

2018

CFA® EXAM REVIEW

CRITICAL  
CONCEPTS  
FOR THE  
CFA EXAM

# CFA® LEVEL I SMARTSHEET

FUNDAMENTALS FOR CFA® EXAM SUCCESS

WILEY

## ETHICAL AND PROFESSIONAL STANDARDS

### ETHICS IN THE INVESTMENT PROFESSION

- Challenges to ethical behavior: overconfidence bias, situational influences, focusing on the immediate rather than long-term outcomes/consequences.
- General ethical decision-making framework: identify, consider, decide and act, reflect.
- CFA Institute Professional Conduct Program sanctions: public censure, suspension of membership and use of the CFA designation, and revocation of the CFA charter (but no monetary fine).

### STANDARDS OF PROFESSIONAL CONDUCT

- Professionalism
  - Knowledge of the Law
  - Independence and Objectivity
  - Misrepresentation
  - Misconduct
- Integrity of Capital Markets
  - Material Nonpublic Information
  - Market Manipulation
- Duties to Clients
  - Loyalty, Prudence and Care
  - Fair Dealing
  - Suitability
  - Performance Presentation
  - Preservation of Confidentiality
- Duties to Employers
  - Loyalty
  - Additional Compensation Arrangements
  - Responsibilities of Supervisors
- Investment Analysis, Recommendations and Actions
  - Diligence and Reasonable Basis
  - Communication with Clients and Prospective Clients
  - Record Retention
- Conflicts of Interest
  - Disclosure of Conflicts
  - Priority of Transactions
  - Referral Fees
- Responsibilities as a CFA Institute Member or CFA Candidate
  - Conduct as Participants in CFA Institute Programs
  - Reference to CFA Institute, the CFA Designation, and the CFA Program

### GLOBAL INVESTMENT PERFORMANCE STANDARDS (GIPS®)

- Compliance by investment management firms with GIPS is **voluntary**.
- Comply with **all** requirements of GIPS on a firm-wide basis in order to claim compliance.
- Third-party verification of GIPS compliance is **optional**.
- Present a minimum of five years of GIPS-compliant historical performance when first claiming compliance, then add one year of compliant performance each subsequent year so that the firm eventually presents a (minimum) performance record for 10 years.
- Nine major sections: Fundamentals of Compliance; Input data; Calculation Methodology; Composite Construction; Disclosures; Presentation and Reporting; Real Estate; Private Equity; and Wrap Fee/Separately Managed Account (SMA) Portfolios.

## QUANTITATIVE METHODS

### TIME VALUE OF MONEY

- Present value (PV) and future value (FV) of a single cash flow

$$PV = \frac{FV}{(1+r)^N}$$

- PV and FV of ordinary annuity and annuity due

$$\begin{aligned} PV_{\text{Annuity Due}} &= PV_{\text{Ordinary Annuity}} \times (1+r) \\ FV_{\text{Annuity Due}} &= FV_{\text{Ordinary Annuity}} \times (1+r) \end{aligned}$$

- PV of a perpetuity

$$PV_{\text{Perpetuity}} = \frac{PMT}{I/Y}$$

### DISCOUNTED CASH FLOW APPLICATIONS

- Positive net present value (NPV) projects increase shareholder wealth.
- For mutually exclusive projects, choose the project with the highest positive NPV.
- Projects for which the IRR exceeds the required rate of return will have positive NPV.
- For mutually exclusive projects, use the NPV rule if the NPV and IRR rules conflict.

### YIELDS FOR US TREASURY BILLS

- Bank discount yield

$$r_{BD} = \frac{D}{F} \times \frac{360}{t}$$

- Holding period yield

$$HPY = \frac{P_1 - P_0 + D_1}{P_0} = \frac{P_1 + D_1}{P_0} - 1$$

- Money market yield

$$R_{MM} = \frac{360 \times r_{BD}}{360 - (t \times r_{BD})}$$

$$R_{MM} = HPY \times (360/t)$$

- Effective annual yield

$$EAY = (1 + HPY)^{365/t} - 1$$

### STATISTICAL CONCEPTS

- Data scales: **Nominal** (lowest), **Ordinal**, **Interval**, **Ratio** (highest)
- Arithmetic mean: simple average
- Geometric mean return: used to average rates of change (or growth) over time

$$R_G = \left[ \sqrt[n]{(1+R_1) \times (1+R_2) \times \dots \times (1+R_n)} \right] - 1$$

- Harmonic mean: used to determine the average cost of shares purchased over time

$$\text{Harmonic mean: } \bar{X}_H = \frac{N}{\sum_{i=1}^N \frac{1}{X_i}}$$

- Variance: average of the squared deviations around the mean

$$\sigma^2 = \frac{\sum_{i=1}^n (X_i - \mu)^2}{n}$$

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

- Standard deviation: positive square root of the variance
- Coefficient of variation: used to compare relative dispersions of data sets (lower is better)

$$\text{Coefficient of variation} = \frac{s}{\bar{X}}$$

- Sharpe ratio: used to measure excess return per unit of risk (higher is better)

$$\text{Sharpe ratio} = \frac{\bar{r}_p - r_f}{s_p}$$

- Positive skew: mode < median < mean
- Kurtosis: leptokurtic (positive excess kurtosis), platykurtic (negative excess kurtosis), mesokurtic (same kurtosis as normal distribution; i.e. zero excess kurtosis)

### PROBABILITY CONCEPTS

- Expected value and variance of a random variable (X) using probabilities

$$E(X) = P(X_1)X_1 + P(X_2)X_2 + \dots + P(X_n)X_n$$

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

- Covariance and correlation of returns

$$\text{Corr}(R_A, R_B) = \rho(R_A, R_B) = \frac{\text{Cov}(R_A, R_B)}{(\sigma_A)(\sigma_B)}$$

- Expected return on a portfolio

$$E(R_p) = \sum_{i=1}^N w_i E(R_i) = w_1 E(R_1) + w_2 E(R_2) + \dots + w_N E(R_N)$$

- Variance of a 2-asset portfolio

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

### BINOMIAL DISTRIBUTION

- Probability of  $x$  successes in  $n$  trials (where the probability of success,  $p$ , is equal for all trials) is given by:

$$P(X=x) = {}_n C_x (p)^x (1-p)^{n-x}$$

- Expected value and variance of a binomial random variable

$$E(x) = n \times p$$

$$\sigma^2 = n \times p \times (1-p)$$

### NORMAL DISTRIBUTION

- 50% of all observations lie in the interval  $\mu \pm (2/3)\sigma$
- 68% of all observations lie in the interval  $\mu \pm 1\sigma$
- 90% of all observations lie in the interval  $\mu \pm 1.65\sigma$
- 95% of all observations lie in the interval  $\mu \pm 1.96\sigma$
- 99% of all observations lie in the interval  $\mu \pm 2.58\sigma$
- A z-score is used to standardize a given observation of a normally distributed random variable

$$z = (\text{observed value} - \text{population mean}) / \text{standard deviation} = (x - \mu) / \sigma$$

