Ethical and Professional Standards

Code of Ethics and Standards of Professional Conduct

KAPLAN SCHWESER

CFA Institute Professional Conduct Program

Disciplinary Review Committee of CFA Institute Board of Governors has responsibility for the Professional Conduct Program and for enforcement of the Code and Standards

CFA Institute, through Professional Conduct staff, conducts **inquiries related to professional conduct**

CFA Institute Professional Conduct Program

Inquiry can be prompted by:

- **Self-disclosure** by members or candidates
- **Written complaints** about a member or candidate's professional conduct
- **Evidence of misconduct** by a member or candidate

CFA Institute Professional Conduct Program

Inquiry can be prompted by:

- Report by a **CFA exam proctor**
- **Analysis** of exam scores and materials, **monitoring** of websites and social media

CFA Institute Professional Conduct Program

CFA Institute Professional Conduct staff may decide:

1. That no disciplinary sanctions are appropriate
2. To issue a cautionary letter
3. To discipline the member or candidate

Sanctions may include condemnation by member's peers or suspension of candidate's participation in the CFA Program

Code of Ethics

Act with integrity, competence, diligence, respect, and in an ethical manner—public, clients, prospects, employers, employees, colleagues. ***Act in an ethical manner.***

Integrity of investment profession and client interests above personal interests. ***Integrity is paramount and clients always come first.***

Code of Ethics

Reasonable care, independent professional judgment when conducting analysis, making recommendations, taking investment actions, and in other professional activities. ***Use reasonable care; be independent.***

Practice, encourage others…in a professional, ethical manner…reflect credit on themselves and profession. ***Be a credit to the investment profession.***

Code of Ethics

Promote integrity of capital markets for ultimate benefit of society. ***Uphold capital market rules and regulations.***

Maintain, improve professional competence, and strive to do the same for other investment professionals. ***Be competent.***

Standards of Professional Conduct

I. Professionalism

A. Knowledge of the Law
B. Independence and Objectivity
C. Misrepresentation
D. Misconduct

Standards of Professional Conduct

II. Integrity of Capital Markets

A. Material Nonpublic Information
B. Market Manipulation

Standards of Professional Conduct

III. Duties to Clients

A. Loyalty, Prudence, and Care
B. Fair Dealing
C. Suitability
D. Performance Presentation
E. Preservation of Confidentiality

Standards of Professional Conduct

IV. Duties to Employers

A. Loyalty
B. Additional Compensation Arrangements
C. Responsibilities of Supervisors

Standards of Professional Conduct

V. Investment Analysis, Recommendations, and Actions

A. Diligence and Reasonable Basis
B. Communication with Clients and Prospective Clients
C. Record Retention

Standards of Professional Conduct

VI. Conflicts of Interest

A. Disclosure of Conflicts
B. Priority of Transactions
C. Referral Fees

Standards of Professional Conduct

VII. Responsibilities as a CFA Institute Member or CFA Candidate

A. Conduct as Participants in CFA Institute Programs
B. Reference to CFA Institute, the CFA Designation, and the CFA Program

Ethical and Professional Standards

Guidance for Standards I - VII

Standard I: Professionalism

Standard I(A) Knowledge of the Law

Understand and comply with all laws, rules, and regulations (including Code and Standards) of any government, regulatory agency, or association governing professional activities

Comply with *more strict* law, rule, and regulation

Do not knowingly assist in violation, otherwise dissociate from activity

Standard I(A) - Knowledge of the Law

Guidance

- Most strict
- First, notify supervisor or compliance
- May confront wrongdoer directly
- Dissociate if necessary
- Inaction may be construed as participation
- No requirement to report violations to governmental authorities, may be appropriate in certain cases

Standard I(A) - Knowledge of the Law

Recommended Procedures

Keep informed, regularly review written compliance procedures, maintain files

Seek compliance/legal advice as needed

Encourage firms to adopt code of ethics

Standard I(A) - Knowledge of the Law

Recommended Procedures

Distribute information internally on applicable laws and regulations

Have written procedures for reporting suspected violations

Members strongly encouraged to report violations by other members

Standard I(B) - Independence and Objectivity

Use reasonable care, judgment to achieve and maintain independence in professional activities

Do not offer, solicit, or accept any compensation that could compromise independence or objectivity

Standard I(B) - Independence and Objectivity

Guidance

Modest gifts okay

Distinguish between gifts from clients and gifts from entities trying to influence a member’s behavior

May accept gift from clients—disclose to employer—get permission if for future performance

Standard I(B) - Independence and Objectivity

Guidance

Members responsible for hiring outside managers should not accept travel, gifts, or entertainment that could impair their objectivity

Investment banking relationships—do not bow to pressure to issue favorable research

For issuer-paid research, flat fee structure is preferred; must disclose

Standard I(B) - Independence and Objectivity

Guidance

Members working for credit rating firms should avoid influence by issuing firms

Users of credit ratings should be aware of this potential conflict

Best practice is for analysts to pay for their own commercial travel to firms being analyzed or to firm events

Standard I(B) - Independence and Objectivity

Recommended Procedures

- Protect integrity of opinions—reports should reflect unbiased opinion
- Create a restricted list
- Restrict special cost arrangements
- Limit gifts; clear value limits by firm
- Be careful with IPO share allocations

Standard I(C) – Misrepresentation

Do not make misrepresentations relating to investment analysis, recommendations, actions, or other professional activities

Standard I(C) – Misrepresentation

Guidance

- Standard covers oral, written, and electronic communications
- Do not misrepresent qualifications, services of self or firm, performance record, or characteristics of an investment
- Do not guarantee a certain return
- No plagiarism

Standard I(C) – Misrepresentation

Recommended Procedures

Firms can assist employees by providing a written list of the firm’s available services and a description of the firm’s qualifications

Maintain records of materials used to prepare research reports, and quote source, except for recognized financial and statistical reporting services

Standard I(C) – Misrepresentation

Recommended Procedures

Models and analysis of others at the firm may be used without attribution

Should encourage firm to establish procedures for verifying marketing claims of third parties recommended to clients

Standard I(D) – Misconduct

Do not engage in any professional conduct involving dishonesty, fraud, or deceit or commit any act that reflects adversely on professional reputation, integrity, or competence

Standard I(D) – Misconduct

Guidance

This Standard covers conduct that may not be illegal, but could adversely affect a member's ability to perform duties.

Standard I(D) – Misconduct

Recommended Procedures

- Adopt a code of ethics to which every employee must adhere
- Disseminate a list of potential violations and associated disciplinary sanctions
- Conduct background checks on potential employees—look for good character and eligibility to work in the investment industry

Standard II: Integrity of Capital Markets

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Standard II(A) Material Nonpublic Information

Members in possession of nonpublic information that could affect an investment's value must not act or cause someone else to act on the information.

Standard II(A) Material Nonpublic Information

Guidance

"Material"—if disclosure of information would affect a security's price or if an investor would want to know before making an investment decision

If price effect is ambiguous, information may not be considered material

Extends to info such as upcoming rating change and influential analysis to be released

Standard II(A) Material Nonpublic Information

Guidance

Information is *nonpublic* until it has been made available to the marketplace.

Information made available to analysts is considered nonpublic until it is made available to investors in general.

Act includes related swaps and options and mutual funds with the security.

Standard II(A) Material Nonpublic Information

Guidance

May use firm-provided information for certain specified purposes (e.g., due diligence for transactions with firm)

Mosaic Theory—no violation when an analyst combines nonmaterial, nonpublic information with public information to reach conclusion

Standard II(A) Material Nonpublic Information

Recommended Procedures

Information barrier or “firewall” is recommended to control interdepartmental communications

Information barrier includes use of restricted list

Review employee trades

Standard II(A) Material Nonpublic Information

Recommended Procedures

Increase review/restrict proprietary trading while firm is in possession of material nonpublic information

Standard II(B) Market Manipulation

Do not engage in practices that distort prices or artificially inflate trading volume with **intent to mislead** market participants

Standard II(B) Market Manipulation

Guidance

Do not engage in transaction-based manipulation:

- Giving false impression of activity/price movement
- Gaining dominant position in an asset to manipulate price of the asset or a related derivative

Do not distribute false, misleading information

Standard III: Duties to Clients and Prospective Clients

Standard III(A) – Loyalty, Prudence and Care

- Duty of loyalty to clients—act with reasonable care and exercise prudent judgment
- Act for benefit of clients and place their interests before employer's or own interests
- Determine and comply with any applicable fiduciary duty

Standard III(A) – Loyalty, Prudence and Care

Guidance

- Take investment actions in client's best interests
- Exercise prudence, care, skill, and diligence that a person familiar with such matters would use

Standard III(A) – Loyalty, Prudence and Care

Guidance

- Follow applicable fiduciary duty
- "Client" may be investing public
- Manage pools of client assets according to terms of governing documents

Standard III(A) – Loyalty, Prudence and Care

Guidance

Make investment decisions in context of total portfolio

Vote proxies responsibly and disclose proxy voting policies to clients

"Soft dollars" must benefit client

Standard III(A) – Loyalty, Prudence and Care

Recommended Procedures

- Follow rules and laws
- Establish client investment objectives
- Diversify
- Deal fairly with clients—investment actions
- Disclose all possible conflicts

Standard III(A) – Loyalty, Prudence and Care

Recommended Procedures

- Vote proxies in best interest of clients and ultimate beneficiaries
- Keep client information confidential
- Seek best trading execution for clients
- Place client interests first

Standard III(B) – Fair Dealing

Deal fairly and objectively with all clients when:

- Providing investment analysis
- Making investment recommendations
- Taking investment action
- Engaging in other professional activities

Standard III(B) – Fair Dealing

Guidance

No discrimination against any clients when disseminating investment recommendations or taking investment action

Fair does not mean *equal*

Standard III(B) – Fair Dealing

Guidance

Different levels of service are okay as long as disclosed and do not disadvantage any clients

All clients must have fair chance to act on every investment recommendation

If client is unaware of recommendation change, advise before accepting trade order

Standard III(B) – Fair Dealing

Guidance

Treat all clients fairly—consider investment objectives and circumstances

Disclose written allocation procedures

Do not disadvantage any clients when distributing “hot” issues

Standard III(B) – Fair Dealing

Recommended Procedures

Limit number of people aware of upcoming changes

Shorten time frame—decision to dissemination

Have pre-dissemination guidelines

Simultaneous dissemination

Standard III(B) – Fair Dealing

Recommended Procedures

Maintain list of clients and their holdings

Disclose trade allocation procedures

Review accounts regularly to ensure fair client treatment

Standard III(B) – Fair Dealing

Recommended Procedures

If firm offers different levels of service, disclose this fact to all clients

Deviations from strict pro rata allocation of IPO is sometimes okay (e.g., minimum block sizes)

Standard III(C) – Suitability

When in advisory relationship with a client:

- Make reasonable inquiry as to client's investment experience, risk/return objectives, financial constraints prior to making any recommendation, or taking investment action
- Update information regularly

Standard III(C) – Suitability

When in advisory relationship with client:

- Ensure investment is suitable to client's situation and consistent with written objectives before recommending an investment or taking investment action
- Look at suitability in a portfolio context

Standard III(C) – Suitability

When responsible for managing a portfolio to a specific mandate, strategy, or style, only make recommendations or take investment actions that are consistent with the stated objectives and constraints of the portfolio

Standard III(C) – Suitability

Guidance

- When in advisory relationship, gather client information at the outset and prepare IPS
- Update IPS at least annually
- Consider whether leverage (derivatives) is suitable for client
- If managing a fund to an index or other mandate, invest according to mandate

Standard III(C) – Suitability

Guidance

If a client requests an unsuitable trade, discuss suitability with the client before executing

- If not material to portfolio, follow firm's policies for client approval
- If material, discuss whether IPS needs update
- If client declines to update IPS, follow firm's policies or reconsider advisory relationship

Standard III(C) – Suitability

Recommended Procedures

When formulating IPS for client, know the client's:

- Return objectives
- Risk tolerance

Standard III: Duties to Clients and Prospective Clients

Standard III(C) – Suitability

Recommended Procedures

Determine the client's constraints:

- Liquidity needs
- Expected cash flows, investable funds
- Time horizon, tax considerations
- Regulatory/legal constraints
- Unique circumstances/needs

Standard III(D) – Performance Presentation

When communicating investment performance information, make reasonable efforts to ensure that it is fair, accurate, and complete

Can make brief presentation, note limited nature, and make detailed information available on request

Standard III(D) – Performance Presentation

Guidance

- Do not misstate performance or mislead clients about investment performance
- Do not misrepresent past performance
- Provide fair and complete performance information
- Do not state or imply ability to achieve returns similar to those achieved in the past

Standard III(D) – Performance Presentation

Recommended Procedures

- Consider audience sophistication when presenting performance
- Use performance of the weighted composite of similar portfolios
- Include terminated accounts as part of historical performance
- Make all disclosures and maintain records

Standard III(E) – Confidentiality

Keep current and prospective client information confidential, unless:

- Illegal activities are suspected
- Disclosure is required by law
- Client or prospect allows disclosure of the information

Standard III(E) – Confidentiality

Guidance

In some cases it may be required by law to report activities to relevant authorities

This Standard extends to former clients

Exception: May provide confidential information to CFA Institute for an investigation under Professional Conduct Program

Standard III: Duties to Clients and Prospective Clients

Standard III(E) – Confidentiality

Recommended Procedures

Avoid discussing any information received from a client except to colleagues working on the same project

Follow firm's electronic data storage procedures; recommend adoption of procedures if none exist

Standard IV:
Duties to Employers

Standard IV(A) – Loyalty

On matters related to employment, act for benefit of employer and do not deprive employer of the advantage of skills/abilities, divulge confidential information, or otherwise cause harm to employer

Standard IV(A) – Loyalty

Guidance

Place client interests first but consider effects on firm integrity and sustainability

Members encouraged to give employer a copy of the Code and Standards

No incentive or compensation structure that encourages unethical behavior

Standard IV(A) – Loyalty

Guidance

Independent Practice:

- If planning to engage in independent practice, notify employer of services provided, expected duration, and compensation
- Do not proceed without consent from employer

Standard IV(A) – Loyalty

Guidance

Leaving an Employer:

- Act in best interest of employer until resignation is effective
- Employer records on any medium (e.g., cell phone, PDA, home computer) are property of the firm
- Simple knowledge of names of former clients is okay; but don't solicit prior to leaving
- No prohibition on use of experience or knowledge gained at former employer

Standard IV(A) – Loyalty

Guidance

Whistleblowing:

- Permitted only if it protects client or integrity of capital markets
- Not permitted for personal gain

Standard IV(A) – Loyalty

Recommended Practices

Encourage firms to adopt policies regarding:

- Outside practice, non-compete agreements
- Leaving employer (resignation, termination)
- Incident reporting
- Employee classification (full-time, part-time, contractor)

Standard IV(B) – Additional Compensation

Do not accept gifts, benefits, compensation, or consideration that competes with, or creates a conflict of interest with, employer's interest unless written consent is obtained from all parties involved

Standard IV(B) – Additional Compensation

Guidance

Compensation and benefits covers direct compensation by the client and other benefits received from third parties

For written consent from "all parties involved," email is acceptable

Standard IV(B) – Additional Compensation

Recommended Procedures

- Written report to employer with details of proposed compensation in addition to normal compensation and benefits
- Details of incentives verified by offering party
- Include nature of compensation, amount, and duration of agreement

Standard IV(C) – Responsibilities of Supervisors

Make reasonable efforts to ensure that anyone subject to your supervision or authority complies with applicable laws, rules, regulations, and Code and Standards

Standard IV(C) – Responsibilities of Supervisors

Guidance

Supervisors must take steps to prevent employees from violating laws, rules, regulations, or the Code and Standards

Supervisors must make reasonable efforts to detect violations

Standard IV(C) – Responsibilities of Supervisors

Recommended Procedures

Adequate compliance procedures should:

- Be clear and understandable
- Designate a compliance officer
- Have checks/balances; permitted conduct
- Have procedures for reporting violations

Standard IV(C) – Responsibilities of Supervisors

Recommended Procedures

Supervisor and compliance officer should:

- Distribute procedures; update periodically
- Continually educate staff
- Review employee actions
- Promptly initiate procedures once a violation has occurred

Standard IV(C) – Responsibilities of Supervisors

Recommended Procedures

Once a violation has occurred, a supervisor should:

- Respond promptly
- Conduct a thorough investigation
- Place appropriate limitations on the wrongdoer until investigation is complete

Standard V: Investment Analysis, Recommendations, and Actions

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Standard V(A) – Diligence and Reasonable Basis

Exercise diligence, independence, thoroughness in analyzing investments, making investment recommendations, and taking investment action

Have a reasonable and adequate basis, supported by research, for analysis, recommendation, or action

Standard V(A) – Diligence and Reasonable Basis

Guidance

Make reasonable efforts to cover all relevant issues when arriving at an investment recommendation

Level of diligence will depend on product or service offered

Standard V(A) – Diligence and Reasonable Basis

Guidance

Using secondary or third-party research:

- Determine soundness of the research—review assumptions, rigor, timeliness, and independence
- Encourage firm to adopt policy of periodic review of quality of third-party research: assumptions, timeliness, rigor, objectivity, and independence

Standard V(A) – Diligence and Reasonable Basis

Recommended Procedures

Establish policy that research and recommendations should have reasonable and adequate basis

Review/approve research reports and recommendations prior to external circulation

Standard V(A) – Diligence and Reasonable Basis

Recommended Procedures

Establish due diligence procedures for judging if recommendation has met reasonable and adequate basis criteria

Develop measurable criteria for assessing quality of research

Standard V(A) – Diligence and Reasonable Basis

Recommended Procedures

Consider scenarios outside recent experience to assess downside risk of quantitative models

Make sure firm has procedures to evaluate external advisers they use or promote, including how often to review

Standard V(A) – Diligence and Reasonable Basis

Recommended Procedures

- Written procedures of acceptable scenario testing, range of scenarios, cash flow sensitivity to assumptions and inputs
- Procedure for evaluating outside information providers including how often
- No need to dissociate from group research that the member disagrees with

Standard V(B) – Communication with Clients and Prospective Clients

Disclose basic format/general principles of investment processes used to analyze investments, select securities, and construct portfolios

Promptly disclose any changes that may affect those processes materially

Standard V(B) – Communication with Clients and Prospective Clients

Disclose risks and limitations (e.g., liquidity, capacity) associated with investment process

- Use reasonable judgment in identifying which factors are important to investment analyses, recommendations, or actions
- Include those factors in communications with clients/prospective clients

Standard V(B) – Communication with Clients and Prospective Clients

Distinguish between fact and opinion in presentation of investment analysis and investment recommendations

Clearly communicate potential gains and losses on an investment

Standard V(B) – Communication with Clients and Prospective Clients

Guidance

Include basic characteristics of the security

Inform clients of any change in investment processes

Suitability of investment—portfolio context

All communication covered, not just reports

Standard V(B) – Communication with Clients and Prospective Clients

Recommended Procedures

The inclusion or exclusion of information depends on a case-by-case review

Maintain records

Standard V(C) – Record Retention

Develop and maintain appropriate records to support investment analyses, recommendations, actions, and other investment-related communications with clients and prospective clients

Standard V(C) – Record Retention

Guidance

- Maintain records to support research, and the rationale for conclusions and actions
- Records are firm’s property and cannot be taken when member leaves without firm’s consent
- If no regulatory requirement or firm policy, CFA Institute recommends retention period of 7 years

Standard V(C) – Record Retention

Recommended Procedures

Responsibility to maintain records generally falls with the firm

However, individuals must retain documents that support investment-related communications

Standard V(C) – Record Retention

Recommended Procedures

When member changes firm, must recreate records from public sources and new firm's information (can't rely on memory or materials from old firm)

Standard VI: Conflicts of Interest

Standard VI(A) – Disclosure of Conflicts

Make full, fair disclosure of all matters that could reasonably be expected to impair independence/objectivity, or interfere with duties to clients, prospects, or employer

Ensure disclosures are prominent, delivered in plain language

Standard VI(A) – Disclosure of Conflicts

Guidance

Disclose to clients:

- All matters that could impair objectivity—allow clients to judge motives, biases
- For example, between member or firm and issuer, investment banking relations, broker/dealer market-making activities, significant stock ownership, board service

Standard VI(A) – Disclosure of Conflicts

Guidance

Disclose to employers:

- Conflicts of interest—ownership of stock analyzed/recommended, board participation, financial and other pressures that may influence decisions
- Also covers conflicts that could be damaging to employer’s business

Standard VI(A) – Disclosure of Conflicts

Recommended Procedures

Disclose compensation arrangements with employer that conflict with clients' interests

If firm does not permit disclosure, consider dissociating from the activity

Firms are encouraged to include compensation information in promotional materials

Standard VI(B) – Priority of Transactions

Investment transactions for clients and employers must have priority over transactions in which a member or candidate is the beneficial owner

Do not use knowledge of pending trades for personal gain

Standard VI(B) – Priority of Transactions

Guidance

- "Beneficial owner"—has direct/indirect personal interest in the securities
- Client, employer transactions take priority over personal transactions (including beneficial ownership)
- Family member accounts that are client accounts must be treated as other client accounts

Standard VI(B) – Priority of Transactions

Recommended Procedures

Firm's compliance procedures should:

- Limit participation in equity IPOs
- Restrict purchase of securities through private placements

Standard VI(B) – Priority of Transactions

Recommended Procedures

Establish blackout/restricted periods

Establish reporting procedures and prior clearance requirements

Disclose policies on personal investing to clients, upon request

Standard VI(C) – Referral Fees

Disclose to employer, clients, and prospective clients, as appropriate, any compensation, consideration, benefit received from, or paid to, others for the recommendation of products or services

Standard VI(C) – Referral Fees

Guidance

Disclosure allows clients and employers to evaluate full cost of service and any potential biases

Disclosure is to be made prior to entering into any formal agreement for services

Disclose the nature of the consideration

Standard VI(C) – Referral Fees

Guidance

Encourage firm to have clear policy regarding referral compensation

Firms that do not prohibit should have clear approval process

Members should update referral compensation disclosure to employer at least quarterly

Standard VII: Responsibilities as a CFA Institute Member or CFA Candidate

Standard VII(A) – Conduct as Participants in CFA Institute Programs

Do not engage in any conduct that compromises the reputation or integrity of CFA Institute or CFA designation, or the integrity, validity, or security of CFA Institute programs

Standard VII(A) – Conduct as Participants in CFA Institute Programs

Guidance

Conduct includes:

- Cheating on the exam
- Disregarding rules and policies or security measures related to exam administration
- Giving confidential information to candidates or public

Standard VII(A) – Conduct as Participants in CFA Institute Programs

Guidance

Conduct includes (continued):

- Improper use of CFA designation to further personal and professional objectives
- Misrepresenting the CFA Institute Professional Development Program or the Professional Conduct Statement

Standard VII(A) – Conduct as Participants in CFA Institute Programs

Guidance

Don't disclose:

- Formulas tested or not tested on exam
- Specific question information
- Topic emphasis on the exam or topics tested

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

When referring to CFA Institute, membership, designation, or candidacy, do not misrepresent or exaggerate the meaning or implications of membership in CFA Institute, holding the CFA designation, or candidacy in the CFA program

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

Guidance

CFA Institute membership:

- Complete PCS annually
- Pay membership dues annually
- Failure to comply with above results in an inactive member status

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

Guidance

Use the marks "Chartered Financial Analyst" or "CFA" in a manner that does not misrepresent or exaggerate the meaning or implications of holding the CFA designation

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

Guidance

Reference to the CFA program:

- Candidates may reference participation in CFA program, but do not imply achievement of any type of partial designation
- Okay to say “passed all levels on first attempt,” but do not imply superior ability

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

Recommended Procedures

Make sure that your employer is aware of the proper references to the CFA designation and CFA candidacy

Ethical and Professional Standards

Application of the Code and Standards

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Edvard Stark

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Edvard Stark
Main Facts of Case

- Stark is a private client adviser for Eyearne Bank.
- Stark manages client portfolios and makes recommendations about outside assets of the clients.
- He recommends 1% allocation to Meerine, a new crypto currency (with low trading volume) to smallest clients.
- He finds Meerine's price to be very volatile but has confidence in it.

Edvard Stark
Main Facts of Case

- Augments income by mining Meerine from home computer
- Highlights Meerine in client review meetings
- Shares Meerine's low equity correlation and price increase since his recommendation, his own mining activity
- Changes recommendation to 3% of assets for Meerine
- Offers to sell his own mined Meerine to larger clients

Edvard Stark
Standards Violated

- III(B) Fair Dealing
  - Recommending initial investment to smallest clients first
  - Offering to sell from his own collection to larger clients
  - Best to have pro-rata trade allocation for block trades of low liquidity security
- III(C) Suitability
  - Crypto currencies are speculative—may not be appropriate as an investment for all. Three percent for all is also problematic.

Edvard Stark
Standards Violated

- IV(B) Duties to Employers: Additional Compensation Arrangements
- V(A) Investment Analysis, Recommendations, and Actions
- VI(A) Conflict of Interest

Subath Agarway

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Subath Agarway, CFA
Main Facts of Case

- Agarway recently joined CrowdWisdom, a small venture capital firm, and is in charge of due diligence.
- CrowdWisdom is an online platform linking startups to investors.
- Founders created *Investor Club* comprising most active capital contributors. Club members get exclusive research.
- Agarway's due diligence screens out smaller companies (<$1B) and those with various issues.

Subath Agarway, CFA
Main Facts of Case

- IT startup Deko passes the screen. Deko has crowdfunded in the past via email to those over 18. Deko's customers may be attractive as leads for CrowdFund investors.
- To meet CrowdFund's targets, Agarway is asked to modify his due diligence process and increase the acceptance rate.
- To overcome time constraints, it is recommended that Agarway spend less time per company in screening them.

Subath Agarway
Standards Violated

- I(A) Knowledge of Law
  - Deko's practice of marketing to teens and their family may be an illegal use of private client information in some countries.
- I(B) Independence and Objectivity
  - Pressure to modify due-diligence process
- VI(A) Disclosure of Conflict of Interest

Quantitative Methods

Introduction to Linear Regression

Linear Regression: Introduction

Linear Regression

- **Dependent ("Y") variable**: Explained variable
- **Independent ("X") variable**: Explains the variation in the dependent variable

  Example: Predict number of **mortgage applications** (dependent) using level of **interest rates** (independent)

Slope Coefficient and Intercept

Algebraic presentation of the slope coefficient and intercept:

Error Term

Dependent Variable → $Y_i = b_0 + b_1 X_i + \varepsilon$

Intercept

Slope Coefficient

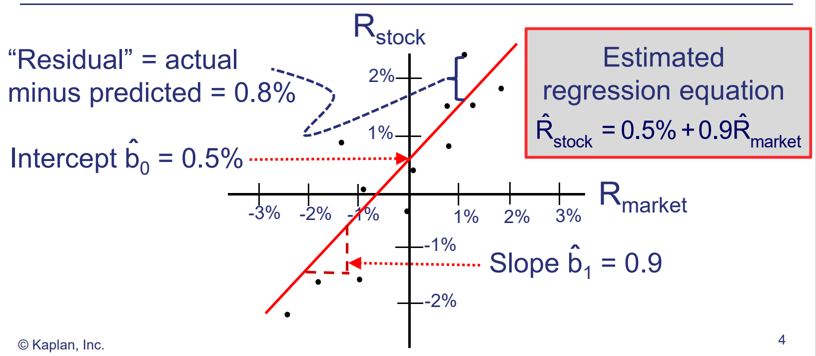
Independent Variable

Note that this is just the equation for a straight line

Assumptions of Linear Regression

- **Linear relation** between dependent and independent variables
- Independent variable **uncorrelated with *error term***
- Expected value of ***error term*** is zero.
- Variance of the ***error term*** is constant.
- ***Error term*** is independently distributed.
- ***Error term*** is normally distributed.

Linear Regression of Monthly Returns



Interpret a Regression Coefficient

- **Intercept**: Predicted value of Y when X = 0
  - *Predicted stock return is 0.5% when market return is zero.*
- **Slope**: Change in Y for 1 unit change in X
  - *Stock return is expected to change by 0.9% for 1% change in market return (BETA!).*

Quantitative Methods

Introduction to Linear Regression

Hypothesis Tests and Confidence Intervals

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Number of Xs and Degrees of Freedom

- Keep track of number of independent variables (k) and sample size (n).
- For simple regression, k = 1, so df = (n – 2).
- For multiple regression, *k* varies, so use df = (n – k – 1).

Regression Coefficient *t*-Test

- Typically, a test of statistical significance (i.e., is slope ≠ 0?)

$$H_0: b_1 = 0 \text{ vs. } H_a: b_1 \neq 0$$

- Use *t*-test with (n – k – 1) degrees of freedom:

$$t_{b_1} = \frac{\hat{b}_1 - b_1}{s_{\hat{b}_1}} = \frac{\text{estimate} - \text{hypothesized}}{\text{standard error}} = \frac{\hat{b}_1 - 0}{s_{\hat{b}_1}} = \frac{\text{slope}}{\text{standard error}}$$

Regression Coefficient *t*-Test

- Estimated slope for ABC (b_1) = 0.64 with a SE = 0.26. Assuming n = 36, determine if slope is significant at 5% level:

$$t_{b_1} = \frac{0.64 - 0}{0.26} = 2.46$$

Critical two-tailed *t*-stat (34 df and 5% significance) is 2.03

Degrees of freedom (df) are 36 – 2 = 34

Computed stat 2.46 > critical stat 2.03; therefore, null is rejected

Confidence Interval for Coefficient

- To calculate confidence interval for slope coefficient:
  - Slope coefficient ± (critical *t*-stat × standard error of slope)
- Critical *t*-stat depends on:
  - Significance = 1 – confidence level
  - Degrees of freedom = (n – k – 1)
- Confidence intervals are always two-tailed

Confidence Interval for Coefficient

- Calculate 95% confidence interval for $b_1 = 0.64$, SE = 0.26, n = 36:

Critical two-tailed *t*-stat (34 df and 5% significance) is 2.03

$$0.64 \pm 2.03 \times 0.26 = 0.11 \text{ to } 1.17$$

Quantitative Methods

Correlation and Regression

Predicting Dependent Variables
and Confidence Intervals

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Predicted Values for "Y" Variable

- **Example**: Given b_0 = –2.3% and b_1 = 0.64 and market excess return = 10%, what is the predicted ABC's excess return according to regression model?

Given on exam!

$$\hat{R}_{stock} = -2.3\% + 0.64(10\%) = 4.1\%$$

Confidence Interval for Predicted "Y"

- When building a confidence interval around Y, we use standard error of forecast (s_f) due to joint uncertainty from intercept and slope estimates:

$$\hat{Y} \pm (t_c \times s_f) \leftarrow s_f^2 = SEE^2\left[1 + \frac{1}{n} + \frac{(X-\bar{X})^2}{(n-1)s_x^2}\right]$$

- Critical t is two-tailed with n – 2 degrees of freedom.
- s_f can be approximated by SEE for large samples.

Confidence Interval for Predicted "Y"

- Calculate 95% confidence interval for predicted Y, given market excess return = 10% and SE of forecast (s_f) = 3.67

Critical two-tailed *t*-stat (34 df and 5% significance) is 2.03

$$4.1\% \pm 2.03 \times 3.67 = -3.4\% \text{ to } 11.6\%$$

Quantitative Methods

Introduction to Linear Regression

ANOVA Tables, R^2, and SEE

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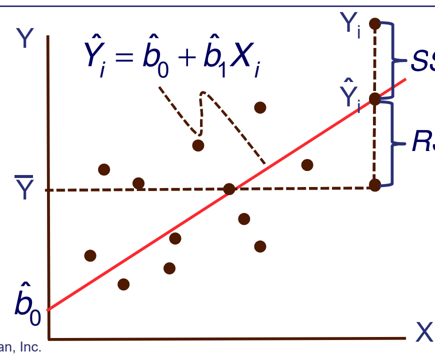
Analysis of Variance (ANOVA)

- Total variation = explained + unexplained
- Or, in statistical language:
  - SST = RSS + SSE

Analysis of Variance (ANOVA)



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

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

SST

SSE + RSS = SST

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

Analysis of Variance (ANOVA)

$$\text{Mean squared regression}\,(\text{MSR}) = \frac{\text{RSS}}{\text{k}}$$

$$\text{Mean squared error}\,(\text{MSE}) = \frac{\text{SSE}}{(\text{n} - \text{k} - 1)}$$

ANOVA Table

Source of Variation	*Df*	*Sum of Squares*	*Mean Square*
Regression (explained)	k	RSS	MSR
Error (unexplained)	n – k – 1	SSE	MSE
Total	n – 1	SST	

These columns vertically sum

ANOVA Table for ABC

Source of Variation	*Df*	*Sum of Squares*	*Mean Square*
Regression (explained)	1	0.0076	0.0076
Error (unexplained)	34	0.0406	0.0012
Total	35	0.0482	

These columns vertically sum

Standard Error of Estimate (SEE)

- SEE measures accuracy of predicted values from regression equation
  - Lower SEE implies greater model accuracy.
- SEE is the standard deviation of the error term.

$$\text{SEE} = \sqrt{\frac{\text{SSE}}{(n-k-1)}} = \sqrt{\text{MSE}}$$

Point: Calculate with ANOVA; the lower the better

Standard Error of Estimate (SEE)

- Calculate SEE based on the ANOVA table for ABC:

$$\text{SEE} = \sqrt{\frac{0.0406}{34}} = \sqrt{0.0012} = 0.035$$

The Coefficient of Determination (aka R^2)

- R^2 measures percentage of total variation in dependent "Y" variable explained by independent "X" variable.
- R^2 ranges between 0 and 1.
- An R^2 of 0.25 means "X" explains 25% of the variation in "Y".

Calculating R^2

$$R^2 = \frac{\text{explained variation}}{\text{total variation}} = \frac{RSS}{SST}$$

- For simple linear regression (i.e., k = 1)

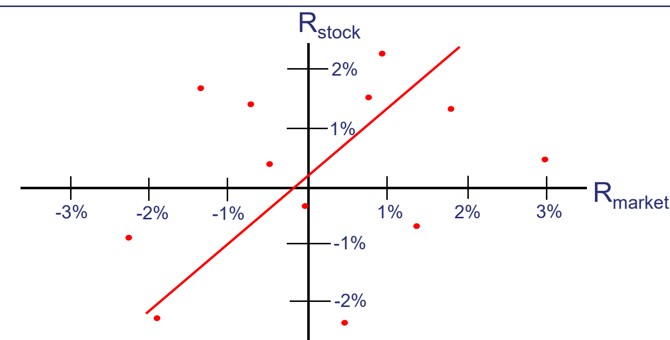
$$R^2 = (r_{XY})^2$$

Calculating R^2

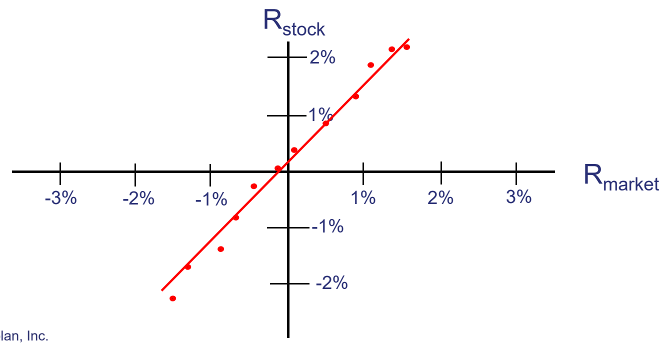
- Calculate R^2 based on the ANOVA table for ABC:

$$R^2 = \frac{RSS}{SST} = \frac{0.0076}{0.0482} = 15.8\%$$

Low R^2 and High SEE



High R^2 and Low SEE



Limitations of Regression

- Relationships change over time (parameter instability).
- Public knowledge of relationships eliminate usefulness to traders.
- Assumption violations (see later)

Quantitative Methods

Multiple Regression

Multiple Regression: Introduction

Multiple Regression

- **Basic idea**: Linear relationship with more than one independent variable

Dependent variable

Independent variables

$$Y_i = b_0 + b_1 X_{1i} + b_2 X_{2i} + \ldots + b_k X_{ki} + \varepsilon_i$$

Intercept

Slope coefficients

Error term

Formulate Regression Equation

- Suppose we think S&P 500 10-year real earnings growth (EG10) is explained by:*
  - Trailing dividend payout ratio of index (PR)
  - Yield curve slope (YCS)
- Example: Formulate a multiple regression equation to describe this relationship

*Adapted from Arnott and Asness (2003)

Formulate Regression Equation

$$EG10 = b_0 + b_1 \times PR + b_2 \times YCS + \varepsilon$$

where:

EG10 = 10-year real earnings growth in S&P 500

PR = trailing dividend payout ratio of index

YCS = yield difference between 10-year T-bond and 3-month T-bill

Formulate Regression Equation

- Regress EG10 on independent variables
  - 46 annual observations (n = 46)
  - Two independent "X" variables (k = 2)

Note: You will need n and k for several formulae

Regression Output: Frequent Starting Point for Exam Questions

Variable	b_i	S_{bi}
b_0	–11.6%	1.657%
PR	0.25	0.032
YCS	0.14	0.28

Interpreting Coefficients

- EG10 will equal –11.6% if the two independent variables are both zero.
- All else constant:
  - 1% increase in PR = 0.25% increase in EG10.
  - 1% increase in YCS = 0.14% increase in EG10.

Predicting the Dependent Variable

- Assume payout ratio (PR) = 50% and yield curve slope (YCS) = 4%. Predict 10-year real earnings growth for S&P:

$$EG10 = -11.6\% + 0.25(50\%) + 0.14(4\%) = 1.46\%$$

Quantitative Methods

Multiple Regression and Machine Learning

Hypothesis Tests and Confidence Intervals

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Regression Coefficient *t*-Test

- Typically, a test of statistical significance (i.e., is slope ≠ 0?)

  H_0: $b_i = 0$ vs. H_a: $b_i \neq 0$

- Use *t*-test with (n – k – 1) degrees of freedom:

$$t_{b_i} = \frac{\hat{b}_i - b_i}{s_{\hat{b}_i}} = \frac{\text{estimate} - \text{hypothesized}}{\text{standard error}} = \frac{\hat{b}_i - 0}{s_{\hat{b}_i}} = \frac{\text{slope}}{\text{standard error}}$$

Example: *t*-Test

- Estimated slope for PR (b_1) = 0.25 with a SE = 0.032. Assuming n = 46, determine if slope is significant at 10% level:

$$t_{b_1} = \frac{0.25 - 0}{0.032} = 7.8$$

Degrees of freedom (df) are 46 – 2 – 1 = 43

Critical two-tailed *t*-stat, given 43 df and 10% significance, is 1.68

Computed stat 7.8 > critical stat 1.68; therefore, null is rejected

Example: *t*-Test (One-Tail)

- Test hypothesis H_0: intercept (b_0) ≥ –10% vs H_a: b_0 < –10% given b_0 = –11.6%, SE = 1.657%, n = 46 at 1% significance level:

$$t_{b_0} = \frac{-11.6\% - (-10\%)}{1.657\%} = -0.96$$

Degrees of freedom (df) are 46 – 2 – 1 = 43

Critical *one-tailed t*-stat, given 43 df and 1% significance, is 2.42

Computed stat –0.96 > critical stat –2.42; therefore, null is *not* rejected

Interpreting *p*-Values

- Another way to test H_0 (always agrees with *t*-test)
- If *p*-value < α, then reject H_0.
  - **Example**: If α = 5% (i.e., a 95% confidence level) and the calculated *p*-value = 0.07, we fail to reject H_0.
- *p*-value can be viewed as smallest significance level (α) at which we can reject H_0.

Example: Interpreting *p*-Values

Variable	b_i	S_{bi}	*t-stat*	*p-value*
b_0	–11.6%	1.657%	–7.0	<0.0001
PR	0.25	0.032	7.8	<0.0001
YCS	0.14	0.28	0.5	0.62

- b_0 and PR are significant (high *t*-stat, low *p*-value) while YCS is insignificant (low *t*-stat and high *p*-value)

Confidence Interval for Coefficient

- From simple linear regression:
  - Slope coefficient ± (critical *t*-stat × standard error of slope)
- Critical *t*-stat depends on:
  - Significance (a.k.a. α) = 1 – confidence level
  - Degrees of freedom = n – k – 1
  - Confidence intervals are always two-tailed

Confidence Interval for Coefficient

- Calculate 90% confidence interval for PR (b_1) = 0.25, SE = 0.032, n = 46:

Critical two-tailed *t*-stat, given 43 df and 10% significance, is 1.68

$$0.25 \pm 1.68 \times 0.032 = 0.196 \text{ to } 0.304$$

Quantitative Methods

Multiple Regression

ANOVA and the *F*-test

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ANOVA Table

Source of Variation	*Df*	*Sum of Squares*	*Mean Square*
Regression (explained)	k	RSS	MSR
Error (unexplained)	n – k – 1	SSE	MSE
Total	n – 1	SST	

These columns vertically sum

Example: ANOVA

- An analyst runs a regression of monthly value-stock returns on five independent variables over 60 months. The total sum of squares for the regression is 460, and the sum of squared errors is 170.
- Prepare an ANOVA table
- Use information from ANOVA table to calculate *F*-test and R^2 (see later)

Example: ANOVA Table

Source of Variation	*Df*	*Sum of Squares*	*Mean Square*
Regression (explained)	5	290	58
Error (unexplained)	54	170	3.15
Total	59	460	

These columns vertically sum

Example: The *F*-Statistic

- Tests whether any of the independent variables explain variation in dependent variable (i.e., test of overall model significance)

  H_0: All slope coefficients = 0

  H_A: At least one slope coefficient ≠ 0
- One-tailed test
- Reject H_0 if *F*-statistic exceeds critical value
- Critical F determined by two sets of degrees of freedom (numerator and denominator)

The *F*-Statistic

$$F = \frac{RSS/k}{SSE/(n-k-1)} = \frac{MSR}{MSE}$$

with k and (n – k – 1) degrees of freedom

Numerator df

Denominator df

The *F*-Statistic

- Perform *F*-test on five independent variables over 60 months at 5% significance. SST = 460, SSE = 170:

H_0: $b_1 = b_2 = b_3 = b_4 = b_5 = 0$ vs. H_a: at least one $b_j \neq 0$

RSS = SST – SSE = 460 – 170 = 290

Critical *F*-value for 5 and 54 df at 5% is 2.40

$$F = \frac{290/5}{170/(60-5-1)} = \frac{58.0}{3.15} = 18.41$$

Comp. stat 18.41 > crit. stat 2.40; therefore, reject H_0

Quantitative Methods

Multiple Regression

Coefficient of Determination and Adjusted R^2

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Coefficient of Determination (a.k.a. R^2)

- R^2 measures percentage of total variation in dependent "Y" variable explained by independent "X" variable
- R^2 ranges between 0 and 1
- An R^2 of 0.25 means "X" explains 25% of the variation in "Y"

Calculating R^2

$$R^2 = \frac{\text{explained variation}}{\text{total variation}} = \frac{RSS}{SST}$$

- For simple linear regression (i.e., k = 1):

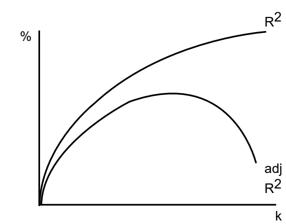
$$R^2 = (r_{XY})^2$$

- Sometimes, r_{xy} may be called *multiple r*

Adjusted R^2

- Unadjusted R^2 increases when new variables are added.
- Adjusted R^2 applies a penalty factor to reflect quality of added variables.

$$R^2_{adj} = 1 - \left[\left(\frac{n-1}{n-k-1}\right) \times \left(1 - R^2\right)\right]$$



Calculating R^2 and Adjusted R^2

- Given regression with five independent variables, n = 60, SST = 460, and SSE = 170, calculate R^2 and adjusted R^2:

$$R^2 = \frac{460 - 170}{460} = 63.0\%$$

$$R^2_{adj} = 1 - \left[\left(\frac{60-1}{60-5-1}\right) \times (1 - 0.63)\right] = 59.6\%$$

Interpreting Adjusted R^2

- Suppose we add four more independent variables. R^2 increases from 63% to 65%, but adjusted R^2 falls from 59.6% to 58.7%. Which model should we choose?
- Answer: Choose the original model because it has a higher adjusted R^2. It has better explanatory power, and uses five rather than nine variables.

Quantitative Methods

Multiple Regression

Dummy Variables

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Dummy Variables

- Dummy variables (a.k.a. binary variables)
  - Can only take the values of 0 and 1
  - Can be used in calendar studies
    - **Example:** Regressing EPS against binary variables that account for quarter
- **Dummy variable trap**: Always use (n – 1) dummy variables to avoid multicollinearity (i.e., 3 dummies for 4 quarters in a year).

Dummy Variables: Example

- **Suppose**: EPS is regressed against quarter

$$EPS_t = b_0 + b_1Q_{1t} + b_2Q_{2t} + b_3Q_{3t} + \varepsilon_t$$

where: fourth quarter is omitted quarter

Q_{1t} = 1 if first quarter, 0 otherwise

Q_{2t} = 1 if second quarter, 0 otherwise

Q_{3t} = 1 if third quarter, 0 otherwise

Dummy Variables: Example

- **Result:**

  $EPS_t = 1.25 + 0.75Q_{1t} – 0.20Q_{2t} + 0.10Q_{3t}$
- **Question #1:** What is the mean fourth quarter EPS?

  = predicted fourth quarter EPS (for next year)

  = 1.25 (omitted quarter shows as intercept)
- **Question #2:** What's the predicted first quarter EPS?

Dummy Variables: Example

- **Question #2 answer:**
  - Mean first quarter EPS (historical)

    = predicted first quarter EPS (for next year)

    = intercept + Q_{1t} coefficient

    = 1.25 + 0.75

    = 2.00

Quantitative Methods

Multiple Regression

Assumptions: Heteroskedasticity

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Assumptions of Multiple Regression

- Linear relationship between Y and X
- No exact linear relationship among X's
- Expected value of error term = 0
- Variance of error term is constant
- Errors not serially correlated
- Error term normally distributed

These are related to violations (see later)

Heteroskedasticity

- Arises when error term variance is non-constant
- **Two types of heteroskedasticity**:
  - **Type 1**: Unconditional heteroskedasticity
    - Not related to independent variables
    - **Point**: **Causes no major problems**

Heteroskedasticity (continued)

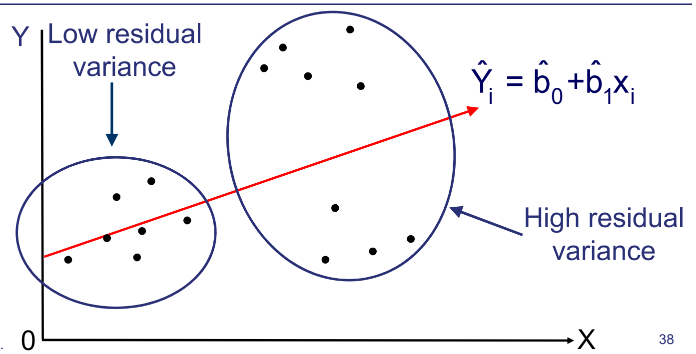
- **Type 2**: Conditional heteroskedasticity
  - Related to independent variables (next slide)
  - This IS a problem
  - Impact: *t*-stats are *usually* artificially high

Think: False significance

$$t_{b_i} = \frac{\hat{b}_i}{s_{\hat{b}_i}} = \frac{\text{estimate} \leftarrow \text{Not affected}}{\text{standard error} \leftarrow \text{Too small}}$$

  - *Standard error too low* = t-*stat too high; Type I errors*

Heteroskedasticity (continued)



Detecting Heteroskedasticity

- **Scatter diagrams**: Plot residual against each independent variable and against time (see previous slide).
- **Breusch-Pagan test**: Regress squared residuals on "X" variables.
  - Point: Test significance of **resulting R^2** (do the independent variables *explain* a significant part of the variation in squared residuals?)
  - H_0: No heteroskedasticity
  - Chi-square test: **BP = $R_{resid}^2 \times$ n** (with k df)

Correcting for Heteroskedasticity

- **First Method:** Use robust standard errors (a.k.a. White-corrected standard errors).
- Result: Standard errors higher, *t*-stats lower, and conclusions more accurate
- **Second Method:** Use *generalized least squares,* modifying original equation to eliminate heteroskedasticity.

Quantitative Methods

Multiple Regression

Serial Correlation

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Serial Correlation

- Positive autocorrelation: Each error term tends in same direction as previous term.
  - Common in financial data
- **NOTE: Same as heteroskedasticity**
  - *T*-stats are too high (Type I errors)

Again: False significance

$$t_{b_i} = \frac{\hat{b}_i}{s_{\hat{b}_i}} = \frac{\text{estimate}}{\text{standard error}}$$

estimate ← Not affected

standard error ← Too small

Detecting Serial Correlation

- **Scatter plot**
  - Visual inspection of residual errors
- **Durbin-Watson statistic**
  - Formal test of error term correlation
  - Next slides

The DW Statistic: Interpretation

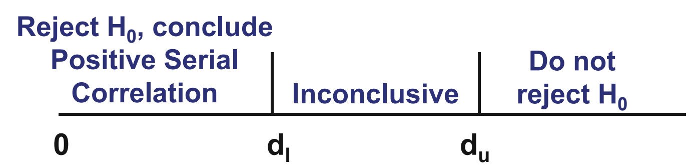
- DW ≅ 2(1 – *r*)
- Three cases: No correlation, positive correlation, and negative correlation
  - **No autocorrelation** (ρ = 0)
    - DW ≅ 2(1 – 0) = 2
  - **Positive serial correlation** (ρ = 1) ← Common
    - DW ≅ 2(1 – 1) = 0
  - **Negative serial correlation** (ρ = –1) ← Not common
    - DW ≅ 2(1 – (– 1)) = 4

The DW Statistic: Interpretation

- **Question**: How close to "2" does DW have to be to conclude "no serial correlation"?
- **Answer:** Look at ranges in **DW tables**
  - Need: Significance level, number of observations (*n*), and number of independent variables (*k*)
  - Table provides **pair of critical values** (d_l and d_u)
    - Interpreted on next slide

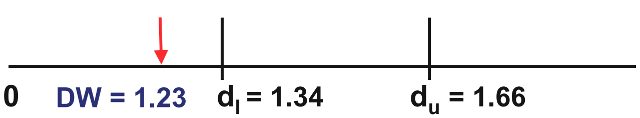
Interpreting DW Values

- **Conclusion**: Depends on where calculated value lies relative to d_l and d_u
- H_0: No positive serial correlation



Interpreting DW Values Example

- Suppose DW = 1.23 in regression with three independent variables and 40 observations.
- **The critical DW values** are d_l = 1.34 and d_u= 1.66 (from the DW table).
- Reject null of "no serial correlation," conclude positive correlation since 1.10 < 1.23.



Correcting for Serial Correlation

- **Preferred method**:
  - Adjust the standard errors upwards using the **Hansen method** and recalculate *t*-statistics
  - Also corrects for conditional heteroskedasticity
- **Result:** *t*-statistics decline, chance of Type I error declines

Quantitative Methods

Multiple Regression

Multicollinearity

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Multicollinearity

- Define: Two or more "X" variables are correlated with each other
- Effects:
  - Inflates SEs; reduces *t*-stats; increases chance of Type II errors
  - **Point**: *t*-stats artificially small so *variables falsely look unimportant*

Detecting Multicollinearity

- Tell-tale signs from regression data:
  - **Observation 1**: Significant *F*-stat (and high R^2), but all *t*-stats insignificant
  - **Observation 2**: High correlation between "X" variables (for k = 2 case only)
- **Correction**
  - Omit one or more of the "X" variables

Detecting Multicollinearity

- Determine if there is multicollinearity in this regression:

Variable	b_i	*p-value*
Avg. P/B	3.52	0.15
Avg. P/E	2.78	0.21
Mkt cap	4.03	0.11
F-test	34.6	<0.001

Significant *F*-test (low *p*-value) coupled with insignificant individual variables (high *p*-values) indicates multicollinearity is present

Quantitative Methods

Multiple Regression

Model Misspecification and
Qualitative Dependent Variables

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Model Specification Issues

- **Model specification**
  - Selection of explanatory variables
  - Transformation of variables
- Affects reliability of inference/hypothesis tests
  - **Point:** If model specified incorrectly, regression coefficients will be biased and inconsistent

Three Types of Model Misspecification

- Functional Form Misspecification
  - Important variables omitted
  - Variables not transformed properly
  - Data pooled improperly
- Time-Series Misspecification
  - X is lagged Y with serial correlation present
  - *Forecasting the past*
  - Measurement error

Effect of Model Misspecification

Model Misspecification

↓

Biased and Inconsistent regression coefficients

↓

Inaccurate predictions and unreliable hypothesis testing

Model Misspecification: Example

- Predict monthly Chinese portfolio stock (R) returns July '96 to June '02 with*:
  - Portfolio beta (β)
  - Natural log of market cap (lnM)
  - Natural log of price-to-book (lnPB)
  - Free float (FF)

$$\boxed{R = b_0 + b_1\beta + b_2 \ln M + b_3 \ln PB + b_4 FF + \varepsilon}$$

**Based on Wang and Xu, FAJ, Nov./Dec. 2004*

Model Misspecification: Example

- Misspecification #1: Omit a variable
  - Leave out lnM (if correlated with B, FF)
- Misspecification #2: Fail to transform
  - Use market cap instead of lnM
- Misspecification #3: Incorrectly pool data
  - What if '96 to '99 is different than '00 to '02?

Model Misspecification: Example

- Misspecification #4: Use lagged Y
  - Use previous month R as ind. variable
- Misspecification #5: Forecast the past
  - Use end of month market cap instead of beginning of month
- Misspecification #6: Measure X's with error
  - FF is proxy for *corporate governance quality*

Qualitative Dependent Variables

- **Example**: Forecasting bond default (dependent variable)
  - Two outcomes: Default (1) or no default (0)
- **Point:** Cannot use ordinary least squares regression (OLS) analysis
- Three examples *(next slide)*

Qualitative Dependent Variables

- **Probit models** estimate probability of default given values of X based on the normal distribution.
- Similarly, **logit models** estimate probability of default based on the logistic distribution (computationally easier than normal distribution).
- **Discriminant models** produce a score or ranking used to classify into categories (e.g., bankrupt, not bankrupt).

Economic Significance

- Statistical significance does not imply economic significance
- **Point:** Analyst must carefully critique:
  - **Underlying statistical analysis**
    - Assumption violations
    - Model misspecifications
  - **Economic significance**

Quantitative Methods

Time-Series Analysis

Linear and Log-Linear Trend Models

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Topical Overview: Time Series Analysis

- Financial data can be difficult to model using conventional multiple regression, so what should you do?
- **Trend models**
  - Linear trend model
  - Log-linear trend model
- **Lagged models**
  - Autoregressive model (AR)

Time Series Analysis

- A time series is a set of values for a particular variable for many time periods.
- Examples:
  - Quarterly sales over the last five years
  - Monthly CPI over the last 12 years
  - Daily returns over the last 180 days

Linear Trend Model

- **Point:** Regression with time as the independent variable:

$$y_t = b_0 + b_1 t + \varepsilon_t \quad t = 1 \text{ to } n$$

Observed value (e.g., unemployment)

Time index: One for the first observation, two for the second…

- The predicted change in y is b_1.

Linear Trend Model: Example

- A linear trend model has b_0 = 1.70 and b_1 = 3.0. Calculate y_t for t = 1 and t = 2:

$$\hat{y}_t = 1.70 + 3.0 \times t + \varepsilon_t$$

$$\hat{y}_1 = 1.70 + 3.0 \times 1 = 4.70$$

$$\hat{y}_2 = 1.70 + 3.0 \times 2 = 7.70$$

b_1 represents the absolute change in the dependent variable

Log-Linear Trend Model

- Log-linear regression assumes the dependent financial variable exhibits exponential growth:

$$y_t = e^{b_0 + b_1 t} \Rightarrow$$

$$\ln(y_t) = b_0 + b_1 t$$

Taking the natural log of both sides yields

- Slope coefficient, b_1, is the constant growth!

Log-Linear Trend Model: Example

- An analyst models quarterly revenue data (in millions of US$) for JP Northfield using a log-linear trend model:

$$\ln(\hat{y}_t) = 4.0 + 0.09 \times t$$

- Estimate revenues for the 49th quarter (t = 49):

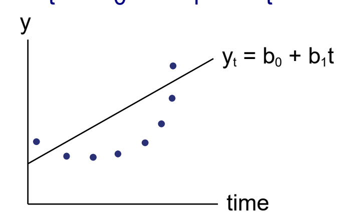
$$\ln(\hat{y}_{49}) = 4.0 + 0.09 \times 49 = 8.41$$

$$y_{49} = e^{8.41} = 4{,}492\text{m}$$

Log-Linear Trend Models (Visual)

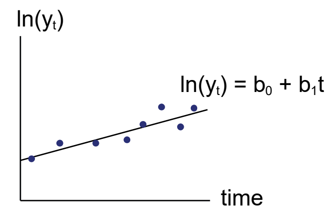
Linear Trend Model

$$y_t = b_0 + b_1 t + \varepsilon_t$$



Log-Linear Trend Model

$$\ln(y_t) = b_0 + b_1 t + \varepsilon_t$$



Serial Correlation in Trend Models

- Regression errors in current period must be uncorrelated with errors from all other periods.
- Use Durbin Watson to test for serial correlation.
- If linear model exhibits autocorrelation, try log-linear
- If log-linear model still exhibits autocorrelation, try autoregression.

