

QUANTITATIVE METHODS

THE TIME VALUE OF MONEY

Required Rate of Return

interest rate = real risk-free rate
 + inflation premium
 + default risk premium
 + liquidity premium
 + maturity premium

FUTURE VALUE (FV) AND PRESENT VALUE (PV)

$$FV = PV(1 + r)^N$$

Effective Annual Rates

$$EAR = \left(1 + \frac{r_{stated}}{m}\right)^m - 1$$

$$EAR_{continuous} = e^{r_{stated}} - 1$$

Annuities

Annuity: Finite set of level sequential cash flows, valued using calculator's TVM function

Ordinary Annuity: 1st cash flow received in one year

Annuity Due: 1st cash flow received immediately

Perpetuity: Ordinary annuity with payments that continue forever, $PV_{perpetuity} = \frac{PMT}{r}$

ORGANIZING, VISUALIZING, AND DESCRIBING DATA

Data Visualization

- Histogram and frequency polygon
- Bar chart (and Pareto chart)
- Tree-map
- Word cloud/tag cloud
- Line chart (and bubble line chart)
- Scatter plot (and scatter plot matrix)
- Heat map

Arithmetic Mean Return

$$\text{Sample mean, } \bar{X} = \frac{1}{n} \sum_{i=1}^n X_i ; n = \text{sample size}$$

Geometric Mean Return

$$R_G = \sqrt[n]{\prod_{t=1}^T (1 + R_t)} - 1$$

Harmonic Mean Return (Cost Averaging)

$$\bar{X}_H = \frac{n}{\sum_{i=1}^n \frac{1}{X_i}}, \text{ where } X > 0 \text{ for } i = 1, 2, \dots, n$$

If returns are volatile, $\bar{X}_{Arith.} > \bar{X}_{Geo.} > \bar{X}_{Har.}$

Quantiles

Location of y^{th} percentile, $L_y = (n + 1) \frac{y}{100}$

If L_y is not an integer, use linear interpolation.

Distributions may be divided into quarters

(Quartiles), fifths (Quintiles), or tenths (Deciles)

E.g., 50th percentile = 2nd quartile = 5th decile

Mean Absolute Deviation

$$MAD = \frac{1}{n} \sum_{i=1}^n |X_i - \bar{X}|$$

Variance and Standard Deviation

$$\text{Sample variance, } s^2 = \frac{1}{n-1} \sum_{i=1}^n (X_i - \bar{X})^2$$

Standard deviation is square root of variance

Target Downside Deviation

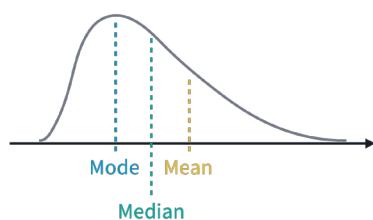
$$\text{Sample target semideviation, } s_{\text{Target}} = \sqrt{\frac{\sum_{X_i \leq B} (X_i - B)^2}{n-1}}$$

Coefficient of Variation

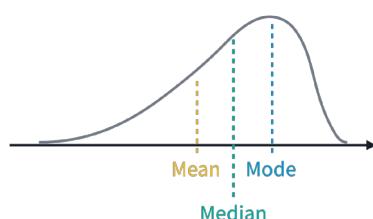
$$CV = s/\bar{X}; \text{ measures dispersion relative to mean}$$

Skewness

Distribution Skewed to the Right
(Positively Skewed)



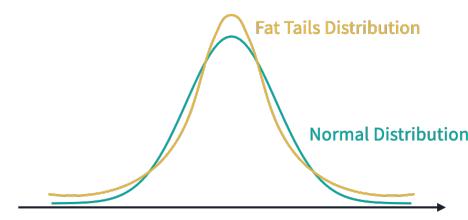
Distribution Skewed to the Left
(Negatively Skewed)



$$\text{Skewness} \approx \left(\frac{1}{n}\right) \frac{\sum_{i=1}^n (X_i - \bar{X})^3}{s^3}$$

Kurtosis (Excess Kurtosis = Kurtosis - 3)

Distribution	Tails	Peaked	Kurtosis
Leptokurtic	Fatter	More	>3
Mesokurtic	Normal	Normal	3
Platykurtic	Thinner	Less	<3



$$\text{Excess kurtosis, } K_E \approx \left(\frac{1}{n}\right) \frac{\sum_{i=1}^n (X_i - \bar{X})^4}{s^4} - 3$$

Sample Covariance

$$s_{XY} = \frac{\sum_{i=1}^n (X_i - \bar{X})(Y_i - \bar{Y})}{n-1}$$

Sample Correlation Coefficient

$$r_{XY} = \frac{s_{XY}}{s_X s_Y}$$

PROBABILITY CONCEPTS

Odds

$$\text{Odds of } E = \frac{P(E)}{1 - P(E)}$$

Probabilities

Unconditional: $P(A)$, probability of A

Conditional: $P(A|B)$, probability of A given B

Joint: $P(AB)$, probability of A and B

Probability Rules

Conditional: $P(A|B) = P(AB)/P(B)$

Multiplication: $P(AB) = P(A|B) \times P(B)$

Addition: $P(A \text{ or } B) = P(A) + P(B) - P(AB)$

Total: $P(A) = P(A|S_1)P(S_1) + \dots + P(A|S_n)P(S_n)$
 where S_1, S_2, \dots, S_n is an exhaustive set of mutually exclusive probabilities

Independence

If A and B are independent events,
 $P(AB) = P(A) \times P(B)$

Expected Value

$$E(X) = \sum_{i=1}^n P(X_i)X_i$$

$$E(X) = E(X|S_1)P(S_1) + \dots + E(X|S_n)P(S_n)$$

Variance

$$\sigma^2(X) = \sum_{i=1}^n P(X_i)[X_i - E(X)]^2$$

$$\text{Cov}(X, Y) = \sum_{i=1}^n \sum_{j=1}^n P(X_i, Y_j)[X_i - E(X)][Y_j - E(Y)]$$

An asset's covariance with itself is its variance

EXPECTED VALUE & VARIANCE OF PORTFOLIO RETURN

$$E(R_p) = \sum_{i=1}^n w_i E[R_i]$$

$$\sigma^2(R_p) = \sum_{i=1}^n \sum_{j=1}^n w_i w_j \text{Cov}(R_i, R_j)$$

$$w_i = \frac{\text{Market value of investment } i}{\text{Market value of portfolio}}$$

For portfolio with 2 investments:

$$E(R_p) = w_A R_A + w_B R_B$$

$$\text{Cov}(R_A, R_B) = \sigma(R_A)\sigma(R_B)\rho(R_A, R_B)$$

$$\sigma^2(R_p) = w_A^2\sigma^2(R_A) + w_B^2\sigma^2(R_B) + 2w_Aw_B\text{Cov}(R_A, R_B)$$

Correlation

$$\rho_{i,j} = \text{Corr}(R_i, R_j) = \frac{\text{Cov}(R_i, R_j)}{\sigma(R_i)\sigma(R_j)}; \min -1, \max 1$$

Bayes' Formula

$$P(\text{Event}|\text{Info}) = \frac{P(\text{Info}|\text{Event}) \times P(\text{Event})}{P(\text{Info})}$$

Updates prior probabilities to give posterior probabilities based on new information

Counting Rules

Factorial: $n! = n(n-1)(n-2) \dots 1$

$$\text{Multinomial: } \frac{n!}{n_1!n_2!\dots n_k!}$$

Counts ways to label n items with k labels

$$\text{Combination: } {}_n C_r = \binom{n}{r} = \frac{n!}{(n-r)!r!}$$

Counts ways to choose r items from n if order does NOT matter

$$\text{Permutation: } {}_n P_r = \frac{n!}{(n-r)!}$$

Counts ways to choose r items from n if order does matter

COMMON PROBABILITY DISTRIBUTIONS

Discrete Uniform Distribution

$$p(x) = \frac{1}{n}, \quad x = x_1, x_2, \dots, x_n$$

Continuous Uniform Distribution

$$f(x) = \frac{1}{b-a}; \quad a \leq x \leq b$$

$$F(x) = \frac{x-a}{b-a}; \quad a \leq x \leq b$$

Binomial Distribution

$$p(x) = \binom{n}{x} p^x (1-p)^{n-x}, \text{ where}$$

n = number of Bernoulli trials

p = probability of success

$$E(X) = np$$

$$\sigma^2(X) = np(1-p)$$

Normal Distribution (μ = mean, σ = SD)

~50% of observations are within $\pm \frac{1}{2}\sigma$ of μ

~68% of observations are within $\pm \sigma$ of μ

~95% of observations are within $\pm 2\sigma$ of μ

~99% of observations are within $\pm 3\sigma$ of μ

$$Z = \frac{\text{Observed value} - \text{Population mean}}{\text{Standard deviation}} = \frac{X - \mu}{\sigma}$$

$$\text{Shortfall Ratio} = \frac{E(R_p) - \text{shortfall level}}{\sigma_p}$$

Lognormal Distribution

- e^X where X is normally distributed

- Used to model asset prices

- Positively skewed

Continuously compounded return from t to $t+1$:

$$r_{t,t+1} = \ln\left(\frac{S_{t+1}}{S_t}\right) = \ln(1 + R_{t,t+1})$$

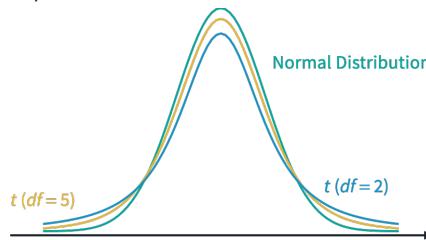
where $R_{t,t+1}$ is the effective annual rate

Student's t-Distribution

Parameters: degrees of freedom (df)

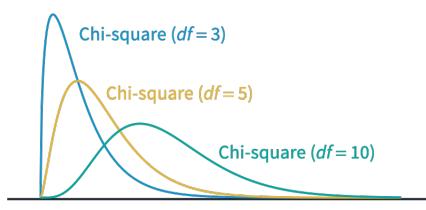
The ratio below is t-distributed with $df = n - 1$:

$$t = \frac{\bar{X} - \mu}{s/\sqrt{n}}$$



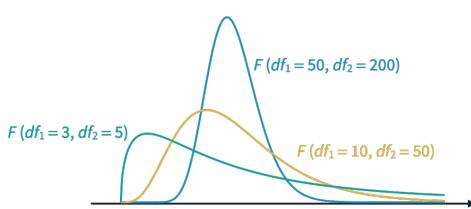
Chi-Square Distribution

Definition: Sum of squares of independent normal random variables. It cannot be negative.



F-Distribution

Definition: A ratio of two chi-square random variables (two df's). It cannot be negative.



Simulation Techniques

Monte Carlo simulation: Generate many random samples to produce a distribution of outcomes

Historical simulation: Sample from a historical record of returns to simulate a process

SAMPLING AND ESTIMATION

Sampling

Simple random sampling: Subset of population is chosen at random

Systematic sampling: Every k^{th} observation is chosen until desired sample size is achieved

Stratified sampling: Simple random samples are drawn from each subpopulation (strata)

Cluster sampling: Sample set is divided into mini-representations of the population (cluster)

Convenience sampling: Samples are selected based on accessibility

Judgmental sampling: Samples are selected based on researchers' knowledge and expertise

Sampling error = Sample mean - Population mean

Central Limit Theorem (CLT)

For a sample of size $n \geq 30$ from a population with mean μ and variance σ^2 , the sample mean \bar{X} approximately follows a normal distribution with mean μ and variance σ^2/n

Standard Error of Sample Mean

Population variance is known: $\sigma_{\bar{X}} = \sigma/\sqrt{n}$

Population variance is not known: $s_{\bar{X}} = s/\sqrt{n}$

Properties of Estimators

A point estimator is:

- *Unbiased* if its value matches the value of the parameter it estimates

- *Efficient* if it has the lowest variance of all unbiased estimators

- *Consistent* if its value approaches the parameter as the sample size increases

Confidence Interval

Point estimate \pm Reliability factor \times Std error

Point estimate: Estimate of population parameter

Reliability factor: Value from distribution of point estimate, such as normal or t-distribution

E.g., $\bar{X} \pm z_{\alpha/2} \times \sigma/\sqrt{n}$

Reliability factors for normal distributions

Significance level	Confidence interval	$z_{\alpha/2}$
10%	90%	1.645
5%	95%	1.960
1%	99%	2.575

If the population is not normally distributed and/or variance is unknown, the t- or z-distributions may be used to get reliability factors.

Normally Distributed?	Variance known?	Small Sample	Large Sample
Yes	Yes	z	z
Yes	No	t	t or z
No	Yes	n/a	z
No	No	n/a	t or z

Resampling

Bootstrap: Replace each drawn sample with an identical element for the next draw

Jackknife: Draw each sample by leaving out one observation at a time without replacement



Biases

- Data snooping bias:* "Drilling" data to find any statistically significant relationship
- Sample selection bias:* Excluding unavailable data
- Survivorship bias:* Excluding the impact of failed funds or companies that no longer exist
- Look-ahead bias:* Information needed is not known on the date the observation was recorded
- Time-period bias:* Using data from an era that makes the results time-period specific

HYPOTHESIS TESTING

Steps in Hypothesis Testing

- State hypotheses (null and alternative)
- Identify test statistic
- Specify significance level
- State decision rule
- Collect data; calculate test statistic
- Make decision regarding hypothesis

Test Statistic (General)

Sample statistic – Hypothesized value

Standard error of sample statistic

Hypothesis Test Results

Type	Hypotheses	Reject H_0 if test statistic is
One-tailed (upper)	$H_0: \mu \leq \mu_0$ $H_a: \mu > \mu_0$	> critical value
One-tailed (lower)	$H_0: \mu \geq \mu_0$ $H_a: \mu < \mu_0$	< critical value
Two-tailed	$H_0: \mu = \mu_0$ $H_a: \mu \neq \mu_0$	< lower critical value or > upper critical value

Hypothesis Testing Decision Errors

Decision	H_0 is True	H_0 is False
Do not reject H_0	Correct	Type II (β)
Reject H_0	Type I (α)	Correct

Power of a test = $1 - P(\text{Type II error}) = 1 - \beta$

p-value: smallest value of α at which H_0 is rejected

Tests Concerning a Single Mean

Population is normal with known variance:

$$z\text{-statistic} = \frac{\bar{X} - \mu_0}{\sigma/\sqrt{n}}$$

Large sample from any population with unknown variance (2 choices):

$$t\text{-statistic} = \frac{\bar{X} - \mu_0}{s/\sqrt{n}}, df = n - 1$$

$$z\text{-statistic} = \frac{\bar{X} - \mu_0}{\sigma/\sqrt{n}}$$

Small sample from normal population with unknown population variance:

$$t\text{-statistic} = \frac{\bar{X} - \mu_0}{s/\sqrt{n}}, df = n - 1$$

Tests Concerning Differences between Means

Normal populations with unknown variances that are assumed equal:

$$t\text{-statistic} = \frac{(\bar{X}_1 - \bar{X}_2) - (\mu_1 - \mu_2)}{\left(\frac{s_p^2}{n_1} + \frac{s_p^2}{n_2}\right)^{1/2}}$$

$$s_p^2 = \frac{(n_1 - 1)s_1^2 + (n_2 - 1)s_2^2}{n_1 + n_2 - 2}$$

$$df = n_1 + n_2 - 2$$

Tests Concerning Mean Differences

Normal populations with unknown variances:

$$t\text{-statistic} = \frac{\bar{d} - \mu_{d0}}{s_d}, df = n - 1$$

Tests Concerning a Single Variance

Normal population ($df = n - 1$):

$$\chi^2 = \frac{(n - 1)s^2}{\sigma_0^2}, \quad s^2 = \frac{1}{n - 1} \sum_{i=1}^n (X_i - \bar{x})^2$$

Tests Concerning Two Variances

Normal populations:

$$F = \frac{s_1^2}{s_2^2}, \quad s_j^2 = \frac{1}{n_j - 1} \sum_{i=1}^{n_j} (x_{ij} - \bar{x}_j)^2 \text{ for } j = 1, 2$$

$$df_1 = n_1 - 1; df_2 = n_2 - 1$$

Nonparametric Tests

Test that is not concerned with parameter and is implemented in situations such as:

