> → NO sunk costs

$t_c \times$ depreciation = **depreciation tax shield**
where t_c = <u>marginal</u> corporate tax rate

Investment = capital expenditure
→ deducted each year as depreciation ≠ cash flow
NWC   = current assets – current liabilities
        = cash + inventory + receivables - payables

! Interest expenses are NOT included (captured through discounting)

2.3 Perfect capital markets

- No taxes/transaction costs
- **Perfect information**
- Perfect competition
- Investors can borrow and lend at the same (risk adjusted) rate
  → Unlimited short selling possible with full access to proceeds

Result: **Law of One Price**
> If equivalent investment opportunities trade simultaneously in different efficient markets, then they must trade for the same price in both markets. Else, arbitrage opportunities would exist.

No Arbitrage Price of any security = PV (all cash flows paid by the security)

→ NPV of buying/selling a security is 0!

<u>Note</u>: financial investment (NPV=0) ≠ real investment (NPV can be > 0)

3.1 Pricing bonds

Assumption: default-free bonds

Zero-coupon bond

- Price = PV (face value) = $\frac{FV}{(1+YTM_n)^n}$ where **YTM** = Yield to Maturity = IRR of the bond
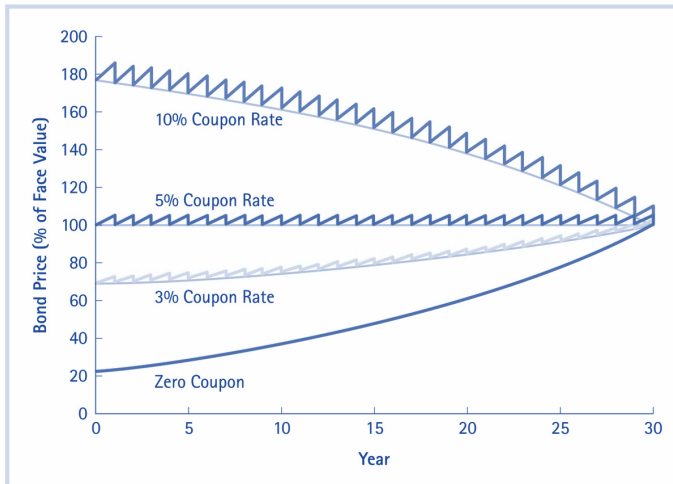
Coupon bond

- Price = PV (interest payments) + PV (face value)

If price > face value → bond trades at a **premium** → coupon rate > YTM
If price < face value → bond trades at a **discount** → coupon rate < YTM

Effect of time on prices:

Effect of interest rates on prices:

- Interest rates and bond yields rise (fall) → prices fall (rise)
- Sensitivity to changes in interest rates measured by **duration**
- **Yield curve** plots yield as a function of maturity
  - Normally upward sloping (higher yields for longer horizons)
  - Inverted yield curve usually precedes recessions
- Discount each coupon payment at **spot rate** r_n
  - YTM is a complicated weighted average r_n
    (zero-coupon bonds: $YTM_n = r_n$)
  - Spot rate $r_n \neq$ **forward rate** f_n
    $(1+f_1)(1+f_2)...(1+f_n) = (1+r_n)^n$

Assumption: risky bonds

Price = $\frac{\text{expected CF}}{(1+E(r_n))^n}$

YTM = $\frac{\text{promised CF}}{P} - 1$ > expected return!!

Default spread = yield on corporate (risky) bonds – treasury (risk-free) bonds

3.2 Pricing stocks

Dividend discount model

- $P_0 = \sum_{t=1}^{\infty} \frac{Div_t}{(1+r)^t}$

- Dividend growth g = retention rate * ROI
  - Constant growth: $P_0 = \frac{Div_1}{r-g}$
  - Changing growth: $P_0 = \sum_{i=1}^{N} \frac{Div_i}{(1+r)^i} + \frac{P_N}{(1+r)^N}$

Discounted FCF model

- $P_0 = \frac{V_0 + cash_0 - debt_0}{shares\ outstanding_0}$

  where V_0 = enterprise value = $\sum_{N=1}^{\infty} \frac{FCF_N}{(1+r_{WACC})^N} + \frac{V_N}{(1+r_{WACC})^N}$

- Note: enterprise value = NPV (continuing existing projects) + NPV (new projects)