- Roy's safety-first criterion: used to compare shortfall risk of portfolios (higher SF ratio indicates lower shortfall risk)

$$\text{Shortfall ratio (SF Ratio)} = \frac{E(R_p) - R_f}{\sigma_p}$$

## SAMPLING THEORY

- **Central limit theorem:** Given a population with any probability distribution, with mean,  $\mu$ , and variance,  $\sigma^2$ , the sampling distribution of the sample mean  $\bar{x}$ , computed from sample size  $n$  will approximately be normal with mean,  $\mu$  (the population mean), and variance,  $\sigma^2/n$ , when the sample size is greater than or equal to 30.
- The standard deviation of the distribution of sample means is known as the standard error of sample mean.
- When the population variance is known, the standard error of sample mean is calculated as

$$\sigma_{\bar{x}} = \frac{\sigma}{\sqrt{n}}$$

- When the population variance is not known, the standard error of sample mean is calculated as

$$s_{\bar{x}} = \frac{s}{\sqrt{n}}$$

- Confidence interval for unknown population parameter based on z-statistic

$$\bar{x} \pm z_{\alpha/2} \frac{\sigma}{\sqrt{n}}$$

- Confidence interval for unknown population parameter based on t-statistic

$$\bar{x} \pm t_{\alpha/2} \frac{s}{\sqrt{n}}$$

- When to use z-statistic or t-statistic

When Sampling from a:	Small Sample n < 30	Large Sample n > 30
Normal distribution with known variance	z-statistic	z-statistic
Normal distribution with unknown variance	t-statistic	t-statistic*
Non-normal distribution with known variance	not available	z-statistic
Non-normal distribution with unknown variance	not available	t-statistic*

\* Use of z-statistic is also acceptable

## HYPOTHESIS TESTING

- One-tailed versus two-tailed tests

Type of test	Null hypothesis	Alternate hypothesis	Reject null if	Fail to reject null if	P-value represents
One-tailed (upper tail) test	$H_0: \mu \leq \mu_0$	$H_1: \mu > \mu_0$	Test statistic > critical value	Test statistic $\leq$ critical value	Probability that lies above the computed test statistic.
One-tailed (lower tail) test	$H_0: \mu \geq \mu_0$	$H_1: \mu < \mu_0$	Test statistic < critical value	Test statistic $\geq$ critical value	Probability that lies below the computed test statistic.
Two-tailed	$H_0: \mu = \mu_0$	$H_1: \mu \neq \mu_0$	Test statistic < lower critical value Test statistic > upper critical value	Lower critical value $\leq$ test statistic $\leq$ upper critical value	Probability that lies above the positive value of the computed test statistic plus the probability that lies below the negative value of the computed test statistic.

- Type I versus Type II errors

Decision	$H_0$ is True	$H_0$ is False
Do not reject $H_0$	Correct decision	Incorrect decision <b>Type II error</b>
Reject $H_0$	Incorrect decision <b>Type I error</b> Significance level = P(Type I error)	Correct decision Power of the test = $1 - P(\text{Type II error})$

- Hypothesis test concerning the mean of a single population

$$t\text{-stat} = \frac{\bar{x} - \mu_0}{s/\sqrt{n}}$$

- Hypothesis test concerning the variance of a normally distributed population

$$\chi^2 = \frac{(n-1)s^2}{\sigma_0^2}$$

- Hypothesis test related to the equality of the variance of two populations

$$F = \frac{s_1^2/s_2^2}{\sigma_1^2/\sigma_2^2}$$

## TECHNICAL ANALYSIS

- Reversal patterns: head and shoulders, inverse head and shoulders, double top and bottom, triple top and bottom.
- Continuation patterns: triangles (ascending/descending/symmetrical), rectangles, flags and pennants.
- Price-based indicators: moving averages, Bollinger bands, momentum oscillators (rate of change, relative strength index, stochastic, moving average convergence/divergence).
- Sentiment indicators: opinion polls, put-call ratio, VIX, margin debt levels, short interest ratio.
- Flow of funds indicators: Arms index, margin debt, mutual fund cash positions, new equity issuance, secondary offerings.
- Cycles: Kondratieff (54-year economic cycle), 18-year (real estate, equities), decennial (best DJIA performance in years that end with a 5), presidential (third year has the best stock market performance).

## ECONOMICS

### DEMAND ELASTICITIES

- Own-price elasticity of demand is calculated as:

$$ED_{Px} = \frac{\% \Delta QD_x}{\% \Delta P_x}$$

- If the absolute value of price elasticity of demand equals 1, demand is said to be unit elastic.
- If the absolute value of price elasticity of demand lies between 0 and 1, demand is said to be relatively inelastic.
- If the absolute value of price elasticity of demand is greater than 1, demand is said to be relatively elastic.
- Income elasticity of demand is calculated as:

$$E_I = \frac{\% \text{ change in quantity demanded}}{\% \text{ change in income}}$$

- Positive for a normal good.
- Negative for an inferior good.
- Cross-price elasticity of demand is calculated as:

$$E_C = \frac{\% \text{ change in quantity demanded}}{\% \text{ change in price of substitute or complement}}$$

- Positive for substitutes.
- Negative for complements.
- Normal good: substitution and income effects reinforce one another.
- Inferior good: income effect partially mitigates the substitution effect.
- Giffen good: inferior good where the income effect outweighs the substitution effect, making the demand curve upward sloping.
- Veblen good: status good with upward sloping demand curve.

### PROFIT MAXIMIZATION, BREAKEVEN AND SHUTDOWN ANALYSIS

- Profits are maximized when the difference between total revenue (TR) and total cost (TC) is at its highest. The level of output at which this occurs is the point where:
  - Marginal revenue (MR) equals marginal cost (MC); and
  - MC is not falling
- Breakeven occurs when TR = TC, and price (or average revenue) equals average total cost (ATC) at the breakeven point of production. The firm is earning normal profit.
- Short-run and long-run operating decisions

Revenue/Cost Relationship	Short-run Decision	Long-run Decision
TR = TC	Continue operating	Continue operating
TR > TVC, but < TC	Continue operating	Exit market
TR < TVC	Shut down production	Exit market

## MARKET STRUCTURES

- Perfect competition
  - Minimal barriers to entry, sellers have no pricing power.
  - Demand curve faced by an individual firm is perfectly elastic (horizontal).
  - Average revenue (AR) = Price (P) = MR.
  - In the long run, all firms in perfect competition will make normal profits.
- Monopoly
  - High barriers to entry, single seller has considerable pricing power.
  - Product is differentiated through non-price strategies.
  - Demand curve faced by the monopoly is the industry demand curve (downward sloping).
  - An unregulated monopoly can earn economic profits in the long run.
- Monopolistic competition
  - Low barriers to entry, sellers have some degree of pricing power.
  - Product is differentiated through advertising and other non-price strategies.
  - Demand curve faced by each firm is downward sloping.
  - In the long run all will make normal profits.
- Oligopoly
  - High costs of entry, sellers enjoy substantial pricing power.
  - Product is differentiated on quality, features, marketing and other non-price strategies.
  - Pricing strategies: pricing interdependence (kinked demand curve), Cournot assumption, game theory (Nash equilibrium), Stackelberg model (dominant firm).
- Firms always maximize profits at the output level where MR = MC
- Identification of market structure
  - N-firm concentration ratio.
  - HHI (add up the squares of the market shares of each of the largest N companies in the market).