- Data do not meet distributional assumptions
- Data are subject to outliers
- Data are given in ranks
- Hypothesis does not concern a parameter

Tests Concerning Correlation

$$t\text{-statistic} = \frac{r\sqrt{n - 2}}{\sqrt{1 - r^2}}, df = n - 2$$

To use the Spearman rank correlation coefficient, substitute the following value into the t-statistic calculation:

$$r_s = 1 - \frac{6 \sum_{i=1}^n d_i^2}{n(n^2 - 1)}$$

INTRODUCTION TO LINEAR REGRESSION

Simple Linear Regression

Y: Dependent variable/explained variable

X: Independent variable/explanatory variable

$$Y = b_0 + b_1 X + \epsilon,$$

where b_0 is the intercept, b_1 is the slope coefficient, and ϵ is the error term

The parameters can be estimated by:

$$\hat{b}_1 = \frac{\text{Cov}[Y, X]}{\text{Var}[X]} = \frac{\sum_{i=1}^n (Y_i - \bar{Y})(X_i - \bar{X})}{\sum_{i=1}^n (X_i - \bar{X})^2}$$

$$\hat{b}_0 = \bar{Y} - \hat{b}_1 \bar{X}$$

$$r = \frac{\text{Cov}[Y, X]}{\sqrt{\text{Var}[Y] \sqrt{\text{Var}[X]}}}$$

Assumptions of Simple Linear Regression Model

- Linear relationship between X and Y
- Homoscedasticity (i.e., constant variance of residuals)
- Independence between X and Y
- Normality of the residuals

Analysis of Variance

Sum of squares error (SSE): Unexplained variation in Y

$$SSE = \sum_{i=1}^n (Y_i - \hat{Y}_i)^2$$

Sum of squares regression (SSR): Explained variation in Y

$$SSR = \sum_{i=1}^n (\hat{Y}_i - \bar{Y})^2$$

Sum of squares total (SST): Total variation in Y

$$SST = SSE + SSR = \sum_{i=1}^n (Y_i - \bar{Y})^2$$

Coefficient of determination:

$$R^2 = \frac{SSR}{SST} = \frac{SSR}{SSE/(n - [k + 1])} = r^2 \text{ (if there is only one independent variable)}$$

F-statistic:

$$F = \frac{MSR}{MSE} = \frac{SSR/k}{SSE/(n - [k + 1])}$$

Standard error of regression:

$$s_e = \sqrt{MSE} = \sqrt{\frac{\sum_{i=1}^n (Y_i - \hat{Y}_i)^2}{n - 2}}$$

Hypothesis Testing of Linear Regression Coefficients

To test a hypothesis about the slope:

$$t = \frac{\hat{b}_1 - b_1}{s_{\hat{b}_1}}$$

$$s_{\hat{b}_1} = \frac{s_e}{\sqrt{\sum_{i=1}^n (X_i - \bar{X})^2}}$$

To test a hypothesis about the intercept:

$$t = \frac{\hat{b}_0 - b_0}{s_{\hat{b}_0}}$$

$$s_{\hat{b}_0} = \sqrt{MSE \left(\frac{1}{n} + \frac{(\bar{X})^2}{\sum_{i=1}^n (X_i - \bar{X})^2} \right)}$$

Estimated variance of the prediction error for Y:

$$s_f^2 = s_e^2 \left[1 + \frac{1}{n} + \frac{(X - \bar{X})^2}{(n - 1)s_x^2} \right]$$

ECONOMICS

TOPICS IN DEMAND AND SUPPLY ANALYSIS

Own-Price Elasticity of Demand

$$E_{P_x}^d = \frac{\% \Delta Q_x^d}{\% \Delta P_x} = \left(\frac{\Delta Q_x^d}{\Delta P_x} \right) \left(\frac{P_x}{Q_x^d} \right)$$

Q_x^d = quantity demanded, P_x = price per unit

$|E_{P_x}^d| > 1$: elastic

$|E_{P_x}^d| < 1$: inelastic

$|E_{P_x}^d| = \infty$: perfectly elastic

$E_{P_x}^d = 0$: perfectly inelastic

$E_{P_x}^d = -1$: unit elastic

Income Elasticity of Demand

$$E_I^d = \frac{\% \Delta Q_x^d}{\% \Delta I} = \left(\frac{\Delta Q_x^d}{\Delta I} \right) \left(\frac{I}{Q_x^d} \right)$$

where I = consumers' income

$E_I^d > 0$: normal good; $E_I^d < 0$: inferior good

Cross-Price Elasticity of Demand

$$E_{P_y}^d = \frac{\% \Delta Q_x^d}{\% \Delta P_y} = \left(\frac{\Delta Q_x^d}{\Delta P_y} \right) \left(\frac{P_y}{Q_x^d} \right)$$

where P_y is the price per unit of another good Y

$E_{P_y}^d > 0$: substitutes; $E_{P_y}^d < 0$: complements

Income and Substitution Effects

Impacts of a reduction in a good's price:

Type of good	Income effect	Substitution effect
Normal	Buy more	Buy more
Inferior	Buy less	Buy more

Goods with positively sloped demand curves:

- *Giffen goods*: Negative income effect is greater than positive substitution effect if good's price falls

- *Veblen goods*: Demand for a status symbol good falls if its price is reduced

Revenue Terms

Total revenue (TR): Price times quantity; $P \times Q$

Average revenue (AR): TR/Q

Marginal revenue (MR): $\Delta TR/\Delta Q$

Cost Terms

Total fixed cost (TFC): Sum of fixed costs

Total variable cost (TVC): Sum of variable costs

Total costs (TC): $TFC + TVC$

Average fixed cost (AFC): TFC/Q

Average variable cost (AVC): TVC/Q

Average total cost (ATC): $AFC + AVFC$ or TC/Q

Marginal cost (MC): $\Delta TC/\Delta Q$

Profit Measures

Accounting profit = Revenue – Accounting costs

Economic costs = Accounting costs + Implicit costs

Economic profit = Revenue – Economic costs

= Accounting profit – Implicit costs

Normal profit = Zero economic profit

Profits maximized if $MR = MC$ and MC isn't falling

Breakeven Analysis

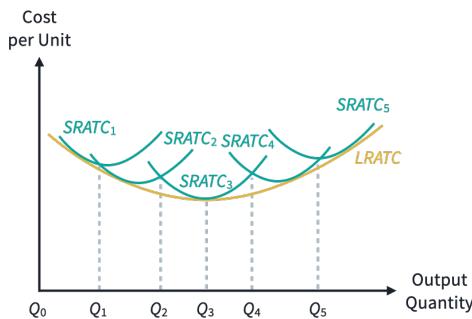
Economic breakeven occurs if a firm's accounting profit is enough to cover its implicit opportunity costs (i.e., normal profit). In the long run, firms cannot earn positive economic profits.

Shutdown Decision (Short-term vs. Long-term)

	Short-Term	Long-Term
$TR \geq TC$	Stay in	Stay in
$TVC < TR < TC$	Stay in	Exit market
$TR < TVC$	Shut down	Exit market

Economies of Scale

Each stage of expansion has its own short-run ATC curve. *Minimum efficient scale* is the low point on the long-run average total cost curve.



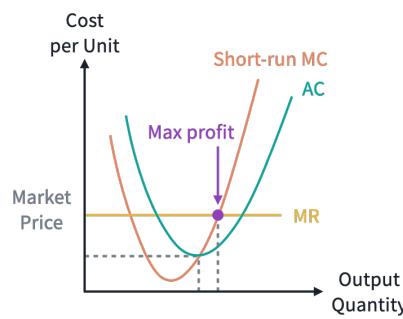
THE FIRM AND MARKET STRUCTURES

Perfect Competition

- Firms: Many
- Products: Identical
- Barriers to entry: Very low
- Pricing power of firms: None

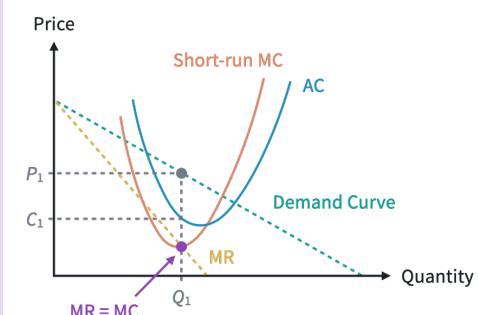
Profit maximization:

- $P = MR = MC$
- $P > ATC$ economic profit, $P < ATC$ economic loss



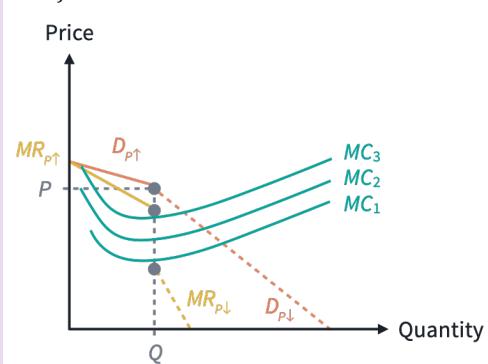
Monopolistic Competition

- Firms: Many
 - Products: Differentiated (via advertising)
 - Barriers to entry: Low
 - Pricing power of firms: Some
- Profit maximization: $MR = MC$



Oligopoly

- Firms: Few
 - Products: Similar (close substitutes)
 - Barriers to entry: High
 - Pricing power: Some or considerable
- Profit maximization: $MR = MC$



Kinked demand curve: A price increase will impact sales more than an equivalent price decrease

Cournot assumption: Competitors will maintain current output levels if one firm changes its price

Game theory: If one firm changes its prices, competitors will adjust to maximize their profits, resulting in a Nash equilibrium

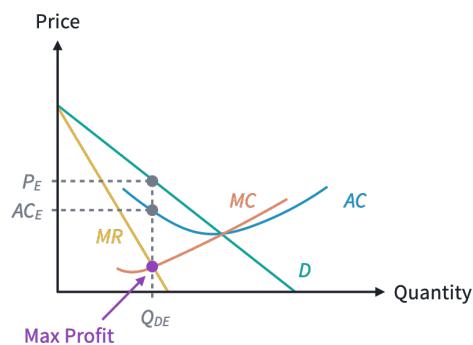
Price collusion is more likely to happen if:

- Few firms or one dominant firm
- Products are relatively similar
- Firms have similar cost structures
- Orders are frequent and relatively small
- Credible threat of retaliation for breaking pact
- The threat of external competition is high

Monopoly

- Firm: One
- Products: Unique (no close substitutes)
- Barriers to entry: Very high
- Pricing power of firm: Considerable (price discrimination possible)

Profit maximization: $MR = MC$



Price discrimination by monopolists:

- 1st degree: Different price for each customer
- 2nd degree: Quantity-based menu options
- 3rd degree: Pricing for demographic groups

Market Power Measures

N-firm concentration ratio: Sum of market share of the N largest firms in the industry

Herfindahl-Hirschman Index (HHI): Sum of squared market share of the N largest firms

AGGREGATE OUTPUT, PRICES, AND ECONOMIC GROWTH

Gross Domestic Product (GDP)

Nominal GDP: GDP in terms of current prices

Real GDP: GDP in terms of base-year prices

GDP deflator: $(\text{Nominal GDP}/\text{Real GDP}) \times 100$

$GDP = C + I + G + (X - M)$

C = consumption

I = investment

G = government spending

X = exports; M = imports

GDI

= Net domestic income

+ Consumption of fixed capital

+ Statistical discrepancy

GDI

= Compensation of employees

+ Gross operating surplus + Gross mixed income

+ Taxes (net of subsidies) on production

+ Taxes (net of subsidies) on products and imports

Personal household income

= Compensation of employees

+ Net mixed income from unincorporated businesses

+ Net property income

Relationship among Saving, Investment, the Fiscal Balance, and the Trade Balance

$$(G - T) = (S - I) - (X - M)$$

G - T = fiscal balance

S - I = savings minus domestic investment

X - M = trade balance

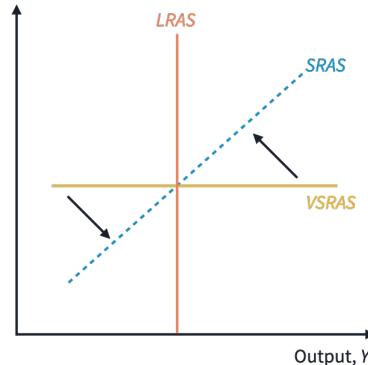
Aggregate Demand (AD)

The downward slope of the AD curve results from:

- *Wealth effect:* Price level ↑, real wealth ↓, quantity demanded ↓
- *Interest rate effect:* Price level ↑, interest rate ↑, investment and consumption expenditures ↓
- *Real exchange rate effect:* Price level ↑, real exchange rate ↑, exports ↓ and imports ↑

Aggregate Supply (AS)

Price Level, P

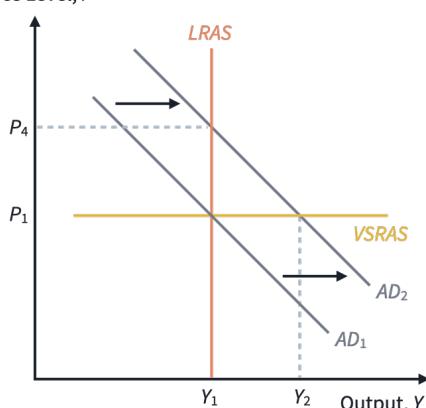


Full employment level of output: Long-run equilibrium level of output

Factors Increasing Aggregate Demand (AD)

- Higher household wealth
- Higher business and consumer confidence
- Higher capacity utilization
- Expansionary monetary and fiscal policies
- Depreciating domestic currency value
- Faster global economic growth

Price Level, P

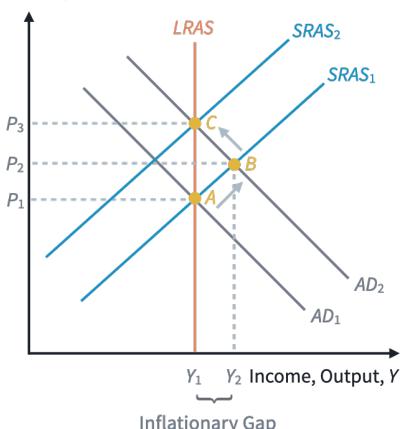


Shifts in Aggregate Supply (SRAS and LRAS)

Increase in	SRAS Shift	LRAS Shift
Labor supply	Right	Right
Natural resources	Right	Right
Human capital	Right	Right
Physical capital	Right	Right
Productivity/Tech	Right	Right
Nominal wages	Left	None
Input prices	Left	None
Price expectations	Right	None
Business taxes	Left	None
Business subsidies	Right	None
Foreign currency values	Right	None

Inflationary Gap

Price Level, P



Effect of Combined Changes in AS and AD

Changes in AS and AD	Real GDP	Prices
AS ↑, AD ↑	Increase	Unclear
AS ↓, AD ↓	Decrease	Unclear
AS ↑, AD ↓	Unclear	Decrease
AS ↓, AD ↑	Unclear	Increase

UNDERSTANDING BUSINESS CYCLES

Business Cycle Phases

Recovery

- *Economy:* Going through a trough
- *Activity level:* Below potential but start to increase
- *Employment:* Layoffs slow, but firms prefer extending overtime to rehiring full-time
- *Inflation:* Moderate
- *Capital spending:* Low but increasing, with a focus on efficiency rather than capacity

Expansion

- *Economy:* Enjoying an upswing
- *Activity level:* Above-average growth rates
- *Employment:* Full-time rehiring, more overtime
- *Inflation:* Moderate, but increasing
- *Capital spending:* Focused on capacity expansion

Slowdown

- **Economy:** Going through a peak
- **Activity level:** Decelerating
- **Employment:** Hiring slows
- **Inflation:** Accelerating
- **Capital spending:** Strong capital spending, but inventory starts building up as sales growth slows

