Corporate Finance [Do not distribute beyond Cowell Fund]

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1 Introduction to Capital Markets

Corporate Investment and Finance Decisions

- Corporations pay for real assets by selling claims called financial assets or securities; securities are traded
- Capital budgeting or capital expenditure (CAPEX) is the determination of how to invest capital
- Capital structure decisions refer to the choice between debt and equity financing
- Types of corporations
  - Sole proprietorship
  - Partnership and limited partnership (LP)
  - Limited liability company (LLC); includes professional limited liability company (PLLC)
  - C Corporation
    - The CEO's goal is shareholder value (often share price) maximization
    - One or more people
    - Corporate tax
  - S Corporation
    - One or more people, but no more than 100, and all must be U.S. citizens
    - Personal tax
  - B Corporation
    - The CEO adheres to the interest of stakeholders—customers, workers, suppliers, communities, investors, and the environment—via the triple bottom line approach (profit, people, planet)
    - Corporate tax
  - Nonprofit
    - One or more people
    - Tax-exempt, but corporate profits can't be distributed
- Advantages of a corporation
  - Separation of ownership and management

The Financial Manager

- Financial Markets
  1. Cash raised by investors
  2. Cash invested in firm

3. Cash generated by firm's operations
4. Cash reinvested in firm
5. Cash returned to investors

- The financial manager's goal: value maximization by maximizing the honest share price
- Principal-agent problem: loss of value due to misaligned goals of the agent (financial manager) and principal (shareholder) known as agency costs

Present and Future Value

- Present value (PV): value today of future cash flow; PV = $\frac{C_t}{(1+r)^t}$
- Future value (FV): value in the future of current cash flow
- Discount rate: interest rate used to compute present value of future cash flow
- Discount factor (DF): present value of a \$1 future payment DF = $\frac{1}{(1+r)^t}$

Net Present Value

- NPV = PV - Investment = net sum of cash flows
- We choose the investment decision that results in positive net present value

Rate of Return

- Return = $\frac{\text{profit}}{\text{investment}}$
- We choose the investment decision with a rate of return higher than the opportunity cost of capital

Discounted Cash Flow (DCF) Formula for Multiple Cash Flows:

$$\text{PV} = \sum_{t=1}^{T} \frac{C_t}{(1+r)^t}$$

$$\text{NPV} = C_0 + \text{PV} = C_0 + \sum_{t=1}^{T} \frac{C_t}{(1+r)^t}$$

How to Value Perpetuities:

$$\text{Return} = \frac{\text{cash flow}}{\text{present value}}$$

$$r = \frac{C}{\text{PV}}$$

$$\text{PV} = \frac{C}{r}$$

How to Value Annuities (an asset that pays a fixed sum each year for a specified number of years):

$$\text{Present value of t-year annuity} = C\left[\frac{1}{r} - \frac{1}{r(1+r)^t}\right]$$

$$\text{Annuity due (a level stream of payments starting immediately)} = \text{ordinary annuity} * (1+r)$$

$$\text{PV of growing annuity} = C * \frac{1}{r-g}\left[1 - \frac{(1+g)^t}{(1+r)^t}\right]$$

Inflation

$$1 + \text{real interest rate} = \frac{1 + \text{nominal interest rate}}{1 + \text{inflation rate}}$$

$$\text{real interest rate} \approx \text{nominal interest rate - inflation rate}$$

Arbitrage

- Taking advantage of price differences in different markets for comparable goods; often short-lived as investors exploit opportunities and drive markets back to equilibrium
- Implications of no arbitrage: all securities are priced with the same discount factor, and securities with identical cash flows should be traded at the same price

Stocks

- Common stock: ownership shares in a publicly held corporation
- Dividend: periodic cash distribution from the firm to the shareholders
- Earnings: total revenue minus total cost
- Book value: net worth of the firm according to the balance sheet = total assets - total liabilities
- Market value: present value of future distributions

Valuing Common Stocks

- Expected return: percentage yield that an investor forecasts from a specific investment over a set period of time

$$\text{Expected return} = r = \frac{\text{Div}_1 + P_1 - P_0}{P_0}$$
$$= \text{Dividend Yield} + \text{Capital Appreciation}$$

- Dividend Discount Model: today's stock price equals the present value of all future discounts

$$P_0 = \sum_{t=1}^{\infty} \frac{\text{Div}_t}{(1+r)^t}$$

- Perpetuity: assumes no growth

$$\text{Perpetuity} = \frac{\text{Div}_t}{r} = \frac{\text{EPS}_1}{r}$$

- Growing Perpetuities: perpetuties that grow at a constant rate forever

$$PV = \sum_{t=1}^{T} \frac{C_t(1+g)^{t-1}}{(1+r)^t} = \frac{C_1}{r-g}$$

- Constant/Gordon Growth Model: dividend discount model where dividends grow at a constant rate

$$\text{Div}_t = \text{Div}_1 * (1+g)^{t-1}$$

- Expected return for constant growth

$$r = \text{Dividend Yield} + \text{Annual Growth Rate} = \frac{\text{Div}_1}{P_0} + g$$

- Return Measurements

$$\text{Dividend Yield} = \frac{\text{Div}_1}{P_0}$$
$$\text{Return on Equity (ROE)} = \frac{\text{Net Income}}{\text{Average Sharehlders' Equity}}$$

- Payout ratio: fraction of earnings paid out as dividends
- Plowback ratio: fraction of earnings retained by the firm

2 Bonds

Bonds

- Issuers: governments, municipalities, companies
- Contrary to the stock, bond holders do not own a company; they lend to a company
- Bond holders have priority over equity investors in case of a bankruptcy; equity investors are the residual claimants
- Order of priority during bankruptcy: secured debt, administrative claims, priority unsecured debt, general unsecured debt, equity holders (preferred stock then common stock)
- Bond holders receive interest payments called coupons each period until maturity and receive the principal at maturity
- Stream of cash flows is as follows: year 1 is C, year 2 is C, ..., year T is P + C
- Coupon yield = $\frac{C}{P}$
- What defines a bond:
  - Face value (principal), coupon (frequency, rate), maturity
- US Treasury Bonds have a face value of $1,000 and pay interest semi-annually
- Treasury bills mature in less than a year; notes mature in 10 years or less; bonds mature in over 10 years