## AGGREGATE SUPPLY AND DEMAND

- Components of GDP
- Expenditure approach

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

- Income approach

$$GDP = \text{National income} + \text{Capital consumption allowance} + \text{Statistical discrepancy}$$

- Equality of Expenditure and Income

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

- To finance a fiscal deficit ( $G - T > 0$ ), the private sector must save more than it invests ( $S > I$ ) and/or imports must exceed exports ( $M > X$ ).

- Factors causing a shift in aggregate demand (AD)

An Increase in the Following Factors	Shifts the AD Curve	Reason
Stock prices	Rightward: Increase in AD	Higher consumption
Housing prices	Rightward: Increase in AD	Higher consumption
Consumer confidence	Rightward: Increase in AD	Higher consumption
Business confidence	Rightward: Increase in AD	Higher investment
Capacity utilization	Rightward: Increase in AD	Higher investment
Government spending	Rightward: Increase in AD	Government spending a component of AD
Taxes	Leftward: Decrease in AD	Lower consumption and investment
Bank reserves	Rightward: Increase in AD	Lower interest rate, higher investment and possibly higher consumption
Exchange rate (foreign currency per unit domestic currency)	Leftward: Decrease in AD	Lower exports and higher imports
Global growth	Rightward: Increase in AD	Higher exports

- Factors causing a shift in aggregate supply (AS)

An Increase in	Shifts SRAS	Shifts LRAS	Reason
Supply of labor	Rightward	Rightward	Increases resource base
Supply of natural resources	Rightward	Rightward	Increases resource base
Supply of human capital	Rightward	Rightward	Increases resource base
Supply of physical capital	Rightward	Rightward	Increases resource base
Productivity and technology	Rightward	Rightward	Improves efficiency of inputs
Nominal wages	Leftward	No impact	Increases labor cost
Input prices (e.g., energy)	Leftward	No impact	Increases cost of production
Expectation of future prices	Rightward	No impact	Anticipation of higher costs and/or perception of improved pricing power
Business taxes	Leftward	No impact	Increases cost of production
Subsidy	Rightward	No impact	Lowers cost of production
Exchange rate	Rightward	No impact	Lowers cost of production

• Impact of changes in AD and AS

	Real GDP	Unemployment Rate	Aggregate Level of Prices
An increase in AD	Increases	Falls	Increases
A decrease in AD	Falls	Increases	Falls
An increase in AS	Increases	Falls	Falls
A decrease in AS	Falls	Increases	Increases

• Effect of combined changes in AD and AS

Change in AS	Change in AD	Effect on Real GDP	Effect on Aggregate Price Level
Increase	Increase	Increase	Uncertain
Decrease	Decrease	Decrease	Uncertain
Increase	Decrease	Uncertain	Decrease
Decrease	Increase	Uncertain	Increase

## BUSINESS CYCLES

- Phases: trough, expansion, peak, contraction (or recession)
- Theories
  - Neoclassical (Say's Law).
  - Austrian (misguided government intervention).
  - Keynesian (advocates government intervention during a recession).
  - Monetarist (steady growth rate of money supply).
  - New Classical (business cycles have real causes, no government intervention).
  - Neo-Keynesian (prices and wages are downward sticky, government intervention is useful in eliminating unemployment and restoring macroeconomic equilibrium).
- Unemployment: natural rate vs frictional vs structural vs cyclical.
- Prices indices: using a fixed basket of goods and services to measure the cost of living results in an upward bias in the computed inflation rate due to substitution bias, quality bias and new product bias.
- Economic indicators
  - Leading (used to predict economy's future state).
  - Coincident (used to identify current state of the economy).
  - Lagging (used to identify the economy's past condition).

## MONETARY AND FISCAL POLICY

• Quantity theory of money

$$MV = PY$$

- Contractionary monetary policy (reduce money supply and increase interest rates) is meant to rein in an overheating economy. Expansionary monetary policy (increase money supply and reduce interest rates) is meant to stimulate a receding economy
- Limitations of monetary policy:
  - Central bank cannot control amount of savings.
  - Central bank cannot control willingness of banks to extend loans.
  - Central bank may lack credibility.
- Contractionary fiscal policy (reduce spending and/or increase taxes) is used to control inflation in an

expansion. Expansionary fiscal policy (increase spending and/or reduce taxes) is used to raise employment and output in a recession

• Fiscal multiplier

$$\frac{1}{[1 - MPC(1 - t)]}$$

- Limitations fiscal policy: recognition, action and impact lags
- Relationships between monetary and fiscal policy
  - Easy fiscal policy/tight monetary policy – results in higher output and higher interest rates (government expenditure would form a larger component of national income).
  - Tight fiscal policy/easy monetary policy – private sector's share of overall GDP would rise (as a result of low interest rates), while the public sector's share would fall.
  - Easy fiscal policy/easy monetary policy – this would lead to a sharp increase in aggregate demand, lowering interest rates and growing private and public sectors.
  - Tight fiscal policy/tight monetary policy – this would lead to a sharp decrease in aggregate demand, higher interest rates and a decrease in demand from both private and public sectors.

## INTERNATIONAL TRADE

- Comparative advantage: a country's ability to produce a good at a lower opportunity cost than its trading partners
- Ricardian model: labor is the only variable factor of production and differences in technology are the key source of comparative advantage.
- Heckscher-Ohlin model: capital and labor are variable factors of production and differences in factor endowments are the primary source of comparative advantage.
- Effect of tariffs, import quotas, export subsidies and voluntary export restraints
- Price, domestic production and producer surplus increase.
- Domestic consumption and consumer surplus decrease.
- Balance of payments components
  - Current account (merchandise trade, services, income receipts and unilateral transfers).
  - Capital account (capital transfers and sales/purchases of non-produced, non-financial assets).
  - Financial account (financial assets abroad and foreign-owned financial assets in the reporting country).
- Current account surplus or deficit.

$$CA = X - M = Y - (C + I + G)$$

## CURRENCY EXCHANGE RATES

- Exchange rates are expressed using the convention A/B; i.e. number of units of currency A (price currency) required to purchase one unit of currency B (base currency). USD/GBP = 1.5125 means that it will take 1.5125 USD to purchase 1 GBP.
- Real exchange rate

$$\text{Real exchange rate}_{D/FC} = S_{D/FC} \times (P_C/P_{DC})$$

• Forward exchange rate (arbitrage-free)

$$F_{D/FC} = \frac{1}{S_{F/D}} \times \frac{(1 + r_{DC})}{(1 + r_{FC})} \text{ or } F_{D/FC} = S_{D/FC} \times \frac{(1 + r_{DC})}{(1 + r_{FC})}$$

- Exchange rate regimes: dollarization, monetary union, fixed parity, target zone, crawling pegs, fixed parity with crawling bands, managed float, independently floating rates.

# FINANCIAL REPORTING AND ANALYSIS

## FINANCIAL REPORTING BASICS

- Types of audit opinions: unqualified, qualified, adverse, disclaimer.
- Accruals: unearned or deferred revenue (liability), unbilled or accrued revenue (asset), prepaid expenses (asset), accrued expenses (liability).
- Qualitative characteristics of financial information: relevance, faithful representation, comparability, verifiability, timeliness, understandability (first two are fundamental qualitative characteristics).
- General features of financial statements: fair presentation, going concern, accrual basis, materiality and aggregation, no offsetting, frequency of reporting, comparative information, consistency.