Quantitative Methods

Time-Series Analysis

Autoregressive Models

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Autoregressive Models

- **Main idea:** The dependent variable is regressed on prior value(s) of itself
- **Simplest form**: AR(1) model:

$$x_t = b_0 + b_1 x_{t-1} + \varepsilon_t$$

- Or more generally, AR(p) model:

$$x_t = b_0 + b_1 x_{t-1} + b_2 x_{t-2} + \ldots + b_p x_{t-p} + \varepsilon_t$$

Covariance Stationarity

- To use autoregressive models, the time series must be covariance stationary:
  - Constant and finite expected value
  - Constant and finite variance
  - Constant and finite covariance with leading or lagged values
- A nonstationary time series will produce meaningless regression results.

Forecasting With an AR(1) Model

- Assume we estimated the following AR(1):

  $\mathbf{X_t = 1.2 + 0.45\, x_{t-1} + e_t}$
- **Question**: If X_0 is 5.0, calculate a two-step ahead forecast:
- One-step-ahead forecast:

  $X_1 = 1.2 + 0.45\ (5) = 3.45$
- Two-step-ahead forecast:

  $X_2 = 1.2 + 0.45\ (3.45) = 2.75$

Serial Correlation in an AR Model

- Cannot use Durbin Watson to test for serial correlation in AR models
- Use a t-test on residual autocorrelations.
- If serial correlation exists, model is incomplete.
- **Solution**: Increase order of model by adding more lagged variables (e.g., AR(2) from AR(1) or adjust for seasonality).

Testing for Serial Correlation in an AR Model

$SE = 1/\sqrt{n}$

Computed autocorrelations (AR1 model):

Lag	Autocorrelation	SE	t-stat
1	0.1884	0.1414	1.3324
2	0.3363	0.1414	2.3784
3	–0.1218	0.1414	–0.8614
4	–0.0285	0.1414	–0.2016

Since $1/\sqrt{n} = 0.1414 \rightarrow n = 50$

Continued →

AR Model Example

Lag	Autocorrelation	SE	t-stat
1	0.1884	0.1414	1.3324
2	0.3363	0.1414	2.3784
3	–0.1218	0.1414	–0.8614
4	–0.0285	0.1414	–0.2016

- Assuming a critical t-value of 2.0, the model is incorrectly specified.
- To correct, try an AR(2) model (i.e., add a lag).

AR Model Example

- The AR(2) model better fits the data.
- No significant correlations

Since all t-stats are insignificant, there is not serial correlation.

Lag	Autocorrelation	SE	t-stat
1	–0.0174	0.1429	–0.1217
2	0.0957	0.1429	0.6701
3	–0.1472	0.1429	–1.0301
4	–0.1520	0.1429	–1.0641

Mean Reversion

- If a time series is mean-reverting:
  - The value of the dependent variable tends to fall when above its mean and rise when below its mean.
- For an AR(1) model: $$\text{MRL} = \frac{b_0}{(1-b_1)}$$
- Note that we would have problems if $b_1 = 1$ (see later).

Mean Reversion

- Calculate mean-reverting level for manufacturing capacity utilization time series given $b_0 = 82.137$ and $b_1 = -0.223$:

$$\text{MRL} = \frac{82.137}{[1-(-0.223)]} = 67.16$$

- Interpretation: If current capacity utilization is above 67.16, it is expected to fall in the next period; if it is below 67.16, it is expected to rise.

Comparing Model Accuracy

- **In-sample**: Data used to develop model
- **Out-of-sample:** Any data outside above range
- Forecasting accuracy is measured by square root of the *m*ean *s*quared *e*rror (RMSE).
- Use the model with the lowest RMSE based on out-of-sample forecasting errors.

Regression Coefficient Instability

- **Point:** Estimated regression coefficients change from one time period to another.
  - Creates a trade-off between statistical reliability of long time series and stability of short time series
  - Has economic process or environment changed?

Quantitative Methods

Time-Series Analysis

Random Walks and Unit Roots

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Random Walks

- Two types: No drift and drift
  - **Defining characteristic**: $b_1 = 1$
- Random walk without a drift:

$$X_t = X_{t-1} + \varepsilon_t$$

  - Or, equivalently:

$$X_t = 0 + (1)X_{t-1} + \varepsilon_t$$

note: $b_0 = 0$

note: $b_1 = 1$

  - Random walk with a drift:

$$X_t = b_0 + X_{t-1} + \varepsilon_t$$

note: $b_0 \neq 0$

Unit Roots

- In an AR(1) model, coefficient must be **< 1.0.**
- If coefficient = 1 ➡ unit root.
- Unit root is defining feature of random walks
- Unit roots are common in series that consistently increase or decrease over time (e.g., 1990s stock market).

Why are Unit Roots Problematic?

- If $b_1 = 1$, then mean reverting level is undefined:

$$\frac{b_0}{1-b_1} = \frac{b_0}{1-1} = \frac{b_0}{0}$$

- Without a mean reverting level, the time series is nonstationary.
- Question: How do we test for a unit root?

Dickey-Fuller Test for a Unit Root

- Test is based on a transformed version of the AR(1) model.
- Subtracting x_{t-1} from both sides:

  $x_t - x_{t-1} = b_0 + (b_1 - 1)x_{t-1} + \varepsilon_t$ or

  $x_t - x_{t-1} = b_0 + g_1 x_{t-1} + \varepsilon_t$ where $g_1 = (b_1 - 1)$

- If there is a unit root in the AR(1) model, then g_1 will be 0.

Dickey Fuller Test (continued)

- DF test: H_0: $g_1 = 0$, time series has a unit root and is nonstationary

  H_a: $g_1 < 0$, time series does not have a unit root

- Test is conducted by calculating a *t*-statistic for g_1 and using a revised set of critical values computed by DF.
- Using a revised set of *t*-stats, if the Null is rejected, there is no evidence of a unit root.

First Differencing

- Use First Differencing to remove unit roots/nonstationarity
- Create a new dependent variable, *y*, defined as the *change* in *x*:

$$y_t = x_t - x_{t-1}$$

and

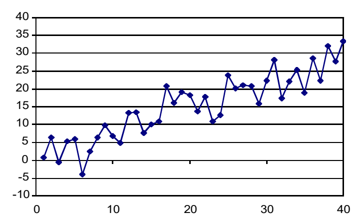
$$y_t = b_0 + b_1\left(y_{t-1}\right) + \varepsilon_t$$

Note: b_0 and b_1 = 0

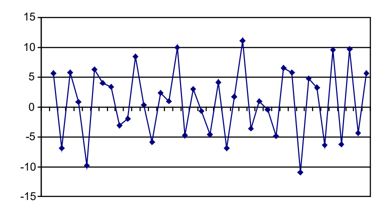
First Differencing

- Notice how first differencing removes the upward trend:

linear trend



$y_t = x_t - x_{t-1}$



Quantitative Methods

Time-Series Analysis

Seasonality

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Seasonality

- A time series shows consistent seasonal patterns
- **Objective**: incorporate seasonal component (x_{t-4} in quarterly or x_{t-12} in monthly models)
- In the following example, an AR(1) model is applied to quarterly occupancy levels for a resort hotel chain.

Seasonality

- Predict quarterly occupancy levels for a resort hotel chain using the following AR(1) model based on 10 years of quarterly data (n = 40) and determine if seasonality exists:

$$\ln x_t = b_0 + b_1 \ln x_{t-1} + \varepsilon_t$$

Seasonality

$$\ln x_t = b_0 + b_1 \ln x_{t-1} + \varepsilon_t$$

R^2	0.7929
Standard error	0.1952
Observations	39

	Coefficients	*Standard Error*	*t-stat*
Intercept	0.0375	0.0274	1.369
lag 1	0.5318	0.1635	3.2526

Does This Suggest Seasonality?

Lag	Autocorrelation	SE	t-stat
1	–0.0615	0.1601	–0.3841
2	–0.0121	0.1601	–0.0756
3	–0.0212	0.1601	–0.1324
4	0.8719	0.1601	5.4460

Significant residual autocorrelation at lag 4 indicates seasonality.

Correcting Seasonality

- Given a significant lag 4 autocorrelation (*t*-stat > approx. 2), we opt for an AR(1) model incorporating a seasonal lag:

$$\ln x_t = b_0 + b_1(\ln x_{t-1}) + b_2(\ln x_{t-4}) + \varepsilon_t$$

Correcting Seasonality

$$\ln x_t = b_0 + b_1(\ln x_{t-1}) + b_2(\ln x_{t-4}) + \varepsilon_t$$

R^2 0.94898
Standard error 0.3754
Observations 36

	Coefficients	Standard Error	t-stat
Intercept	0.0085	0.0049	1.7347
lag 1	0.2598	0.0527	4.9298
lag 4	0.7921	0.2166	3.6570

Correcting Seasonality

Lag	Autocorrelation	SE	t-stat
1	–0.0526	0.1667	–0.3156
2	0.0715	0.1667	0.4290
3	–0.0241	0.1667	–0.1446
4	–0.0435	0.1667	–0.2610

- No significant residual autocorrelations and improvement in R^2 indicate the new model is correctly specified.

Forecasting With an AR Model

- Given occupancy levels for 2015, b_0 = 0.0085, b_1 = 0.2598 and b_2 = 0.7921, forecast hotel occupancy for 2016.1:

Quarter	Occupancy
2015.1	250,000
2015.2	750,000
2015.3	450,000
2015.4	600,000
2016.1	???

$$\ln x_t = 0.0085 + 0.2598\,(\ln 600{,}000) + \\ +0.7921\,(\ln 250{,}000) = 13.3103$$

$$x_t = e^{13.3103} = 603{,}378.52$$

Quantitative Methods

Time-Series Analysis

ARCH and Multiple Time Series

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Autoregressive Conditional Heteroskedasticity (ARCH) Models

- Heteroskedasticity occurs when variance of error is:
  - Nonconstant; and
  - Conditional on independent variable
- Standard errors, *t*-stats, and conclusions are incorrect
- **Solution**: Use generalized least squares or other methods to correct for heteroskedasticity.

ARCH

- To test whether a time series is ARCH(1), squared residuals are regressed on first lag of squared residuals:

$$\hat{\varepsilon}_t^2 = a_0 + a_1\hat{\varepsilon}_{t-1}^2 + \mu_t$$

- If a_1 is significant, the time series is ARCH(1).

ARCH (continued)

- Also, if a_1 is significant, future variance of errors can be predicted using:

$$\hat{\sigma}_{t+1}^2 = \hat{a}_0 + \hat{a}_1\hat{\varepsilon}_t^2$$

- Essentially, a volatility forecasting model

ARCH (continued)

- Determine if below results indicate ARCH(1) and, if so, predict next period's variance given current period squared error of 0.5625:

Variable	a_i	S_{bi}	*t-stat*	*p-value*
Constant	5.9068	1.08631	5.4375	<0.001
lag 1	0.4515	0.09558	4.7238	<0.001

ARCH (continued)

- The high *t*-stat (low *p*-value) on the lag 1 coefficient indicate a_1 is significant, and so, the time series is ARCH(1).
- Next period estimated variance of error is:

$$\hat{\sigma}^2_{t+1} = 5.9068 + 0.4515 \times 0.5625 = 6.1608$$

Multiple Time Series

- Can we use regression on time series containing **unit roots**?
  - **Example**: Estimating stock beta
  - Regress a time series of stock returns on a time series of market returns.
- Either or both time series could have a unit root.
- **How reliable is the beta estimate?**

First Check for Unit Roots!

- Both time series are covariance stationary.

  → *Reliable*
- Only the dependent variable time series or only the independent time series is covariance stationary.

  → *Not reliable*
- Neither time series is covariance stationary.

  → *Check for Cointegration*

Cointegration

- **Cointegration**: Two time series are related to same macro variables or follow same trend.
  - If time series are cointegrated, error term from regressing one on the other is covariance stationary and *t*-tests are reliable.
  - **Point:** If cointegrated, model can be used!

Quantitative Methods (2)

Machine Learning

Types of Learning and Overfitting Problems

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Machine Learning

- The goal of machine learning (ML) is to filter useful information from great quantities of data by learning from known examples to find a pattern in the data.
- The objective is to determine structure or generate forecasts without human intervention.
- One straightforward way to think of machine learning is "find the pattern, apply the pattern."

Supervised Machine Learning

- Supervised learning requires us to have labeled training data, plus organized sets of observed features (inputs, or Xs) and the associated target (output, or Y).
- Can be either a regression or classification problem.
  - If the target variable is continuous, then it is regression.
  - If the target variable is ordinal or categorical (e.g., bond rating), then it is a classification.

Unsupervised Machine Learning

- In unsupervised learning, algorithms are trained *without* using labeled data.
- Relations between features are inferred, reflecting an underlying structure that was not provided.
- Kinds of problems that are appropriate for unsupervised ML include clustering and dimension reduction.

Deep Learning

- Deep learning is a ML algorithm based on neural networks.
- Deep learning is used for complex tasks like classification, speech recognition and natural language processing, face recognition, and reinforcement learning.

Overfitting

- **Generalization** refers to the extent to which a machine learning model is able to make accurate *out-of-sample* (vs. in-sample) predictions.
- One big reason for a lack of generalization, is overfitting.
  - **Overfitting** has occurred when the machine learning algorithm has been styled too closely against the training data, with the result that the algorithm may not generally apply to new unfamiliar data.

Out-of-Sample Error

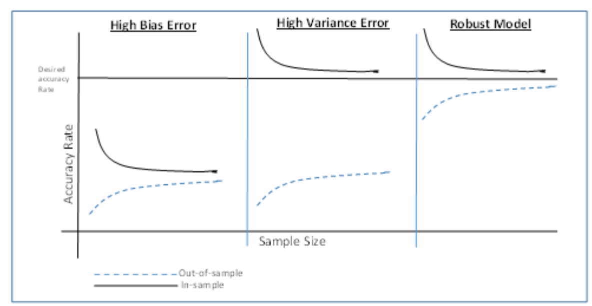
Out-of-sample error can originate from three sources:

- **Bias error:** The extent to which the model fits training data.
- **Variance error:** The extent to which a model's results change in response to test and validation sample data.
- **Base error:** Originates from randomness in the data.

out-of-sample error = bias error + variance error + base error

Learning Curve

A learning curve plots the accuracy rate (i.e., 1 – error rate) versus the size of the training sample.



Preventing Overfitting in Supervised ML

k-fold cross-validation: A method for alleviating the holdout sample problem (when the training set is reduced too much).

Details of the process:

- The data are shuffled randomly.
- Then divided into k equal sub-samples.
- k – 1 samples are used as training samples.
- One sample, the kth, is used as a validation sample.

Quantitative Methods (2)

Machine Learning

Supervised Learning Algorithms

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Supervised Machine Learning Algorithms

- Supervised machine learning algorithm examples:
  - Penalized regression
  - Support vector machine
  - k-nearest neighbor
  - Classification and regression tree
  - Ensemble learning
  - Random forest

Penalized Regression Example: LASSO

LASSO (Least Absolute Shrinkage and Selection Operator)

- A popular type of penalized regression.
- Penalty based on sum of absolute regression coefficient values. Penalty increases with number of features included.
- A feature needs to add to model fit to offset the penalty from it being included.
- Produces *parsimonious* models (few predictor variables).

Support Vector Machine (SVM)

- Support vector machine is a linear classification algorithm.
- SVM attempts to find the optimal hyperplane that separates two sets of data by the maximum amount.
- SVM is used for bond classification, or sentiment classification of textual data.
  - For example: classifying debtors as likely- or not-likely-to-default, or sorting text as positive vs. negative.

K-Nearest Neighbor (KNN)

- k-nearest neighbor (KNN) is a supervised learning technique most often used for classification.
- New observations are classified by finding the "nearest" (most similar) between a new observation and its k-nearest pieces of data in the current data set.
- If k = 5, the algorithm will look for the 5 nearest neighbors.
- Investment applications of KNN include assigning bond ratings, predicting bankruptcy, predicting stock prices, etc.

Classification and Regression Tree (CART)

- CART is another supervised machine learning technique.
- CART is used to forecast either a categorical target variable, resulting in a classification tree, or a continuous target variable, generating a regression tree.
- Binary CART algorithms repeatedly divide the data until the terminal nodes are reached (e.g., Yes/No)
- Applications of CART include detecting fraudulent financial statements and selecting stocks and bonds.

Ensemble Learning

- **Ensemble learning** is a technique of combining the predictions from a collection of models.
- Any individual model will have a certain error rate and will make noisy predictions. But by averaging predictions from many models, we can reduce the noise.
- Ensemble learning generally produces predictions than are more stable and accurate than those of any single model.

Random Forest Classifier

- A **random forest classifier** is an assembly of a large number of decision trees trained via a bagging method.
- In **bagging**, the original training data set is used to generate *n* new training data sets or "bags" of data.
  - Each new bag is generated by random sampling *with* replacement. Bagging helps to improve the stability of predictions and protects against overfitting the model.
- Investment applications include factor-based asset allocation and prediction models for the success of an IPO.

Quantitative Methods (2)

Machine Learning

Unsupervised Learning Algorithms and Other Models

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Unsupervised Machine Learning Algorithms

Unsupervised machine learning algorithms include:

- Principal components analysis.
- k-means clustering.
- Hierarchical clustering.

Each of these unsupervised ML algorithms is suited for different kinds of problems.

Principal Components Analysis (PCA)

- PCA is an unsupervised machine learning algorithm.
- PCA transforms the feature covariance matrix in order to reduce highly correlated features into a smaller number of uncorrelated composite variables.
- PCA produces *eigenvectors* that define the new uncorrelated composite variables, and *eigenvalues* that reflect the proportion of total variance that is explained by each eigenvector.

K-Means Clustering

- k-means is an older kind of unsupervised ML algorithm.
- k-means partitions observations into a fixed number (k) of non-overlapping clusters.
- Each cluster is described by a centroid.
- Each observation is assigned to the cluster whose centroid it is closest to.

Hierarchical Clustering

- Hierarchical clustering is an iterative unsupervised algorithm used to form a hierarchy of clusters.
- Bottom-up (agglomerative) clustering begins with each observation as its own cluster.
- Top-down (divisive) clustering starts with all observations belonging to one single cluster.
- The algorithms create rounds of clusters of increasing or decreasing size until a final clustering is reached.

Neural Networks

- Neural networks consist of nodes connected by links.
- Three layers: input layer, hidden layers, and output layer.
- Learning happens in the hidden layer nodes.
  - Each has a summation operator and activation function.
- Neural networks have been effective in tasks that feature non-linearities and complex interactions among variables.

Deep Learning Nets (DLNs)

- DLNs are neural networks with many hidden layers.
- Are the backbone of the artificial intelligence revolution.
- DLNs take a set of inputs, which are then passed through several layers of non-linear mathematical functions (neurons). At the final layer, a category is assigned based on highest probability.
- Used for complex activities, including pattern, image, and speech recognition.

Reinforcement Learning (RL)

- An RL algorithm attempts to maximize rewards over time within the constraints of its environment.
- Reinforcement learning does not have direct labeled data for each observation, nor instantaneous feedback.
- An RL algorithm learns by testing new actions and reusing its previous experiences.
- Learning occurs via millions of trial and error repetitions.

Quantitative Methods (2)

Big Data Projects

Data Analysis Steps

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Big Data Projects

- Big data has great potential for various fintech applications including many in investment management.
- In this reading, we consider the key steps in big data projects that use machine learning (ML) models.
- We take a close look at linking textual big data with structured inputs.

Big Data Projects

Big data is characterized by three Vs:

- Volume – Big data suggests a huge volume of data.
- Velocity – Speed of data creation and collection.
- Variety – E.g., emails, images, clickstreams, etc.

- And, when used for inferences, a fourth V:
  - Veracity – Accuracy/validity of data.

Steps in a Data Analysis Project

Traditional ML model:

1. Conceptualization of the problem
2. Data collection
3. Data preparation and wrangling
4. Data exploration
5. Model training

Textual ML model:

1. Text problem formulation
2. Text curation
3. Text preparation and wrangling
4. Text exploration
5. Model training

**Note that these five steps are iterative.*

Objectives of Preparing and Wrangling Data

- Data preparation and wrangling for structured data involve **data cleansing** and **data preprocessing**.
- **Data cleansing** typically involves resolving:
  - Incompleteness errors
  - Invalidity errors
  - Inaccuracy errors
  - Inconsistency errors
  - Non-uniformity errors
  - Duplication errors

Steps in Preparing and Wrangling Data

Addressing outliers in the data set:

- **Trimming:** The highest and lowest x% of observations are excluded.
- **Winsorization:** Extreme values are replaced by the maximum value allowable for that variable.

Steps in Preparing and Wrangling Data

Preprocessing for structured data typically consists of performing the following conversions:

- Extraction – Inferring new data from the data provided.
- Aggregation – Combining multiple variables into one.
- Filtration – Eliminating irrelevant observations.
- Selection – Removing features, i.e., columns of data.
- Conversion – Of varying data types (e.g., nominal, ordinal).

Steps in Preparing and Wrangling Data

Normalization scales variable values between 0 and 1:

$$\text{normalized } X_i = \frac{X_i - X_{min}}{X_{max} - X_{min}}$$

Standardization centers the variables at 0 and scales them as units of standard deviations from the mean:

$$\text{standardized } X_i = \frac{X_i - \mu}{\sigma}$$

Steps in Preparing and Wrangling Data

- Preparation and wrangling text (unstructured) data consists of a specific set of cleansing and preprocessing tasks.
- Text cleansing typically involves removing the following:
  - Html tags – From data collected from web pages.
  - Punctuation – Text analysis often does not require this.
  - (Most) numbers – If value is not important to analysis.
  - White spaces – Tabs, indents, etc. are not needed.

Preparing, Wrangling, and Exploring Text Data

Normalizing text:

- **Lowercasing:** So that Dog = dog
- **Removal of stop words:** Such as *the* and *is*
- **Stemming:** Integrate = integration = integrating → integrat
- **Lemmatization:** Return the base of a word, e.g., saw → see
- **Creating bag-of-words (BOW) and n-grams**
- **Organizing the BOW and n-grams into a DTM**

Quantitative Methods (2)

Big Data Projects

Data Exploration

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Data Exploration

Data exploration encompasses:

1. **Exploratory Data Analysis (EDA)** – Understanding properties, finding patterns, evaluating hypotheses.
2. **Feature selection** – Selecting the data attributes needed. More features = higher complexity.
3. **Feature engineering** – Creating new features by transforming or combining multiple features.

Data Exploration

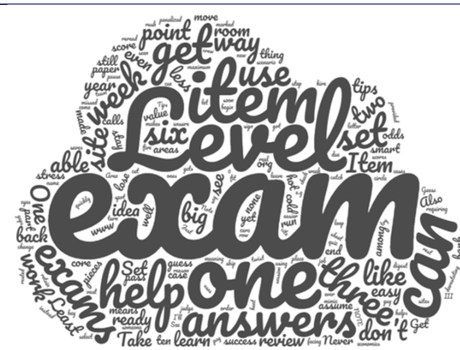
Visualization tools help share knowledge and derive optimal solutions.

Frequently employed to explore structured data are:

- Scatterplots – Dots in a two-dimensional visualization.
- Box plots – Highlight the median, quartiles, and outliers.
- Histograms – Capture observations in equal width bins.

Sample Word Cloud

- **Word clouds** are a useful way to give a high-level overview of the text content.
- This is a word cloud based on CFA exam prep.



Extracting Features from Textual Data

- In feature selection, we try to include *only* the features that contribute to the model's out-of-sample predictive power.
- A **parsimonious model** (i.e., a model with fewer features) reduces noise and improves prediction accuracy.
- **Feature selection** methods applied to text data include:
  - Term frequency.
  - Document frequency.
  - Chi-square test.
  - Mutual information (MI) measure.

Engineering Features from Textual Data

- **Feature Engineering (FE)** involves optimizing and improving the selected features.
  - FE seeks to make model training faster and easier.
  - Can involve decomposing a feature into multiple features or changing a current feature to a new feature.
- **One-hot encoding (OHE)** is used to convert a categorical feature into a binary variable for machine processing.

Quantitative Methods (2)

Big Data Projects

Model Training and Evaluation

Model Training

- The model training steps are generally similar for structured vs. unstructured data projects.
- Both feature:
  1. Method selection.
  2. Performance evaluation.
  3. Model tuning.

Steps in Model Training

1. **Method selection**

Governed by the following considerations:

- **Supervised learning vs. unsupervised learning**
  - labeled data (→ supervised learning)
  - unlabeled data (→ unsupervised learning)
- **Type of data** (continuous, numerical, or categorical; image data; text data; speech data; etc.)
- **Size of the dataset**

Steps in Model Training

2. **Model Performance Evaluation**

- Used to determine the effectiveness of models.
- Various tools are used to quantify model performance.
- Involves error analysis:
  - Building confusion matrixes.
  - Determining receiver operating characteristics.
  - Computing root mean square error.

Steps in Model Training

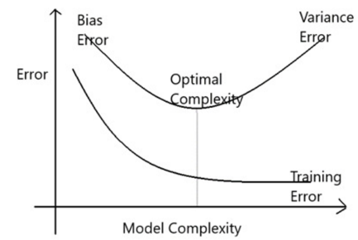
3. **Model tuning**

- After model evaluation, the model is revised until it reaches an acceptable performance level.
- Involves managing the trade-off between:
  - Model bias error → related to underfitting.
  - Model variance error → related to overfitting.

Steps in Model Training

3. **Model tuning** (continued)

- **Fitting curve** to manage bias vs. variance error trade-off.
  - Y-axis: In-sample (training sample) error and out-of-sample (cross-validation sample) error.
  - X-axis: Model complexity.



Evaluating the Fit of an ML Algorithm

- To produce an error analysis for each model, a **confusion matrix** is produced.
- The following are tallied:
  - True positives (TPs)
  - True negatives (TNs)
  - False positives (FPs)
  - False negatives (FNs)

	Actual: Positive	**Actual: Negative**
Prediction: Positive	True positive (TP)	False positive (FP, type I)
Prediction: Negative	False negative (FN, type II)	True negative (TN)

Evaluating the Fit of an ML Algorithm (cont.)

$$\text{Accuracy} = \frac{\text{(true positives + true negatives)}}{\text{(all positives and negatives)}}$$

$$\text{Precision (P)} = \frac{\text{true positives}}{\text{(false positives + true positives)}}$$

$$\text{Recall (R)} = \frac{\text{true positives}}{\text{(true positives + false negatives)}}$$

$$\text{F1 score} = \frac{(2 \times P \times R)}{(P + R)}$$

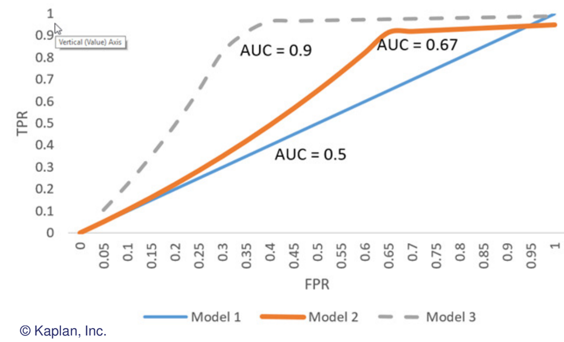
Evaluating the Fit of an ML Algorithm (cont.)

Receiver Operating Characteristic (ROC): Plots a curve showing the tradeoff between FPs and TPs.

- The true positive rate (TPR) is the same as recall and is plotted along the Y-axis.
- The false positive rate (FPR) is the ratio of FPs to all actual negatives and is plotted along the X-axis.

TPR = TP / (TP + FN)   FPR = FP / (FP + TN)

Evaluating the Fit of an ML Algorithm (cont.)



The area under the curve (AUC) is a value from 0 to 1. The closer the value of AUC to 1, the higher the predictive accuracy of the model.

Evaluating the Fit of an ML Algorithm (cont.)

Root mean square error (RMSE)

- RMSE is a single metric summarizing the prediction error.
- Useful for continuous data, e.g., regression models.

$$\text{RMSE} = \sqrt{\frac{\sum_{i=1}^{n}(\text{predicted}_i - \text{actual}_i)^2}{n}}$$

Quantitative Methods

Probabilistic Approaches Scenario Analysis, Decision Trees, and Simulations

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Steps in Simulation

- Determine key input variables for simulation
- Define probability distributions of key variables
- Check for correlations across variables
- Run the simulation

Defining Probability Distributions

This is the most difficult step. Three options exist:

- Historical
  - For variables with long history and reliable data
- Cross-sectional
  - For variables with available comparables
- Statistical distribution and parameters
  - E.g., Normally distributed growth with estimated mean and variance

Dealing With Correlations Across Variables

- When two input variables are highly correlated, such as interest rates and inflation, then:
  - Either choose only one variable to vary (e.g., one with the largest impact on valuation)
  - Or, build correlations explicitly into simulation (resulting in greater detail but requiring more sophisticated simulation software)

Advantages of Using Simulations

- Better input estimation
  - Forces analyst to think about variability in estimates instead of picking “single best”
- A distribution rather than a point estimate
  - Simulations highlight uncertainty in valuing risky assets and explain divergence in analyst estimates

Simulation With Constraints

Simulation may include constraints which, if violated, may lead to large costs or bankruptcy.

- Book value of equity
  - Maintaining minimum regulatory capital and ensuring equity is +ve
- Earnings and cash flow
  - Externally and internally imposed restrictions on profitability
- Market value
  - Comparing value of business to value of debt in all scenarios

Issues in Simulation

- GIGO
- Real data may not fit distributions
- Non-stationarity
- Dynamic correlations

Scenario Analysis

- Defines best, worst, and base case; hence, ignores all other possibilities
- Therefore, sum of probabilities in scenario analysis < 1
- Better suited for discrete outcomes
- Better suited for risks that occur concurrently
- Can deal with correlations subjectively by building them into each scenario

Decision Trees

- Better suited for sequential and discrete risks because events are considered in phases
- Correlated risks are difficult to model with decision trees
- Best suited when historical data is available because probabilities have to be estimated at each node

Simulations

- Considers all possible outcomes
- Better suited for continuous risks, which can be either sequential or concurrent
- Allow for explicitly modelling correlations of input variables

Keys to the Exam

- Advantages of simulation
- Issues in simulation
- Simulations with constraints
- Appropriateness of simulations vs. decision trees/scenario analysis

Economics

Currency Exchange Rates:
Understanding Equilibrium Value
(Forex Quotes, Spreads,
and Triangular Arbitrage)

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Foreign Exchange Quotations

<u>Quote on Swiss francs (CHF):</u>

- USD/CHF 0.9521 – 0.9536 (= 0.9521 / 36 = 0.9521-36)
- CHF is the base currency, and USD is the priced currency (quoted)
- Bid price is \$0.9521/CHF; ask price is \$0.9536/CHF
- Spread (in dollars): 0.9536 – 0.9521 = USD 0.0015 (or 15 'pips' = 0.0015 × 10,000)

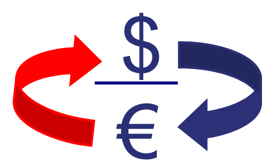
Factors Affecting Spread

- The spread in the interbank market:
  - Currency pair involved
  - Time of day window
  - Market volatility
- The size of the transaction
- Dealer/client relationship
- Forward spreads are positively related to maturity

How to Use Bid/Ask Prices: A Trick

- But how do you know whether the bid or the ask is the appropriate rate?
- **Up-the-bid, multiply,** and **down-the-ask, divide**

BID **means turning € into \$**



ASK **means turning \$ into €**

Example: Using Bid/Ask Prices

Dealer quote: AUD/GBP 1.5060 – 1.5067

- **Calculate** the Proceeds of converting 1 million GBP

Since we are going "**up**" the quote, use **bid price** and **multiply**:
1 million GBP × 1.5060 = 1,506,000 AUD

- **Calculate** the Proceeds of converting 1 million AUD

Using ask price, 1 million AUD / 1.5067 = 663,702.13 GBP

Cross Rates

Definition: The exchange rate between two currencies implied by their exchange rates with a common third currency.

- **Example:** Suppose you have the following quotes:
  - USD/GBP
  - CHF/USD
- The common currency is the **USD**
  - The cross rate defines the value of the GBP vs. the CHF

Example: Cross Rates

- **Given** the following FX rates:
  USD/GBP 1.5600 and **CHF/USD 1.4860**
- **Calculate** the GBP/CHF cross exchange rate

$$\frac{\cancel{USD}}{GBP} \times \frac{CHF}{\cancel{USD}} = \frac{CHF}{GBP}$$

$$1.5600\frac{USD}{GBP} \times 1.4860\frac{CHF}{USD} = 2.3182\ \frac{CHF}{GBP}$$

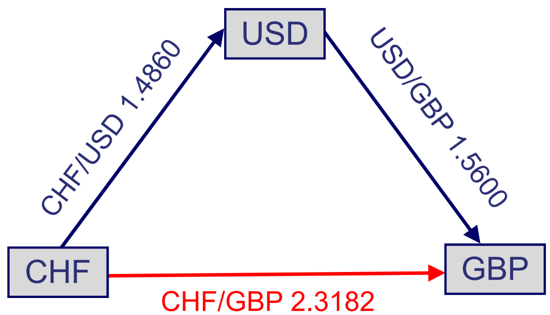
Just algebra: Set up the quotes so the common currency cancels

If you want GBP/CHF, take the reciprocal of 2.3182:
1 / (2.3182) ≈ GBP/CHF 0.4314

The Triangle: A Visual Representation

- To convert CHF into GBP, there are two paths:
  - **Path #1**: Exchange CHF for GBP at CHF/GBP 2.3182
  - **Path #2**: Exchange CHF for USD at CHF/USD 1.4860 and then convert the USD into GBP at USD/GBP 1.5600
- **No arbitrage requirement**: The two paths to get from CHF to GBP must yield the same results
  - Visualize the *currency triangle*

The Triangle



Example: Cross Rates With Bid-Ask Quotes

USD/AUD 0.6000 – 0.6015 USD / MXN 0.0933 – 0.0935

- **Compute** implied MXN/AUD cross rates
- Remember: **The equation needs to be set up to cancel the common currency.**

$$\left(\frac{MXN}{USD}\right)_{bid} = \frac{1}{\left(\frac{USD}{MXN}\right)_{offer}} = \frac{1}{0.0935} = 10.70 \qquad \left(\frac{MXN}{USD}\right)_{offer} = 10.72$$

Calculating Cross Bid and Ask Rates

USD/AUD 0.6000 – 0.6015 MXN / USD 10.70 – 10.72

$$\boxed{\frac{USD}{AUD} \times \frac{MXN}{USD} = \frac{MXN}{AUD}}$$

$$0.6000\frac{USD}{AUD} \times 10.70\frac{MXN}{USD} = 6.4200\frac{MXN}{AUD}(\text{bid})$$

$$0.6015\frac{USD}{AUD} \times 10.72\frac{MXN}{USD} = 6.4481\frac{MXN}{AUD}(\text{ask})$$

Dealing With Arbitrage Questions

- Exam questions dealing with arbitrage revolve around three issues:
  1. Verify the arbitrage (does an opportunity exist, meaning quoted rate ≠ calculated rate?)
  2. **Structure the trades** to exploit the opportunity (sell overvalued at quoted rate, buy undervalued). The direction is the key!
  3. Calculate the profit <u>given</u> an initial investment (may start with the *third* currency such as USD)

Problem: Triangular Arbitrage

- Continuing our example, if Dealer quotes:

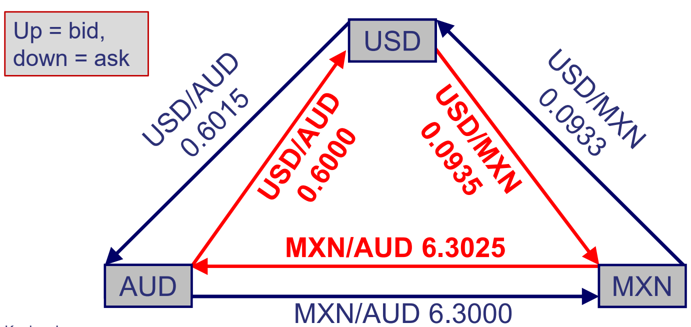
  MXN / AUD $\Rightarrow$ 6.3000 / 6.3025

- Structure a profitable arbitrage trade

Solution: Triangular Arbitrage

- Recall that the cross bid/ask quote:
  - MXN/AUD **= 6.4200 / 6.4481**
- Go around the triangle one way to see if there is any arbitrage profits. If not, try the other way!

Solution: Triangular Arbitrage



Solution: Triangular Arbitrage

- Convert 1M USD to MXN at USD/MXN 0.0935 **Down—divide**
  - \$1,000,000 / 0.0935 = MXN 10,695,187
- Convert MXN to AUD at MXN/AUD 6.3025 **Down—divide**
  - MXN 10,695,187 / 6.3025 = AUD 1,696,975
- Convert AUD to USD at USD/AUD 0.6000 **Up—multiply**
  - AUD 1,696,975 × 0.6000 = USD 1,018,185
  - Profit = USD 18,185 or 1.82%

Spot Market vs. Forward Market

- **Spot rates**: Exchange rates for immediate delivery
- **Forward rates**: Exchange rates for currency exchange on a specified future date
  - Typically for 30, 60, or 90 days
  - Both parties are obligated to complete the transaction at the future date
- **(Bid-ask) spread** is calculated just as for spot rates
  - Typically, forward spreads > spot spreads

Forward Discount or Premium

$$\begin{pmatrix}\text{forward premium}\\ \text{or discount}\end{pmatrix} = \text{forward rate} - \text{spot rate}$$

- Often expressed as points (decimal × 10,000 typically)
- Forward discount: Forward value < spot value
  - Negative points
- Forward premium: Forward value > spot value
  - Positive points

Forward Discount or Premium

Example: Find the forward CAD discount or premium for the following AUD/CAD

spot = 1.0511/1.01519; 30-day forward = +3.9/+4.1

CAD Premium = 3.9/10,000 – 4.1/10,000 = 0.00039 – 0.00041

Forward = 1.0511 + 0.0039 / 1.01519 + 0.00041
= 1.05149 – 1.05231

Economics

Currency Exchange Rates:
Understanding Equilibrium Value
(Mark to Market Value, and Parity Conditions)

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Mark-to-Market Value of Forward

- After inception, a forward contract is valued assuming an offsetting position is taken by the trader

$$V_t = \frac{(FP_t - FP)(\text{contract size})}{\left[1 + R\left(\frac{\text{days}}{360}\right)\right]}$$

V_t = value in price currency of the forward contract (t < T)

In units of long currency

Days = number of days to maturity (T – t)

FP_t = forward price (bid) at time *t* for a new contract maturing at time T (long currency = base)

R = the interest rate of the price currency

Problem: Mark-to-Market Valuation

- Yip is long 1M CAD 90-day forward against AUD at 1.05358 AUD/CAD. Thirty days later, FX quotes and interest rates are as follows:

Spot	1.0612/1.0614
30-day	+4.9/+5.2
60-day	+8.6/+9.0
90-day	+14.6/+16.8
180-day	+42.3/+48.3

Int. Rates:	AUD
30-day	1.12%
60-day	1.16%
90-day	1.20%

- **Compute:** Mark-to-market value of the contract in AUD

Solution: Mark-to-Market Valuation

- Offsetting contract would be to convert CAD for AUD using a 60-day forward price. Use bid of 1.0612 + 8.6 / 10,000 = 1.06206

$$V_t = \frac{(1.06206 - 1.05358)(1{,}000{,}000)}{\left[1 + (0.0116)\left(\frac{60}{360}\right)\right]} = +\$8{,}463.64$$

Covered Interest Rate Parity (CIRP)

- **CIRP:** Forward premium/discount will just offset differences in interest rates.
- **Big point #1:** The currency with the higher nominal interest rate will trade at a forward discount.
- **Big point #2:** When CIRP holds, an investor will make the same return holding either currency.
- **If:** The USD rate is 8% and the euro rate is 6%
  - **Then:** USD will trade at a forward discount of 2% relative to the euro (if CIRP holds)

Covered Interest Rate Parity (CIRP)

- The formal CIRP relationship:

$$\text{Spot} \times \frac{\left[1+r_{\text{price currency}}\left(\frac{n}{360}\right)\right]}{\left[1+r_{\text{base currency}}\left(\frac{n}{360}\right)\right]} = \text{Forward (zero arbitrage)}$$

Problem: Covered Interest Arbitrage

- **Suppose:**
  - 1-year interest rate in USD = 8.0%
  - 1-year interest rate in euro = 6.0%
  - Current spot rate is USD/EUR = $1.30
  - Quoted USD/EUR 1-year forward = $1.35
- **Required:**
  - Calculate the correct 1-year forward rate
  - Describe the correct arbitrage trade
  - Calculate arbitrage profits

Solution: Covered Interest Arbitrage

- 1-year interest rate in USD = 8.0%
- 1-year interest rate in EUR = 6.0%
- Current spot rate is USD/EUR = 1.30

vs. quote of $1.35

Arbitrage free forward rate $= 1.30 \times \frac{[1+0.08]}{[1+0.06]} = \$1.3245$

Solution: Covered Interest Arbitrage

- Quoted USD/EUR of: **1.3500 > 1.3245**

  ➔EUR is overpriced in the forward market

Why? It should take only 1.3245 USD to buy a EUR. But, the quoted forward rate is 1.35 USD per EUR.

As always: Buy low, sell high!

Solution: Covered Interest Arbitrage

- **Today:**
  - **Step 1**: Sell EUR forward vs. USD, and buy EUR at spot vs. USD
  - **Step 2**: Borrow USD and invest EUR for 1 year
- **In one year:**
  - Use the investment proceeds (EUR) to deliver against the forward contract and proceeds from the forward transaction (USD) to repay the loan

Solution: Covered Interest Arbitrage

Cash flows t = 0:

1. Borrow $1,000 at 8% (repay $1,080 in one year)
2. Convert $1,000 at spot $1.30/€ = €769.23
3. Invest €769.23 at 6% (receive €815.38 in one year)
4. Sell €815.38 forward @ $1.35/€ (proceeds of $1,100.76)

Net cash flow = 0 (only borrowed funds used!)

Solution: Covered Interest Arbitrage

Cash flows t = 1 year later:

1. Receive investment proceeds of €815.38
2. Settle forward by delivering €815.38 and receiving $1,100.76
3. Repay loan of $1,080
4. Arbitrage profit = $1,100.76 – $1,080 = $20.76

Relative PPP

- **Relative PPP**: Changes in exchange rates will just offset changes in price levels (i.e., differences in inflation)
- Ex-ante: $E(\%\Delta S)_{(A/B)} = E_{(\pi A)} - E_{(\pi B)}$
- Countries with higher (relative) inflation expect to see their currencies depreciate (by the inflation differential).

International Fisher Relation (IFR)

- Domestic Fisher Relation:
  $R = r + E(\pi)$
  R = nominal interest rate, r = real interest rate, π = inflation
- International Fisher Relation:
  Assuming real rates are constant (**real rate parity**):
  $R_A - R_B = E(\pi_A) - E(\pi_B)$
  (i.e., interest rate differential = inflation differential)

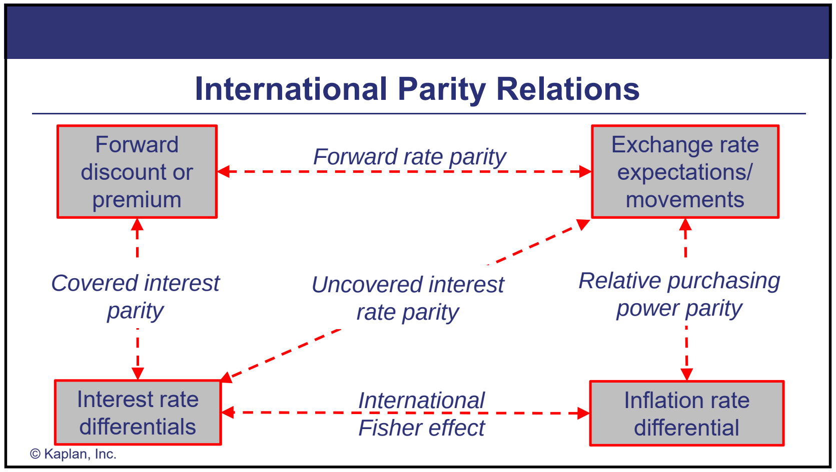
Uncovered Interest Rate Parity

- Relative form PPP + international Fisher relation = **uncovered interest rate parity**
- Links spot exchange rates, expected spot exchange rates, and nominal interest rates

$$E(\%\Delta S)_{(A/B)} = R_A - R_B$$

Similarity

- Covered and uncovered IRP are related
- Why? Because $F = E(S_1)$ **if** **forward rate parity** holds
  - **Uncovered IRP**: Forecast future spot = $E(S_1)$
    - Remember, this is a non-traded price
  - **Covered IRP**: Calculate the forward rate = F
    - All the elements are tradable (S, F, $r_{\$}$, $r_{£}$)
    - Covered IRP is bound by arbitrage


International Parity Relations
Forward discount or premium
Forward rate parity
Exchange rate expectations/ movements
Covered interest parity
Uncovered interest rate parity
Relative purchasing power parity
Interest rate differentials
International Fisher effect
Inflation rate differential
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Economics

Currency Exchange Rates:
Understanding Equilibrium Value
(Exchange Rate Determinants, Carry Trade, and Central Bank Influence)

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Carry Trade

- **If** uncovered interest rate parity does not work in the short term, one can profit by investing in higher yielding currency and borrowing in lower yielding currency.
- Assume that USD interest rate = 1% while GBP interest rate = 3% and spot USD/GBP = 1.50 and is expected to remain the same at the end of the year
- Return = interest earned on investment – funding cost – currency depreciation = 3% – 1% – 0% = 2.0%.

Risks of Carry Trade

- Carry trade is a leveraged bet.
- **Crash risk** due to non-normal distribution of carry trade returns
  - In times of high volatility, the country with the higher interest rate typically sees its currency depreciate by a greater amount than uncovered IRP suggests
  - Negative skewness and excess kurtosis of return distribution

Balance of Payments Accounts

- **Current account influences:**
  1. Flow mechanism
  2. Portfolio composition mechanism
  3. Debt sustainability mechanism

  Deficits eventually cause currency to depreciate

  Flow mechanism:
  - Size of initial deficit
  - Influence of XΔ rates on domestic imports and export prices
  - Price elasticity of demand

Balance of Payments Accounts

- **Capital (financial) account:**
  - Capital account flows are determined by relative real rates of return. Higher real rate countries attract capital flows and, hence, appreciation of domestic currency.
  - Excessive (speculative) capital flows can lead to excessive real appreciation and can be problematic for some emerging market economies.

Mundell-Fleming Model

- Impacts of inflation not modeled (focuses on interest rate)

Monetary policy / Fiscal policy	Capital Mobility High	Capital Mobility Low
Expansionary / Expansionary	Uncertain	Depreciation
Expansionary / Restrictive	Depreciation	Uncertain
Restrictive / Expansionary	Appreciation	Uncertain
Restrictive / Restrictive	Uncertain	Appreciation

Fixed Exchange Rate Regimes

- Mundell-Fleming model predicts exchange rate movements under flexible exchange rate systems.
- Under fixed exchange rate systems, the depreciation of local currency under an expansionary monetary policy (high capital mobility) would necessitate the government buying back of its own currency (offsetting the expansionary stance).
- Can't have **independent monetary policy** under fixed rate system.

Monetary Approach Focuses on Inflation Impacts

- **Pure monetary approach**: PPP holds at any point in time. Expansionary (restrictive) monetary policies lead to higher (lower) inflation and depreciation (appreciation) of currency.
- **Dornbusch overshooting model**: Prices may not reflect policy changes in sync (sticky output prices). This leads to overreaction to policy changes. Expansionary (restrictive) monetary policies lead to higher (lower) inflation (but with a lag) and excessive depreciation (appreciation) of currency.

Portfolio Balance Approach

- Mundell-Fleming model looks at short-term implications of fiscal policy.
- Portfolio balance approach looks at long-term implications of fiscal policy. In the long term, governments may find it increasingly difficult to fund sustained deficits, leading to depreciation of the currency.

Objectives of Central Bank Intervention

- Ensure that the domestic currency does not appreciate excessively
- Allow the pursuit of independent monetary policies
- Reduce excessive inflow of capital

Effectiveness of Central Bank Intervention

- Central bank can intervene in FX markets or policy makers can employ capital controls.
- Effectiveness of intervention in FX markets depends on the size of central bank reserves relative to trading volume of their currency. Usually not effective for developed countries.

Warning Signs of Currency Crisis

- Terms of trade deteriorate
- Dramatic decline in official foreign exchange reserves
- Currency value rises above historical mean
- Inflation increases
- Liberalized capital markets (free flows of capital)
- Money supply relative to bank reserves increases
- Banking crisis (can be coincident)

Economics

Economic Growth and the Investment Decision

Growth Factors and Production Function

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Conditions Suitable For Growth

1. Savings and investment
2. Financial markets and intermediaries
3. Political stability, rule of law, property rights
4. Investment in human capital
5. Tax and regulatory systems
6. Free trade and unrestricted capital flows

Stock Market Appreciation

$P = (GDP) \times (E/GDP) \times (P/E)$

$\boxed{\%\Delta P = \Delta GDP + \%\Delta(E/GDP) + \%\Delta(P/E)}$

In the long run:

$\%\Delta(E/GDP) = \%\Delta(P/E) = 0$

Growth in equity prices = GDP growth rate

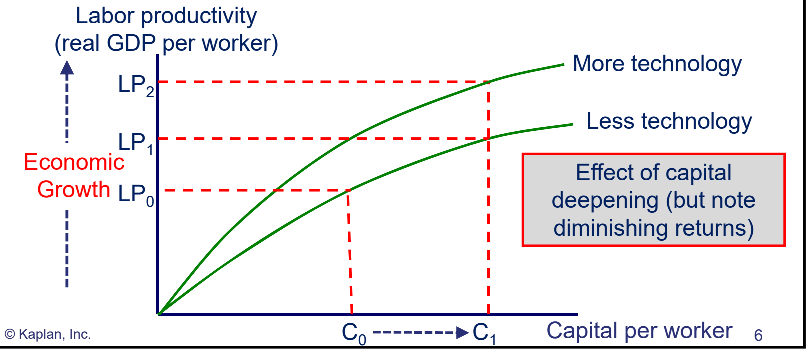
Potential GDP

- Higher the potential GDP growth rate, higher the real rates (interest and asset returns).
- Implications for fixed-income investors:
  - When actual GDP growth > potential GDP growth rate, inflationary pressure is higher and more likely that monetary/fiscal policy is restrictive.
  - Higher potential GDP growth rate reduces expected credit risk of all debt issues.

Capital Deepening and Technological Progress

- Cobb-Douglas production function: $\boxed{Y = TK^{\alpha}L^{(1-\alpha)}}$
- α and (1 – α) are the shares of output allocated to capital (K) and labor (L); α < 1
- T = total factor productivity
- Cobb-Douglas function: diminishing marginal productivity of labor and capital, but constant returns to scale.
- In steady state, marginal product of capital (MPK) = rental price of capital (r): $\boxed{\alpha Y/K = r}$

Productivity Curve and Economic Growth



Productivity Curve

- **Productivity curve**: Graph of labor productivity vs. capital per worker for given level of technology
  - Two sources of economic growth (growth in labor productivity):
    1. Growth in capital per worker – capital deepening (movement along the productivity curve)
    2. Technological change (growth in total factor productivity)

Economics

Economic Growth and the Investment Decision

Growth Accounting and Influencing Factors

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Growth Accounting Relations

Cobb Douglas: $\boxed{Y = TK^{\alpha}L^{(1-\alpha)}}$

The growth accounting equation:

long-term growth rate of capital

$$\text{Growth rate in potential GDP} = \frac{\Delta Y}{Y} = \frac{\Delta T}{T} + \alpha\frac{\Delta K}{K} + (1-\alpha)\frac{\Delta L}{L}$$

Growth rate of total factor productivity (technology)

elasticities

long-term growth rate of labor

Growth Accounting Relations

The labor productivity growth accounting equation:

Growth rate in potential GDP = long-term growth rate of labor force + long-term growth rate in labor productivity

Includes capital deepening and changes in total factor productivity

Example: Growth Accounting

Following information is available for Azikland:

Variable	Long-term Forecast
Labor force growth rate	1.5%
Cost of labor/total factor cost	60%
Growth rate of capital	3%
Growth of total factor productivity	2%

Calculate the growth rate in potential GDP

Solution: Growth Accounting

Growth rate of potential GDP:

$$= \frac{\Delta T}{T} + \alpha \frac{\Delta K}{K} + (1-\alpha)\frac{\Delta L}{L}$$

$$= 2\% + (0.4 \times 3\%) + (0.6 \times 1.5\%)$$

$$= 4.1\%$$

Impact of Natural Resources

- Ownership of natural resources is not important as long as there is access (via trade).
- Ownership of natural resources may actually hinder growth:
  1. Dutch disease: Ownership of natural resources pushes up the value of domestic currency to the detriment of other industries.
  2. Other industries may be neglected.

Labor Supply

- Labor supply factors
  1. Demographics: Aging of population
  2. Participation: Labor force/working age population
  3. Immigration: Can be used to overcome declining labor force
  4. Average hours worked: Cultural factors, labor regulations, and taxation

Capital and Technology

- Human capital: Qualitative measure of knowledge and skills
- Physical capital: ICT and non-ICT
- Technological development
  - Includes investment in physical and human capital
- Public infrastructure

Economics

Economic Growth and the Investment Decision

Growth and Convergence Theories

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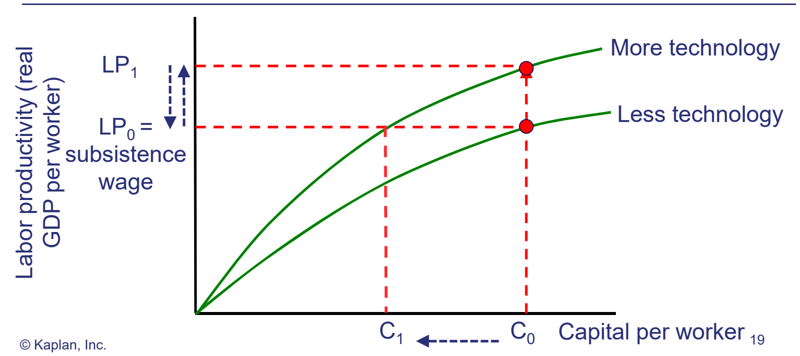
Growth Theories

- **Three** growth theories:
  1. Classical Growth Theory
  2. Neoclassical Growth Theory
  3. Endogenous growth theory
- Be able to distinguish major tenets
- **Focus on the big picture**!

Classical Growth Theory

- **Main point:** No permanent improvement in standard of living from new technologies
- Technological advances lead to:
  1. Short-term economic growth
  2. Temporary improvement of standard of living
- ***Reversing mechanism* is population growth**
  - Economic growth leads to population growth

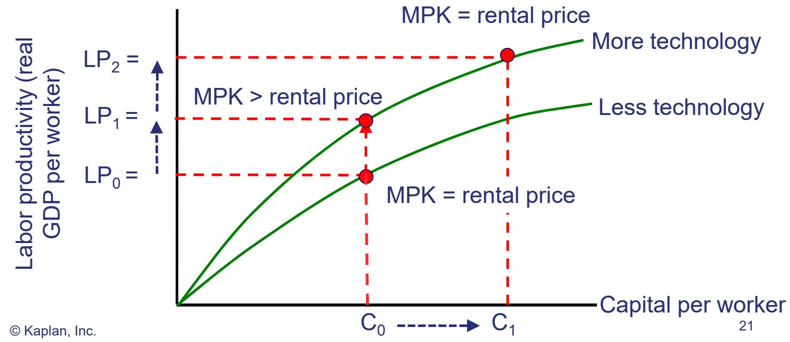
Classical Growth Theory



Neoclassical Growth Theory

- **Main point:** Economic growth results for *lucky* discoveries of new technologies
- **Major difference with classical theory**:
  - Economic growth is independent of population growth
- Technological advances lead to:
  1. Short-term economic growth
  2. Permanently higher living standard

Neoclassical Growth Theory



Neoclassical Growth Theory

1. Sustainable growth rate of output per capita (g*)

$$g^* = \frac{\theta}{(1-\alpha)}$$

2. Sustainable growth rate of output (G*)

$$G^* = \frac{\theta}{(1-\alpha)} + \Delta L$$

In steady state, growth rate in productivity depends only on technology and $(1 - \alpha)$

Neoclassical Growth Theory

Major tenets:

1. Capital deepening occurs affecting output but not the growth rate
2. Economy will move towards its steady state equilibrium regardless of initial capital to labor ratio or level of technology
3. Steady state savings and investment are just sufficient to cover new workers and capital depreciation (capital per worker constant)

Neoclassical Growth Theory

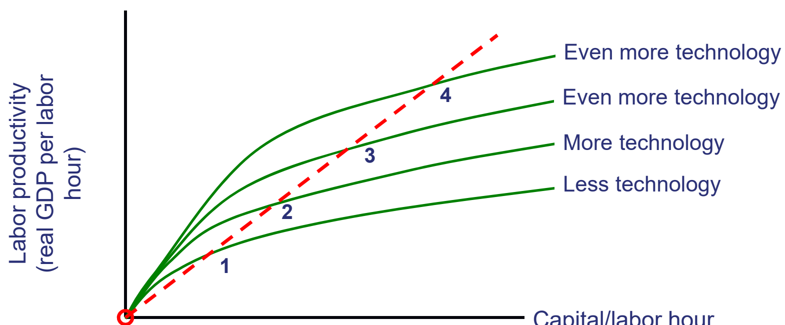
Major tenets continued:

4. Developing countries (with low capital to labor) would have lower diminishing marginal productivity of capital

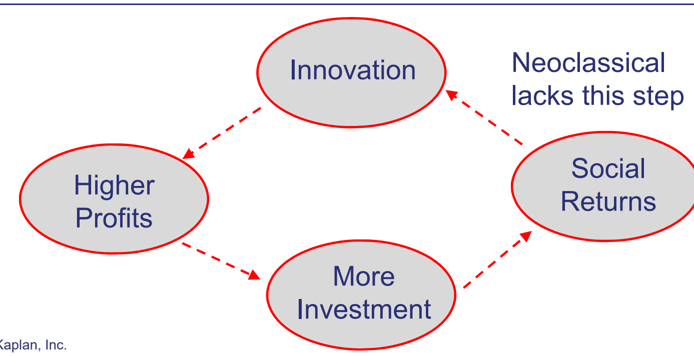
Endogenous Growth Theory

- **Main point**: Economy is *perpetual motion machine*
  - Why? No stopping mechanism!
    - Technological progress is *endogenous*

Endogenous Growth Theory



Endogenous vs. Neoclassical



Convergence Hypothesis

1. **Absolute Convergence:** Standard of living will converge globally as productivity differences between developed and developing countries diminish over time.
2. **Conditional Convergence**: Convergence only for countries with similar savings rates, population growth rates and production functions.
3. **Club Convergence**: Countries belonging to a club will converge. Clubs are countries with similar institutional features.