Zero Coupon Bonds

- A zero-coupon bond, or a zero, maturing at time T is a bond that pays its face value at that time and no coupons prior
- Stream of cash flows: year 1 is 0, Year 2 is 0, ..., Year T is P
- Popular zero-coupon bonds are Treasury strips
- The fair value of a t-period zero is:

$$d_t = \frac{C_t}{(1 + r_t)^t}$$

Other Types of Bonds

- Floating rate bonds: bonds with a coupon rate that varies (often, it floats over the market interest rate like LIBOR or the US T-bill rate) and is reset on a pre-specified basis like every 3 months
- Index-linked bonds: coupons and principal grow in line with inflation; they are considered real, risk-free securities

Bonds with Option Features

- Callable bonds: can be repaid early; early repayment might be restricted to a specified date (European) or allowed any time prior to maturity (American)
- Puttable bonds: the redemption date is under the control of the holder (i.e., the opposite of callable bonds)
- Convertible bonds: corporations sometimes issue debt which can be converted into a share in the firm's equity

Default Risk and Bond Rating

- A bond obliges a borrower to repay nominal cash flows at specified dates; however, the borrower may be unable to meet obligations (default)
- If agent A is more likely to default than agent B, one would charge a higher rate of interest for agent A, reflecting a higher default risk premium

Bond Ratings

	Moody's	S&P's & Fitch
Investment Grade		
	Aaa	AAA
	Aa	AA
	A	A
	Baa	BBB
Junk Bonds		
	Ba	BB
	B	B
	Caa	CCC
	Ca	CC
	C	C

Valuing a Bond

$$\text{PV} = \sum_{t=1}^{T} \frac{C_t}{(1+r)^t}$$

Yield to Maturity

- YTM is an implicit, constant interest rate based on future cash flows and current price of a bond that makes the present value of future cash flows equal to current price
- Given a bond price, we let price equal PV equal to the bond valuation equation below and solve for y; y = YTM

$$\text{Price} = \sum_{t=1}^{T} \frac{C_t}{(1+y)^t}$$

- Par: market price = face value; YTM = coupon rate
- Discount: market price < face value; YTM > coupon rate; capital appreciation
- Premium: market price > face value; YTM < coupon rate; capital loss
- Yield is analagous to internal rate of return (IRR) and can be computed using the IRR function in Excel (=IRR(C_0, $[C_1, ..., C_t)]$))

Forward Rates

- The forward rate is the future one-period interest rate that is implied by the comparison of two zero-coupon bonds
- If we have a k-year zero and a (k-1)-year zero followed by a one-year zero at a predetermined rate, payoff(i) = $(1 + y_k)^k$, payoff(ii) = $(1 + y_{k-1})^{k-1}(1 + f_{t+k})$, and the forward rate from t+2 to t+3 is $(1 + f_{t+k}) = \frac{(1+y_k)^k}{(1+y_{k-1})^{k-1}}$

Yield Curve (Term Structure)

- Spot rate: the actual interest rate for a given period as of today (YTM on zeros)
- Forward rate: the interest rate, set today, on a loan made in the future at a fixed time, implied by two spot rates
- Future rate: the spot rate in the future, which is unknown
- What can we learn from the yield curve?

  - The following interpretations are according to the EH; the LPH says the slope is always positive, and the MSH says that we cannot infer much from the curve
  - Upward sloping: future short rates are expected to increase according
  - Downward sloping: future short rates are expected to decrease
  - Flat: future short rates are expected to remain constant
- What explains the shape of the yield curve?
  - The expectations hypothesis: investors are risk neutral
    * Strategy 1 invest in a k-period zero: $(1+y_k)^k$ - this is equivalent to investing in the zero
    * Strategy 2 invest at the short rate in period t, then at the short rate in period t+1, t+2, ..., t+k: $(1+r_t)...(1+r_{t+k})$ - this equivalent to investing in the short rate
    * When risk neutral, investing in the short rate is the same as just investing in the zero over a long period of time; forward rates are equal to expected future short rates
    * We can infer market expectations of future interest rates from the observed yield curve
  - The liquidity preference hypothesis: investors are risk-averse and prefer liquid cash because of flexibility and the ability to meet financial obligations
    * When faced with two identical investments, the investor will choose the short-term zero because he prefers liquid cash; this results in forward rates' liquidity premium; they are more expensive than future short rates
    * Upward-sloping yield curve
  - Market segmentation hypothesis
    * Long- and short-term bonds are traded in distinct, separated markets with their own equilibrium; therefore, there is no relation between the forward rate and the future short rate
    * Yield curve unrelated to short and long-term expectations/rates

Duration: the elasticity of price with respect to changes in yields; the % change in price associated with a 1% change in yield

$$\text{Macaulay D} = \sum_{j=1}^{N} \frac{\text{PV of cash flow j}}{\text{PV of all cash flows}} * j$$

$$= \sum_{j=1}^{N} \frac{\text{PV of cash flow j}}{\text{PV of all cash flows}} * \text{Duration of cash flow j}$$

$$= \frac{B_1}{B_1+B_2} D_1 + \frac{B_2}{B_1+B_2} D_2$$

$$\text{Modified Duration} = \text{D}^* = \frac{\text{D}}{1+\text{y}}$$

$$\frac{B_{new}-B}{B} \approx -D^* * \text{change in r}$$

- Macaulay Duration is the value-weighted average of the payment time of individual cash flows
- The weights are the proportion of the total value of the bond that is accounted for by each payment

Immunization

- A method to shield wealth from interest rate fluctuations; the goal is to set modified duration (D^*) to 0
- Company assets usually have longer durations than liabilities
- Net Worth Duration = $\frac{A}{A-L} D_A - \frac{L}{A-L} D_L$
- One can set modified duration to zero by converting cash into securities with longer durations like zero coupon treasury notes

$$\text{Amount to exchange} = \frac{\Delta\text{Portfolio duration * Portfolio value}}{\Delta\text{Asset duration}}$$

3 Risk

Attitude Towards Risk

- Risk averse; investors are usually risk averse → stock prices adjust to offer a premium for holding risky stocks
- Risk neutral
- Risk loving