## INCOME STATEMENTS

- Revenue recognition methods: percentage of completion, completed contract, installment method, cost recovery method.
- Discontinued operations: reported *net of tax* as a separate line item *after* income from continuing operations.
- Unusual or infrequent items: listed as separate line items, *included* in income from continuing operations, reported *before-tax*.
- Accounting changes
  - Change in accounting principle (applied retrospectively).
  - Change in an accounting estimate (applied prospectively).
  - Correction of prior-period errors (restate all prior-period financial statements).
- Basic EPS

$$\text{Basic EPS} = \frac{\text{Net income} - \text{Preferred dividends}}{\text{Weighted average number of shares outstanding}}$$

• Diluted EPS (taking into account all dilutive securities)

$$\text{Diluted EPS} = \frac{\left[ \text{Net income} - \text{Preferred dividends} \right] + \left[ \text{Convertible preferred dividends} \right] + \left[ \text{Convertible debt interest} \times (1 - t) \right]}{\left[ \text{Weighted average shares} \right] + \left[ \text{Shares from conversion of convertible preferred shares} \right] + \left[ \text{Shares from conversion of convertible debt} \right] + \left[ \text{Shares issuable from stock options} \right]}$$

## BALANCE SHEETS

• Accounting for gains and losses on marketable securities

	Hold-to-Maturity Securities	Available-for-Sale Securities	Trading Securities
Balance Sheet	Reported at cost or amortized cost.	Reported at fair value.	Reported at fair value.
Items recognized on the income statement	Interest income. Realized gains and losses.	Unrealized gains or losses due to changes in market values are reported in other comprehensive income within owners' equity. Dividend income. Interest income. Realized gains and losses.	Dividend income. Interest income. Realized gains and losses. Unrealized gains and losses due to changes in market values.

- Common-size balance sheet: expresses each balance sheet as a % of total assets to allow analysts to compare firms of different sizes

## CASH FLOW

- CFO (direct method)
  - Step 1: Start with sales on the income statement.
  - Step 2: Go through each income statement account and adjust it for changes in all relevant working capital accounts on the balance sheet.
  - Step 3: Check whether changes in these working capital accounts indicate a source or use of cash.

- Step 4: Ignore all non-operating items and non-cash charges.
- CFO (indirect method)
  - Step 1: Start with net income.
  - Step 2: Go up the income statement account and remove the effect of all non-cash expenses and gains from net income.
  - Step 3: Remove the effect of all non-operating activities from net income.
  - Step 4: Make adjustments for changes in all working capital accounts.
- Free cash flow to the firm (FCFF)

$$FCFF = NI + NCC + [Int * (1 - \text{tax rate})] - FCInv - WCInv$$

$$FCFF = CFO + [Int * (1 - \text{tax rate})] - FCInv$$

- Free cash flow to equity (FCFE)

$$FCFE = CFO - FCInv + \text{Net borrowing}$$

## FINANCIAL ANALYSIS TECHNIQUES

- Activity ratios

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

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

$$\text{Receivables turnover} = \frac{\text{Revenue}}{\text{Average receivables}}$$

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

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

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

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

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

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

- Liquidity ratios

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

$$\text{Quick ratio} = \frac{\text{Cash} + \text{Short-term marketable investments} + \text{Receivables}}{\text{Current liabilities}}$$

$$\text{Cash ratio} = \frac{\text{Cash} + \text{Short-term marketable investments}}{\text{Current liabilities}}$$

$$\text{Defensive interval ratio} = \frac{\text{Cash} + \text{Short-term marketable investments} + \text{Receivables}}{\text{Daily cash expenditures}}$$

$$\text{Cash conversion cycle} = \text{DSO} + \text{DOH} - \text{Number of days of payables}$$

- Solvency ratios

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

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

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

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

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

- Profitability ratios

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

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

$$\text{Pretax margin} = \frac{\text{EBT (earnings before tax, but after interest)}}{\text{Revenue}}$$

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

$$\text{ROA} = \frac{\text{Net income}}{\text{Average total assets}}$$

$$\text{Adjusted ROA} = \frac{\text{Net income} + \text{Interest expense} (1 - \text{Tax rate})}{\text{Average total assets}}$$

$$\text{Operating ROA} = \frac{\text{Operating income or EBIT}}{\text{Average total assets}}$$

$$\text{Return on total capital} = \frac{\text{EBIT}}{\text{Short-term debt} + \text{Long-term debt} + \text{Equity}}$$

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

$$\text{Return on common equity} = \frac{\text{Net income} - \text{Preferred dividends}}{\text{Average common equity}}$$

- DuPont decomposition of ROE

$$\text{ROE} = \frac{\text{Net income}}{\text{Average total assets}} \times \frac{\text{Average total assets}}{\text{Average shareholders' equity}}$$

↓    ↓  
ROA    Leverage

$$\text{ROE} = \frac{\text{Net income}}{\text{Revenue}} \times \frac{\text{Revenue}}{\text{Average total assets}} \times \frac{\text{Average total assets}}{\text{Average shareholders' equity}}$$

↓    ↓    ↓  
Net profit margin                          Asset turnover                          Leverage

$$\text{ROE} = \frac{\text{Net income}}{\text{EBT}} \times \frac{\text{EBT}}{\text{EBIT}} \times \frac{\text{EBIT}}{\text{Revenue}} \times \frac{\text{Revenue}}{\text{Average total assets}} \times \frac{\text{Average total assets}}{\text{Avg. shareholders' equity}}$$

↓    ↓    ↓    ↓    ↓  
Tax burden    EBIT margin    Leverage

- Dividend-related measures

$$\text{Dividend payout ratio} = \frac{\text{Common share dividends}}{\text{Net income attributable to common shares}}$$

$$\text{Retention Rate} = \frac{\text{Net income attributable to common shares} - \text{Common share dividends}}{\text{Net income attributable to common shares}}$$

$$\text{Sustainable growth rate} = \text{Retention rate} \times \text{ROE}$$

## INVENTORIES

- LIFO vs FIFO with rising prices and stable inventory levels

LIFO versus FIFO when Prices are Rising		
	LIFO	FIFO
COGS	Higher	Lower
Income before taxes	Lower	Higher
Income taxes	Lower	Higher
Net income	Lower	Higher
Cash flow	Higher	Lower
Ending inventory	Lower	Higher
Working capital	Lower	Higher

- LIFO to FIFO conversion with rising prices and stable or rising inventory quantities

- Inventory under FIFO = Inventory under LIFO + LIFO reserve

- COGS under FIFO = COGS under LIFO - Change in LIFO reserve
- Net income under FIFO = Net income under LIFO + Change in LIFO reserve × (1 - tax rate)
- Equity under FIFO = Equity under LIFO + LIFO reserve × (1 - tax rate)
- Liabilities under FIFO = Liabilities under LIFO + LIFO reserve × tax rate

## LONG-LIVED ASSETS

- Capitalizing vs expensing

	Capitalizing	Expensing
Net income (first year)	Higher	Lower
Net income (future years)	Lower	Higher
Total assets	Higher	Lower
Shareholders' equity	Higher	Lower
Cash flow from operations	Higher	Lower
Cash flow from investing	Lower	Higher
Income variability	Lower	Higher
Debt-to-equity	Lower	Higher