Incentives to Private Investing

- **Social returns:** External benefits to the economy of investing in R&D projects
- Private benefits may be insufficient to cover the required rate of return on some R&D projects.
- When private benefits and social returns together exceed the required rate of return, government subsidies may provide incentives for investment in R&D.

Removal of Trade Barriers

- Removal of trade barriers benefits growth via:
  1. Access to foreign savings
  2. Comparative advantage in production
  3. Economies of scale
- Neoclassical growth theory focuses on convergence.
- Endogenous growth theory focuses on social benefits.

Economics

Economics of Regulation

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Need for Regulatory Intervention

Regulations are needed in the presence of:

1. Informational frictions: When information is not equally available (asymmetry)
2. Externalities: Consumption of public goods (cost is not borne in proportion to consumption)
3. Weak competition: Antitrust issues
4. Social objectives

Regulating Commerce

- Company law, bankruptcy law, competition laws, contract law, etc.
- Regulations essential for business decision making (e.g., investing in R&D when intellectual property protection is not available)
- Regulatory framework may help or hinder commerce

Regulating Financial Markets

- **Security markets**:
  1. Disclosure requirements promote investor confidence
  2. Mitigating agency problem inherent in financial intermediaries acting as agents
  3. Protection for small investors and hence lax regulatory environment for hedge funds—who only market to qualified individuals

Regulating Financial Markets

- **Financial institutions**:
  - Prudential supervision to reduce system-wide risks and to protect investors
  - Coherent policy globally to prevent regulatory arbitrage and contagion

Antitrust Regulation

- **Antitrust**
  - Excessive concentration of market share
  - Anticompetitive behavior (e.g., discriminatory pricing, bundling, exclusive dealing)
- Analysts often evaluate announced merger based on probable regulator response

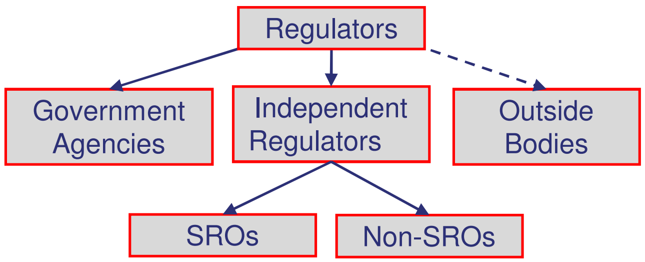
Types of Regulation

- **Regulation types:**
  1. Statutes
     - Laws made by legislative bodies
  2. Administrative regulations
     - Rules issued by government agencies
  3. Judicial law
     - Findings of the court

Types of Regulators

1. Government agencies
2. Independent regulators
   - Given powers by the government but politically independent
3. Self-regulating organizations (SRBs)
   - SRBs that are recognized by the government
4. Outside bodies (work referenced)

Types of Regulators



Self Regulation in Financial Markets

- Conflict of interest between members of SRO and the regulatory role of SRO
- Independent SROs more common in common-law countries
- Independent SROs more effective when properly supervised

Regulatory Interdependencies

- Regulatory capture theory
  - Regulators end up being influenced by regulated industry/entity
- Regulatory competition
  - Regulators in different jurisdictions compete for business
- Regulatory arbitrage
  - Business shop for friendly regimes or find loopholes

Regulatory Tools

1. Price mechanisms: Tax/subsidy
2. Restricting/requiring certain activities
3. Provision of public goods or financing private projects

Effectiveness of regulatory tools depends on enforcement abilities of the regulator.

Benefits/Costs of Regulation

- **Benefits**:
  - Easy to view but difficult to quantify
- **Costs:**
  - Regulatory burden: direct and indirect cost of regulation
  - Net regulatory burden: regulatory burden minus the private benefits of regulation
  - Costs easier to assess ex-post

Evaluation of a Specific Regulation

- Regulation can significantly impact valuation
- Taxes shrink an industry while subsidies help it to grow
- Review to include proposed regulations
- Is regulator captive?
- Different types of regulations affect different industries

Financial Reporting and Analysis (1)

Intercorporate Investments
(Classifications)

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Corporate Investment Categories

- Classification of intercorporate investments is based on degree of influence or control
- Percentage ownership (bright-line criteria) is used only as a guide to degree of control

< 20% ownership	20% to 50% ownership	> 50% ownership
Financial Assets	Investments in Associates	Business Combinations
Passive	*Influence*	*Control*

Shared control by two or more entities = Joint Venture

Financial Reporting and Analysis (1)

Intercorporate Investments

Financial Assets

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IFRS 9

1. **Amortized cost (debt securities only)**

   Conditions:

   1. Business model test (how the asset is managed)
   2. Cash flow characteristic test (are the payments solely interest and principal)

   Business model: must be to collect contractual cash flows

   Accounting treatment same as held-to-maturity

IFRS 9 (cont.)

1. **Amortized cost** (cont.)
   - Carried on the balance sheet at amortized cost
   - Changes in market value NOT recognized unless impaired

IFRS 9 (cont.)

2. **Fair Value through P&L**: Debt and equity securities
   - Interest, dividend income, realized and unrealized gains/losses reported on income statement
   - Interest = coupon + amort. discount – amort. premium
   - Carried on the balance sheet at fair value

IFRS 9 (cont.)

3. **Fair Value through OCI**: Debt and equity securities
   - Interest and dividend income reported on income statement
   - Interest = coupon + amort. discount – amort. premium
   - Carried on the balance sheet at fair value
   - Unrealized gains/losses reported directly in equity
   - When sold, realized gain/loss is recognized on income statement

IFRS 9 (cont.)

Reclassification:

- For equity securities, the initial choice of FVPL/FVOCI is irrevocable.
- Reclassification of debt securities from amortized cost to FVPL (or vice-versa) is permitted only if the business model has changed.

IFRS 9 (cont.)

Reclassification:

- Unrecognized gains/losses on debt securities carried at amortized cost and reclassified as FVPL are recognized in the income statement.
- Debt securities reclassified out of FVPL to amortized cost are transferred at fair value on the transfer date, and that fair value will become the carrying amount.

Classification of Securities

	Security Classification		
	Fair Value through P&L	Fair Value through OCI	Amortized Cost
Balance Sheet Asset	Fair Value	Fair Value	Amortized Cost
Income Statement	Dividends Interest Realized G/L Unrealized G/L	Dividends Interest Realized G/L	Interest Realized G/L

Divs/interest and realized G/L always recognized in Income Statement

Unrealized G/L only in Income with FVPL

Debt Instruments

	Income Statement	Balance Sheet
Amortized Cost	Coupon and Amortization of Discount/premium	Amortized Cost
Fair Value through OCI	Interest Income (as above)	Fair Value Unrealized G/L to Equity (OCI)
Fair Value through P&L	Interest Income and Unrealized G/L	Fair Value

Unrealized Gains/(Losses)

Debt Securities:

Fair value – amortized cost = cumulative unrealized gain

Equity Securities:

Fair value – purchase price = cumulative unrealized gain

Unrealized gain/(loss) for period = Δ cumulative unrealized gain

Financial Investment Example

At the beginning of the year, Midland Corporation purchased a 9% annual coupon bond with a face value of $100,000 for $96,209, yielding 10%. The fair value of the bond at year end is $98,500. The bond is sold on the first day of Year 2 for $101,000.

Determine the balance sheet and income statement effects if the bond is classified as amortized cost, fair value through P&L, or fair value through OCI.

Amortized Cost Security

End of Year 1

Balance sheet $96,830 ← [$96,209 + $621*]

Income statement

Interest income $9,621 ← [$96,209 × 10%] or [$9,000 + $621]

Sell for $101,000 at beginning of Year 2

Income statement

Realized gain $4,170 ← [$101,000 – $96,830]

*Amortized discount = $9,621 – $9,000 = $621

Fair Value through P&L

End of Year 1

Balance sheet	$98,500	[$96,830 + $1,670]
Income statement		
Interest income	$9,621	[$96,209 × 10%] or [$9,000 + $621]
Unrealized gain	$1,670	
	$11,291	

Cumulative unrealized gain ($98,500 – $96,830) = $1,670

Periodic unrealized gain = $1,670 – $0 = $1,670

Fair Value through P&L

Sell for $101,000 at beginning of Year 2

Income statement		
Reverse unrealized gain	($1,670)	Cumulative unrealized gains from prior periods
Realized gain	4,170	[$101,000 – $96,830]
Net gain	$2,500	[$101,000 – $98,500]

Fair Value through OCI

End of Year 1

Balance sheet	$98,500	[$96,830 + $1,670]
Income statement		
Interest income	$9,621	[$96,209 × 10%] or [$9,000 + $621]

Cumulative unrealized gain ($98,500 – $96,830) = $1,670 taken to equity (OCI)

Fair Value through OCI

Sell for $101,000 at beginning of Year 2

Income statement

Realized gain $4,170 [$101,000 – $96,830]

Note: $1,670 cumulative unrealized gain is removed from equity (OCI).

Financial Reporting and Analysis (1)

Intercorporate Investments
Investment in Associates, Part 1 - Equity Method

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Investment in Associates and Joint Ventures: Equity Method (Significant Influence)

>20% but ≤ 50% ownership, includes joint ventures

Balance sheet: Reported at cost + earnings – dividends

Income statement: Earnings

Balance sheet investment
= (%Share in co × Earnings) – (%Share in co × Dividends)
= %Share in company × (Earnings – Dividends)
= %Share in company × Δ in Retained earnings

Evidence of Significant Influence

- Representation on board of directors
- Participation in policy making
- Material transactions between the parties
- Interchange of key personnel
- Technological dependency

Influence
- Financing
- Operating
- Amount and timing of dividends

Equity Method – Example

Company P invests $1,000 in Company S for a 30% stake on December 31, 20x5. Earnings and dividends for the next two years are:

Paladini Enterprises	**20x6**	**20x7**
Earnings	$400	$600
Dividends	$100	$150

Equity Method – Solution

- Company P Balance Sheet

	20x6	20x7
Investment in Company S	$	$
Opening balance	1,000	1,090
+ Earnings	120	180
– Dividends	(30)	(45)
Closing balance	1,090	1,225

Original investment

Company P Income Statement

	20x6	20x7
Equity income	120	180

Purchase Price > BV

- Red Company purchased a 30% stake in Blue for $80,000. At acquisition the following data applies:

	Book Value $		Fair Value $
Current Assets	225,000		225,000
PP&E	25,000	$50,000	75,000
Total Assets	250,000		300,000
Liabilities	50,000		50,000
Net Assets	200,000		250,000

FMV>BV Example (cont.)

Blue's equipment is depreciated over a 10-year period using the straight line method. Blue reported net income of $100,000 and paid dividends of $60,000 in the first year after the investment was made.

Calculate:

A. Goodwill

B. Earnings attributable to the equity investment in the first year in Red's accounts

C. The carrying value of the investment in Red's year-end balance sheet

A. Goodwill

	$
Purchase Price	80,000
30% BV Net Assets	(60,000)
Attributable to FMV_{adj}:	
PPE 30% × $50,000	(15,000)
Goodwill	5,000

$75,000

% ownership × FMV net assets
30% × $250,000

The investment is still shown in the B/S at $80,000

Goodwill of $5,000 is included in the carrying value

B. Equity Income

Red's Equity Income $

	$
Red's proportionate share of Blue's reported Net Income $100,000 × 30%	30,000
% share of FMV_{adj} to PPE $50,000 × 30% = $15,000 Depreciated over 10 years (S/L)	(1,500)
	28,500

Shown after the tax line in Red's P&L

C. Balance Sheet Investment

Balance Sheet Investment	$
Purchase Price	80,000
Equity Income (Part B)	28,500
Dividends Received	(18,000)
Year-end Investment	90,500

Investment in Red's B/S

Financial Reporting and Analysis (1)

Intercorporate Investments
Investment in Associates, Part 2

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Equity Method Impairment

- IFRS: Fair value < carrying value and not temporary
- U.S. GAAP: Fair value < carrying value and deemed to be permanent
- IFRS need objective evidence
  - Loss event
  - Impact on future cash flows
  - Reliable measurement
- Asset written down to fair value and impairment loss is recognized in the income statement
- No reversal under U.S. GAAP or IFRS
- Goodwill not separately tested

Transactions With Associates

- Intercompany transfers
  - Upstream profit on transaction in associate's accounts
  - Downstream profit on transaction in parent's (investor's) accounts
- Investor company can influence amount and timing
- Pro-rata share of profit not confirmed through resale or use is eliminated from equity income

Upstream Example

Investor owns 30% of Investee. During the year, Investee sold goods to Investor and recognized a profit of \$15,000. At year-end 50% of the goods remained in Investor's inventory.

Reduction of Investor's Equity Income:

$\$15{,}000 \times 50\% \times 30\% = \$2{,}250$

Downstream Example

Investor owns 30% of Investee. During the year, Investor sold $40,000 of goods to Investee for $50,000 and recognized a profit of $10,000. At year-end 10% of the goods remained in Investee's inventory.

<u>Reduction of Investor's Equity Income:</u>

$10,000 × 10% × 30% = $300

Fair Value Option

- Election to treat equity method investments at fair value
- U.S. GAAP: All entities
- IFRS: Venture capital, mutual funds, unit trusts only
- Irrevocable election
- Unrealized gains and losses to income statement

Analyst Issues – Equity Method

- Is Equity Method appropriate?
  Influence should dominate bright-line ownership %
- <u>Balance Sheet</u>
  Netting assets against liabilities may obscure liabilities and understate leverage
- <u>Income Statement</u>
  - Only share of NI shown
  - Earnings may not be distributed as dividends – lower earnings quality

Financial Reporting and Analysis (1)

Intercorporate Investments

Business Combinations: Balance Sheet

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Business Combinations: Acquisition Method (Control)

Balance Sheet

1. Record any finance raised, cash spent, and investment at cost in parents accounts (if given preacquisition accounts)
2. Eliminate investment account (purchase price) of parent and preacquisition equity accounts of subsidiary
3. Create minority interest (share of equity not owned)
4. Calculate goodwill
5. Combine 100% of assets and liabilities of both firms (net of intercompany transactions)

Acquisition Example

- On January 1, Company P acquired 80% of Company S for $8,000 cash. Use the following pre-acquisition balance sheets to consolidate the investment:

Balance Sheet	Co. P $	Co. S $	Adj $	Consolidated $
Current Assets	48,000	16,000	(8,000)[1]	56,000[5]
Investment in S	0	0	8,000[1] – 8,000[2]	0[5]
Other Assets	32,000	8,000		40,000[5]
Total Assets	80,000	24,000		96,000

Acquisition Example (cont.)

Balance Sheet	Co. P $	Co. S $	Adj $	Consolidated $
Total Liabilities	40,000	14,000		54,000[5]
Minority Interest	0	0	2,000[3]	2,000[5]
Common Stock	28,000	6,000	(6,000)[2]	28,000[5]
R/E	12,000	4,000	(4,000)[2]	12,000[5]
Total L+E	80,000	24,000		96,000

Acquisition Example (cont.)

Minority Interest[3]
Noncontrolling interest = MI% × FMV_{adj} Net Assets
Noncontrolling interest = 0.20 × \$10,000 = \$2,000

Goodwill[4]
Partial GW = Proceeds – %(FMV_{adj} Net Assets)
Partial GW = \$8,000 – 0.8(\$10,000) = \$0

Equity Accounting vs. Acquisition

Balance Sheet	Equity \$	Acq. \$
Current Assets	40,000	56,000
Investment in S	8,000	0
Other Assets	32,000	40,000
Total Assets	80,000	96,000

Balance Sheet	Equity \$	Acq. \$
Total Liabilities	40,000	54,000
Minority Interest	0	2,000
Common Stock	28,000	28,000
R/E	12,000	12,000
Total L+E	80,000	96,000

Financial Reporting and Analysis (1)

Intercorporate Investments
Business Combinations: Income Statement

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Business Combinations: Acquisition Method (Control)

Income Statement

6. Eliminate subsidiary earnings from parent (dividends)
7. Subtract minority share of earnings (share of earnings not owned)
8. Combine revenues and expenses* of both firms (net of intercompany transactions)

**Only include post-acquisition results*

Acquisition Example

Use the following year-end income statements to consolidate the earnings of Sub one year after acquisition:

Income Statement	Co. P $	Co. S $	Adj $	Consolidated $
Revenues	60,000	20,000		80,000[8]
Expenses	(40,000)	(16,000)		(56,000)[8]
Minority Interest	0	0	(800)[7]	(800)[8]
Net Income	20,000	4,000		23,200

Equity Accounting vs. Acquisition

Income Statement	Equity $	Acquisition $
Revenues	60,000	80,000
Expenses	(40,000)	(56,000)
Equity Income	3,200	0
Minority Interest	0	(800)
Net Income	23,200	23,200

Financial Reporting and Analysis (1)

Intercorporate Investments
Business Combinations: Goodwill

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U.S. GAAP Business Combinations

Merger

Co A + Co B = Co A. Net assets transferred from B to A.

Acquisition

Co A + Co B = (Co A + Co B). Co A = parent, Co B = sub

Consolidation

Co A + Co B = Co C. A and B cease to exist and a new entity C is created.

Variable Interest Entity

Control is not based on equity ownership

Goodwill Example

Wood Corporation paid $600m for all of the outstanding stock of Pine Corporation. At the acquisition date, Pine reported the following B/S amounts:

	Book value ($m)
Current assets	80
Net PP&E	760
Goodwill	30
Liabilities	400
Stockholders' equity	470

Goodwill Example (cont.)

The fair value of PP&E was $120m above book value. The fair value of all other identifiable assets and liabilities equalled book value. Compute goodwill.

	$m	$m
Purchase price		600
Book value net assets	440	
FMV adjustment	120	
FMV Net identifiable assets		(560)
Goodwill		40

Partial vs. Full Goodwill

U.S. GAAP requires full goodwill, but IFRS permits full or partial goodwill method

- Partial goodwill: Goodwill is purchase price (of partial interest), minus the % owned times fair value of net identifiable assets.

  Noncontrolling (minority interest) is % not owned times fair value of net identifiable assets.

Partial vs. Full Goodwill (cont.)

U.S. GAAP requires full goodwill, but IFRS permits full or partial goodwill method

- Full goodwill equals total fair value of subsidiary minus FV of net identifiable assets.

  Noncontrolling (minority) interest is % not owned times total fair value of subsidiary.

Partial vs. Full Goodwill – Example

Continuing the previous example: Suppose Wood paid $450m for 75% of the stock of Pine. Compute goodwill under the full and partial methods:

- Fair value of subsidiary is $450m / 0.75 = $600m
- Fair value of identifiable assets less identifiable liabilities = $560m
- Full goodwill is $40m
- Partial goodwill is 0.75 × $40m = $30m

Comparison of Methods

Balance Sheet	Full Goodwill	Partial Goodwill
Goodwill	$600m – $560m = $40m	$450m – (0.75 × $560m) = $30m
	75%	
Noncontrolling interest	25% × $600m = $150m	25% × $560m = $140m

Total assets and total liabilities + equity are $10m more with full goodwill

Note: No difference for 100% owned subsidiaries

Impairment of Goodwill

- Goodwill is not amortized; it is tested for impairment annually.
- Goodwill cannot be separated from the overall business.
- Goodwill is impaired when carrying value of business unit is greater than its fair value.
- Impairment is reported as line item on income statement.
- Goodwill impairments cannot be reversed.

Impairment of Goodwill IFRS vs. U.S. GAAP

1. **IFRS** – Allocated across *cash generating* units that will benefit from acquisition

   U.S. GAAP – Allocated across reporting units: operating segment or component

Impairment of Goodwill IFRS vs. U.S. GAAP

2. **IFRS – One-step process**
   - If recoverable amount of cash generating unit < carrying value, recognize difference as impairment

   U.S. GAAP – Two-step process
   - If fair value of reporting unit < carrying value, goodwill is impaired
   - Amount of impairment is unit's reported goodwill – current fair value of unit's goodwill (recalculated with current asset/liability values)

Impairment of Goodwill IFRS vs. U.S. GAAP

3. **IFRS –** If loss is greater than unit goodwill, remainder is allocated proportionally to (impairment of) other (non-cash) assets of the unit.

   U.S. GAAP – If loss is greater than current fair value of unit goodwill, unit goodwill is reduced to zero; no other allocation of impairment amount.

   Under both standards, impairment loss is recognized in the **income statement** as a separate line item.

Goodwill Impairment Example

Last year Parent Company acquired Sub Company for $1m. On the date of acquisition the fair value of Sub's identifiable net assets was $800,000.

At the end of the current year, the fair value of Sub is estimated to be $950,000 and the fair value of net assets $775,000. The carrying value of Sub (including goodwill) is $980,000.

Determine the impairment loss under both IFRS and US GAAP

Goodwill Solution

On Acquisition

	$
Proceeds	1,000,000
FMV Net Assets Acq	(800,000)
Goodwill	200,000

Current Period

1. Identification:

$980,000 > $950,000

There has been an impairment

IFRS impairment loss $30,000

Impairment loss US GAAP

2. Loss Measurement:

$200,000 – $175,000 = $25,000

	$
FMV	950,000
FMV Net Assets	(775,000)
Implied GW	175,000

Bargain Purchase

Purchase price < FMV net assets

- **IFRS and U.S. GAAP**
  - Take as gain to I/S

Financial Reporting and Analysis (1)

Intercorporate Investments
Joint Ventures

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Joint Ventures

Control shared by 2 or more investors IFRS:

1. Joint venture:
   - Separate vehicle (separate legal form)
   - Each party has rights to Net Assets (equity investment)
   - Equity account
2. Joint operation:
   - Not a separate vehicle
   - Each party has rights to the individual assets and liabilities
   - Proportionate consolidation

US GAAP: Proportionate consolidation allowed in rare situations

Proportionate Consolidation Example

On January 1, Company P acquired 80% of Company S for $8,000 cash. Use the following pre-acquisition balance sheets to proportionately consolidate the investment:

Balance Sheet	Co. P $	Co. S $	Adj $	Prop' Consol' $
Current Assets	48,000	16,000	(8,000) + (80% × 16,000)	52,800
Investment in S	0	0	8,000 – 8,000	0
Other Assets	32,000	8,000	8,000 × 80%	38,400
Total Assets	80,000	24,000		91,200

Proportionate Consolidation Example

Balance Sheet	Co. P $	Co. S $	Adj $	Prop. Consol. $
Total Liabilities	40,000	14,000	14,000 × 80%	51,200
Common Stock	28,000	6,000	(6,000)	28,000
R/E	12,000	4,000	(4,000)	12,000
Total L+E	80,000	24,000		91,200

Proportionate Consolidation vs. Equity Accounting

Balance Sheet	Equity $	Prop. Consol. $
Current Assets	40,000	52,800
Investment in S	8,000	0
Other Assets	32,000	38,400
Total Assets	80,000	91,200

Balance Sheet	Equity $	Prop. Consol. $
Current Liabilities	40,000	51,200
Common Stock	28,000	28,000
R/E	12,000	12,000
Total L+E	80,000	91,200

Proportionate Consolidation Example

Use the following year-end income statements to proportionally consolidate the earnings of Co. S one year after acquisition:

Income Statement	Co. P $	Co. S $	Adj $	Prop. Consol. $
Revenues	60,000	20,000	20,000 × 80%	76,000
Expenses	(40,000)	(16,000)	16,000 × 80%	(52,800)
Income from Sub	800	0	(800)	0
Net Income	20,800	4,000		23,200

Proportionate Consolidation vs. Equity Accounting

Income Statement	Equity $	Prop. Consol. $
Revenues	60,000	76,000
Expenses	(40,000)	(52,800)
Equity Income	3,200	0
Net Income	23,200	23,200

Financial Reporting and Analysis (1)

Intercorporate Investments

Special Purpose Vehicles

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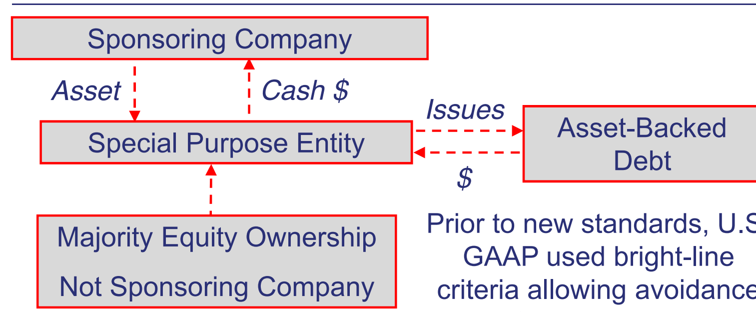
What is a Special Purpose Entity (SPE)?

- SPE is a legal structure created to isolate certain assets and obligations of the sponsor
- Created to serve specific purpose: purchase assets, fund R&D, lease assets, enhance the balance sheet
- Typical motive is to obtain low-cost financing
- Prior to new IFRS and U.S. GAAP standards, SPEs did not have to be consolidated by sponsor; instead accounted for using equity method

Typical SPE Uses

Synthetic Leases	Sale and Leaseback structured as operating lease
Securitized Loans	Loans or mortgages sold to SPE which issues mortgage backed securities
Sale of Receivables	Company sells AR to the SPE which uses the AR as collateral to borrow
R&D Cost	SPE established to fund R&D avoids recognition of R&D expense or liabilities

Special Purpose Entities



Prior to new standards, U.S. GAAP used bright-line criteria allowing avoidance of consolidation.

Consolidation of SPEs

IFRS consolidation when sponsor has control, indicated by the following:

- SPE is for benefit of sponsor
- Sponsor has decision-making power
- Sponsor able to absorb rewards and risks
- Sponsor has residual interest

Consolidation of SPEs

Under U.S. GAAP, an SPE is considered a VIE (and must be consolidated) if any of the following conditions are met:

- Insufficient at-risk investment (typically less than 10% equity capital)
- Shareholders lack decision-making rights
- Shareholders do not absorb expected losses
- Shareholders do not receive expected residual returns

QSPE – no longer permitted (post 2009)

Effects of Consolidation

Consider a securitization SPE

- Borrows money to purchase receivables from sponsor

Consolidation requires:

- Receivables added back to sponsor balance sheet
- Debt added to sponsor's liabilities
- Leverage ratios increase, receivables increase, receivables turnover decreases, and ROA decreases
- Net impact – no longer off-balance-sheet

SPE Consolidation Example

Company P wants to borrow $100m. It has two options:

Option A: Borrow $100m from Bank B

Option B: Sell $100m of accounts receivable to an SPE created for this purpose. The SPE will fund the purchase by borrowing from Bank B.

Co. P B/S prior to borrowing

Balance Sheet	Co. P $m	Balance Sheet	Co. P $m
Cash	50	Current Liabilities	500
Accounts Rec.	200	Debt	1,200
Fixed Assets	2,000	Equity	550
Total Assets	2,250	Total L+E	2,250

Option A Solution

- Cash and debt both increase by $100m

Co. P B/S after borrowing

Balance Sheet	Co. P $m
Cash	150
Accounts Rec.	200
Fixed Assets	2,000
Total Assets	2,350

Balance Sheet	Co. P $m
Current Liabilities	500
Debt	1,300
Equity	550
Total L+E	2,350

Option B Solution

- Cash increases by $100m, AR decreases by $100m

Co. P B/S after the sale of AR

Balance Sheet	Co. P $m
Cash	150
Accounts Rec.	100
Fixed Assets	2,000
Total Assets	2,250

Balance Sheet	Co. P $m
Current Liabilities	500
Debt	1,200
Equity	550
Total L+E	2,250

Option B Solution

SPE B/S after the purchase of AR and bank loan

Balance Sheet	SPE $m
Accounts Rec.	100
Total Assets	100

Balance Sheet	SPE $m
Debt	100
Total L+E	100

Option B Solution

- Cash and debt both increase by $100m

Co. P B/S after consolidating the SPE

Balance Sheet	Co. P $m
Cash	150
Accounts Rec'	200
Fixed Assets	2,000
Total Assets	2,350

Balance Sheet	Co. P $m
Current Liabilities	500
Debt	1,300
Equity	550
Total L+E	2,350

Recognition and Measurement

Recognition and Measurement: Identifiable assets and liabilities

- Identifiable assets and liabilities recorded at fair value
- Acquirer must recognize assets and liabilities that the acquiree had not recognized (i.e., internally developed intangibles)

Recognition and Measurement (cont.)

Contingent Liabilities: Obligations from past events

- **IFRS** – Recognize fair value at acquisition if can be measured reliably
- **U.S. GAAP** – Recognize fair value at acquisition if **probable** and can be reliably estimated

Recognition and Measurement (cont.)

Indemnification Assets

- Acquirer must recognize an indemnification asset if seller contractually indemnifies a contingency, uncertainty, or future losses

Financial Assets and Liabilities

- Acquirer reclassifies at date of acquisition based on contractual terms, economic conditions, and acquirers' accounting policies

Recognition and Measurement (cont.)

In-Process R&D

- **In-process R&D** – Capitalize at acquisition then amortize as completed or impaired (**IFRS** & **U.S. GAAP**).

Restructuring Costs

- **Restructuring costs** – not part of acquisition cost. Expense when incurred (**IFRS** & **U.S. GAAP**).

IFRS vs. U.S. GAAP

Contingent consideration

IFRS and U.S. GAAP

- Recognize estimated fair value at acquisition as asset, liability or in equity
- Changes in fair value of liabilities to income statement
- Changes in fair value of equity settled in equity

U.S. GAAP only

- Changes in fair value of asset to income statement

Comparison of Methods

Item	Equity Method	Proportionate Consolidation	Acquisition Method
Sales	Lower	Middle	Higher
Expenses	Lower	Middle	Higher
Net Income	Same	Same	Same
Assets & Liabilities	Lower	Middle	Higher
SH Equity	Lower	Same as Equity	Higher*

**Only the case for subsidiaries with minority interests*

Equity Method = Best Ratios

Ratio	Equity Method	Proportionate Consolidation	Acquisition Method
Net profit margin	Higher	In between	Lower
ROE	Higher*	Same as equity	Lower*
ROA	Higher	In between	Lower

** Only the case if there is minority interest*

Financial Reporting and Analysis (1)

Post-Employment and Share-Based Compensation

Types of Plans

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Pension Plans

"A pension plan is an agreement under which an employer agrees to pay monetary benefits to employees on their retirement from active service."

"Employee benefits are based on predetermined factors such as average or final compensation, years of service, and age."

Types of Plans

	Defined Benefit	Defined Contribution
Risk	Employer carries the risk	Employee carries the risk
Asset ownership	Employer owns assets	Employee owns assets, employer acts as agent
Asset management	Employer will appoint an investment manager	Employee directs investment policy
Pre-funding	Contributions to pension trust	Not applicable

Defined Contribution Accounting

Employer does not promise a specific level of retirement benefits.

Accounting

- Income statement: Employer contribution
- Balance sheet: Asset/liability = Excess or shortfall in payments relative to specified contribution
- No significant issues for the analyst

Defined Benefit Accounting

Non-pay-related Plans	Pay-related Plans
Pension benefits are unrelated to the employee's salary level	Pension benefits are based on future compensation

- Employer (plan sponsor) bears the investment risk in DB plans because it has promised a specific benefit amount.
- The employer needs to estimate future benefit payments to determine required contributions.
- Difficult accounting/analysis issues

Financial Reporting and Analysis (1)

Post-Employment and Share-Based Compensation

Defined Benefit Plans – Balance Sheet

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Pension Liability Measures

Projected Benefit Obligation (PBO)

- Present value of all future pension payments earned to date based on expected salary increases over time. Assumes employee works until retirement.
  - Estimate of liability on a going concern basis.
  - Under IFRS, the PBO is referred to as the present value of the defined benefit obligation (PVDBO).

B/S Asset/Liability

IFRS and U.S. GAAP

- Net of PBO and fair value of plan assets
- Asset/liability = funded status
- If overfunded, asset
- If underfunded, liability

PBO Components

Current Service Cost – The change in PBO attributed to employees' efforts during the year. The actuarial PV of pension benefits earned in a year

Interest Cost – The increase in the PBO resulting from the passage of time. PBO at start of period × discount rate*

**Subject to discount rate remaining constant*

PBO Components

Actuarial Gains and Losses	Gains and losses resulting from changes in actuarial assumptions affecting the PBO.
Past Service Costs	Retroactive impact on past benefits awarded to employees resulting from plan amendments. For example, changing the payout from 60% to 65% of final salary.
Benefits Paid	Payments made from the fund to existing retirees

PBO Components

×	Opening PBO
+	Service cost
+	Interest cost
+/–	Actuarial (gains) or losses
+/–	Past service cost
–	Benefits paid
=	Closing PBO

Only actuarial assumptions affecting PBO

Reconciliation disclosed in footnotes

PBO Calculation: Example

- Retirement age: 65
- Pension: 2% of salary × years worked (benefit based on final salary). Paid annually in arrears
- Rate of compensation growth 4% p.a.
- Life expectancy post retirement = 15 years
- Discount rate = 8%

One employee:

John McElwain was hired on January 1st, 2016. John's starting salary is $50,000. John has 25 years to retirement.

PBO After 1 Year of Employment

Salary on retirement:

$\$50{,}000 \times (1.04)^{24} = \$128{,}165.23$

Annual payment after working for 1 year:

$\$128{,}165.21 \times 2\% \times 1 \text{ year} = \$2{,}563.30$

PBO at retirement date:

PMT = –$2,563.30, N=15, I/Y = 8, CPT PV = $21,940.55

PBO at the end of 2016:

FV = $21,940.55, N=24, I/Y = 8, CPT PV = $3,460.01

PBO After 2 Years of Employment

Annual payment after working for 2 years:

$128,165.21 × 2% × 2 years = $5,126.61

PBO at retirement date:

PMT = –$5,126.61, N=15, I/Y = 8, CPT PV = $43,881.09

PBO at the end of 2017:

FV = $43,881.09, N=23, I/Y = 8, CPT PV = $7,473.62

Reconciliation of PBO

	$
2016 PBO	3,460.01
Current Service Cost	3,736.81
Interest Cost	276.80
2017 PBO	7,473.62

Interest cost:

= Opening PBO × discount rate

= $3,460.01 × 8% = $276.80

Additional benefits earned during the period:

$128,165.21 × 2% × 1 year

= $2,563.30

PMT = –$2,563.30, N=15,
I/Y = 8, CPT PV = $21,940.55

FV = $21,940.55, N=23,
I/Y = 8, CPT PV = $3,736.81

Fair Value of Plan Assets

Employer Contributions

Funding policy is a function of:
- Income tax
- ERISA rules
- Cash flow considerations

Return on Assets (ROA)

Actual capital gains/dividends/interest
Will fluctuate with market

Benefits Paid

Payments made from the fund to existing retirees

Fair Value of Plan Assets

×	Fair value of plan assets at start of year
+/–	Actual return on plan assets
+	Employer contributions
–	Benefits paid to retirees
=	Fair value of plan assets at end of year

Reconciliation disclosed in foot notes

Note: Don't be confused; this is exactly what the name implies—the market value of plan assets

Funded Status

Fair Value of Plan Assets – PBO = Funded Status

FV > PBO = Overfunded

FV < PBO = Underfunded

Funded Status = Economic Position of Plan

Funded Status = Balance Sheet Asset/Liability*

*If reporting asset, subject to ceiling of PV of future economic benefits

Financial Reporting and Analysis (1)

Post-Employment and Share-Based Compensation

Defined Benefit Plans, Part 1: Periodic Cost

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Periodic Pension Cost

$\boxed{\text{Total Periodic Pension Cost = Contributions} - \Delta\text{Funded Status}}$

TPPC = Contributions – (End FS – Beg FS)

TPPC = Income Statement Expense + Δ OCI items

Total Periodic pension cost is same under IFRS and U.S. GAAP but differ on where the pension cost is reflected (Income statement vs. OCI)

TPPC = periodic economic cost

Delayed Recognition of Pension Costs

- IFRS allows for recognition of certain events that affect the Pension cost in OCI (instead of income statement)
- Under U.S. GAAP, the events are amortized in the income statement over time (until then, in OCI)
- Terminology:
  - **IFRS**: Remeasurement gains and losses = actuarial gains and losses (affecting PBO) plus differences in actual and expected return on assets
  - **U.S. GAAP**: Actuarial gains and losses = IFRS definition of remeasurement gains and losses

Delayed Recognition of Pension Events

The two main delayed events:

1. Remeasurements (**IFRS & U.S. GAAP)**
   - From changes in actuarial assumptions affecting the PBO (Actuarial gains and losses)
   - From differences in the actual and expected return on plan assets (Note IFRS, exp. return = disc. rate)
2. Past service costs **(U.S. GAAP only)**
   PBO changes due to plan amendments. Amortized over service life of plan participants. Expensed immediately under IFRS.

Remeasurements

Net

Plan Assets

Actual vs. Expected returns

Assumed (GAAP) or discount rate (IFRS)

Plan Liabilities (PBO)

Actuarial gains and losses resulting from changes in actuarial assumptions:

- Discount rate
- Rate of salary increase
- Composition of participants

Actuarial Gains and Losses - Corridor Approach (U.S. GAAP only)

- Amortize over the remaining service life, the *beginning* net gain/loss that *exceeds*:

10% of greater of opening values of:

PBO | Plan Assets

Periodic Pension Cost (U.S. GAAP)

Net Periodic Benefit Costs

+	Service cost	Recurring costs (actual)
+	Interest cost	
–	Expected return on plan assets	Smoothed events
+/–	Amort. of actuarial (gains) and losses	
+/–	Amortization of past service costs	
=	**Pension expense on income statement**	

Unamortized past service cost and actuarial gains and losses in OCI.

Periodic Pension Cost (IFRS)

Net Periodic Benefit Costs

+	Service cost
+/–	Net interest expense/(income)*
+/–	Past service costs
=	**Pension expense on income statement**

Remeasurements are reflected in OCI and not amortized.

**Net interest expense/(income) = beg funded status × discount rate*

IFRS vs. US GAAP

Opening PBO	×	discount rate	=	Interest expense

U.S. GAAP allows different rates

Opening plan assets	×	% expected return	=	$ expected return
Opening funded status	×	discount rate	=	Net interest expense/income

IFRS expected return = discount rate

Financial Reporting and Analysis (1)

Post-Employment and Share-Based Compensation

Defined Benefit Plans, Part 2: Periodic Cost Example

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Periodic Pension Cost: Example

The following information is provided about the defined benefit pension plan of Zenith Industries year ending 20x5:

	€		€
Employer contributions	1,200	Closing plan assets	30,682
Current service costs	1,850	Actual return (assets)	1,795
Past service cost	120	Benefits paid	635
Opening PBO	38,750	Unamortized actuarial losses	3,150
Actuarial Loss	628		
Closing PBO	43,619	Expected return (assets)	6%
Opening plan assets	28,322	Discount rate	7.5%

Funded Status

Opening funded status = Opening plan assets – Opening PBO

-€10,428 = €28,322 - €38,750

Closing funded status = Closing plan assets – Closing PBO

-€12,937= €30,682 - €43,619

Change in funded status

-€2,509

PBO & Plan Assets Reconciliations

	€
Opening PBO	38,750
Current service cost	1,850
Interest cost	2,906
Past service cost	120
Actuarial loss/(gain)	628
Benefits paid	(635)
Closing PBO	43,619

	€
Opening plan assets	28,322
Employer contributions	1,200
Actual return	1,795
Benefits paid	(635)
Closing plan assets	30,628

Opening PBO × discount rate

€38,750 × 7.5% = €2,906

Total Periodic Pension Cost

	€
Employer contributions	1,200
- Δ in funded status	2,509
TPPC	3,709

	€
Current service cost	1,850
Interest cost	2,906
Past service cost	120
Actuarial losses/(gains)	628
Actual return on assets	(1,795)
TPPC	3,709

Periodic Cost in P&L US GAAP

	€
Current service cost	1,850
Interest cost	2,906
Expected return on plan assets	(1,699)
Amortization	0
Pension expense	3,057*

	€
Unamortized actuarial losses	3,150
Opening PBO	38,750
	8.1%

No amortization required

*Amortization of past service cost is ignored

Opening plan assets × expected return%

€28,322 × 6% = €1,699

Periodic Cost in P&L IFRS

	€
Current service cost	1,850
Past service cost	120
Net interest cost	782
Pension expense	2,752

Opening funded status × discount rate

€10,428 × 7.5% = €782

Periodic Cost in OCI

Periodic cost in OCI = TPPC – Periodic cost in P&L

U.S. GAAP:

€652 = €3,709 – €3,057

IFRS:

€957 = €3,709 – €2,752

Financial Reporting and Analysis (1)

Post-Employment and Share-Based Compensation

Defined Benefit Plan Assumptions

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Actuarial Pension Plan Assumptions

- All plans must make/disclose **three assumptions**:
  1. Discount rate
  2. Rate of compensation increase
  3. Expected return on plan assets (U.S. GAAP only)
- These assumptions can affect:
  - Balance sheet (through effect on PBO)
  - Income statement (pension cost)
- ***Pension accounting****: "The greatest earnings manipulation tool known to management."*

Impact of Assumptions

	Higher Discount Rate	*Higher Wage Rate Increases*	*Higher Expected Rate of Return*
B/S Liability	Lower	Higher	No change
TPPC	Lower**	Higher	No change
Periodic cost in P&L	Lower**	Higher	Decrease*

* U.S. GAAP only   ** Mature plans

IFRS vs. U.S. GAAP

- U.S. GAAP expected return and discount rate may differ. IFRS expected return = discount rate
- U.S. GAAP interest and $ expected return shown separately. IFRS netted
- IFRS Remeasurements taken OCI. U.S. GAAP actuarial gains and losses either recognized in income statement or more commonly taken to OCI
- U.S. GAAP Opening OCI balances subject to potential amortization. IFRS no amortization

IFRS vs. U.S. GAAP

- IFRS past service costs taken to I/S
- U.S. GAAP past service costs taken to OCI and amortized over remaining service life
- U.S. GAAP uses a 10% corridor approach for amortizing actuarial gains and losses
- IFRS discount rate = yield on high quality corporate debt with similar duration to plan liabilities
- U.S. GAAP discount rate = rate at which pension benefits can be settled

Financial Reporting and Analysis (1)

Post-Employment and Share-Based Compensation

Analyst Adjustments

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Income Statement Adjustments

- Full pension expense is taken through operating expenses (SG&A)
- Only service cost is operating
- Remove pension expense from operating expenses and include service cost
- Add interest cost to interest expense
- Add actual return on plan assets to non-operating income
- Amortization ignored

Total I/S effect = Service + Interest – Actual Return

Adjusting I/S Expense: Example

Use the following information to reclassify the components of periodic pension cost between operating and nonoperating:

Income statement extracts	$
Operating profit	145,000
Interest expense	(12,000)
Other income	2,000
Income before tax	135,000

Other data	$
Current service cost	7,000
Interest cost	5,000
Expected return on assets	8,000
Actual return on assets	9,500

Adjusting I/S Expense

Income Statement	Reported	Adjustments	Adjusted I/S
	$	$	$
Operating profit	145,000	+ 4,000 – 7,000	142,000
Interest expense	(12,000)	-$5,000	(17,000)
Other income	2,000	+9,500	11,500
Income before tax	135,000		136,500

Cash Flow Adjustment

For analytical purposes, adjust CFO and CFF for the *after-tax* difference in economic pension expense and cash contributions

- Contribution > Total Periodic Pension Cost = Principal PMT
  (Contribution – TPPC)(1 – T) ↓CFF ↑CFO
- Contribution < Total Periodic Pension Cost = Borrowing
  (Contribution – TPPC)(1 – T) ↑CFF ↓CFO

Adjusting Cash Flow: Example

Bhaskar Thakur is analyzing the financial statements of Box Car (BC) Inc., a manufacturer of equipment for the rail road industry. He finds out the company made a €340m contribution to the plan during the year. He collects the following information:

	€m		€m
Opening funded status	2,530	CFO	948
Closing funded status	2,180	CFF	112
Net income	812	Tax rate	40%

Adjusting Cash Flow

Total periodic pension cost: = contribution – Δ in funded status
= €340m – (€2,180m – 2,530m)
= €690m

Contribution shortfall: = Employers contribution – TPPC
= €340m - €690m = -€350m

After tax cash flow adjustment: = -€350m(1-0.4) = -€210m
CFO = €948m - €210m = €738m
CFF = €112m + €210m = €322m

Financial Reporting and Analysis (1)

Post-Employment and Share-Based Compensation

Share Based Compensation

Other Post Employment Benefits

Healthcare

- Classified as defined benefit plans
- Liability is present value of expected future payments
- Often not funded in advance
- Complex estimation of future increases in healthcare costs: Assumption that inflation in health care costs will taper of to a lower constant rate (ultimate health care trend rate) typical

Other Post Employment Benefits (cont.)

- Disclosure:
  - Near term increases in healthcare costs
  - Ultimate healthcare trend rates
  - Year in which ultimate trend rate is reached

Share-Based Compensation

Advantages

1. No cash outlays
2. Aligns management and shareholder interests

Disadvantages

1. Employees have limited influence over stock price
2. Increase stock ownership ↑ risk aversion
3. Option awards may increase risk taking
4. Existing shareholders diluted

Share-Based Compensation

Disclosures Required

1. Nature and extent of share-based compensation arrangements during the period
2. How fair value was determined
3. Impact on income for the period

Accounting

- Allocate fair value over service period

Share-Based Compensation

Stock Grants

- Compensation expense equals market value at grant date
- Allocated over period benefited by employees service (presumed to be current period)
- Restricted stock: Ownership returned to company if conditions not met (length of service or performance goals)
- Performance shares: Granted on meeting performance goals

Share-Based Compensation (cont.)

Stock Options

- Fair value at grant date = estimated option premium
- Service period equals time between grant date and vesting date
- Vesting date = first date the options may be exercised

Option Valuation Methods

- Fair value measured “based on the observable market price (premium) of an option with the same or similar terms and conditions, if one is available”
- In the absence of a market-based instrument, fair value is determined by an option valuation model:
  1. Black-Scholes-Merton model
  2. Binomial model
  3. Monte Carlo simulation

Model Assumptions

<u>All models require six assumptions:</u>

1. Exercise price
2. Stock price at grant date
3. Volatility
4. Risk-free rate
5. Expected term (time to expiry)
6. Dividend yield

Assumptions affect fair value and hence compensation expense

Stock Appreciation Rights

Rewards employees based on changes in the value of shares *(Employees don't hold shares)*

<u>Advantages</u>

- Avoids dilution
- Less risk aversion (no downside)

<u>Disadvantages</u>

- Cash outflows
- Expense – valued at fair value and spread over service life

Financial Reporting and Analysis (1)

Multinational Operations

Transaction Exposure

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Transaction Exposure

Imports and exports denominated in overseas currencies:

- Transactions recorded at spot rate on the date of transaction
- Receipt or payment at a later date
- Issue: Δ in spot rates between transaction and settlement date
- Record realized gain or loss at settlement date in income statement

Transaction Exposure: Example

A U.S. firm sells goods to an Italian firm for €10,000 when the spot rate is $1.60 per euro.

Payment occurs in 30 days when the euro has depreciated to $1.50.

At Transaction Date: Solution

Balance Sheet		Income statement	
	At transaction date		**At transaction date**
Cash	0	Revenue	$16,000
Accounts receivable	$16,000		

At Settlement Date: Solution

Balance Sheet		Income statement	
	At settlement date		**At settlement date**
Cash	$15,000	FX Loss	($1,000)
Accounts receivable	0		
Net assets ↓ $1,000		**Stockholders' equity**	
		Retained earnings	($1,000)

Transaction Exposure

Settlement after B/S date

- Record unrealized gain (loss) at B/S date
- A further gain (loss) will be recorded in subsequent year at settlement

Transaction Exposure: Example

A U.S. firm sells goods to an Italian firm on December 15th for €10,000 when the spot rate is $1.60 per euro.

Payment occurs in 30 days on January 15th when the euro has depreciated to $1.50.

At the year-end the exchange rate was $1.56 per euro.

At Transaction Date: Solution

Balance Sheet		Income statement	
	At transaction date		**At transaction date**
Cash	0	Revenue	$16,000
Accounts receivable	$16,000		

At Year-end: Solution

Balance Sheet	At year-end date	Income statement	At year-end date
Cash	0	FX Loss	($400)
Accounts receivable	$15,600		
	Net assets ↓ $400	**Stockholders' equity**	
		Retained earnings	($400)

At Settlement date: Solution

Balance Sheet	At settlement date	Income statement	At settlement date
Cash	$15,000	FX Loss	($600)
Accounts receivable	0		
	Net assets ↓ $600	**Stockholders' equity**	
		Retained earnings	($600)

Exposures

		Foreign Currency	
Transaction (in FC)	**Exposure**	**Strengthens**	**Weakens**
Export Sale	Asset (AR)	Gain	Loss
Import Purchase	Liability (AP)	Loss	Gain

Analytical Issues

- IAS 21 and FASB 52 both require transaction gains/(losses) to be reported in I/S
- Issue = neither state where
- Alternatives:
  - Component of operating income/expense (within SG&A)
  - Non-operating income/expenses (financing cost)

  Key = distorts comparison of operating margins between companies

Financial Reporting and Analysis (1)

Multinational Operations

Translation

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Translation Exposure

Translation of foreign currency financial statements:

- Converting the accounts of overseas subsidiaries to reporting currency
- Three-step process:
  1. Identify subs functional currency
  2. Convert foreign currency balances into functional currency
  3. Convert functional currency balances to parent's reporting currency using closing rates (if functional and reporting currencies differ)

Foreign Currency Translation

SFAS 52 DEFINITIONS

Functional currency — The currency of the primary economic environment in which the firm operates. This is the currency in which the firm generates and spends cash (some subjectivity).

Presentational currency — The currency in which the multi-national firm prepares its final, consolidated financial statements

Local currency — The currency of the country in which the foreign subsidiary is located

Functional Currency

IAS 21 Factors to consider:

1. Currency that influences sales price
2. Currency of the country whose competitive forces and regulations determine sales price
3. Currency in which funds from financing activities are generated
4. Currency in which receipts from operating activities are retained
5. Subsidiary's autonomy

Most important

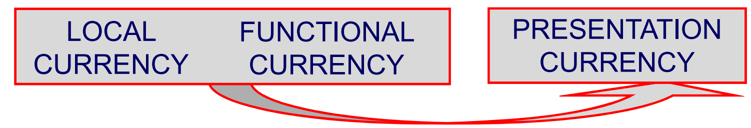
Functional Currency

IAS 21 Factors to consider (cont.):

6. Main currency that influences cost of production (labor, materials, etc.)
7. Financing from parent (reliance) to service debt
8. Remittance of cash flows to parent
9. Transactions with parent

Foreign Currency Translation SFAS 52

Temporal method *of translation a.k.a. "Remeasurement"*



Current rate method *of translation a.k.a. "Translation"*

Exchange Rate Definitions

1. Current rate = Foreign exchange (FX) rate as of balance sheet date (i.e., closing rate)
2. Average rate = Average FX rate over reporting period
3. Historical rate = FX rate that existed when a particular transaction occurred
   - Each transaction may have its own historical rate
   - Example: Rate when stock was issued

Financial Reporting and Analysis (1)

Multinational Operations

Temporal Method

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Temporal Method

- Alternative names: Remeasurement, monetary/nonmonetary method
- Views the overseas operation as an extension of the parent companies activities
- Assets and liabilities translated at rates that preserve the measurement bases after translation:
  1. Current value
  2. Historic cost

Temporal Method

Balance Sheet	Income Statement
Monetary Assets & Liabilities (Cash/AR/AP/STD/LTD) Current rate	Revenues & Expenses Average rate
All other Assets & Liabilities (PP&E, Intangibles, Inv. at cost) Historical rate	COGS, Depreciation, & Amortization Historical rate
Capital Stock Historical rate	Exchange gains/(losses)
Total Equity Mixed rate	Dividends = Historical Rate when declared

Temporal Method

1. Produce top of Balance Sheet (Total Assets)
2. Produce Shareholders' Equity and Liabilities (retained earnings = plug figure (β) to ensure that the balance sheet balances

	$	
Liabilities (current)	X	
Common Stock (historic)	X	
Retained Earnings β	X	
Liabilities + Equity	X	← Same as Total Assets

Temporal Method (cont.)

3. Derive net income from reconciliation of retained earnings

	$
Opening R/E	X
NI β	X
Dividends	(X)
Closing R/E	X

Temporal Method (cont.)

4. Produce the income statement. Net income (NI) in the income statement will be different from NI in retained earnings.
5. Force the income statement NI to agree to the NI in the retained earnings reconciliation by adding a “gain” or “loss”.

Inventory & Cost of Goods Sold: Temporal

Inventory (historic rate):

FIFO = ending inventory translated at relatively recent rates

LIFO = ending inventory converted at older rates

AVCO = ending inventory converted at average exchange rate

Cost of goods sold:

FIFO/LIFO at weighted historic rate when the items assumed to have been sold during the year were acquired

AVCO = weighted average exchange rate

Financial Reporting and Analysis (1)

Multinational Operations

Current Rate Method

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Current Rate Method

- Alternative names: Translation
- Views the overseas operation as an investment
- All assets and liabilities (i.e., net assets are exposed to exchange rate risk)
- Exchange rate gains and losses are unrealized and stored in equity until the overseas operation is disposed of
- CTA realized in income statement on disposal

Current Rate Method

Balance Sheet	Income Statement
All Assets & Liabilities Current rate	Revenues & Expenses Average rate
Capital Stock Historical rate	Dividends = Historical Rate when declared
Retained Earnings Accumulated average rates	Aggregate stockholders' equity at current rate
Cumulative FX Gain/Loss Plug figure	

Applying the Current Rate Method

1. Convert the income statement—all revenues and expenses are translated at the average rate
2. Derive closing retained earnings

Opening retained earnings	X
NI (from income statement)	X
Dividends	(X)
Closing retained earnings	X

Applying the Current Rate Method

3. Convert the balance sheet—all assets and liabilities are translated at the current rate
4. Balance sheet will not balance. The difference is the translation gain/(loss)
5. Force the balance sheet to balance by including the adjustment in shareholders' equity (Cumulative Translation Adjustment)

   Note that the exchange rate gain or loss for the period is the change in the CTA.

Calculating Ending CTA Balance: Example

Given the following B/S data, calculate the ending balance of the CTA. The beginning CTA was $20.

	$
Assets	1,000
Liabilities	600
Common stock	150
Beginning retained earnings	175
Net Income	50
Dividends paid	25

Calculating Ending CTA Balance: Solution

Assets	- Liabilities	= Equity
$1,000	- $600	= $400

Common Stock	150	Beginning R/E	175
R/E	200	Net Income	50
CTA	50	Dividends	(25)
Equity	400	Closing R/E	200

Translation gain for the period = $50 – $20 = $30

Calculating Currency Exposure

- **Exposure**:
  - **Temporal** method exposure:

    = **(cash + A/R) – (A/P + current debt + LTD)**
  - **Current rate** method exposure

    = assets – liabilities = **shareholders' equity**
- **Insight**: These are the B/S accounts that are affected by the current rate for each method

Calculating Currency Exposure

	Method	Appreciating Overseas currency	Depreciating Overseas Currency
Net monetary assets	Temporal	Gain	Loss
Net assets	Current	Gain	Loss
Net monetary liabilities	Temporal	Loss	Gain

Financial Reporting and Analysis (1)

Multinational Operations

Temporal/Current Rate: Example

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Example: FlexCo International.

FlexCo International, a U.S. firm, has a subsidiary, Vibrant Inc., located in the country of Martonia.

Vibrant was acquired by FlexCo on December 31st, 2014.

FlexCo reports its financial results in U.S. $. The currency of Martonia is the loca (LC).

Vibrant's operational, financial, and investment decisions are made locally in Martonia, although Vibrant does rely on FlexCo for IT expertise.

Example: FlexCo International.

The following exchange rates between the U.S. $ and loca were observed:

Exchange Rates $/LC			
31st Dec 2014	$0.50	HR: PP&E	$0.4881
31st Dec 2015	$0.4545	HR: ending inventory	$0.4560
Average 2015	$0.4762	HR: beginning inventory	$0.5200
HR: equity	$0.50	Purchases were made evenly throughout the year	

HR = historic rate

Example: FlexCo International

Vibrant December 31st Balance Sheets		
	2014	**2015**
	LC	***LC***
Cash	100	100
Accounts receivable	500	650
Inventory	1,000	1,200
PP&E	700	900
Total Assets	2,300	2,850

Example: FlexCo International.