Basic Statistical Measures

$$\text{Expected (Mean) Return} = E(R) = \sum_{s=1}^{S} R_s \rho_s$$

$$\text{Sample Average} = \overline{E}[R] = \overline{R} = \frac{1}{T} \sum_{t=1}^{T} R_t$$

$$\text{Population Variance} = Var(R) = E[R - E(R)]^2 = \sum_{s=1}^{S} [R_s - E(R)]^2 \rho_s$$

$$\text{Sample Variance} = \frac{1}{T-1} \sum_{t=1}^{T} (R_t - \overline{r})^2$$

$$\text{Standard Deviation} = Std(R) = \sqrt{Var(R)}$$

$$\text{Covariance} = Cov(R_i, R_j) = E[R_i - E(R_i) R_j - E(R_j)] = \sum_{s=1}^{S} [R_{is} - E(R_i) R_j s - E(R_j)] \rho_s$$

$$\text{Sample Covariance} = \overline{Cov}(R_t, R_j) = \frac{1}{T-1} \sum_{t=1}^{T} (R_{it} - \overline{r}_i)(R_{jt} - \overline{r}_j)$$

$$\text{Correlation} = \frac{Cov(R_i, R_j)}{Std(R_i) Std(R_j}$$

Notes on Covariance:

$$cov(Z, W) = cov(W, Z)$$

$$cov(Z, Z) = var[Z]$$

$$var[aZ] = a^2 var[Z]$$

$$cov(aZ, bW) = abcov(Z, W)$$

$$cov(Z_1 = Z_t W) = cov(Z_1, W) + cov(Z_2, W)$$

Portfolio Risk (assume x_1 and x_2 are portfolio weights):

$$E(x_1 r_1 + x_2 r_2) = x_1 E(r_1) + x_2 E(r_2)$$

$$Var(x_1 r_1 + x_2 r_2) = x_1^2 Var(r_1) + x_2^2 Var(r_2) + 2 x_1 x_2 Cov(r_1, r_2)$$

- Positive covariance: stock returns move together → greater risk/volatility/variance
- Negative covariance: stick returns move against one another → less risk/volatility/variance

Diversification

- Portfolio risk/standard deviation decreases as the number of securities increases; i.e., unique risk decreases

- However, market risk is always prevalent; the goal is for portfolio risk to asymptotically approach market risk
- Diversification: strategy to reduce risk by spreading the portfolio across many investments
- Unique risk (a.k.a. diversifiable risk): risk factors affecting only a specified firm
- Market risk (a.k.a. systematic risk): economy-wide sources of risk that affect the overall stock market

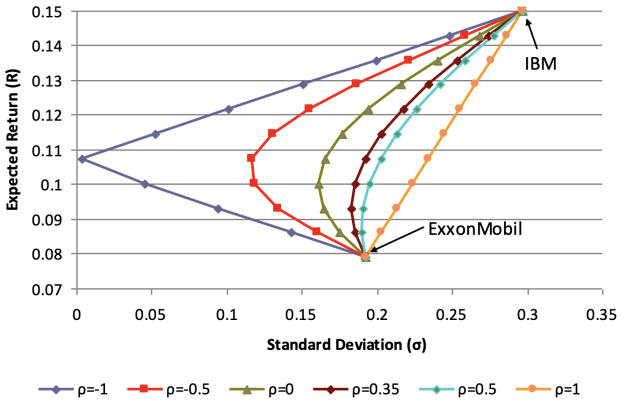
$$\text{Risk of a Share (Variance)} = \text{Market Risk of the Share} + \text{Specific Risk of the Share}$$

$$\text{Risk of a Portfolio} = \text{Market Risk of the Portfolio} + \text{Specific Risk of the Portfolio}$$

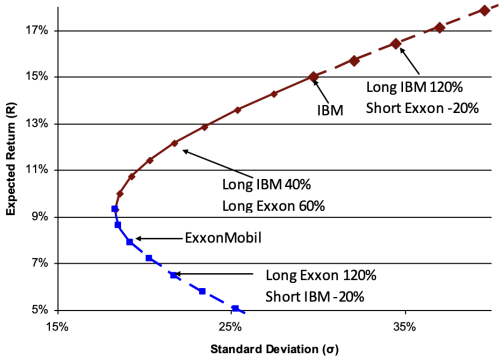
Markowitz Portfolio Theory

- Assumes that investors only care about (higher) expected returns and (lower) standard deviations; i.e., they hold Mean-Variance Efficient Portfolios
- Combining stocks into portfolios reduces standard deviation, holding the expected return constant

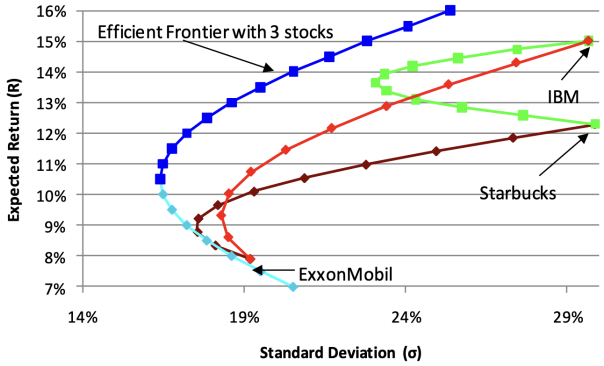
The Efficient frontier



- Efficient frontier: the upward sloping part of the portfolio frontier, which offers the highest expected returns given risk
- Note how the efficient frontier varies with correlation; this implies that lower correlations allow for more efficient portfolios; when ρ = -1, we can achieve a riskless portfolio
- Short-selling (the short position): selling and rebuying borrowed stocks in the hope that they will decrease in value; this carries a negative portfolio weight w $<$ 0
- The long position: a positive investment in a security with w $>$ 0
- See below how short-selling expands the efficient frontier



- See below for the efficient frontier with more than two stocks

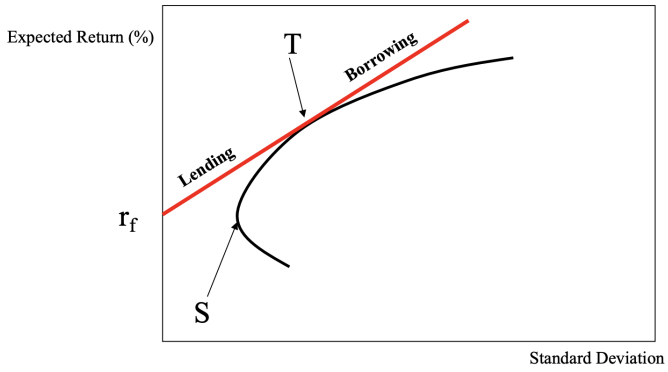


- Two features of efficient frontiers:
  1. A linear combination of two efficient portfolios is efficient
  2. Portfolios on the N-stock efficient frontier dominate the portfolios on 2-, 3-, N-1 stock frontiers

$$E(R) = (1 - x)$$

Efficient Frontier with Risk Free Asset

- Suppose that one can lend or borrow money at some risk free rate r_f; one can achieve any combination along the security market line (a.k.a. the capital market line or CML) connecting Treasury bills and the market portfolio in the graph below; the point T is the point of tangency and the optimal point along the efficient frontier, in which one should invest (but not necessarily all their money, depending on risk aversion)