Contraction

- **Economy:** Weakens and may go into a recession
- **Activity levels:** Below potential
- **Employment:** Hiring freezes, then layoffs
- **Inflation:** Decelerating, but with a lag
- **Capital spending:** New orders halted and existing orders canceled, scale back on maintenance

Business Cycle Theories

- **Neoclassical:** "Invisible hand" lets markets reach a natural equilibrium; government should not intervene
- **Austrian:** Like Neoclassical, focus on loose monetary policy causing credit-fueled booms
- **Keynesian:** Countercyclical fiscal policy should be used to support aggregate demand
- **Monetarist:** Oppose Keynesian fiscal focus, call for steady growth of money

Unemployment

- **Unemployed:** Jobless people who are seeking jobs
- **Labor force:** People with a job or unemployed
- **Unemployment rate:** Unemployed/Labor force

Type	Result of
Frictional	Temporary transitions
Structural	Long-run changes in economy
Cyclical	Changes in economic activity

Inflation

- **Deflation:** Negative inflation rate
- **Disinflation:** Declining inflation rate
- **Hyperinflation:** Extremely high inflation rate
- **Cost-push:** From decrease in aggregate supply
- **Demand-pull:** From increase in aggregate demand
- **Laspeyres index:** Use base consumption basket
- **Paasche index:** Use current consumption basket
- **Fisher index:** $\sqrt{Laspeyres \times Paasche}$

Economic Indicators

- **Leading:** Stock indexes, building permits
- **Coincident:** Real income, industrial production
- **Lagging:** Unemployment rate, prime lending rate

MONETARY AND FISCAL POLICY

Monetary Policy

$$\text{Required reserve ratio} = \frac{\text{Required reserves}}{\text{Total deposits}}$$

Money multiplier = $1/\text{Reserve requirement}$

$$\text{Fisher effect: } R_{\text{nominal}} = R_{\text{real}} + \pi^e$$

Central Bank Roles

- Sole currency supplier
- Lender of last resort
- Bank for commercial banks and government
- Regulate and supervise payments system
- Gold and foreign exchange reserves holder
- Oversee monetary policy

Monetary Policy Tools

Expansionary monetary policy measures:

- **Policy rate:** Set policy rate below neutral level
- **Reserve requirement:** Reduce reserves for commercial banks
- **Open market operations:** Buy bonds from commercial banks

Fiscal Policy: Spending Tools

Transfer payments: Redistribution of wealth (e.g., unemployment benefits)

Current spending: Spending on goods and services

Capital spending: Spending on infrastructure

Fiscal Policy: Revenue Tools

Direct taxes: Tax on income (e.g., income taxes, corporate taxes, capital gains taxes)

Indirect taxes: Tax on goods and services

Fiscal Multiplier

$$= \frac{1}{1 - MPC(1 - t)}, \text{ where MPC} = \text{marginal propensity to consume; } t = \text{tax rate}$$

Difficulties Executing Fiscal Policy

Recognition lag: Government must see need

Action lag: Time needed to choose policy

Impact lag: Policies do not have immediate impact

INTRODUCTION TO GEOPOLITICS

National Governments and Political Cooperation

State actors possesses the authority to deploy a country's national security resources

Non-State Actors and the Forces of Globalization

Non-state actors participate in global political, economic, or financial affairs but do not control a country's national security resources

Assessing Geopolitical Actors and Risk



The Tools of Geopolitics

National security tool: Military force, espionage

Economic tools: Currency union, nationalization

Financial tools: Currency markets, sanctions, capital controls

Incorporating Geopolitical Risk into the Investment Process

Types of geopolitical risk:

- Event risk
- Exogenous risk
- Thematic risk

Assessing Geopolitical Threats

To assess geopolitical risk, consider:

- The likelihood of occurrence
- The velocity (speed) of impact
- The size and nature of impact

INTERNATIONAL TRADE & CAPITAL FLOWS

Basics of International Trade

Terms of trade: Price of exports/Price of imports

Autarky: No trade with other countries

Absolute advantage: Lower total cost of production

Comparative advantage: Lower opportunity cost

International Trade Models

Ricardian: Labor is the only factor of production, comparative advantage due to labor productivity

Hecksher-Ohlin: Both labor and capital are factors, income redistribution is possible through trade

Trade Restrictions

Tariffs: Taxes on imported goods

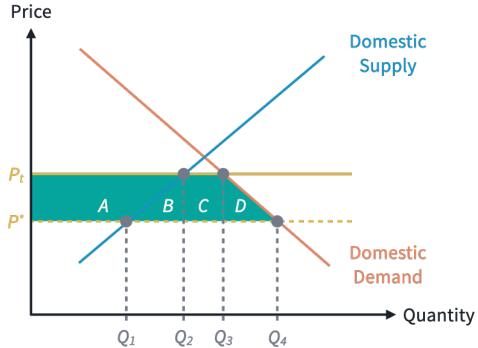
Quotas: Limits on quantity of imported goods

Export subsidies: Payments to exporters

Minimum domestic content requirements

Voluntary export restraints: Self-imposed limitations by foreign producers

Impact of Trade Restrictions



- Price increases from P^* to P_t
- Domestic production increases from Q_1 to Q_2
- Domestic consumption falls from Q_4 to Q_3
- Imports fall from $(Q_4 - Q_1)$ to $(Q_3 - Q_2)$
- Loss of consumer surplus = $(A + B + C + D)$
- National welfare loss = $(B + D)$
- Increase in producer surplus = A
- Tariff revenue/Quota rent = C

Regional Trading Blocs

Free trade area (FTA): Free trade among members

Customs union (CU): FTA + common trade policy

Common market (CM): CU + free movement of factors of production within bloc

Economic union (EU): CM + common economic institutions and coordination of economic policies

Monetary union (MU): EU + common currency

Balance of Payments Components

Current account: Merchandise and services, income receipts, unilateral transfers

Capital account: Capital transfers, non-financial assets sales/purchases

Financial account: Government-owned assets abroad, foreign-owned assets in the country

CURRENCY EXCHANGE RATES

Exchange Rate Calculations

$$\text{Real ex. rate}_{d/f} = \text{Nominal ex. rate}_{d/f} \times \left(\frac{\text{CPI}_f}{\text{CPI}_d} \right)$$

$$\text{Forward exchange rate}_{d/f} = \frac{1 + i_d}{1 + i_f}$$

$$\text{Spot exchange rate}_{d/f} = \frac{1}{1 + i_f}$$

$$\text{Cross rate: } S_{A/B} = S_{A/C} \times S_{C/B}$$

Forward exchange rates in points:

- Unit of points is last decimal place in the rate quote (e.g., 1.5301 to 1.5302 is a 1-point increase)

Ideal Currency Regime

1. Exchange rates are credibly fixed
 2. Fully convertible currencies, free capital flows
 3. Countries pursue independent monetary policies
- Such an ideal currency regime is NOT possible

Exchange Rate Regimes

Dollarization: Adopt another country's currency

Monetary union: Adopt a common currency

Currency board: Commitment to exchange domestic currency at fixed exchange rate

Fixed peg: Currency is pegged to foreign currency (or basket of currencies) within $\pm 1\%$ margin

Target zone: Fixed peg with wider margin

Crawling peg: Peg rate is periodically adjusted

Crawling bands: Margin increases over time, usually to transition from fixed peg to floating

Managed floating: Monetary authority intervenes, but no official target exchange rate

Independently floating: Market sets exchange rate

Marshall-Lerner Condition

Currency devaluation can improve a country's trade balance if demand elasticities cause export receipts to increase more than import expenditures

Income Statement Line Items

Revenue

- Cost of goods sold (COGS)

Gross Profit

- Selling, General & Admin. (SG&A)

EBITDA

- Depreciation and Amortization

EBIT (Operating profit)

- Interest

EBT (Earnings before taxes)

- Taxes

Net Income (NI)

Separately Reported Items

- Discontinued operations
- Unusual or infrequent items (US GAAP only)
- Non-operating items

Basic Earnings per Share

$$\text{Net income} - \text{Preferred dividends}$$

Weighted average of shares outstanding

Diluted Earnings per Share

$$\frac{\text{Net income} - \text{Preferred dividends}}{\text{Shares from average} + \frac{\text{preferred dividends}}{1 + t}}$$

Convertible debt interest

Shares issuable from stock options

Must be equal to or less than basic EPS

UNDERSTANDING BALANCE SHEETS

Classified Balance Sheet

Current Assets: To be used within one year

- Cash and equivalents
- Marketable securities
- Accounts receivable, net of bad debt expense
- Inventories
- Other (e.g., prepaid expenses)

Non-Current Assets

- Property, Plant, and Equipment (PP&E)
- Investment property
- Intangible assets
- Goodwill
- Financial assets

Current Liabilities: To be settled within one year

- Accounts payable
- Notes payable
- Accrued expenses
- Deferred income (Unearned revenue)

Long-term Liabilities

- Long-term debt
- Deferred tax liabilities

Equity

- Contributed capital
- Preferred shares
- Treasury shares
- Retained earnings
- Accumulated other comprehensive income (OCI)
- Non-controlling (minority) interest



UNDERSTANDING CASH FLOW STATEMENTS

Cash Flow Statement Classifications

CFO: Cash flows from regular operations

CFI: Cash flows for buying/selling long-term assets

CFF: Financial transactions with capital providers

Item	US GAAP	IFRS
Dividends paid	CFF	CFO/CFF
Interest paid	CFO	CFO/CFF
Dividends received	CFO	CFO/CFI
Interest received	CFO	CFO/CFI
Tax expenses	CFO	CFO*

*IFRS treat tax expenses for investing or financing transactions as CFI or CFF

CFO Direct Method

- Convert each accrual-based item in the income statement to cash inflow/outflow
- CFO is net of cash inflows and outflows

CFO Indirect Method

- Start with net income
- Add noncash expenses (e.g., Depreciation)
- Subtract gains/add losses
- Add increases in current liabilities
- Subtract increases in (non-cash) current assets

Beginning accounts receivable

+ Revenue

- Ending accounts receivable

Cash collected from customers

Cost of goods sold

+ Increase in inventory

Purchases from suppliers

- Increase in accounts payable

Cash paid to suppliers

Free Cash Flow (FCF)

Free cash flow to the firm (FCFF): Cash available to equity owners and debt holders.

$$FCFF = NI + NCC + I \times (1 - t) - FCI - WCI \\ = CFO + I \times (1 - t) - FCI$$

Free cash flow to equity (FCFE): Cash flow available to common shareholders

$$FCFE = CFO - FCI + \text{Net Borrowing}$$

FINANCIAL ANALYSIS TECHNIQUES

Common-Size Analysis

Vertical:

- State income statement items as % of revenue
- State balance sheet items as a % of total assets
- State each cash flow statement item as a % of total cash inflows/outflows

Horizontal (Trend) Analysis:

- State each item relative to its base-year value

Activity Ratios

$$\text{Receivables turnover} = \frac{\text{Annual sales}}{\text{Average receivables}}$$

$$\text{Days of sales outstanding} = \frac{365}{\text{Receivables turnover}}$$

$$\text{Inventory turnover} = \frac{\text{Cost of goods sold}}{\text{Average inventory}}$$

$$\text{Days of inventory on hand} = \frac{365}{\text{Inventory turnover}}$$

$$\text{Payables turnover} = \frac{\text{Purchases}}{\text{Average trade payables}}$$

$$\text{Number of days of payables} = \frac{365}{\text{Payables turnover}}$$

$$\text{Total asset turnover} = \frac{\text{Revenue}}{\text{Average total assets}}$$

$$\text{Fixed asset turnover} = \frac{\text{Revenue}}{\text{Average net fixed assets}}$$

$$\text{Working capital turnover} = \frac{\text{Revenue}}{\text{Average working capital}}$$

Liquidity Ratios

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

$$\text{Quick ratio} = \frac{\text{Cash} + \text{Marketable securities} + \text{Receivables}}{\text{Current liabilities}}$$

$$\text{Cash ratio} = \frac{\text{Cash} + \text{Marketable securities}}{\text{Current liabilities}}$$

$$\text{Defensive interval} = \frac{\text{Cash} + \text{Marketable securities} + \text{Receivables}}{\text{Average daily expenditures}}$$

$$\text{Cash conversion cycle} = \frac{\text{Days of sales outstanding} + \text{Days of inventory on hand} - \text{Number of days payables}}{\text{Days of sales}}$$

Solvency Ratios

$$\text{Debt-to-equity} = \frac{\text{Total debt}}{\text{Total shareholders' equity}}$$

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

$$\text{Debt-to-assets} = \frac{\text{Total debt}}{\text{Total assets}}$$

$$\text{Financial leverage} = \frac{\text{Average total assets}}{\text{Average total equity}}$$

$$\text{Interest coverage} = \frac{\text{EBIT}}{\text{Interest payments}}$$

$$\text{Fixed charge coverage} = \frac{\text{EBIT} + \text{Lease payments}}{\text{Interest payments} + \text{Lease pmts}}$$

Profitability Ratios

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

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

$$\text{Operating profit margin} = \frac{\text{EBIT}}{\text{Revenue}}$$

$$\text{Pretax margin} = \frac{\text{EBT}}{\text{Revenue}}$$

$$\text{Return on assets (ROA)} = \frac{\text{Net income}}{\text{Average total assets}}$$

$$\text{Return on total capital} = \frac{\text{EBIT}}{\text{Average total capital}}$$

$$\text{Return on equity (ROE)} = \frac{\text{Net income}}{\text{Average total equity}}$$

Valuation Ratios

$$\text{Dividend payout ratio} = \frac{\text{Dividends declared}}{\text{NI available to common}}$$

$$\text{Retention rate (RR)} = 1 - \text{Dividend payout ratio}$$

$$\text{Sustainable growth rate (g)} = \text{RR} \times \text{ROE}$$

$$\text{P/E Ratio} = \frac{\text{Price per share}}{\text{Earnings per share}}$$

DuPont Analysis

$$\text{ROE} = \left(\frac{\text{Net income}}{\text{Assets}} \right) \left(\frac{\text{Assets}}{\text{Book Value of Equity}} \right)$$

$$= (\text{ROA}) (\text{Leverage ratio})$$

$$= \left(\frac{\text{NI}}{\text{Revenue}} \right) \left(\frac{\text{Revenue}}{\text{Assets}} \right) \left(\frac{\text{Assets}}{\text{Equity}} \right)$$

$$= \left(\frac{\text{Net profit margin}}{\text{Asset turnover}} \right) (\text{Leverage ratio})$$

$$= \left(\frac{\text{NI}}{\text{EBIT}} \right) \left(\frac{\text{EBIT}}{\text{Revenue}} \right) \left(\frac{\text{Revenue}}{\text{Assets}} \right) \left(\frac{\text{Assets}}{\text{Equity}} \right)$$

$$= (\text{Tax burden}) (\text{Interest burden}) (\text{Margin}) (\text{Asset turnover}) (\text{Financial leverage})$$



INVENTORIES

Inventory Valuation Requirements

IFRS: Lower of cost or net realizable value

US GAAP: Lower of cost or market value

Reversals of inventory write-downs are allowed under IFRS, but not under US GAAP

Inventory Valuation Methods and Systems

	US GAAP	IFRS
FIFO	Allowed	Allowed
LIFO	Allowed	N/A
Weighted average	Allowed	Allowed
Specific Identification	Allowed	Allowed

Impact of Inventory Valuation Method

If prices are rising	FIFO	LIFO
Ending Inventory	Higher	Lower
COGS	Lower	Higher
Net income	Higher	Lower
Income Tax Expense	Higher	Lower
Operating cash flow	Lower	Higher

Perpetual vs. periodic inventory system:

- Periodic system matches total units sold for the period with total purchases for the same period
- Perpetual system updates after each transaction
- Under FIFO, ending inventory and COGS are the same for periodic or perpetual
- Weighted average and LIFO will show differences

LIFO Reserve

Used to adjust LIFO COGS and ending inventory (EI) to FIFO-equivalent values

$$EI_{FIFO} = EI_{LIFO} + \text{LIFO Reserve}$$

$$COGS_{FIFO} = COGS_{LIFO} - \Delta \text{LIFO Reserve}$$

$$\text{Tax}_{FIFO} = \text{Tax}_{LIFO} + \Delta \text{LIFO Reserve} \times t$$

LIFO Liquidations

- Happen when units sold exceed units purchased
- May result in higher gross profit than otherwise