Valuation based on multiples
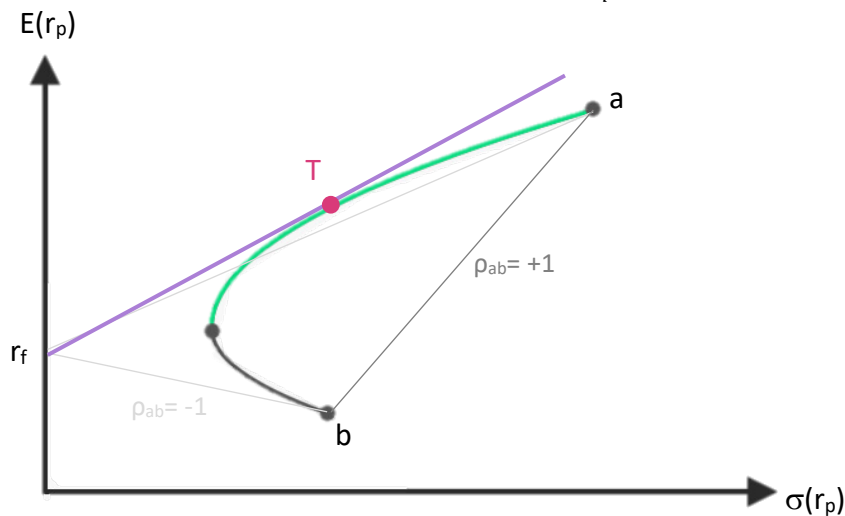
4.1 Portfolio and CAPM theory

Portfolio theory

Assumptions:

- *Mean – variance preferences*
- *Means and variances of each stock are known*

Volatility & expected return

- Correlation impacts volatility:
  - Lower correlation → lower volatility can be obtained (= **diversification**)
  - Perfect correlation ($\rho_{ab} = 1$) → no benefits of diversification
- Efficient frontier of risky investments = set of efficient (risky) portfolios = portfolios where no higher expected return can be obtained without increasing volatility
- Efficient frontier including risk-free investment
- Tangent portfolio earns highest **Sharpe Ratio** = $\frac{E(r_p) - r_f}{SD(r_p)}$

CAPM theory

Assumptions:

- *Efficient capital markets*
- *Mean – variance preferences*
- *Homogeneous expectations*

Tangent portfolio = efficient portfolio

→ Expected return of a stock i $E(r_i)$ $= r_f + \frac{\sigma_{iT}}{\sigma_T^2} (E(r_T) - r_f)$

$= r_f + \beta_i (E(r_T) - r_f)$

where β_i = **systematic**/undiversifiable **risk** = $\frac{\text{cov}(r_i, r_T)}{\text{var}(r_T)}$

Everyone holds tangent portfolio, independent of risk preferences → demand = tangent portfolio
Supply = market portfolio

→ **Tangent portfolio = market portfolio**

Efficient frontier incl. risk-free investment = capital market line
Security market line = expected return as a function of β (linear): all stocks fall along the SML

What if
- *No efficient capital markets: borrowing and saving rates differ*
  → Demand = T_{Saving} + $T_{Borrowing}$
- *No mean – variance preferences*
  If willing to hold inefficient portfolios → someone can earn α_i = $E(r_i) - (r_f + \beta_i (E(r_{Mkt}) - r_f) > 0$
- *No homogenous expectations*
  → Rational expectations are sufficient: holding market portfolio guarantees α_i = 0

4.2 Factor models

CAPM problems:

In practice, some portfolios earn $\alpha_i > 0$

How to identify the market portfolio?

→ **Arbitrage Pricing Theory**
- Well-diversified **factor portfolios** combined to form the tangent portfolio
- $E(r_i) = r_f + \sum_{n=1}^{N} \beta_i^{Fn}(E(r_{Fn}) - r_f)$
- Rewriting: $E(r_{Fn}) - r_f$ = return of **self-financing portfolio**
  - = portfolio weights sum to 0
  - $E(r_i) = r_f + \sum_{n=1}^{N} \beta_i^{Fn} E(r_{Fn})$
  - Selecting factor portfolios by holding short and long positions in stocks only
    E.g. Fama-French-Carhart Specification

4.3 CAPM in practice

Estimating beta
- Using historical data and linear regression
  $(r_i - r_f) = \alpha_i + \beta_i (r_{Mkt} - r_f) + \varepsilon_i$
  $E(r_i) = r_f + \beta_i (r_{Mkt} - r_f) + \alpha_i$
  - If $\alpha_i > 0$ → stock performed better than predicted by CAPM
  - If $\alpha_i < 0$ → stock lies below SML
  - Market proxy: use value-weighted portfolio
- Using average industry beta