- The borrowing portion of the line indicates "buying on margin," borrowing money (such as from a risk free asset like a T-bill) to invest in the market (key terms: leverage, margin call)
- The Sharpe ratio is the highest ratio of risk to standard deviation that gives the slope of that line; we want to maximize the Sharpe Ratio

$$\text{Sharpe ratio} = \frac{\text{Risk premium}}{\text{standard deviation}} = \frac{r - r_f}{\sigma} = \frac{E(r) - E(r_f)}{\sigma}$$

- Furthermore, we have the following where TP is the tangent portfolio:

$$E(R_{r_f+TP}) = \text{Expected return of a portfolio combination of } r_f \text{ and TP}$$
$$= \text{risk free rate} + \text{expected risk premium} = r_f + xE(R_{TP} - r_f)$$

- From the above, we have the following:

$$SD(R_{r_f+TP}) = xSD(R_{TP})$$

4 The Capital Asset Pricing Model (CAPM)

Assumptions

- There are N stocks and one riskless asset in the economy
- Each investor holds a mean-variance efficient portfolio
- Investors have a one-period horizon
- Investors have the same beliefs
- Market clears (i.e., demand = supply)
- All investors hold some combination of the tangent portfolio and the risk free asset; therefore, demand for risky assets is represented by the tangency portfolio

CAPM

- Suppose there are N stocks in the economy, and stock i has market capitalization (number of shares * price) V_i; the proportion of wealth allocated to asset i (a.k.a. the weight) is below:

$$w_i^M = \frac{V_i}{V_1 + ... + V_N}$$

- Furthermore, the market portfolio can be estimated by a value-weighted index of all stocks traded in the market
- Supply of all risky assets is the market portfolio; at market clearing, the market portfolio is the tangency portfolio

Deriving CAPM

- Because the market portolio is equivalent to the tangency portfolio, we find that the variance-adjusted risk premiums of all stocks are equal

$$\frac{E(r_A) - r_f}{Cov(r_A, r_M)} = \frac{E(r_M) - r_f}{Var(r_M)}$$

- This gives us the following security market line:

$$E(r_A) = r_f + \frac{Cov(r_A, r_M)}{Var(r_M)(E(r_M) - r_f)} = r_f + \beta_A(E(r_M) - r_f)$$

$$E(r_A) = r_f + \beta_A(E(r_M) - r_f)$$

- This implies that a market that has a higher covariance (is correlated more with the market) has a higher risk premium; a higher β implies higher covariance and higher returns
- $\beta = 0 \rightarrow E[r_j] = r_f$ as the asset does not contribute to the riskiness of an efficient portfolio
- $\beta > 0 \rightarrow E[r_j] > r_f$ as the asset decreases the riskiness of an efficient portfolio; investors require a risk premium
- $\beta < 0 \rightarrow E[r_j] < r_f$ as the asset decreases the riskiness of an efficient portfolio; the asset is valuable, and investors will buy it even if the expected return is lower than the risk free rate

Beta

- β represents a stock's sensitivity to overall movements in the market; $\beta = 1.1$ implies that the stock experiences more pronounced changes in price compared with the market (it is procyclical); $\beta = 1$ is the market sensitivity and can be represented by the S&P500

- We calculate β as the linear regression between the rate of return of a stock and the rate of return of the market
- Estimate expected returns for:
  - Project evaluation and selection
  - Benchmark to evaluate investment strategies (risk adjustment)
  - Evaluate performance of money managers

$$E(r_A) = r_f + \beta_A(E(r_M) - r_f + \alpha_i)$$

$$\alpha_i = E(r_A) - r_f - \beta_A(E(r_M) - r_f)$$

  - if $\alpha_i > 0$, the money manager is outperforming the market

Empirical Evidence on the CAPM

- High beta stocks have lower returns than predicted by the CAPM
- Low beta stocks have higher returns than predicted by the CAPM
- Estimation error in betas (noise) may explain part of this problem
- The Roll critique: we use a proxy for the market return rate; the market should include bonds, real estate, human capital, etc.; the real market portfolio is unobservable, and the CAPM cannot be tested
- We can try to improve the CAPM by:
  - Accounting for market frictions that limit borrowing, lending, and short selling
  - Accounting for consumption (Consumption CAPM); we consumer more than stocks
  - Accounting for multiple periods (Intertemporal CAPM)
  - Accounting for additional sources of risk (Arbitrage Pricing Theory or APT)
  - Multifactor pricing models: e.g., $r = r_f + \beta_{market} * (r_M - r_f) + \beta_{SMB} * r_{SMB} + \beta_{SML} * r_{HML}$
    - Farma-French three-factor model: considered market risk, size, and value;
      - Size: small minus big factor that small companies tend to outperform larger companies in terms of stock returns
      - Value: value stocks (stocks with low prices relative to book value) tend to outperform growth stocks (stocks with high prices relative to book value)

5 Market Efficiency

Efficient Market Hypothesis (EMH)

- An efficient market is one where prices always "fully reflect" available information (Fama) or one where no investor can make economic profits by trading on the basis of a given (public) information set (Malkiel)
- Underlying assumptions
  - Random Walk Theory: stock prices are random and unpredictable
  - Arbitrageurs (investors) have the capital and risk appetite to act on currently available information; they instantaneously eliminate predictable trends in stock prices
- Tests of EMH:
  - Unable to achieve abnormal returns (average returns that cannot be explained by risk factors)

  - Events studies: gauge effect of earnings/takeover announcements by estimating:

$$\text{Abnormal stock return} = \text{actual stock return - expected stock return}$$

$$\alpha = r - \beta(r_M)$$

Three Forms of Market Efficiency

- Weak form efficiency: market prices reflect all information on the history of stock prices → technical analysis (see below) is unprofitable
  - Chartism: look at a portion of a graph and analyze a particular portion via head and shoulders (HAS) approach
  - Moving average: calculate average price and buy when short-term moving average crosses above long-term moving average; sell when it crosses below
- Semistrong form efficiency: market prices reflect all publicly available information → fundamental analysis (analyzing financial statements, company performances, economic factors, etc.) is unprofitable; evidence for this: M&A and mutual funds
- Strong form efficiency: market prices reflect all information, both public and private → insider trading is unprofitable

Sources of M&A Value

- Economies of scale and scope
- Vertical integration
- Expertise
- Greater market power
- Efficiency gains
- Increase leverage and interest tax shield
- The above synergies are the most common justification the bidders give for the premium they pay for the target company