LONG-LIVED ASSETS

Long-Term Assets

Property, plant, and equipment (PP&E):

IFRS

- Both cost model and revaluation model allowed
- Recoverable amount is greater of:
 - (1) fair value less selling costs, and
 - (2) value in use (PV of asset's future cash flows)
- Loss recoveries are allowed

US GAAP

- Only cost model is allowed
- Loss recoveries not allowed

Depreciation Methods

$$\text{Straight-line: } = \frac{\text{Cost} - \text{Salvage value}}{\text{Depreciable life}}$$

Double-declining balance (DDB):

$$\text{Depreciation}_t = \left(\frac{\text{Book value}_t}{\text{Depreciable life}} \right) \times 2$$

Units-of-production:

$$\text{Depreciation}_t = \frac{\text{Cost} - \text{Salvage}}{\text{Total output}} \times \text{Output units}_t$$

Intangible Assets

Purchased: Record at fair value (purchase price)

Developed internally:

IFRS

- Research expenditures are expensed
- Development expenditures are capitalized

US GAAP

- Generally, both R&D costs are expensed

Acquired in business combination:

Purchase price is allocated to each asset on fair value basis; excess recorded as goodwill

Capitalizing vs. Expensing

- Capitalizing increases assets on the balance sheet and investing cash outflows
- Expensing reduces net income by the after-tax expenditure amount in the period it is incurred

Impairment of PP&E and Intangible Assets

US GAAP

- Asset tested for impairment only when firm may not recover carrying value through future use
- Asset is impaired when carrying value exceeds asset's future undiscounted cash flows
- Impaired asset's value is written down to fair value and a loss is recognized and cannot be subsequently reversed

IFRS

- Assets are tested annually for impairment
- Impaired if carrying value > recoverable amount
- Impaired asset's value is written down to recoverable amount and a loss is recognized
- Loss can be reversed if asset value recovers, but only up to pre-impairment carrying value

INCOME TAXES

Temporary Taxable Differences

Deferred tax assets (DTA): Created when taxes payable exceeds income tax expense

Deferred tax liabilities (DTL): Created when taxes payable is less than income tax expense

Tax base of assets: Amount that will be deducted on the tax return as asset's benefits are realized

Tax base of liabilities: Carrying value of liability minus amount that will be deductible

Asset carrying amount > Tax base	DTL
Asset carrying amount < Tax base	DTA
Liability carrying amount > Tax base	DTA
Liability carrying amount < Tax base	DTL

Impact of tax rate changes

If tax rate increases, DTA and DTL will increase

If tax rate decreases, DTA and DTL will decrease

Income tax exp. = Taxes payable + ΔDTL - ΔDTA

Valuation Allowance

Contra account used if it is unlikely that future profits will be sufficient to use DTAs and credits

Deferred Tax Charges Directly to Equity

- Revaluation of PP&E (IFRS only)
- Impact of changes in accounting policies
- Impact of exchange rate fluctuations
- Changes in fair value of certain investments

NON-CURRENT (LONG-TERM) LIABILITIES

Long-Term Liabilities

Premium bond: Coupon rate > yield at issuance

Discount bond: Coupon rate < yield at issuance

Issuance costs:

US GAAP – capitalized as an asset

IFRS – reduces initial bond liability

Derecognition of debt: If an issuer redeems a bond before maturity, a gain/loss (book value minus redemption price) is recognized

Debt covenants: Affirmative – borrower promises to do certain things; negative – borrower promises to refrain from certain things

Lessee Accounting

US GAAP

Finance lease:

- Lessee purchases the asset, financed by the lessor
- Lessee's periodic lease payments have separate depreciation and interest components

Operating lease (like a rental agreement):

- Single lease expense, not separated into different components for depreciation and interest
- The value of an operating lease payment is calculated as a straight-line allocation of total payments over the term of the lease



Conditions requiring a lease to be a finance lease:

- Ownership of the leased asset is transferred to the lessee
- Lessee has the option to purchase the asset and will likely do so
- Lease term covers most of asset's useful life
- The present value of lease payments at inception is close to the asset's fair value
- The leased asset is so specialized that only the lessee can use it without modification

IFRS require all leases to be treated in the manner that is prescribed by US GAAP for finance leases.

Lessor Accounting

- For operating leases (under both IFRS and US GAAP), the lessor retains the leased asset on its balance sheet and incurs the associated depreciation expense. Lease income from the lessor is recorded as revenue.
- For finance leases (under both IFRS and US GAAP), the lessor removes the leased asset from its balance sheet and creates an asset with a value equal to the lease receivable and any residual value.
- Lease payments are recognized as an operating inflow on the lessor's cash flow statement (for both operating leases and finance leases)

Pensions

Defined benefit (DB): Firm makes periodic payments to employee after retirement.

Overfunded (underfunded) plan is recognized as an asset (liability).

CORPORATE ISSUERS

CORPORATE STRUCTURES AND OWNERSHIP

Sole Proprietorship

- Extension of owner
- Operated by owner
- Business liability is retained by owner
- Business profits are owned by owner and taxed as personal income
- Owner is the main source of capital
- Owner's capital and risk appetite limit business growth

General Partnership

- Set by partnership agreement
- Operated by partner
- Business liability is retained and shared by partners
- Business profits are shared by partners and taxed as personal income
- Partners are the main source of capital
- Partners' resources and risk appetite limit business growth

Limited Partnership

- Set by partnership agreement
- Operated by GP
- Business liability is limited by LPs and unlimited for GP
- Business profits are shared by partners and taxed as personal income
- Partners are the main source of income
- Partners' resources, risk appetite, and GP's competence/integrity limit business growth

Corporations (Limited Companies)

- Legal identity is separated from owners
- Operated by management team voted by shareholders
- Limited business liability for shareholders
- Financed by equity and debt
- Profits are taxed directly; double taxation occurs when shareholders are taxed on their dividend income

Public and Private Corporations

Market capitalization: Product of the current share price and the number of outstanding shares

$$\text{Enterprise value} = \text{MV}_{\text{Shares}} + \text{MV}_{\text{Debt}} - \text{Cash}$$

Private placement memorandum (PPM) is used by private companies to raise capital in primary market

Private companies can go public by:

- Initial public offering (IPO)
- Direct listing (DL)
- Acquisition

Public companies can go private by:

- Leveraged buyout (LBO)
- Management buyout (MBO)

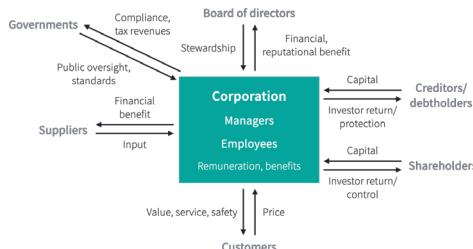
Lenders and Owners

Risk vs return characteristics of equity and debt:

	Equity	Debt
Upside potential	Unlimited	Limited to payments
Maximum loss	Cannot be more than the investment value	
Investment risk	Higher	Lower
Investment interest	Maximize company value	Timely repayment

INTRODUCTION TO CORPORATE GOVERNANCE AND OTHER ESG CONSIDERATIONS

Stakeholder Groups



Principal-Agent and Other Relationships

Shareholder vs. manager/director

- **Entrenchment:** Managers avoid justifiable risks to avoid losing their positions
- **Empire building:** Making unjustified acquisitions to increase company size and compensation
- **Excessive risk taking:** Taking unjustifiable risks to maximize returns on stock-based compensation
- **Agency costs** reduce the potential for exploitation in an agency relationship

Controlling shareholder vs. minority shareholder

- **Dispersed ownership:** Controlled by many minority shareholders
- **Concentrated ownership:** Controlled by a single shareholder
- **Multiple-class share structures:** Disproportionate voting power to certain shareholder classes

Shareholder vs. creditor

- Equity owners prefer growth and have a higher risk tolerance
- Creditors prefer stability and limited downside risk

Corporate governance can be described as:

- A system of internal controls and procedures for managing organizational business
- A framework for defining the rights and responsibilities of individuals and groups within the organization
- An arrangement of checks, balances, and incentives to minimize and manage conflicts between the interests of insiders and external stakeholders

Stakeholder Mechanisms

Shareholder:

- Corporate reporting and transparency
- Shareholder meetings (cumulative voting, proxy voting)
- Shareholder activism
- Derivative lawsuits
- Corporate takeovers (proxy contests, tender offers, hostile takeovers)

Creditor:

- Bond indentures, collateral, and trustees
- Corporate reporting
- Creditor committees

Board of director and management:

- Audit committee
- Governance committee
- Remuneration/Compensation committee
- Nomination committee
- Risk committee
- Investment committee

- Employee:**
- Labor laws
 - Code of ethics and compliance department
 - Whistleblower protections
 - Employee contracts

- Customer and supplier:**
- Commercial contracts
 - Public reputation and social media

- Government:**
- Laws and regulations
 - Corporate governance codes
 - Common law and civil law systems

Risks and Benefits of Corporate Governance and Stakeholder Management

- Operational risks of poor stakeholder governance:**
- Weak control systems that do not treat all stakeholders fairly
 - Ineffective decision-making process
 - Inadequate board scrutiny
 - Diminished operating performance

- Financial risks of poor stakeholder governance:**
- Higher default and bankruptcy risks
 - Higher borrowing costs
 - Poor equity returns

Factors Relevant to Corporate Governance and Stakeholder Management Analysis

- Economic ownership and voting control
- Board of directors representation
- Remuneration and company performance
- Investors in the company
- Strength of shareholders' rights
- Management of long-term risks

ESG Considerations for Investors and Analysts

- ESG investment approaches:**
- Responsible investing
 - Sustainable investing
 - Socially responsible investing (SRI)
 - Value-based and values-based approaches

- ESG investment styles:**
- Negative screening
 - Positive screening
 - ESG integration
 - Thematic investing
 - Engagement/active ownership
 - Impact investing

Green finance: Use financial instruments to support economic growth while minimizing environmental impact

BUSINESS MODELS & RISKS

Value Proposition

- Target customers
- Product/service offering
- Channel strategy
- Pricing strategy

Channel strategy:

- Traditional channel
- Direct sales
- Drop shipping
- Omnichannel strategy

Pricing model:

- Cost-based
- Value-based

Price discrimination:

- Tiered pricing
- Dynamic pricing
- Auction/reverse auction models

Pricing for multiple products:

- Bundling
- Razors-and-blades pricing
- Optional product pricing

Pricing for rapid growth:

- Penetration pricing
- Freemium pricing
- Hidden revenue business model

Alternatives to ownership:

- Subscription pricing
- Fractionalization
- Leasing
- Licensing
- Franchising

Value Chain

Value chain: Systems and functions within the firm that create value for its customers

Supply chain: Series of steps and processes needed to prepare a product to be sold to the consumer

Profitability and Unit Economics

Unit economics: The quantitative analysis of a company's revenues and costs on a per unit basis

$$\text{Breakeven point} = \frac{\text{Fixed costs}}{\text{Contribution margin}} \\ = \frac{\text{Fixed costs}}{\text{Unit price} - \text{Variable cost per unit}}$$

Business Model Types

- Private label manufacturers
- Licensing arrangements
- Value added resellers
- Franchises
- Network effects
- Crowdsourcing
- Hybrid business models

E-commerce business models:

- Affiliate marketing
- Marketplace businesses
- Aggregators

Business Models: Financial Implications

External factors:

- Economic conditions
- Demographics
- Sector demand
- Industry cost characteristics
- Social and political trends

Firm-specific factors:

- Firm maturity
- Competitive position
- Business model

Business Models: Risks

Macro risk:

- Exchange rates
- Interest rates
- Political instability
- Legal and regulatory changes
- Country-level risks

Business risk:

- Industry risks
- Company-specific risks

Financial risk:

$$\begin{aligned} \text{Total leverage} &= \text{Operating leverage} \\ &\quad \times \text{Financial leverage} \\ &= \frac{\text{Contribution margin}}{\text{EBIT}} \times \frac{\text{EBIT}}{\text{EBT}} \\ &= \frac{\text{Contribution margin}}{\text{EBT}} \end{aligned}$$

CAPITAL INVESTMENTS

Types of Capital Investments

Business maintenance:

- Going concern projects
- Regulatory/compliance projects

Business growth:

- Expansion projects
- Pet projects/high-risk investments

Principles of Capital Budgeting

Key assumptions of capital allocation:

- Decisions are based on cash flows instead of accounting concepts
- Cash flows are not equivalent to accounting income or economic income
- Cash flows must account for opportunity costs
- Analysis is done on an after-tax basis
- Timing of cash flows is important
- Financing costs are ignored

Other important considerations:

- Sunk costs are ignored
- Opportunity cost is the value of a resource's next-best use
- Incremental cash flows reflect the cash flows realized from a decision
- Externalities (e.g., cannibalization) may have unexpected negative impact the company
- Conventional cash flow pattern only has one sign change



Net Present Value (NPV)

Sum of present values of expected future cash inflows, net of initial cash outlay

$$NPV = \sum_{t=1}^n \frac{CF_t}{(1+r)^t} - \text{Outlay}$$

Accept a project if $NPV > 0$

Internal Rate of Return (IRR)

IRR is r such that $NPV = 0$

Accept a project if its IRR > required return

BA II Plus NPV Worksheet Function

- Cash inflows are positive; outflows are negative
- F01, F02, etc. refer to cash flow frequencies
- CPT + NPV to compute NPV; CPT + IRR for IRR

Common Capital Budgeting Pitfalls

- Inertia
- Source of capital bias
- Failing to consider alternatives
- Pet projects
- Basing decisions on earnings metrics
- Internal forecasting errors

Corporate Usage of Capital Allocation Methods

Return on invested capital (ROIC):

$$ROIC = \frac{\text{After-Tax Net Profit}}{\text{Average BV of Invested Capital}}$$

Real Options

- *Timing option*: Option to delay the investment
- *Sizing option*: Option to expand, grow, or abandon
- *Flexibility option*: Option to alter operations, such as changing prices or substituting inputs
- *Fundamental option*: Option to alter decisions based on future events (e.g., drill based on price of oil, continue R&D depending on initial results)

Analyzing Projects with Real Options

- Use the discounted cash flow (DCF) analysis without considering real options
- Adjust the stand-alone DCF analysis by including the present value of the expected costs and benefits options
- Use option pricing models
- Use decision trees

WORKING CAPITAL & LIQUIDITY

Internal Financing

- Increasing after-tax operating cash flows
- Improving working capital efficiency
- Converting liquid assets to cash

External Financing: Financial Intermediaries

- Uncommitted lines of credit
- Committed lines of credit
- Revolving credit agreements
- Secured (asset-based) loans
- Factoring
- Others (web-based lenders and non-bank lenders)

External Financing: Capital Markets

- Short-term commercial paper
- Long-term debt
- Common equity

Conservative Working Capital Management

Advantages:

- Low rollover risk
- Greater cash flow certainty
- Low risk of inventory shortages
- Flexibility to adapt to adverse market conditions

Disadvantages:

- High borrowing costs
- High cost of equity and shareholder dilution
- Less flexibility to borrow on an as-needed basis
- Longer lead times
- More covenants
- High risk of obsolete inventory

Aggressive Working Capital Management

Advantages:

- Low financing costs under an upward-sloping yield curve
- Great flexibility to borrow only as needed
- Short-term borrowing involves less rigorous credit analysis

Disadvantages:

- Risk of having to refinance at higher short-term rates
- Potential difficulty rolling over short-term debt with market turmoil
- Possible need to rely on expensive trade credit
- Tight customer credit terms

Liquidity and Short-Term Funding Needs

Primary sources of liquidity:

- Free cash flows
- Ready cash balances (bank accounts)
- Short-term funds (lines of credit)
- Cash flow management (centralized collection)

Secondary sources of liquidity:

- Negotiating debt contracts
- Liquidating assets
- Filing for bankruptcy

Drag on liquidity: Delayed cash inflows, such as uncollected receivables and obsolete inventory