Risk-free rate

Market risk premium
- Historical average excess return of the market
- Valuation model: $r_{Mkt} = \frac{Div_1}{P_0}$ + g = dividend yield + expected dividend growth

5.1 Capital structure in perfect markets

Assumption: perfect markets
Unlevered firm
$E(r_U) = r_f + \beta (r_M - r_f)$

Levered firm
MM Proposition I
- Total firm value is independent of its capital structure
- Allocation of cash flows changes, not total cash flow

MM Proposition II
- Leverage increases the risk/cost of equity!!
- Total cost of capital remains unchanged: $r_U = r_{WACC} = \dfrac{E}{E+D} r_E + \dfrac{D}{E+D} r_D$
- Unlevered beta $\beta_U = \dfrac{E}{E+D} \beta_E + \dfrac{D}{E+D} \beta_D$

Difficulties
- Net debt = debt − cash
- Leverage can increase EPS ≠ increase in stock price
- Issuing new shares does not dilute value of existing shareholders

5.2 Trade-off theory and optimal leverage

Taxes
Increasing debt → increases i**nterest tax shield** = corporate tax rate * interest payments
MM Proposition I with taxes
- $r_{WACC} = \dfrac{E}{E+D} r_E + \dfrac{D}{E+D} r_D (1 - \tau_C)$

Bankruptcy & distress costs
Increasing debt → increases risk of bankruptcy
! Risk of bankruptcy itself does <u>not</u> affect the firm's value
Costs associated with bankruptcy incur a deviation from MM
- Direct costs
- **Indirect costs of financial distress**

Agency costs
Increasing debt → agency costs
- **Asset substitution problem**: excessive risk taking due to financial distress
- **Debt overhang problem**: underinvestment or cashing out due to financial distress

Increasing debt → agency benefits
- Less cash on hand for manager to overspend on private perks

<u>Conclusion</u>: $V_L =$ V_U
                 + PV (interest tax shield)
                 − PV (financial distress costs)
                 − PV (agency costs of debt)
                 + PV (agency benefits of debt)
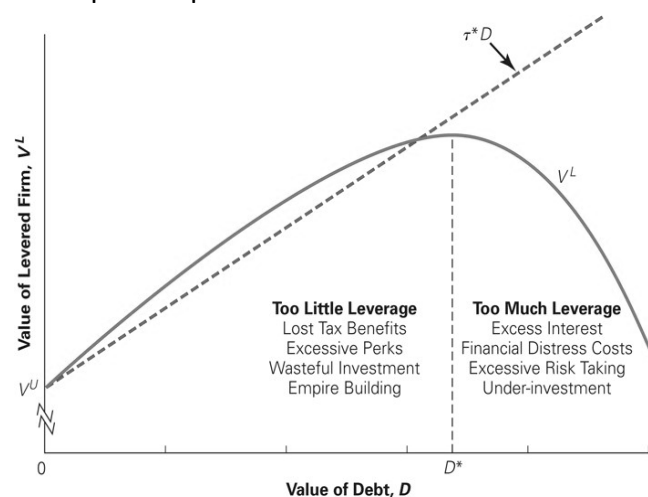
6. Capital budgeting and valuation with leverage

Assumptions:
- *Perfect markets with corporate taxes as only imperfection*
- *Market risk of any project = average market risk of the firm*
- *Debt-equity ratio d remains constant*
  Implementation: **debt capacity** $D_t = d * V_t^L$

6.1 WACC method
1. Calculate unlevered FCF
2. Compute after-tax WACC: $r_{WACC} = \frac{E}{E+D} r_E + \frac{D}{E+D} r_D (1 - \tau_C)$
3. Discount FCF at r_{WACC}

6.2 APV method
1. Determine unlevered value
   a. Calculate unlevered FCF
   b. Compute pre-tax WACC: $r_{WACC} = \frac{E}{E+D} r_E + \frac{D}{E+D} r_D$
      Pre-tax $r_{WACC} = r_U$ *if firm maintains target leverage ratio*
   c. Discount FCF at r_U
2. Determine PV (interest tax shield)
   a. Interest paid in year t = $r_D * D_{t-1}$
   b. Discount interests tax shield at r_U
3. $V_L = V_U + PV$ (interest tax shield)

6.3 FTE method
1. Calculate FCFE = unlevered FCF – $(1 - \tau_C)$ * interest + net borrowing
2. Compute equity cost of capital.
3. Discount FCFE at r_E

## 6.4 Project based cost of capital and other effects of financing
What if
- *Market risk and leverage of the project $\neq$ average market risk and leverage of entire firm*
  → Estimate unlevered cost of capital via similar firms
  → Apply APV or calculate r_{WACC} for WACC or r_E for FTE
- *Issuance and other financing costs*
  → Include fees in NPV
- *Security mispricing*
  → Include NPV of the transaction = actual money raised – true value of the securities sold
- *Financial distress and agency costs*
  → Affect FCF and raises cost of capital
  ➔ Unlevered cost of capital no longer independent of the firm's leverage

Part 2: (Real) options – when to invest?