Vibrant December 31st Balance Sheets cont.	2014	2015
	LC	*LC*
Accounts payable	400	500
Current debt	100	200
Long-term debt	1,300	950
Total liabilities	1,800	1,650

Example: FlexCo International.

Vibrant December 31st Balance Sheets cont.	2014	2015
	LC	*LC*
Common stock	400	400
Retained earnings*	100	800
Total equity	500	1,200
Total liabilities & equity	2,300	2,850

* Retained earnings on 31st Dec 2014, were $50

Example: FlexCo International.

Vibrant Income Statement 2015	
	LC
Revenue	5,000
COGS	(3,300)
Gross margin	1,700
Other expenses	(400)
Depreciation	(600)
Net income	700

Current Rate Method Solution

I/S 2015	LC	XΔ Rate	$
Sales	5,000	$0.4762	2,381
COGS	(3,300)	$0.4762	(1,571.5)
Gross profit	1,700		809.5
Other expenses	(400)	$0.4762	(190.5)
Depreciation	(600)	$0.4762	(285.7)
Net income	700		333.3

Current Rate Method Solution

W_1. Reconciliation of retained earnings:

	LC	XΔ	$
Opening R/E	100	given	50
Net income	700	$0.4762	333.3
Dividend	(0)	Historic	(0)
Closing R/E	800		383.3

Current Rate Method Solution

Vibrant December 31st Balance Sheets

	2015 LC	XΔ	2015 $
Cash	100	$0.4545	45.5
Accounts receivable	650	$0.4545	295.4
Inventory	1,200	$0.4545	545.4
PP&E	900	$0.4545	409.1
Total Assets	2,850		1,295.4

Current Rate Method Solution

Vibrant December 31st Balance Sheets cont.

	2015 LC	XΔ	2015 $
Accounts payable	500	$0.4545	227.3
Current debt	200	$0.4545	90.9
Long-term debt	950	$0.4545	431.8
Total liabilities	1,650		750.0

Net Assets = $1,295.4 – $750.00 = $545.4

Current Rate Method Solution

Vibrant December 31st Balance Sheets cont.

	2015 LC	XΔ	2015 $
Common stock	400	$0.5000	200
Retained earnings	800	W_1	383.3
CTA		Plug	(37.9)
Total equity	1,200		545.4
Total liabilities & equity	2,850		1,295.4

Net Assets = $1,295.4 – $750.00 = $545.4

Temporal Solution

Vibrant December 31st Balance Sheets			
	2015		**2015**
	LC	**XΔ**	**$**
Cash	100	$0.4545	45.5
Accounts receivable	650	$0.4545	295.4
Inventory	1,200	$0.4560	547.2
PP&E	900	$0.4881	439.3
Total Assets	2,850		1,327.4

Temporal Solution

Vibrant December 31st Balance Sheets cont.			
	2015		**2015**
	LC	**XΔ**	**$**
Accounts payable	500	$0.4545	227.3
Current debt	200	$0.4545	90.9
Long-term debt	950	$0.4545	431.8
Total liabilities	1,650		750.0

Net Assets = $1,327.4 – $750.00 = $577.4

Temporal Solution

Vibrant December 31st Balance Sheets cont.			
	2015		**2015**
	LC	**XΔ**	**$**
Common stock	400	$0.5000	200
Retained earnings	800	Plug	377.4
Total equity	1,200		577.4
Total liabilities & equity	2,850		1,327.4

Net Assets = $1,327.4 – $750.00 = $577.4

Temporal Solution

W_1. Reconciliation of retained earnings:

	LC	**XΔ**	**$**
Opening R/E	100	given	50
Net income	700	Plug	327.4
Dividend	(0)	Historic	(0)
Closing R/E	800		377.4

Temporal COGS

W_2	LC	XΔ	$
Beginning Inventory	1,000	$0.5200	520
Purchases (plug)	3,500	$0.4762	1,666.7
Ending inventory	(1,200)	$0.4560	(547.2)
Cost of goods sold	3,300		1,639.5

- EI should be at the historic rate relating to purchases it includes (FIFO, LIFO, and ACVO will impact)

Temporal Solution

I/S 2015	LC	XΔ Rate	$
Sales	5,000	$0.4762	2,381
COGS	(3,300)	W_2	(1,639.5)
Gross profit	1,700		741.5
Other expenses	(400)	$0.4762	(190.5)
Depreciation	(600)	$0.4881	(292.9)
Net income	700		258.1
Remeasurement gain		Plug	69.3
Net Income		W_1	327.4

Financial Reporting and Analysis (1)

Multinational Operations

Temporal vs. Current Rate: Ratios

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Translated (Current Rate) vs. LC Ratios

- No change from translation using Current Rate method for *pure* income statement and balance sheet ratios
- Mixed ratios are distorted
- FX rate changes affect consolidated ratios, even when no "real" change occurs

Compare Temporal to Current Rate

- **Point:** Temporal vs. Current Rate more difficult to analyze than LC vs. Current Rate results
  - Best to analyze ratios individually
  - Numerator and denominator will likely change by different proportions
- **Your job**: Determine whether ratio will be larger or smaller given the choice of accounting methods

Compare Temporal to Current Rate

- **Process**
  - **Step 1**: LC appreciating or depreciating?
  - **Step 2**: Examine numerator
    - Translated at which rate? (current, avg., etc.)
    - Will numerator be larger or smaller?
  - **Step 3**: Examine denominator
    - Same as numerator
  - **Step 4**: Determine impact on ratio

Compare Temporal to Current Rate

Example: Effect on Fixed Asset Turnover with appreciating LC

- **LC appreciating**: end rate > avg. rate > beg. rate
  - Numerator (sales): Translated at avg. rate under **both methods**
  - Denominator (fixed assets): Temporal = historical rate, current rate method = closing rate

Fixed asset turnover is higher under temporal method if the historic rate is lower.

Impact on Ratios – Vibrant Inc.

Ratio	€ LC	Current rate	Temporal
Gross margin	34%	34%	31.1%
Net margin	14%	14%	13.8%
LTD-to-total capital	0.44	0.44	0.43
Current ratio	2.79	2.79	2.79*
Quick ratio	1.07	1.07	1.07

* Could differ due to ending inventory

Impact on Ratios – Vibrant Inc. (cont.)

Ratio	€ LC	Current rate	Temporal
Accts Rec. T/O	7.69	8.1	8.1
Inventory T/O	2.75	2.9	3.0
Asset T/O	1.8	1.8*	1.8*
ROE	58.3%	61.1%	56.7%
ROA	24.6%	25.7%	24.7%

* Could differ due to assets

Financial Reporting and Analysis (1)

Multinational Operations

Hyperinflation

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Hyperinflation

- A hyperinflationary environment = 3-year cumulative compound inflation rate > 100% (U.S. GAAP)
- In hyperinflation, using the Current Rate method results in lower asset and liability values
- Nonmonetary assets and liabilities are not as affected by hyperinflation (disappearing plant)
- U.S. GAAP – Temporal method is required
- IAS – Foreign currency financial statements are restated for inflation and then translated at the current exchange rate

Restating for Inflation (IAS)

1. Nonmonetary assets and liabilities – restate using a price index from acquisition date to balance sheet date. Revalued assets indexed from date of revaluation.
2. Monetary assets and liabilities are not restated
3. Equity is restated by multiplying the change in the index from the beginning of the period, or date of contribution if later, to the balance sheet date

Restating for Inflation (IAS)

4. Revenues and expenses are restated by multiplying the change in the index from the transaction date to the balance sheet date
5. A purchasing power gain or loss is recognized in the income statement based on the net monetary asset or liability exposure
   - Net monetary asset exposure = loss
   - Net monetary liability exposure = gain

Adjusting For Inflation: Example

A subsidiary was created on 31st Dec 2014. LC is the currency of the country in which the foreign sub. is located. Financial data for the subsidiary is shown below:

(in LCs)	2014	2015		2014	2015
Cash	5,000	8,000	Acc. payable	20,000	20,000
Supplies	25,000	25,000	Common stock	10,000	10,000
Total assets	30,000	33,000	Retained earn.	0	3,000
			Liab's + equity	30,000	33,000

Adjusting For Inflation: Example

(in LCs)	2015
Revenue	15,000
Expenses	(12,000)
Net income	3,000

Price indices	
31st Dec 2014	100
31st Dec 2015	150
Average 2015	125

Prepare inflation adjusted balance sheet and income statement for 2015

Adjusting For Inflation: Solution

(in LCs)	2015	Adj. factor	Infl. adjusted
Cash	8,000		8,000
Supplies	25,000	150/100	37,500
Total assets	33,000		45,500
Acc. payable	20,000		20,000
Common stock	10,000	150/100	15,000
Retained earn.	3,000	Plug	10,500
Liab's + equity	33,000		45,500

Adjusting For Inflation: Solution

(in LCs)	2015	Adj. factor	Infl. adjusted
Revenue	15,000	150/125	18,000
Expenses	(12,000)	150/125	14,400
Net purchasing power gain		Plug	6,900
Net Income	3,000		10,500

Beg R/E	0
Net Income	10,500
Dividends	(0)
End R/E	10,500

Similarities of Methods

Temporal Method	Inflation Adjusted F/S
Monetary A/L are exposed to changing exchange rates	Monetary A/L are exposed to risk of inflation
Net monetary liability exposure when foreign currency is depreciating will result in a gain	Net monetary liability exposure in hyper-inflation will result in a purchasing power gain
Gain or loss from changing exchange rates is recognized in the income statement	Purchasing power gain or loss is recognized in the income statement

Financial Reporting and Analysis (1)

Multinational Operations

Tax and Sales Growth

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Multinational Operations and Tax

- Issue = transfer pricing
- Shift profits from high tax rate to low tax rate countries via intercompany transactions
- Countries have laws to prevent aggressive transfer pricing
- Payment of domestic tax on overseas income varies globally
- Tax treaties prevent double taxation – credit granted for overseas tax (United States)

Tax Effects: Example

Item	AMCO	BIANCO
Statutory tax rate	25.0%	30.0%
Effect of disallowed expenses	3.0%	1.0%
Effect of exempt income	(2.0%)	(0.5%)
Effect of taxes in foreign jurisdictions	3.4%	(1.2%)
Effect of recognition of prior losses	(0.8%)	(3%)
Effective tax rate	28.6%	26.3%

Tax Effects: Solution

- The effect of foreign operations resulted in an increase in effective tax rate for AMCO by 3.4% and a decrease for BIANCO by 1.2%. BIANCO benefited from their foreign operations in reducing their effective tax rate and tax expense.
- An increase in foreign operations as a percentage of total revenues would further reduce BIANCO's tax expense in the future and increase AMCO's tax expense in the future.

Earnings Sustainability

1. Organic growth in sales (growth excluding the effects of acquisitions/divestitures and currency effects) are usually more sustainable
2. Currency effects on reported revenues distort sustainable growth estimates
3. Management can affect volume and price but have no control over exchange rates
4. Currency effects can mean revert
5. Remove currency effects for forecasting future revenues

Currency and Sales Growth

Region	%Δ Sales	Currency impact	%Δ Sales excluding currency effects
North America*	3%	-2%	5%
Asia	2%	0%	2%
Europe	2%	3%	-1%

* Excluding U.S.

Comment on the growth rates observed in different markets.

Currency Effects on Profits

- Currency value fluctuations affect a company's reported results due to:
  - Transaction exposure
  - Translation effects

  No requirement to separately disclose
- Disclosures may help analysts in determining the extent of impact of currency effects on financial statements
- IFRS & U.S. GAAP disclosure:
  - Exchange differences in I/S
  - CTA and reconciliation of opening and closing amounts

Analysis of Financial Institutions

Financial Institutions

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Financial Institutions

Financial institutions provide diverse services:

- Financial intermediation
- Facilitate asset risk management
- Execute transactions (securities, derivatives, commodities, real assets)

Focus of reading:

- Banks (deposit-taking, loan-making institutions)
- Insurance companies

Differences From Other Companies

- Systemic importance: interlinked depositors and borrowers, financial institutions, households, corporations, and governments
- Contagion effect
- Bank runs

The big risks

- Regulated: minimum capital requirements, minimum liquidity requirements, limits on risk taking
- Assets: financial assets recorded at fair value

Basel III Purpose

An international framework focused on:

- Improving the banking sectors' ability to absorb shocks
- Improving risk management and governance
- Strengthening banks' transparency and disclosures

Basel Committee developed the framework and monitors adoption by member jurisdictions.

Key Aspects of Regulation

- Risk of global contagion requires globally coordinated rules and oversight (prevention of regulatory arbitrage)
- Basel Committee on Banking Supervision (develops an international regulatory framework)
  1. Minimum capital: based on risk of banks' assets
  2. Minimum liquidity: sufficient liquid assets to meet demand under a 30-day liquidity stress scenario
  3. Stability of funding: proportionate to tenor of banks' assets

Other Global Organizations

1. Financial Stability Board: identifies and manages systemic risks in the financial sector
2. International Association of Deposit Insurers: enhances the effectiveness of deposit insurance
3. IOSCO: fair and efficient securities markets
4. International Association of Insurance Supervisors: maintains fair, safe, and stable insurance markets.

Analysis of Financial Institutions

Capital Adequacy and Asset Quality

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Six Factor Analysis (CAMELS)

1. Capital adequacy
2. Asset quality
3. Management
4. Earnings
5. Liquidity
6. Sensitivity

Framework for banks: deposit takers, loan makers

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Capital Adequacy

- Goal = sufficient capital to absorb potential losses without causing insolvency
- Based on risk-weighted assets (considers: credit risk, market risk, and operational risk)
- More risky assets require higher capital
- Risk weighting specified by individual regulators

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Capital Adequacy: Example

Mega Bank is regulated by the central bank of Zima. The table below gives the central bank's risk weightings:

Asset Type	Risk Weight
Cash and central bank deposits	0%
Corporate loans – performing	100%
Corporate loans – non-performing	200%
Consumer real estate loans	90%

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Capital Adequacy: Example cont.

Analysis of Mega Bank's balance sheet 20x8:

Asset Type	Amount ($'000)
Cash and central bank deposits	120
Corporate loans – performing	1,130
Corporate loans – non-performing	920
Consumer real estate loans	2,450

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Risk Weighted Assets: Solution

Asset Type	Risk Weight	Amount ($'000)	RWA ($'000)
Cash and central bank deposits	0%	120	0
Corporate loans – performing	100%	1,130	1,130
Corporate loans – non-performing	200%	920	1,840
Consumer real estate loans	90%	2,450	2,205
Total			5,175

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Capital Adequacy

- Basel III tiered approach:

Most important

Tier 1:

A. **Common equity**: common stock, APIC, retained earnings, and OCI, *less* intangibles and DTAs
B. Subordinated instruments with no specified maturity and contractual dividends/interest

Tier 2:

Subordinated instruments w/ original maturity > 5 years

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Basel III Rules

- Common equity Tier 1 minimum 4.5% RWA
- Tier 1 capital minimum 6% RWA
- Total capital (Tier 1 + Tier 2) minimum 8% RWA

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Capital Adequacy: Example

Mega Bank's RWA for 20x7 and 20x8 were $4,700,000 and $5,175,000. Analysis of Mega Bank's capital reveals the following:

Capital Type	Amount ($'000) 20x7	20x8
Common equity Tier 1	200	190
Subordinate debt no maturity or interest	85	95
Subordinated debt maturity > 5 years	110	120

Capital Adequacy: Solution

Capital Type	% of RWA 20x7	20x8
Common equity Tier 1	4.26	3.67
Subordinated debt no maturity or interest	1.81	1.84
Total Tier 1	6.07	5.51
Subordinated debt maturity > 5 years	2.34	2.32
Total capital	8.40	7.83

Basel III breaches

Asset Quality

- Evaluates: process of generating and managing assets, as well as risk control
- Evaluation includes existing and potential credit risk

Bank Asset Accounting

Bank loan's carrying value = amortized cost – allowance for losses

Securities	U.S. GAAP	IFRS
Debt	HTM, Available for sale, Trading	Amortized cost, FVOCI, FVTPL
Equity	FVTPL*	FVOCI, FVTPL

* New U.S. GAAP rules effective post 15 Dec 2017

Unlisted equity U.S. GAAP: Cost – impairment

Banks' Balance Sheet Assets

Loans:

- Loans and advances to banks
- Loans and advances to customers
- Reverse repos (collateralized lending)

Assets held for sale:

- Balance sheet long-term assets no longer held for use
- Value driven by disposal

Asset Credit Risk: Factors to Consider

1. Credit risk of loans (counterparty risk)
2. Asset composition: loans, securities, etc.
3. Off-balance sheet items: guarantees, unused committed credit lines, letters of credit
4. Liquidity of assets
5. Diversification of credit risk: across asset types (asset base) and counterparties

Asset Credit Analysis: Example

The following table provides information for loans held by Mega Bank at the end of 20x7 and 20x8:

Loans	$'000	
	20x8	20x7
Very strong credit quality	661	596
Strong credit quality	882	894
Good credit quality	1,488	1,292
Satisfactory credit quality	606	696
Subtotal	3,637	3,478

Asset Credit Analysis: Example cont.

Loans (cont.)	$'000	
	20x8	20x7
Subtotal (previous slide)	3,637	3,478
Substandard credit quality	992	894
Past due but not impaired	276	199
Impaired	441	298
Seriously impaired	165	99
Total gross amount	5,511	4,968

Asset Credit Risk: Solution

Loans	% of Total Loans 20x8	20x7
Very strong credit quality	12%	12%
Strong credit quality	16%	18%
Good credit quality	27%	26%
Satisfactory credit quality	11%	14%
Subtotal	66%	70%

Asset Credit Risk: Solution cont.

Loans (cont.)	% of Total Loans 20x8	20x7
Subtotal (previous slide)	66%	70%
Substandard credit quality	18%	18%
Past due but not impaired	5%	4%
Impaired	8%	6%
Seriously impaired	3%	2%
Total gross amount	100%	100%

Asset Credit Risk: Solution cont.

Conclusions:

- Proportion of high quality (satisfactory and above) has declined by 4%
- Total of loans past due date or impaired has increased by 4%

Loan Loss Provisions and Allowances

- Allowance for loan losses = B/S contra account

  Represents expected losses on balance sheet loan assets
- Charge-offs = bad loans eliminated from balance sheet and charged against allowance (net of recoveries)
- Provision for loan losses = bad debt expense in the I/S = net charge offs + Δ allowance for loan losses

Loan Losses: Example

	$'000	
	20x8	20x7
Total loans	5,511	4,968
Non-performing loans	606	397
Provision for loan losses	122	108
Allowance for loan losses	338	404
Charge-offs	202	178
Recoveries	(14)	(19)
Net charge-offs	188	159

Loan Losses: Example

	$'000	
Loan loss allowance 20x7	404	20x7 contra B/S
Charge-offs	(202)	
Recoveries	14	
Loan loss provision	122	20x8 expense I/S
Loan loss allowance 20x8	338	20x8 contra B/S

Loan Losses: Solution

Key ratios:	20x8	20x7
Allowance for loan losses / Non-performing loans	0.56	1.02
Allowance for loan losses / Net loan charge-offs	1.80	2.54
Provision for loan losses / Net loan charge-offs	0.65	0.68

Loan Losses: Solution

Conclusions:

- Loan loss allowance has declined from 102% of non-performing loans to 56%
- Reduction in loan loss allowance also seen in decline in provision for loan losses to net loan charge-offs declining from 0.68 to 0.65
- Possible under-provision (aggressive accounting)

Analysis of Financial Institutions

Management Capabilities
and Earnings Quality

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Management Capabilities

Quality: ability to exploit profitable opportunities while controlling risk

- Compliance with laws and regulation
- Strong corporate governance: independent board, avoidance of excessive compensation
- Risk management (identification and control)
- Strong internal controls, risk monitoring
- Quality of financial reports

Earnings

- High quality = ROE > r
  - Sustainable
  - Positive trend
  - Unbiased estimates
  - Recurring sources

Estimates and Judgments

- Impairment allowances based on estimated losses:
  - Default assessment
  - Value of collateral

  Assumptions sensitive to economic and credit conditions
- Fair value estimation when not based on market prices
  - Fair value hierarchy based on observability of inputs

Fair Value Hierarchy

Level 1: Quoted market prices of identical assets

Level 2: Inputs observable, but not market prices of identical assets (e.g., quoted price of similar assets, interest rates, spreads, implied volatility)

Level 3: Inputs non-observable and therefore subjective (e.g., model-based valuation based on discounted future cash flows)

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Banks' Major Earning Sources

1. Net interest income ← Typically largest source
2. Service income
3. Trading income ← Most volatile

Higher % for net interest and service income = increased stability

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Analysis of Financial Institutions

Liquidity Position and
Sensitivity to Market Risk

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Liquidity

- Assets: loans with long dated maturities require stable funding, highly liquid assets do not
- Funding sources: long dated deposits are more stable than short term deposits
- Deposits from retail customers are more stable than similar maturity deposits from other counterparties (i.e., corporates)

Liquidity

Basel III 2 minimum liquidity standards:

1. Liquidity Coverage Ratio (LCR)

$$\frac{\text{Highly liquid assets}}{\text{Expected cash outflows}^{*}}$$

*One month liquidity needs in a stress scenario
Minimum LCR = 100%

2. Net Stable Funding Ratio (NSFR)

$$\frac{\text{Available stable funding}}{\text{Required stable funding}}$$

ASF based on funding sources
RSF based on asset base
Minimum NSFR = 100%

Available Stable Funding Components

Focus on maturity and composition

Funding Component	**ASF Factor**
• Regulatory capital *less* Tier 2 instruments maturing < 1 yr • Other capital instruments maturity > 1 yr	100%
• Stable term and demand deposits (maturity < 1 yr) from retail and small business customers	95%
• Less stable demand deposits (maturity < 1 yr) from retail and small business customers	90%

Maturity = residual maturity

Available Stable Funding Components

Funding Component (cont.)	ASF Factor
• Funding from non-financial corporates (maturity < 1 yr) • Operational deposits • Funding from sovereigns, public sector entities, and multilateral and national development banks (maturity < 1 yr) • Other funding (not covered above) with maturity between 6 months and 1 year	50%
• All other liabilities	0%

Other Basel III Metrics

- Concentration of funding:
  - Proportion of funding from a single source
  - Excessive concentration exposure to withdrawal risk
- Contractual maturity mismatch:
  - Asset and liability (funding sources) maturity differences
  - Upwards sloping yield curve: borrow short maturity, lend long maturity
  - Creates liquidity risk

Liquidity Analysis: Example

The following data relates to Mega Bank:

Description	$'000 20x9	$'000 20x8
Highly liquid assets	1,250	1,100
Average monthly withdrawals	900	750
Monthly outflows in a stress scenario	1,300	1,050

Liquidity Analysis: Solution

LCR 20x8 = 1,100 / 1,050 = 104.76%

LCR 20x9 = 1,250 / 1,300 = 96.15%

Conclusions:

Bank's LCR has declined year on year

20x9 LCR below minimum 100% Basel III criteria

Increasing liquidity risk

Sensitivity to Market Risk

Earnings sensitive to market risks:

- Volatility of security prices
- Currency values
- Interest rate changes
- Commodity prices
- Liquidity risk

Derivative positions create off-balance sheet exposures to market risk

Banks disclose earnings sensitivities to different market risks

Sensitivity Risk Measures

Equity: beta

Fixed income: duration and convexity

Options: delta, vega, gamma

Overseas assets: exchange rate risk

VaR

Sensitivity and scenario analysis

Discussed in Portfolio Management

Sensitivity to Interest Rate Risk

- Typically assets > liabilities: an increase in rates increases net interest income
- Interest rate sensitivity factors:
  - Maturity
  - Repricing frequency
  - Reference rates
  - Shaping risk

Analysis of Financial Institutions

Other Factors

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Other Risk Factors

1. Government support
   - Systematic economic risk of failure (SIFIs)
   - Maintain confidence in banking sector
   - Close banks that might fail
   - Assist banks to keep them afloat (TARP)
2. Government ownership
   - Aids financial development
   - Aids public confidence
   - Bailouts (e.g., 2008 financial crisis)

Other Risk Factors

3. Bank Mission
   - Community banks: less diversified, concentrated assets
   - Global banks: better diversified
   - Mission affects management of assets and liabilities
4. Corporate Culture
   - Risk averse vs. risk taking
   - Too risk averse = insufficient returns
   - Too risk loving = boom, bust, volatility

Corporate Culture Evaluation

1. Has the bank generated recent losses from narrow focused investment strategies or over exposure to risky sectors?
2. Accounting restatements due to internal control failures
3. Excessive management compensation linked to stock price performance
4. Speed with which the bank adjusts loan loss provisions to actual loss behavior

General Factors

1. Competitive environment: position relative to peers, growth of market share with little regard to risk
2. Off-balance sheet items:
   - Derivative positions
   - Leases
   - Non-consolidated VIEs/SPEs
   - Assets under management (AUM)

General Factors

3. Segmental disclosure: allocation of capital between the bank's competing functions
4. Currency exposure:
   - Transaction risk
   - Translation risk (subsidiaries)
   - Asset values
   - Derivative contracts
   - Trading positions

Analysis of Financial Institutions

Insurance Companies

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Insurers

1. Property and Causality (P&C): provide protection against adverse events related to homes, cars, and commercial activities (liability insurance)
2. Life and Health (L&H): provide mortality and health-related insurance products; also offer savings products
3. Reinsurance: insure insurers, reimburse insurance companies for claims paid; global business = systemic risk

Insurers

Revenue:

- Premiums
- Income earned on float (premiums not paid out in claims)

Policies:

- Property and Causality (P&C): short term; claims are "lumpier" (based on unpredictable events)
- Life and Health (L&H): longer term; claims are predictable based on actuarial mortality rates

Insurers

Accounting rules:

- Differ from U.S. GAAP and IFRS: greater focus on solvency

Property and Causality (P&C)

- Protect insured parties for losses many times greater than premiums paid
- Act as risk managers and investment companies

Keys to profitability:

1. Prudence in underwriting
2. Pricing of premiums
3. Diversification of risk
4. Reinsurance

 5

Property and Causality (P&C)

- Short policy periods (often annual)
- Property insurance → insures specific assets against loss due to insured events
- Causality insurance → protects against a legal liability due to the occurrence of a covered event
- Multiple peril policy → covers both property and causality losses occurring during a covered event

 6

P&C Profitability

- P&C margins cyclical
  - High competition, price cutting, slim (or negative) profit margins (soft pricing)
  - Soft pricing leads to losses and reduction of capital base
  - Insurers leave industry or stop underwriting new policies
  - Reduced competition, higher margins (hard pricing), and increased capital base
  - Higher margins attract new competition

 7

P&C Profitability

- Direct writers: own sales and marketing staff
  - Higher fixed costs (salaries)
- Agency writers: use agents and insurance brokers
  - Higher variable costs (commissions paid)
- Soft/hard pricing: combined ratio

$$\frac{\text{Total incurred losses + expenses}}{\text{Net premium earned}}$$

High = soft market
Low = hard market
>100% = underwriting loss

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P&C Profitability

- Combined ratio = sum of underwriting loss ratio and expense ratio
- Underwriting loss ratio:

Incurred losses = claims + change of loss reserves

$$\frac{\text{Incurred losses + loss adjustment expenses}}{\text{Net premium earned}}$$

(quality of underwriting activities)

Loss adjustment expenses = cost of investigating claims

P&C Profitability

- Expense ratio (a.k.a. underwriting expense ratio):

$$\frac{\text{Underwriting expenses (incl' commissions)}}{\text{Net premium written}}$$

(efficiency of operations)

Underwriting expenses include:
- Agents' commissions
- Staff salaries
- Marketing expenses
- Overheads

P&C Profitability

- Net premium written: premiums earned over the period of coverage (net of reinsurance)
- Net premium earned: premiums earned over a relevant accounting period
- Note that underwriting loss ratio and expense ratio have different denominators
- U.S. GAAP uses net premium earned for both ratios

Loss Reserves

- Loss reserves = claims that have occurred but not yet been paid out
  - Based on historical data
  - Incorporates estimates of future losses
- Optimistic loss reserves (small) can result in insufficient premiums given the risks borne
- Longer obligation period = harder to estimate loss reserves (changes in the size of court awarded payouts)

Loss Reserves

- Constantly adjusted:
  - downward revision = conservative initial estimates
  - upward revision = aggressive initial estimates
- Revisions could indicate earnings management

Profitability Ratios

1. Dividend to policyholders (shareholders) ratio:

$$\frac{\text{Dividends to policyholders}}{\text{Net premium earned}}$$

2. Combined ratio after dividends (CRAD):

Combined ratio + dividends to policyholders ratio

Profitability Ratios: Example

Andy Miranda is evaluating 3 P&C insurers and collected the following data for the latest fiscal year:

Description ($m)	ABC Inc.	PDQ Inc.	XYZ Inc.
Loss and loss adjustment expense	5,400	3,212	2,467
Underwriting expenses	2,111	1,860	1,387
Dividend to policyholders	412	232	148
Net premiums earned	8,114	5,445	4,087
Net premiums written	8,217	5,348	4,299

Profitability Ratios: Solution

- Loss and loss adjustment expense ratio:

ABC Inc.: $\frac{5{,}400}{8{,}114} = 66.55\%$

PDQ Inc.: $\frac{3{,}212}{5{,}445} = 58.99\%$

XYZ Inc.: $\frac{2{,}467}{4{,}087} = 60.36\%$

Policies priced most profitably relative to risks borne

Profitability Ratios: Solution

- Underwriting expense ratio:

ABC Inc.: $\frac{2,111}{8,217} = 25.69\%$

PDQ Inc.: $\frac{1,860}{5,348} = 34.78\%$

XYZ Inc.: $\frac{1,387}{4,299} = 32.26\%$

Most efficient underwriting operations

Profitability Ratios: Solution

- Combined ratio:

ABC Inc.: 66.55% + 25.69% = 92.24%

PDQ Inc.: 58.99% + 34.78% = 93.77%

XYZ Inc.: 60.36% + 32.26% = 92.63%

Lowest combined costs to premiums = greatest profitability on operating activities

Profitability Ratios: Solution

- Dividends to policyholders (shareholders) ratio:

ABC Inc.: $\frac{412}{8,114} = 5.08\%$

PDQ Inc.: $\frac{232}{5,445} = 4.26\%$

XYZ Inc.: $\frac{148}{4,087} = 3.62\%$

Greatest dividends relative to net premiums earned

Profitability Ratios: Solution

- Combined after dividends (CAD) ratio:

ABC Inc.: 92.24% + 5.08% = 97.32%

PDQ Inc.: 93.77% + 4.26% = 98.03%

XYZ Inc.: 92.63% + 3.62% = 96.25%

Stricter measure of efficiency than combined ratio

P&C Investment Returns

- Uncertainty
  - Risk insured, uncertainty of payouts
  - Competition during hard pricing
- Conservative investment
  - Steady return
  - Low risk
  - Diversification
  - High liquidity

High proportions of fixed income and money market instruments. Low proportions of equity and real estate.

P&C Investment Returns

- Performance evaluation:

$$\text{Total investment return ratio} = \frac{\text{total invesment income}}{\text{invested assets}}$$

Calculated using total investment income with and without unrealized returns

P&C Liquidity

- Uncertainty of payments requires high liquidity
- Use hierarchy of fair value reporting (see CAMELS):
  - Tier 1—traded in liquid markets
  - Tier 2—less liquid
  - Tier 3—illiquid

Capitalization

- Unlike in banking, no international risk-based capital standards exist
- IAIS is developing a risk-based global insurance capital standard
- Jurisdictional standards:
  - EU Solvency II Regime 2014
  - U.S. NAIC risk-based capital requirements 1990

Life and Health Insurance (L&H)

Revenues:

- Premiums
- Provision of investment products
- Investment income

Products (Life Insurance):

- Payout on death to beneficiary within term period
- Provide benefits on death and act as savings vehicles
- Annuities (fixed or variable payments)

Life and Health Insurance (L&H)

Products (Health Insurance):

- Cover specific medical expenses and treatments
- Provide income on injury or sickness

Sales: direct or via agents (agents more expensive but variable cost)

Diversification: revenue sources, product offerings, geographic coverage, distribution channels, and investment assets

L&H Earnings Characteristics

Expenses:

- Benefit payments to policyholders (life insurance)
- Other claims to policyholders
- Annuity payments
- Contract surrenders (contracts that have savings elements)

L&H Earnings Characteristics

Estimates and Assumptions:

- Estimation of future benefits and claims by policyholders (actuarial assumptions)
- Expense impacted by benefits paid and estimated liability for future claims/benefits liability
- Cost of acquiring new and renewal business capitalized and amortized based on actual and estimated future profits
- Mismatches: assets at market value, liabilities at historic cost

L&H Earnings Metrics

- General measures: ROE, ROA, growth, volatility of capital, book value per share, pre and post tax operating margins
- Specific metrics: $\dfrac{\text{total benefits paid}}{\text{net premiums paid + deposits}}$

  $\dfrac{\text{commissions + expenses}}{\text{net premiums paid + deposits}}$

L&H Investment Returns

Key Aspects:	Diversification, performance, interest rate risk and liquidity
Characteristics:	Longer float period and more predictable claims (relative to P&C)
Impact:	Can take more risk
Investments:	Long-term debt, equity, real estate derivatives
Issues:	Duration mismatch (assets and liabilities)
Performance:	$\dfrac{\text{total invesment income}}{\text{invested assets}}$

L&H Liquidity

- Policy surrenders unpredictable but claims/benefits more predictable than P&C
- Liquidity less important than P&C
- Liquidity ratio used by S&P:

  $\dfrac{\text{Liquidity adjusted investment assets}}{\text{Withdrawal adjusted liabilities}}$

  Calculated under normal market conditions and stress scenarios

Capitalization L&H

- Unlike banking, there are no international risk-based capital standards
- Typically, claims considered more predictable
- Result: lower equity cushions and capital requirements
- Many products create exposure to interest rate risk; calculation of risk-based capital factors in interest rate risk

Financial Reporting and Analysis (2)

Evaluating Quality of Financial Reports

Quality of Financial Reports

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Quality of Financial Reports

- **Reporting quality**
  1. Decision useful information
  2. Accurate (GAAP compliant) and relevant
  3. Enables assessment
- **Earnings quality (results quality)**
  1. Return on equity (covers cost)
  2. Sustainable
- Conceptual framework—answers these two questions

Financial Reports Quality

1. GAAP compliant and decision-useful, high-quality earnings
2. GAAP compliant and decision-useful, low-quality earnings
3. GAAP compliant but not decision-useful (biased)
4. Noncompliant accounting
5. Fraudulent accounting

High

Low

Problems Affecting Quality

1. <u>Measurement and timing issues</u>
   - Affect multiple financial statement elements

   Examples:
   - Overly aggressive/conservative revenue recognition
   - Omission or postponement of expense recognition
2. <u>Classification within a financial statement</u>
   - Operating vs. nonoperating items
   - Current vs. noncurrent assets
   - Current vs. noncurrent liabilities

Classification Issues—Examples

1. Selling accounts receivable or treating as a long-term receivable
2. Reclassification of inventory to long-term assets
3. Reclassification of noncore revenues as revenue from core continuing operations
4. Reclassification of operating expenses as nonoperating
5. Treating investing cash flows as operating cash flows (i.e., on asset disposal)

Financial Reporting and Analysis (2)

Evaluating Quality of Financial Reports

Evaluating Earnings Quality, Part 1

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Biased Accounting

1. Mechanisms to misstate profitability:
   - Aggressive revenue recognition, channel stuffing, bill and hold sales, fake sales
   - Lessor use of finance lease classification
   - Classification of nonoperating revenues
   - Classification of operating expenses
   - Channel gains through NI but losses through OCI

Biased Accounting (cont.)

1. **Warning signs of misstated profitability**
   - Revenue growth higher than peers
   - Receivables growth higher than revenue growth
   - High rate of returns from customers
   - Higher Q4 revenues
   - Unexplained boost to operating margins
   - CFO lower than earnings

Biased Accounting (cont.)

1. **Warning signs of misstated profitability** (cont.)
   - Inconsistent classification of operating/nonoperating items over time
   - Aggressive accounting assumptions
   - Executive compensation tied to financial results

Biased Accounting (cont.)

2. Mechanisms to misstate assets/liabilities
   - Model choice and model inputs affecting estimated values
   - Classification from current to noncurrent
   - Over- or understating **allowances** and **reserves**
   - Understating identifiable assets and overstating goodwill in **business combinations**

Biased Accounting (cont.)

2. Warning signs of misstated assets/liabilities
   - Inconsistency in model inputs for valuation of assets vs. liabilities
   - Typical current assets being treated as noncurrent
   - Allowances and reserves either out of line with peers or fluctuating
   - High goodwill relative to total assets
   - Use of SPEs

Biased Accounting (cont.)

2. Warning signs of misstated assets/liabilities cont.
   - Off-balance-sheet liabilities
   - Fluctuating deferred tax assets/liabilities

Biased Accounting (cont.)

3. Mechanisms to overstate cash flow from operations (CFO or OCF)
   - Managing activities to affect CFO
   - Misclassifying cash flow into CFO

Biased Accounting (cont.)

3. **Warning signs of overstated OCF**
   - Increases in payables combined with decreases in inventory and receivables
   - Capitalized expenditures (CFI, not CFO)
   - Sale and lease back transactions
   - Increases in bank overdraft

Business Combinations

Business combination issues:

- **Motivation**: Boost declining CFO?
- Stock based acquisitions:
  - Acquirer incentive to boost stock price using aggressive accounting
  - Target incentive to boost stock price prior to acquisition (maximize sales price)
- Pursuing **acquisitions to hide pre-acquisition accounting irregularities**

Business Combinations (cont.)

Business combination issues:

- Understating identifiable acquired net assets to **boost goodwill** (and future earnings)

Failing to Reflect Economic Substance

Issue: Compliance with relevant GAAP but not reflecting **economic substance**

Example: avoidance of consolidating SPEs (Enron) prior to Fin 46(R)

Restructuring provisions and impairments:

- Overstatement of earnings in prior periods
- Provisions enable early recognition of future expenses
- Impairments boost future earnings via lower depreciation
- Reversal of provisions boost future earnings

Financial Reporting and Analysis (2)

Evaluating Quality of Financial Reports

Evaluating Earnings Quality, Part 2

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Steps in Evaluation

1. Understand the company, industry, accounting principles, and appropriateness
2. Understand the management, remuneration packages, insider trades, and related party transactions
3. Identify material accounting areas open to subjectivity and estimation

continued…

Steps in Evaluation (cont.)

4. Make cross sectional and time series comparisons of statements and ratios
5. Check for warning signs
6. Conglomerates: check segmental disclosure for shifting profits (transfer pricing)
7. Use quantitative tools to evaluate likelihood of earnings management

The Beneish Model

Probit regression model estimating the probability of earnings manipulation using eight variables:

M-score = –4.84 + 0.920 (DSRI) + 0.528 (GMI) + 0.404 (AQI) + 0.892 (SGI) + 0.115 (DEPI) – 0.172 (SGAI) + 4.67 (Accruals) – 0.327 (LEVI)

M-score > –1.78 = possible earnings management

The Beneish Model (cont.)

Limitations

- Relies on accounting data that may not reflect economic substance
- Gaming the model—predictive power decreasing

Evaluating Quality of
Financial Reports

The Beneish Model – 8 Inputs

- DSRI = days' sales receivables index:

$$\frac{\text{days' sales outstanding}_T}{\text{days' sales outstanding}_{T-1}}$$

- GMI = gross margin index:

$$\frac{\text{gross margin}_{T-1}}{\text{gross margin}_T}$$

Evaluating Quality of
Financial Reports

The Beneish Model – 8 Inputs (cont.)

- AQI = asset quality index:

$$\frac{\left(\text{Noncurrent assets} / \text{total assets}\right)_T}{\left(\text{Noncurrent assets} / \text{total assets}\right)_{T-1}}$$

- SGI = sales growth index:

$$\frac{\text{sales}_T}{\text{sales}_{T-1}}$$

Evaluating Quality of
Financial Reports

The Beneish Model – 8 Inputs (cont.)

- DEPI = depreciation index: depreciation rate =

$$\frac{\text{depreciation rate}_{T-1}}{\text{depreciation rate}_T} \qquad \frac{\text{depr}^n \text{ expense}}{\text{depr}^n \text{ expense+PP\&E}}$$

- SGAI = sales, general, and administrative expenses index:

$$\frac{\left(\text{SG\&A expense} / \text{sales}\right)_T}{\left(\text{SG\&A expense} / \text{sales}\right)_{T-1}}$$

The Beneish Model—8 Inputs (cont.)

- LEVI = leverage index:

$$\frac{\left(\text{total debt}/\text{total assets}\right)_T}{\left(\text{total debt}/\text{total assets}\right)_{T-1}}$$

- Accruals (highest weighting in model):

$$\frac{\text{income before extraordinary items} - \text{CFO}}{\text{total assets}}$$

Beneish Model Interpretation

Beneish's M-score analysis for Pattern Processors Inc (PPI) is shown below:

Variable	Value	Variable	Value
DSRI	1.19	SGAI	0.78
GMI	0.88	Accruals	0.12
AQI	0.90	LEVI	0.55
SGI	1.12	M-score	-1.53
DEPI	1.19	Probability	9.58%

The Altman Model

- Discriminant model used to assess likelihood of bankruptcy
- Five variables to produce a Z-score
- Single period model using accounting data

Variables:

1. Working capital/total assets
2. Retained earnings/total assets
3. Operating profit/total assets
4. Market value of equity/BV of liabilities
5. Sales/total assets

Higher values = higher Z-score = lower bankruptcy risk

Low Quality Earnings

- Low quality earnings:
  1. Earnings < cost of capital
  2. Not sustainable
  3. Financial reporting quality poor (does not reflect firm's economic performance)

Low Quality Earnings (cont.)

- Nonsustainable earnings:
  - High proportion of nonrecurring items
  - Gaming: **classification shifting**
  - Beware of operating margin improvements coupled with unusual and infrequent items
  - Review proforma versus reported income

Earnings Persistence Regression

- Basic model: $\boxed{\text{earnings}_{T+1} = \alpha + \beta_1 \text{earnings}_T + \varepsilon}$
- Accruals model:

$$\text{earnings}_{T+1} = \alpha + \beta_1 \text{cash flow}_T + \beta_2 \text{ accruals}_T + \varepsilon$$
$$\beta_1 > \beta_2$$

  - Accruals-based earnings can be categorized as discretionary or nondiscretionary accruals
- **Other indicators:**
  - Consistently just-beating consensus estimates
  - SEC enforcement actions and restatements

Mean Reversion—Earnings

- Earnings at extreme levels mean revert:
  - Earnings > cost of capital = economic profit
  - Economic profit attracts competition
  - Economic losses eliminated by abandoning negative value projects
  - Earnings generated by **accruals** will reverse (e.g., earnings generated from unrealistically low depreciation rates should be reversed by future impairments or losses on disposal)

Evaluating Earnings Quality

- **Revenue recognition issues**
  - Subjective area
  - Evaluate quantity and quality

Concerns:
  - Accelerated revenue (long-term contracts)
  - Channel stuffing
  - Bill-and-hold sales
  - Fake sales
  - Related party transactions
  - Collectability of credit sales – DSO increases
  - Deterioration of margins – discounting

Evaluating Earnings—Example

Daniel Springs Inc (extracts F/S data)	20x1	20x2	20x3
	$	$	$
Sales	12,117	13,112	14,766
AR	1,272	1,573	2,363

Industry Averages	20x1	20x2	20x3
DSO	22.6 days	22.8 days	22.4 days
AR T/O	16.2	16.0	16.3

1. Compute the increase in revenues and receivables
2. Comment on the trend in DSO and receivables turnover
3. Comment on potential revenue recognition issues

Evaluating Earnings—Solution

Daniel Springs Inc. (analysis)	20x1	20x2	20x3
Change in sales	–	8.2%	12.6%
Change in receivables	–	23.7%	50.2%
Receivables/Revenue	10.5%	12.0%	16.0%
Change in Rec/Rev	–	14.3%	33.3%
DSO	38.3 days	43.8 days	58.4 days
Receivable turnover	9.5	8.3	6.3

Evaluating Earnings—Solution

Warning signs

- Growth in AR greater than sales growth
- DSO greater than industry norms and increasing

Conclusions

- Possible credit control issues (low quality of receivables)
- Possible fake sales/low quality sales
- Revenues of DSI are potential inferior quality

Steps in the Analysis

- **Analysis of revenue recognition practices:**
  1. Understand the revenue recognition practices
     - Shipping/credit terms
     - Returns policy
     - Multiple deliverables
     - Practices of peer group companies
  2. Evaluate ageing of receivables
     - Time series
     - Cross-sectional (peer group) comparison

Steps in the Analysis (cont.)

- **Analysis of revenue recognition practices:**
  3. Cash vs. accruals
     - Cash- vs. accruals-based earnings evaluation
  4. Compare financials with physical data provided by the company:
     - Capacity utilization levels, order books
  5. Compare revenue trends to peers:
     - Use segmental analysis

Steps in the Analysis (cont.)

- **Analysis of revenue recognition practices:**
  6. Check for related party transactions
  - Transactions with associates
  - Transfer pricing

Capitalizing Expenses

- **Incorrect capitalization:**
  - Expense missing from I/S
  - Long-lived asset created in B/S
  - Defers cost recognition in I/S

Warning signs

- PP&E/total assets increases
- Margin improvement
- Deterioration in asset T/O
- Increases in capex/gross PP&E
- Capex growth > sales growth

Capitalizing Expenses

- **Analysis of expense recognition practices:**
  1. Review cost capitalization disclosures, depreciation disclosures, and compare to peers
  2. Evaluate changes in noncurrent assets, margins, depreciation expense/rate, and capex
     - Time series
     - Cross sectional

Capitalizing Expenses (cont.)

- **Analysis of expense recognition practices:**
  3. Check for related party transactions
     - Shifting assets to associates
     - Propping up earnings

Financial Reporting and Analysis (2)

Evaluating Quality of Financial Reports

Evaluating Cash Flow Quality

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Cash Flow Quality

- High quality operating cash flows (CFO):
  - CFO positive and sustainable
  - CFO > capex + debt service + dividends
- Manipulation:
  - Classification between CFO, CFI, and CFF
  - IFRS flexibility: dividends, interest
  - Working capital management:
    - Delaying payments to suppliers
    - Reducing inventory levels
    - Selling AR

Cash Flow Quality (cont.)

- Analysis of cash flow quality:
  1. Review for unusual items
  2. Check for revenue quality:
     - Outflows due to increased AR
     - Outflows due to inventory increases when fake sales are reversed
  3. Provisions:
     - Provisions for restructuring—cash inflow when created

Balance Sheet Quality

1. **Completeness:**
   - Lack of off balance sheet finance:
     - Operating leases
     - Take or pay, or throughput agreements
   - Equity accounted associates

Balance Sheet Quality (cont.)

2. **Unbiased measurement:**
   - Pension liability
   - Value of illiquid investments
   - Goodwill impairment
   - Inventory valuation and write downs
   - Impairment of PP&E and intangibles

   Subjective inputs

3. **Clear presentation**

Sources of Information About Risk

- Financial statements
- Audit report (size and change of audit firm)
- Notes to financial statements
  - Disclosure of accounting principles
  - Disclosure of changes to accounting estimates
  - Disclosures on liability amounts and timings
  - Contingent liability disclosure
  - Financial instrument disclosure (credit risk, liquidity risk, market risk, and pension assumptions)

Sources of Information About Risk (cont.)

- Management discussion and analysis
  - Principal risks unique to business
  - Often low utility
  - Unaudited
- SEC form NT
  - Filed if company is unable to file required financial statements in time

Sources of Information About Risk (cont.)

- Financial press
  - Must conduct own due diligence

Financial Reporting and Analysis (2)

Evaluating Quality of Financial Reports

Evaluating Balance Sheet Quality

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Balance Sheet Quality

1. **Completeness:**
   - Lack of off balance sheet finance:
     - Operating leases
     - Take or pay, or throughput agreements
   - Equity accounted associates

Balance Sheet Quality (cont.)

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Evaluating Quality of
Financial Reports

Sources of Information About Risk (cont.)

- Financial press
  - Must conduct own due diligence

Financial Reporting and Analysis (2)

Integration of Financial Statement Analysis

Framework For Analysis

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Foundation Concepts

- Note: Many of the "adjustments" mentioned in this topic review are discussed elsewhere in the curriculum at levels I and II
- The point of this topic review is to "put it all together" (i.e., to detail how to take the individual adjustments and restate the financial statements) before calculating ratios

Framework for Analysis

1. Establish the objectives
   - **Input**
     - Analyst's perspective (evaluate a debt or equity investment, or establish a credit rating)
     - Needs communicated by client or supervisor
     - Institutional guidelines

Framework for Analysis (cont.)

1. Establish the objectives (input and output)
   - **Output**
     - Purpose statement and specific questions to be answered
     - Nature and content of final report
     - Timetable and budget

Framework for Analysis (cont.)

2. Data collection
   - **Input**
     - Financial statements
     - Communication with management, suppliers, customers, and competitors
   - **Output**
     - Organized financial information

Framework for Analysis (cont.)

3. Processing the data from Step 2
   - **Output**
     - Adjusted financial statements
     - Common-size statements
     - Ratios
     - Forecasts

Framework for Analysis (cont.)

4. Analyzing the data from Steps 2 & 3
   - **Output**
     - Results of analysis
5. Develop and communicate conclusions
   - **Input**
     - Results from analysis using report guidelines
   - **Output**
     - Recommendations

Framework for Analysis (cont.)

6. Follow-up
   - **Input**
     - Periodically update information
   - **Output**
     - Update analysis and recommendations

Analysis

- Earnings sources and performance
- Asset base
- Capital structure
- Capital allocation decisions
- Earnings quality and cash flow analysis
- Market value decomposition
- Off-balance-sheet financing
- Anticipating changing accounting standards

Financial Reporting and Analysis (2)

Integration of Financial Statement Analysis

Earnings Sources and Performance

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Earnings Sources and ROE

- Assess the firm's performance drivers by decomposing ROE using the extended DuPont equation

Tax burden, Interest burden, EBIT margin, Asset turnover, Financial leverage

$$ROE = \underbrace{\frac{NI}{EBT}}_{\text{Tax burden}} \times \underbrace{\frac{EBT}{EBIT}}_{\text{Interest burden}} \times \underbrace{\frac{EBIT}{Revenue}}_{\text{EBIT margin}} \times \underbrace{\frac{Revenue}{Average\ assets}}_{\text{Asset turnover}} \times \underbrace{\frac{Average\ assets}{Average\ equity}}_{\text{Financial leverage}}$$

Earnings Sources and ROE (cont.)

- Determine whether the firm's earnings are generated internally (from operations), from acquisitions, or from investment income from associates (equity method)
- Adjustment
  - Remove equity method income and the investment asset from the extended DuPont equation

Earnings Sources and ROE (cont.)

- Equity method earnings after the tax line

NI – equity accounted earnings

Typical = leave unadjusted unless the financing of the investment is known

$$ROE = \frac{NI_{adj}}{EBT} \times \frac{EBT}{EBIT} \times \frac{EBIT}{Revenue} \times \frac{Revenue}{Average\ assets_{adj}} \times \frac{Average\ assets}{Average\ equity}$$

Assets – carrying value of equity accounted investment

Earnings Sources: Example

Thunderbird Corp. (extracts)	2016 $m	2015 $m	2014 $m
Revenue	75,286	68,921	63,781
EBIT	10,517	9,311	8,313
EBT	9,463	8,474	7,258
Earning from associates	896	674	627
Net Income	7,967	6,894	6,023

Earnings Sources: Example

Thunderbird Corp. (extracts)	2016 $m	2015 $m	2014 $m	2013 $m
Total Assets	80,261	71,264	71,093	61,731
Inv in Associates	6,255	5,901	4,951	3,638
Stockholders' equity	37,964	36,994	34,348	27,382

Earnings Sources: Example

Extended DuPont Analysis (as reported)

	Tax burden %	×	Interest burden %	×	EBIT margin %	×	Total asset T/O	×	Financial leverage	=	ROE %
2014	82.98	×	87,31	×	13.03	×	0.955	×	2.165	=	19.51
2015	81.35	×	91.01	×	13.51	×	0.963	×	2.007	=	19.33
2016	84.19	×	89.98	×	13.97	×	0.994	×	2.021	=	21.26

Earnings Sources: Solution

Adjusted tax burden[1]	2016 $m	2015 $m	2014 $m
Net Income	7,967	6,894	6,023
Earning from associates	(896)	(674)	(627)
Adj' Net Income	7,071	6,220	5,396
÷ EBT	9,463	8,474	7,258
= Adj' Tax burden %	74.72	73.40	74.35

Earnings Sources: Solution

Adjusted total asset turnover[2]	2016 $m	2015 $m	2014 $m	2013 $m
Total assets	80,261	71,264	71,903	61,731
Inv in Associates	(6,255)	(5,901)	(4,951)	(3,638)
Adj assets	74,006	65,363	66,952	58,093
Average assets	69,685	66,158	62,523	
Revenue	75,286	68,921	63,781	
Adj Asset turnover	1.080	1.042	1.020	

Earnings Sources: Solution

Extended DuPont Analysis (excluding associate)

	Tax burden[1] %	×	Interest burden %	×	EBIT margin %	×	Total asset T/O[2]	×	Financial leverage	=	ROE %
2014	74.35	×	87.31	×	13.03	×	1.020	×	2.165	=	18.68
2015	73.40	×	91.01	×	13.51	×	1.042	×	2.007	=	18.87
2016	74.72	×	89.98	×	13.97	×	1.080	×	2.021	=	20.51

Financial Reporting and Analysis (2)

Integration of Financial Statement Analysis

Evaluation of Asset Base and Capital Structure

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Asset Base

- Examine the composition of the balance sheet assets over time
  - Common-size analysis is helpful
  - Useful in identifying acquisitions and goodwill
  - Recall that goodwill is no longer amortized but subject to impairment

Asset Base: Example

$m	2016		2015		2014	
Current assets	25,039	31.2%	24,714	34.7%	29,236	40.7%
PP&E	15,445	19.2%	14,161	19.9%	13,293	18.5%
Identifiable intangibles	5,052	6.3%	2,641	3.7%	1,996	2.8%
Goodwill	23,396	29.1%	19,959	28.0%	18,893	26.3%
Other noncurrent assets	11,329	14.1%	9,789	13.7%	8,485	11.8%
Total assets	80,261		71,264		71,903	

Capital Structure

- The capital structure must support management's strategic objectives and allow the firm to honor its future obligations
- Examine long-term debt-to-total capital
- Some liabilities are less onerous than others and may not necessarily require an outflow of cash
  - Employee benefit obligations
  - Deferred taxes
  - Restructuring provisions

Capital Structure: Example

$m	2016		2015		2014	
LTD	4,290	8.6%	4,866	10.0%	5,794	12.4%
Other long-term liab.	7,679	15.4%	6,669	13.7%	6,663	14.2%
Stockholders equity	37,964	76.0%	36,994	76.2%	34,348	73.4%
Total long-term capital	49,933		48,529		46,805	

Working Capital

Thunderbird selected data	2016 $m	2015 $m	2014 $m	2013 $m
Cash & equivalents	4,616	3,695	3,261	3,431
Marketable securities	2,031	4,338	8,915	7,266
Accounts receivable	10,795	10,204	10,004	8,266
Inventories	6,490	5,620	5,713	4,918
Other current assets	1,107	857	1,343	818
Current Assets	25,039	24,714	29,236	24,699

Working Capital cont.

Thunderbird selected data	2016 $m	2015 $m	2014 $m	2013 $m
Accounts payable	9,925	8,800	7,782	6,352
Notes payable	17,179	10,846	13,189	10,305
Other current liabilities	3,224	3,089	4,127	3,732
Current liabilities	30,328	22,735	25,098	20,389

Working Capital cont.

Thunderbird selected data	2016 $m	2015 $m	2014 $m
Revenue	75,286	68,921	63,781
Cost of goods sold	31,526	28,499	26,542
Purchases	32,396	28,406	27,337
Ave. daily expenditure	173.3	159.5	148.4

Working Capital Ratios

Thunderbird ratios	2016	2015	2014
Current ratio	0.83	1.09	1.16
Quick ratio	0.58	0.80	0.88
Defensive interval	100.6	114.3	149.4
DSO	50.9	53.5	52.3
DOH	70.1	72.6	73.1
Days' payables	(105.5)	(106.5)	(94.4)
Cash conversion cycle	15.5	19.6	31.0

Financial Reporting and Analysis (2)

Integration of Financial Statement Analysis

Capital Allocation: Segmental Analysis

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Capital Allocation Decisions

- Consolidation can hide the individual characteristics of dissimilar subsidiaries
- Firms must disaggregate financial information into segments to assist users
- Segment disclosures are valuable in identifying:
  - Revenue and profit by segment
  - The relationship between capital expenditures and returns
  - Segments that should be de-emphasized

Segmental Analysis

Reportable business or geographic segment:

50% of its revenue from sales external to the firm **and** at least 10% of a firm's revenue, earnings, or assets:

- For each segment, firm reports *limited* financial statement information.
- For primary segments, must report revenue (internal and external), operating profit, assets, liabilities (IFRS only), capex, depreciation, and amortization.