Pull on liquidity: Accelerated cash outflows, such as settling payables earlier

Net operating cycle (a.k.a. cash conversion cycle) = # days of inventory + # days of receivable - # days of payable

Evaluating Short-Term Financing Choices

Factors influencing a company's short-term borrowing strategy:

- Size and creditworthiness
- Legal and regulatory considerations
- Sufficient access
- Flexibility of borrowing options

COST OF CAPITAL - FOUNDATIONAL TOPIC

Weighted Average Cost of Capital (WACC)

$$WACC = w_d r_d (1 - t) + w_p r_p + w_e r_e$$

w_d = percentage of debt in capital structure

w_p = percentage of preferred stock

w_e = percentage of common stock

t = tax rate

r_d = cost of debt

r_p = cost of preferred stock = D_p/P

r_e = cost of common stock

$$= R_f + \beta [E(R_m) - R_f]$$

(CAPM)

$$= r_d + \text{Risk Premium}$$

(Bond Yield plus Risk Premium)

Costs of the Various Sources of Capital

Cost of debt:

- Yield-to-maturity approach

$$P_0 = \left[\sum_{t=1}^n \frac{PMT_t}{\left(1+\frac{r_d}{2}\right)^t} \right] + \frac{FV}{\left(1+\frac{r_d}{2}\right)^n}$$

- Debt rating approach (e.g., matrix pricing)

Cost of preferred stock:

$$r_p = D_p/P$$

Cost of common stock:

- Yield-to-maturity approach

$$r_e = r_f + \beta [r_m - r_f]$$

- Multifactor model

$$r_e = r_f + \beta_1(\text{Factor}_1) + \beta_2(\text{Factor}_2) + \dots + \beta_j(\text{Factor}_j)$$

- Bond yield plus risk premium approach

$$r_e = r_d + \text{Risk Premium}$$

Estimating Beta

Blume's beta adjustment formula:

$$\text{Adjusted } \beta = \left(\frac{2}{3} \right) (\text{Unadjusted } \beta) + \left(\frac{1}{3} \right) (1.0)$$

Asset beta/unlevered beta for comparable company:

$$\beta_U = \beta_E \left[\frac{1}{(1-t) \frac{D}{E} + 1} \right]$$

Levered project beta for subject firm:

$$\beta'_E = \beta_U \left[(1-t) \frac{D'}{E'} + 1 \right]$$

Flotation Costs

r_e adjusted for flotation costs (amount):

$$r_e = \frac{D_1}{P_0 - F} + g$$

r_e adjusted for flotation costs (percentage):

$$r_e = \frac{D_1}{P_0 [1-f]} + g$$

CAPITAL STRUCTURE

Internal Factors Affecting Capital Structure

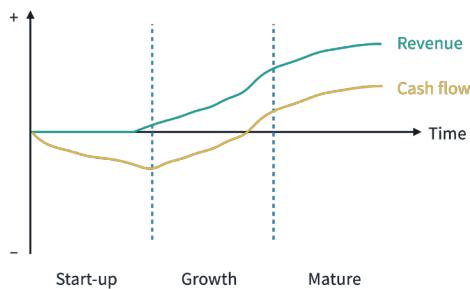
Business model characteristics:

- Revenue, earnings, and cash flow sensitivity
- Asset type
- Asset ownership
- Existing leverage:**
 - Liquidity
 - Profitability
 - Interest coverage
 - Leverage

Corporate tax rate: The higher the tax rate, the more benefit of using debt

Capital structure policies/guidelines: Firm-specific policies and debt covenants

Company life stage:



External Factors Affecting Capital Structure

- Market conditions/business cycles
- Regulatory constraints
- Industry/peer firm leverage

Modigliani and Miller Propositions

MM Proposition I: A firm's capital structure would have no effect on its value, assuming:

1. Investors have homogeneous expectations
 2. No market frictions (e.g., transaction costs, taxes, or costs of financial distress)
 3. No agency costs
 4. Investors can borrow and lend at risk-free rate
 5. Investing/financing decisions are independent
- MM Proposition II:** Cost of equity increases with the debt-to-equity ratio.

Without Taxes

Firm value	$V_L = V_U$
Cost of Equity	$r_e = r_0 + (r_0 - r_d) \left(\frac{D}{E} \right)$

With Taxes

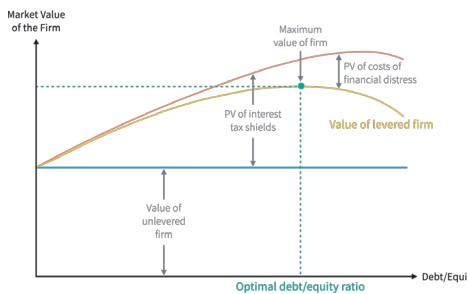
Firm value	$V_L = V_U + tD$
Cost of Equity	$r_e = r_0 + (r_0 - r_d)(1-t) \left(\frac{D}{E} \right)$

r_0 = cost of capital for a firm financed only by equity

Optimal and Target Capital Structure

Static trade-off theory balances costs of financial distress with tax shield benefits from using debt:

$$V_L = V_U + tD - PV(\text{costs of financial distress})$$



To estimate a company's target capital structure:

- Assume the company will main its current capital structure
- Infer target weights the company is moving toward
- Use the industrial average

Pecking order theory: Since managers have an asymmetric information advantage, they prefer capital sources that reveal the least amount of information:

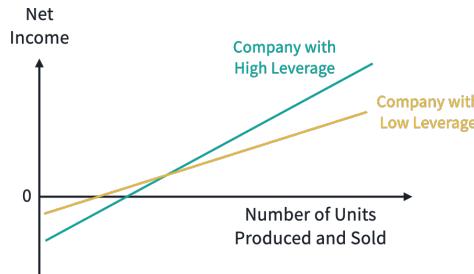
1. Internally generated earnings (best option)
2. New debt
3. New equity (least attractive for managers)

Stakeholder Interests

Agency costs arise from conflicts between managers and owners. The interests of managers, shareholders, and bondholders are not always aligned.

MEASURES OF LEVERAGE

Leverage



Business Risk

Two components of business risk are:

- Sales risk: determined by the elasticity of demand for products and services
- Operating risk: determined by the share of fixed costs as a share of total operating costs

Measures of Leverage

Degree of operating leverage (DOL):

$$DOL = \frac{\% \Delta \text{ Operating income}}{\% \Delta \text{ Units sold}} = \frac{Q(P - V)}{Q(P - V) - F}$$

Degree of financial leverage (DFL):

$$DFL = \frac{\% \Delta \text{ Net income}}{\% \Delta \text{ Operating income}} = \frac{Q(P - V) - F}{Q(P - V) - F - C}$$

Degree of total leverage (DTL):

$$DTL = \frac{\% \Delta \text{ Net income}}{\% \Delta \text{ Units sold}} = \frac{Q(P - V)}{Q(P - V) - F - C}$$

$$DTL = DOL \times DFL$$

Breakeven

$$\text{Breakeven: } Q_{BE} = \frac{F + C}{P - V}$$

$$\text{Operating breakeven: } Q_{OBE} = \frac{F}{P - V}$$

Q = quantity; P = price; V = variable cost/unit
 F = fixed operating cost; C = fixed financial cost

EQUITY

MARKET ORGANIZATION AND STRUCTURE

Functions of the Financial System

- Saving
- Borrowing
- Raising Equity Capital
- Managing Risks
- Exchanging Assets
- Information-Motivated Trading

Securities Markets

- **Spot vs. Forward Markets:** Spot market trades are settled within 3 days.
- **Primary vs. Secondary Markets:** Primary market transactions are done directly with the issuer, while secondary market trades take place on organized exchanges.
- **Capital vs. Money Markets:** Money markets are used for securities with maturities of less than one year, while longer-dated securities are traded in capital markets.

Positions

Long positions: Benefit from price *appreciation*

Short positions: Benefit from price *depreciation*

Leveraged Positions

$$\text{Leverage ratio} = \frac{\text{Position}}{\text{Equity}}$$

$$\text{Maximum initial leverage ratio} = \frac{1}{\text{Initial margin}}$$

Maintenance margin: minimum amount of equity required

Margin call is triggered if the equity falls below the maintenance margin. Additional equity will be requested to bring the account balance back to the initial margin.

Execution Instructions (How to fill)

- **Market:** Fill immediately at market price
- **Limit:** Buy below maximum price or sell above minimum price specified in order
- **All-or-nothing:** Cancel order if not fully filled
- **Hidden:** Visible to brokers and exchanges, but invisible to other traders
- **Iceberg:** Only a fraction of order amount is visible

Validity Instructions (When to fill)

- **Day orders:** Cancelled if unfilled at end of day
- **Good-till-cancelled:** No set expiry date
- **Good-on-close:** Filled at end of day
- **Stop-loss:** Sell if prices fall below specified level

Clearing Instructions

Settlement/clearing typically done by brokers for retail trades; brokers or custodians for institutional trades

Primary Market Transactions

- Initial Public Offerings (IPOs)

- Private placements

- Shelf registrations: Part of issue is held back to be sold directly to secondary market investors later

- Dividend reinvestment plans (DRIPs): Investors can roll over dividend payments to purchase new shares, possibly at a discount

- Rights offerings: Current shareholders gain right to purchase additional shares at below-market price; dilutes value of existing shares

Market Structure

Quote-driven: Investors trade with dealers

Order-driven: Exchanges use order matching rules

Brokered: Trades arranged by brokers

Call markets: Conduct periodic single price auctions, otherwise completely illiquid

Continuous Trading markets: Allow trades whenever market is open, may use call market auction at beginning and/or end of each day

Trade Pricing Rules

Uniform pricing rules: Used by call markets, all trades executed at the price that maximizes total quantity traded

Discriminatory pricing rules: Used by continuous markets, fills most aggressively priced orders first

Derivative pricing rules: Used by crossing networks to trade at midpoint of quotes from other markets

Complete Markets

- Facilitate savings/investment

- Facilitate lending to creditworthy borrowers

- Allow risk exposures to be hedged

- Facilitate exchange of currencies/commodities

An ideal financial system is *complete* (see above), *operationally efficient* (low transaction costs), and *informationally efficient* (prices reflect all info.)

SECURITY MARKET INDEXES

Price Return over Single Period

$$PR_i = \frac{P_{i1} - P_{i0}}{P_{i0}} \quad PR_I = \sum_{i=1}^N w_i PR_i$$

Total Return over Single Period

$$TR_i = \frac{P_{i1} - P_{i0} + Inc_i}{P_{i0}} \quad TR_I = \sum_{i=1}^N w_i TR_i$$

Price Return Index over Multiple Periods

$$V_{PRIT} = V_{PRi0}(1 + PR_{i1})(1 + PR_{i2}) \dots (1 + PR_{iT})$$

Total Return Index over Multiple Periods

$$V_{TRIT} = V_{TRi0}(1 + TR_{i1})(1 + TR_{i2}) \dots (1 + TR_{iT})$$

Price-Weighted Indexes

$$w_i^P = \frac{P_i}{\sum_{j=1}^N P_j}$$

- Like buying one share of each stock
- Advantage is simplicity
- Disadvantage is arbitrary weights
- A stock's weight is halved due to a stock split, requiring an adjustment to the divisor

Equally Weighted Indexes

$$w_i^E = \frac{1}{N}$$

- Like investing the same amount in each stock
- Advantage is simplicity
- Disadvantages are that the impact of large companies is underrepresented and frequent rebalancing is required

Capitalization-Weighted Indexes

$$w_i^M = \frac{Q_i P_i}{\sum_{j=1}^N Q_j P_j}$$

- Like holding all stocks in proportion to their market values
- Float adjustment may be used to reflect the number of shares that may be actively traded
- Advantage is that the asset classes' performance is well-represented
- Disadvantage is that returns are heavily driven by large-cap (possibly overvalued) firms

Fundamentally Weighted Indexes

- Built like price-weighted indexes, but using a fundamental measure such as sales or cash flows
- Contrarian effect of rebalancing by selling off top performers and buying underperforming stocks produces a value tilt

Types of Equity Market Indexes

- *Broad market indexes:* Covers one equity market
- *Multi-market indexes:* Covers equity markets in multiple countries
- *Sector indexes:* Important for assessing a manager's performance (selection vs. allocation)
- *Style indexes:* Large/small cap; Value/growth

MARKET EFFICIENCY

Forms of Efficient Market Hypothesis (EMH)

	Market Prices Reflect:		
Form	Past market data	Public info	Private info
Weak	✓		
Semi-strong	✓	✓	
Strong	✓	✓	✓

Implications of EMH

- If weak form holds, investors will not earn abnormal profits from technical analysis
- If markets are semi-strong efficient, investors must have a comparative advantage to earn abnormal profits from fundamental analysis

Market Anomalies

Changes in a security's price that are not attributable to known information

Selected Behavioral Biases

- *Loss aversion:* Disliking losses more than liking equivalent gains
- *Information Cascades:* Those who act first will convey information that influences others
- *Representativeness:* Rely too much on current state when assessing probabilities
- *Mental accounting:* Keep track of gains and losses separately for different investments/goals
- *Conservatism:* Failing to incorporate new information in a timely manner
- *Narrow framing:* Focusing on certain issues in isolation

OVERVIEW OF EQUITY SECURITIES

Common Share Voting Methods

Statutory: One vote per share

Cumulative: Votes can be bundled

Example: 10 board positions

Statutory: 1 share votes for 10 different candidates

Cumulative: 10 votes may go to 1 candidate

Cumulative method advantages small shareholder

Preference Shares

- *Cumulative:* Accrue dividends if payments missed
- *Non-cumulative:* Missed dividends do not accrue, but no common dividends allowed if preferred shareholders do not receive their dividend
- *Participating:* May receive additional dividend if firm is profitable or in the event of liquidation
- *Non-participating:* No compensation beyond dividends and face value in a liquidation

Private Equity Securities

- *Venture capital (VC):* Start-up, early-state, or mezzanine financing with IPO as exit strategy
- *Leveraged buyouts (LBO):* Debt-financed deals to take undervalued listed companies private
- *Private investment in public equity (PIPE):* Companies can raise new capital quickly, investors can negotiate discounts



Depository Receipts (DRs)

Sponsored DRs: Issued directly by foreign company; Investors receive same voting rights and dividends as other common shareholders

Unsponsored DRs: Foreign company not involved; Depository bank purchases shares, issues DRs, and retains voting rights

Global DRs: Issued outside company's home country to avoid limits on capital flows; May be denominated in any currency, but USD is common; Cannot be listed on US exchanges, but US investors can purchase them via private placements

American DRs: USD-denominated GDRs that can be traded on US exchanges; Underlying securities, American depository shares, trade in issuer's domestic market

Global Registered Shares: Traded on multiple exchanges, including issuer's domestic market; Denominated in multiple local currencies; Unlike DRs, GRS represent an actual ownership interest

INTRODUCTION TO INDUSTRY AND COMPANY ANALYSIS

Porter's Five Forces Framework

- Threat of substitute products
- Bargaining power of customers
- Bargaining power of suppliers
- Threat of new entrants
- Intensity of rivalry

Industry Life Cycle Stages

- *Embryonic:* Slow growth, high prices, high failure risk, significant investment required
- *Growth:* Rapidly increasing demand, improving profitability, falling prices, low competition
- *Shakeout:* Slowing growth, intense competition, declining profitability
- *Mature:* Little or no growth, industry consolidation, high entry barriers
- *Decline:* Negative growth, excess capacity, high competition

Key Competitive Strategies

- *Low-cost leadership:* To hold/gain market share
- *Product differentiation:* To charge premium prices

EQUITY VALUATION: CONCEPTS AND BASIC TOOLS

Dividend Discount Model (DDM)

$$V_0 = \sum_{t=1}^{\infty} \frac{D_t}{(1+r)^t} = \sum_{t=1}^n \frac{D_t}{(1+r)^t} + \frac{P_n}{(1+r)^n}$$