7.1 Option methods in valuation and capital budgeting

Standard DCF	Dynamic DCF/decision tree analysis
Low uncertainty/flexibility	High uncertainty/flexibility = real options
Expected cashflows	Contingent cashflows
→ Lower bound on project value	→ Financial options (8.1 – 8.3)
	→ Valuing a levered firm (8.4)
	→ Capital budgeting (9.1 – 9.5)

7.2 Financial options basics
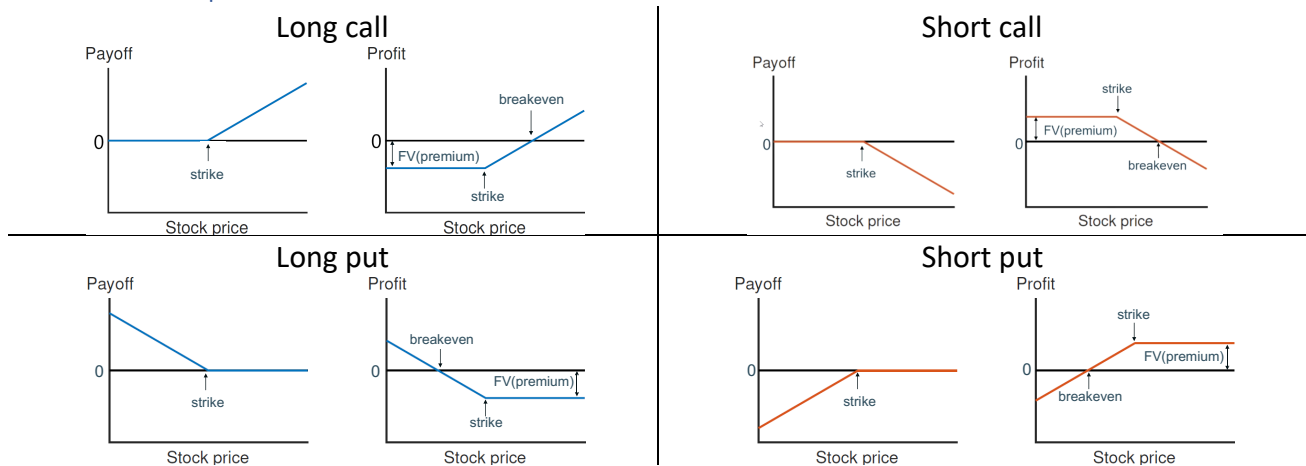
Put-call parity

$S_0 + P(K,T) = C(K,T) + PV_{0,T}(K)$

- Intrinsic value >< time value
    - Non-dividend-paying call

        C =   S – K   +   dis(K) + P

        = intrinsic value   +   time value

        → Exercising early never optimal: price European call = price American call
    - Non-dividend-paying put

        P =   K – S   +   C – dis(K)

        = intrinsic value   +   time value

        → Exercising early optimal when C < dis(K): price European put < price American put
- Including dividends

    $S_0 + P(K,T) = C(K,T) + PV_{0,T}(K) + PV_{0,T}(Div)$
    - Dividend-paying call

        C =   S – K   +   dis(K) + P – PV(Div)
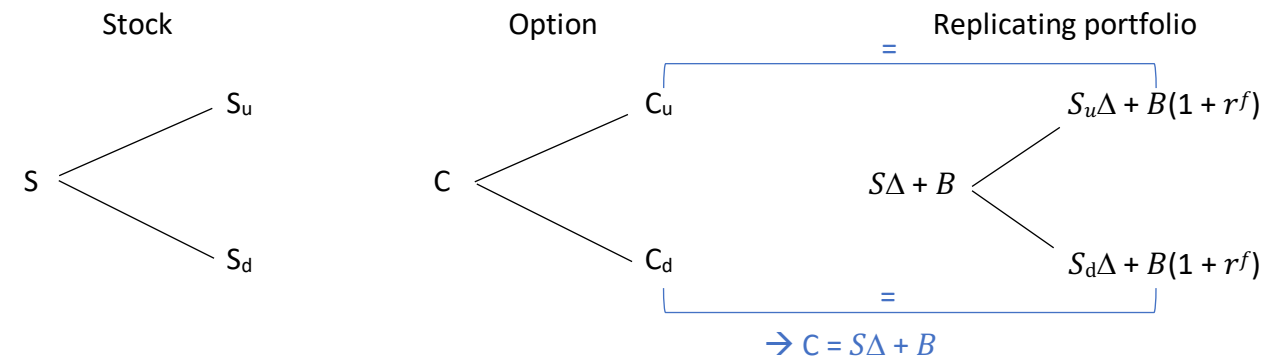
        = intrinsic value   +   time value