Behavioral Finance

- Provides explanations for market inefficiencies: psychological/social biases, limits to arbitrage due to market frictions, limited arbitrage capital/risk capacity

Challenges to the Efficient Market Hypothesis

- Intermediate-term stock price momentum: stocks that performed well in the past n (3-12) months tend to perform well in the following months
- Long-term stock price reversal: things that performed well in the past n (3-5) years tend to perform poorly in the following years
- Short-term stock price reversal: stocks that performed well in the past n (1-4) weeks tend to perform poorly in the following weeks
- Earnings announcement puzzle: stock prices don't increase/decrease as much as they should when earnings surprises are announced
- Twin-stock (-share) puzzle: Shell and Royal Dutch merged, but the stock price did not reflect the share of earnings; also Unilever in Netherlands vs. UK
- Bubbles: Dutch tulip in 17th century, railroad, real estate 2004-2008, dot com, Chinese stock market 2014-2015
- Limits to arbitrage: implementation costs (short-sell constraints result in limited capital), noise trader risk (traders act irrationally, resulting in mispricing in the short-run)

6 Futures and Options

Risk Management (Hedging)

- How firms choose their risk profile Consider a firm whose stock returns are

$$r_t = \alpha + \beta_1 F_{1t} + ... + \beta_n F_{nt} + \epsilon_t$$

- Fs are macro risk factors that are non-diversible; a firm can hedge to offset this position
- Firm-specific risk (ϵ_t) is diversifiable
- Risks to a business: financial distress, interest rate risk, variable costs, currency fluctuations, weather changes
- If a firm deviates from the Modigliani-Miller Theorem (a.k.a. M&M; the value of a firm is independent of capital structure when no financial frictions are present; financing, whether through debt or equity, doesn't affect a firm's market value), a firm can use derivatives (forwards, futures, options, swaps) to hedge risk

Forward Contracts

- Spot contract: a contract for the immediate sale and delivery of an asset
- Forward contract: a contract for the delivery of an asset or commodity at a predetermined price on a predetermined future date
- Going long: commit to buying the asset
- Going short: commit to selling the asset
- Cash settlement: settling the financial contract without exchanging goods (can sell/but in the market and repay difference)

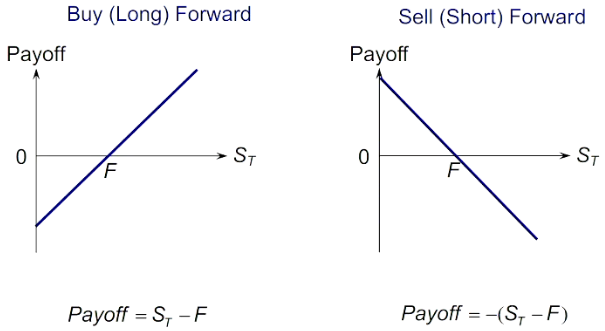
Futures Contracts

- Standardized, over-the-counter (OTC) "forward contracts"
- Eliminate counterparty risk as they are traded on exchanges (e.g., CME) and are standardized (clearing house is insured)
- Have margin requirement (collateral required in margin account; margin call if there is not enough money in the margin account) and are marked-to-market (MTM; recorded value is continuously adjusted to reflect market value; settled daily $\rightarrow$ daily cash flow)

Valuing Forwards

$$\text{Buyer's gain at maturity} = \text{price at maturity - forward price} = S_T + F$$

$$\text{Seller's gain} = -(S_T - F)$$



- The value of a forward on a non-dividend-paying stock where $r_{t,T}$ is the spot rate between years t and T, while F is the forward price at time 0:

$$V_t = S_t - \frac{F}{(1 + r_{t,T})^{T-t}}$$

- Forwards on dividend-paying stocks

$$V = (S - PV(Div)) - \frac{F}{(1 + r_T)^T}$$

- Forwards on commodities

$$F = (S - PV(\text{benefits}) + PV(\text{storage cost})) * (1 + r)$$

$$\text{Convenience yield} = \frac{B}{S} = \frac{\text{benefits}}{\text{price}}$$

$$\text{Net convenience yield} = \frac{(B - C)}{S} = \frac{\text{benefit - cost}}{\text{price}}$$

Options

- Option: the right to buy or sell a security at a specified price on or before a specified date
- Call option: the right to buy a security at a specified price on or before a specified date
  - Exercise when $S_T > K$; "in the money"
  - Do not exercise when $S_T < K$; "out of the money"
  - $C = max(0, S_T - K)$
- Put option: the right to sell a security at a specified price on or before a specified date
  - Exercise when $K > S_T$;
  - Do not exercise when $K < S_T$
  - Payoff $= max(0, K - S_T) - \text{Cost}$
- American option: can be exercised at any time prior to and on the expiration date
- European option: can only be exercised on the expiration date
- Strike price: predetermined price
- Notation: S - current price, C - call option price, P - put option price, K - strike price, T - maturity (expiration date)
- Put-Call Parity:

$$C - P = S - \frac{K}{(1 + r)^T}$$

- Binomial Model for Pricing Options

$$C = \frac{qC_{upstate} + (1 - q)C_{downstate}}{(1 + r)}$$

- q is the risk neutral probability of the up state

$$q = \frac{1 + r - d}{u - d}$$

7 Capital Budgeting: NPV and Real Options

Disadvantages of NPV

- Cash flows are difficult to estimate
- The discount rate is difficult to estimate
- Does not reflect the capital structure of a firm (debt and equity financing)
- Ignores interaction (like economies of scope)
- Ignores management discretion

Addressing these Disadvantages

- Taking in the capital structure via return on assets, we have the weighted average cost of capital (the new discount rate) where V = D + E:

$$R_A = \frac{D}{V}R_D + \frac{E}{V}R_E$$

  Beta of assets:

$$\beta_A = \frac{E}{D+E}\beta_E + \frac{D}{D+E}\beta_D$$

- After unlevering betas of comparison firms, we have the discount rate where r_A represents the cost of capital:

$$r_A = r_f + \beta_A(E(r_M - r_f)$$

- Note that we also have the following:

$$r_E = r_f + \beta_E(E(r_M - r_f)$$

$$r_D = r_f + \beta_D(E(r_M - r_f)$$

- This still needs to be supplemented with the real assets approach

Sources of Positive NPV (Sources of Competitive Advantages)

- Barriers to entry
- Economies of scale
- Economies of scope

Advantages of NPV

- Uses all cash flows
- Discounts them at the appropriate discount rate
- Respects value additivity
- There is an arbitrage argument that justifies NPV for riskless cash flows