Perpetual preferred stock; constant dividend:

$$V_0 = \frac{D_0}{r - g}$$

Gordon constant growth model (GGM):

$$V_0 = \sum_{t=1}^{\infty} \frac{D_0(1+g)^t}{(1+r)^t} = \frac{D_0(1+g)}{r - g} = \frac{D_1}{r - g}$$

$$g = (\text{Retention rate}) \times \text{ROE} = (1 - D/E) \times \text{ROE}$$

Multistage DDM:

$$V_0 = \sum_{t=1}^n \frac{D_t}{(1+r)^t} + \frac{P_n}{(1+r)^n}$$

$$P_n = \frac{D_{n+1}}{r - g_L}$$

$$D_{n+1} = D_0(1+g_S)^n(1+g_L)$$

Price Multiples

$$\frac{P_0}{E_1} = \frac{D_1/E_1}{r - g}$$

P/B = Price per share/Book value per share

P/CF = Price per share/Cash flow per share

P/S = Price per share/Sales per share

Asset-Based Valuation Models

Useful for companies with natural resource or a large share of current assets/liabilities; Not useful if company has a large share of PP&E/intangibles

Enterprise Value (EV)

$$\begin{aligned} &= \text{MV(Common equity)} + \text{MV(Preferred stock)} \\ &+ \text{MV(Debt)} - (\text{Cash} + \text{Short term investments}) \end{aligned}$$

FIXED INCOME

FIXED-INCOME SECURITIES: DEFINING ELEMENTS

Types of Bonds

- *Collateral Trust Bonds:* Backed by financial assets
- *Equipment Trust Bonds:* Backed by physical assets
- *Covered Bonds:* Backed by a segregated pool of loans that are replaced if they stop performing

Principal Repayment Structures

- *Bullet Bonds:* Full principal repaid at maturity
- *Fully Amortizing:* Equal annuity-like payments contain a mix of interest and principal
- *Partially Amortizing:* Some principal is amortized, remainder repaid as a lump sum at maturity
- *Sinking Funds:* Certain percentage of principal retired each year

Coupon Structures

- *Fixed-rate bonds:* Set percentage of principal
- *Floating-rate (FRNs):* Reference rate + spread
- *Step-up:* Coupon rate increases on schedule
- *Credit-Linked:* Coupon rate is increased if issuer is downgraded, reduced if upgraded
- *Payment-in-kind:* Coupons may be paid with more bonds rather than cash
- *Deferred (Split) Coupon:* No coupons in early years, high coupons in later years

Inflation-Indexed Bonds

- *Zero-coupon:* Principal amount is adjusted
- *Interest-indexed:* Coupons are adjusted
- *Capital-indexed:* Fixed rate, adjusted principal
- *Indexed-annuity:* Amortizing bonds with annuity payments adjusted for inflation

Credit Enhancements

Internal: Subordination, over-collateralization, reserve accounts

External: Surety bonds, letters of credit, guarantees from financial institutions

Bonds with Contingency Provisions

Callable Bonds

May be recalled by issuer if rates fall

$$V_{\text{Callable bond}} = V_{\text{Non-callable bond}} - V_{\text{Call}}$$

Putable Bonds

May be sold back to issuer if rates rise

$$V_{\text{Putable bond}} = V_{\text{Non-putable bond}} + V_{\text{Put}}$$

Convertible Bonds

Conversion price: Price per share at which bond can be converted into shares

Conversion ratio: Number of common shares each bond can be converted into

Conversion value:

Current share price × Conversion ratio

Conversion premium:

Convertible bond's price – Conversion value

Warrants: Options to buy equity, lowers debt costs

Convertible Contingent Bonds (CoCos)

- Automatically convert to equity if a condition is met (e.g., capitalization ratio falls)
- Lender does not control if option is exercised
- Primarily issued by financial institutions

FIXED-INCOME MARKETS: ISSUANCE, TRADING, AND FUNDING

Bond Markets

- *Primary bond markets:* Markets in which issuers initially sell bonds to investors to raise capital
- *Secondary bond markets:* Markets in which bonds are subsequently traded among investors; Most trading is OTC rather than on organized exchanges
- *Grey market:* Informal forward market to gauge interest in upcoming bond issues and set prices for the primary market

Sovereign Debt

- Issued by national governments, zero default risk
- Bills mature < 1 year; Bonds mature > 1 year
- On-the-run: Most recent issues of a given maturity; more liquid than off-the-run issues

Non-Sovereign Debt

- Municipal bonds (sub-national issuers)
- Quasi-government bonds (gov't-backed agencies)
- Supranational bonds (i.e., IMF, World Bank)

Corporate Debt

- Commercial paper (CP) used for < 1 year, but carries rollover risk
- Long-term bonds ~12+ years
- Bilateral/syndicated bank loans are also used



Medium-Term Notes (MTNs)

- Used to bridge gap between CP and L/T bonds
- Offered to investors through an agent in a range of maturities
- Lower registration/underwriting costs than bonds, but relatively illiquid

USCP vs. Eurocommercial Paper

	USCP	ECP
Currency	US dollar	Any currency
Maturity	Overnight to 270 days	Overnight to 364 days
Interest calculation	Discount basis	Interest-bearing or discount basis
Settlement	T + 0	T + 2
Negotiable	Can be sold	Can be sold

Structured Financial Instruments

- *Guarantee certificate*: Zero-coupon bond with a call option on the issuer's equity
- *Credit-linked note*: Seller earns a premium for providing credit protection on underlying bond
- *Participation Instruments*: Coupon payments based on underlying rate (e.g., FRNs)
- *Leveraged Instruments*: Modify returns
Leveraged floater: $2 \times (\text{Reference rate})$
Deleveraged floater: $0.5 \times (\text{Reference rate})$
Leveraged inverse floater: Max coupon - $2 \times (\text{RR})$

Factors Increasing Repurchase (Repo) Rates

- Higher Collateral risk
- Longer term
- Delivery requirement
- Low quality collateral
- Higher rates for alternative sources of funds

INTRODUCTION TO FIXED-INCOME VALUATION

Bond Pricing with Spot Rates

$$PV = \frac{PMT}{(1+z_1)^1} + \frac{PMT}{(1+z_2)^2} + \dots + \frac{PMT + FV}{(1+z_N)^N}$$

CR: Coupon Rate; MDR: Market Discount Rate

CR = MDR	Price = Par Value	Par
CR < MDR	Price < Par Value	Discount
CR > MDR	Price > Par Value	Premium

Bond Pricing Relationships

- *Inverse effect*: Price moves opposite to yield
- *Convexity effect*: Falling yield has greater price impact than equivalent increase in yield
- *Coupon effect*: Yield changes have greater impact on lower coupon bonds
- *Maturity effect*: Yield changes have greater impact on longer-term bonds (may not apply to low-coupon bonds trading at very deep discounts)

Flat Price, Accrued Interest, and Full Price

$$PV_{\text{Full}} = PV_{\text{Flat}} + AI = (PV)(1+r)^{t/T}$$

$$AI = (t/T) \times PMT$$

Yield Measures

$$\text{Current yield} = \frac{\text{Annual cash coupon payment}}{\text{Flat price}}$$

$$\text{Simple yield} = \frac{\text{Annual cash coupon payment} + \text{gain/loss}}{\text{Flat price}}$$

Yield-to-call (YTC) = IRR assuming bond is called

Yield-to-worse = $\min[YTC, YTM]$

Yield Measures for FRNs

Quoted margin (QM): Spread paid by FRN

Discount margin (DM): Spread required by market

If QM > DM, FRN will trade above par

FRN pricing formula:

$$= \frac{\frac{(Ref + QM)(FV)}{m}}{\left(1 + \frac{(Ref + DM)}{m}\right)^1} + \dots + \frac{\frac{(Ref + QM)(FV)}{m} + FV}{\left(1 + \frac{(Ref + DM)}{m}\right)^N}$$

Yield Measures for Money Market Instrument

Discount Rate (DR) Basis

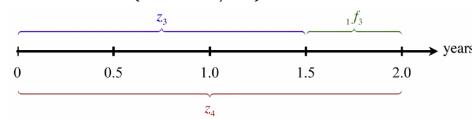
$$PV = FV \times \left(1 - \frac{\text{Days}}{\text{Year}} \times DR\right)$$

Add-on Rate (AOR) Basis

$$PV = FV / \left(1 + \frac{\text{Days}}{\text{Year}} \times AOR\right)$$

Implied Forward Rate (IFR)

$$(1 + z_A)^A \times (1 + IFR_{A,B-A})^{B-A} = (1 + z_B)^B$$



Yield Spreads over Benchmark Yield Curve

G-spread = YTM - Government bond yield

I-spread = YTM - Swap rate

Z-spread

$$PV = \frac{PMT}{(1+z_1+Z)^1} + \frac{PMT}{(1+z_2+Z)^2} + \dots + \frac{PMT + FV}{(1+z_N+Z)^N}$$

(Can only be calculated by trial-and-error)

Option-adjusted spread (OAS)

OAS = Z-spread - Option value (in basis points)

INTRODUCTION TO ASSET-BACKED SECURITIES

Parties to a Securitization

- *Seller/Depositor*: Originates loans (assets)
- *Issuer*: Special purpose vehicle (SPV) established to create asset-backed securities (ABS)
- *Servicer*: Collects payments on underlying loans

ABS Tranching

- *Credit tranching*: Certain tranches absorb credit losses before others
- *Absolute priority rule*: Senior claims outrank subordinated claims in the event of a liquidation
- *Time tranching*: Certain tranches are exposed to prepayment risk

Securitization Example

- Firm sells equipment on credit
- Firm creates bankruptcy-remote SPV
- SPV issues debt to purchase loans from firm
- SPV creates securities backed by loans
- Investors purchase securities from SPV
- SPV collects loan payments from firm's customers
- SPV distributes cash flows to investors

Residential Mortgage Loans

- Interest: fixed, adjustable, convertible
- Amortization: full, partial, interest-only
- Prepayment: penalty, no penalty
- Foreclosure: non-recourse, recourse

Residential Mortgage-Backed Securities

- *Agency RMBS*: Issued by government agencies; must have conforming loans
- *Non-agency RMBS*: Issued by private companies and may have non-conforming loans
- *Pass-through rate*: MBS coupon rate
- *Prepayment risk*: Contraction (faster-than-expected); extension (slower-than-expected)
- Prepayment rates are relative to PSA benchmark

Collateralized Mortgage Obligations (CMOs)

- Unlike pass-through securities, CMOs have tranches to redistribute cash flows and risks
- *Sequential-pay CMOs* have principal and prepayments paid to the tranches sequentially
- *Planned amortization class (PAC) CMOs* have support tranches to absorb prepayment risk

Non-Mortgage ABS

- *Amortizing*: E.g., auto loan ABS
- *Non-amortizing*: E.g., credit card receivable ABS

Collateralized Debt Obligations (CDOs)

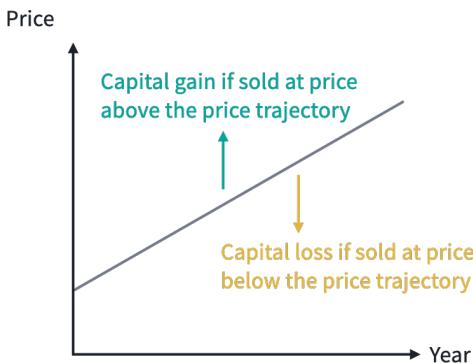
Securities backed by pool of debt obligations, such as corporate bonds, leveraged bank loans, or credit default swap on securities

Covered Bonds

- Dual recourse against the issuing financial institution and the cover pool
- One bond class per cover pool
- Issuer must replace non-performing asset with performing asset

UNDERSTANDING FIXED-INCOME RISK AND RETURNS

Constant Yield Price Trajectory



Yield Duration vs. Curve Duration

Yield duration: Sensitivity to YTM

Measures: Macaulay duration, modified duration, money duration, price value of basis point (PVBP)

Curve duration: Sensitivity to benchmark yields (e.g., effective duration); for bonds with options

Macaulay Duration

$$D_{\text{Mac}} = \left(\frac{1+r}{r} - \frac{1+r+N(c-r)}{c[(1+r)^N - 1] + r} \right) - \frac{t}{T}$$

r: YTM

c: Coupon rate

N: Number of periods to maturity

t: Number of days since last coupon payment

T: Number of days in each coupon period



Modified Duration

$$\text{ModDur} = \frac{D_{\text{Mac}}}{1+r}$$

$$\% \Delta PV^{\text{Full}} = -\text{AnnModDur} \times \Delta \text{Yield}$$

$$\text{ApproxModDur} = \frac{(PV_-) - (PV_+)}{2(\Delta \text{Yield})(PV_0)}$$

Money Duration and PVBP

$$\text{MoneyDur} = \text{AnnModDur} \times PV^{\text{Full}}$$

$$\Delta PV^{\text{Full}} \approx -\text{MoneyDur} \times \Delta \text{Yield}$$

$$\text{Price value of a basis point} = \frac{(PV_-) - (PV_+)}{2}$$

$$\text{Basis point value} = D_{\text{Mod}} \times 0.0001$$

Effective Duration

$$\text{EffDur} = \frac{(PV_-) - (PV_+)}{2(\Delta \text{Curve})(PV_0)}$$

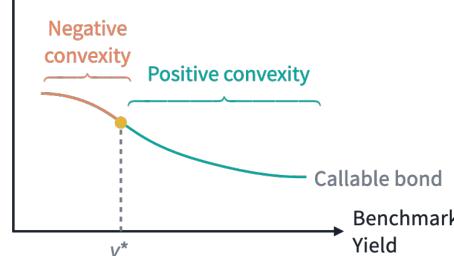
Convexity

$$\text{ApproxConv} = \frac{(PV_-) + (PV_+) - [2 \times (PV_0)]}{(\Delta \text{Yield})^2 (PV_0)}$$

$$\% \Delta PV^{\text{Full}} = -D_{\text{Mod}} \times \Delta \text{YTM} + \frac{1}{2} (\text{Conv}) (\Delta \text{YTM})^2$$

$$\text{EffConv} = \frac{(PV_-) + (PV_+) - 2(PV_0)}{(\Delta \text{Curve})^2 (PV_0)}$$

Price



Duration Gap

$$\text{Duration gap} = D_{\text{Mac}} - \text{Investment horizon}$$

- If positive: Price risk > Reinvestment risk
- If negative: Reinvestment risk > Price risk

FUNDAMENTALS OF CREDIT ANALYSIS

Credit Risk

- Default risk: Probability of default
- Loss severity: Loss given default

$$E[\text{Loss}] = \text{Pr}(\text{Default}) \times \text{Loss severity}$$

$$\text{Loss severity} = 1 - \text{Recovery rate}$$

Spread Risk

- Credit migration risk: Possibility of downgrade
- Market liquidity risk: Need to sell at a discount

Seniority Ranking

- First Lien Loan – Senior Secured
- Second Lien Loan – Secured
- Senior Unsecured
- Senior Subordinated
- Subordinated
- Junior Subordinated

Pari passu: All creditors in the same ranking, regardless of maturity, have the same priority

Credit Ratings

Investment grade: Baa3/BBB- and above

Non-investment grade: Ba1/BB+ and below

Four C's of Credit Analysis

- Capacity
- Collateral
- Covenants
- Character

Corporate Bond Yield Components

- Real risk-free interest rate
- Expected inflation rate
- Maturity premium
- Liquidity premium
- Credit spread

Yield spread

DERIVATIVES

DERIVATIVE INSTRUMENT AND DERIVATIVE MARKET FEATURES

Derivative Underlyings

- Equities
- Fixed-income instruments and interest rates
- Currencies
- Commodities
- Credit
- Other (e.g., weather, crypto, longevity risk)

Derivatives Markets

	OTC Market	ETD Market
Liquidity	Lower	Higher
Trading costs	Higher	Lower
Transparency	Less	Greater
Standardization	Lower	Higher
Flexibility/customization	Higher	Lower
Counterparty credit risk	Higher	Lower

FORWARD COMMITMENT AND CONTINGENT CLAIM FEATURES AND INSTRUMENTS

Types of Derivatives

Forward commitments: Obligation to trade on a specified date at a previously agreed price