        → Exercising early can be optimal if PV(Div) large

Factors influencing option prices

Greek	Variable	C_{Eur}	P_{Eur}	C_{Amer}	P_{Amer}
Delta	S_0	+	-	+	-
Vega	σ	+	+	+	+
Theta	T	?	?	+	+
Rho	r	+	-	+	-
	K	-	+	-	+
	Div	-	+	-	+

8.1 Single-period binomial model

Stock

$$S \nearrow \begin{matrix} S_u \\ \\ S_d \end{matrix}$$

Option

$$C \nearrow \begin{matrix} C_u \\ \\ C_d \end{matrix}$$

Replicating portfolio

$$= $$

$$S\Delta + B \nearrow \begin{matrix} S_u\Delta + B(1 + r^f) \\ \\ S_d\Delta + B(1 + r^f) \end{matrix}$$

$$=$$

→ C = $S\Delta + B$

$$\beta_{option} = \frac{\Delta S}{\Delta S + B}\beta_S + \frac{B}{\Delta S + B}\beta_B = \underbrace{\frac{\Delta S}{\Delta S + B}}_{\text{Leverage ratio}}\beta_S$$
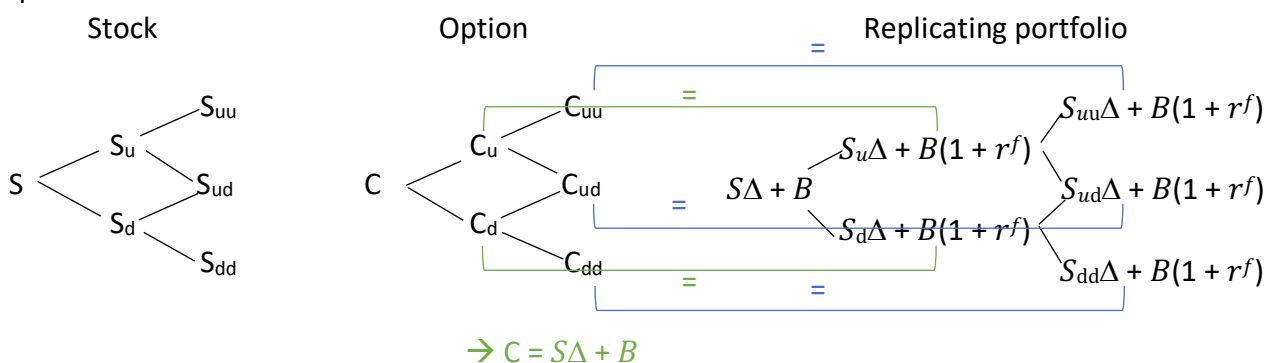
- Call option:
    - Buy Δ stock and borrow \$B → leveraged investment
    - Leverage ratio > 1 → $\beta_{call} > \beta_S$ → higher expected return than stock
- Put option:
    - Go Δ short in stock and lend \$B → hedged position
    - Leverage ratio < 0 → $\beta_S > 0$ implies $\beta_{put} < 0$ → lower expected return than stock

Risk-neutral valuation

- p* = risk-neutral probability: $\frac{p^* S_u + (1-p^*)S_d}{S} = 1 + r_f \Leftrightarrow$ p* = $\frac{(1+r_f)S - S_d}{S_u - S_d}$
- Used to discount risky cashflows:
    - Transform future payoff into certainty equivalent via p* → discount at r_f

    C = $\frac{1}{1+r_f}\left(\frac{(1+r_f)S - S_d}{S_u - S_d}C_u + \left(1 - \frac{(1+r_f)S - S_d}{S_u - S_d}\right)C_d\right) = \frac{1}{1+r_f}(p^* C_u + (1 - p^*)C_d)$
    - Equivalent to discounting expected cash flow at risk-adjusted discount rate
- Used in common simulation techniques for pricing derivative assets