"Embedded" Options

- Managers know that the adoption of any project allows future discretion (e.g., to cancel, downsize, or expand a project)
- Subsequent opportunities will only be pursued if they prove to be valuable
- There is no obligation the do these if unprofitable, but the right to do them if profitable

Real (A.K.A. Strategic) Options

- Future discretion to make profit-enhancing decisions
- Evaluated in the same way as financial options

Valuation Methods

- Tracking Portfolio Approach
$$PV = \frac{F_1 Q_1 - K_1}{(1 + r_1)} + \frac{F_2 Q_2 - K_2}{(1 + r_2)^2}$$
  - Where F is the forward price, Q is quantity, and K is cost
  - The cash flows and discount rates are now riskless

8 The Irrelevance of Capital Structure

Modigliani-Miller Proposition I

- Firm's total cash flow to debt and equity holders is not affect by financing choices
- No taxes; no transaction costs; no bankruptcy costs; no arbitrage opportunities (we like only the assumption of no arbitrage)
- Then, total market value of the firm is not affected by financing choices
- However, if one of these assumptions is violated, then the proposition is not true
- Proof by (absence of) arbitrage
  - Consider two firms U and L, identical except U is equity financed and L is leveraged (has debt D); they produce cash flows X
  - $V_U = E_U$
  - $V_L = D + E_L$
  - $V_U > V_L$
  - Earn arbitrage profit by buying outstanding debt and equity of L and short sell U
  - A reverse argument applies if $V_U < V_L$
  - Sell α of E_L and D; payoff = αE_L and αD; Buy $\alpha(\frac{V_L}{V_U})$ of E_U; payoff = $\alpha(\frac{V_L}{V_U})E_U$; payoff t=1 = $\alpha(1 - \frac{V_L}{V_U})X > 0$
  - Eventually, this opportunity disappears as we profit and decrease the supply of E_L and $E_L + D_L = E_U$
  - Note: $max(X - B_L, 0) + min(X, B_L) = X$
- Proof by homemade leverage
  - If an unleveraged firm leverages itself to buy back shares to increase EPS (earnings per share) for investors, this is the same as investors borrowing capital and buying more shares themselves
- Proof using risk neutral probabilities
  - The expected future cash flows of the firms are identical under the risk-neutral measure, and so, their values must be equal when these cash flows are discounted at the risk-free rate
- Implication of Proposition I A change in capital structure does not change firm value and thus cannot change rate of return on assets R_A This means that R_A is unaffected by D/E

MM Proposition II

- Suppose the assumptions of MM Proposition I hold. Then:
- The expected return on the common stock of a leveraged firm increases in proportion to the leveraged ratio D/E
- The rate of increase depends on the spread between returns R_A and R_D

$$R_A = \frac{E}{V}R_E + \frac{D}{V}R_D$$

$$VR_A = ER_A + DR_D$$

$$(D+E)R_A = ER_A + DR_D$$

$$\frac{(D+E)}{E}R_A = R_E + \frac{D}{E}R_D$$

$$R_E = R_A + \frac{D}{E}(R_A - R_D)$$

- Hence, increasing the D/E ratio increases the return on equity but does not affect the return on assets

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

- These equations are of important note for determining share price and number of shares from issuing debt or equity, where n = number of shares repurchased, P = price, and S = total shares:

$$nP = D$$

$$(S-n)P = E$$

9 Taxes and Capital Structure

Corporate Tax Code

- Corporations pay tax and debit is tax deductible
- We get the following for cash flows of a leveraged firm U: $[X(1-T_C) + RTD$ where X = cash flow, T_C = corporate tax, R = net rate (dividend on debt), D = debt; RTD is the interest tax shield
- We get the following for cash flows of an unleveraged firm: $X(1-T)$
- Thus $V_L = V_U + TD$

WACC (Weighted Average Cost of Capital) with Tax Shield

$$R_{WACC} = \frac{D}{V}R_D(1-T_C) + \frac{E}{V}R_E$$

Trade-off Theory of Capital Structure

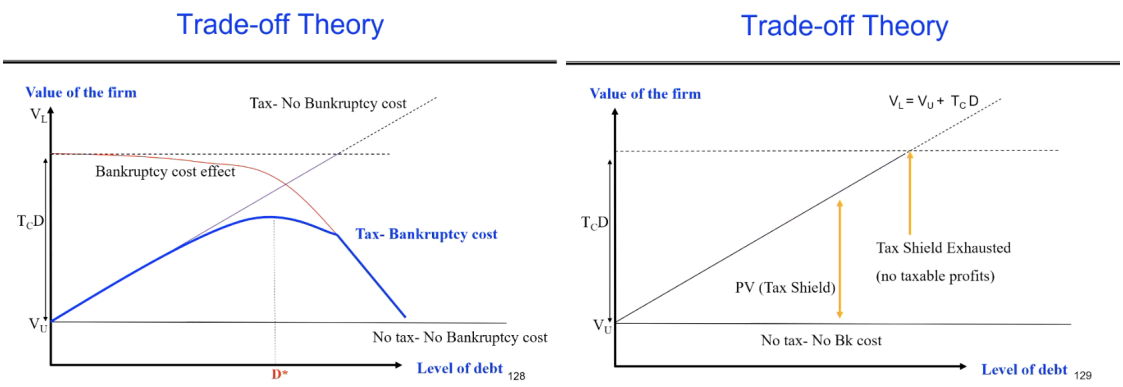
$$V_L = V_U + \text{PV(tax shield)} - \text{PV(financial distress/bankruptcy costs)}$$

Bankruptcy

- A legal method for the transfer of ownership from equity-holder to debt-holders
- Costs of bankruptcy: legal, physical liquidation, other indirect
- Indirect costs:
  - Cutting profitable new investments

- Financial distress and unable to respond to competition like Hyundai 2008 car buyback insurance
- Customer, supplier, employee relations
- Assets sold at fire-sale prices because they are specific, with a limited number of other buyers; can explain why tech firms (semiconductor, software) have extremely low leverage; more serious when the whole sector is in distress