Contingent claims: Trade may or may not occur depending on market conditions

Forward Commitments	Contingent Claims
Forward contract Futures contracts Swaps	Options Credit derivatives

DERIVATIVE BENEFITS, RISKS, AND ISSUER AND INVESTOR USES

Derivative Benefits and Risks

Benefits:

- Risk allocation, transfer, and management
- Information discovery
- Operational advantages
- Market efficiency

Risks:

- Potential for speculative use
- Lack of transparency
- Basis risk
- Liquidity risk
- Counterparty credit risk
- Destabilization and systemic risk

Derivative Benefits and Risks

Issuers use derivatives to perform:

- Cash flow hedge
- Fair value hedge
- Net investment hedge

Investors use derivatives to hedge their risk exposures and take speculative positions

ARBITRAGE, REPLICATION, AND THE COST OF CARRY IN PRICING DERIVATIVES

No-Arbitrage Forward Price with Benefits/Income and Costs

Annual compounding:

$$F_0(T) = [S_0 + P_{V_0}(C) - P_{V_0}(I)](1 + r)^T$$

Continuous compounding:

$$F_0(T) = S_0 e^{(r+c-d)T}$$

No-Arbitrage Currency Forward Price

$$F_{0,f/d}(T) = S_{0,f/d} e^{(r_f - r_d)T}$$

PRICING AND VALUATION OF FORWARD CONTRACTS

Pricing and Valuation of Forward Commitments

Valuation at initiation:

$$F_0(T) = S_0(1 + r)^T$$

Valuation at maturity:

- Long party:

$$V_T(T) = S_T - F_0(T)$$

- Short party:

$$V_T(T) = -[S_T - F_0(T)]$$

Valuation during the life of the contract:

$$V_t(T) = S_t - F_0(T)(1 + r)^{-(T-t)}$$

Pricing and Valuation of Currency Forward Contracts

Valuation at initiation:

$$F_{0,f/d}(T) = S_{0,f/d} e^{(r_f - r_d)T}$$

Valuation during the life of the contract:

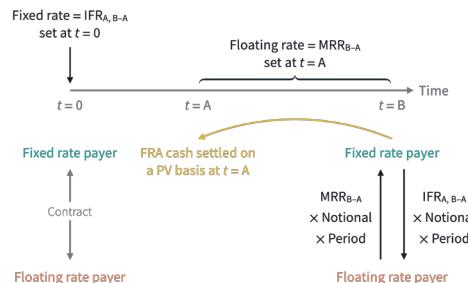
$$V_t(T) = S_{t,f/d} - F_{0,f/d}(T) e^{-(r_f - r_d)(T-t)}$$

Pricing and Valuation of Interest Rate Forward Contracts

Implied forward rate:

$$IFR_{A,B-A} = \left[\frac{(1 + z_B)^B}{(1 + z_A)^A} \right]^{1/(B-A)} - 1$$

Forward rate agreements:



Net payment received by the FRA buyer:

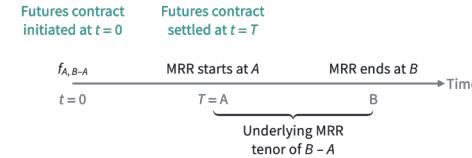
$$(MRR - Fixed IFR) \times \text{Notional principal} \times \text{Period}$$

PRICING AND VALUATION OF FUTURE CONTRACTS

Pricing of Futures and Forward Contracts

Price of interest rate futures contract:

$$f_{A,B-A} = 100 - (100 \times MRR_{A,B-A})$$



Type	Gains from Rising MRR	Gains from Falling MRR
Interest rate futures	Short futures contract	Long futures contract
Forward rate agreement	Long FRA: Fixed-rate payer	Short FRA: Floating-rate payer

Futures Contract Value

$$= \text{Notional Principal} \times \left[1 + \left(\frac{\text{MRR}}{M} \right) \right]$$

Futures Contract BPV

$$= \text{Notional Principal} \times 0.0001 \times \text{Period}$$

Forward Price vs. Futures Price

The relationship between forward prices and futures prices depends on the correlation between futures prices and interest rates:

Correlation	Relationship
None	Futures price = Forward price
Positive	Futures price > Forward price
Negative	Futures price < Forward price

PRICING AND VALUATION OF INTEREST RATES AND OTHER SWAPS

Swap Values and Prices

Periodic settlements:

Periodic Settlement Value

$$= \text{Notional Principal} \times 0.0001 \times \text{Period}$$

PRICING AND VALUATION OF OPTIONS

Option Moneyness

Option Moneyness	Call	Put
In-the-money	$S_t > X$	$S_t < X$
At-the-money	$S_t = X$	$S_t = X$
Out-of-the-money	$S_t < X$	$S_t > X$

Option Values

$$c_T = \max[0, S_T - X]$$

$$p_T = \max[0, X - S_T]$$

$$c_t = \max[0, S_t - X/(1 + r)^{T-t}] + \text{Time value}$$

$$p_t = \max[0, X/(1 + r)^{T-t} - S_t] + \text{Time value}$$

Arbitrage and Replication for Options

Call option:

$$- \text{Lower bound } (c_t) = \max[0, S_t - X/(1 + r)^{T-t}]$$

$$- \text{Upper bound } (c_t) = S_t$$

Put option:

$$- \text{Lower bound } (p_t) = \max[0, X/(1 + r)^{T-t} - S_t]$$

$$- \text{Upper bound } (c_t) = X$$

Factors Impacting Option Values

Increase in	Call	Put
Value of underlying	↑	↓
Exercise price	↓	↑
Time to expiration	↑	↑*
Risk-free rate	↑	↓
Volatility of underlying	↑	↑
Payments on underlying	↓	↑
Cost of carry	↑	↓

*Except for some deep-in-the-money put options

OPTION REPLICATION USING PUT-CALL PARITY

Put-Call Parity

$$c_0 + X/(1 + r)^T = s_0 + p_0$$

Fiduciary call = Protective put

Put-Call-Forward Parity

$$c_0 + X/(1 + r)^T = F_0(T)/(1 + r)^T + p_0$$

Fiduciary call = Protective put w. forward contract

Put-Call Parity Applications: Firm Value

$$V_0 + p_0 = c_0 + PV(D)$$

VALUING A DERIVATIVE USING A ONE-PERIOD BINOMIAL MODEL

Binomial Valuation

Hedging portfolio:

$$V_0 = hS_0 - c_0$$

Hedge ratio:

$$h = \frac{c_1^u - c_1^d}{S_1^u - S_1^d}$$

Risk Neutrality

Risk-neutral probabilities:

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

Risk-neutral probability-weighted call price:

$$c_0 = \frac{\pi c_1^u + (1 - \pi)c_1^d}{1 + r}$$

ALTERNATIVE INVESTMENTS

CATEGORIES, CHARACTERISTICS, AND COMPENSATION STRUCTURES OF ALTERNATIVE INVESTMENTS

Qualities of Alternatives vs. Traditional Assets

- Narrow manager specialization
- Low correlation with traditional investments
- Less regulation and lower transparency
- Limited historical risk and return data
- Unique legal and tax considerations
- High fees
- High use of leverage
- Restrictions on redemptions

Investment Methods

- *Fund Investing*: Indirect investing
- *Co-Investing*: Hybrid between direct investing and indirect investing
- *Direct investing*: Without the use of intermediary



Compensation Structures

- *Soft hurdle rate*: Incentive fee applies to entire return if hurdle rate is cleared
- *Hard hurdle rate*: Incentive fee is only paid on return in excess of hurdle rate

Common Clauses and Provisions

- *Catch-up clause*: Allows the GP to receive 100% of the return in excess of the hurdle rate until the GP catches up with their cumulative performance fee
- *High-water mark clause*: Reflects the highest value used to calculate an incentive fee
- *Waterfall*: Distribution method that defines the order of allocations to the LPs and GPs
- *Clawback provision*: Allows the LPs to get back incentive fees that have been paid if gains are subsequently reversed

PERFORMANCE CALCULATION AND APPRAISAL OF ALTERNATIVE INVESTMENTS

Common Approaches and Application Challenges

$$\text{Sharpe ratio} = \frac{r_p - r_f}{\sigma_p}$$

- Easy to calculate
- Fails to capture tail-risk and treat volatility equally

$$\text{Sortino ratio} = \frac{r_p - r_f}{\sigma_D}$$

- Does not penalize upside volatility
- More difficult to calculate than Sharpe ratio, but is more appropriate with non-normal returns

$$\text{MAR ratio} = \frac{\text{Average compounded annual return (since inception)}}{\text{Max. drawdown (since inception)}}$$

$$\text{Calmar ratio} = \frac{\text{Average compounded annual return (period)}}{\text{Max. drawdown (period)}}$$

- Appropriate for assets with long left-tail distributions

Performance Evaluation: Private Equity and Real Estate

- Internal rate of return (IRR)
 - Multiple of invested capital (MOIC)
- $$\text{Realized value} + \frac{\text{Unrealized value}}{\text{of investment}} = \frac{\text{Realized value} + \text{Unrealized value}}{\text{Total amount of investment}}$$

- Quartile ranking
- Cap rate

Performance Evaluation: Hedge Funds

- Leverage
- Illiquidity and asset valuations
- Potential redemption pressures (notice periods, lockup periods, liquidity gates)

PRIVATE CAPITAL, REAL ESTATE, INFRASTRUCTURE, NATURAL RESOURCES, AND HEDGE FUNDS

Private Equity: Leveraged Buyouts

- *Management buyouts*: Current management team is involved in the acquisition
- *Management buy-ins*: Current management team is being replaced by the acquiring team

Private Equity: Venture capital

- *Formative-stage financing*: Angel investing, seed-stage financing, early-stage financing
- *Later-stage financing*: After commercial production and sales have begun but before IPO
- *Mezzanine-stage financing*: Prepare to go public
- *Exit strategies*: Trade sale (best price), IPO, recapitalization, secondary sale, liquidation

Private Debt

- *Direct lending*: Direct capital in the form of senior and secured loans
- *Mezzanine debt*: Debt subordinated to senior secured debt but senior to equity
- *Venture debt*: To complement existing equity financing of start-up or early-stage companies
- *Distressed debt*: Funding provided to mature companies facing financial distress

Forms of Real Estate Investing

	Debt	Equity
Private	Mortgages, Construction lending	Direct ownership, Real estate funds, Private REITs
Public	MBS, CMOs, Mortgage REITs	Shares in RE corps., REITs

Infrastructure Investments

- New (greenfield) or existing (brownfield) assets
- Economic (roads) or social (healthcare facilities)
- Direct ownership or indirect (via LP or ETF)
- Private vehicles or public securities (uncommon)

Commodities

- Futures price*:

$$S_0(1+r) + \text{Storage costs} - \text{Convenience yield}$$

	Contango	Backwardation
Price curve slope	Upward	Downward
Convenience yield	Low	High

Timberland and Farmland

Sources of return:

- Biological growth
- Prices of timber/crops
- Land price changes

Hedge Fund Strategies

- *Equity hedge*: Long and short positions in equity and equity derivative securities; Bottom-up
- *Event-driven*: Seek to profit from short-term events (e.g., Mergers); Bottom-up
- *Relative value*: Seek to profit from pricing discrepancies between related securities
- *Macro*: Emphasize top-down approach to identifying global economic trends

PORTFOLIO MANAGEMENT

PORTFOLIO MANAGEMENT: AN OVERVIEW

Portfolio Management Process

Planning: List objectives and constraints in IPS

Execution: Asset allocation, security analysis, portfolio construction

Feedback: Monitoring and rebalancing, performance measurement and reporting

Institutional Investor Clients

- *DB pension plans*: Younger beneficiaries increase time horizon and risk tolerance
- *Endowments/Foundations*: Generally longer time horizon, low liquidity needs, high risk tolerance
- *Banks*: Short time horizon, high liquidity need, very low risk tolerance
- *Insurers*: Short time horizon (longer for Life than P&C), high liquidity needs, low risk tolerance
- *Investment companies*: Time horizon and risk tolerance vary by mandate, liquidity needs are usually high due to potential redemptions
- *Sovereign Wealth Funds*: Vary by mandate

Robo-Advisors

- Cater to underserviced segments, "mass affluent"
- Lower fees compared to traditional managers
- Relatively low barriers to entry

Mutual Funds

- *Open-end*: Accept new investors after launch
- *Closed-end*: No new shares created after launch, may trade at a premium/discount to NAV
- *No-Load*: No investing/redemption fees, funds charge a percentage of NAV

Exchange Traded Funds (ETFs)

- Mutual funds only trade at the end of each day, ETFs can be traded at any time during the day
- Investors can sell ETFs short or buy on margin
- ETFs do not trade at discount/premium to NAV
- ETFs distribute dividends to investors, mutual funds reinvest dividends
- ETFs have lower minimum investment levels

PORTFOLIO RISK AND RETURN: PART I

Money-Weighted Return (MWR)

- IRR derived from all cash inflows and returns
- Can be skewed by timing/value of cash flows
- Appropriate if manager controls timing of CFs

Time-Weighted Return (TWR)

- Geometric mean of sub-period returns
- Compound growth for an initial \$1 investment
- Unaffected by timing/value of cash flows

Risk Aversion

Combination of ability and willingness to take risk

Risk averse: Requires a premium to take more risk

Risk neutral: Only concerned with expected return, indifferent to level of risk

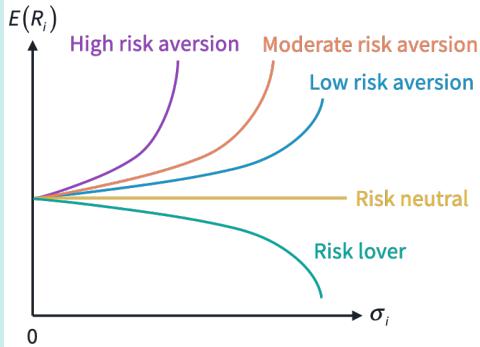
Risk seeking: Will pay a premium to take more risk

Utility Function

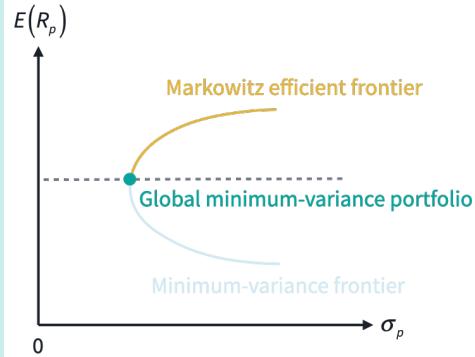
$$U = E(r) - \frac{1}{2}A\sigma^2$$

A is the degree of risk aversion, it is >0 for risk-averse, 0 for risk-neutral, and <0 for risk-seeking

Indifference Curves



Minimum-Variance Portfolios

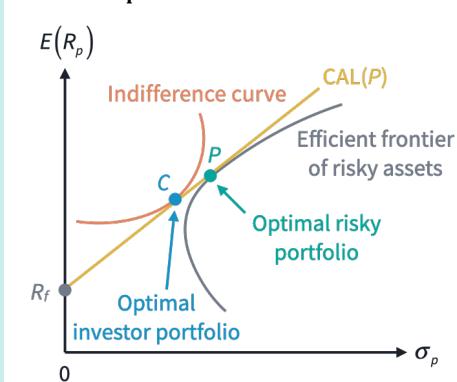


Capital Allocation Line (CAL)

Line representing possible combinations of risk-free assets and optimal risky asset portfolio

$$E[R_p] = R_f + \left(\frac{E[R_i] - R_f}{\sigma_i} \right) \sigma_p$$

Investor's Optimal Portfolio



PORTFOLIO RISK AND RETURN: PART II

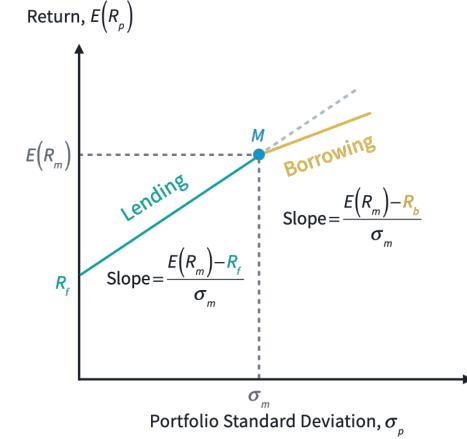
Capital Market Line (CML)