Divisional Analysis

Compute

- % of revenue from each division
- % of assets used by each division
- % of operating profit (EBIT) contributed by each division
- % of capex attributed to each division
- Divisional margin $\boxed{\dfrac{\text{Segment EBIT}}{\text{Segment sales}}}$
- Resource allocation $\boxed{\dfrac{\text{\% capex}}{\text{\% assets}}}$

Segmental Analysis

- If ratio of proportional capex to proportional assets is greater than 1:
  - Firm is growing the segment by allocating more resources to the segment
- If ratio of proportional capex to proportional assets is less than 1:
  - Firm is allocating less resources to the segment
  - If trend continues, the segment will become less significant over time

Revenue by Segment

Revenue $m	2016		2015		2014	
Aircraft	11,027	14.6%	8,856	12.8%	7,863	12.3%
Automotive	34,631	46.0%	32,754	47.5%	30,276	47.5%
Marine	22,345	29.7%	20,566	29.8%	19,491	30.6%
Speciality	7,283	9.7%	6,745	9.8%	6,151	9.6%
	75,286		68,921		63,781	

EBIT by Segment

EBIT $m	2016		2015		2014	
Aircraft	2,440	23.2%	1,955	21.0%	1,696	20.4%
Automotive	5,059	48.1%	4,674	50.2%	4,115	49.5%
Marine	2,482	23.6%	2,160	23.2%	2,020	24.3%
Speciality	536	5.1%	522	5.6%	482	5.8%
	10,517		9,311		8,313	

Assets by Segment

Assets* $m	2016		2015		2014	
Aircraft	14,777	27.5%	6,861	15.4%	5,288	12.8%
Automotive	20,059	37.4%	19,553	43.9%	19,166	46.6%
Marine	12,310	22.9%	11,927	26.8%	10,779	26.2%
Speciality	6,509	21.1%	6,219	14.0%	5,928	14.4%
	53,655		44,560		41,161	

**Not equal to total assets due to unallocated and non-segment assets*

Capital Expenditure by Segment

Capex $m	2016		2015		2014	
Aircraft	383	11.3%	336	11.8%	240	10.4%
Automotive	1,432	42.3%	1,199	42.1%	1,018	44.3%
Marine	841	24.8%	667	23.4%	618	26.9%
Speciality	730	21.6%	646	22.7%	421	18.3%
	3,386		2,848		2,297	

Analysis by Segment

Analysis	EBIT Margin			Capex%/Asset%		
	2016	2015	2014	2016	2015	2014
Aircraft	22.1%	22.1%	21.6%	0.41	0.77	0.81
Automotive	14.6%	14.3%	13.6%	1.13	0.96	0.95
Marine	11.1%	10.5%	10.4%	1.08	0.87	1.03
Speciality	7.4%	7.7%	7.8%	1.79	1.62	1.27

Depreciation & Estimated Cash flow by Segment

$m	Depreciation & Amortization			Estimated cash flow		
	2016	2015	2014	2016	2015	2014
Aircraft	172	165	142	2,612	2,120	1,838
Automotive	644	590	603	5,703	5,264	4,718
Marine	377	328	366	2,859	2,488	2,386
Speciality	329	318	251	865	840	733
Total	1,522	1,401	1,362	12,039	10,712	9,675

Estimated cash flow = EBIT + Depreciation/Amortization

Analysis by Segment

Analysis	Cash flow/Average assets		EBIT Margin	
	2016	2015	2016	2015
Aircraft	24.1%	34.9%	22.1%	22.1%
Automotive	28.8%	27.2%	14.6%	14.3%
Marine	23.6%	21.9%	11.1%	10.5%
Speciality	13.6%	13.8%	7.4%	7.7%

Financial Reporting and Analysis (2)

Integration of Financial Statement Analysis

Earnings Quality and Cash Flow Analysis

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Earnings Quality

- Persistent and sustainable earnings are considered "high quality"
- Earnings can be disaggregated into cash flow and accruals using:
  - Balance sheet approach
  - Cash flow statement approach
- Measure earnings quality using the ratio of accruals to average net operating assets
  - Interpretation: Lower ratio, higher quality

Measuring Earnings Quality

Earnings have a cash flow component and an accrual component:

Aggregate accruals = Accrual based earnings – Cash earnings

Aggregate accruals can be measured using either:

- Balance sheet approach
- Cash flow statement approach

Inverse relationship between accruals and earnings quality

Balance Sheet Based Accruals

$$\text{Net operating assets (NOA)} = (\text{Total assets} - \text{cash*}) - (\text{Total liabilities} - \text{total debt})$$

$$\text{Aggregate accruals} = NOA_t - NOA_{t-1}$$

$$\text{Accruals ratio} = \frac{\text{Aggregate accruals}}{(NOA_t + NOA_{t-1}) / 2}$$

**Also includes cash equivalents and marketable securities*

Net Operating Assets (NOA)

$m	2016	2015	2014
Total assets	80,261	71,264	71,903
Cash and securities	(6,647)	(8,033)	(12,176)
Operating assets	73,614	63,231	59,727
Total liabilities	42,297	34,270	37,555
Debt (ST & LTD)	(21,469)	(15,712)	(18,983)
Operating liabilities	20,828	18,558	18,572

Balance Sheet Aggregate Accruals

$m	2016	2015	2014
Operating assets	73,614	63,231	59,727
Operating liabilities	(20,828)	(18,558)	(18,572)
NOA	52,786	44,673	41,155
Aggregate accruals	8,113	3,518	6,541*

*2013 NOA = $34,614

Cash Flow Based Accruals

$$\boxed{\text{Aggregate accruals}} = \boxed{\text{NI} - (\text{CFO}_t + \text{CFI}_t)}$$

Issue—different treatment of Interest and dividends under IAS and U.S. GAAP

$$\boxed{\text{Accruals ratio}} = \boxed{\frac{\text{Aggregate accruals}}{(\text{NOA}_t + \text{NOA}_{t-1}) / 2}}$$

Cash Flow Based Accruals

$m	2016	2015	2014
Net Income	7,967	6,894	6,023
Less: CFO	9,407	8,173	7,144
Less: CFI	(11,027)	(7,364)	(3,261)
Aggregate accruals	9,587	6,085	2,140

Accruals Ratio

$m	2016	2015	2014
Balance sheet approach:			
BS Accruals / Ave NOA	8,113 / 48,730 = 16.6%	3,518 / 42,914 = 8.2%	6,541 / 37,885 = 17.3%
Cash flow approach:			
CF Accruals / Ave NOA	9,587 / 48,730 = 19.7%	6,085 / 42,914 = 14.2%	2,140 / 37,885 = 5.6%

Cash Flow Analysis

- Determine whether earnings are confirmed with cash flow
  - Adjust operating cash flow (OCF) by adding-back cash interest and cash taxes if included = CGO
  - Compare adjusted OCF to operating income (EBIT)
- Calculate cash basis ratios:
  - Cash flow return on assets
    - OCF / average total assets
  - Operating earnings quality
    - Adjusted OCF (CGO) / EBIT

Cash Flow Analysis (cont.)

- Calculate cash basis ratios:
  - Cash flow to reinvestment
    - Adjusted OCF (CGO) / capital expenditures
  - Cash flow interest coverage
    - Adjusted OCF (CGO) / cash interest
  - Cash flow to total debt
    - Adjusted OCF (CGO) / total debt

Cash Generated From Operations (CGO)

$m	2016	2015	2014
CFO	9,407	8,173	7,144
Plus: Cash interest paid	552	419	306
Plus: Cash taxes paid	2,150	1,968	1,778
CGO	12,109	10,560	9,228

Cash Flow Analysis

$m	2016	2015	2014
Operating earnings quality:			
$\frac{\text{CGO}}{\text{EBIT}}$	$\frac{12,109}{10,517} = 1.15$	$\frac{10,560}{9,311} = 1.13$	$\frac{9,228}{8,313} = 1.11$
Cash return on total assets:			
$\frac{\text{CGO}}{\text{Ave Assets}}$	$\frac{12,109}{75,763} = 16.0\%$	$\frac{10,560}{71,584} = 14.8\%$	$\frac{9,228}{66,817} = 13.8\%$

Cash Flow Analysis

$m	2016	2015	2014
Cash flow to reinvestment:			
$\frac{\text{CGO}}{\text{Capex}}$	$\frac{12,109}{3,386} = 3.6$	$\frac{10,560}{2,848} = 3.7$	$\frac{9,228}{2,297} = 4.0$
Cash flow to total debt:			
$\frac{\text{CGO}}{\text{Total debt}}$	$\frac{12,109}{21,469} = 56.4\%$	$\frac{10,560}{15,712} = 67.2\%$	$\frac{9,228}{18,983} = 48.6\%$

Cash Flow Analysis

$m	2016	2015	2014
Cash flow interest coverage:			
$\frac{\text{CGO}}{\text{Interest paid}}$	$\frac{12,109}{552} = 21.9$	$\frac{10,560}{419} = 25.2$	$\frac{9,228}{306} = 30.2$

Financial Reporting and Analysis (2)

Integration of Financial Statement Analysis

Market Value Decomposition

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Market Value Decomposition

- Determine the implied value of the parent excluding the value of associates
- × Market capitalization of parent
  – Parent's share of associates' market cap
  = Implied value of parent
- Note: It may be necessary to convert the associates' market cap to the parent's reporting currency at the current exchange rate

Market Value Decomposition (cont.)

- Next, determine the implied P/E of the parent by eliminating the associates' income from the parent

$$= \frac{\text{Implied value of parent excluding associates}}{\text{Net income} - \text{Parent's share of associates' earnings}}$$

- Note: It may be necessary to convert the associates' earnings to the parent's reporting currency using the average exchange rate

Market Value Decomposition

Details of Thunderbird's Associate: 30% interest in Eagle Corporation, a European listed firm.

Market data	
Market capitalization: Thunderbird	$137bn
Market capitalization: Eagle	€60bn
Year end $/€	1.40
Net Income	$8bn
Equity a/c income	$896m

Market Value Decomposition

Unadjusted and adjusted P/E ratios

Thunderbird unadjusted P/E:

$$\frac{\text{Market Cap}}{\text{Earnings}} \quad \frac{\$137\text{bn}}{\$8\text{bn}} = 17.1$$

Thunderbird core P/E:

$$\frac{\text{Adj. Market Cap}}{\text{Adj. earnings}} \quad \frac{(\$137\text{bn} – \$25.2\text{bn})}{(\$8\text{bn} – \$0.896\text{bn})} = 15.7$$

Thunderbird's share pro-rata share of Eagle's market capitalization:

€60bn × 30% × \$1.40 = \$25.2bn

S&P Multiple: 20.1

Thunderbird

Support	Concerns
Growth in earnings: organic, acquisitions, and associate	Potential earnings manipulation: increased accruals ratio
ROE positive and growing	
Earnings supported by cash flow	Over allocation of resources to underperforming divisions
Cash flow supports capex	
Low leverage	Future impairment of goodwill
Cash return on assets growing	
Core P/E potential undervaluation?	

Corporate Finance (1)

Capital Budgeting

Cash Flow Estimation

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Capital Budgeting Principles

- Decisions based on incremental A-T cash flows, not accounting income
  - **Sunk costs:** Not incremental
  - **Externalities:** Incremental
- Cash flow **timing** is important (Think: TVM)
- **Important point: Financing costs** reflected in required return
  - Treat projects as if *all equity* financed

Incremental Project Cash Flows

Cash flows are evaluated in 3 stages:

- Initial investment outlay (Outlay)
- After-tax operating cash flow over project's life (OCF)
- Terminal-year cash flow (TNOCF)

1. Initial Investment Outlay (Outlay)

Cost of fixed capital

Outlay = FCInv + NWCInv

Δnon-cash current assets – Δnon-debt current liabilities
Cash outflow if > 0
Cash inflow if < 0

2. After-Tax Operating Cash Flow (CF)

Sales

Depreciation expense

$CF = (S - C - D)(1 - T) + D$

Cash operating expenses

Marginal tax rate

Same:
Choose one

$CF = (S - C)(1 - T) + (T \times D)$

3. Terminal Year After-Tax Non-Operating Cash Flows (TNOCF)

Pre-tax cash proceeds from sale of fixed capital

$TNOCF = Sal_T + NWCInv - T(Sal_T - B_T)$

Recovery of NWCInv

Book value of fixed capital

Example: Expansion Project

- **Mayco's expansion plan (tax rate of 40% and r = 12%)**:
  - Building ($24,000); equipment ($16,000)
  - MACRS depreciation (for both): Year 1 = $3,512; Year 2 = $5,744; Year 3 = $3,664; Year 4 = $2,544
  - Working capital increase of $12,000
  - Project life of four years. SV: building—$15,000 (BV $21,816); equipment—$4,000 (BV $2,720)
  - Revenues and costs of $80,000 and $58,000 per year

(cont.)

Solution: Expansion Project

Step 1: Calculate the initial outlay

Equipment cost

Outlay = $24k + $16k + $12k = $52,000

Building cost

Increase in working capital

Solution: Expansion Project

Step 2: Calculate the operating cash flow for each year of the project

(Revenues – expense)(1-T) | Depreciation tax shield

Year 1 CF = ($80,000 – $58,000)(1 – 0.4) + (0.4)($3,512)
= $14,605

Depreciation

Solution: Expansion Project

Year 2 CF = ($80,000 – $58,000)(1 – 0.4) + (0.4)($5,744)
= $15,498

Year 3 CF = ($80,000 – $58,000)(1 – 0.4) + (0.4)($3,664)
= $14,666

Year 4 CF = ($80,000 – $58,000)(1 – 0.4) + (0.4)($2,544)
= $14,218

Solution: Expansion Project

sale of asset | Recapture of Working Capital

Step 3: Calculate the terminal cash effects

TNOCF = $19k + $12k – 0.4($19,000 – $24,536)
= $31k + $2,214 = $33,214

Tax (credit) on sale of asset

Solution: Expansion Project

Year	CFs
0	(52,000)
1	$14,605
2	$15,498
3	$14,666
4	$47,432

Yr 4 OCF + TNOCF

NPV: $13,978 IRR: 21.9%
Accept: NPV > 0 and IRR > 12%

CFs for a Replacement Project

- Differences:
  - **Sale of old:** Reduce the initial outlay by the after-tax proceeds from the sale (t = 0)
  - **Depreciation:** Use only the difference between old and new depreciation
  - **Operating CFs:** Consider only incremental cash flows from new project

Replacement Project

Year	Cash Flows (R)	Cash Flows (NR)	Incremental CF
0	FCInv + NWCInv – Sal_0+ T (Sal_0 – B_0)	0	FCInv + NWCInv – Sal_0 + T(Sal_0 – B_0)
1-T	(NS – NC)(1 – T) + NDT	(OS – OC)(1 – T) + ODT	(ΔS – ΔC)(1 – T) + ΔDT
T	$NSal_T$ + NWCInv – T($NSal_T$ – NB_T)	$OSal_T$ – T($OSal_T$ – OB_T)	ΔSal_T + NWCInv – T(ΔSal_T – ΔB_T)

Example: Replacement Project

- The existing printer was purchased 10 years ago at a cost of $15,000. This printer is being depreciated using straight-line depreciation of $1,000 per year for 15 years (after which time it will have zero value). The current value of the printer is $2,000.
- The new high-speed copier can be purchased for $24,000, and will result in an increase in NWC of $3,000. Over its five-year life, it will reduce annual cash operating costs by $6,000. The new copier can be sold for $4,000 after five years and falls in MACRS three-year class (depreciation of $7,920, $10,800, $3,600, and $1,680 in years 1, 2, 3, and 4, respectively).
- The tax rate is 40% and cost of capital is 11.5%.

Example: Replacement Project

Year	Incremental CF	
0	FCInv + NWCInv – Sal_0 + T(Sal_0 – B_0)	$24,000 + $3,000 – $2,000 + 0.4 ($2,000 – $5,000) = $23,800
1–3	(ΔS – ΔC)(1 – T) + ΔDT	CF1 = [0 – (–6,000)](1 – 0.4) + (7,920 – 1,000)(0.4) = $6,368 CF2 = [0 – (–6,000)](1 – 0.4) + (10,800 – 1,000)(0.4) = $7,520 CF3 = [0 – (–6,000)](1 – 0.4) + (3,600 – 1,000)(0.4) = $4,640

Example: Replacement Project

Year	Incremental CF	
4–5	$(\Delta S - \Delta C)(1 - T) + \Delta DT$	CF4 = [0 – (–6,000)](1 – 0.4) + (1,680 – 1,000)(0.4) = $3,872 CF5 = [0 – (–6,000)](1 – 0.4) + (0 – 1,000)(0.4) = $3,200
5	$\Delta Sal_T + NWCInv - T(\Delta Sal_T - \Delta B_T)$	(4,000 – 0) + 3,000 – 0.4[(4,000 – 0) – (0)] = $5,400

NPV @ 11.5% = –$1,197.28

Effects of Inflation on Analysis

- **Nominal vs. real CFs:** must match cash flows with correct discount rate
- **Higher than expected inflation**:
  1. Reduces value of depreciation tax shield
  2. Decreases value of fixed payments to bondholders
  3. Different impact on revenues vs. costs

Corporate Finance (1)

Capital Budgeting

(Evaluation of Projects and Discount Rate Estimation)

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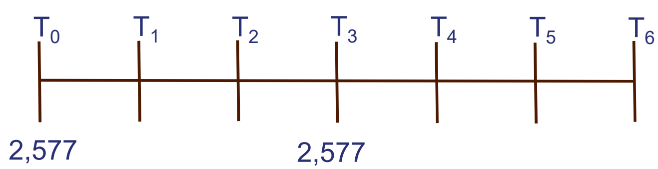
Projects With Unequal Lives

- **Situation**: Two mutually exclusive projects with different lives (details of CFs omitted) and projects replaced repeatedly
- Project cost of capital = 12%
  - NPV of book press with 6-year life = \$3,245
  - NPV of offset printer with 3-year life = \$2,577
- **Point:** The 6-year may not be better
  - Takes longer to generate the higher NPV

Least Common Multiple of Lives Method



Combined NPV of two offset printer: One today and one in three years

$NPV_{\text{chained printers}}$ @ 12% = \$4,412; IRR = 25.2%

Least Common Multiple of Lives Method

- NPVs can now be directly compared
- Press (6-year project): NPV = \$3,245
- Printer (6-year replacement): NPV = \$4,412
- Decision: Select the higher (equal-life) NPV

Equivalent Annual Annuity (EAA)

- EAA: Annual payment equivalent for each NPV:
  - 6-year book press PV = –3,245; N = 6; I = 12;

    → PMT = $789

    Which would you rather have?
  - 3-year offset print PV = –2,577; N = 3; I = 12;

    → PMT = $1,073
  - Decision: Select the project with the higher EAA

Capital Rationing

- Point: Allocate fixed capital to maximize shareholder wealth
- How?: Choose the combination of projects that has the highest total NPV
- Rank projects using profitability index $1+\frac{\text{NPV}}{\text{Outlay}}$

Project Risk Analysis

1. Sensitivity analysis:
   - Begin with the base case
   - Change a **single** input variable
   - **Note** the change in NPV
   - Change other input variables
     - **Point**: Projects with NPVs more sensitive to changes in input variables are riskier

Project Risk Analysis

2. Scenario analysis:
   - Uses best-case, worst-case, and most-likely case scenarios
   - Calculate the mean and σ of NPV
3. Monte Carlo simulation:
   - Forecast probability dist. for key inputs
   - Do random draw, calculate NPV, repeat
   - Generate probability distribution of NPV

Discount Rate Using the CAPM

- **Point**: Must use project beta (not firm beta)
- **Project cost of capital**: Use project beta with CAPM to find the appropriate discount rate:

  $R_{project} = R_F + \beta_{project}[E(R_{MKT}) - R_F]$

- Calculate project NPV using $R_{project}$ (the **hurdle rate**)

See Equity and Portfolio Management for more on the CAPM

Corporate Finance (1)

Capital Budgeting

Real Options and Pitfalls
in Capital Budgeting

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Real Options

- **Point:** Managers have the *option* to make future decisions that can change the value of projects initiated today
  - Called Real Options
  - Similar in concept to call and put options
  - Based on real assets rather than financial assets
- **Big Point:** Real options can improve NPV estimates for projects
  - **Difficult to quantify**

Types of Real Options

- Timing: Wait for better information
- Abandonment: Exit project early if failure
- Expansion: Invest more $ if successful
- Flexibility:
  - Price-setting: Change product price
  - Production flexibility: Overtime, different materials, different variety of product
- Fundamental: Entire project is an option; payoff depends on underlying asset (e.g., copper mine)

Evaluating Projects With Real Options

- **Step 1:** Determine project NPV without option
- **Step 2:** Add estimated value of option to project NPV
  - How?
    - Use decision trees
    - Use option pricing models

Example: Abandonment Option

- There is a three-year project with an initial investment of $1,000. There is a 50% probability that the annual cash flows will be $200 and a 50% probability that they will be $600 (expected cash flows of $400).
- There is an option to abandon the project at the end of the first year and receive the salvage value of $650.
- The required rate of return is 14%.

Example: Abandonment Option

- CF0 = –$1,000; C01–C03 = $400;
  NPV without option = –$71.35
- If project is a success, CF0 = –$1,000; C01–C03 = $600; NPV = +$393
- If project is a failure, abandon after one year
- CF0 = –$1,000; C01 = $650 + $200 = $850; NPV = –$254
- Expected NPV = 0.5(393) + 0.5 (–$254) = +$69.50
- Value of option = +69.60 – (–$71.35) = $140.85

Capital Budgeting Pitfalls

- Fail to incorporate competitor/market response
- Misuse standardized templates
- Pet projects not analyzed properly
- Base investment decisions on EPS or ROE
- Use IRR for mutually exclusive projects
- Poor cash flow estimation
- Over/underestimate overhead costs

Capital Budgeting Pitfalls

- Use incorrect discount rate
- Internal politics involved with spending entire capital budget vs. returning excess funds
- Fail to generate alternative investment ideas
- Handle sunk costs and opportunity costs improperly

Capital Budgeting Alternatives: Economic and Accounting Income

- Alternatives to DCF approach to capital budgeting; should give us consistent results
- Economic income: (Not accounting income!)
  - After-tax operating cash flow (CF) minus economic depreciation

Computing Economic Income

- Omni Corporation project costs $25,000
- Cost of capital = 12%
- Cash flows:
  - Year 1: $10,000
  - Year 2: $12,000
  - Year 3: $15,000

PV of remaining cash flows at the start of each year

$$\text{Beginning MV} = \frac{10{,}000}{(1.12)} + \frac{12{,}000}{(1.12)^2} + \frac{15{,}000}{(1.12)^3} = \$29{,}172$$

Computing Economic Income

PV of remaining CFs

Economic ROR = Economic Income/Beginning MV

	Year 1	Year 2	Year 3
Beginning MV	$29,172	$22,672	$13,393
Ending MV	22,672	13,393	0
Change in MV	– 6,500	– 9,279	– 13,393
After-tax CF	10,000	12,000	15,000
Economic Income	$3,500	$2,721	$1,607
Economic ROR =	12%	12%	12%

Not accounting income!

Must equal project cost of capital

Economic vs. Accounting Income

- **Accounting income:** Reported net income on firm's financial statements
- **Big Point**: Computation is nothing more than constructing a firm's income statement
- Differs from economic income:
  - Accounting depreciation is based on original cost of the investment, not market value
  - Financing costs are separate

Alternative Valuation Models

- Economic profit: Profit in excess of dollar cost of capital invested in project
- Focus on return to all capital suppliers
- EP = NOPAT – \$WACC ← Think: EVA (in Equity)
  - NOPAT = EBIT(1 – tax rate)
  - \$WACC = WACC × capital
- Market value added (MVA) is NPV based on economic profit: $MVA = \sum_{t=1}^{\infty} \frac{EP_t}{(1+WACC)^t}$

Alternative Valuation Models

Link to RI in Equity

- Residual income: Focus on returns to equity holders
- Residual income = NI – equity charge
  - Equity charge = required return on equity × beginning book value of equity

$$NPV = \sum_{t=1}^{\infty} \frac{RI_t}{(1+r_e)^t}$$

Alternative Valuation Models

- Claims valuation approach: Divides CFs into the claims of debt and equity holders
- **Point**: Debt and equity cash flows valued separately, then added together to estimate value
  - **CF to debt holders** = interest and principal, discounted at cost of debt
  - **CF to equity holders** = dividends and share repurchases, discounted at cost of equity

Corporate Finance (1)

Capital Structure

Theories of Capital Structure

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Capital Structure Objective

- Goal: Determine the mix of debt and equity that minimizes the firm's WACC
  - Also maximizes the firm's stock price
- Called the optimal capital structure

Review from Level I: WACC is weighted average of the marginal costs for each type of capital

$$WACC = \left[w_d \times k_d \times (1-t)\right] + (w_e \times k_e)$$

MM Propositions I and II

- Modigliani and Miller (MM):
  - Proposition I: The value of a firm
  - Proposition II: The WACC
- Know both with:
  - No taxes
  - Taxes

Think: Four related concepts

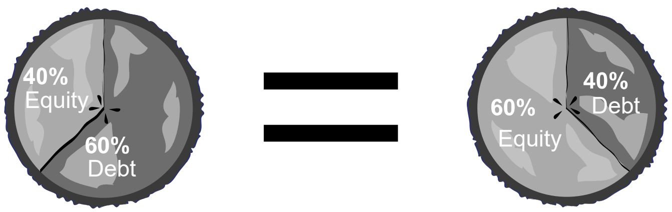
- Both use some extremely restrictive assumptions

Concept #1 – MM Proposition I (No Taxes): Capital Structure Irrelevance

- Point: Value of a firm is unaffected by its capital structure
  - Levered and unlevered firm have same value
    - Notation: $V_L = V_U$
- Holds in perfect markets:
  - No taxes
  - No transaction costs
  - **No costs of financial distress**

MM Proposition I (No Taxes): Capital Structure Irrelevance

- Pie analogy: Pie is the same size no matter how you slice it
  - $V_L = V_U$



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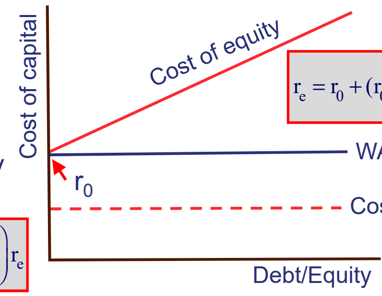
Concept #2 – MM Proposition II (No Taxes): WACC Unchanged by Leverage

- Cost of equity increases linearly as company increases its leverage
- WACC is unaffected by capital structure

$$\mathrm{WACC} = \left(\frac{D}{V}\right) r_d + \left(\frac{E}{V}\right) r_e$$



$$r_e = r_0 + (r_0 - r_d)\left(\frac{D}{E}\right)$$

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Concept 1 and 2 Review: MM with NO Taxes

- Big Point: Both Prop I and Prop II show that in a world with no taxes, Capital Structure Doesn't Matter
  - The pie is the same however you slice it
  - WACC is unaffected by leverage
- Next to consider: The impact of taxes

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Concept #3 – MM Prop I With Taxes

- Debt creates a tax shield:
  - Debt interest payments are tax deductible
    - Tax shield increases the size of the pie!
  - **Result:** $V_L = V_U$ + (tax rate × value of debt)
  - **Big Point:** Optimal capital structure = 100% debt

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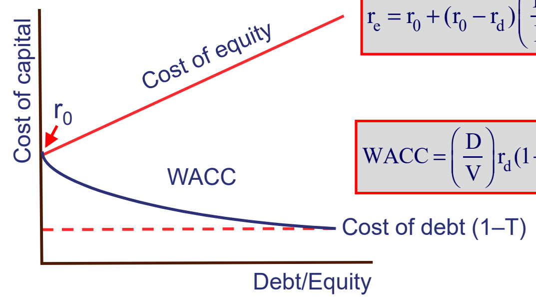
Concept #4 – MM Prop II (With Taxes)



$$r_e = r_0 + (r_0 - r_d)\left(\frac{D}{E}\right)(1-t)$$

$$WACC = \left(\frac{D}{V}\right) r_d (1-t) + \left(\frac{E}{V}\right) r_e$$

Concepts 3 and 4 Review – MM With Taxes

- **Big Point:** Both Prop I and Prop II show that in a world with taxes, firms should use 100% Debt
  - Why? Debt tax shield increases size of pie!
- Of course, that doesn't work in practice because of the risk of bankruptcy
- Next to consider: Cost of financial distress

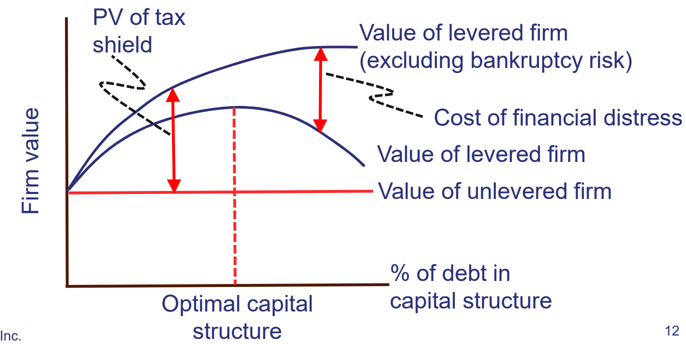
Costs of Financial Distress

- **What?:** Costs incurred when company has trouble paying fixed financing costs (interest)
  - Direct costs: e.g., legal expenses of filing for bankruptcy
  - Indirect costs: e.g., loss of customer trust
- **Probability of financial distress**
  - Higher operating or financial leverage leads to higher probability of financial distress
  - Better corporate governance ➡ lower probability

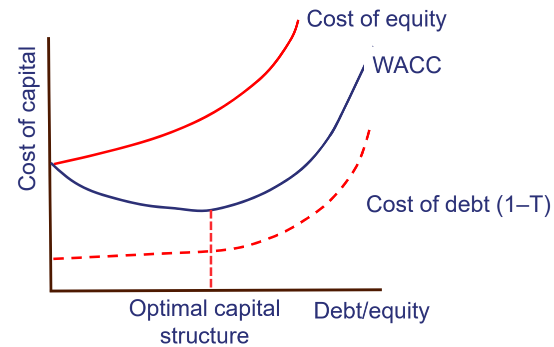
Static Trade-Off Theory

- **Think**: Tax shield plus cost of financial distress
  - **At some point**: Value added by tax-shield is exceeded by value-reducing costs of financial distress
  - This point is the optimal capital structure

Static Trade-Off Theory



Static Trade-Off Theory



Corporate Finance (1)

Capital Structure

Factors Affecting Capital Structure

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Agency Costs of Equity

- **Agency costs**: Costs of conflict of interest between managers and owners
- **Types of agency costs of equity**:
  1. Monitoring costs (better corp. governance, lower agency costs)
  2. Bonding costs (e.g., non-compete agreement)
  3. Residual losses (can't eliminate)
- **Point**: Greater financial leverage reduces agency costs
  - Managers have less FCF to squander

Costs of Asymmetric Information

- Asymmetric information: Managers know more about firm prospects than owners
- Costs higher if complex products or poor financial statements
- Valuation implications:
  - **Stock offering** → negative signal (offering to sell overvalued stock)
  - **Debt offering** → positive signal (avoid selling undervalued stock; management confident can make payments)

Pecking Order Theory

- Management sends signals based on their financing choices
- Financing choices are from most favored to least favored (pecking order) based on their information content
  - Internally generated funds (most favored)
  - Debt
  - Newly issued equity (least favored)

Actual vs. Optimal Capital Structure

- **Point**: Target capital structure = optimal capital structure
- However, capital structure may deviate from optimal
  - Exploit opportunities in a specific financing source (e.g., cheap equity)
  - Market value fluctuations

Role of Debt Ratings

- **Point**: Lower debt ratings = higher credit risk
  - Cost of capital tied to debt ratings
  - Managers try to maintain certain debt rating in order to minimize the cost of capital
- An increase in debt rating will lower cost of debt and cost of capital

Evaluating Capital Structure Policy

- **Factors to consider**:
  - Changes in capital structure over time
  - Capital structure of competitors with similar business risk
  - Agency costs
    - Higher quality of corporate governance → lower agency costs and less debt

Leverage: Analysis Implications

Country Factor	Use of Total Debt	Debt Maturity
Institutional, Legal, and Taxation Factors		
Strong legal system	LOWER	LONGER
Less information asymmetry	LOWER	LONGER
Favorable personal tax rates on dividends vs. interest	LOWER	N/A
Common law vs. Civil law	LOWER	LONGER

U.S., U.K. firms issue less debt than Japanese or French firms.
U.S. firms use longer maturity debt than Japanese firms.

Leverage: Analysis Implications

Country Factor	Use of Total Debt	Debt Maturity
Financial Market and Banking System Factors		
More liquid markets	N/A	LONGER
Greater reliance on banking system	HIGHER	N/A
Greater institutional investor presence	LOWER	LONGER
Macroeconomic Factors		
Higher inflation	LOWER	SHORTER
Higher GDP growth	LOWER	LONGER

Corporate Finance (1)

Dividends and Share Repurchases: Analysis
Theories of Dividend Policy

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Types of Dividends

- **Regular Cash Dividend**
  - DRPs: open market or new issuance
  - DRPs allow shareholders to acquire additional shares, sometimes at a discount, without transaction costs and allow dollar cost averaging. However, additional recordkeeping would be required.
- **Extra or Special Dividend**
  - One-time (irregular)

Types of Dividends

- **Liquidating Dividend**
  - When whole or part of the firm is sold
  - Dividends paid in excess of cumulative retained earnings
- **Stock Dividend**
  - Non-cash dividend (issuance of additional shares)
- **Stock Splits**
  - Larger stock-dividends

Types of Dividends – Accounting Issues

- Cash Dividend and Special Dividends
  - Reduce cash and stockholder's equity
  - Lower quick and current ratios while higher leverage ratios (e.g., D/E)
- Stock Dividends and Stock Splits
  - No change in ratios

Dividend Irrelevance Theory

- MM: Dividend policy is irrelevant
  - Assumes perfect markets: No corporate taxes, bankruptcy costs, transactions costs
- **Homemade dividends**
  - Investors wanting more dividends can sell shares (or fractions of shares)
  - Investors wanting less dividends can use dividends to buy new shares (or share fractions)

Dividend Preference Theory

- **Dividend Preference**: Suggests that investors prefer the certainty of a cash dividend over the uncertainty of a stock price increase (Bird-in-hand argument)
- **Result**: Higher dividends lead to higher stock prices (lower cost of equity)

Tax Aversion Theory

- **Investors prefer small dividend payments** to large payments because:
  - Capital gains are:
    1. Sometimes taxed at a lower rate
    2. Not taxed until realized
- **Result**: Smaller dividends result in higher stock price and lower cost of equity

Signaling Content of Dividends

- Signalling due to information asymmetry between managers and investors.
- **Increase**: **Positive** signal
- **Decrease/omission: Negative** signal
- **Initiation: Positive** signal (usually)
  - However: Is it great prospects or lack of positive NPV opportunities?

Clientele Effect

Clientele effect occurs due to:

- Tax considerations (next slide)
- Requirements of institutional investors
- Individual investor preferences

Clientele Effects Due to Taxes

- In the presence of differential taxes on dividends and capital gains, investors would prefer one over other.
- For a given amount of dividend (D), investor would be indifferent if the price of the stock would drop by ΔP when it goes ex-dividend.

$$\Delta P = \frac{D(1-T_D)}{(1-T_{CG})}$$

Agency Issues

Agency Conflict

- Between shareholders and managers
  - Dividends reduce free cash flow for managers to invest in empire building
- Between shareholders and bondholders
  - Dividends *transfer* wealth from bondholders to shareholders

Factors Affecting Dividend Payout Policy

1. Investment opportunities
2. Expected volatility of future earnings
3. Financial flexibility
4. Tax considerations
5. Flotation costs
6. Contractual and legal restrictions

Effective Tax Rate on Dividends

- **Double taxation** and **split-rate** systems:

effective tax rate =
tax corporate + (1 – tax corporate)(tax individual)

For **split-rate** system, use the **corporate tax rate for distributed income**

- **Imputation system**:

effective tax rate = shareholder's tax rate

Example: Effective Tax Rate

- A U.S. company's annual earnings are $300, and it pays out 100% of after-tax profits in dividends.
- Assuming a 35% corporate tax rate and 15% tax rate on dividends, calculate the effective tax rate assuming double taxation and split rate taxation (corporate tax rate on distributed income of 20%).
- Assume that the company pays out 100% of its earnings as dividends.

Example: Effective Tax Rate

- Double taxation:

effective tax rate =
tax corporate + (1 – tax corporate)(tax individual)

= 0.35 + (0.65)(0.15) = 0.4475 or 44.75%

- Split rate = 0.20 + (0.80)(0.15) = 0.32 or 32%
- Tax imputation: 15%

Stable and Constant Dividend Policy

- **Stable dividend policy**
  - Dividends are based on long-term earnings forecast. Dividends are smoothed so as to not fluctuate with earnings.
- **Constant dividend payout policy**
  - Dividend payout *ratio* is constant and hence dividends fluctuate directly with earnings; seldom used

Corporate Finance (1)

Dividends and Share Repurchases: Analysis
Stock Buybacks

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Residual Dividend Model

- **Point**: Dividends = earnings minus funds retained to finance equity portion of capital budget
- Model based on:
  - Investment opportunity schedule
  - Target capital structure
  - Access to and cost of external capital

Residual Dividend Model

Steps to determine target payout ratio:

1. Identify optimal capital budget
2. Determine amount of equity needed given target capital structure
3. Meet equity requirements to extent possible with retained earnings
4. Pay dividends with the residual earnings

Residual Dividend Model

- **Advantages**
  - Model simple to use
  - Management can identify investment opportunities without considering dividends
- **Disadvantages**
  - Dividend payments may be unstable
  - Uncertainty about future dividends signals higher risk; potentially raises capital costs

Long-Term Residual Dividend Model

- Remove the year-to-year fluctuation from residual dividend model
  - Forecast capital budget out 5 to 10 years
  - Allocate left-over earnings as dividends
  - Pay out in relatively equal amounts
  - Distribute excess with share repurchases

Target Payout Approach

- **Target payout adjustment model**: Dividends paid out as a percentage of total earnings
- **General approach**:
  - Set target dividend payout based on long-term sustainable earnings
  - Move slowly toward that target
  - Avoid cutting or eliminating dividend except in extreme circumstances

Example: Calculating Dividends Using Target Payout Adjustment Model

- Last year, Buckeye, Inc., had earnings of \$3.50 per share and paid a dividend of \$0.70. In the current year, the company expects to earn \$4.50 per share.
- The company has a 35% target payout ratio and plans to bring its dividend up to the target payout ratio over a 5-year period

Target Payout Adjustment Model

$$\begin{pmatrix}\text{expected increase}\\ \text{in dividend}\end{pmatrix} = \left[\begin{pmatrix}\text{expected}\\ \text{EPS}\end{pmatrix} \times \begin{pmatrix}\text{target}\\ \text{payout}\\ \text{ratio}\end{pmatrix} - \begin{pmatrix}\text{previous}\\ \text{dividend}\end{pmatrix}\right] \times \begin{pmatrix}\text{adjustment}\\ \text{factor}\end{pmatrix}$$

$$\begin{aligned}\text{expected } \Delta \text{ dividend} &= \left[(\$4.50 \times 0.35) - 0.70\right] \times (1/5)\\ &= \$0.175\end{aligned}$$

Share Repurchase Methods

- **Open market**: Flexible, allows the company to time the repurchase and buy when the price is attractive
- **Fixed price tender offer**: Offers premium over market price, quick execution, shareholders not selling are at a disadvantage, pro rata acceptance in case a higher-than-needed number of shares are tendered

Share Repurchase Methods (cont.)

- **Dutch Auction**:
  - Specifies a range of prices, invites bids and accepts lowest bid first, and continues until target achieved
  - **All sellers** receive the highest accepted bid price
  - Cheaper than fixed price tender but slower
- **Direct Negotiation**: with a single large holder; common in greenmail transactions

Impact of Repurchase on EPS

- Impact on EPS depends on whether the repurchase is financed with excess cash or new borrowing.
- When using excess cash, if the earnings yield > after-tax opportunity cost of cash, EPS would increase.
- When using new borrowing, if earnings yield > after-tax cost of debt, EPS would increase.

Example: Impact on EPS

Zelda Inc. has 50,000 shares outstanding and has just reported EPS of $2. Zelda's board is evaluating repurchase of 20% of outstanding shares at a price of $30 per share.

Calculate the percentage change in EPS after completion of repurchase assuming that the total cost is funded with:
(a) excess cash that is not earning any interest.
(b) debt with an after-tax cost of 3%.

Solution: Impact on EPS

Cost of acquisition = 10,000 shares × \$30 = \$300,000

Current NI = 50,000 × \$2 = \$100,000 = NI (cash financing)

EPS = 100,000 / 40,000 = \$2.50 or 25% increase

With debt, NI = \$100,000 – 0.03 × 300,000 = \$91,000

EPS = 91,000 / 40,000 = \$2.275 or 13.75% increase

Impact of Repurchase on BVPS

- If the price paid for repurchase > pre-purchase BVPS, BVPS will decline.
- If the price paid for repurchase < pre-purchase BVPS, BVPS will increase.

Share Repurchase vs. Cash Dividend

- If tax treatment is the same, **no difference** in effect on shareholder wealth
  - $P_{\text{with dividend}} = P_{\text{ex-dividend}}$ + dividend
- **Rationales for share repurchase**:
  1. Tax advantage to shareholders if tax rate on capital gains < tax rate on dividends
  2. Signal to shareholders that management believes shares are undervalued

Rationales for Share Repurchases

3. Added Flexibility: Repurchase is not sticky and so can be used whenever there is excess cash
4. Offsetting dilution: Prevents EPS dilution from exercise of employee stock options
5. Increase leverage: Repurchase shares to increase financial leverage

Global Trends in Dividend Policy

- Lower proportion of U.S. companies pay cash dividends (compared to European companies)
- Proportion of companies paying cash dividends is declining over time in developed markets
- Proportion of companies making stock repurchases is increasing over time in developed markets

Dividend Coverage Ratios

$$\text{Dividend Payout Ratio} = \frac{\text{dividends}}{\text{net income}}$$

$$\text{Dividend Coverage Ratio} = \frac{\text{net income}}{\text{dividend}}$$

$$\text{FCFE Coverage Ratio} = \frac{\text{FCFE}}{\text{dividends + share repurchases}}$$

Higher coverage ratios ➡ Higher dividend sustainability

Example: Dividend Sustainability

- Calculate 2008 and 2009 payout and coverage ratios:

Year Ending December 31 (US $ Millions)	2009	2008
Net income	$ 10,483	$ 23,931
Cash flow from operations	$ 19,373	$ 29,632
Capital expenditures (FCInv)	$ 19,843	$ 19,666
Net borrowing	$ 1,659	$ 1,682
Dividends paid	$ 5,373	$ 5,261
Stock repurchases	$ (168)	$ 6,821

Example: Dividend Sustainability

- Dividend payout ratio = dividend / net income
  - 2008: 5,261 / 23,931 = 0.22 or 22%
  - 2009: 5,373 / 10,483 = 0.51 or 51%
- Dividend coverage ratio = net income / dividend
  - 2008: 23,931 / 5,261 = 4.55
  - 2009: 10,483 / 5,373 = 1.95

Example: Dividend Sustainability

- FCFE = cash flow from operations – FCInv + net borrowings
  - 2008: FCFE = 29,632 – 19,666 + 1,682 = 11,648
  - 2009: FCFE = 19,373 – 19,843 + 1,659 = 1,189
- FCFE coverage ratio = FCFE / (dividends + share repurchases)
  - 2008: 11,648 / (5,261 + 6,821) = 0.96
  - 2009: 1,189 / [5,373 + (–168)] = 0.23

Corporate Finance (2)

Corporate Governance and Other ESG Considerations in Investment Analysis

Global Variations in Ownership Structures

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Global Ownership Structures

Concentrated vs. dispersed ownership

- Concentrated ownership: A single shareholder or a group of shareholders have control over the corporation.
- Percentage ownership is not always reliable (e.g., vertical ownership arrangement, dual-class shares).

Ownership Structures & Conflicts

- Dispersed ownership and dispersed voting power: principal-agent problem is a concern.
- Concentrated ownership and concentrated voting power: principal-principal problem is a concern.
- Dispersed ownership and concentrated voting power: via pyramid structures or dual-class shares. Principal-principal problem.
- Concentrated ownership and dispersed voting power: due to voting caps. Principal-agent problem.

Influential Shareholders

- **Banks**: As lenders or equity investors can exert influence. May misuse power to lend at to the firm at higher-than-market rates.
- **Families**: Family ownership/interlocking directorships results in concentration of control of one/many companies.
  - While principal-agent problem may be reduced, problems with recruiting professional management.

Influential Shareholders (cont.)

- **State-owned enterprises (SOE)**: In strategic industries, seeks to provide societal benefits rather than focus on shareholder wealth maximization.
- **Institutional investors:** Provide expertise and wield their influence to reduce the principal-agent problem.
- **Private equity firms:** Reduce principal-agent problem by linking management compensation to performance.

Influential Shareholders (cont.)

- **Group companies**: Similar to family ownership. Cross-holdings make it hard for outsiders to take control. Related-party transactions contribute to principal-principal problem.
- **Foreign investors**: Typically benefit minority shareholders in emerging markets by demanding greater management accountability.
- **Managers and directors**: Align the interests of insiders with that of other investors.

Corporate Governance

- **Director independence:** Important when principal-agent problem is severe (dispersed ownership).
- **Board structures**: One-tier (most common) consists of internal (executive) directors and external (nonexecutive) directors. Two-tier structure has the **supervisory board** supervising the **management board**.
- **Special voting arrangements:** Provide an advantage to minority shareholders in board nomination and election.

Corporate Governance (cont.)

- **Corporate governance codes, laws, and listing requirements:** “Comply or explain” provisions require firms to follow best practices in in corporate governance codes —or explain why they have not.
- **Stewardship codes:** Seek to engage investors in corporate governance by exercising their legal rights.

Corporate Finance (2)

Corporate Governance and Other ESG Considerations in Investment Analysis

Evaluating ESG Exposures

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Board Policies and Practices

- Structure: CEO duality (i.e., also chairs the board).
- Board independence: Majority independent to reduce principal-agent problem.
- Committees: Those related to financial reporting, management selection, and compensation should be sufficiently independent.
- Member skill/experience: Sufficient industry-specific experience to provide effective supervision.

Board Policies and Practices (cont.)

- Composition: Diversity (age, gender, length of tenure, education, culture, and place of birth) promotes effectiveness.
- Other considerations: Include structure, tenure, culture, interaction with management. Self-evaluations or evaluations from outsiders.

Compensation/Voting rights

- Executive compensation: Linked to performance—with clawback provisions.
- Shareholder voting rights: May be diminished in the presence of dual-class shares.

ESG Disclosures

- ESG-related disclosures have risen with awareness of ESG-related risks.
- Disclosures are purely voluntary—no uniformity. Some can be found in corporate communications as well as in corporate filings.
- Analysts should consider investment horizon and materiality of information.

ESG Factors

Analysts should first determine which ESG factors are most relevant to that industry and then collect that information:

- ESG data providers such as MSCI, Sustainalytics, and RepRisk provide rankings, scores, and quantitative analysis.
- Industry organizations such as IIRC and SASB provide standardized ESG related information.
- Proprietary methods can be used to gather information from government groups, published reports, 10-Ks, etc.

Analyst Issues

- Fixed-income analysts usually will focus on ESG factors' downside risks.
- ESG factors might render an equipment obsolete (i.e., a **stranded assets issue**), and the value of the firm's long-term bonds that should be particularly sensitive to the risk.
- Equity analysts consider both the upside and downside impact of ESG factors when valuing a firm's stock; reducing discount rate for firms with favorable ESG policies while increasing it for firms with negative policies.

ESG Integration

- ESG factors can be included in a firm's valuation by making various adjustments to the company's financial statements.
- The credit spread of a fixed-income instrument may be adjusted to reflect ESG concerns.
- An adjustment to discount rate or cost of capital may be used to reflect ESG considerations in an equity analysis.
- Green bonds should finance green projects, but proceeds may be diverted to other uses (i.e., ***greenwashing***).

ESG Integration Examples

- Example 1 (environmental factors): Soft-drink company lowering water usage in manufacturing process. Leads to higher margins, higher stock prices, and lower credit spreads on the firm's bonds.
- Example 2 (social factors): A drug company with a history of product recalls and quality concerns may have brand reputation concerns. Incorporating this information would lead to lower future stock price and higher credit spreads.
- Example 3 (governance issues): A bank's board is aligned with the management. Equity and credit risk premium for valuation of the bank's stock and bonds would be higher.

Corporate Finance (2)

Mergers and Acquisitions

Merger Motivations

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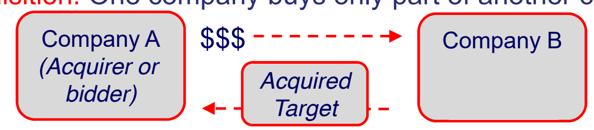
Forms of Integration

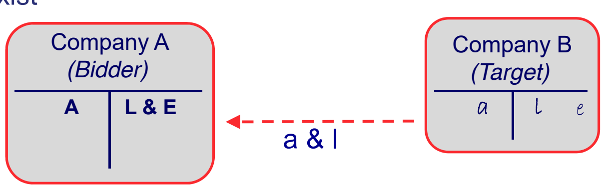
- Acquisition: One company buys only part of another company



- Merger: One company absorbs another company entirely

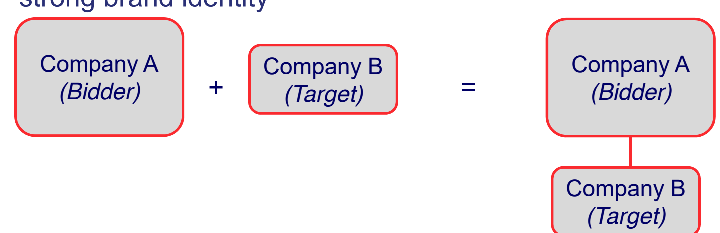
Forms of Integration

- Statutory Merger: Acquiring company obtains all of the target's assets and liabilities; the target company ceases to exist



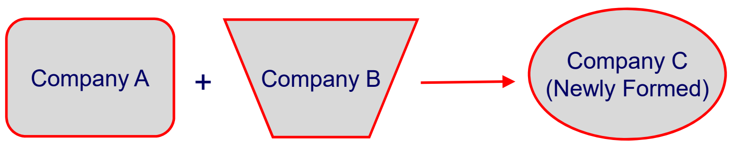
Forms of Integration

- Subsidiary Merger: The target company becomes a subsidiary of the acquirer; often used when target has strong brand identity



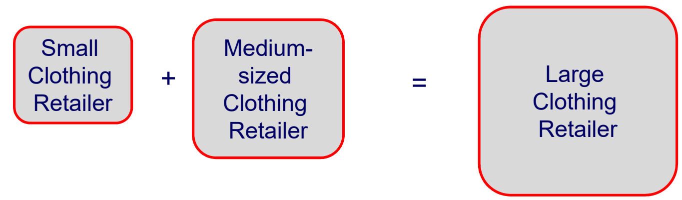
Forms of Integration

- Consolidation: Acquirer and target cease to exist in their prior form but come together to form a completely new company



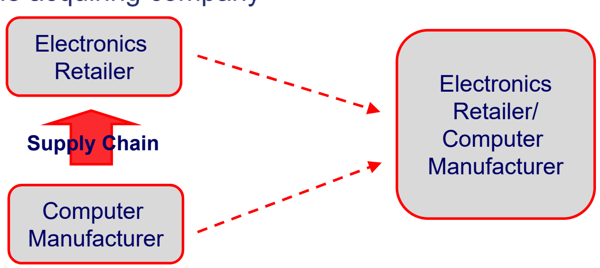
Types of Mergers

- Horizontal merger: Two businesses operate in the same or similar industries



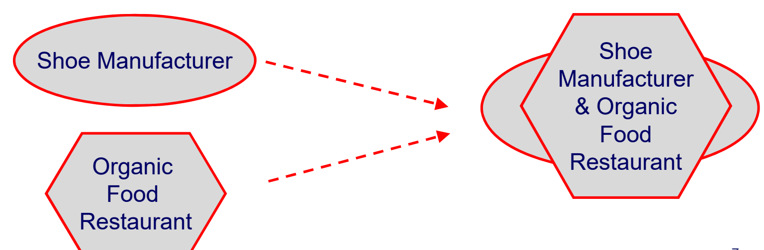
Types of Mergers

- Vertical merger: Target company is along the supply chain of the acquiring company



Types of Mergers

- Conglomerate merger: Two companies from completely separate industries



Merger Motivations

1. Synergies
   - Merged companies worth more than the combined value of two individual entities
     - Think: Economies of scale/scope
2. Achieving more rapid growth
   - Increased revenues growth
   - Less risky to acquire growth

Merger Motivations

3. Increased market power
   - Market share and price influence
   - Reduce dependence on outside suppliers
4. Gaining access to unique capabilities
   - Cost effective way to acquire resources or capabilities
5. Diversification
   - Finance theory: Unlikely to increase value
   - Stabilize cash flow

Merger Motivations

6. Bootstrapping
   - Positive impact on EPS from stock deal
   - Stay tuned – more info in a few slides
7. Personal benefits for managers
   - High correlation between the size of the company and manager compensation
   - Power and prestige of a large company

Merger Motivations

8. Tax benefits
   - Acquirer can use target's tax losses to lower tax liability
   - Regulators tend not to approve
9. Unlocking hidden value
   - Accomplished by improving management, adding resources, or improving organizational structure

Merger Motivations

10. Achieving international business goals
    - Take advantage of market inefficiencies (e.g., cheap labor)
    - Avoid disadvantageous government policies (e.g., tariffs)
    - Use technology in new markets
    - Product differentiation
    - Provide support to existing clients

Bootstrapping

- Bootstrapping EPS: Increased EPS that occurs when a high P/E firm acquires a lower P/E firm
  - Increase in earnings per share
  - Real economic gains are not necessarily achieved
  - **Point:** EPS increases, but the share price may not!

Bootstrapping

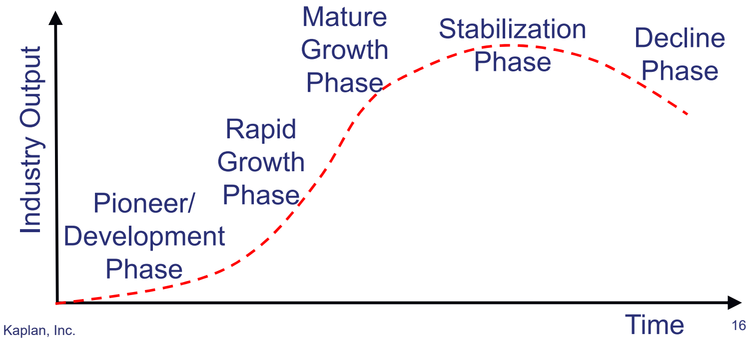
- Example: Fastgro, Inc. is planning to acquire Slowgro, Inc.
  - Financial data shown on next slide
- **Calculate:**
  1. Fastgro's **post-merger EPS**
  2. Determine whether the merger created economic gains

Bootstrapping

	Fastgro, Inc.	Slowgro, Inc.	Fastgro Post Merger
Price	$80.00	$40.00	$80.00
EPS	$3.00	$2.00	**$3.20**
P/E	26.7	20	**25**
# Shares	200,000	100,000	250,000
Earnings	$600,000	$200,000	$800,000
Market Cap	$16,000,000	$4,000,000	$20,000,000

50,000 shares issued (i.e., 50,000 × $80 = $4MM)

Industry Life Cycle



Pioneer/Development Phase: Common Mergers

- Uncertain of product acceptance, low profit margins, and large capital requirements
- **Merger motivations**:
  - Access to capital, management talent
- **Types of mergers:**
  - Conglomerate and horizontal

Rapid Growth Phase: Common Mergers

- High profit margins, accelerating sales, and earnings, but still low industry competition
- **Merger motivations**:
  - Access to capital, expand growth capacity
- **Types of mergers:**
  - Conglomerate and horizontal

Mature Growth Phase: Common Mergers

- Reduced profit margins due to new competition, but potential still exists for above average growth
- **Merger motivations**:
  - Efficiency, economies of scale/synergies
- **Types of mergers**:
  - Horizontal and vertical

Stabilization Phase: Common Mergers

- Competition squeezes margins and increases capacity underuse
- **Merger motivations**:
  - Economies of scale, reduce costs, improve management
- **Types of mergers**:
  - Horizontal

Decline Phase: Common Mergers

- Declining profit margins, overcapacity, and lower demand due to shifts in consumer tastes
- **Merger motivations**:
  - Survival, operating efficiencies, new growth opportunities
- **Types of mergers:**
  - Horizontal, vertical, and conglomerate

Industry Lifecycles and Common Mergers

- For the exam:
  - Horizontal mergers common in all life cycle stages
  - Tend to see vertical mergers primarily in mature growth stage
  - Conglomerate mergers only common at beginning and end of industry life cycle

Corporate Finance (2)

Mergers and Acquisitions

Defense Mechanisms and Antitrust

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Forms of Acquisition

- Stock purchase: Target company's stockholders sell their shares directly to the acquiring firm
- Asset purchase: Acquirer makes payment to target company to acquire assets

Payment method:

- Securities offering: Target shareholders receive shares of acquirer's common stock
  - Based on exchange ratio (e.g.,1.4 to 1)
- Cash offering: Target shareholders receive cash for shares

Comparing Forms of Acquisition

	Stock Purchase	Asset Purchase
Payment	To shareholder	To target
Approval	Shareholders	None for small
Corporate taxes	None	*Target pays CGT
S/H taxes	*S/H pay CGT	None
Liabilities	Acquirer assumes	Usually avoids assuming

*CGT = capital gains tax

Attitude of Target Management

- Friendly merger offers

Acquirer approaches management

↓

Negotiations and due diligence

↓

Definitive merger agreement

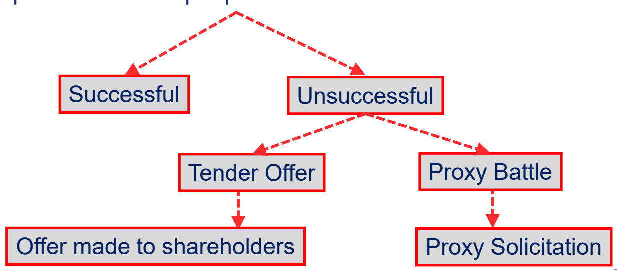
↓

Public announcement and shareholders vote

Attitude of Target Management

- Hostile merger offers

  Acquirer submits proposal to board of directors



Pre-Offer Defense Mechanisms

- Poison pill: Shareholders given right to purchase more shares at a discount
  - Flip-in pill: Buy target's shares
  - Flip-over pill: Buy acquirer's shares
- Poison put: Bondholders can demand immediate repayment in case of a takeover
- States with restrictive takeover laws: Company can reincorporate in a state with anti-takeover laws (e.g., Ohio)

Pre-Offer Defense Mechanisms

- Staggered board: Bidder can only win a minority of the board seats in one year
- Restricted voting rights: Equity ownership above threshold level causes loss of voting rights unless approved by the board
- Supermajority voting provision for mergers: Corporate charter requires shareholder support in excess of simple majority (e.g., 75%)

Pre-Offer Defense Mechanisms

- Fair price amendment: Requires a *fair* price to be offered to shareholders based on an independent appraisal
- Golden parachutes: Managers receive lucrative cash payouts if they leave the target company after a merger

Post-Offer Defense Mechanisms

- "Just say no" defense: Refuse takeover offer, then convince shareholders to do the same
- Litigation: File a lawsuit against the acquirer to consume acquirer's time and money
- Greenmail: Target repurchases shares from the acquirer at a premium
  - Like a payoff to acquirer, think "blackmail"
  - 50% tax on greenmail profits

Post-Offer Defense Mechanisms

- Share repurchase: Target submits a tender offer for its own shares
- Leveraged recapitalization: Target assumes a large amount of debt to repurchase shares
- Crown jewel defense: Target sells a major asset to a neutral third party
  - Risk is that court could declare sale illegal
- Pac-man defense: Target makes a counteroffer to acquire the acquirer

Post-Offer Defense Mechanisms

- White knight defense: Friendly third party makes offer to acquire target
  - May start bidding war
- White squire defense: Friendly third party buys minority stake in target
  - Block potential acquirer from gaining enough shares

Corporate Finance (2)

Mergers and Acquisitions

Target Company Valuation

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Herfindahl-Hirschman Index

- Herfindahl-Hirschman Index (HHI): key measure of market power for determining antitrust violations

$$HHI = \sum_{i=1}^{n} (MS_i)^2$$

In percentage form

MS_i = market share of firm i (%)

n = number of firms in the industry

Herfindahl-Hirschman Index

Post-Merger HHI	Industry Concentration	Change in HHI	Antitrust Action
< 1000	Not concentrated	Any amount	No action
Between 1000 and 1800	Moderate	100 or more	Possible
> 1800	High	50 or more	Virtually certain

Example: HHI

- Suppose that there are 20 firms in the industry, each with a 5% market share.
- Also imagine that firms 19 and 20 decide to merge.
- Calculate the pre-merger and post-merger HHI and discuss the likelihood of an antitrust challenge of the merger.