Trade-off Theory



The Miller's Critique

- Bankruptcy costs are low compared to tax benefits they balance
- Other forms of debt like income bonds have lower bankruptcy implications but are still rarely used
- Companies do not issue too much debt because they don't want to pay personal taxes
- Shareholders receive $(1 - T_C)(1 - T_E)$ and bondholders receive $(1 - T_D)$ profit where T_E is personal tax on equity (weighted average of tax on dividends and capital gains) and T_D is personal tax on debt
- Effective tax advantage of debt is given by:

$$T^* = 1 - \frac{(1 - T_C)(1 - T_E)}{(1 - T_D)}$$

$$V_L = V_U + T^* D$$

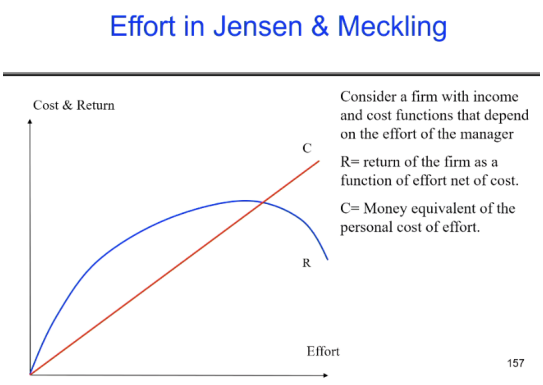
- For tax-exempt institutions like mutual funds, pension funds, and endowments, T^* is very close to T_C
- However, there is no empirical evidence for firms with higher taxable earnings having more debt; there is no relationship between EBIT and leverage; firms with the highest EBIT have very low leverage

10 Agency Conflicts, Asymmetric Information, and Capital Structure

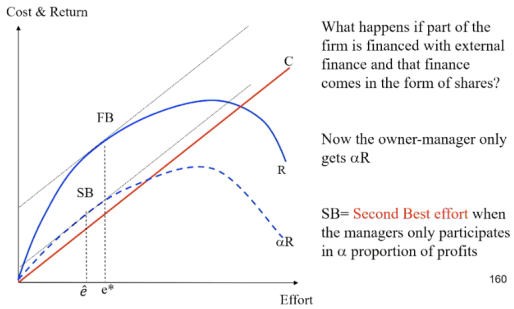
Harris-Raviv Classification of Approaches to Capital Structure

- Agency approach: agents (managers) and principals (shareholders) have distinct objectives
  - Free cash flow problem: when excessive free cash flow leads to over-investment such as the oil industry in the 70s (high interest rates and oil prices; they invested in drilling new oil fields, which had a negative NPV instead of returning money to shareholders) and Occidental Petroleum (CEO Hammer performed poorly; stock price went up when he entered the ICU)
  - Solutions: give the manager a share of the firm; more debt (more owned by the manager; less "free cash" and "empire building")

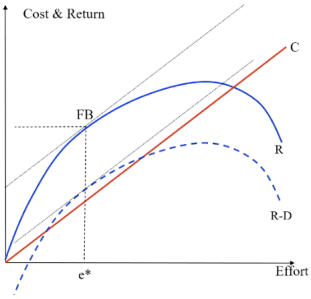
– See effort in Jensen and Meckling below where C = money equivalent to personal cost of effort and R = return of firm as function of effort



– We want $\frac{\partial R}{\partial e}R(e) = C$



– See below how debt financing causes a parallel shift of R, so the level of effort is unaffected



– The manager optimizes $R(e) - D - C(e)$ where $R'(e) = C$

– Sealed Air Corporation: increased debt ratio; operating income increased by 65% and total market value increased by 80%

– Downsides of debt

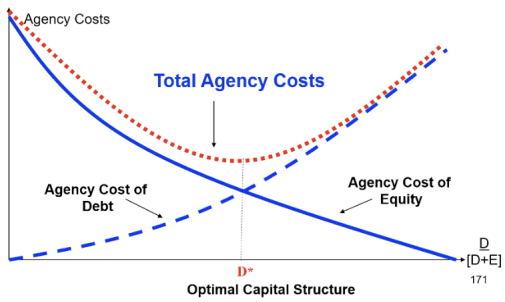
  * Debt leads to a different set of conflicts of interest between shareholders and debt-holders
  * Shareholders maximize their value, and do not care about the value of debt; they gamble and invest in negative NPV projects
  * Underinvestment problem
  * Equity-debt holder conflicts

– Other solutions

  * Options as compensation; doesn't really work that well; could reward luck instead of skill; incentives risk-taking and earnings manipulation (increasing stock prices only for short periods of time)
  * Takeovers discipline bad managers; very costly; free riding problems (all shareholders think that some other shareholder will pay the cost of takeover)

- Asymmetric information approach
- Product/input market interactions
- Corporate control considerations

Trade-off Theory (minimizing agency costs)



Equity-Debt Holder Conflict

- Debt overhang: leads to underinvestment; when a firm's debt load causes it to pass up positive NPV projects because borrowing is too costly or impossible
- Asset substitution problem (a.k.a. risk-shifting): leads to overinvestment; equity holders invest in negative NPV projects because equity has the structure of a call option, which skews incentives
- Reluctance to liquidate: equity holders may hope that things will improve and have less of an incentive than debt holders to liquidate, especially because debt holders have priority
- Private benefits, perks
- Asset stripping: buying companies and selling off their assets, while leaving the rest of the company to decline (corporate raids)
- Shortsighted investments

Risk-Shifting in Practice (debt dilution)

- Spinoffs of safer part of business (Marriott)
- Play for time: postpone efficient liquidation in hope of a miracle
- Making excessive dividends or share repurchases
- Using cash or senior debt to take over a risky firm (Nabisco)

Solutions to the Equity-Debt Holder Conflict

- Protective debt covenants
  - Examples: restrict how much additional debt a company can raise; limit dividends, share repurchases, sale of assets
  - Limitations: hard to foresee all eventualities like COVID; hard to force investors to take positive NPV projects
- Bank and privately placed debt
  - Solves the free rider issue that exacerbated debt overhang; allows for direct monitoring, long-term relationships; more flexible than debt covenants
  - Problems: bank debt is more costly; relationship lending can lead to a "hold-up" problem
- Short-term rather than long-term debt

  - Provide financing in stages; debt-holders can cut off financing
  - Problems: exposure to interest rate changes

- Security design
  - Example: convertible bond (holder can exchange bond for shares of a firm); empirical evidence by Mikkelson that shows they are issued by highly-leveraged, high-growth firms

Asymmetric Information Approach

- Insiders know more about the firm than outsiders
- Capital structure shows the strength of a company
- Dynamic theory of capital structure: capital structure arises in stages according to the pecking order (retained earnings → debt → equity)
- Pooling equilibrium: bad firms imitate good firms; investors cannot separate the two
- Separating equilibrium: Good firms separate themselves (at a cost) from bad firms
- Myers-Majluf Model: bad firms self-select to issue equity (adverse selection); if both good firms and bad firms issue equity, good firms have to "subsidize" bad firms by taking a lower price; this prevents good firms from issuing equity; justifies the pecking order
- Implications for equity issuance: stock prices decline after the announcement of equity issue and rise prior; firms issue equity when information asymmetries are small (e.g., after earnings announcements); Lucas and McDonald empirical evidence
- When firms increase leverage, stock prices increase; when firms decrease leverage, stock prices fall