8.2 Multiperiod binomial model

2-period binomial model

Stock

$$S \nearrow \begin{matrix} S_u \nearrow \begin{matrix} S_{uu} \\ S_{ud} \end{matrix} \\ S_d \nearrow \begin{matrix} S_{ud} \\ S_{dd} \end{matrix} \end{matrix}$$

Option

$$C \nearrow \begin{matrix} C_u \nearrow \begin{matrix} C_{uu} \\ C_{ud} \end{matrix} \\ C_d \nearrow \begin{matrix} C_{ud} \\ C_{dd} \end{matrix} \end{matrix}$$

Replicating portfolio

$$=$$

$$S\Delta + B \nearrow \begin{matrix} S_u\Delta + B(1 + r^f) \nearrow \begin{matrix} S_{uu}\Delta + B(1 + r^f) \\ S_{ud}\Delta + B(1 + r^f) \end{matrix} \\ S_d\Delta + B(1 + r^f) \nearrow \begin{matrix} S_{ud}\Delta + B(1 + r^f) \\ S_{dd}\Delta + B(1 + r^f) \end{matrix} \end{matrix}$$

→ C = $S\Delta + B$

Replicating portfolio (Δ and B) changes every time stock price changes
→ β_{option} changes everytime
→ no fixed cost of capital!

n-period binomial model
- $S_{t+h,u} = uS_t$ and $S_{t+h,d} = dS_t$ where u and d capture key features of stock returns : lognormal distribution (variance $h\sigma^2$, mean $h\mu$)
- n↑ → more realistic (limit n → ∞: Black-Scholes)

8.3 Black Scholes model

Assumptions:
- *Continuously compounded returns are lognormally distributed (volatility σ, mean μ)*
- *Perfect capital markets*

Non-dividend-paying stock
- Call $C = SN(d_1) - e^{-rT}KN(d_2)$
- Put $P = C - S + PV(K) = SN(d_1) - e^{-rT}KN(d_2) - S + e^{-rT}K$

Dividend-paying stock
Replace S by $S^X = S - PV_{[0,T]}(Div)$ = price excluding present value of any dividend prior to T
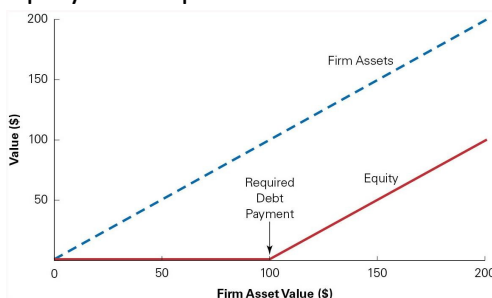
Replicating portfolio
- $C = S\Delta + B$
  - $\Delta = N(d_1) > 0$ → long position in stock
  - $B = -e^{-rT}KN(d_2) < 0$ → short position in bond
- $P = S\Delta + B$
  - $\Delta = -(1-N(d_1)) < 0$ → short position in stock
  - $B = e^{-rT}K(1-N(d_2)) > 0$ → long position in bond

Risk-neutral probabilities

$$C = e^{-rT}\left(N(d_2)\left(e^{rT}\frac{N(d_1)}{N(d_2)}S - K\right) + (1 - N(d_2)) * 0\right)$$

8.4 Capital structure options

Equity = call option on firm value

- S = firm value
- σ = volatility of firm value
- K = face value of debt
- T = time to maturity of debt
- r_f
- If firm value < K → equity holders receive 0
  ! If debt doesn't mature now, equity still has value !
- If firm value > K → equity holders receive firm value – K

- **Asset substitution problem**: equity holders invest in (reject) NPV < 0 (> 0) project if $\sigma\uparrow(\downarrow)$
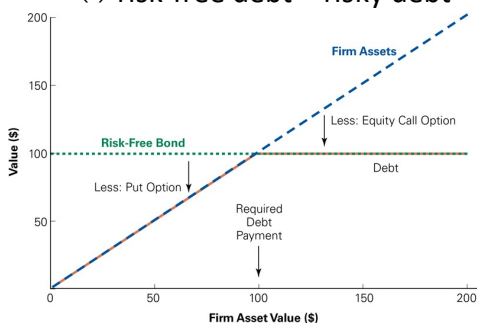- Replicating portfolio: E = AΔ + B

$$\beta_E = \beta_{option} = \frac{A\Delta}{A\Delta+B}\beta_A = \frac{A\Delta}{E}\beta_U = \frac{(E+D)\Delta}{E}\beta_U = \Delta(1 + \frac{D}{E})\beta_U$$