Example: HHI

- Pre-merger HHI = 20 x 5^2 = 500
- Post-merger HHI = (18 x 5^2) + (1 x 10^2) = 550
- Since post-merger HHI < 1,000 antitrust action is unlikely

Valuing a Target Company

- **Your job:** Compare and contrast three methods
  1. Discounted cash flow method
     - Determine FCF and discount (like FCFF)
  2. Comparable company analysis
     - Use relative value metrics + premium
     - Start with minority interest values
  3. Comparable transaction analysis
     - Same, only start with majority prices

Approach #1:Discounted Cash Flow

- **Step 1:** Determine which FCF model to use
  - Two-stage or three-stage?
- **Step 2:** Develop pro forma financials
- **Step 3**: Calculate free cash flows
- **Step 4:** Discount FCFs back to the present
- **Step 5:** Determine terminal value and discount it back to the present
- **Step 6:** Add discounted values for each stage

DCF Method Step 3: Calculate FCF

x Net income
+ Net interest after tax
= Unlevered net income
± Change in deferred taxes
= Net operating profit less adj. taxes (NOPLAT)
+ Net noncash charges (think depreciation)
± Change in net working capital
– Capital expenditures
= Free cash flow (FCF)

DCF Method Step 3: Calculate FCF

- Alternatively using formula from SS 12:

  $FCFF = NI + NCC + [Int\ (1 – T)] – FC_{Inv} – WC_{Inv}$

- Result is the same

Approach #2: Comparable Company Analysis

- The basics:
  - **Uses relative value metrics** from similar firms
  - **Adds a takeover premium** to determine fair price to pay
  - **Big point**: Valuation relative to minority prices
    - Does not use *transacted* firms

Comparable Company Analysis Steps

- **Step 1:** Identify the set of comparable firms
- **Step 2:** Calculate relative value measures based on comparables' market prices
- **Step 3**: Calculate descriptive statistics and apply to the target firm
- **Step 4:** Estimate a takeover premium
- **Step 5:** Calculate the estimated takeover price (sum of stock value and premium)

Comparable Company Analysis Example

- Example: Gracio Corp. is considering acquiring AGSI
  - Using comparable companies, **calculate:**
    - Mean valuation metrics
    - Estimated value of Roslovic

Comparable Company Data (GIVEN)

Company Stats. ($)	AGSI	Firm 1	Firm 2	Firm 3
Price		$25.00	$33.00	$19.00
EPS	2.95	1.50	2.25	1.20
BV/Share	15.20	8.80	10.50	6.00
CF/Share	3.80	2.00	2.90	1.80
Sales/Share	46.00	21.60	28.70	19.50

Takeover Prices in Recent M&A Transactions (GIVEN)

Takeover Prices in Recent M&A Transactions (GIVEN)		
Target Company	**Pre-Takeover Price**	**Takeover Price**
Target 1	$22.00	$27.25
Target 2	$18.25	$21.00
Target 3	$108.90	$130.00
Target 4	$48.50	$57.00

Comparable Company Analysis Example

- **Answer:**
  - **Step 1:** We've compiled the *Comparable Company Data* (given on exam)
  - **Step 2:** Using the data from Step 1, calculate relative value measures using current market prices of comparable firms

Step 2: Relative Value Measures for Comparable Firms

Measure	Firm 1	Firm 2	Firm 3	Mean
Stock Price	$25.00	$33.00	$19.00	
P/E	16.67	14.67	15.83	**15.72**
P/BV	2.84	3.14	3.17	**3.05**
P/CF	12.50	11.38	10.56	**11.48**
P/Sales	1.16	1.15	0.97	**1.09**

Step 3: Estimated Stock Value for Roslovic Restaurants Solution

Target Statistic	AGSI Stats. (a)	RVM	Mean RVM (b)	Estimated Stock Value (a × b)
EPS	2.95	P/E	15.72	$46.37
BV/S	15.20	P/B	3.05	$46.36
CF/S	3.80	P/CF	11.48	$43.62
Sales/S	46.00	P/Sales	1.09	$50.14
	Mean estimated stock value =			**$46.62**

Comparable Company Analysis Example

- **Step 4:** Estimate a takeover premium
  - Compare stock price prior to takeover to completed deal prices
  - Calculate average of takeover premiums
    - **In case you've forgotten**, this is just a holding period return calculation:
      - Prem = $(P_{deal} – P_{pre\text{-}deal})/P_{pre\text{-}deal}$

Calculation of Takeover Premium Solutions

Company	Pre-Takeover Price (a)	Deal Price (b)	Takeover Premium [(b) – (a)] / (a)
Target 1	$22.00	$27.25	23.9%
Target 2	$18.25	$21.00	15.1%
Target 3	$108.90	$130.00	19.4%
Target 4	$48.50	$57.00	17.5%
		Mean premium:	**19.0%**

Comparable Company Analysis Example

- **Step 5:** Estimate takeover price = stock value based on comparables + takeover premium
- Estimated stock value based on comparable firms
  = $46.62
- Estimated takeover premium
  = 19.0%
- Estimated takeover price for Roslovic
  = $46.62 × 1.19 = $55.48

Corporate Finance (2)

Mergers and Acquisitions

Bid Evaluation

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Evaluating a Merger Bid

- Post-merger value of an acquirer:

  $V_{AT} = V_A + V_T + S - C$

  where:

  V_{AT} = post-merger value of combined firm

  V_A = pre-merger value of acquirer

  V_T = pre-merger value of target

  S = synergies created by the merger

  C = **cash paid** to target shareholders

Evaluating a Merger Bid

- Gains accrued to the target

  $Gain_T = TP = P_T - V_T$

  where:

  $Gain_T$ = gains accrued to target

  TP = takeover premium

  P_T = price paid for target

  V_T = pre-merger value of target

Evaluating a Merger Bid

- Gains accrued to the acquirer

  $Gain_A = S - TP = S - (P_T - V_T)$

  where:

  $Gain_A$ = gains to acquirer's shareholders

  Note that gains accrued to the target shareholders + gains accrued to the acquirer = synergies

Evaluating a Merger Bid

- Adjustment for **stock** payment

  $P_T = (N \times P_{AT})$ ← Important point!

  where:

  N = number of new shares target receives

  P_{AT} = price per share after merger announced

Example: Merger Gains

- Giant Foods is acquiring Kazmaier's at $27 per share for Kazmaier's stock.

	Giant	Kazmaier
Pre-merger stock price	$36	$24
# of shares outstanding (millions)	50	24

- Assuming estimated synergies of $120 million, calculate the merger gains to either party assuming cash payment or stock offer of 0.75 Giant shares per share of Kazmaier.

Example: Merger Gains

- Under cash payment:
  - Gains to Kazmaier s/h = $3 per share × 24 million = $72 million
  - Gains to Giant s/h = $120 – $72 = $48 million
- Stock payment:
  - New shares to Kazmaier: 24 million × 0.75 = 18 million
  - $V_{AT} = V_A + V_T + S - C$ = 1,800 + 576 + 120 – 0 = $2,496 million
  - P_{AT} = 2,496 / (50 + 18) = $36.70

Example: Merger Gains

- Stock payment (cont.):
  - $P_T = (N \times P_{AT})$ = (18 × $36.70) = $660.60
  - TP = 660.60 – 576 = $84.60 million
  - Gains to Giant = 120 – 84.60 = $35.40 million

Effects of Price and Payment Method

- Effect of price
  - Acquirer will want to pay the lowest possible price
    - Pre-merger value of the target, V_T
  - Target will want to receive the highest possible price
    - Pre-merger value of the target plus expected synergies, $V_T + S$

Effects of Price and Payment Method

- Effect of payment: Cash offer
  - Acquirer assumes the risk and receives the potential reward
  - Gain for target shareholders is limited
    - **Synergies > expected**: Takeover premium for target is fixed, so acquirer wins
    - **Synergies < expected**: Acquirer loses

Effects of Price and Payment Method

- Effect of payment: Stock offer
  - Some of the risks and potential rewards shift to the target firm
  - Target shareholders will own part of acquiring firm

Distribution of Merger Benefits

- Short-term effect on stock price
  - Target average gain approximately 30%
  - Acquirer loses between 1% and 3%
    - “Winner’s curse”
    - *Managerial hubris*
- Long-term effect on stock price
  - **Acquirers tend to underperform**
    - Failure to capture promised synergies

Downsizing Operations Through Corporate Restructuring

- **Divestitures:** Selling, liquidating, or spinning off a division or subsidiary
- **Equity carve-outs:**
  - **Creates a new, independent company**
  - Sell shares to outside stockholders through a public offering

Downsizing Operations Through Corporate Restructuring

- **Spin-offs:**
  - **Create a new, independent company**
  - Distribute shares to parent company shareholders – no cash for parent
- **Split-offs:**
  - Existing shareholders must exchange shares for shares of new division
- **Liquidations:** Break up firm; sell its assets piece by piece

Major Reasons for Divestitures

1. **Division no longer fits long-term strategy**
   - Sell to focus on core business
2. **Lack of profitability**
3. **Individual parts are worth more than the whole**
   - Reverse synergy
4. **Infusion of cash**
   - Useful if parent has financial difficulty

Equity Valuation (1)

Equity Valuation: Applications and Processes

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Equity Valuation

Intrinsic Value (IV): True underlying value of the security given complete understanding

Estimated Value (VE): Investor estimate of intrinsic value

Market Price (P): Current price

Two Sources of Perceived Mispricing:

VE – P = (**VE** – IV) + (IV – **P**)

Other Value Concepts

- **Going Concern Value**: Typically the relevant intrinsic value for publicly traded companies; assumes assets remain in place and continue to produce cash flow into the future via continuing operations
- **Liquidation Value:** The value if the firm ceases to operate, all assets are sold, and the firm is dissolved
- **Orderly Liquidation Value:** Assumes adequate time to realize liquidation value

Other Value Concepts

- **Fair Market Value**: Price at which an arm's length transaction between a willing and informed buyer and willing and informed seller. Usually, market price is equal to fair market value.
- **Investment Value:** Value to a specific buyer including the value of perceived synergies. Useful for valuation in acquisitions.

Uses of Equity Valuation

1. **Stock selection—our focus**
2. Inferring inputs from the market vs. history
3. Projecting worth of company actions
4. Fairness opinions for mergers
5. Planning and consulting—maximum s/h value
6. Communication with investors
7. Valuing private business
8. Portfolio management

Porter's Elements of Industry Analysis

1. Intra-industry rivalry
2. New entrants
3. Substitutes
4. Supplier power
5. Buyer power

Porter's Elements of Competitive Strategy

1. Cost leadership – lowest cost producer
2. Differentiation – unique products or services
3. Focus – target segment(s) of industry using either of the above strategies

Importance of Evaluating the Quality of Financial Statement Information

Revenue Recognition and Gains

- Early revenue recognition
- Misclassification of non-operating income

Importance of Evaluating the Quality of Financial Statement Information

Expenses and Losses

- Too little or too much reserves
- Inappropriate capitalization of expenses

Off-Balance-Sheet Financing – understate liabilities

Operating Cash Flow – may be artificially inflated

Absolute vs. Relative Valuation

Absolute valuation models:

- Intrinsic value based on fundamental characteristics—EPS, asset turns and leverage, return on equity, growth (g)
- (e.g., DDM, free cash flow, residual income)

Relative valuation models:

- Value derived from relative comparison to similar assets, based on law of one price
- P/E, P/B, P/CF, P/S models

Sum-of-the-Parts Valuation

- **Sum-of-the-parts**: Value each division separately and add the component values to obtain whole company value.
- **Conglomerate Discount (CD):** Sum-of-the-parts value – market price.
- **Reasons for C.D.:** Internal capital inefficiency, endogenous factors, and research measurement errors.

Appropriate Valuation Approach

Consistent with characteristics of company

- Understand the company and how its assets create value

Based on quality and availability of data

- DDM problematic when no dividends
- P/E problematic with highly volatile earnings

Consistent with purpose of analysis

- Free cash flow vs. dividends for controlling interest

Wrap Up: Equity Valuation Process

- Model suitability
- Quality of the inputs—financial statement analysis, footnotes
- Absolute versus relative valuation

Equity Valuation (1)

Return Concepts

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Seven Return Concepts

1. **Holding Period Return (HPR)**—capital gains plus any cash flow stated as a percentage of the initial investment:
   - HPR = $(P_1 - P_0 + CF_1) / P_0$ **or** $[(P_1 + CF_1) / P_0] - 1$
   - HPR = Price appreciation + dividend yield
2. **Realized Return**—historical return based on observed prices and cash flows
   – **Can be calculated as an ex-post HPR**

Seven Return Concepts

3. **Expected Return**—return based on forecasts of a future price and cash flows
   – **Think**: forecast return (**ex-ante HPR**)
4. **Required Return**—the minimum return an investor requires given the asset's risk
   – Frequently calculated with the CAPM
5. **Return from Convergence**—return expected/realized as market price converges to intrinsic value

Seven Return Concepts

6. **Discount Rate**—rate used to determine the present value of an investment
7. **Internal Rate of Return** (IRR)—the rate that equates the discounted cash flows to the current market determined price
   - Again, **you see this calculation frequently** in the CFA syllabus (capital budgeting, YTM, cash flow yield, etc.)

Equity Risk Premium (ERP)

- **Equity Risk Premium**—additional return above the risk-free rate investors require for holding (risky) equity securities
  - **Think**: Required return – RFR
- The risk-free rate should be equal to the investor's investment horizon
  - T-Bills for short horizons
  - T-Bonds for longer holding periods

Equity Risk Premium (ERP)

- **Required Return for a Stock**
  - The ERP can be used to determine the required return for an individual security given its level of systematic risk

Risk-free rate

$$R_i = R_f + \beta \underbrace{\left(R_M - R_f\right)}_{\text{Average equity risk premium}}$$

Beta (systematic risk)

Strengths and Weaknesses of Approaches to Estimating the ERP

1. **Historical ERP**—historical mean difference between broad market equity index and T-bill
   - **Strength**—objective and simple
   - **Weaknesses**:
     - Assumes stationary mean and variance of returns over time
     - Upwardly biased due to survivorship bias
     - Which risk-free rate to use?

Strengths and Weaknesses of Estimating the ERP

2. **Forward-Looking ERP**—utilizes current market conditions and expectations concerning economic and financial variables
   - **Strength**—does not require stationary
   - **Weaknesses**:
     - Requires frequent updates
     - Makes lots of assumptions

Forward-Looking ERP

1. **Gordon Growth Model**

   $E(R) = D_1 / P_0 + g = Y + g$

   $ERP = E(R) – R_f = Y + g – R_f$

2. **Macroeconomic Model**—use macroeconomic and financial variables such as inflation, earnings growth, and so forth (next slide)
   - **Strength**—robust results
   - Weakness—used only with developed countries

Forward-Looking ERP

- **Ibbotson-Chen (Macroeconomic model)**

  $ERP = Y + [(1 + E(I))(1 + g_R)(1 + PEG) – 1] – R_f$

  where:

  Y = dividend yield

  E(I) = Expected inflation

  PEG = PE growth due to market correction

  g_R = Real growth rate (est. real GDP growth)

Forward-Looking ERP

3. **Survey**—consensus of experts
   - Strength—easy to obtain
   - Weakness—wide disparity between opinions

CAPM: Single Factor Required Return on Equity Model

- **Capital Asset Pricing Model (CAPM)**

Risk-free rate   Expected equity risk premium

$$R_i = \underbrace{R_f}_{\text{Risk-free rate}} + \underbrace{\beta}_{\text{Beta (systematic risk)}} \overbrace{(R_M - R_f)}^{\text{Expected equity risk premium}}$$

Beta (systematic risk)

$\boxed{\text{Single Factor Model}}$

Multifactor Models of Required Return

- **Multifactor Models**: Use multiple *factors* to explain returns
- **Required return = Rf + RP_1 + RP_2 + … + RP_n**
  - where RP = Risk premium = (sensitivity) × (**factor**)
- Factor sensitivity (factor loading)—asset's sensitivity to a factor
  - **Think**: Beta (the one sensitivity in the CAPM)
- Factor risk premium—return driver
  - Think: ERP (the single factor in the CAPM)

Multifactor Models of Required Return

- **Two types of models**
- Arbitrage models
  - Fama-French
  - Pastor-Stambaugh
  - Arbitrage Pricing Model (BIRR version)
- Ad hoc model
  - Build-up (i.e., bond yield + risk prem)

All are very easy to implement – inputs given on exam!

Various Required Return on Equity Models

- Fama-French Model Example:
  - Risk-free rate of 3%
  - Small Cap factors and sensitivities

	Factor	Sensitivity
(Market index – Rf)	5%	1.1
(Small – Big) returns	3%	0.4
High B/M – Low B/M	2%	– 0.8

R_i = 3% + 1.1(5%) + 0.4(3%) – 0.8(2%) = 8.1%

Various Required Return on Equity Models

- **Pastor-Stambaugh Model**
  - Adds a liquidity factor to the Fama-French Model

	Factor	Sensitivity
(Market index – Rf)	5%	1.1
(Small – Big) returns	3%	0.4
High B/M – Low B/M	2%	– 0.8
Liquidity premium	4%	– 0.1

R_i = 3% + 1.1(5%) + 0.4(3%) – 0.8(2%) – 0.1(4%) = 7.7%

Various Required Return on Equity Models

- Arbitrage Pricing Model: Competitor to CAPM
  - Factors not specified
- BIRR version is closest to *accepted* factors:
  1. Investor confidence risk
  2. Time horizon risk
  3. Inflation risk
  4. Business-cycle risk
  5. Market-timing risk

Do not memorize

Various Required Return on Equity Models

- Build-Up Method
  - Used with closely held companies
  - Used when beta estimates *unobtainable*
  - E(r) = Rf + ERP + size premium + company specific premium
- Inputs will be given
- Method does not use betas!

Beta Estimation: Public Firms

- **Public company betas:** Estimated with regression
  - Regress the company's returns on the returns of the overall market index
    - $R_{company} = \alpha + \beta\,(R_{market})$
      - Index choice: S&P 500
      - Interval: Five years, monthly data
  - Beta drift: Observed tendency of a computed beta to migrate towards 1.0

The estimated Beta!

Beta Estimation: Thinly Traded/Nonpublic Firms

Four-step procedure (called a *pure play*)

1. **Identify a publicly traded firm** with similar industry characteristics
2. **Estimate the beta** of the publicly traded firm using regression (last slide) → B_E
3. **Unlever** the beta $B_{unlevered} = [1/(1+(D/E_{comp.firm}))]B_E$
4. **Relever** beta $B_{nonpublic} = [1+(D/E_{nonpublic})]B_{unlevered}$

D/E ratio of the nonpublic firm

Strengths and Weaknesses of the Required Rate of Return Approaches

- **CAPM**—simple, easy to compute, single factor model
  - Simplicity comes with potential loss of explanatory power
- **Multi-factor models**—higher explanatory power
  - More complex and expensive
- **Build up**—simple
  - Ad hoc and uses historical values

International Considerations in Required Return Calculations

- **Exchange rates**—compute the required return in the home currency and adjust it by the forecast for the change in the exchange rate
- **Emerging market premium**—use a developed market benchmark and add an emerging market premium

Weighted-Average Cost of Capital

- Weighted-Average Cost of Capital

Required returns

$$WACC = (w_e \times r_e) + [w_d \times r_d \times (1 - t)]$$

MV weights <u>OR</u> target weights

Matching of Discount Rate with Cash Flows

- Firm value = FCFF, discount at WACC
- Equity value = FCFE, discount at R_E
  - Use FCFE when capital structure are not volatile
  - Use FCFF with high debt levels, negative FCFE
- Equity value = firm value – MV of debt

Main Point: You must align the discount rate with the cash flows!

Keys to the Exam
Return Concepts

- Seven return concepts
- Estimating the equity risk premium
- CAPM, Fama-French, and related models
- Beta estimation
- WACC

Equity Valuation (2)

Industry and Company Analysis

Forecasting Financial Statements

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Approaches for Developing Inputs

- **Bottom-up** analysis: Forecasts rely on company-specific information (e.g., product introductions).
- **Top-down** analysis: Begins with expectations about a macroeconomic variable (e.g., expected growth rate of nominal GDP).
- **Hybrid** analysis: Incorporates elements of both top-down and bottom-up analysis.

Forecasting Revenues

- In a **growth relative to GDP growth** approach, sales could be modeled as *GDP growth plus x%* or *to increase at the growth rate of GDP times 1 + x%*.
- A **market growth and market share** approach begins with an estimate of industry sales (market growth), and then company revenue is estimated as a percentage of industry sales (market share).

Economies of Scale

- If the average cost of production decreases as industry sales increase, we say that the industry exhibits **economies of scale.**
- A company with economies of scale will have higher operating margins as production volume increases. Sales volume and margins will tend to be positively correlated.
- Economies of scale in an industry are evidenced by larger companies having higher margins.

Forecasting the Income Statement

- **COGS** can be forecasted based on forecasted sales.
- Gross margins need to be evaluated in relation to margins of competitors.
- Impact of hedging activities should be considered.
- SG&A comprises elements that are relatively fixed (e.g., office expenses) and those that are relatively variable (e.g., selling and distribution expenses).

Interest Expense

- The primary determinants of interest expense are level of gross debt and interest rate.
- **Net debt** is *gross debt* minus cash, cash equivalents, and short-term securities.
- **Net interest expense** is gross interest expense minus interest income on cash and short-term debt securities.

Income Tax Expense

- The **statutory rate** is the percentage tax charged in the country where the firm is domiciled.
- The **effective tax rate** is income tax expense as a percentage of pretax income on the income statement.
- The **cash tax rate** is cash taxes paid as a percentage of pretax income.
- Changes in deferred tax items account for the difference between income tax expense and cash taxes due.

Income Tax Expense (cont.)

- If a multinational company has relatively more (less) rapid earnings growth in a high tax country, its effective tax rate will increase (decrease).
- An analyst should pay special attention to estimates of tax rates for companies that consistently report an effective tax rate that is less than the statutory rate (or consistently less than that of comparable peer companies).

Forecasting the Balance Sheet

- Many balance sheet items flow from income statement forecasts.
- Forecasted inventory = $\dfrac{\text{forecasted COGS}}{\text{inventory turnover}} \leftarrow \dfrac{\text{COGS}}{\text{inventory}}$
- Forecasted A/R = $\left(\begin{array}{c}\text{days sales}\\ \text{outstanding}\end{array}\right) \times \left(\dfrac{\text{forecast sales}}{365}\right)$

$$\uparrow$$

$$\dfrac{\text{AR T/O}}{365} \leftarrow \dfrac{\text{Sales}}{\text{AR}}$$

Forecasting the Balance Sheet (cont.)

- Net PPE = begin. balance + Capex – acc. depreciation
- Capex can be based on a relationship with sales or based on company-specific information.
- Capex can be separated into Capex for maintenance and Capex for growth.

Equity Valuation (2)

Industry and Company Analysis

Competitive Analysis and Growth

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ROIC and Competitive Advantage

- ROIC = NOPLAT / invested capital
- Firms with higher ROIC (relative to their peers) are likely exploiting some **competitive advantage** in the production and/or sale of their products.
- When comparing firms with different capital structures, ROIC is preferred over ROE.
- Return on capital employed is similar to ROIC but uses pre-tax earnings in numerator.

Porter's Five Force Analysis

- Companies have less (more) pricing power when the **threat of substitute products** is high (low) and switching costs are low (high).
- Companies have less (more) pricing power when the **intensity of industry rivalry** is high (low).
- Pricing power is low when industry concentration is low, when fixed costs and exit barriers are high, when industry growth is slow or negative, and when products are not differentiated to a significant degree.

Porter's Five Force Analysis (cont.)

- Company prospects for earnings growth are lower when the **bargaining power of suppliers** is high.
- Companies have less pricing power when the **bargaining power of customers** is high, especially in a circumstance where a small number of customers are responsible for a large proportion of a firm's sales and also when switching costs are low.
- Companies have more pricing power and better prospects for earnings growth when the **threat of new entrants** is low.

Input Cost Price Inflation

- Firms with commodity-type inputs can hedge their exposure.
- Vertically integrated firms are less affected by input cost price inflation.
- Analyst must judge if a company can pass on the price increase to customers.
- The effects of increasing a product's price depend on the product's elasticity of demand and the actions of rivals.

Technological Developments

- Some advances in technology decrease costs of production, which will increase profit margins.
- Technological advancement may result in improved substitutes (cannibalization).
- **Cannibalization factor** is the percentage of the market for the existing product that will be taken by the new substitute.

Forecast Horizon

- May be based on expected holding period
- Must include mid-cycle for cyclical firms
- When there are recent material events, such as acquisitions, mergers, or restructurings, the forecast horizon should be long enough that the perceived benefits of such events can be realized (or not)
- May be dictated by employer

Long-Term Growth Rate

- For terminal value estimation, a long-term growth rate assumption is necessary.
- Analysts should look for **inflection points.**
- Inflection points occur due to changes in:
  - Overall economic environment
  - Business cycle stage
  - Government regulations
  - Technology

Pro Forma Financial Statements

- Estimate sales and COGS
- Estimate SG&A and financing costs
- Estimate tax expense and cash taxes
- Estimate balance sheet items
  - Items related to sales
  - Capex for replacement and growth
- From pro forma balance sheet and income statement, prepare cash flow statement

Equity Valuation (2)

Discounted Dividend Valuation

DDM Basics

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Discounted Cash Flow Valuation

- An asset's intrinsic value is the present value of its *expected* future cash flows.

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

Very important concept!

Various Measures of Cash Flow in Valuation

- Measures of **cash flow**
  - Dividends = cash paid to shareholders, used in DDM
  - Free cash flow = cash *available* to pay shareholders, broader scope
  - Residual income = economic profit
- **Key point:** Valuation metric (e.g., dividends or FCF) must be measurable and related to earnings power

Dividends

- **Advantages**
  - Less volatile than other cash flow measures
  - Theoretically justified – dividends are what you receive when you buy a stock
  - Accounts for reinvested earnings to provide a basis for increased future dividends

Dividends

- **Disadvantages**
  - Non-dividends paying firms
  - Dividends artificially small for tax reasons
  - Dividends may not reflect the control perspective desired by the investor

Dividends Suitability

- Situations when appropriate
  - Company has history of paying dividends
  - Board of directors has a dividend policy that has an understandable and consistent relationship to profitability
  - Minority shareholder takes a non-control perspective
  - Mature firms, profitable but not fast growth

Free Cash Flow (FCF)

- FCF represents cash flow distributable to the providers of capital:
  - Free cash flow to the firm (FCFF): Cash flow distributable to all providers of capital (i.e., debt and equity)
  - Free cash flow to equity (FCFE): Cash flow distributable to equity holders
- Much more on this topic in later readings.

Residual Income (RI)

- **Residual income:** Earnings in excess of the investors' required return on the beginning-of-period investment
  - Residual income focuses on profitability in relation to all opportunity costs faced by the firm
  - **Think:** Economic profit
    - More in upcoming readings.

DDM: How To

- **Process**: Discount the future dividends at the required rate of return:

  Step 1: Estimate future dividends

  Step 2: Determine required return

  Step 3: Value = PV (expected dividends)

Dividend Discount Models

- **The Rule**: Value is present value of all future dividends discounted at required return
- That is: $V_0 = \sum_{t=1}^{\infty} \frac{D_t}{(1+r)^t}$

The basic model

- **Problem**: Requires estimation of infinite stream of CFs

Single Period DDM

- Single-period DDM is the present value of the future dividend and sales price

Terminal value

$$V_0 = \frac{D_1}{(1+r)^1} + \frac{P_1}{(1+r)^1} = \frac{D_1 + P_1}{(1+r)^1}$$

- Notice that there are two cash flows in the final period

Example: Single Period DDM

- **Example:** Is BB over- or under-valued?
  - Current market price = €26
  - Expected year-end dividend = €1.25
  - Expected year-end stock price = €28
  - Required return = 8%

Solution: Single Period DDM

$$V_0 = \frac{D_1 + P_1}{(1+r)} = \frac{€1.25 + €28}{(1.08)} = €27.08$$

$\Rightarrow$ undervalued!

Current market price of €26 is less than intrinsic value of €27.08 and is, therefore, a buy.

Two-Period DDM

- **Two period DDM**: Extends single period model
  - Value = PV two years of cash flows and the future sales price

Terminal value

$$V_0 = \frac{D_1}{(1+r)^1} + \frac{D_2}{(1+r)^2} + \frac{P_2}{(1+r)^2} = \frac{D_1}{(1+r)^1} + \frac{D_2 + P_2}{(1+r)^2}$$

- Notice that in the final year, two cash flows occur

Example: Two-Period DDM

- Machines Unlimited (MU) shares sell for C$40 today. Is MU over- or under-valued?
  - Expected Year 1 dividend = C$1.55
  - Expected Year 2 dividend = C$1.72
  - Expected price at the end of Year 2 = C$42
  - Required return = 14%

Solution: Two-Period DDM

$$V_0 = \frac{D_1}{(1+r)^1} + \frac{D_2 + P_2}{(1+r)^2}$$

$$= \frac{C\$1.55}{1.14} + \frac{C\$1.72 + C\$42}{1.14^2} = C\$35.00$$

Current price = C$40; thus, overvalued

Multiple-Period DDM

- The model takes the present value of all future cash flows
- **Note:** If you can do 1 and 2 periods, you can do *n* periods

$$V_0 = \frac{D_1}{(1+r)^1} + \ldots + \frac{D_n}{(1+r)^n} + \frac{P_n}{(1+r)^n}$$

Terminal value

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

Dividend Discount Models

- **Simplifying assumptions** for future growth:
  1. Constant growth (Gordon model)
  2. Two-stage growth
  3. H-model
  4. Other assumptions (e.g., N-stage, spreadsheet)

Very important!

Also know

Nah…

Equity Valuation (2)

Discounted Dividend Valuation

Gordon Growth Model

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Gordon Growth Model

$$V_0 = \frac{D_0 \times (1+g)}{(r-g)} = \frac{D_1}{(r-g)}$$

Be careful with the subscripts!

where:

D = dividend

g = sustainable growth rate

r = required return on equity

DDM: Constant Growth (Gordon)

Assumptions:

1. Dividend (D_1) expected in one year
2. Dividends grow at constant rate (g) forever
3. Growth rate less than required return (r > g)

DDM: Constant Growth (Gordon) (cont.)

Situations in which model is useful:

1. Mature (late in life cycle) firms
2. Broad-based equity index
3. Terminal value in more complex models
4. International valuation
5. Can be used to calculate justified P/E ratio *(later SS)*

Example: Constant Growth (Gordon)

- **Down Under:**
  - **Paid a dividend yesterday** of A$1.80
  - Dividends are expected to grow at a long-term constant rate of 3.5%
  - Beta is 1.50, risk-free rate and expected return on market is 4% and 8% respectively

Solution: Constant Growth (Gordon)

Calculate the intrinsic value:

Required rate of return r = 4% + 1.50 (8% - 4%) = 10%

$$V_0 = \frac{A\$1.80\ (1.035)}{0.10 - 0.035} = A\$28.66$$

Implied Growth Rate

- Given **current market price**, we can calculate the implied growth rate:

  $g = r - (D_1/P_0)$

PV of Growth Opportunities

- **Equity value has two components**:
  1. Value of no growth firm (E_1/r) (i.e., assets/earnings currently in place)
  2. Present value of future growth opportunities (PVGO)
- **Model:**

$$\mathbf{P_0 = E_1/r + PVGO}$$

PVGO Model Using Leading P/E_1

- **Point:** Morph PVGO model into a (leading) P_0/E_1 model
  - Just divide through by E_1

  $P_0/E_1 = 1/r + PVGO/E_1$
- **Intuition:**
  - $1/r = P/E_1$ ratio for a no growth company
  - $PVGO/E_1 = P/E_1$ component related to growth

Example: PVGO

- **Reliable's** stock price is SFr. 60, expected earnings of SFr. 5.0, and required rate of return of 10%.
- **Calculate**
  - **PVGO**
  - Proportion of stock price attributable to PVGO

Solution: PVGO

$$V_0 = \frac{E_1}{r} + PVGO$$

$$60 = \frac{5}{0.10} + PVGO \Rightarrow PVGO = SFr\ 10.00$$

- P/E of the firm = 60/5 = 12
- P/E attributable to PVGO = 10/5 = 2
- 2/12 (or SFr 10 / SFr 60) = 16.7% attributable to PVGO

Gordon and Justified P/Es

- Point: The GGM can also be used to calculate a *justified* fundamental price multiple
- As shown in a later study session, rearranging GGM yields:

$$P_0 = \frac{D_1}{r-g} \Rightarrow \text{justified leading } \frac{P_0}{E_1} = \frac{D_1/E_1}{r-g} = \frac{(1-b)}{r-g}$$

DDM: Constant Growth (Gordon)

Suitability:

- Company has history of paying dividends
- Board of directors has a dividend policy that has an understandable and consistent relationship to profitability
- Minority shareholder takes a non-control perspective
- Mature firms, profitable but not fast growth

DDM: Constant Growth (Gordon) (cont.)

Strengths:

- Used with broad market indexes (developed markets)
- Estimate g, r, and PVGO
- **Supplement to more complex models (terminal value)**

DDM: Constant Growth (Gordon) (cont.)

Weaknesses:

- Value (V_0) **very sensitive to estimates of *r* and *g***
- Difficult to use with non-dividend-paying stocks

Model selection: Minority perspective only

- Not useful for valuing M&A

Multi-Stage DDM Models

- **GGM assumption**: Stable dividend growth rate forever
  - **Problem:** Unrealistic for most firms
- **Solutions include**:
  - Two-stage
  - H-model, three-stage
  - Spreadsheet modeling
- Growth can be expressed in three distinct phases

Next Slide

Phases of Growth

1. **Initial growth** phase—use three-stage model
   - Rapid EPS growth, negative FCF
   - ROE > *r*, no or low dividend payout
2. **Transitional** phase—use two-stage/H-model
   - Sales and EPS growth slow, dividend increase
   - ROE approaching *r*, positive FCF
3. **Mature** phase—use GGM
   - Growth at economy-wide rate, positive FCF
   - ROE = r, high competition, saturation

Terminal Value

- **Terminal value** = forecasted value at beginning of the final mature growth phase
  - Also known as the ***future sales price***
- **Two estimation methods**:
  1. Apply trailing multiple (P/E) × forecasted EPS_t in year *t*
  2. Gordon Growth Model $D_n / (r – g)$

Equity Valuation (2)

Discounted Dividend Valuation

Multiperiod Models

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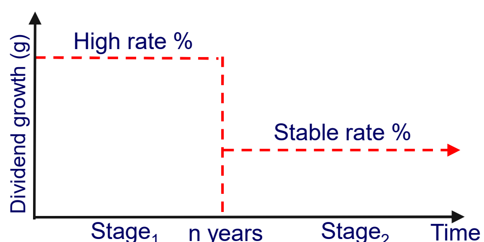
Two-Stage DDM

- **Assumes stages of growth:**
  - **First:** Fixed period of supernormal growth
  - **Then**: Indefinite growth at *normal level*
- Useful in cases when growth rate is expected to drop suddenly:
  - Patent expiration
  - Firm enters mature phase of life cycle after a rapid growth stage

Two-Stage DDM

- **Problem:** GGM constant *g* assumption unrealistic
- **Solution:** Assume rapid growth for *n* years, then long-term sustainable growth
- Two-stage assumes a *drop-off* in growth

Important!



Application: The Two-Stage Model

- **Two stages of growth**:
  1. Initial high-growth phase
  2. Perpetual stable-growth phase
- Two approaches:
  1. Formula
  2. Timeline
- **Suggestion**: **Use the timeline**—it provides the flexibility to solve many types of problems

Application: The Two-Stage Model

- **Methodology**:
  1. Individual estimation of supernormal dividends, *followed by…*
  2. Calculation of a terminal value
- **Note**: Very important concept

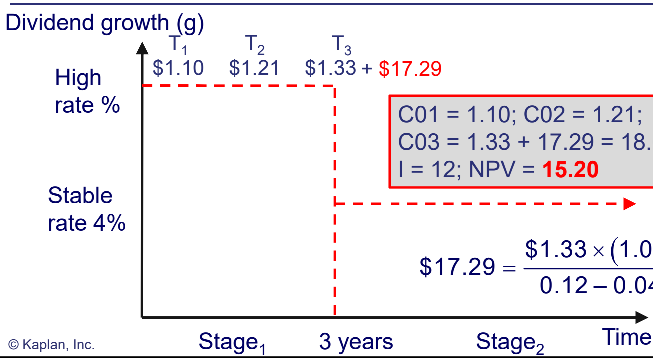
V_0 = PV(dividends over first *n* years) + PV(terminal value)

From Gordon growth model or price multiple approach

Example: The Two-Stage Model

- **Sea Island** currently pays dividend of **$1.00** which will grow at **10%** per year for **three** years.
  - Stage two constant growth = **4%**
  - Required return = **12%**
- **Calculate the value today**

Solution: The Two-Stage Model

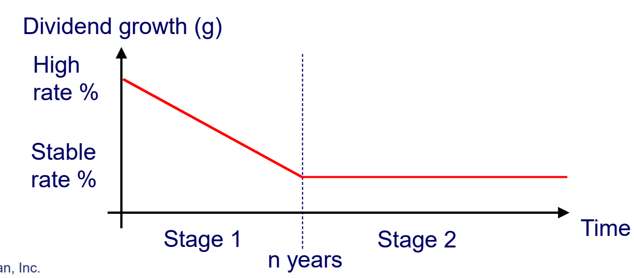


C01 = 1.10; C02 = 1.21;
C03 = 1.33 + 17.29 = 18.62
I = 12; NPV = **15.20**

$$\$17.29 = \frac{\$1.33 \times (1.04)}{0.12 - 0.04}$$

The H-Model

- Assumes a gradual decay in *g* as firm matures over a transition period



The H-Model (cont.)

- **Problem**: Two-stage model assumes high growth rate will suddenly drop
- **The H-model**: More realistic assumption
  - Firm will start with high growth rate
  - Growth declines linearly over a transition period T = "2H" years

Note: Only an approximation method; more accurate when H and $(g_s - g_L)$ is small.

The H-Model Formula

Most recent dividend

Short-term *high* growth rate

H = Transition period/2

$$V_0 = \left[\frac{D_0 \times (1+g_L)}{r - g_L}\right] + \frac{D_0 \times H \times (g_S - g_L)}{r - g_L}$$

Required return

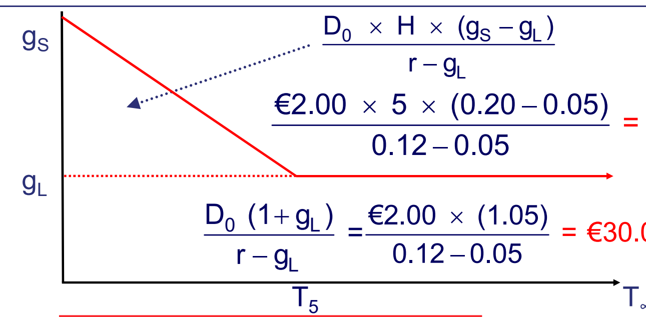
Long-term *low* growth rate

Example: H-Model

- **Omega Foods Inc.:**
  - Currently pays a dividend of €2.00
  - Stage one growth rate is 20%
  - Growth is expected to decay over 10 years
  - Constant growth rate of 5% thereafter
  - Required return is 12%

Calculate the intrinsic value

Solution: H-Model



$$\frac{D_0 \times H \times (g_S - g_L)}{r - g_L}$$

$$\frac{€2.00 \times 5 \times (0.20 - 0.05)}{0.12 - 0.05} = €21.43$$

$$\frac{D_0\,(1+g_L)}{r - g_L} = \frac{€2.00 \times (1.05)}{0.12 - 0.05} = €30.00$$

P_0 = €30.00 + €21.43 = €51.43

The H-Model (cont.)

- **Calculating rate of return (r) in the H-model given the market price:**

$$r = \left[\left(\frac{D_0}{P_0}\right)\left\{(1+g_L) + \left[H \times (g_S - g_L)\right]\right\}\right] + g_L$$

DDM: Multi-Stage Models

Three-stage model: Two approaches

1. **Three distinct phases**, simply add an additional growth stage to the two-stage model
   - Growth, transition, and mature
2. **High-growth phase + H-model pattern**
   - High followed by ***linearly declining*** followed by perpetual growth

The Multi-Period Models

- **Strengths**
  - Ability to model many growth patterns
  - Solve for *V*, *g*, and *r*
- **Weaknesses**
  - Require high-quality inputs (GIGO)
  - Value estimates sensitive to *g* and *r*
  - Model suitability very important

SGR: The Sustainable Growth Rate

- **SGR (g)** = sustainable growth rate in earnings and dividends if we **assume**:
  - Growth uses internally generated equity
  - Capital structure remains unchanged
  - Several key ratios held constant
    - **Formula:**

      g = retention rate (b) × NI/SE

      g = b × ROE

SGR: The Sustainable Growth Rate

- Three-Part DuPont ROE Decomposition:

$$ROE = \left(\frac{\text{net income}}{\text{sales}}\right) \times \left(\frac{\text{sales}}{\text{assets}}\right) \times \left(\frac{\text{assets}}{\text{equity}}\right)$$

$$ROE = \left(\begin{matrix}\text{net profit}\\ \text{margin}\end{matrix}\right) \times \left(\begin{matrix}\text{asset}\\ \text{turnover}\end{matrix}\right) \times \left(\begin{matrix}\text{equity}\\ \text{multiplier}\end{matrix}\right)$$

- **Note**: Always use beginning-of-year balance sheet numbers (unless told otherwise)
- **Point:** SGR = retention × ROE

SGR Value Drivers and Their Impact

1. **Net income/sales measures profitability**, higher margins result in a higher ROE
2. **Sales/total assets** measures **operational efficiency**, higher turns result in higher ROE
3. **Assets/equity measures financial leverage** via the equity multiplier based on the firm's financing policies, higher leverage higher ROE

Spreadsheet Modeling

- **Allows more flexibility in forecasting cash flows**
- **Steps:**
  - Establish base level cash flows
  - Forecast deviations for near future (e.g., supernormal growth for first four years)
  - Project *normal* growth beyond near future
  - Discount all cash flows to PV

Equity Valuation (3)

Free Cash Flow Valuation

FCF Computation

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Introduction to Free Cash Flow

- Dividends are the cash flows **actually paid** to stockholders
- Free cash flow is the cash flow **available** for distribution each year after subtracting cash spent on working capital and fixed capital investments in the year (denoted WC_{Inv}, FC_{Inv})

FCF Defined

- **FCFF** (**F**ree **C**ash **F**low to the **F**irm)
  - Cash available to shareholders and bondholders after taxes, capital investment, and WC investment; *pre-levered cash flow*
- **FCFE** (**F**ree **C**ash **F**low to **E**quity)
  - Cash available to equity holders after payments to and inflows from bondholders; *post-leverage cash flow*
  - Not equal to dividends actually paid

Interpret FCF Strengths

- **Strengths**
  - Used with firms that have no dividends
  - Functional model for assessing alternative financing policies
  - Rich framework provides additional detailed insights into company
  - Other measures EBIT, EBITDA, and CFO either double count or omit important cash flows

Interpret FCF Limitations

- **Limitations**
  - If FCF < 0 due to large capital demands
  - Requires detailed understanding of accounting and FSA
  - Information not readily available or published

FCFF vs. FCFE

- **Firm value** = FCFF discounted at WACC
- **Equity value** = FCFE discounted at required return on equity (r)
  - Use FCFE when capital structure is stable
  - Use FCFF when high or changing debt levels, negative FCFE
- **Equity value = firm value – MV of debt**

Ownership Perspective

- **FCFE = control perspective**
  - Ability to change dividend policy
  - Used in control perspective
- **DDM = minority owner**
  - No control
  - Used in valuing minority position in publicly traded shares

FCF Formula References

- **NI** = Net income to common shareholders, after preferred dividend but before common dividends
- **NCC** = noncash charges
- **Int(1 – t)** = after-tax interest expense
- **FC_{Inv}** = **net** fixed capital investment
- **WC_{Inv}** = working capital investment
- **Net borrowings** = new debt – repayments

Noncash Charges (NCC)

- Applies to both FCFE and FCFF
- Represent adjustments for noncash decreases and increases in net income based on accrual accounting, but did not result in an outflow of cash
  - If noncash charges **decrease** net income, **add back to net income**
  - If noncash charges **increase** net income, **subtract from net income**

Common Exam Noncash Charges

Non Cash Items	Adjustment to NI	Location
Depreciation and Amortization	Add	I/S or CFO
Impairment/write down	Add	I/S
Gains (losses) on asset sale or early debt retirement	Subtract (Add)	I/S
Restructuring expense (income)	Add (Subtract)	I/S
↑Deferred tax liability	Add*	I/S B/S
Amortization of bond discount (premium)	Add (Subtract)	CFO

*If unlikely to reverse

Equity Valuation (3)

Free Cash Flow Valuation

FCInv and WCInv Computation

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Net Fixed Capital Investment (FC_{Inv})

- Investments in fixed capital (FC_{Inv}) represent a cash out flow necessary to support the company's current and future operations
- Viewed as a capital expenditure (Cap Ex) that reduces both FCFE and FCFF
- Expenditures can include acquisition of intangible items such as trademarks
- Care should be used with nonrecurring large acquisitions in forecasts

Net FC_{Inv} Adjustments

- From statement of cash flows:
  Capex included in investing activities
- From balance sheet:
  FC_{Inv} = end net PPE – beg net PPE + depreciation +/– loss/gain on sale

See next slide

Net FC_{Inv} Adjustments (cont.)

Beg net PPE	X	Proceeds (plug)	X
(–) Depreciation	(X)	(–) Book value of disposal*	(X)
(–) Book value of disposal*	(X)	I/S gain/(loss)	X/(X)
(+) additions (plug)	X		
End net PPE	X		

FC_{INV} = additions – proceeds

* Carrying value of disposed asset may not be given. Ignore from both columns. Additions and proceeds are incorrect, but the net (FC_{INV}) is correct.

Investment in Working Capital (WC_{Inv})

- Working capital includes all short-term *operating* assets and liabilities
- Specifically excludes:
  - Cash and cash equivalents
  - Short-term interest-bearing debt
  - Notes payable
  - Current portion of long-term debt
  - Dividends payable

Working Capital Adjustments

- There is a **direct relationship** between changes in **liabilities** and changes in cash flow
- An **increase in a liability** account is a **source** (addition/plus) of cash
- A **decrease in a liability** is a **use** (negative/subtraction) of cash

Equity Valuation (3)

Free Cash Flow Valuation

Net Borrowings and Variations of Formulae

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Net Borrowing Adjustments

- Net borrowings only affect **FCFE**, not FCFF. Include issue repayment of:
  - Long-term debt
  - Notes payable
  - Current portion of long-term debt
- Cash flow = B/S change in debt instruments – amortized discounts + amortized premiums

FCFF and FCFE Beginning with Net Income

- **FCFF = NI** + NCC + Int(1 – t) – WC_{Inv} – FC_{Inv}
- **FCFE = NI** + NCC – WC_{Inv} – FC_{Inv} + net borrowing
- **FCFE = FCFF – Int(1 – t) + net borrowing**

FCFF and FCFE Beginning with CFO

- Recall, **CFO = NI + NCC – WC_{Inv}**
- CFO is an after-interest starting point
- **FCFF = CFO** + Int(1 – t) – FC_{Inv}
- Subtracting after-tax interest and adding back net borrowing from the FCFF equations gives us the FCFE from CFO
- **FCFE = CFO** – FC_{Inv} + net borrowing

FCFF Beginning with EBIT

- To show the relation between EBIT and FCFF, start with the FCFF equation and assume that the noncash charge (NCC) is depreciation (Dep):
  - FCFF = NI + Dep + Int(1 – t) – WC_{Inv} – FC_{Inv}
- Net income (NI) can be expressed as:
  - NI = (EBIT – Int)(1 – t), rearranging
  - NI = EBIT(1 – t) – Int(1 – t)
  - **FCFF = EBIT (1 – t) + Dep – WC_{Inv} – FC_{Inv}**

FCFF Beginning with EBITDA

- To get FCFF from EBITDA (earnings *before* interest, taxes, depreciation, and amortization), use the formula for FCFF:

  FCFF = EBITDA (1 – t) + Depr (t) – WC_{Inv} – FC_{Inv}
- We add back the NCC (depreciation) times the tax because we capture the tax benefit from deducting the depreciation; it represents the cash flow savings from the deduction.

FCFF Formula Review

- **FCFF = NI** + NCC + [Int(1 – t)] – WC_{Inv} – FC_{Inv}
- **FCFF = CFO** + [Int(1 – t)] – FC_{Inv}
- **FCFF =** [**EBIT**(1 – t)] + NCC – WC_{Inv} – FC_{Inv}
- **FCFF = EBITDA**(1 – t) + (NCC × t) – WC_{Inv} – FC_{Inv}
- Notice: No net borrowings!

FCFE Formula Review

- **FCFE = NI** + NCC – WC_{Inv} – FC_{Inv} + net borrowings
- **FCFE** = **CFO** – FC_{Inv} + net borrowings
- **FCFE** = FCFF – [Int(1 – t)] + net borrowings

Important Concept – FCFF and FCFE

- There is only one value for FCFF and only one value for FCFE
- The various equations are all different ways to get to the same value
- Use whichever equation is easiest with the data given in the problem

Equity Valuation (3)

Free Cash Flow Valuation

Example

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Sting's Deli Balance Sheet: Example

	Forecast 2010	Actual 2009
Cash	$10.0	$5.0
A/R	30.0	15.0
Inventory	40.0	30.0
PP&E cost	400.0	300.0
Accumulated dep	(190.0)	(140.0)
Total assets	$290.0	$210.0

Sting's Deli Balance Sheet: Example

	Forecast 2010	Actual 2009
Accounts payable	$20.0	$20.0
Short-term debt	20.0	10.0
Long-term debt	114.0	100.0
Common stock	50.0	50.0
Retained earnings	86.0	30.0
Total liab. and OE	$290.0	$210.0

Sting's Deli. Income Statement: Example

	Forecast 2010	Actual 2009
Sales	$300.0	$250.0
COGS	120.0	100.0
Gross profit	$180.0	$150.0
SG&A	35.0	30.0
Depreciation	**50.0**	**40.0**
EBIT	$95.0	$80.0

Sting's Deli Income Statement: Example

	Forecast 2010	Actual 2009
Interest expense	**$15.0**	**$10.0**
Pre-tax income	80.0	70.0
Income tax expense (30%)	(24.0)	(21.0)
Net income	**$56.0**	**$49.0**

Sting's Deli Forecast CFO: Example

	Forecast 2010
Net Income	$56.0
+ Depreciation	50.0
– WCInv	(25.0)
Cash flow from operations	**$81.0**

Sting's Deli FCFF and FCFE Solution

- FC_{Inv} = ($210 – $160) + $50 = **$100**

Accounts Receivable | Inventory | Accounts Payable

- WC_{2010} = ($30 + $40) – ($20) = $50
- WC_{2009} = ($15 + $30) – ($20) = $25
- WC_{Inv} = $50 – $25 = **$25**
- Net borrowing = ($20 + $114) – ($10 + $100) = $24

Sting's Deli FCFF from NI and CFO Solution

- **FCFF** = **NI** + NCC + Int(1 – t) – WC_{Inv} – FC_{Inv}

  –8.50 = 56 + 50 + 15(1 – 0.30) – 25 – 100

- **FCFF** = **CFO** + Int(1 – t) – FC_{Inv}

  –8.50 = 81 + 15(1 – .30) – 100

Sting's Deli
FCFE from NI and CFO Solution

- **FCFE = NI** + NCC – WC_{Inv} – FC_{Inv} + net borrowing

  + 5 = 56 + 50 – 25 – 100 + 24

- **FCFE** = **CFO** – FC_{Inv} + net borrowing

  +5 = 81 – 100 + 24

Sting's Deli FCFF and FCFE

- **FCFE = FCFF** – [Int(1 – t)] + net borrowing

  +$5 = –$8.50 – [$15(1 – 0.30)] + 24

FCFE from EBIT and EBITDA

- **FCFE = EBIT(1 – t)** – Int(1 – t) + NCC – WC_{Inv} – FC_{Inv} + net borrowing
  - +5 = 95 (1 – 0.30) – 15 (1 – 0.30) + 50 – 25 – 100 + 24
- **FCFE = EBITDA**(1 – t) – Int(1 – t) + NCC(t) – WC_{Inv} – FC_{Inv} + net borrowings
  - +5 = 145 (1 – 0.30) – 15 (1 – 0.30) + 50(0.30) – 25 – 100 + 24

FCFF from EBIT and EBITDA

- **FCFF = [EBIT**(1 – t)] + NCC – WC_{Inv} – FC_{Inv}

  –8.50 = 95 (1 – 0.30) + 50 – 25 – 100

- **FCFF = EBITDA**(1 – t) + NCC(t) – WC_{Inv} – FC_{Inv}

  –8.50 = 145 (1 – 0.30) + 50(0.30) – 25 – 100

Equity Valuation (3)

Free Cash Flow Valuation

Other Aspects

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Two Approaches to Forecast FCF

- Calculate **historical** FCF: ← Most common
  - Estimate FCF for current period
  - Apply growth rate FCF × $(1 + g)^n$
- **Forecast components** of FCF:
  - Forecast each underlying component of free cash flow: Net income, FC_{Inv}, NCC, and WC_{Inv} are tied to sales forecast
  - Realistic and flexible but time consuming

Two Approaches (contd.)

- **Forecast FCFE**:
  - Alternately, if given that capital structure is constant/fixed we can calculate NB
  - NB = DR × [(FCinv – Dep) + WCInv]

FCFE = NI – [(1-DR) × (FCInv – Dep)] – [(1-DR) × WCInv]

where, DR = debt-to-asset ratio

Recognition of Value Between FCFE and DDM

- The general valuation models are the same but the numerator is different.
- The share of common stock is the present value of dividend or FCFE, where FCFE could be either greater or less than dividends based on the adjustments to arrive at FCFE.