11 Dividend Policy

Dividend Policy versus Payout Policy

- Payout policy: how much of a firm's profits should be returned to shareholders
- Dividend policy: how much should be paid in dividends
- Methods of paying back shareholders: share repurchases and dividends
- Modigliani-Miller says dividend policy is irrelevant under similar assumptions as the other propositions
- However, the tax on capital gains (20%) is lower than the tax on dividends (40%), so share repurchases are encouraged

Why Do We Pay Dividends

- Dividend clienteles: transaction costs apply to stock repurchases; also, some shareholders (pension funds, university endowments, etc.) are exempt from taxes; firms choose different dividend policies to attract different clients; not much empirical support
- Asymmetric information: firms have long-run target dividend payout ratios and are more worried about changes in dividends than levels → dividends are signals (dividends up → stock price up); this explains why mangers don't want to adjust dividends; this way good firms separate themselves from bad firms as only good firms can increase dividends; weaker signal than leverage; does not trigger default like not paying back debt; caveat: firms may pay high dividends if they lack future investment opportunities and may cut dividends to finance positive NPV projects; example: Intel 1992 dividends → 1.2% increase in price

12 Initial Public Offerings

Advantages of Going Public

- Directly raise new finance
- Indirectly raise new finance: extra liquidity, transparency and the release of information
- Publicity
- Possibility of market price based incentives for managers
- New ownership
- Opportunity to cash in and leave management
- Good timing may allow to exploit mispricing

Disadvantages of Going Public

- Direct issue costs
- Listing/compliance costs
- Underpricing
- Costs of dealing with shareholders
- Information revealed to competitors

Choice of Intermediary

- Going public is intermediated (unless direct IPO) by underwriters (IBs or IB consortiums who do marketing and underwriting)
- Types of IPOs: firm commitment and best effort
- Methods of IPO: fixed price (firm price is announced early) and bookbuilding (a price range is announced early and a firm price later)

Role of Underwriters

- Due diligence: valuation by DCF, real options, peer group
- Pre-marketing: phone calls with potential institutional customers and solicit feedback
- Publication of initial (or final) prospectus: called a red-herring or preliminary/pathfinder prospectus that includes pricing
- Go on a "road show" with the prospectus and talk with investors
- Pricing and allocation: decide on final price and put in final prospectus

Firm Commitment versus Best Effort IPO

- Firm Commitment
  - Preliminary prospectus with tentative price before road show
  - Final prospectus where underwriter commits to a price, less an underwriting discount
  - Underwriter sells shares
  - More risky for the underwriter because they guarantee to sell at a certain price; undersubscribed $\rightarrow$ underwriter can sell at a lower price

  - Greenshoe option: underwriter may get an extra 15% (max) of additional shares
  - Large IPOs generally use firm commitment
- Best Effort
  - Firm and underwriter agree on offer price and number of shares to be sold
  - Underwriter makes best effort to sell but can withdraw
  - Typically for small IPOs

Under- and Oversubscription (Fixed Price)

- Undersubscription: sell all demanded shares at fixed price
- Oversubscription: must ration
- Fixed price offerings are often heavily regulated
- Pro-rata rationing, discriminatory rationing, random rationing

Book Building

- Preliminary prospectus only has indicative price range
- Investment bank decides on a group of investors who can participate in the marketing phase
- During the marketing phase, selected investors are invited to bid; limit bids (buy shares only if the price is below a certain price); step bids (buy shares at different stages of pricing); step bids are more informative
- Price range can be revised during book building
- Pricing and allocation occurs at conclusion
- The purpose of book building is to gather information from investors to determine the right price
- No formal auction rules (demand doesn't have to match supply) in pricing and allocation phase
- Secrecy over allocation rules to produce returns for investors

Formal Auctions

- Done until the 1980s
- Uniform Price Auction: investors submit how many shares they demand at each price; selling price is highest such that whole issue is sold; all bidders who submitted demand at or above selling price get to buy at selling price; Google IPO 2004
- Gets rid of underpricing; lower IB fees; fair access and allocation; however, underpricing is still present

After the IPO

- Sometimes IB has no further role
- Sometimes IB plays role in price stabilization
- Overallotment option: can short sell (oversell) up to 10-15% of shares at offer price; option exercised if demand is high; shares bought back if demand is low
- Underwriters act as market makers in the stock, provide analyst coverage for the company, and provide future seasoned equity offerings

Costs of IPO

- Empirically 7% in the US
- Fixed costs (marketing, legal, accounting) and variable costs (selling commissions)
- Price paid to IB is expressed as spread
- Spread decreases as a function of size

IPO Puzzles

- Underpricing: first-day trading prices typically exceed IPO price
  - $>$ 15% in industrialized countries; $>$ 60% in developing countries
  - Varies with method
  - Netscape 1995 and Google 2004
  - Higher in best effort IPOs (IPO $<$ \$2M) vs firm commitment (IPO $>$ %10M)
  - Owners lose and shares are diluted; investors gain
- Underpricing and volume: cycles in underpricing and volume of IPOs; IPOs come in waves; IPO volume is positively autocorrelated (likely to be high in following years if it is high in current years)
- Long run underperformance: IPO shares do worse than similar firms over several years
  - Ritter observed that people who buy on the first day and sell 3 years later underperform similar companies by 30%
  - Behavioral explanations: clever entrepreneurs take their firms public when overvalued $\rightarrow$ price declines overtime; example: Coinbase

Theories of Underpricing

- Noninformational I: companies are worried about companies suing if they lose money; no good empirical evidence; underpriced IPOs sue more often
- Noninformational II: corporate shareholders buy blocks of shares in IPOs; current management don't like this and generate excess demand by underpricing; evidence is weak
- Informational I: underpricing "leave[s] a good taste in the mouths of investors"; assymetric information theory
- Informational II: underpricing is a signal; good firms can undertake losses and lower prices; evidence is weak
- Informational III: underwriters extract information during the road show in the book building method; investors must be given incentive in the form of underpricing
- Informational IV: underwriters reward investors for information gathered in the book building process; underpricing is more pronounced when there is higher demand during the book building phase; Hanley (1993) finds this
- Informational V: Winner's Curse Model (the person who buys the item believes they have overpaid, while other informed investors did not); informed investors avoid the winner's curse and buy at a lower price
- Informational VI: underpricing is sufficient to produce zero returns for uninformed investors