- Depreciation expense

- Straight line

$$\text{Depreciation expense} = \frac{\text{Original cost} - \text{Salvage value}}{\text{Depreciable life}}$$

- Double declining balance (DDB)

$$\text{DDB depreciation in Year X} = \frac{2}{\text{Depreciable life}} \times \text{Book value at the beginning of Year X}$$

- Depreciation components

$$\text{Estimated useful life} = \frac{\text{Gross investment in fixed assets}}{\text{Annual depreciation expense}}$$

$$\text{Average age of asset} = \frac{\text{Accumulated depreciation}}{\text{Annual depreciation expense}}$$

$$\text{Remaining useful life} = \frac{\text{Net investment in fixed assets}}{\text{Annual depreciation expense}}$$

- Revaluation of long-lived assets

- IFRS allows revaluation model or cost model (only cost model under US GAAP).
- If revaluation initially decreases the asset's carrying amount, the decrease is recognized as a loss on the income statement.
- If revaluation initially increases the asset's carrying amount, the increase goes directly to equity.
- Impairment of property, plant and equipment
  - IFRS: asset is impaired when its carrying amount exceeds its recoverable amount (impairment loss is the difference between these two amounts).
  - US GAAP: asset is impaired when its carrying value exceeds the total value of its undiscounted expected future cash flows (impairment loss is the difference between the asset's carrying value and its fair value).

## DEFERRED TAXES (DUE TO TEMPORARY DIFFERENCES)

- A deferred tax liability (asset) arises when:

- Taxable income is lower (higher) than pretax accounting profit.
- Taxes payable is lower (higher) than income tax expense.
- If a company has a DTL, a reduction (increase) in tax rates would reduce (increase) liabilities, reduce (increase) income tax expense, and increase (reduce) equity
- If a company has a DTA, a reduction (increase) in tax rates would reduce (increase) assets, increase (reduce) income tax expense, and reduce (increase) equity
- DTA carrying value should be reduced to the expected recoverable amount using a valuation allowance



## ACCOUNTING FOR BONDS

- Effective interest method required under IFRS and preferred under US GAAP
- Interest expense for a given period is calculated as the book value of the liability at the beginning of the period multiplied by market interest rate at bond issuance.
- Coupon payments are classified as cash outflows.
- Book value of the bond liability at any point in time is the PV of the bond's remaining cash flows (discounted at the market interest rate at issuance).

## LEASES

- Lease accounting from lessee's perspective: treating a lease as a finance lease (compared to an operating lease) results in:
  - Higher assets, current liabilities, long-term liabilities, EBIT, CFO, leverage ratios.
  - Lower net income (early years), CFF, asset turnover, current ratio, ROA (early years), ROE (early years).
  - Same total cash flow.

## FINANCIAL REPORTING QUALITY

- Conditions conducive to issuing low quality financial reports: opportunity, motivation, rationalization
- Mechanisms that discipline financial reporting quality: markets, regulatory authorities, registration requirements, auditors, private contracting

## CORPORATE FINANCE

### CORPORATE GOVERNANCE

- Key areas of interest: economic ownership and voting control, board of directors representation, remuneration and company performance, investors in the company, strength of shareholders' rights, managing long-term risks

### CAPITAL BUDGETING

- Consider incremental after-tax cash flows, externalities and opportunity costs. Ignore sunk costs and financing costs from calculations of operating cash flows
- For mutually exclusive projects, use the NPV rule if the NPV and IRR rules conflict
- Payback period ignores time value of money, risk of the project and cash flows that occur after the payback period is reached
- Discounted payback period ignores cash flows that occur after the payback period is reached
- Average Accounting Rate of Return (ratio of project's average net income to its average book value) is based on accounting numbers and ignores the time value of money
- Profitability index (PI): PI exceeds 1 when NPV is positive

$$PI = \frac{PV \text{ of future cash flows}}{\text{Initial investment}} = 1 + \frac{NPV}{\text{Initial investment}}$$

### COST OF CAPITAL

- Weighted average cost of capital (WACC)

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

- Cost of preferred stock

$$r_p = \frac{D_p}{V_p}$$

- Cost of equity

- Capital asset pricing model (CAPM)

$$r_e = R_f + \beta_1[E(R_M) - R_f]$$

- Dividend discount model

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

- Bond yield plus risk premium

$$r_e = r_d + \text{risk premium}$$

- Project beta

- unleveraged beta for a comparable asset

$$\beta_{\text{ASSET}} = \beta_{\text{EQUITY}} \left[ \frac{1}{1 + \left( (1-t) \frac{D}{E} \right)} \right]$$

- Beta for a project using a comparable asset releveraged for target company

$$\beta_{\text{PROJECT}} = \beta_{\text{ASSET}} \left[ 1 + \left( (1-t) \frac{D}{E} \right) \right]$$

## MEASURES OF LEVERAGE

- Degree of operating leverage (DOL)

$$DOL = \frac{\text{Percentage change in operating income}}{\text{Percentage change in units sold}}$$

- Degree of financial leverage (DFL)

$$DFL = \frac{\text{Percentage change in net income}}{\text{Percentage change in operating income}}$$

- Degree of total leverage (DTL)

$$DTL = \frac{\text{Percentage change in net income}}{\text{Percentage change in the number of units sold}}$$

$$DTL = DOL \times DFL$$

- Breakeven quantity of sales = (Fixed operating costs + Fixed financial costs) ÷ Contribution margin per unit
- Operating breakeven quantity of sales = Fixed operating costs ÷ Contribution margin per unit

## WORKING CAPITAL MANAGEMENT

- Sources of liquidity: primary (e.g. cash balances and short-term funds) and secondary (e.g. negotiating debt contracts, liquidating assets, filing for bankruptcy protection).
- Additional liquidity measures

$$\text{Purchases} = \text{Ending inventory} + \text{COGS} - \text{Beginning inventory}$$

$$\text{Operating cycle} = \text{Number of days of inventory} + \text{Number of days of receivables}$$

$$\text{Net operating cycle} = \text{Number of days of inventory} + \text{Number of days of receivables} - \text{Number of days of payables}$$

- Trade discounts (e.g. "2/10 net 30" means a 2% discount is available if the amount owed is paid within 10 days, otherwise full amount is due by the 30th day)

$$\text{Implicit rate} = \text{Cost of trade credit} = \left( 1 + \frac{\text{Discount}}{1 - \text{Discount}} \right)^{\frac{365}{\text{Number of days beyond discount period}}} - 1$$

## PORTFOLIO MANAGEMENT

### OVERVIEW

- Steps in the portfolio management process: planning (includes developing IPS), execution (includes asset allocation, security analysis and portfolio construction), feedback (includes portfolio monitoring/rebalancing and performance measurement/reporting).