Effect of Financing Decisions on FCF

	FCFF	FCFE
Dividends	None	None
Share repurchase	None	None
Share issue	None	None
Change in leverage	None	ST & LT effects partially offset*

Note: Share repurchase/issue is use of FCF; not determinant

*e.g., if leverage increases, FCFE higher in current year (net borrowing) and lower in future years (interest expense)

NI is a Poor Proxy for FCFE

- NI is an accrual concept, not cash flow
- NI recognizes noncash charges, such as depreciation, amortization, and gains on sale of equipment, alternatively…
- NI fails to recognize the cash flow impact of investments in working capital and net fixed assets, and net borrowings

EBITDA is a Poor Proxy for FCFF

- EBITDA doesn't reflect taxes paid
- EBITDA ignores effect of depreciation tax shield [Depr (tax)]
- EBITDA does not account for needed investments in working capital and net fixed assets for going concern viability

Single-Stage FCFF Model

- **Point:** Analogous to Gordon growth model
  - Useful for stable firms in mature industries
- Two assumptions:
  1. Constant growth rate *g* forever
  2. Growth rate *g* is less than WACC

$$\text{Firm value}_0 = \frac{FCFF_1}{WACC - g} = \frac{FCFF_0 \times (1+g)}{WACC - g}$$

Single-Stage FCFE Model

- **Point**: Similar to FCFF/GGM model
- Often used with international firms, especially in high-inflation countries (use real rates)

$$\text{Equity value} = \frac{FCFE_1}{r - g} = \frac{FCFE_0 \times (1+g)}{r - g}$$

Required return on equity (CAPM, APT, Build-up)

Multi-Stage Models

- **Four major variations:**
  1. FCFF or FCFE?
  2. Two stages or three?
  3. Total FCF or components of FCF?
  4. Terminal value via GGM or P/E?
- **Note:** All are very similar
- **Always**: Value = PV of future cash flows discounted at appropriate required return

Base case: two-stage, historical growth, FCFE with the GGM for terminal value

Selection of Appropriate Model

- **Single-stage model**
  - Income stock (slow, constant growth)
  - International setting or volatile inflation rates: Use real rates
- **Two-stage and three-stage models**
  - Competitive advantage will disappear over time

Match growth pattern or company lifecycle approach to the appropriate model

Sensitivity Analysis

- Apply sensitivity to each of the following variables:
  - The base-year value for the FCFF or FCFE
  - Future growth rate
  - Risk factors: beta, risk-free rate, and ERP
  - Relationship between discount rate and the growth rate is critical
  - **Most sensitive:** Beta and FCF growth rate
  - **Least sensitive**: FCF and Rf

Terminal Value

- Terminal value = forecasted value at beginning of normal growth phase
- Apply average trailing multiple (P/E) to forecasted EPS $= P/E \times EPS_n$
- Or, use single-stage (Gordon Growth) model
- Terminal value is added to the last period cash flow and then discounted along with the prior period dividends or FCFs

Equity Valuation (3)

Market-Based Valuation: Price and Enterprise Value Multiples

P/E Multiple

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Method of Comparables

- The **method of comparables** involves using a price multiple to evaluate whether an asset is *relatively* fairly valued, relatively undervalued, or relatively overvalued in relation to a benchmark value of the multiple
- Most widely used method by analysts
- The economic rationale for the method of comparables → Law of One Price

Method of Comparables

- Price scaled by a measure of value such as sales, net income, book value, or CF
- Compare relative to a benchmark multiple
- Choices for the benchmark value of a multiple include the multiple of a closely matched individual stock or the average (or median value) for the stock's peer group of companies or industry

Method of Forecasted Fundamentals

- Relates multiples to company **fundamentals—growth, risk, and payout**
- Based on discounted cash flow model
- Permits the analyst to explicitly examine how valuations differ across stocks and against a benchmark given different expectations for growth and risk

Price Multiple Fundamentals

- **Justified** price multiple: What the price multiple should be if the stock is fairly valued
- Also warranted and intrinsic price multiple
  - Actual = justified = **properly valued**
  - Actual < justified = **undervalued**
  - Actual > justified = **overvalued**

What You Need to Know!

- For relative valuation measures such as **P/E, P/B, P/S, P/CF,** and **dividend yield,** know the following **for each ratio**:
  - **Rationale** for using ratio
  - Possible **drawbacks** of ratio
  - **Calculation** of ratio
  - **Fundamental influences**
  - **Calculate justified ratio**
  - Evaluate a stock with the ratio

Rationale for P/E Ratio

Rationale

- Earnings power (EPS) key to investment value
- Focal point for Wall Street
- Differences in P/Es may be related empirically to differences in long-run stock returns according to research
- Ratio can be used as a proxy for risk and growth

Drawbacks for Using the P/E Ratio

Drawbacks

- Negative and very low earnings make P/E useless
- Volatile or transitory earnings make interpretation difficult
- Management discretion on accounting choices can distort earnings (*FSA link*)
- Solely using the ratio **avoids addressing the fundamentals** (growth, risk, and cash flows)

Market P/E Ratio

- **Trailing P/E$_0$**: Uses EPS from last year

$$P_0/E_0 = \frac{\text{market price per share}}{\text{EPS last 12 months}}$$

- **Leading P/E$_1$** (forward or prospective): Uses forecasted earnings for coming year

$$P_0/E_1 = \frac{\text{market price per share}}{\text{forecast EPS next 12 months}}$$

Problems with Trailing P/E$_0$

- When calculating a P/E ratio using trailing earnings, care must be taken in determining the EPS number. The issues include:
  - Transitory, nonrecurring components of earnings that are company-specific
  - Cyclicality components of earnings due to business or industry trends
  - Differences in accounting methods
  - Potential dilution of EPS

Underlying Earnings

Goal: Analysts want to remove nonrecurring items from earnings for forecasting purposes

Nonrecurring items to remove include:

- Gains/losses on asset sales
- Asset write-downs – impairment
- Loss provisions
- Changes in accounting estimates

Result: Persistent, continuing, and core earnings

Normalized Earnings

- Adjust EPS to remove cyclical component of earnings and capture mid-cycle or an average of earnings under normal market conditions
- **Two normalization methods**:
  - Method of historical average EPS
  - Method of average ROE

Example: Normalized Earnings

Year	2005	2006	2007	2008
EPS	$4.00	$3.80	$5.25	$4.50
BVPS	$25.00	$26.00	$26.00	$28.00
ROE	15%	15%	21%	16%

Solution: Normalized Earnings

$$\text{average EPS} = \frac{\$4.00 + \$3.80 + \$5.25 + \$4.50}{4} = \$4.39$$

$$\text{average ROE} = \frac{0.15 + 0.15 + 0.21 + 0.16}{4} = 0.1675$$

$$\text{average ROE} \times \text{BVPS}_{2008} = 0.1675 \times \$28.00 = \$4.69$$

E/P: Earnings Yield

- **Problem:** Negative earnings make P/E ratios meaningless
- **Potential solution:** Substitute E/P, simply the inverse of the P/E
  - Price is never negative
  - High E/P suggests cheap security
  - Low E/P suggests expensive security

Earnings Yield

	Current Price	Trailing EPS	Trailing P/E	E/P Ratio
ABC	$26.00	$0.49	53.06	1.9%
GHI	$19.20	$(0.11)	NM	–0.6%
PQR	$8.59	$(0.40)	NM	–4.7%
TUV	$8.07	$(3.15)	NM	–39.0%

Justified Price Multiple

- **Recall**:
  - **Justified multiple** = multiple if the stock is fairly valued
- **Forecasted fundamentals:**
  - Justified multiple = the ratio of **value** from **any** DCF model to earnings, book value, sales, or cash flow
- **Typical CFA LII case**: Use the Gordon growth model (GGM) to derive justified multiples and identify determinants

Justified Leading P/E$_1$

Justified leading P/E$_1$: Start with GGM

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

$$\text{justified leading } \frac{P_0}{E_1} = \frac{D_1 / E_1}{r-g} = \frac{(1-b)}{r-g}$$

- **Note**: All derivations are just (1) substitution and (2) algebra. The relationships are exact.

Justified Trailing P/E$_0$

Justified trailing P/E$_0$: Start with GGM

$$P_0 = \frac{D_0(1+g)}{r-g}$$

$$\text{justified trailing } \frac{P_0}{E_0} = \frac{\left(D_0 / E_0\right)(1+g)}{r-g} = \frac{(1-b)(1+g)}{r-g}$$

$$= (\text{justified leading } P/E)(1+g)$$

Justified P/E

Fundamental factors affecting justified P/E:

- P/E **positively** related to **growth rate** and **payout**, *all else equal*
  - Assumes no interaction between *g*, payout, and *ROE*
  - Recall: g = ROE × (1 – Div/EPS)
- P/E **inversely** related to required return, (**real rate, inflation, and equity risk premium**) all else equal

Predicted P/E From Regression

- The P/E and company characteristics are measured cross-sectionally
- The P/Es are regressed against the stock and company characteristics
- The estimated equation exhibits the relationship between the P/E and the stock's characteristics:
  - Positive coefficient with growth and payout
  - Negative coefficient with beta

Example: Predicted P/E From Regression

Predicted P/E regression:

- Dividend payout ratio = 0.50
- Beta = 0.95
- Expected earnings growth rate = 6%

A regression on related public utility firms produces the following equation:

Predicted P/E
= 6.75 + (4 × dividend payout) +(12.35 × growth) **–** (0.5 × beta)

- **Calculate** the predicted P/E

Solution: Predicted P/E From Regression

- **Predicted P/E**
  = 6.75 + (4 × 0.50) + (12.35 × 0.06) – (0.50 × 0.95) = **9.02x**
- Useful for large data sets
- Infrequently used due to these limitations:
  - Changing relationships
  - Multicollinearity
  - Unknown predictive power

Valuation Using Comparables

- Select and calculate the comparative price multiple for the security
- Select the benchmark asset and calculate the mean or median P/E
- Compare the stock's P/E with the benchmark's P/E
- Are observed differences between asset and benchmark P/E explained by underlying determinants of P/E? If not, asset may be mispriced. Watch the fundamentals!

PEG Ratio

- **PEG ratio** is a stock's P/E divided by the expected long-term earnings growth rate (*g*):

$$PEG = \frac{P/E}{g}$$

Whole number, not decimal

- Calculates a stock's P/E per unit of expected growth
- Lower PEG – more attractive valuation
- Higher PEG – less attractive valuation

Problems With PEG Ratios

PEG ratio does not account for:

- Differences in firm risk attributes
- Differences in the duration of growth
- Nonlinear relationship between growth and the P/E ratio

Terminal Value Estimation

- **Terminal value**: value projected at end of estimation horizon
- Terminal value = (trailing P/E) × (earnings forecast)
- **Two methods**
  1. **Fundamentals**: Requires estimates of *g*, *r*, and payout
  2. **Comparables**: Uses market data to calculate benchmark

Equity Valuation (3)

Market-Based Valuation: Price and Enterprise Value Multiples

P/B Multiple

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Price-to-Book Ratio P/B_0

- Book value per share (BVPS) attempts to represent the investment that common shareholders have made in the company
- BVPS is calculated as common equity divided by number of shares outstanding
- There is only a current P_0/B_0, not a leading P/B

Rationale P/B_0 Ratio

Rationale

- Usually **positive** (even when EPS < 0)
- Less volatile, **more stable** than EPS
- Good for firms with mostly **liquid assets** (e.g., financial firms)
- Useful for distressed firms, liquidation
- Differences in P/B ratios explain differences in long-run average returns

Drawbacks P/B_0 Ratio

Drawbacks

- Does not reflect value of **intangible assets**, off-B/S assets (e.g., human capital)
- Misleading when comparing firms with significant **differences in asset size**
- Different accounting conventions obscure **comparability** (particularly international)
- Inflation and technological change can cause big differences between BV and MV

Justified P_0/B_0 Ratio

- By using the Gordon growth model and using the expression $g = b \times$ ROE for the sustainable growth rate, the expression for the justified P/B ratio based on the most recent book value (B_0) is:

$$\frac{P_0}{B_0} = \frac{ROE - g}{r - g}$$

Justified P/B

- **Fundamental factor affecting P/B**:
  - **(ROE – r)**
    - Larger spread = value creation = higher market value
    - Compare to residual income model
    - Intuition: Firms that earn ROE = r will have a P/B of 1

Fundamental Factors Influencing P_0/B_0 Ratio

Positive relationship

- P/B increases as *ROE* increases
- P/B increases as *g* increases

Inverse relationship

- P/B increases as *r* decreases (falling risk, interest rates, inflation, and beta)

Equity Valuation (3)

Market-Based Valuation: Price and Enterprise Value Multiples

P/S and P/CF Multiples

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Rationale for Using P_0/S_0

Rationale

- P/S useful for distressed firms
- Sales revenue is always positive
- Sales are generally more stable and less prone to distortion than EPS, over time
- P/S useful for mature, cyclical, and zero-income stocks
- Differences in P/S ratios may be related to difference in long-run average returns

Drawbacks to Using P_0/S_0

Drawbacks

- High sales growth does **not** translate to operating profitability
- P/S ratio does not capture different cost structures between firms
- Revenue recognition methods can distort reported sales and forecasts

Market P/S_0 Ratio

$$P/S = \frac{\text{market value of equity}}{\text{total sales}}$$

$$= \frac{\text{market price per share}}{\text{sales per share}}$$

Justified P_0/S_0 Based on Fundamental Factors

$$\frac{P_0}{S_0} = \frac{(E_0/S_0)\times(1-b)\times(1+g)}{r-g}$$

$$\frac{P_0}{S_0} = \text{(Net Margin) x (Trailing P/E)}$$

Profit margin = E_0/S_0 Required return = r

Payout = 1 – b Sustainable growth rate = g

Relationship of Fundamentals to the P_0/S_0 Ratio

- P_0/S_0 increases as:
  - Current profit margin (E_0/S_0) improves
  - Sustainable growth (g) increases
  - Risk falls
- P_0/S_0 decreases as:
  - The profit margin decreases
  - Risk increases
  - Inflation increases
  - Growth decreases

Valuation Using Comparable P_0/S_0

- Same method as P/E and P/B
- Low P/S undervalued
- Use trailing sales to calculate
- In choosing comparables, control for:
  - Profit margin
  - Expected growth
  - Risk
  - Quality of accounting data

Rationales for Using P/CF_0

Rationales

- More difficult to manipulate CF than EPS
- Cash flow is more stable than earnings
- Addresses quality of earnings problem
- Differences in P/CFs may explain differences in long-run average returns

Drawbacks Against Using P/CF_0

Drawbacks

- Earnings plus noncash charges approach ignores some cash flows such as net fixed investments, working capital investment, and net borrowings
- FCFE is preferable to CFO, but FCFE more volatile and more difficult to compute
- FCFE can be negative with large CapEx

Market P/CF Ratio

$$P/CF = \frac{\text{market value of equity}}{\text{total cash flow}}$$

$$= \frac{\text{market price per share}}{\text{cash flow per share}}$$

What is Cash Flow?

1. **Traditional cash flow**:
   CF = net income + noncash charges
2. **CFO** (from statement of cash flows)
3. **Adjusted CFO**:
   Adj. CFO = CFO + [interest × (1 − t)]
4. **EBITDA**: (Also used for EV/EBITDA ratio)
5. **FCFE**: Theoretically superior (from this study session)

Cash Flow Definitions

- **FCFE cash flow concept with the closest relationship to theory**, although can be more volatile due to CapEx
- EBITDA is a pre-tax, pre-interest, pre-investment in working capital, and pre-investment in fixed assets
  - Appropriate for firm value, not equity

Justified P/CF

- **Two-Step Process**:
  - **Step 1**: Calculate stock value using suitable DCF model:

$$V_0 = \frac{FCFE_0(1+g)}{r-g}$$

  - **Step 2**: Divide result by cash flow:

Justified P/CF = V_0/CF

Fundamental Factors Affecting Justified P/CF

Justified P/CF will increase, all else equal, if:

- Cash flow increases
- Growth rate increases
- Required return decreases
- Same relationship as all other ratios

Valuation Using Comparable P/CF

- Same method as P/E, P/B, and P/S
- Low P/CF undervalued
- Control for:
  - Return and risk
  - Cash flow
  - Growth rate

Equity Valuation (3)

Market-Based Valuation: Price and Enterprise Value Multiples

EV and Other Aspects

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P/EBITDA or EV/EBITDA?

- EBITDA is an earnings flow to both debt and equity holders
- A multiple using total company value: Enterprise Value (EV) in the numerator is logically more appropriate than equity market price (P)
- Because the numerator is enterprise value, EV/EBITDA is a valuation indicator for the overall company rather than common stock

EV / EBITDA Ratio

Enterprise Value (EV) or Firm Value

= MV of common stock + MV of debt + MV preferred – cash and investments

Divided by

EBITDA = earnings before interest, taxes, depreciation, and amortization

- Ratio provides an indication of company/firm value, **not** equity value

Example: EV / EBITDA Ratio

Calculate EV/EBITDA:

Recent share price Sf 22.50; 40 million shares outstanding Market value of debt Sf 137 million; Cash and marketable securities Sf 62.3 million; Investments Sf 327 million;

Net income Sf 137.5 million; Interest expense Sf 6.9 million; Depreciation and amortization Sf 10.4 million; Taxes Sf 95.9 million

Solution: EV / EBITDA Ratio

- EV = (22.50 × 40) +137 – 62.3 – 327 = Sf 647.7 million
- EBITDA = 137.5 + 6.9 + 95.9 + 10.4 = Sf 250.7 million
- EV/EBITDA = 647.7 / 250.7 = 2.6 times

Rationale EV/EBITDA

Rationale

- Comparing firms with different financial leverage since EBITDA is pre-interest
- Controls for dep/amort differences
- EBITDA usually positive when EPS is negative

Drawbacks EV/EBITDA

Drawbacks:

- Ignores changes in WC investments
- FCFF (which controls for CapEx) is more closely tied to value

Valuation Using EV / EBITDA

- Firm EV/EBITDA < benchmark = undervalued
- Firm EV/EBITDA > benchmark = overvalued

Arguments For Using D_0/P_0

- Dividend yield is a component of total return
- Dividends are a less risky component of total return than capital appreciation

Market Dividend Yield (D/P)

$$\text{trailing D/P} = \frac{4 \times \text{most recent quarterly DIV}}{\text{market price per share}}$$

$$\text{leading D/P} = \frac{\text{next 4 quarters forecasted DIVs}}{\text{market price per share}}$$

For practical purposes, dividend yield, D/P is preferred over P/D (zero dividends are a problem)

Justified Dividend Yield D_0/P_0

- The justified dividend yield in a Gordon model is:

$$\frac{D_0}{P_0} = \frac{r-g}{1+g}$$

Fundamental Factors Affecting D_0/P_0

Dividend yield increases as:

- Required return increases (price falls)
- High growth rate decreases the firms payout and therefore the firm is less able to pay dividends which results in a lower D/P ratio
- High D/P strategy = *value strategy*

Cross Border Valuation Differences

- Comparing companies across borders frequently involves accounting method differences, cultural differences, economic differences, and resulting differences in risk and growth opportunities
- For example, P/E ratios for individual companies in the same industry across borders have been found to vary widely

Momentum Indicators

- Momentum indicators based on price, such as the relative strength indicator, have also been referred to as **technical indicators**
- **Unexpected earnings** (also called **earnings surprise**) is the difference between reported earnings and expected earnings

$$UE_t = EPS_t - E(EPS_t)$$

Momentum Indicators

- Another momentum indicator based on the relative change in earnings per share is called Standardized Unexpected Earnings

$$SUE_t = \frac{EPS_t - E(EPS_t)}{\sigma\left[EPS_t - E(EPS_t)\right]}$$

Measuring Central Tendency in Multiples

- Arithmetic mean
  - Most affected by outliers
- Harmonic mean
  - Less affected by large, more by small, outliers
- Weighted harmonic mean
  - Effect of outliers depends on market value weight
- Median
  - Least affected by outliers

(Simple) Harmonic Mean

- Outliers:
  - Reduces impact of large outliers
  - May worsen impact of small outliers
    - Small outliers bounded by zero, so less problematic
- Weighting:
  - Less weight on higher ratios
  - More weight on lower ratios

$$\bar{X}_{Harmonic} = \frac{N}{\sum_{i=1}^{N} \frac{1}{X_i}}$$

(Simple) Harmonic Mean

- Lower value than arithmetic mean (unless all observations are the same value)
- Used when market weight information unavailable

Weighted Harmonic Mean

- Similar to simple harmonic mean except in weighting:
  - Uses market value weights
  - Major advantage: Corresponds to portfolio value (e.g., total price/total earnings)

Equity Valuation (3)

Residual Income Valuation

Residual Income Defined

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Concept of Residual Income (RI)

- Traditional financial statements are prepared to reflect earnings available to owners. Net income includes an interest charge to represent the cost of debt capital (interest expense).
- Dividends or other charges for equity capital are not explicitly deducted
- GAAP accounting leaves equity owners the task to determine whether the resulting earnings exceeded the cost of equity capital

Residual Income (RI)

- Residual income has close links to other valuation models already covered:
  - **PVGO model**: P = EPS_1/r + PVGO
  - **P/B ratio using fundamentals**:
    - P/B = (ROE – g)/(r – g)
  - The **five forces model** and competitive strategies

Defining Residual Income

- **Residual income (RI):**
  - Equivalent to *economic profit*
  - RI = net income less opportunity cost of equity capital
- Accounting income will **overstate** returns from equity investor perspective because it ignores cost of equity
- Residual income explicitly deducts all capital costs of both debt and equity

Defining Residual Income

Using a ***post-levered figure:***

RI = net income – (equity capital × cost of equity)

Alternatively, using a ***pre-levered figure:***

RI = EBIT (1 – t) – (total capital × WACC%)

- Recall, WACC implicitly accounts for both the cost of debt and equity on a weighted-average basis

Residual Income Calculation: Example

Example:

- Estimated 2009 EPS = \$1.20
- Book value per share 2008 = \$10.00
- Equity required return = 10%

Residual Income Calculation: Solution

Calculate Residual Income

- $RI = EPS_1 – (BVPS_{t–1} \times r)$
- \$0.20 = \$1.20 – (\$10.00 × 0.10)
- The firm earned positive RI of \$0.20 providing value to both debt and equity holders

Alternative RI Measures: EVA®

- **Economic value added (EVA®)** measures valued added to shareholders by management
- EVA® = NOPAT – (WACC% × Invested cap.)
- Recall, NOPAT = EBIT (1 – t)
- Positive EVA® – management is adding value
- Negative EVA® – value not added
- Evaluate the relative change in EVA over time

Alternative RI Measures: Market Value Added (MVA)

- **MVA** measures the effect on value of management's decisions since the firm's inception
- MVA = market value of firm – invested cap
- A company producing positive MVA will have an excess of market value over the book value of invested capital
- Evaluate the *change in MVA over time*

Uses of Residual Income

- **Common usage**:
  - Evaluate managerial effectiveness
  - Executive compensation
- For exam, we are most interested in the **equity valuation** applications

Equity Valuation (3)

Residual Income Valuation

Residual Income Computation

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Intrinsic Value and Residual Income

- **RI approach**: Value = BV + PV all future RI
- General formula similar to DDM:

Important!

$$V_0 = \underbrace{B_0}_{\text{Book value of equity}} + \underbrace{\left\{ \frac{RI_1}{(1+r)^1} + \frac{RI_2}{(1+r)^2} + \frac{RI_3}{(1+r)^3} + \ldots \right\}}_{\text{PV of expected future residual income}}$$

Calculating Future RI

RI model breaks intrinsic value V_0 of equity into these two components:

1. **Current book value** of equity B_0, **plus**
2. **Present value of expected future RI_t**

$$V_0 = B_0 + \sum_{t=1}^{n} \frac{RI_t}{(1+r)^t}$$

$$RI_t = E_t - (r \times B_{t-1})$$

Important!

Calculating Future RI

- **Two methods for calculating Ri_t**
  1. $RI_t = EPS_t - (r \times BV_{t-1})$
  2. $RI_t = (ROE_t - r) \times BV_{t-1}$
- With a little substitution:

$$V_0 = B_0 + \sum_{t=1}^{\infty} \frac{(ROE_t - r) \times B_{t-1}}{(1+r)^t}$$

Example: Intrinsic Value and Residual Income

- **Consolidated Pipe Products:**
  - Required return on equity = 14%
  - BV/share = C$6.50 beg of 20x1
  - Earnings forecast: 20x1 = C$1.10; 20x2 = C$1.00; 20x3 = $0.95
  - Dividends: 20x1 = C$0.50; 20x2 = C$0.60
  - **Dividend in 20x3 is liquidating event**
- **Calculate**: Intrinsic value using RI model

Solution: Intrinsic Value and Residual Income

	20x1	20x2	20x3
Beginning BV/share (B_{t-1})	**C$6.50**	7.10	7.50
EPS forecast (E_t)	1.10	1.00	0.95
DPS forecast (D_t) – 50% payout	0.50	0.60	**8.45**
BV/share forecast ($B_{t-1} + E_t - D_t$)	7.10	7.50	0.0
Equity charge/share ($r \times B_{t-1}$)	0.91	0.99	1.05
RI/share ($E_t - (r \times B_{t-1})$)	C$0.19	0.01	–0.10

Solution: Intrinsic Value and Residual Income

- **Calculate the PV** (using calculator)
  - CF_0 = +6.50 (current BV)
  - CF_1 = +0.19 (RI_1)
  - CF_2 = +0.01 (RI_2)
  - CF_3 = –0.10 (RI_3)
  - I = 14 (%)
- CPT → NPV = C$6.61 = equity value today

Difference in Value Recognition: Between RI vs. DCF Models

- **Value is recognized earlier** under RI model (BV_0) than under the DCF model, therefore **less sensitive to terminal value estimates**
- BV_0 usually represents a large percentage of intrinsic value
- In the DDM or FCF model, terminal value is most of the value estimate, which is subject to substantial forecasting risk due to the forecast horizon and the relationship between *r* and *g*

Value Drivers of Residual Income

- **Main point: If ROE > required return:**
  - RI will be positive
  - Justified market-to-book > 1
- **If ROE = required return**:
  - Justified market value = book value
  - Market-to-book ratio = 1

Residual Income Valuation and Justified P/B Ratio Relationship

- RIMs can be used to establish market multiples such as the P/B ratio based on forecasted ROE and EPS
- RIMs are most closely related to the justified P/B and Tobin's *q* ratio (MV debt + MV Equity)/Replacement cost of total assets
- When the present value of expected future RI is positive, the justified P/B based on fundamentals is greater than 1.0

Equity Valuation (3)

Residual Income Valuation

Constant Growth Model
for Residual Income

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Constant Growth Residual Income

- **Single-stage RI assumes**:
  - Constant ROE
  - Constant earnings growth: $V_0 = B_0 + \left[\frac{(ROE - r) \times B_0}{r - g}\right]$

Current book value

Value generated by firm's ability to produce economic profits when ROE > r

Example: Single-Stage Residual Income

- **Western Atlantic Railroad**:
  - Book value $23.00
  - ROE 14%
  - Required return 12%
  - Dividend payout 60%

Positive spread b/w ROE and r

- **Calculate**: Share value using single-stage RI model

Single-Stage Residual Income: Solution

- Growth rate: $g = b \times ROE$
  $= (1 - 0.60) \times 0.14$
  $= 0.056 = 5.6\%$

Note: SGR!

- Intrinsic value: $V_0 = \$23.00 + \left[\frac{(0.14 - 0.12) \times \$23.00}{0.12 - 0.056}\right]$
  $= \$30.19$

Calculating Implied Growth Rate

- **Rewrite the formula**: $$g = r - \left[\frac{(ROE - r) \times B_0}{V_0 - B_0}\right]$$
- **Calculate** the implied growth rate in previous example if the stock price was $35

$$g = 0.12 - \left[\frac{(0.14 - 0.12) \times 23}{35 - 23}\right] = 0.0817 = 8.17\%$$

RI vs. Price Multiples and DCF

- **Point:** In theory, all methodologies should lead to the same result—but not always in practice
- **Price Multiples**
  - RI most closely related to P/B
  - If RI is positive, justified P/B > 1
- **DDM/FCF**
  - Both involve discounting of future benefits
  - RI: BV + PV of RI
  - DDM/FCF: PV of relevant CFs

Equity Valuation (3)

Residual Income Valuation

Continuing Residual Income

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Continuing Residual Income

- **Possible approaches** for continuing RI:
  1. Drop immediately to zero (**$\omega = 0$**), no competitive advantage, pure competition
  2. Persist at current level forever (**$\omega = 1$**), perpetual competitive advantage
  3. Decline over time to zero **($0 < \omega < 1$)**
  4. Decline to mature industry level

Multi-Stage Residual Income Model

- **Intrinsic value** = **sum of three components**:

  $V_0 = B_0$ + (PV high-growth RI) + (PV cont. RI)

- **Three parts**:
  1. (Calculate current BV) +
  2. (Calculate RI for years 1 through T – 1) +
  3. (Calculate continuing RI) as:

$$PV\left(\text{cont RI in yr. } T-1\right) = \frac{RI_T}{1+r-\omega}$$

Multi-Stage Model – Continuing RI

- **Approach 1:** Drop to zero ($\omega = 0$)

$$PV\left(\text{cont RI in yr. } T-1\right) = \frac{RI_T}{1+r-0} = \frac{RI_T}{1+r}$$

- **Approach 2:** Current level forever ($\omega = 1$)

Think: perpetuity

$$PV\left(\text{cont RI in yr. } T-1\right) = \frac{RI_T}{1+r-1} = \frac{RI_T}{r}$$

Multi-Stage Model – Continuing RI

- **Approach 3:** Decline slowly to 0 ($0 < \omega < 1$)

$$\text{PV}(\text{cont RI in yr. } T-1) = \frac{RI_T}{1+r-\omega}$$

- **Approach 4:** Mature industry

$$\text{market value} = \text{book value} + \text{PV}(\text{cont RI in yr. } T)$$

$$\Rightarrow \text{PV}(\text{cont RI in yr. } T) = P_T - B_T$$

$$\text{PV}(\text{cont RI in yr. } T-1) = \frac{(P_T - B_T) + RI_T}{1+r}$$

Example: Multi-Stage Model

- **FastShip Data**:
  - ROE of 20% per year for four years
  - BV_0 = \$8.00
  - No dividends
  - Required return = 15%
  - Forecast earnings = BV_0 × ROE (by definition)
- **CI approach #1**: After four years RI = 0
- **Calculate:** Intrinsic value

Multi-Stage Model (Approach 1)

= \$8.00 × 0.2

= \$8.00 × 0.15

Year	E_t	Ending BV	ROE	Equity Charge	Residual Income
0		\$8.00			
1	1.60	9.60	0.20	1.20	0.40
2	1.92	11.52	0.20	1.44	0.48
3	2.30	13.82	0.20	1.73	0.57
4	2.76	16.58	0.20	2.07	0.69

end BV = beg BV + E – D

= \$1.6 – \$1.2 = \$8(0.2 – 0.15)

Multi-Stage Model (Approach 1)

- PV (continuing RI Year 3) = 0.69 / 1.15 = **0.60**
- **Calculate intrinsic value**:
  - CF_0 = 8.00
  - CF_1 = 0.40
  - CF_2 = 0.48
  - CF_3 = 0.57 + **0.60** = **1.17**
  - I = 15% (given)

T_0	T_1	T_2	T_3
\$8.00	0.40	0.48	**1.17**

- CPT → NPV = \$9.48 (lowest value)

Multi-Stage Model (Approach 2)

- **Change continuing RI assumption:**
  - **Assume:** Constant residual income of \$0.69 after three years, think perpetuity
  - Include the PV of RI for Years 4 to infinity

PV (continuing RI year 3) = 0.69 / 0.15 = 4.60

Multi-Stage Model (Approach 2)

- **Calculate intrinsic value**:
  - CF_0 = 8.00
  - CF_1 = 0.40
  - CF_2 = 0.48
  - CF_3 = 0.57 + **4.60** = **5.17**
  - I = 15% (given)
- CPT → NPV = \$12.11 (highest value)

T_0	T_1	T_2	T_3
\$8.00	0.40	0.48	**5.17**

Multi-Stage Model (Approach 3)

- **Change Continuing RI assumption:**
  - **Assume:** Starting in Year 4 RI will decrease to zero over time with a **persistence factor of 0.6**

$$\text{Cont RI}_3 = \frac{\$0.69}{1+0.15-0.6} = \$1.25 \rightarrow$$

Next slide

Notice we stop one year earlier in Year 3
not Year 4 because it's the PV of RI in t – 1!

Multi-Stage Model (Approach 3)

- **Calculate intrinsic value**:
  - CF_0 = 8.00
  - CF_1 = 0.40
  - CF_2 = 0.48
  - CF_3 = 0.57 + **1.25** = **1.82**
  - I = 15% (given)
- CPT → NPV = \$9.91

T_0	T_1	T_2	T_3
\$8.00	0.40	0.48	**1.82**

Multi-Stage Model (Approach 4)

- **Change continuing RI assumption:**
  - **Assume:** At t = 4 price-to-book falls to 1.1

From table

MP = 10% premium over BV

  - BV_4 = $16.58, ➡ P_4 = **1.1** × $16.58 = $18.24
  - PV_4 of RI after year 4 = $18.24 – $16.58 = $1.66

$$\text{Cont RI}_3 = \frac{\$0.69 + \$1.66}{1.15} = \$2.04$$

Multi-Stage Model (Approach 4)

- **Calculate intrinsic value**:
  - CF_0 = 8.00
  - CF_1 = 0.40
  - CF_2 = 0.48
  - CF_3 = 0.57 + **2.04** = **2.61**
  - I = 15% (given)
- CPT → NPV = $10.43

T_0	T_1	T_2	T_3
$8.00	0.40	0.48	**2.61**

Equity Valuation (3)

Residual Income Valuation
Strengths/Weaknesses

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RI, DDM, and FCFE Models

- DDM and FCF models measure value by discounting a stream of expected cash flows including a future terminal value
- RI starts with BV_0 and adds the expected stream of positive or negative residual income
- Theoretically, RI values should have the identical recognition values as DCF values if inputs used are the same

Strengths of Residual Income Model

1. **Terminal value** does not dominate intrinsic value estimate
2. Accounting data usually **accessible**
3. Applicable even **without dividends or positive cash flow**
4. Applicable even when **cash flows are volatile** or unpredictable
5. Focus on **economic profitability**

Weaknesses of Residual Income Model

1. Accounting data can be **manipulated** by management
2. Requires many **adjustments** (link to FRA)
3. Assumes **clean surplus relation** holds or that its failure to hold has been taken into account (link to FR&A):

$$B_t = B_{t-1} + E_t - D_t$$

RI assumes no adjustments directly to equity

Accounting Issues

Point: While residual income valuation is straightforward, in practice it requires **many adjustments**:

1. Violations of **clean surplus relationship**
2. Off-balance-sheet items
3. Nonrecurring items on income statement
4. Aggressive accounting practices
5. International accounting differences

Clean Surplus Relationship Violations

- **Examples** of clean-surplus violations:
  - FX translation gain/losses (SFAS 52)
  - Balance sheet adjustments to fair value
  - Pension liability (remeasurements)
  - Unrecognized gain/(loss) on available-for-sale securities
  - Deferred gain/(loss) on cash flow hedges

Nothing new: All from the FR&A study sessions

Clean Surplus Relationship Violations

- **Implication**: Book value is correct, but net income and ROE forecast are incorrect
- Issue OCI items that do not net to zero over time (reverse)
- **Solution:** Calculate ROE using comprehensive income
- Note: Comprehensive income = income under clean surplus accounting

Off-Balance-Sheet Items

- **Examples** of items needing adjustment:
  - Operating leases
  - Off-balance-sheet SPEs
  - LIFO to FIFO inventory
  - Deferred tax assets and liabilities

Nothing new: All from FR&A

- **Implication**: Book value misstated

Nonrecurring Items

- **<u>Examples</u>** of items requiring exclusion:
  - Discontinued operations
  - Accounting changes
  - Restructuring charges

Same issue as earnings for P/E

- **Implication**: Exclude nonrecurring items on the income statement, RI should be based on <u>recurring</u> items only

Aggressive Accounting Practices

- **<u>Examples:</u>**
  - Accelerating revenue to current period
  - Deferring expenses to later period
  - Using reserves to smooth income
  - Unrealistic accounting estimates

Again, link to FR&A: "Evaluating Quality of Financial Reports"

International Accounting Differences

Point: Difficult to apply Residual Income valuation in international context with less strict accounting regulations

Questions to consider:

1. Are EPS forecasts reliable?
2. Is clean surplus relation violated?
3. Do financial statements reflect economic reality?

Equity Valuation (3)

Private Company Valuation

Private Company Basics

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Private vs. Public Companies
Company-Specific Factors

- Stage of lifecycle
- Size
- Quality/depth of management
- Management/shareholder overlap
- Short-term investors
- Quality of information
- Taxes

Private vs. Public Companies
Stock-Specific Factors

- Liquidity
- Restrictions on liquidity
- Concentration of control

Private vs. Public Companies

- More heterogeneity with private firms
  - Greater variety in risk
  - Greater variety in valuation methods

Reasons For Valuing Private Companies

- **Transactions:**
  - Venture capital financing
  - IPO
  - Firm sale
  - Bankruptcy
  - Stock-based compensation

Reasons for Valuing Private Companies

- **Compliance:**
  - Financial reporting
  - Taxes
- **Litigation:**
  - Shareholders suits
  - Damage claims
  - Lost profits
  - Divorces

Definitions of Value

- Fair market value
- Fair value for financial reporting
- Fair value for litigation
- Market value
- Investment value
- Intrinsic value

Approaches to Valuation

- **Income:** PV of future income
- **Market:** Price multiples of comparables
- **Asset-based:** Assets – Liabilities

Lifecycle stage should be considered.

Equity Valuation (3)

Private Company Valuation

Income Based Valuation

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Normalized Earnings Adjustments

1. Nonrecurring and unusual items
2. Discretionary expenses
3. Nonmarket compensation levels
4. Personal expenses
5. Real estate expenses
6. Non-market lease rates
7. Strategic vs. nonstrategic buyers

Issues in Cash Flow Estimation

- Controlling vs. noncontrolling interests
- Scenario analysis
- Lifecycle stage
- Management biases
- Capital structure changes

Income Approach Methods

- Free cash flow
- Capitalized cash flow
- Excess earnings

Free Cash Flow Method

- PV (discrete CFs plus a terminal value)
- Terminal value
  - Constant growth model
  - Price-multiple approach
- Potential double counting of high growth

Capitalized Cash Flow Method

$$\text{direct capitalization} = \frac{\text{cash flow}_1}{\text{discount rate - growth}}$$

$$\text{value of the firm} = \frac{FCFF_1}{WACC - g}$$

$$\text{value of equity} = \frac{FCFE_1}{r - g}$$

Excess Earnings Method Example

Working capital	$300,000
Fixed assets	$1,000,000
Normalized earnings (year just ended)	$130,000
Required return for working capital	6%
Required return for fixed assets	10%
Growth rate of residual income	5%
Discount rate for intangible assets	14%

Excess Earnings Method Solution

Return on working capital =

6% × $300,000 = $18,000

Return on fixed assets =

10% × $1,000,000 = $100,000

Residual income =

$130,000 – $18,000 – $100,000 = $12,000

Excess Earnings Method Solution

Value of intangible assets
= ($12,000 × 1.05) / (0.14 – 0.05) = $140,000

Value of firm
= $300,000 + $1,000,000 + $140,000
= $1,440,000

Discount Rate Estimation Elements

- Size premiums
- Availability and cost of debt
- Acquirer vs. target
- Projection risk
- Lifecycle stage

Discount Rate Models

- CAPM
- Expanded CAPM
- Build-up approach
- Possible risk premiums for:
  - Size
  - Company-specific risk
  - Industry risk

Estimating WACC

- Current vs. optimal capital structure
- Public vs. private firm debt capacity and cost

Equity Valuation (3)

Private Company Valuation

Market Based Valuation

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Market Approaches

- Guideline Public Company Method
- Guideline Transactions Method
- Prior Transaction Method

See Corporate Finance study session for calculations

Market Approaches
Guideline Public Company Method

- Multiples from publicly traded firms
- Advantage: Plenty of data
- Disadvantage: Data may not be comparable

Example: Guideline Public Company Method

- **Rensealer Corp. Valuation**:
  - Smaller than comparable GPC, higher risk (risk premium deflator = 20%).
  - Recent transaction in same industry was at premium of 30%.
  - Market value of debt $1,100,000
  - Normalized EBITDA $12,800,000
  - Average MVIC/EBITDA multiple 8.0
- **Calculate** pure investment (non-synergistic) acquisition value

Solution: Guideline Public Company Method

- Takeover premium probably related to synergies; not relevant for this valuation.
- Adjusted MVIC/EBITDA multiple = 8 (1 – 0.20) = 6.40
- Firm value = 6.40 × $12,800,000 = $81,920,000
- Value of equity = 81,920,000 – 1,100,000 = $80,820,000

Market Approaches
Guideline Public Company Method

Control premium issues:

- Transaction type
- Industry conditions
- Type of consideration
- Reasonableness

Market Approaches – Guideline Transactions Method

- Multiples from sales of entire public and private firms
- Note: Private firm data may not be available or accurate

Market Approaches – Guideline Transactions Method

- Data issues:
  - Transaction type
  - Contingent consideration
  - Type of consideration
  - Availability of data
  - Date of data

Market Approaches – Prior Transaction Method

Uses historical sales data from subject firm.

Best when:

- Valuing minority interest
- Data is arms-length
- Data is of same motivation
- Data is recent

Asset-Based Approach

- Not used for going concerns
- Usually the lowest valuation
- Difficulties in valuation:
  - Individual assets
  - Specialized assets
  - Intangibles

Can be used for:

- Troubled firms
- Finance firms
- Investment companies
- Firms with few intangibles
- Natural resource firms

Equity Valuation (3)

Private Company Valuation

Valuation Discounts

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Discount for Lack of Control (DLOC)

Estimate using reported earnings instead of normalized earnings or:

$$DLOC = 1 - \left[\frac{1}{1 + \text{Control Premium}}\right]$$

If control premium is 22%

$$DLOC = 1 - \left[\frac{1}{1 + 0.22}\right] = 18.0\%$$

Using Control Premiums and Discounts

Comparable Data	*Subject Valuation*	*Adjustment to Comparable Data*
Controlling Interest	Controlling Interest	None
Controlling Interest	Noncontrolling Interest	DLOC
Noncontrolling Interest	Controlling Interest	Control Premium
Noncontrolling Interest	Noncontrolling Interest	None

DLOM Varies With…

- Likelihood of IPO, firm sale, or dividends
- Asset duration
- Contractual restrictions
- Pool of buyers
- Asset risk

Estimating DLOM

- Restricted vs. Publicly traded shares
- Pre-IPO vs. Post-IPO prices
- Put prices

Example: Applying Discount/Premium

- Minority shareholder (15% owner) given that:
  - Scenario 1: CEO (majority owner) wants to sell the firm soon at a value of $10MM (DLOM of 5%)
  - Scenario 2: No imminent sale (DLOM of 20%); equity valued at $9MM (after DLOC) using normalized earning method
- **Value** the minority interest (after applying discount/premium) in each scenario

Solution: Applying Discount/Premium

- Scenario 1:
  - DLOM of 5% is applied to sale value (no DLOC) of $10MM
  - Value = (0.15) ($10MM)(1 – 0.05) = $1,425,000
- Scenario 2:
  - DLOM of 20% is applied to value after DLOC is applied
  - Value = (0.15) ($9MM)(1 – 0.20) = $1,080,000

Challenges With Valuation Standards

- No single standard
- Compliance is not mandatory
- Difficulty in ensuring compliance
- Limited technical guidance
- Value differs as definition varies

Fixed Income (1)

The Term Structure and Interest Rate Dynamics

Spot and Forward Rates, Part 1

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Spot Rates

- **Spot rates:** Yield on zero-coupon bonds
  - No coupons → no reinvestment risk
- **Spot yield curve** (spot curve): Graph of the spot rate S_T versus the maturity T
  - Shape and level changes continuously

Forward Rates

- **Forward rate:** The annualized interest rate on a loan to be initiated at a future period
- **Forward curve:** Forward rates vs. maturity
- Forward curves and spot curves are mathematically related
- Notation:
  - $f_{(j,k)}$ = the annualized interest rate applicable on a k-period loan starting at time period j
  - $F_{(j,k)}$ = forward price at time j, of a \$1 par zero-coupon bond maturing at time j+k

Yield to Maturity (Coupon Bond)

Example: 3-year, 4% annual-pay, \$1,000 par bond.

$\boxed{S_1=5\%,\ S_2=6\%,\text{ and } S_3=7\%}$ respectively. ← Upward sloping spot curve

Price of the bond using the spot rate curve:

$$\text{Price} = \frac{40}{(1.05)} + \frac{40}{(1.06)^2} + \frac{1040}{(1.07)^3} = \$922.64$$

$S_1 < y_3 < S_3$ and y_3 is closest to S_3

Yield-to-maturity (y_3):

N =3; PV = –922.64; PMT = 40; FV = 1,000;
CPT I/Y→ 6.94 y_3= 6.94%

Expected Return

- **Expected return:** Ex-ante holding period return an investor expects to earn from a bond
- The expected return will be equal to the bond's yield only when:
  - The bond is held to maturity, and
  - Coupon and principal received on-time; and
  - All coupons reinvested at the original YTM
- Reinvesting coupons at the YTM is the least realistic assumption

Forward Pricing Model

- **Forward pricing model:** Values forward contracts using arbitrage-free pricing
- Investor A purchases a $1 par, zero-coupon bond maturing in (j+k) years for $P_{(j+k)}$
- Investor B enters into a j-year forward contract to purchase a $1 par, zero-coupon bond maturing in k-years. Cost today is $P_j F_{(j,k)}$
- Two investments should have the same price:

$$P_{(j+k)} = P_j F_{(j,k)}$$

Forward Rate Model

- The **forward rate model** relates forward and spot rates as follows:
  - $[1+S_{(j+k)}]^{(j+k)} = (1+S_j)^j \, [1+f_{(j,k)}]^k$
  - $[1+f_{(j,k)}]^k = [1+S_{(j+k)}]^{(j+k)} / (1+S_j)^j$
- Buying a 5-year zero (return of S_5), versus buying a 2-year zero (return of S_2) and at maturity reinvesting the principal for three additional years at **locked-in** $f_{(2,3)}$

Forward Rates: Example

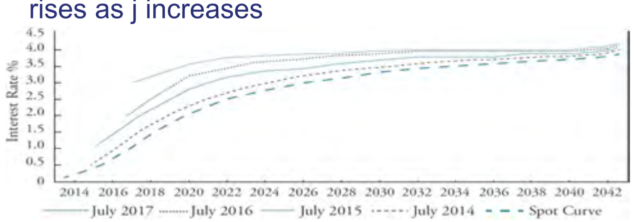
Example: $S_2 = 4\%$, $S_5 = 6\%$. Calculate the implied 3-year forward rate for a loan starting in two years:

$$[1+f_{(j,k)}]^k = \frac{[1+S_{(j+k)}]^{(j+k)}}{(1+S_j)^j} \qquad [1+f_{(2,3)}]^3 = \frac{[1+0.06]^5}{[1+0.04]^2}$$

$$[1+f_{(2,3)}]^3 = 1.23726 \qquad f_{(2,3)} = [1.23726]^{\frac{1}{3}} - 1 \qquad f_{(2,3)} = 7.35\%$$

Spot and Forward Rate Relationships

- For an upward-sloping yield curve, the forward rate *f*(j,k) rises as j increases



Spot curves and forward curves as of July 2013

- Because the yield curve is upward sloping, the forward curves lie above the spot curve

Par Rates

- Par rate is the YTM for a bond trading at par
- Par rate = coupon rate
- For a bond with a single cash flow remaining (i.e., last coupon + principal), par rate = spot rate
- Typically, par rates are used to generate spot rates using bootstrapping *(next slide)*

Bootstrapping Spot Rates: Example

1-year, 2-year, and 3-year par rates are 1%, 1.25%, and 1.50% respectively. Using bootstrapping calculate S_1, S_2, and S_3:

S_1 = 1-year par rate = 1% by definition

2 year bond: $100=\frac{1.25}{1.01}+\frac{101.25}{(1+S_2)^2}$ $\quad 98.7624=\frac{101.25}{(1+S_2)^2}$

$\frac{101.25}{98.7624}=(1+S_2)^2$ $\quad S_2=(1.0252)^{\frac{1}{2}}-1 = 1.252\%$

Bootstrapping Spot Rates: Example (cont.)

1-year, 2-year, and 3-year par rates are 1%, 1.25%, and 1.50% respectively. Using bootstrapping calculate S_1, S_2, and S_3:

3 year bond: $100=\frac{1.50}{1.01}+\frac{1.50}{(1.0252)^2}+\frac{101.50}{(1+S_3)^3}$

$97.0517=\frac{101.50}{(1+S_3)^3}$ $\quad S_3=(1.0458)^{\frac{1}{3}}-1 = 1.51\%$

Fixed Income (1)

The Term Structure and Interest Rate Dynamics

Spot and Forward Rates, Part 2

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Spot and Forward Rate Relationships

- Return on a bond over one year is always equal to the one-year risk-free rate if spot rates develop as predicted by today's forward curve
- An active portfolio manager will try to outperform the market by predicting how the future spot rates will differ from those predicted by the current forward curve
- If the future spot rates are below the current forward rates, the portfolio manager will earn a return greater than the one-year risk-free rate

Riding the Yield Curve

- **Riding the yield curve**: If the yield curve is upward-sloping, investor will purchase bonds with higher maturity than their holding period
- As time passes and maturity shortens, the bond's cash flows will be discounted at successively lower yields
- Will produce superior returns if the yield curve remains stable over the investment horizon
- Disadvantage: Increases interest rate risk

Fixed Income (1)

The Term Structure and Interest Rate Dynamics

The Swap Rate Curve

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The Swap Rate Curve

- Swap spread: Amount fixed-rate payer side of an interest rate swap exceeds the yield of a government bond with the same maturity

swap spread = swap fixed rate – treasury yield

The Swap Rate Curve

- **Yield curve**: Typically based on Treasury securities
- **Swap rate curve**: Yield curve based on series of fixed-rate quotes on interest rate swaps (swap rates reflect credit risk)
- **Point**: Increasingly preferred as benchmark
  - Not affected by government regulation
  - More comparable across countries
  - Quotes at more maturities

Fixed Income (1)

The Term Structure and Interest Rate Dynamics

Spread Measures

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I-Spread

- I-spread = bond's yield – swap fixed rate
- Swap fixed rate may have to be **interpolated**
- I-spread reflects credit risk relative to LIBOR

Interpolated Swap Fixed Rate: Example

Using the swap curve, calculate the I-spread on 6% Zinni bonds maturing in 1.6 years and yielding 2.35%.

Tenor	0.5	1	1.50	2.0
Swap rate	1.00%	1.25%	1.35%	1.50%

Interpolated swap rate =

$$0.0135+(0.015 - 0.0135)\text{x}\left(\frac{(1.6 - 1.5)}{(1.5 - 2.0)}\right) = 1.38\%$$

Interpolated swap rate = 2.35 – 1.38 = 0.97%

The Z-Spread

- Z-spread: When added to each spot rate on the default-free spot curve, makes the present value of a bond's cash flows equal to the bond's market price
- Constant spread added to default-free spot curve
- The Z-spread is a spread over the entire spot rate curve

The Z-Spread (Cont.)

- The term *zero* volatility in the Z-spread refers to the assumption of zero interest rate volatility
- Z-spread is not appropriate to use to value bonds with embedded options
- If used for bonds with embedded options, the Z-spread includes the risk premium for option risk (in addition to credit and liquidity risk premium)

The TED Spread

TED = **T**-bill and **ED** *(Eurodollar ticker)*

Difference in interest rate on loans between banks (LIBOR) and the rate on T-bills

Example: 3-month LIBOR is 0.33%, and the 3-month T-bills rate is 0.03%, then:

TED spread = (3-mo. LIBOR) – (3 mo. T-bill)

= 0.33% – 0.03% = 0.30% or 30 bps

The TED Spread (Cont.)

- TED spread is seen as an indication of the level of credit risk in the economy
  - T-bills are considered to be risk-free
  - LIBOR reflects the risk of lending to banks
- A rising TED spread suggests banks are increasingly likely to default on loans
- A rising TED spread = falling liquidity

The Libor-OIS Spread

- OIS = Overnight Indexed Swap
- OIS roughly equals Federal funds rate
  - Includes minimal counterparty risk
- Libor-OIS spread: Amount by which Libor rate (which includes credit risk) exceeds the OIS rate (includes only minimal credit risk)
- Useful as a measure of credit risk and an indication of wellbeing of banking system

Fixed Income (1)

The Term Structure and
Interest Rate Dynamics

Term Structure Theory

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Traditional Theories of the Term Structure of Interest Rates

Why does yield curve take a particular shape?