CAL with risky portfolio being market portfolio

$$E[R_p] = R_f + \left(\frac{E[R_m] - R_f}{\sigma_m} \right) \sigma_p$$

Borrowing vs. Lending

Expected Portfolio



Beta

$$\beta_i = \frac{\text{Cov}(R_p, R_m)}{\sigma_m^2} = \frac{\rho_{i,m}\sigma_i}{\sigma_m}$$

Systematic risk = Non-diversifiable (market) risk

Nonsystematic risk = Diversifiable risk

Total risk = Systematic risk + Nonsystematic risk

Capital Asset Pricing Model (CAPM)

Assumptions:

- Investors are risk-averse, utility-maximizing, rational individuals
- Markets are frictionless
- All investors plan for same single holding period
- Investors have homogeneous expectations
- Investments are infinitely divisible
- Investors are price takers

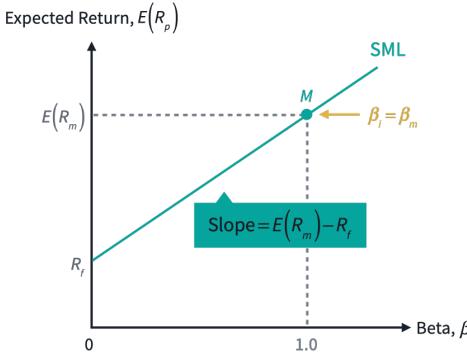
$$E[R_p] = R_f + \beta_i [E[R_m] - R_f]$$

Limitations:

- Single-factor: Only accounts for systematic risk
- Single-period: Does not consider multiple periods
- Inclusion of assets that are not investable, such as human capital and assets in closed economies

Security Market Line (SML)

Graphical representation of CAPM:



Identifying Mispriced Stocks

Stocks that plot above the SML are underpriced; stocks that plot below the SML are overpriced

Ratios

Total risk	Sharpe ratio	$\frac{R_p - R_f}{\sigma_p}$
M-squared	$(R_p - R_f) \frac{\sigma_m}{\sigma_p} + R_f$	
Systematic risk	Treynor ratio	$\frac{R_p - R_f}{\beta_p}$
	Jensen's alpha	$R_p - [R_f + \beta_p(R_m - R_f)]$

BASICS OF PORTFOLIO PLANNING AND CONSTRUCTION

Investment Policy Statements (IPS)

Investment objectives: Risk/return objectives

Constraints: Liquidity, time horizon, tax concerns, legal and regulatory factors, unique circumstances

Asset Allocation

Strategic asset allocation: Set of exposures to IPS-permissible asset classes in weights that are consistent with the client's long-term objectives

Tactical asset allocation: Deliberate deviations from policy weights based on forecasts of asset class returns over the near term

THE BEHAVIORAL BIASES OF INDIVIDUALS

Cognitive Errors

- *Conservatism bias:* People fail to incorporate new information that conflicts with their opinions
- *Confirmation bias:* People seek "evidence" that confirms their prior beliefs
- *Representativeness bias:* People inappropriately classify new information based on past similar situations
- *Illusion of control bias:* People overestimate their ability to control or predict events
- *Hindsight bias:* People believe past events would have been predictable
- *Anchoring and adjustment bias:* People rely too much on initial information in their estimation
- *Mental accounting bias:* People put money in separate mental buckets
- *Framing bias:* People answer the same question differently based on how it is framed
- *Availability bias:* People assume outcomes that are easier to remember are more likely

Emotional Biases

- **Loss-aversion bias:** People strongly prefer avoiding losses more than achieving gains
- **Overconfidence bias:** People overestimate their own abilities
- **Self-control bias:** People lack self-discipline to make decisions based on their long-term goals
- **Status quo bias:** People are more inclined to do nothing rather than make changes
- **Endowment bias:** People value an asset more when they hold the rights to it
- **Regret-aversion bias:** People avoid making decisions that could potentially turn out badly

Market Anomalies

Factors that cause anomalies misclassifications:

- Inappropriate asset pricing model
- Statistical issues due to small samples
- Temporary disequilibria

AN INTRODUCTION TO RISK MANAGEMENT

Risk Management

Risk management framework:

- Risk governance
- Risk identification and measurement
- Risk infrastructure
- Defined policies and processes
- Risk monitoring, mitigation, and management
- Communications
- Strategic analysis or integration

Risk tolerance: Which risks are acceptable and how much risk should be taken

Risk budgeting: How the risks should be taken

Financial risks: Arise from financial market activities (e.g., market, credit, liquidity risk)

Non-financial risks: Arise from within entity or from external (e.g., operational, legal, regulatory, political, model, tail risk)

Risk measures: Standard deviation, beta, duration, delta, gamma, VaR, CVaR, etc.

Risk modification: By prevention and avoidance, transfer (insurance), or shifting (derivatives)

TECHNICAL ANALYSIS

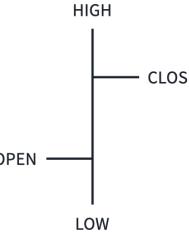
Technical Analysis: Principles

- The market discounts everything
- Prices move in trends and countertrends
- Price action is repetitive with reoccurring patterns

Technical Analysis: Charts

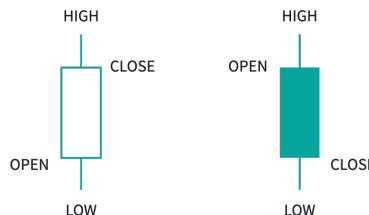
Line chart: A plot of price data, typically closing prices, with a line connecting the points

Bar chart



Candlestick chart

White body: close > open; Dark body: close < open



Trends

Uptrend: Price reaches higher highs/lows

Downtrend: Price reaches lower highs/lows

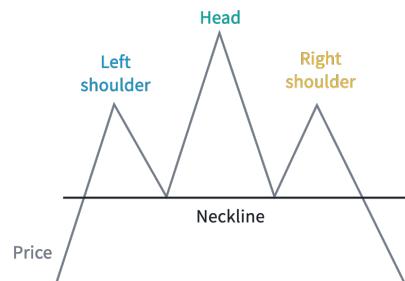
Support: Buying is sufficient to stop further decline

Resistance: Selling pressure stops further increase

Reversal Patterns

Head and shoulders (H&S): Indicate an upcoming downturn following a preceding uptrend

Inverse H&S: Indicate an upcoming uptrend following a preceding downturn



Price target = Neckline - (Head - Neckline)

Double tops: When an uptrend reverses twice at about the same high

Price target = Valley - (Top - Valley)

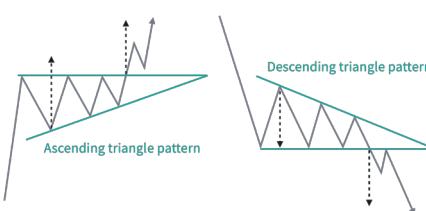
Double bottoms: When a downtrend reverses twice at about the same low

Price target = Top + (Top - Valley)

Triple Tops/Bottoms: More significant indicators than double tops/bottoms

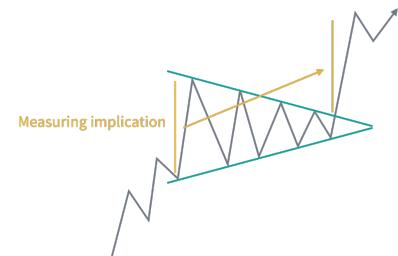
Continuation Patterns

Triangles (Ascending and Descending)

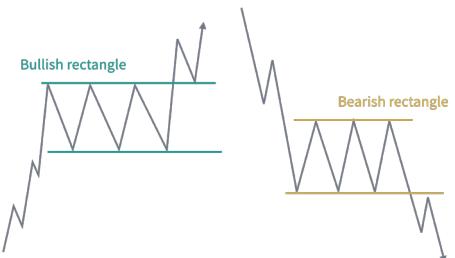


Triangle (Symmetrical)

Narrowing = bullish; Widening = bearish



Rectangles (Bullish and Bearish)



Flag: Parallel trend lines over short period

Pennant: Converging trend lines over short period

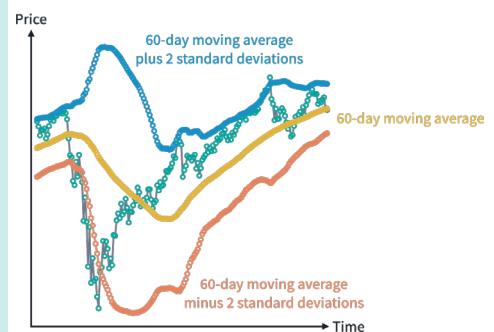
Price-Based Indicators

Moving average (MA): Average closing price over a specified number of periods (e.g., 7-day, 60-day)

Golden cross: Short-term MA crosses long-term MA from below; bullish indicator

Dead cross: Short-term MA crosses long-term MA from above; bearish indicator

Bollinger bands: Lines representing MA \pm 2 standard deviations; Bullish if MA reaches lower bound, bearish if MA reaches upper bound



Momentum Oscillators

Rate of Change (ROC) Oscillator:

$$M = (V - V_x) \times 100$$

V = last closing price

V_x = closing price x days ago, typically 10

ROC oscillator crossing 0 in the same direction as the trend direction is buy/sell signal

Relative Strength Index:

$$RSI = 100 - \frac{100}{1 + RS}, \quad RS = \frac{\Sigma(\text{Up changes})}{\Sigma(|\text{Down changes}|)}$$

Stochastic Oscillator:

$$\%K = 100 \left(\frac{\text{Last closing price} - \text{Low in past 14}}{\text{High in past 14} - \text{Low in past 14}} \right)$$

%D = average of last 3 daily %K values

MA convergence/divergence (MACD) oscillator:

Consists of MACD line and signal line: MACD line is the difference between two exponentially smoothed moving averages (12 and 26 days); Signal line is the exponentially smoothed average of MACD line (9 days)

Sentiment Indicators

Put/call ratio: Volume of put options traded divided by volume of call options traded

CBOE Volatility Index (VIX): Measures near-term market volatility calculated by the CBOE

Intermarket Analysis

The combined analysis of major categories of securities (equities, bonds, etc.) to identify patterns and inflection points

- *Top-down approach:* Focus on global equity markets, then narrow down to specific companies

- *Bottom-up approach:* Select stocks based on a set of predefined criteria regardless of economy and sector

FINTECH IN INVESTMENT MANAGEMENT

Machine Learning

Supervised learning: Algorithm finds relationships among labeled training data

Unsupervised learning: Algorithm works with unlabeled data to create clusters/groupings

Data Processing Methods

Data capture: Collecting data, transforming into usable format

Data curation: Cleaning data to ensure high quality

Data storage: Recording, archiving, accessing data

Search: Finding specific information in datasets

Transfer: Moving data from source or storage location to the analytical tool

Uses of Fintech in Investment Management

Text Analytics: Analysis of unstructured data

Natural Language Processing: Interpreting human language (e.g., speech recognition)

Distributed Ledger Technology (DTL)

Ownership of assets is created and exchanged on a peer-to-peer network

Smart contracts: Programmed to execute if specified conditions are met

Blockchain: Digital ledger for blocks of linked transactions validated through user consensus

Permissionless networks: No centralized authority needed to validate transactions

Permissioned networks: Members are restricted from participating in certain activities

Uses of DTL in Investment Management

Cryptocurrencies: Allow transactions without intermediaries, such as banks

Tokenization: Represents ownership of physical assets on a blockchain or distributed ledger

Clearing/Settlement: DLT allows near real-time trade verification and reconciliation

Compliance: Allows regulators to conduct near real-time review of all transactions

ETHICAL AND PROFESSIONAL STANDARDS

I(A) Knowledge of the Law

Obey strictest applicable law. Disassociate immediately from any illegal or unethical activity.

I(B) Independence and Objectivity

Do not offer or accept gifts that might impair independence and objectivity. Gifts from clients may be permissible.

I(C) Misrepresentation

Cite sources. Do not plagiarize or omit important information. Act quickly to correct any errors.

I(D) Misconduct

Does not apply to personal behavior unless it reflects poorly on the investment profession.

II(A) Material Nonpublic Information

Do not act or cause others to act on material nonpublic information. Seek public dissemination.

II(B) Market Manipulation

Do not take any actions that distort prices or trading volume. Market making and legitimate trading strategies are allowed.

III(A) Loyalty, Prudence, and Care

Place clients' interest above yours. Disclose policies on proxy voting and soft commissions.

III(B) Fair Dealing

Treat all clients fairly. Treat non-immediate family like other clients. Communicate investment recommendations and changes simultaneously.

III(C) Suitability

Use a regularly updated IPS during investment decisions. Evaluate decisions in a portfolio context.

III(D) Performance Presentation

Performance data should be fair, accurate, and complete. Do not promise returns for risky assets.

III(E) Preservation of Confidentiality

Keep all client information confidential unless: client is involved in illegal activity, you are legally required, or you have the client's permission.

IV(A) Loyalty

Get permission before taking outside work (even unpaid) that competes with employer. Abide by non-compete agreement (if applicable) and do not take employer's property.

IV(B) Additional Compensation Arrangements

Obtain written permission from all parties before receiving any compensation for outside work.

IV(C) Responsibilities of Supervisors

Supervisors must adequately train and monitor subordinates. Responsibilities may be delegated.

V(A) Diligence and Reasonable Basis

Exercise diligence and thoroughness. Support actions with research and investigation.

V(B) Communication with Clients and Prospective Clients

Make appropriate disclosures. Distinguish between fact and opinion in analysis and recommendations.

V(C) Record Retention

Maintain records to support recommendations and decisions. 7-year retention period recommended.

VI(A) Disclosure of Conflicts

Disclose any matters that may impair independence and objectivity, prominently and in plain language.

VI(B) Priority of Transactions

Execute clients' transactions before accounts in which you have a beneficial interest.

VI(C) Referral Fees

Disclose referral fees to clients and employer, including non-monetary arrangements.

VII(A) Conduct as Participants in CFA Institute Program

Do not share confidential exam details. Expressing opinions about CFAI policies is permissible.

VII(B) Reference to CFA Institute, the CFA Designation, and the CFA Program

Do not misrepresent the meaning of CFA Institute membership, designation, or candidacy.

Basic Operations

- [2ND]**: Access secondary functions (in yellow)
- [ENTER]**: Send value to a variable
- [2ND] + [ENTER]**: Toggle between options
- [↑][↓]**: Navigate between variables/options
- [STO] + [0 - 9]**: Store current value into memory
- [RCL] + [0 - 9]**: Recall value from memory

Time Value of Money (TVM)

For annuity, loan, and bond calculations

- [N]**: Number of periods
- [I/Y]**: Effective interest rate per period (in %)
- [PV]**: Present value
- [PMT]**: Payment/coupon amount
- [FV]**: Future value/redemption value
- [CPT] + [one of the above]**: Solve for unknown
- [2ND] + [BGN]**: Toggle between ordinary annuity and annuity due
- [2ND] + [CLR TVM]**: Clear TVM worksheet

Note:

- Always clear the TVM worksheet before starting a new calculation
- For bonds, PMT and FV should have the same sign, and opposite signs to PV

Cash Flow Worksheet ([CF]**, **[NPV]**, **[IRR]**)**

For non-level payments

Input **[CF]**

CFO: Initial cash flow

C01: 1st distinct cash flow after initial cash flow

F01: Frequency of C01

C0n: nth distinct cash flow

F0n: Frequency of C0n

Note:

- Always clear the CF worksheet before starting a new calculation
- The use of F0n is optional. You can leave them as 1 and input repeating cash flows multiple times. If you do so, C01 will be the cash flow at time 1, C02 will be the cash flow at time 2, and so on.

Output **[NPV]**, **[IRR]**

I: Effective interest rate per period (in %)

[NPV] + [CPT]: Solve for net present value

[IRR] + [CPT]: Solve for internal rate of return