### INVESTMENT POLICY STATEMENT

- Investment objectives: risk objectives and return objectives
- Investment constraints: liquidity, time horizon, tax concerns, legal/regulatory factors, unique circumstances

## RISK MANAGEMENT

- Financial risks: market, credit (default or counterparty risks), liquidity (or transaction cost risk)
- Non-financial risks: settlement, legal, compliance (including regulatory, accounting and tax risks), model, operational, solvency
- Methods of risk modification: risk prevention/avoidance, risk acceptance (self-insurance and diversification), risk transfer, risk shifting/modification

## PORTFOLIO RISK AND RETURN

- Utility function

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

- The higher the correlation between the individual assets, the higher the portfolio's standard deviation and the lower the diversification benefits (no diversification benefits with a correlation coefficient of +1)
- The Markowitz efficient frontier contains all the possible portfolios in which rational, risk-averse investors will consider investing
- Optimal capital allocation line: line drawn from the risk-free asset to a portfolio on the efficient frontier, where the portfolio is at the point of tangency. The optimal CAL offers the best risk-return tradeoff to an investor
- The point where an investor's indifference (utility) curve is tangent to the optimal CAL indicates the investor's optimal portfolio
- With homogenous expectations, the capital market line (CML) becomes a special case of the optimal CAL, where the tangent portfolio is the market portfolio
- CML equation (slope of line is called the market price of risk)

$$E(R_p) = R_f + \frac{E(R_M) - R_f}{\sigma_m} \times \sigma_p$$

- Complete diversification of a portfolio eliminates unsystematic risk. A well-diversified investor expects to be compensated for taking on systematic risk
- Beta captures an asset's systematic risk (relative to the risk of the market)

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

- The capital asset pricing model (CAPM) is used to calculate an asset's required return given its beta (the security market line)

$$E(R_i) = R_f + \beta_i [E(R_M) - R_f]$$

- If an asset's expected return using price and dividend forecasts is higher (lower) than its CAPM required return, the asset is undervalued (overvalued).
- Portfolio performance evaluation measures
  - Sharpe ratio (uses total risk)

$$\text{Sharpe ratio} = \frac{R_p - R_f}{\sigma_p}$$

- Treynor ratio (uses beta)

$$\text{Treynor ratio} = \frac{R_p - R_f}{\beta_p}$$

- M-squared (uses total risk)

$$M^2 = (R_p - R_f) \frac{\sigma_m}{\sigma_p} - (R_m - R_f)$$

- Jensen's alpha (uses beta)

$$\alpha_p = R_p - [R_f + \beta_p (R_m - R_f)]$$

## EQUITY INVESTMENTS

### MARKET ORGANIZATION AND STRUCTURE

- Purchasing stock on margin (leveraged position)
  - Leverage ratio is the reciprocal of the initial margin.
  - Price at which the investor receives a margin call

$$P_0 \times \frac{(1 - \text{Initial margin})}{(1 - \text{Maintenance margin})}$$

- Types of orders
  - Execution instructions, e.g. market orders, limit orders.
  - Exposure instructions, e.g. hidden orders, iceberg orders.
  - Validity instructions, e.g. day orders, good till cancelled orders, immediate or cancel orders, good on close orders, stop orders.
  - Clearing instructions, e.g. how final settlement should be arranged (security sale orders must also indicate whether the sale is a long sale or a short sale).
- Execution mechanisms
  - Pure auction (order-driven) market: ranks buy and sell orders on price precedence, then display precedence, then time precedence.
  - Dealer/quote-driven/price-driven market: dealers create liquidity by purchasing and selling against their own inventory of securities.
  - Brokered market: brokers arrange trades among their clients.
- Features of a well-functioning financial system: timely and accurate disclosure, liquidity (which facilitates operational efficiency), complete markets and external (or informational) efficiency.

### INDICES

- Price-weighted index: value equals the sum of the security prices divided by the divisor (typically set to the number of securities in the index at inception).
- Equal-weighted index: each security is given an identical weight in the index at inception (over-represents securities that constitute a relatively small fraction of the target market and requires frequent rebalancing).
- Market-capitalization weighted index: initial market value is assigned a base number (e.g. 100) and the change in the index is measured by comparing the new market value to the base market value (stocks with larger market values have a larger impact on the index).

### MARKET EFFICIENCY

- Weak form EMH: current stock prices reflect all security market information. Abnormal risk-adjusted returns cannot be earned by using trading rules and technical analysis.
- Semi-strong form EMH: current stock prices reflect all security market information and other public information. Abnormal risk-adjusted returns cannot be earned by using important material information after it has been made public.
- Strong form EMH: current stock prices reflect all public and private information. Abnormal risk-adjusted returns cannot be earned (assuming perfect markets where information is cost-free and available to all).
- Behavioral biases that may explain pricing anomalies: loss aversion, herding, overconfidence, information cascades, representativeness, mental accounting, conservatism, narrow framing.

### RISKS OF EQUITY SECURITIES

- Preference shares are less risky than common shares.
- Putable common shares are less risky than callable or non-callable common shares.
- Callable common and preference shares are more risky than their non-callable counterparts.

- Cumulative preference shares are less risky than non-cumulative preference shares as they accrue unpaid dividends.

### INDUSTRY ANALYSIS

- Porter's five forces: threat of substitute product, bargaining power of customers, bargaining power of suppliers, threat of new entrants, intensity of rivalry.
- Industry life-cycle analysis
  - Embryonic (slow growth, high prices, high risk of failure).
  - Growth (sales grow rapidly, improved profitability, lower prices, relatively low competition).
  - Shakeout (slower growth, intense competition, declining profitability, focus on cost reduction, some failures/mergers).
  - Mature (little or no growth, industry consolidation, high barriers to entry, strong cash flows).
  - Decline (negative growth, excess capacity, price competition, weaker firms leave).
- Competitive strategies: cost leadership, product/service differentiation.

### EQUITY VALUATION

- Dividend discount model (DDM) for common stock
  - One-year holding period

$$V_0 = \frac{\text{dividend to be received}}{(1+k_c)^1} + \frac{\text{year-end price}}{(1+k_c)^1}$$

- Gordon growth model (constant growth rate of dividends to infinity)

$$V_0 = \frac{D_0(1+g_c)^1}{(k_c - g_c)^1} = \frac{D_1}{k_c - g_c}$$

- Multi-stage DDM

$$\text{Value} = \frac{D_1}{(1+k_c)^1} + \frac{D_2}{(1+k_c)^2} + \dots + \frac{D_n}{(1+k_c)^n} + \frac{P_n}{(1+k_c)^n}$$

where:

$$P_n = \frac{D_{n+1}}{k_c - g_c}$$

$D_n$  = Last dividend of the supernormal growth period

$D_{n+1}$  = First dividend of the constant growth period

- Valuation of preferred stock
  - Non-callable, non-convertible preferred stock with no maturity date

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

- Non-callable, non-convertible preferred stock with maturity at time  $n$

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

- Price multiples: price-to-earnings, price-to-sales, price-to-book, price-to-cash flow.
- Justified P/E ratio

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

- Enterprise value (EV): market value of the company's common stock plus the market value of outstanding preferred stock (if any) plus the market value of debt, less cash and short-term investments (EV can be thought of as the cost of taking over a company).
- EV/EBITDA multiple is useful for comparing companies with different capital structures and for analyzing loss-making companies.

## FIXED INCOME

### BASIC FEATURES OF BONDS

- Types of collateral backing: collateral trust bonds, equipment trust certificates, mortgage-backed securities, covered bonds
- Credit enhancements
  - Internal: subordination, overcollateralization, excess spread (or excess interest cash flow).
  - External: surety bonds, bank guarantees, letters of credit.
- Covenants
  - Affirmative: requirements placed on the issuer.
  - Negative: restrictions placed on the issuer.
- Repayment structures
  - Bullet: entire principal amount repaid at maturity.
  - Amortizing: periodic interest and principal payments made over the term of the bond.
  - Sinking fund: issuer repays a specified portion of the principal amount every year throughout the bond's life or after a specified date.
- Bonds with contingency provisions
  - Callable: issuer has the right to redeem all or part of the bond before maturity.
  - Putable: bondholders have the right to sell the bond back to the issuer at a pre-determined price on specified dates.
  - Convertible: bondholders have the right to convert the bond into a pre-specified number of common shares of the issuer (can also have callable convertible bonds).
  - Contingent convertible bonds (CoCos): convert automatically upon occurrence of a pre-specified event.