→ Can be used to estimate cost of capital of firm with <u>risky debt</u>

Debt = owner of firm value – call option on firm value
= risk-free bond – put option on firm value
⇔ risk-free debt = risky debt + **put option on firm value** (=**credit default swap**)

- S = firm value
- σ = volatility of firm value
- K = face value of debt
- T = time to maturity of debt
- r_f
- If firm value < K → debt holders receive firm value
- If firm value > K → debt holders receive K

9.1 Real options
Key: **uncertainty** & **flexibility**

Financial → real option
Many assumptions!!
- Underlying asset is traded (commodity investment)
  → Use replicating portfolio
- Underlying asset is not traded
  → Assume access to **twin security**
  - Start with standard DCF analysis: lower bound
  - Apply valuation technique for financial options

9.2 Option to defer and abandon
Option to defer
- ~ call option with PV(project) ~ S
- Higher value when
  - Lower lost cash flows ~ dividends
  - Higher irreversible investment costs ~ strike price
  - High uncertainty
→ Even if NPV > 0, deferring can be optimal!

Option to abandon
- ~ put option with PV(project) ~ S and salvage value ~ K
→ Even if NPV < 0, investing can be interesting!
→ Investing in flexibility is costly, but valuable

9.3 Growth options
~ call option with PV(cashflows from growth) ~ S and growth investment ~ K
- Compound option: $\beta_{\text{firm with growth option}} > \beta_{\text{firm with developed product}}$
→ Even if NPV < 0, investing can be interesting!

9.4 Choosing & staging projects with real options
- Choosing from independent projects (2.1: use Profitability Index)
- Choosing between mutually exclusive projects
  - Compare NPV over the same life span
  → Short-term investments are costly, but offer flexibility!
- Choosing optimal order of dependent projects
  - Start with <u>least expensive</u> project: defer high investment
  - Start with <u>riskier</u> project: learn more
  - Start with <u>lengthier</u> project: defer investment further
  → Rank by **Failure Cost Index** = $\frac{1-\text{PV(success)}}{\text{PV(investment)}}$
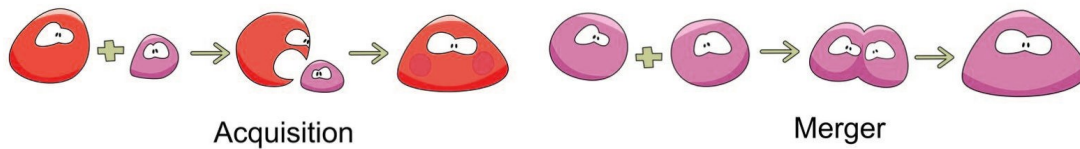
9.5 Real options in a market setting
A real option must have substantial value → **exclusivity** is required → no risk of pre-emption

Information acquired via
- Observing state of the world after competitor's action
  → **Second-mover advantage**
- Observing competitor's action
  → **Information cascade**

Part 3: Special topics
10. Mergers & acquisitions

Acquisition   Merger

Horizontal merger (→ market power, economies of scale, …)
↔ Vertical merger (→ coordination, reduction of bargaining costs, …)
↔ Conglomerate merger (→ diversification)

10.1 Stylized facts

- Large investments – huge economic significance
- Mergers occur in waves
    - Dominated by specific type of merger
    - Response to certain economic/technological development
    - Link with stock market (see ⭐)
    - Industry clusters
- Payment methods vary over time
- Acquisition premium
- Stock price acquirer upon announcement ↓
  Stock price target upon announcement ↑
  (see ✷)

10.2 Event studies

1. Choose estimation window
2. Define event window
3. Compute expected returns
   Market model: $R_{it} = \alpha + \beta R_{mkt} + \varepsilon_{it}$
   $\widehat{E(R_{it})} = \hat{\alpha} + \hat{\beta} R_{mkt}$
4. Compute abnormal returns
   $\widehat{AR_{it}} = R_{it} - \widehat{E(R_{it})}$
5. Test for statistical significance

10.3 Motives for mergers & acquisitions

$$NPV_A = V_{T+A} - V_A - (P_T + C)$$
$$= \text{value of merged firm} - \text{opportunity cost} - \text{total cost of acquisition}$$
$$= V_{T+A} - (V_T + V_A) - C - (P_T - V_T)$$
$$= \text{total NPV of acquisition} - \text{premium to target } (NPV_T)$$

If Net Economic Value ($NPV_A + NPV_T$) < NPV_T → acquirer overpays, but Net Economic Value can > 0