### FIXED INCOME MARKETS

- Public offering mechanisms: underwritten, best efforts, auction, shelf registration
- Corporate debt
  - Bank loans and syndicated loans (mostly floating-rate loans).
  - Commercial paper (unsecured, up to a maturity of one year).
  - Corporate notes and bonds.
  - Medium-term notes (short-term, medium- to long-term, structured segments).
- Short-term wholesale funds: central bank funds, interbank funds, certificates of deposits
- Repurchase agreements (repos)
  - Repo: seller is borrowing funds from the buyer and providing the security as collateral.
  - Reverse repo: buyer is borrowing securities to cover a short position.
  - Repo margin or haircut: the percentage difference between the market value of the security and the amount of the loan.
  - Repo rate: annualized interest cost of the loan.
  - Any coupon income received from the bond provided as security during the repo term belongs to the seller/borrower.

### FIXED INCOME VALUATION

- Bond pricing with yield-to-maturity (uses constant interest rate to discount all the bond's cash flows)
  - If coupon = YTM, the bond's price equals par value.
  - If coupon > YTM, the bond's price is at a premium to par.
  - If coupon < YTM, the bond's price is at a discount to par.
- Price is inversely related to yield: when the yield increases (decreases), the bond's price decreases (increases).
- Bond pricing with spot rates (uses the relevant spot rates to discount the bond's cash flows)

- Spot rate: yield on a zero-coupon bond for a given maturity.
- Accrued interest when a bond is sold between coupon payment dates
- Full price: calculated as the PV of future cash flows as of the settlement date.
- Accrued interest (AI) included in full price: seller's proportional share of the next coupon, where  $t$  is the number days from last coupon date to the settlement date and  $T$  is the number of days in the coupon period (actual/actual for government bonds, 30/360 for corporate bonds)

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

- Flat or clean or quoted price: full price less AI, or equivalently

$$PV^{Full} = PV^{Flat} + AI$$

- Yield measures
  - Effective annual yield depends on periodicity of the stated annual yield.
  - Annual-pay bond: stated annual yield for periodicity of one = effective annual yield.
  - Semiannual-pay bond: stated annual yield for periodicity of two = semiannual bond basis yield = semiannual bond equivalent yield = yield per semiannual period  $\times 2$ .
  - Current yield: annual cash coupon payment divided by the bond price.
  - Yield-to-call: computed for each call date.
  - Yield-to-worst: lowest yield among the YTM and the various yields to call.
- Money market pricing on a discount rate basis

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

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

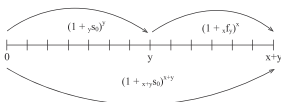
- Money market pricing on an add-on rate basis

$$PV = \frac{FV}{1 + \frac{\text{Days}}{\text{Year}} \times AOR}$$

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

- Bond-equivalent yield: money-market rate stated on a 365-day year on an add-on basis.
- Forward rate
  - Interest rate on a loan originating at some point in the future.
  - Implied forward rates can be computed from spot rates.

$$(1 + {}_y s_0)^y (1 + {}_x f_y)^x = (1 + {}_{x+y} s_0)^{x+y}$$



- Yield spreads
  - G-spread: spread over government bond yield.
  - I-spread: spread over the swap rate.
  - Z-spread: spread over the government spot rate.
  - Option-adjusted spread: z-spread less option value (bps per year).
- Asset-backed securities
  - Residential MBS: agency RMBS vs non-agency RMBS (require credit enhancements).
  - Mortgage pass-through securities (backed by pool of residential mortgage loans): single monthly mortality rate (SMM).

$$SMM_t = \frac{\text{Prepayment in month } t}{\text{Beginning mortgage balance for month } t - \text{Scheduled principal payment in month } t}$$

- Prepayment risk: contraction risk occurs when interest rates fall (leading to an increase in prepayments), while extension risk occurs when interest rates rise (leading to a decrease in prepayments).
- CMOs (backed by pool of mortgage pass-through securities): sequential-pay tranches (shorter-term tranches receive protection from extension risk, longer-term tranches receive protection from contraction risk); PAC/support tranches (support tranche provides protection against contraction and extension risk to the PAC tranche); floating rate tranches (floater and inverse floater).
- Credit enhancements for non-agency RMBS: internal (cash reserve funds, excess spread accounts, overcollateralization, senior/subordinate structure) and external (monoline insurers).
- Commercial MBS (backed by non-recourse commercial mortgage loans): investors have significant call protection but are exposed to balloon risk (like extension risk).
- Non-mortgage asset-backed securities: auto-loan receivable-backed securities (backed by amortizing auto loans) and credit card receivable-backed securities (with lockout period before principal amortizing period sets in).
- CDOs: structured as senior, mezzanine and subordinated bonds (or equity class). CDO manager engages in active management of the collateral to generate the cash flow required to repay bondholders and to earn a competitive return for the equity tranche.

## INTEREST RATE RISK

- Two types of interest rate risk
  - Reinvestment risk: future value of any interim bond cash flows increases (decreases) when interest rates rise (decline). Matters more to long-term investors.
  - Market price risk: selling price of a bond decreases (increases) when interest rates rise (decline). Matters more to short-term investors.
- Macaulay duration: weighted average of the time it would take to receive all the bond's promised cash flows.
- Modified duration: estimated percentage price change for a bond in response to a 100 bps (1%) change in yields

$$\text{ModDur} = \frac{\text{MacDur}}{1 + r}$$

- If Macaulay duration is not known, annual modified duration can be estimated using the following formula:

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

- Effective duration: measures the sensitivity of a bond's price to a change in the benchmark yield curve (appropriate measure for bonds with embedded options)

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

- Key rate duration: measure of a bond's sensitivity to a change in the benchmark yield for a given maturity (used to assess yield curve risk, i.e. non-parallel shifts in the yield curve)
- Portfolio duration: weighted average of the durations of the individual bonds held in the portfolio, where each bond's weight equals its proportion of the portfolio's market value
- Money duration: measure of the dollar price change in response to a change in yields

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

- Price value of a basis point (PVBp): estimates the change

in the full price of a bond in response to a 1 bp change in its YTM

$$PVBp = \frac{(PV_-) - (PV_+)}{2}$$

- Approximate convexity: used to revise price estimates of option-free bonds based on duration to bring them close to their actual values

$$\text{ApproxCon} = \frac{(PV_-) + (PV_+) - [2 \times (PV_0)]}{(\Delta Y \text{ield})^2 \times (PV_0)}$$

- The percentage change in a bond's full price for a given change in yield based on duration with convexity adjustment is estimated as follows:

$$\% \Delta PV^{Full} \approx (-\text{AnnModDur} \times \Delta Y \text{ield}) + \left[ \frac{1}{2} \times \text{AnnConvexity} \times (\Delta Y \text{ield})^2 \right]$$

- Effective convexity: use for bonds with embedded options instead of approximate convexity.
- Callable bonds can exhibit negative convexity when benchmark yields decline. Puttable bonds always exhibit positive convexity.