If Economic Value large enough → NPV_A can > 0

Motives (legitimate or not)
- Cost synergies (economies of scale/scope)
  BUT
  - Higher costs to manage
  - Antitrust authorities
- Vertical integration: coordination
  BUT
  - Small focused supplier may have lower cost
  - More power over small outside supplier than within firm
- Complementary resources
- Acquire market power
  BUT
  - Effect on merged firms unclear
  - Antitrust authorities
  - Also achievable via agreements
- Purchase of under-valued firm
  Low Q-ratio (= $\frac{\text{market value of capital}}{\text{replacement costs of assets}}$) → target
  High Q-ratio → acquirer
  BUT
  - Misvaluation-driven mergers don't generate value
- Correcting managerial failures
  - Threat of takeover has disciplining effect
- Diversification → tax benefits: losses can offset profits
  BUT
  - Diversification can be achieved by shareholders themselves
    However,
    - Diversification → larger debt capacity → tax shield
    - Private firms
- EPS growth
- Managerial objectives
  - Conflicts of interest
  - Overconfidence (11.1)

10.4 The takeover process (tender offer)

0. Formulate acquisition strategy + identify target
1. Valuation
   a. Status quo valuation target = **minimum** price offer
      - Discount target's FCF at target's WACC
      - Use comparable firms and multiples
      - Higher debt capacity = cost synergy
      - Higher debt tax shield = control benefit
   b. Valuation of control
      = V_T if optimally run − V_T with current management
   c. Valuation of synergies
      = V_{T+A} − (V_T + V_A)
   $\sum$ = **maximum** price offer
2. Tender offer: price, expiry date, min./max. nr of shares, method of payment
   Stock-swap merger has $NPV_A > 0$ $\leftrightarrow P_{T+A} > P_A$
            $\leftrightarrow xP_A < T + S$
            $\leftrightarrow$ **Exchange ratio** $= \dfrac{x}{N_T} < \dfrac{P_A}{P_T}\left(1 + \dfrac{S}{T}\right)$
3. Bidding process: competition ✸
   Hostile takeover (**unsolicited** tender offer and/or **proxy fight**)→ takeover defences
      - Poison pills
      - Staggered/classified board
      - White Knight
      - Golden Parachute
      - Recapitalization
      - …
   → Deter hostile bidder and/or raise price
4. End of bidding: decide to tender or not
5. Majority → control: exchange management + propose merger

10.5 The free-rider problem

Assumumption: dispersed shareholders
If $P_{old} <$ offer price B $< P_{new}$ → shareholders don't tender
If $P_{old} <$ B = P_{new} → shareholders tender, but raider gains nothing ✸
Solutions:
- Toehold
- Leveraged buyout
   o $P_{new} = V_{new} - x\%B$
   o Profit of raider = x ($P_{new} - 0$)

11. Overconfidence

Assumptions:

- *Irrational managers*
- *Rational investors, but with limited governance mechanisms*

Miscalibration or overprecision
= underestimate volatility/range of outcomes + overestimate precision of forecasts

Better than the average effect
→ optimism
→ illusion of control

11.1 Negative effects on corporate investment

Miscalibration

CFO survey on forecasting market returns and volatility shows:

- Confidence intervals too narrow
- Subjective volatility estimates too low   ⎤ CFO's are highly miscalibrated!
                                                 ⎦   (underestimating risk)

Miscalibration also in forecasting firm-specific variables;
Higher investment + higher leverage

Affects firm value!

Better-than-average effect

Measures of overconfidence based on underdiversified CEOs:

- **Holder 67**: postponed at least twice exercise of vested in-the-money options
- **Longholder**: held option until last year
- **Net buyer**: bought extra company equity

Alternative interpretations?

- Inside information, signalling, risk tolerance, taxes, procrastination
→ Don't hold!

Paper tests hypotheses and data provides support for:

- Overconfident CEOs → higher investment-cashflow sensitivity
- More investment-cashflow sensitivity in equity-dependent firms

Overinvest if sufficient cashflows
Underinvest if insufficient cashflows (not issuing equity)

Affects firm value!

Overconfidence as a motive for mergers & acquisitions
Miscalibration:
- Overconfident in own estimate
    → **Winner's curse**:
      o Takeover price > true target value
      o Takeover premium = valuation error
Better-than-average effect
- Overestimate ability to make merger work
    → Engage in negative NPV merger & destroy value
    → Market reaction is more negative for mergers announced by overconfident CEO

Solutions
- ~~Stock-based incentives~~
- Restrict financing: debt overhang
- Involvement of independent directors

11.2 Positive effects on corporate investment
Overconfidence can balance out risk aversion:
- Overconfident managers are greater innovators