## CREDIT ANALYSIS

- Two components of credit risk: default risk (or default probability) and loss severity (or loss given default). Loss severity equals 1 minus the recovery rate.
- Expected loss

$$\text{Expected loss} = \text{Default probability} \times \text{Loss severity given default}$$

- Spread risk consists of downgrade risk (or credit migration risk) and market liquidity risk.
- Corporate family rating (CFR): issuer rating.
- Corporate credit rating (CCR): rating for a specific issue.
- Four Cs: capacity, collateral, covenants, character.
- Return impact of a change in the credit spread (includes convexity adjustment for larger changes)

$$\text{Return impact} = -(\text{MDur} \times \Delta \text{Spread}) + (1/2 \times \text{Convexity} \times \Delta \text{Spread}^2)$$

## DERIVATIVES

### TYPES OF DERIVATIVES

- Forward commitments: forwards, futures, interest rate swaps.
- Contingent claims: options, credit derivatives.

### DERIVATIVE PRICING AND VALUATION

- Derivative pricing is based on risk-neutral pricing.
- Forward contracts
  - Price at contract initiation (assuming underlying asset entails benefits and costs)

$$F(0, T) = (S_0 - \gamma + \theta)(1+r)^T \text{ or } F(0, T) = S_0(1+r)^T - (\gamma - \theta)(1+r)^T$$

\*Note that benefits ( $\gamma$ ) and costs ( $\theta$ ) are expressed in terms of present value.

- Value of a forward contract during its life (long position)

$$V_t(0, T) = S_t - (\gamma - \theta)(1+r)^{T-t} - [F(0, T) / (1+r)^{T-t}]$$

- Value of a forward contract at expiration (long position)

$$V_T(0, T) = S_T - F(0, T)$$

- Forward rate agreement (FRA)
  - Long (short) position can be viewed as the party that



has committed to take (give out) a hypothetical loan.

- If LIBOR at FRA expiration > FRA rate, the long benefits.
- If LIBOR at FRA expiration < FRA rate, the short benefits.
- Futures: similar to forwards but standardized, exchange-traded, marked-to-market daily, clearinghouse guarantees that traders will meet their obligations
- Forward vs futures prices
  - If underlying asset prices are positively (negatively) correlated with interest rates, the futures price will be higher (lower) than the forward price.
  - If futures prices are uncorrelated with interest rates or if interest rates are constant, forwards and futures would have the same price.
- Interest rate swaps
  - The swap fixed rate represents the price of the swap (swap has zero value to the swap counterparties at swap initiation).
  - If interest rates increase after swap initiation, the swap will have positive value for the fixed-rate payer.
  - If interest rates decrease after swap initiation, the swap will have positive value for the floating-rate payer.
  - An interest rate swap can be viewed as a combination of FRAs.
- Options
  - Call (put) option gives the holder/buyer the right to buy (sell) the underlying asset at the exercise price.
  - European option: can only be exercised at the option's expiration.
  - American option: can be exercised at any point up to the option's expiration.
  - Call (put) option is in-the-money when the stock price is higher (lower) than the exercise price.
  - Intrinsic or exercise value: the amount an option is in-the-money by (minimum value of 0).
  - Put-call parity for European options (options and bond have the same time to expiration/maturity T)

$$C_0 + \frac{X}{(1+R_f)^T} = P_0 + S_0$$

- Put-call parity formula can be rearranged to create synthetic call, put, underlying asset and bond, e.g. synthetic call = long put + long underlying stock + short bond).
- Factors affecting the value of an option

Impact of an increase in:	Call	Put
Value of the underlying	Increase	Decrease
Exercise price	Decrease	Increase
Risk-free rate	Increase	Decrease
Time to expiration	Increase	Increase (except for deep in-the-money European puts)
Volatility of the underlying	Increase	Increase
Benefits from the underlying	Decrease	Increase
Cost of carry	Increase	Decrease

- One-period binomial model for a call option (based on risk-neutral probability  $\pi$ )

$$c = \frac{\pi c^+ + (1-\pi)c^-}{(1+r)}$$

$$\pi = \frac{(1+r-d)}{(u-d)} \quad \text{Where } u = \frac{S_u^+}{S_0} \text{ and } d = \frac{S_u^-}{S_0}$$

## ALTERNATIVE INVESTMENTS

- Potential benefits of alternative investments: low correlations with returns on traditional investments and higher returns than traditional investments
- Hedge funds
  - Event-driven strategies: merger arbitrage, distressed/restructuring, activist, special situations.
  - Relative value strategies: fixed income convertible arbitrage, fixed income asset backed, fixed income general, volatility, multi-strategy.
  - Macro strategies: long and short positions in broad markets (e.g. equity indices, currencies, commodities, etc.) based on manager's view regarding overall macro environment.
  - Equity hedge strategies: market neutral, fundamental growth, fundamental value, quantitative directional, short bias, sector specific.
  - Two types of fees: management fee (based on assets under management) and incentive fee (which may be subject to a hurdle rate or high water mark provision).
- Private equity
  - Leveraged buyouts (LBOs): management buyouts (MBOs) and management buy-ins (MBIs).
  - Venture capital: formative stage financing (angel investing, seed-stage financing, early-stage financing), later-stage financing, mezzanine-stage financing.

- Development capital: includes private investment in public equities (PIPEs).
- Distressed investing: buying debt of mature companies in financial distress.
- Exit strategies: trade sale, IPO, recapitalization, secondary sale, write-off/liquidation.
- Valuation methods for portfolio company: market or comparables approach, discounted cash flow approach, asset-based approach.
- Real estate
  - Investment categories: residential property, commercial real estate, REITs, timberland/farmland.
  - Performance measurement: appraisal indices (tend to understate volatility), repeat sales indices (sample selection bias), REIT indices (based on prices of publicly traded shares of REITs).
  - Real estate valuation approaches: comparable sales approach, income approach (direct capitalization method and discounted cash flow method), cost approach.
  - REIT valuation approaches: income-based approaches, asset-based approaches (NAV).
- Commodities
  - Investors prefer to trade commodity derivatives to avoid costs of transportation and storage for physical commodities.
  - Price of a commodity futures contract.

$$\text{Futures price} = \text{Spot price} \times (1 + \text{Risk-free short-term rate}) + \text{Storage costs} - \text{Convenience yield}$$

- When the futures price is higher (lower) than the spot price, prices are said to be in contango (backwardation).
- Sources of return on a commodity futures contract: roll yield, collateral yield, spot prices.
- Infrastructure
  - Investments in real, capital intensive, long-lived assets.
  - Economic infrastructure: assets such as transportation and utility assets.
  - Social infrastructure: assets such as education, healthcare and correctional facilities.
  - Brownfield investments: investments in existing infrastructure assets.
  - Greenfield investments: investments in infrastructure assets to be constructed.
- Risk-return measures
  - Sharpe ratio is not appropriate risk-return measure since returns tend to be leptokurtic and negatively skewed.
  - Downside risk measures more useful, e.g. value at risk (VAR), shortfall risk, Sortino ratio.

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