Traditional theories:

1. Unbiased Expectations Theory
2. Local Expectations Theory
3. Liquidity Preference Theory
4. Segmented Markets Theory
5. Preferred Habitat Theory

1. Unbiased Expectations Theory

- Also known as pure expectations theory
- "Investors' expectations determine the shape of the interest rate term structure."
- Forward rates = expected future spot rates
- Long-term interest rates equal the mean of future expected short-term rates
- If the yield curve is upward sloping, short-term rates are expected to rise

2. Local Expectations Theory

- Local expectations does not say that every maturity strategy should have the same return over a given investment horizon
- Over longer periods, risk premium exists
- Risk-neutrality is preserved for only short-term under local expectations
- Shown not to work ➡ Short-holding period returns of long-maturity bonds is higher than short-maturity bonds

3. Liquidity Preference Theory

- Proposes that forward rates reflect investors' expectations of future spot rates, plus a liquidity premium for interest rate risk
- Interest rate risk: longer dated cash flows more sensitive to rate changes
  - Premium is positively related to maturity
  - 25-year bond will have a large premium

3. Liquidity Preference Theory

- Forward rates are ***biased*** estimates of future rates because of the liquidity premium
- A positive-sloping yield curve may be due to future expectations or liquidity premium

4. Segmented Markets Theory

- Yield at each maturity is determined independently of yields at other maturities
- Various market participants only deal in securities of a particular maturity
  - Because they are prevented from operating at different maturities
- Yield determined by supply and demand

5. Preferred Habitat Theory

- Also proposes that forward rates are expected future spot rates plus a premium
  - Does not state that premium is directly related to maturity
  - Investors prefer a particular maturity
  - Would be willing to leave preferred maturity habitat to obtain a lower price (hence higher yield)
  - Preferred habitat theory can be used to explain almost any yield curve shape

Fixed Income (1)

The Term Structure and
Interest Rate Dynamics

Interest Rate Models

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Modern Theories of the Term Structure of Interest Rates

1. **Equilibrium Term Structure Models**
   a. The Vasicek Model
   b. The Cox–Ingersoll–Ross Model

   Single-factor models

2. **Arbitrage-Free Models**
   a. The Ho-Lee Model

   Think: binomial trees

The Vasicek Model

- Suggests that interest rates are mean reverting to a long-run value

$$dr = \overbrace{a(b-r)dt}^{\text{deterministic}} + \overbrace{\sigma dz}^{\text{stochastic}}$$

- The a(b-r)*dt* term forces the interest rate *r* to mean-revert towards the long-run value *b*, at a speed determined by *a*

The Cox–Ingersoll–Ross (CIR) Model

- Two terms: drift and random

$$dr = \overbrace{a(b-r)dt}^{\text{deterministic}} + \overbrace{\sigma\sqrt{r}\ dz}^{\text{stochastic}}$$

- Deterministic term same as the Vasicek model
- Improvement over the Vasicek model in the stochastic term

Vasicek vs. CIR Model

- Under the **Vasicek** model:
  - Volatility does not increase as the level of interest rates increase
  - Interest rates could become negative
- Under the **CIR** model:
  - **Volatility** related to the current level of the interest rate (prevents negative rates)

The Ho-Lee Model

- The Ho-Lee model takes the following form:

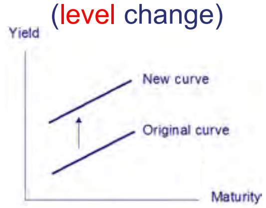
$$dr_t = \theta_t d_t + \sigma dz_t$$

- Where θ_t is a time-dependent drift term
- **Calibrated** by using market prices to find the θ_t that generates the current term structure
- Model can then be used to price zero-coupon bonds and determine the spot curve
- Produces a normal distribution of rates

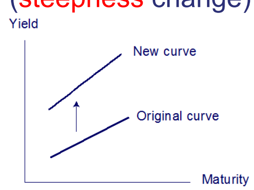
Yield Curve Shifts

- Yield curve shifts can be either simple parallel shifts, or more-complex nonparallel shifts

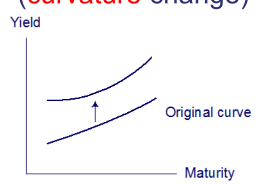
Parallel shift (level change)



Nonparallel shift (steepness change)



Nonparallel shift (curvature change)



Methods of Measuring Yield Curve Sensitivity

1. Effective duration
2. Key rate duration
3. Sensitivity to parallel, steepness, and curvature movements

1. Effective Duration

Effective duration: Measures price risk for small ***parallel*** shifts in yield curve

- Problem: Most yield curve shifts have nonparallel characteristics
- Solution: Use key rate duration which measures impact of nonparallel shifts

2. Key Rate Duration

- A more sophisticated method, used to quantify price sensitivity to *nonparallel* yield curve shifts
- *Key rate duration* is price sensitivity to 1% change in a single **par** rate, holding other par rates constant

3. Sensitivity to Level, Steepness, and Curvature Movements

- Decomposes risk into sensitivity to these categories of yield curve movements:
  - Level (Δx_L): A parallel increase or decrease of interest rates
  - Steepness (Δx_S): Long maturity interest rates increase, and short rates decrease
  - Curvature (Δx_C): Short and long rates increase; intermediate rates don't change

Sensitivity to Parallel, Steepness, and Curvature Movements

- We can then model the change in the value of our portfolio as follows:

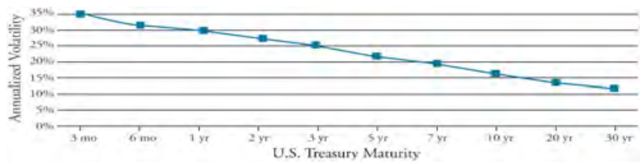
$$\Delta P/P \approx -D_L \Delta X_L - D_S \Delta X_S - D_C \Delta X_C$$

Sensitivities to changes in:

- Level $\rightarrow D_L$
- Steepness $\rightarrow D_S$
- Curvature $\rightarrow D_C$

Maturity Structure of Yield Curve Volatilities

- The term structure of interest rate volatility is the graph of yield volatility versus maturity
- As shown here, short-term interest rates are more volatile than are long-term rates



Maturity Structure of Yield Curve Volatilities

- Interest rate volatility will drive price volatility in a fixed income portfolio
- Especially important when securities have embedded options (sensitive to volatility)
- Long-maturity volatility is associated with uncertainty of the real economy and inflation
- Volatility at the short-maturity end reflects risks regarding monetary policy

Fixed Income (2)

The Arbitrage-Free Valuation Framework

Binomial Trees, Part 1

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Arbitrage-Free Valuation

- **Arbitrage-free**: Consistent with market price of other securities
  - Upholds value additivity principle
    - Stripping
    - Reconstitution
  - Does not allow for dominance
    - One security cannot be priced more attractively as compared to otherwise identical security

Example: Arbitrage-Free Valuation

- Sam Givens, a fixed income analyst at GBO Bank, has been asked to value a three-year, 3% annual pay, €100 par bond with the same liquidity and risk as the benchmark. What is the value of the bond using the spot rates provided below?
- € Benchmark Spot Rate Curve:

Year	1	2	3
Rate	3.00%	3.25%	3.50%

Solution: Arbitrage-Free Valuation

- 3% annual pay, €100 par bond:

Value = $(3/1.03) + (3/1.0325^2) + (103/1.035^3)$ = €98.63

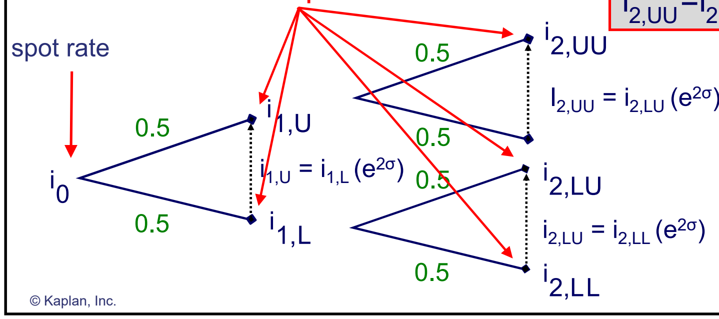
Binomial Interest Rate Model

- **Model**: *System* for building interest rate trees
  - Rate tree represents possible paths
  - Assumes **equal** probability of upward or downward interest rate movements
  - Lognormal random walk based on **assumed volatility** in interest rates (non-negative rates and higher volatility at higher rates)
  - **Your job**: Know how to use the tree, you won't be creating the tree on the exam

Binomial Interest Rate Tree

Nodal values → expected future rates

$$i_{2,UU}=i_{2,LL}e^{4\sigma}$$

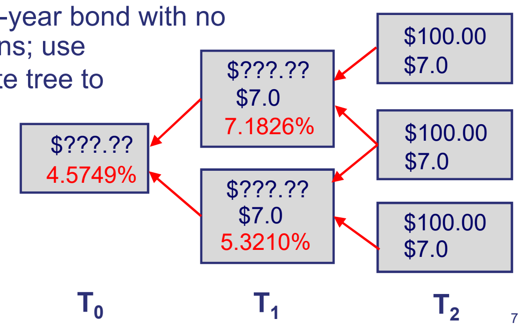


Backward Induction Methodology

- **Approach**: Value bond by moving backward from last period to time zero
  - **Things to know**:
    - Value at maturity is known
    - Value at any node is average PV of two possible values from next period
    - Discount rate is forward rate for that node

Backward Induction Methodology: Example

- **Example:** 7%, 2-year bond with no embedded options; use given interest rate tree to find bond values for each node



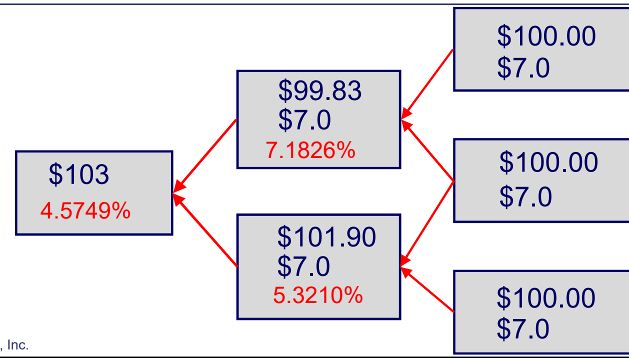
Backward Induction Methodology

$$V_{1,U} = \left(\frac{100+7}{1.071826}\right) = 99.83$$

$$V_{1,L} = \left(\frac{100+7}{1.05321}\right) = 101.594$$

$$V_0 = \left(\frac{99.83+101.594}{2}+7\right) / (1.045749) = 103$$

Backward Induction Methodology



Fixed Income (2)

The Arbitrage-Free Valuation Framework

Binomial Trees, Part 2

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Tree Should Be *Arbitrage-Free*

- **Arbitrage-free pricing**:
  - Create tree
  - Calibrate arbitrage-free interest rates
    - Interest rate tree should generate values for on-the-run benchmark securities equal to market prices
    - Think Ho Lee model

Valuation Using Spot or Zero-Coupon Yield

Example: Value the same 7%, 2-year, option-free bond using spot rates.

Maturity	Spot Rate
1	4.5749%
2	5.4060%

$$\text{Value} = \frac{7}{1.045749} + \frac{107}{(1.05406)^2} = \$103$$

Valuation would be same as before!

Pathwise Valuation

- Mathematically identical approach to binomial model. Rates are from binomial tree!
- Number of paths = $2^{(n-1)}$

  where n = number of periods

Pathwise Valuation

- Each cash flow is discounted at appropriate 1-period spot and/or forward rate(s)
- Differs from valuation using spot rate curve
- Valuation is based on equal weight for each path

Pathwise Valuation: Example

- Example: Value the 2-year, 7% bond using pathwise valuation

Path	Year 1	Year 2	Value
1	4.5749%	7.1826%	$102.16
2	4.5749%	5.3210%	$103.84
		Average	$103.00

$$\text{Value for path 1} = \frac{7}{1.045749} + \frac{107}{(1.045749)(1.071826)} = \$102.16$$

$$\text{Value for path 2} = \frac{7}{1.045749} + \frac{107}{(1.045749)(1.05321)} = \$103.84$$

Monte Carlo Method

- Generate many random interest rate paths based on a probability distribution and assumed volatility—uses pathwise valuation
- Model may impose upper and lower bounds consistent with mean reversion of rates
- Paths are calibrated to ensure arbitrage-free valuation of benchmark securities
- Useful for valuation of securities whose value is path-dependent (e.g., MBS)

Fixed Income (2)

Valuation and Analysis:
Bonds With Embedded Options

Types of Embedded Option

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Types of Embedded Options

- Call and put (simple options)
  - European-type
  - American-type
  - Bermudan-type
- Estate puts
  - Put contingent on death of investor
- Sinking fund (issuer options)
  - Set aside funds to retire the bond

Complex options

Valuing Embedded Options

- Embedded calls: Investors get a discount equal to call value:

  $V_{call} = V_{straight} - V_{callable}$

- Embedded puts: Investors pay a premium equal to put value:

  $V_{put} = V_{putable} - V_{straight}$

Fixed Income (2)

Valuation and Analysis:
Bonds With Embedded Options

Valuing Bonds with Embedded Options, Part 1

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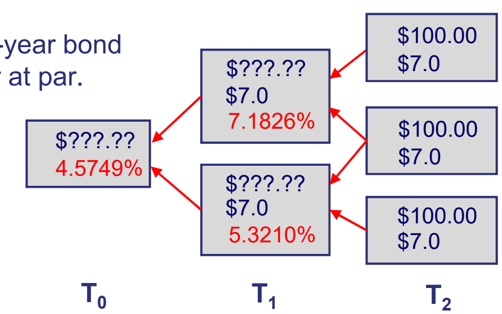
Valuation of Bonds with Options

- Usual backward induction process in a binomial tree
- Assuming the option can be exercised:
  - Value at any node is average PV of two possible values from next period or the call price, whichever is lower (for callables)
  - Value at any node is average PV of two possible values from next period or the put price, whichever is higher (for putables)

Backward Induction Methodology: Example

Example: 7%, 2-year bond callable in 1 year at par.



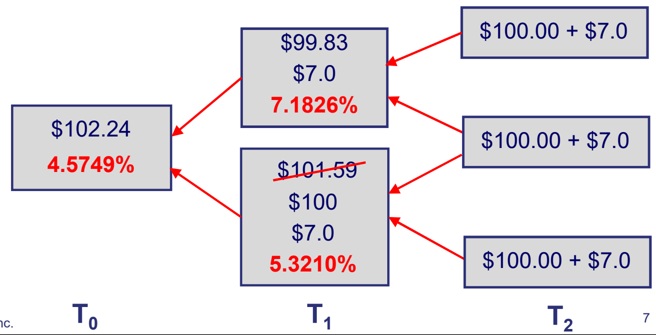
Straight Bond Valuation

$$V_{1,U} = \left(\frac{100+7}{1.071826}\right) = 99.83$$

$$V_{1,L} = \left(\frac{100+7}{1.05321}\right) = 101.59$$

$$V_0 = \left(\frac{99.83+101.59}{2}+7\right) / (1.045749) = 103$$

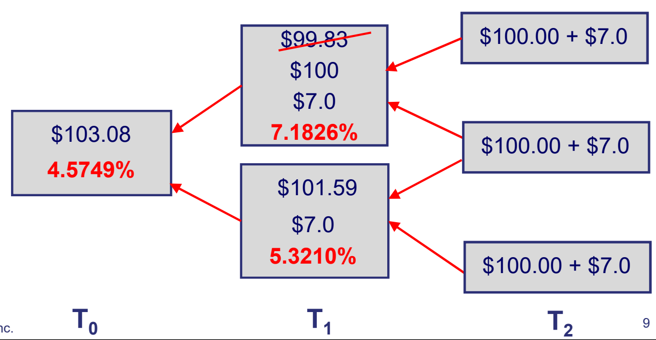
Callable Bond Valuation: Example



What About Putable Bonds?

- **Point**: All interest-sensitive embedded options valued in the same manner
  - At each node, evaluate whether the option will be exercised
    - **If so:** Use the exercise value
    - **If not:** Use the calculated value
- **Example:** 7%, 2-year bond putable in 1 year at par

Putable Bond Valuation: Example



Valuing Embedded Options

$V_{call} = V_{straight} - V_{callable}$

$0.76 = $103 – $102.24

$V_{put} = V_{putable} - V_{straight}$

$0.08 = $103.08 – $103

Fixed Income (2)

Valuation and Analysis:
Bonds With Embedded Options

Valuing Bonds with Embedded Options, Part 2

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Volatility and Embedded Options

- Straight bond values are **NOT** affected by volatility
- **Point**: Embedded options **ARE** affected by volatility
  - If: Rate volatility increases
  - Then: Value of embedded call/put increases
    - Value of callable bond falls
    - Value of putable bond increases

Decreases → $V_{callable} = V_{straight} - V_{call}$ ← Increases

Increases → $V_{putable} = V_{straight} + V_{put}$ ← Increases

Level and Shape of Yield Curve

- **Upside on a callable limited** when rates decline
- **Downside on a putable limited** when rates increase
- When yield curve **steepens**, **call option** is unlikely to be exercised and has **low value** while the **put option is valuable**
- When the yield curve **flattens**, the **call option** becomes **more valuable** while the **put option loses value**

Fixed Income (2)

Valuation and Analysis:
Bonds With Embedded Options

Option Adjusted Spread

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Option-Adjusted Spread (OAS)

- Problem: Benchmark interest rate trees do not produce arbitrage-free values for credit risky bonds (i.e., the tree is incorrectly calibrated).
- Need to add a spread to account for credit risk

Option-Adjusted Spread (OAS)

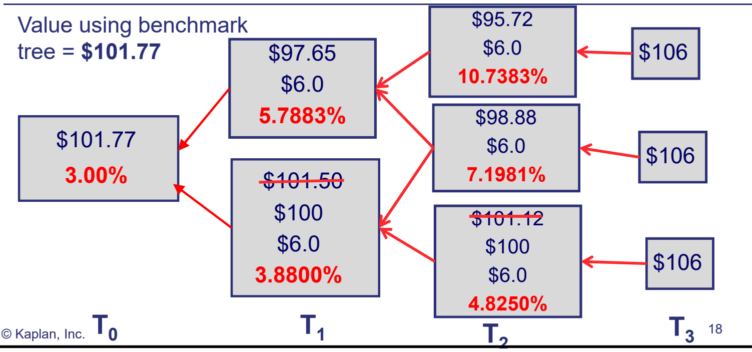
- **OAS:**
  - **Main point**: OAS is the constant interest rate spread added to all rates in binomial tree, so **model price = market price**
  - **Interpretation**: Spread after accounting for option risk
  - **Better name**: Option-removed spread

Option-Adjusted Spread: Example

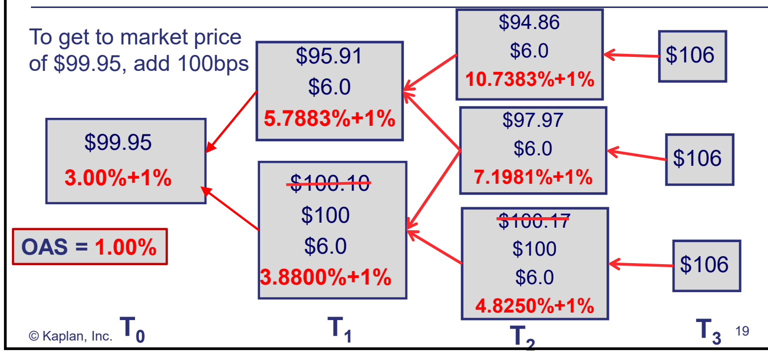
- **Example:** A $100-par, 3-year, 6% annual-pay ABC Inc. callable bond trades at $99.95. The underlying call option is a Bermudan-style option that can be exercised in one or two years at par. Rates are as follows:

Year 0	Year 1	Year 2
3.000%	5.7883%	10.7383%
	3.8800%	7.1981%
		4.8250%

Solution: OAS



Solution: OAS



OAS and Volatility

- The assumed level of volatility in a binomial interest rate tree affects the *calculated* value of the underlying options. Both call and put options increase in value when volatility is assumed to be higher.
- If the option value is higher, the computed value of a callable bond will be lower and the value of a putable bond will be higher.

OAS and Volatility (continued)

- Keeping market price of the bond constant, the higher volatility results in lower <u>computed</u> OAS for a callable bond and higher <u>computed</u> OAS for a putable bond
- Hence a higher volatility assumption may make a risky callable bond less attractive and a risky putable bond more attractive

Fixed Income (2)

Valuation and Analysis:
Bonds With Embedded Options

Duration

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Effective Duration and Convexity

$$ED = \frac{BV_{-\Delta y} - BV_{+\Delta y}}{2 \text{ x } BV_0 \text{ x } \Delta y}$$

$$EC = \frac{BV_{-\Delta y} + BV_{+\Delta y} - (2 \text{ x } BV_0)}{BV_0 \text{ x } \Delta y^2}$$

Steps:

1. Using backward induction, calculate OAS of the bond.
2. Shock yields by Δy, add OAS from step 1 and calculate $BV_{+\Delta y}$ and $BV_{-\Delta y}$.
3. Use formulae to compute ED and EC.

Effective Durations

- $\text{Duration}_{\text{callable or putable}} \leq \text{Duration}_{\text{straight}}$
- $\text{Duration}_{\text{zero}} \approx$ Bond maturity
- $\text{Duration}_{\text{fixed-rate}} <$ Bond maturity
- $\text{Duration}_{\text{floater}} \approx$ Time (years) to next reset

Fixed Income (2)

Valuation and Analysis:
Bonds With Embedded Options

Key Rate Duration

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One-Sided Durations

- Impact of yield changes on price of bonds with embedded options is **asymmetric—**one-sided durations are better
- When the underlying option is near money:
  - Callable bonds will have lower one-sided down-duration than one-sided up-duration
  - Putable bonds will have higher one-sided down-duration than one-sided up-duration

Key Rate Durations

- Price impact of **par rate** changes for specific maturities
- Applicable for nonparallel shifts in yield curve
- Captures **shaping risk**
- Option-free bond's maturity-matched rate is the most important (i.e., its key rate duration is highest)
- **Callable bond** with option deep out of money (low coupon rate) will have highest key rate durations corresponding to their maturity

Key Rate Durations (continued)

- **Putable bond** with option deep out of money (high coupon rate) will have highest key rate duration corresponding to their maturity
- As the option moves into money, the time-to-exercise rate becomes more important. Key rate duration corresponding to the time-to-exercise will be highest.

Effective Convexity

- **Convexity is positive** for **straight and putable bonds**; price impact of rate decrease is higher than the price impact of rate increase
- The price appreciation of callable bonds is limited due to the short call (price compression)
- **Callable bonds** will have **negative convexity** when the call option is at or near money

Fixed Income (2)

Valuation and Analysis:
Bonds With Embedded Options

Capped and Floored Floaters

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Capped and Floored Floaters

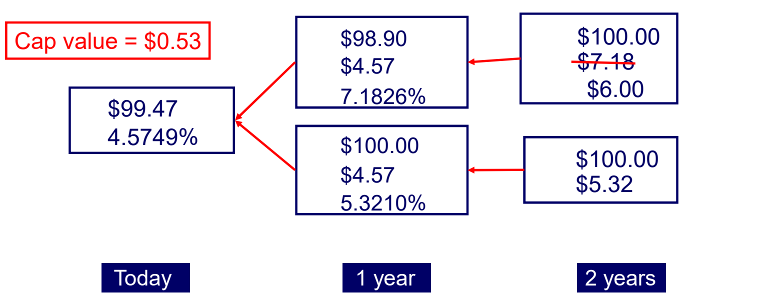
- **Floaters** pay coupon based on a variable rate, typically set in arrears

  Value of capped floater
  = value of straight floater – value of embedded cap

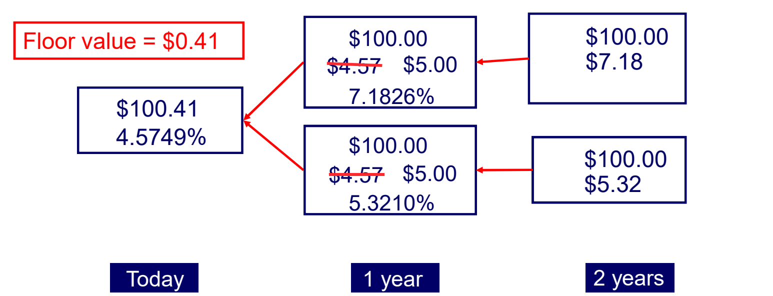
  Value of floored floater
  = value of straight floater + value of embedded floor

- **Example:** Compute the value of a 2-year capped floater, cap = 6%, and also for a floored floater with floor = 5%

Capped Floater Valuation



Floored Floater Valuation



Fixed Income (2)

Valuation and Analysis:
Bonds With Embedded Options

Convertible Bonds

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Convertible Bonds

- **What:** Bond convertible into fixed number of shares
  - Intuition: Call option on stock held by bondholder
- **Important point:** Conversion option is NOT interest-rate sensitive
- **Exam tip: Know the terminology!** (next slides)

CV Bonds: Valuation

- Conversion ratio: Number of shares per bond
- Market conversion price: Effective price per share when converting
  - Market price of bond/conversion ratio
- Conversion value: Market price of stock after conversion × conversion ratio

CV Bonds: Valuation

- Straight value: PV of CFs, if not convertible
  - Usually given on exam
- Minimum value of a convertible bond: Greater of conversion value and straight value
- Market conversion premium: market conversion price – market price of stock

CV Bonds: Valuation

- Market conversion premium ratio:
  market conversion premium / market price
- Premium over straight value:
  (MV of bond / straight value) – 1

Example: Convertible Bonds

Consider a BSC convertible bond with a 7% coupon that is currently selling at \$985 with a conversion ratio of 25 and a straight value of \$950. Suppose that the value of BSC's common stock is currently \$35 per share and that it pays \$1 per share in dividends annually.

Calculate the minimum price, market conversion premium ratio, and premium over straight value.

Solution: Convertible Bonds

- Conversion ratio: Number of shares per bond = 25
- Market conversion price: Effective price per share when converting
  - Market price of bond/conversion ratio = 985 / 25 = \$39.40
- Conversion value: Market price of stock after conversion × conversion ratio = 35 × 25 = \$875

Solution: Convertible Bonds

- Straight value: PV of CFs, if not convertible = \$950
- Minimum value of a convertible bond: Greater of conversion value and straight value = Max (875, 950) = \$950
- Market conversion premium: market conversion price – market price of stock = 39.40 – 35 = \$4.40

CV Bonds: Valuation

- Market conversion premium ratio:
  market conversion premium / market price = 4.40 / 35 = 12.57%
- Premium over straight value:
  (MV of bond / straight value) – 1 = (985 / 950) – 1 = 3.68%

Convertible Bonds

- **(Noncallable/nonputtable) convertible bond**
  BV = straight bond + call on stock
- What about a **callable convertible**?
  CCBV = straight bond + call on stock – call on bond
- **Point:** Value a CV bond as straight bond ± value of embedded options

Convertible Bonds

- CV bonds: Limits downside risk
  - Why? If stock price is low, convertible is still worth something as a bond
- **Stocks vs. CV bonds**:
  - Stock price ↓, CV bond outperforms stock
  - Stock price ↑, stock outperforms CV bond
  - Stock flat: CV bond outperforms because of coupons (assuming no change in rates or credit risk)

Fixed Income (2)

Credit Analysis Models

Credit Risk Measures

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Credit Risk Measures

- **Exposure:** Amount at risk before factoring recovery
- **Recovery rate:** Percent recovered = (1 – loss severity)
- **Loss given default:** exposure x loss severity
- **Hazard rate** = initial probability of default
- **Probability of survival** = $(1 – \text{hazard rate})^t$
- **Probability of default** = hazard rate × PS_{t-1}

Credit Valuation Adjustment (CVA)

Expected loss
= probability of default × loss given default

CVA = present value of expected loss

CVA = value of comparable risk-free bond – value of risky bond

Example: Credit Measures

A 3-year, $100 par, zero-coupon corporate bond has a hazard rate of 2% per year. Its recovery rate is 60%, and the benchmark rate curve is flat at 3%.

Calculate the expected exposure, probability of survival, probability of default, loss given default, and CVA.

Solution: Credit Measures

- Exposure at the end of 3 years is the face value of the bond ($100). Exposure at the end of year 2 is present value of $100 discounted for 1 period at 3% (= 100 / 1.03). Exposure at end of year 1 is the present value discounted for 2 periods (= $100 / 1.03^2$).
- LGD = exposure × (1 – 0.60)
- DF is the present value of $1. Year 2 DF = $1 / (1.03)^2$ = 0.942596.

Solution: Credit Measures

- Probabilities of survival (PS) for years 1, 2, and 3 are calculated as $(1 – 0.02)^1 = 0.98$, $(1 – 0.02)^2 = 0.9604$, and $(1 – 0.02)^3 = 0.9412$.
- Probability of default is 2% in the first year and decreases with the PS. PD for year 2 = 2% of PS for year 1 = 0.02 × 0.98 = 0.0196 or 1.96%. Similarly, the PD for year 3 = 0.02 × 0.9604 = 0.019208 or 1.9208%.

Solution: Credit Measures

Year	Exposure	LGD	PS	PD	Expected Loss	DF	PV of Expected Loss
1	94.260	37.704	98.000%	2.000%	0.754077	0.970874	0.732113
2	97.087	38.835	96.040%	1.9600%	0.761165	0.942596	0.717471
3	100.000	40.000	94.119%	1.9208%	0.76832	0.915142	0.703122
						CVA	2.152706

Risk-Neutral Probability of Default

- Is the probability of default *implied* in the current market price
- Is calculated by assuming a certain recovery rate
- Assumed recovery rate and risk-neutral probability of default are positively correlated

Fixed Income (2)

Credit Analysis Models

Analysis of Credit Risk

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Example: Expected Rates of Return

A 3-year, $100 par, zero-coupon corporate bond has a hazard rate of 2% per year. Given a recovery rate of 60% and a flat benchmark curve at 3%, the CVA is $2.15. Exposure at the end of years 1, 2, and 3 is $94.26, $97.09, and $100, respectively.

Calculate the IRR on the investment if the bond defaults in each of the 3 years, as well as if it does not default.

Solution: Expected Rates of Return

Bond Price = VND – CVA = $[100/(1.03)^3] - 2.15 = 89.36$

At the end of year 1, there are two possible outcomes: default or no default. If default occurs, a recovery of 60% of exposure, or 0.6×94.26 = $56.56, occurs.

Similarly, in years 2 and 3, in case of default, the recovery amounts are $58.25 and $60, respectively.

If default occurs in year 1:

PV = –89.36, N=1, FV = 56.56, CPT I/Y = –36.71%

Solution: Expected Rates of Return

If default occurs in year 2:

PV = –89.36, N = 2, FV = 58.25, CPT I/Y = –19.26%

If default occurs in year 3:

PV = –89.36, N = 3, FV = 60.0, CPT I/Y = –12.43%

If the bond does not default:

PV = –89.36, N = 3, FV = 100.0, CPT I/Y = 3.82%

Solution: Expected Rates of Return

	Year 1		Year 2		Year 3	
	Cash Flow	IRR	Cash Flow	IRR	Cash Flow	IRR
Default	56.56	-36.71%	58.25	-19.26%	60.00	-12.43%
No default	0	–	0	–	100.00	3.82%

Example: Relative Risk Analysis

Elsa Jaitley is comparing three corporates for inclusion in her fixed income portfolio. Based on the following information, which bond has the highest risk? It is a better value?

Bond	Exposure (Per $100 Par)	Recovery (Per $100 Par)	Probability of Default
X	102	40	1.25%
Y	88	45	1.30%
Z	92	32	1.65%

Example: Relative Risk Analysis

Calculate expected loss:

Bond	Exposure (Per $100 Par)	Recovery (Per $100 Par)	Probability of Default	LGD (Per $100 Par)	Expected Loss
X	102	40	1.25%	62	0.775
Y	88	45	1.30%	43	0.559
Z	92	32	1.65%	60	0.99

Bond Z has the highest expected loss and is most risky. Absent price info, no conclusion can be reached about value.

Fixed Income (2)

Credit Analysis Models

Credit Scores and Credit Ratings

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Credit Scoring/Rating

- Credit scoring and credit rating models are ordinal rankings that categorize credit quality.
  - But, they provide no information on the degree of difference in quality between rankings.
- Credit scoring is used for small businesses and individuals.
  - Higher scores indicate better credit quality.
- Credit ratings are also issued for corporate debt, asset-backed securities, and government and quasi-government debt.

Credit Scoring/Rating

- The **FICO score** in the U.S. factors in the age of accounts, delinquencies, utilization of lines of credit, types of accounts, and number of hard inquiries.
- **Notching** in credit ratings (between several issues of same entity) accounts for seniority, and hence, LGD.
- Apart from a letter grade, credit ratings also specify outlook (positive, negative, or stable).

Example: Credit Migration

Suppose a bond with a modified duration of 6.32 gets downgraded from AAA to AA. The typical AAA credit spread is 60 bps, while the typical AA credit spread is 87 bps.

Calculate the percentage change in the price of the bond, assuming the bond is priced at typical spreads.

Solution: Credit Migration

change in spread = (87 – 60) = 27 bps = 0.0027

$\Delta\%P = -(\text{modified duration of the bond}) \times (\Delta \text{ spread})$

$= -6.32 \times 0.0027 = -0.0171$ or -1.71%.

Fixed Income (2)

Credit Analysis Models

Structural and Reduced Form Models

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Structural Models

- Are based on structure of a company's balance sheet and insights from option pricing
- Shareholders have a call option on the company's assets (A_T) with the face value of debt (K) as the strike price:
  - Value of stock = max (0, A_T – K)
  - Value of debt = value of Assets – value of equity
    = A_T – max (0, A_T – K)
    = min (A_T, K)

Structural Models

value of risky debt = value of risk-free debt – value of a put option on the company's assets

Value of debt at maturity:

if A_T > K (no default) = K

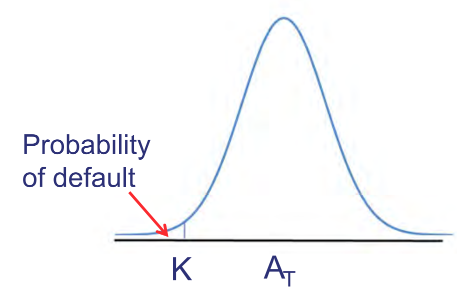
if A_T < K (default) = A_T

Pay off on a put option (X – S_T)

Loss given default = K – A_T

value of put option = CVA

Structural Models



Reduced Form Models

- Treats defaults as exogenous
- Does not explain why default occurs
- Uses **default intensity** (estimated using regression model)
- Allows linkage of default intensity, risk-free rate, and recovery rate to the state of the economy

Structural Model Strengths

- Structural models provide an economic rationale for default (i.e., $A_T < K$) and explain why default occurs.
- Structural models utilize option pricing models to value risky debt.

Structural Model Weaknesses

- Company assets are not actually traded and, hence, their value is not directly observable.
- It assumes a simple balance sheet structure. Complex balance sheets and those with off-balance sheet liabilities would be poorly modeled.

Reduced Form Strengths/Weakness

Strengths

- Do not assume that company assets trade
- Default intensity is allowed to fluctuate as company fundamentals change, as well as with business cycle

Weaknesses

- Do not explain why default occurs
- Treats defaults as random surprises

Fixed Income (2)

Credit Analysis Models

Credit Spread Analysis

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Credit Risk Measures (continued)

- **Credit spread** is the difference between YTM of a credit-risky, zero-coupon bond and a risk-free zero-coupon bond.

Credit spread = YTM of a credit risky zero-coupon bond – YTM of a risk-free zero-coupon bond

- VND = Value assuming no default

Example: Credit Spread

Jack Gordon, a fixed income analyst for Omega Bank PLC is evaluating an AA corporate bond for inclusion in the bank's portfolio. The $100 par, 3.50%, annual-pay 5-year bond is currently priced with a credit spread of 135bps over the benchmark par rate of 2%.

Calculate the bond's CVA implied in its market price.

Solution: Credit Spread

VND for the bond = present value of bond's cash flows using benchmark YTM.

N= 5, PMT = 3.50, I/Y = 2, FV = 100, PV = 107.07 = VND

YTM on risky bond = Risk-free rate + Credit spread = 2% +1.35% = 3.35%

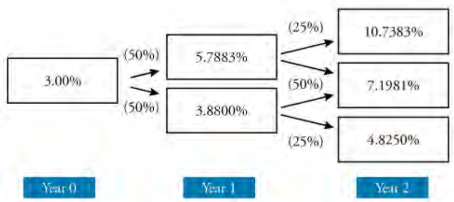
Value of risky bond:

FV = 100, N = 5, PMT = 3.5, I/Y = 3.35, CPT PV = 100.68 = value (risky)

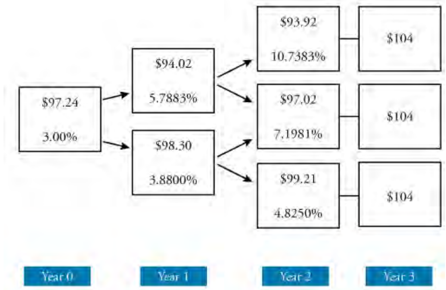
CVA = 107.07 – 100.68 = $6.39

Example: Binomial Tree

For a 3-year, annual pay, 4% coupon, $100 par corporate bond using the interest rate tree calculate: (a) the VND for the bond and (b) the expected exposure for each year.



Solution: Binomial Tree



VND = $97.24

Solution: Binomial Tree

Expected exposure for year t
= Σ (value in node at time t × node probability) + Coupon at time t

Expected exposure for year 1
= (0.5)(98.30) + (0.5)(94.02) + 4 = $100.16

Expected exposure for year 2
= (0.25)(93.92) + (0.5)(97.02) + (0.25)(99.21) + 4 = $100.79

Expected exposure for year 3 = $104 (no need to calculate!)

Fixed Income (2)

Credit Analysis Models

Credit Spread

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Credit Spread

- Credit spread is compensation for default risk.
- Credit spread is a function of default probability and recovery rate.
- Spreads change as expectations about state of the economy change.
- Expectation of an impending recession increases spreads.

Example: Changing Expectations

Joan de Silva, a junior analyst, works for a regional bank. Currently, she is evaluating a 3-year, annual pay, 3% XYZ corporate bond priced at $102. The government yield curve is flat at 1.75%.

De Silva estimates the spread using:

(a) a hazard rate of 1.25% and recovery rate of 70%; and

(b) a hazard rate of 1.50% and recovery rate of 60%.

Example: Hazard rate = 1.25% and RR = 70%

Yr	Exposure	LGD	PD	PS	EL	DF	PVEL
1	105.436	31.631	1.250%	98.750%	0.395	0.983	0.389
2	104.229	31.269	1.234%	97.516%	0.386	0.966	0.373
3	103.000	30.900	1.219%	96.297%	0.377	0.949	0.358
						CVA	1.1189

Example: Hazard rate = 1.50% and RR = 60%

Yr	Exposure	LGD	PD	PS	EL	DF	PVEL
1	105.436	42.174	1.500%	98.500%	0.633	0.983	0.622
2	104.229	41.691	1.478%	97.023%	0.616	0.966	0.595
3	103.000	41.200	1.455%	95.567%	0.600	0.949	0.569
						CVA	1.7859

Example: Changing Expectations

1. Based on assumptions (a), is the bond correctly priced?

2. **Calculate** the credit spread on the bond implied in the current market price.

3. Assuming that the market price changes consistent with assumptions (b), **calculate** the new credit spread.

Solution 1: Changing Expectations

Based on assumptions (a), CVA = 1.12 (given)

Calculate VND using benchmark rates:

N = 3, PMT = 3, I/Y = 1.75, FV = 100, CPT PV = 103.62 = VND

bond value = VND – CVA = 103.62 – 1.12 = 102.50

Given the market price of $102, the bond is **undervalued**.

Solution 2: Changing Expectations

risk-free YTM = par rate = 1.75% (given)

Using the market price of the bond ($102), the YTM on the bond is calculated as:

PV = –102, N = 3, PMT = 3, FV = 100, CPT I/Y = 2.30%

credit spread = 2.30% – 1.75% = 0.55%

Solution 3: Changing Expectations

risk-free YTM = par rate = 1.75% (given)

Based on assumptions (b) CVA = $1.79 (given)

market price of risky bond = VND – CVA = 103.62 – 1.79 = $101.83

PV = –101.83, N = 3, PMT = 3, FV = 100, CPT I/Y = 2.36%

credit spread = 2.36 – 1.75 = 0.61%.

Term Structure of Credit Spread

- Term structure of credit spread represents the relationship of credit spreads to debt maturity.
- Credit spread is the difference in yields for credit-risky bonds and risk-free bonds.
- It is useful for relative pricing and pricing of new issues.
- It uses interpolation for missing benchmark yields (if maturity-matched, liquid benchmark prices are not available).
- Differences in seniority, first/second lien provisions, and embedded options distort the computed credit spread.

Term Structure Determinants

- Quality: Higher rated sectors have flatter term structures.
- Financial conditions: They are steeper when expecting recessions.
- Market demand and supply: Spreads are affected by more liquid securities, and hence, more recent issues dominate the spread curve.
- Equity market volatility: Increases in equity market volatility increases credit spreads.

Fixed Income (2)

Credit Analysis Models

Credit Analysis of Securitized Debt

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Securitized Debt

- Bankruptcy remote SPE
- Lower cost and higher leverage for issuer
- Higher diversification and higher risk premium for investors

Credit Analysis of Securitized Debt

- Collateral: Granularity (asset transparency) and homogeneity (similarity across the pool assets). Short-term granular and homogenous, use statistical-based approach. Medium-term granular and homogenous, use a portfolio-based approach. Discrete and non-granular, evaluate at the individual loan level
- Servicer quality
- Structure: Credit enhancements and distribution waterfall

Covered Bonds

- Originating in Germany, covered bonds have spread to the rest of Europe, Asia, and Australia.
- They are issued by a financial institution.
- Senior, secured bonds are backed by a collateral pool *as well as* by the issuer (i.e., covered bond investors have recourse rights).
- While the collateral types vary by jurisdiction, common forms are commercial and residential mortgages, as well as public sector loans.

Fixed Income (2)

Credit Default Swaps

CDS Features and Terms

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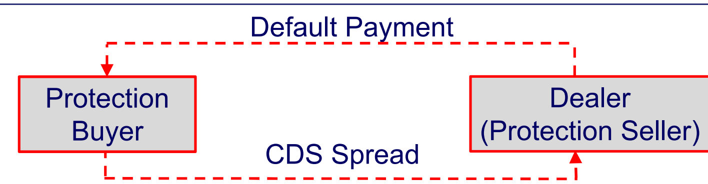
Credit Default Swap (CDS)



- Reference obligation is a debt instrument issued by the reference entity.
- Protection buyer buys credit protection from the protection seller and pays CDS spread for the coverage.

Obligations and Risks

- Protection buyer is short credit risk and is obligated to make CDS spread payments.
- Protection seller is long credit risk and is obligated to make a payment if a credit event occurs.
- A CDS on a single specific borrower is called a single-name CDS.
- Payoff on single-name CDS is based on the cheapest-to-deliver (CTD) obligation with the same seniority.

Example: Cheapest-to-deliver

Party X is a protection buyer in a $10 million notional principal senior CDS of Alpha, Inc. There is a credit event (i.e., Alpha defaults), and the market prices of Alpha's bonds after the credit event are as follows:

- Bond P, a subordinated unsecured debenture, is trading at 15% of par.
- Bond Q, a 5-year senior unsecured debenture, is trading at 25% of par.
- Bond R, a 3-year senior unsecured debenture, is trading at 30% of par.

What will be the payoff on the CDS?

Solution: Cheapest-to-deliver

- Reference obligation is a senior debenture
- CTD with same seniority is bond Q (trading at 25% of par)
- Payoff = $10m – (0.25)($10m) = $7.5m

Index CDS

- A CDS on an equally weighted combination of borrowers is called an index CDS.
- Credit correlation is important factor in pricing of index CDS.

Index	Description	Number of Entities
CDX-IG	North America—Investment Grade	125
CDX-HY	North America—High Yield	100
iTraxx Main	Europe, Asia, Australia—Investment Grade	125
iTraxx Crossover	Europe, Asia, Australia—High Yield	Up to 50

CDS Spreads

- Standardization in CDS market makes CDS coupon ≠ CDS spread.

Coupon standardized by ISDA:
1% Investment grade
5% High yield

- Hence, an upfront payment is made by one of the counterparties to the CDS; this is called an upfront premium.

ISDA Credit Events

- **Bankruptcy**: A bankruptcy protection filing allows the defaulting party to work with creditors under the supervision of the court so as to avoid full liquidation
- **Failure to pay**: Occurs when the issuer misses a scheduled coupon or principal payment without filing formal bankruptcy
- **Restructuring**: Occurs when the issuer forces the creditors to accept terms that are different than those specified in the original issue

CDS Settlement After a Credit Event

- Can be physical settlement or cash settlement

Physical Settlement on Credit Default Swap

Cash Settlement on Credit Default Swap

Fixed Income (2)

Credit Default Swaps

Factors Affecting CDS Pricing

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Determinants of CDS Spread

- **Probability of default** is the likelihood of default in any given year by the reference entity.
- **Conditional probability of default** or **hazard rate** is the probability of default given that no prior default has occurred.
- **Loss given default** is the expected amount of loss in the event a default occurs.

$$\boxed{(\text{expected loss})_t = (\text{hazard rate})_t \times (\text{loss given default})_t}$$

Upfront Payment

Upfront payment (from protection buyer) = PV(protection leg) – PV(premium leg)

PV(protection leg): expected cash flows paid by protection seller (upon default)

PV(premium leg): expected coupon payments made by protection buyer

Upfront premium % (from protection buyer) ≈ (CDS spread – CDS coupon) × duration

Price of CDS (per $100 notional) ≈ $100 – upfront premium (%)

Profit on CDS After Inception

Profit for protection buyer
≈ change in spread (in bps) × duration × notional principal

Monetizing the gains (losses) of a CDS exposure means to capture the gains (losses) on an existing in-the-money (out-of-money) CDS

- Can be done by undertaking an offsetting transaction

Example: CDS Pricing/Valuation

Aki Mutaro, bond portfolio manager for a regional bank, is buying protection on $10 million par value Alpha Inc. bonds. 10-year CDS on Alpha Inc. bonds have a coupon rate of 5% while 10-year Alpha CDS spread is 3.5%. The duration of the CDS is 7.

- Calculate the approximate upfront premium in %.
- If the CDS spread changes to 3% after inception (duration changes to 5.5), calculate the profit/loss on the bank's CDS exposure.

Solution: CDS Pricing/Valuation

Upfront premium % ≈ (CDS spread – CDS coupon) × duration

= (3.50 – 5.00) × 7 = –10.5%

- If the CDS spread changes to 3% after inception:

  Profit for protection buyer

  ≈ change in spread × duration × notional principal

  = (–0.005) × 5.5 × 10M = –$275,000

- The bank would incur a loss of $275,000 due to the narrowing of the CDS spread.

Fixed Income (2)

Credit Default Swaps

CDS Usage

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Uses of CDS

In anticipation of declining (increasing) credit spreads, an investor may increase (decrease) credit exposure by selling (buying) protection.

Naked CDS: An investor with no underlying exposure buys CDS protection (bets on default).

Long/short trade: An investor purchases protection on one reference entity, while selling protection on another. Investor is betting that the difference in credit spreads will change to the investor's advantage.

Uses of CDS (cont.)

Curve trade: A long/short trade where the investor is buying and selling protection on the *same* reference entity but with a different maturity.

- An investor that expects an upward-sloping credit curve to flatten should buy protection in a short-maturity CDS and sell protection in a long-maturity CDS.
- An investor who believes that the short-term outlook is better than the long-term outlook can use a **curve-steepening trade**; going short a long-term CDS and long a short-term CDS.

Uses of CDS (cont.)

Basis trade: Exploiting credit spread differences between the bond market and CDS market.

- Another transaction: Buy and sell debt of the same entity based on which the CDS market suggests to be over- or underpriced.

Uses of CDS (cont.)

Synthetic CDOs: Constructed using CDS (rather than actual bonds as in a cash CDO).

- If a synthetic CDO can be created at a cost lower than a cash CDO, profit by buying the synthetic CDO and selling the cash CDO.

Derivatives

Pricing and Valuation of Forward Commitments

Pricing and Valuation of Equity Forwards

KAPLAN SCHWESER

Valuing a Forward Contract

- We can determine the value of a forward contract during its life.
- As the underlying price changes, the forward contract will accrue value.
  - **Long** (buy): Gains when price of underlying increases
  - **Short** (sell): Gains when price of underlying decreases

Valuing a Forward Contract

- The no-arbitrage value of a *long* forward contract during the life of the contract (V_t) is:

PV of forward price

$$V_t\left(\begin{array}{c}\text{of long position}\\ \text{during life of contract}\end{array}\right)=S_t-\left[\frac{FP}{(1+R_f)^{T-t}}\right]$$

- Value of the short position = negative of the long position (Because it's a zero-sum game, I win and you lose)

Valuing a Forward Contract

- Value of long position at initiation = 0
  - Because contract is priced to prevent arbitrage
- Value of long position at maturity = S_T – FP
- Value of long position prior to maturity = PV(S_T) – PV(FP)

Pricing Equity Forward Contracts

- Interim cash flows (e.g., dividends, coupons) are considered **benefits of carry**
- Benefits of carry **reduce** the forward price
- Essentially, they offset costs of carry such as R_f

Pricing Equity Forward Contracts

- Pricing equity forwards – formula:

$$FP(\text{on equity security}) = (S_0 - PVD) \times (1 + R_f)^T$$

$$FP(\text{on equity security}) = \left[S_0 \times (1 + R_f)^T\right] - FVD$$

- Both versions are mathematically equivalent
  - Both reduce forward price by value of dividends
- Use **# days/365**

Example: Pricing Equity Forward Contracts

Calculate the no arbitrage forward price for a 100-day forward on a stock that is currently priced at $30.00 and is expected to pay a dividend of $0.40 in 15 days, $0.40 in 85 days and $0.50 in 175 days.

The annual risk-free rate is 5%, and the yield curve is flat.

Solution: Pricing Equity Forward Contracts

Note: The final dividend (175 days) occurs after maturity and hence is not relevant.

$$PVD = \frac{\$0.40}{1.05^{15/365}} + \frac{\$0.40}{1.05^{85/365}} = \$0.7946$$

$$FP = [\$30.00 - \$0.7946] \times 1.05^{100/365} = \$29.60$$

Valuing Equity Forwards

- What about the value of an equity forward **after initiation**?
- Formula:

$$V_t(\text{long position}) = (S_t - PVD_t) - \left[\frac{FP}{(1+R_f)^{(T-t)}}\right]$$

Example: Valuing Equity Forwards

After 60 days, the value of the stock in the previous example is $36.00. Calculate the value of the equity forward contract assuming the risk-free rate is still 5% and the yield curve is flat.

Note: There is only one dividend remaining (in 25 days)

$$PVD_{60} = \frac{\$0.40}{1.05^{25/365}} = \$0.3987$$

Solution: Valuing Equity Forwards

$$V_{60}(\text{long}) = (S_{60} - PVD_{60}) - \left[\frac{FP}{(1+R_f)^{(40/365)}}\right]$$

$$V_{60}(\text{long}) = (\$36.00 - \$0.3987) - \left[\frac{\$29.60}{1.05^{40/365}}\right] = \$6.16$$

Pricing Index Forward Contracts

- **Equity index** = Basket of many stocks
- **Main point:** Viewed as paying a continuous dividend
- In this case, the continuous dividend is an offset to the cost of carry.
  - Think: Borrowing cost takes money away; continuous dividends bring some of it back.

Pricing Index Forward Contracts

- Formula:

$$FP(\text{on equity index}) = S_0 \times e^{\left(R_f^c - \delta^c\right)\times T}$$

$$= \left(S_0 \times e^{-\delta^c \times T}\right) \times e^{R_f^c \times T}$$

where:

R_f^c = continuously compounded risk-free rate

δ^c = continuous dividend yield

Example: Pricing Index Forward Contracts

The value of the S&P500 index is 1,140. The continuously compounded risk-free rate is 4.6% and the continuous dividend yield is 2.1%. Calculate the no-arbitrage price of a 140-day forward contract on the index.

$$FP = S_0 \times e^{\left(R_f^c - \delta^c\right)\times T}$$

$$FP = 1{,}140 \times e^{(0.046-0.021)\times(140/365)} = 1{,}151$$

Derivatives

Pricing and Valuation of Forward Commitments

Pricing and Valuation of Fixed Income Forwards

KAPLAN SCHWESER

Forward Contracts on Fixed Income Securities

- Fixed-income securities typically pay interim CFs to the holder.
- As with dividend-paying stocks, these CFs offset the cost of carry and, therefore, reduce the futures price.
- **Key point:** Pricing is analogous to equities; replace PVD (PV of dividends) with PVC (PV of coupons).

Forward Contracts on Fixed Income Securities

- Formula:

$$FP(\text{on FI security}) = (S_0 - PVC) \times (1 + R_f)^T$$
$$= S_0 \times (1 + R_f)^T - FVC$$

- The value after initiation is:

$$V_t(\text{long position}) = (S_t - PVC_t) - \left(\frac{FP}{(1 + R_f)^{(T-t)}} \right)$$

Example: Pricing Forward Contracts on Fixed Income Securities

Calculate the price of a 250-day forward contract on a 7% U.S. Treasury bond with a spot price of $1,050 (including accrued interest) that has just paid a coupon and will make another coupon payment in 182 days. The annual risk-free rate is 6%.

Note: U.S. Treasuries make semiannual coupon payments:

C = $1,000 × 7% × 0.5 = $35.00

Solution: Pricing Forward Contracts on Fixed Income Securities

$$PVC = \frac{\$35.00}{1.06^{182/365}} = \$34.00$$

$$FP = (S_0 - PVC) \times (1 + R_f)^{250/365}$$

$$FP = [\$1{,}050 - \$34.00] \times 1.06^{250/365} = \$1{,}057.37$$

Example: Valuing Forward Contracts on Fixed Income Securities

After 100 days, the value of the bond in the previous example is $1,090. Calculate the value of the forward contract on the bond to the long position, assuming the annual risk-free rate is 6%.

Note: There is only one coupon payment remaining before maturity (in 82 days).

$$PVC = \frac{\$35.00}{1.06^{82/365}} = \$34.54$$

Solution: Valuing Forward Contracts on Fixed Income Securities

$$V_t(\text{long}) = (S_{100} - PVC_{100}) - \left(\frac{FP}{(1+R_f)^{(150/365)}}\right)$$

$$V_t(\text{long}) = (\$1{,}090 - \$34.54) - \left(\frac{\$1{,}057.37}{(1.06)^{(150/365)}}\right) = \$23.11$$

Bond Futures Contracts

- Ignoring mark-to-market, futures are the same as forwards.
- Bond futures may allow short a delivery option—in which case, they are priced based on cheapest-to-deliver (CTD) bond.
- The quoted (or clean) price does not include accrued interest.

$$\text{accrued interest (AI)} = \left(\frac{\text{days since last coupon payment}}{\text{days between coupon payments}}\right) \times \text{coupon amount}$$

  - Full price = clean price + accrued interest

Bond Futures Contracts

- Adjust the forward pricing formula to account for the short's delivery option.
- Each deliverable bond is assigned a conversion factor (CF) to adjust the settlement payment for delivery of higher or lower coupon bonds.
- Use the CF for the *cheapest-to-deliver* bond.

Quoted $\rightarrow$ $$\boxed{\text{QFP} = \left[\text{full price} \times (1+R_f)^T - AI_T - \text{FVC}\right] \times \frac{1}{\text{CF}}}$$

Example: Bond Futures Contracts

Calculate the quoted futures price for a 1.2-year T-bond futures contract, if the cheapest-to-deliver bond is a 7% T-bond with exactly 10 years remaining and a quoted price of $1,040 with a conversion factor of 1.13.

There is currently no accrued interest as the bond has just paid a coupon. The annual risk-free rate is 5%. The accrued interest on the bond at maturity of the futures contract will be $14.

Example: Bond Futures Contracts

- The full price is $1,040 as there is no accrued interest:
  - Semiannual coupon = $1,000 × 7% × 0.5 = $35.00
  - Coupons are due 0.5 years (0.7y to maturity of the contract) and 1.0 year (0.2y to maturity of the contract)

Solution: Bond Futures Contracts

$$\text{QFP} = \left[\text{full price} \times (1+R_f)^T - AI_T - \text{FVC}\right] \times \frac{1}{\text{CF}}$$

$$\text{FVC} = \left(\$35 \times 1.05^{0.7}\right) + \left(\$35 \times 1.05^{0.2}\right) = \$71.56$$

$$\text{QFP} = \left[(\$1{,}040 \times 1.05^{1.2}) - \$14 - 71.56\right] \times \frac{1}{\text{CF}}$$

$$\text{QFP} = [(\$1{,}040 \times 1.05^{1.2}) - \$14 - \$71.56]\frac{1}{1.13} = \$900.13$$

Derivatives

Pricing and Valuation of
Forward Commitments

Pricing Forward Rate Agreements

KAPLAN SCHWESER

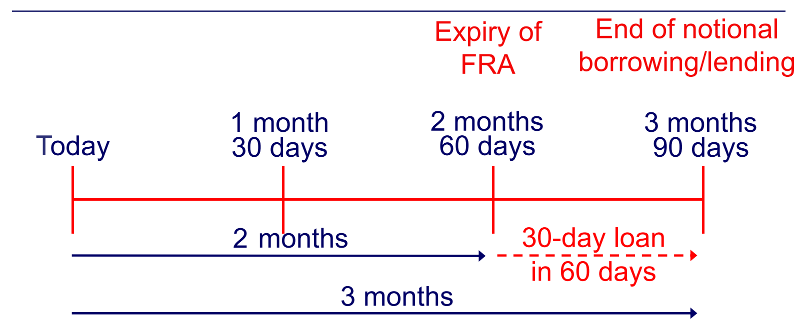
Forward Rate Agreements (FRA)

- **FRA**: Agreement to borrow (long) or lend (short) at a fixed rate in the future
- Usually based on LIBOR with # days/360 day-count convention
- Long FRA = Pay fixed and receive floating rate
- Short FRA = Pay floating and receive fixed rate
- Fixed rate = Forward rate (price)

Forward Rate Agreements (FRA)

- In a "2 × 3" FRA, the long agrees to borrow money starting two months from today at a fixed rate for a term that ends three months from today
- That is, the *underlying* in a 2 × 3 FRA is a **30-day loan 60 days from now**

2 × 3 FRA



Pricing an FRA

- The price of the 2 × 3 FRA is the implied 30-day forward rate in 60 days, calculated using the 60- and 90-day spot rates. [Note: The same process is used in the Fixed Income study session]

Step 1: De-annualize relevant LIBOR spot rates

Step 2: Calculate period rate as [(1+long) / (1+short)] – 1

Step 3: Annualize

Example: Pricing an FRA

Calculate the price of a 1 × 4 FRA given the following spot rates:

- 30-day LIBOR is 4%
- 120-day LIBOR is 5%

Solution: Pricing an FRA

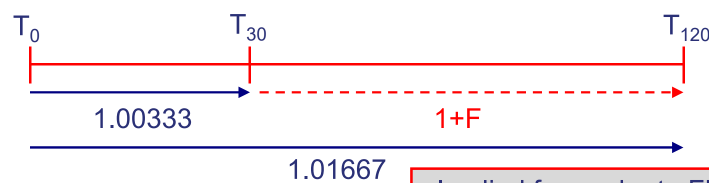
- **The De-annualized** 30-day rate is:

$$R_{30} = 0.04 \times \frac{30}{360} = 0.00333$$

- **The De-annualized** 120-day rate is:

$$R_{120} = 0.05 \times \frac{120}{360} = 0.01667$$

Solution: Pricing an FRA



$$\text{1x4 FRA} = \frac{1.01667}{1.00333} - 1 = 0.0133$$

Implied forward rate FRA price is stated as an annualized simple rate:

1.33% × 360/90 = 5.32%

Derivatives

Pricing and Valuation of Forward Commitments

Valuing Forward Rate Agreements

KAPLAN SCHWESER

Valuing an FRA

- **Three keys for valuing an FRA**
  1. Value is determined by rate changes

     (e.g., you contracted to borrow at 5.3% and rates increased to 6%).
  2. The **long wins when rates go up.**
  3. Paid in arrears: The impact of rate changes won't be realized until the **end of the borrowing/lending period**.

Example: Valuing an FRA

Taking our original example (1 × 4 FRA) priced at 5.32%, assume the notional principal was $1m.

- 10 days have now passed and LIBOR is now:
  - The 20-day rate is 5.7%
  - The 110-day rate is 5.9%

  What is the value to the long party?

Solution: Valuing an FRA

4-Step Process:

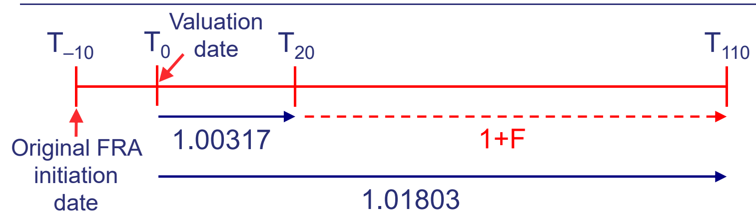
1. De-annualize:

$$R_{20} = 5.7\% \times \frac{20}{360} = 0.317\%$$

$$R_{110} = 5.9\% \times \frac{110}{360} = 1.803\%$$

2. Calculate what the fixed rate would now be on a new FRA [(1 + long) / (1 + short)] – 1.
3. Compare the fixed rate on the original FRA to the fixed rate on a new FRA to compute payoff.
4. Discount the payoff back to today.

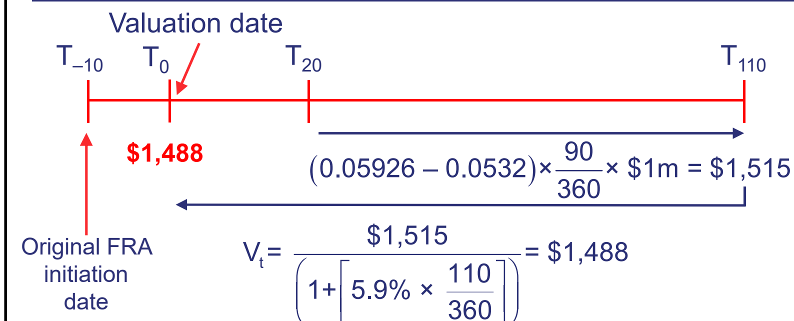
Solution: Valuing an FRA (Step 2)



The fixed rate on a new FRA 10 days later for the same 60-day loan period:

$$= \left(\frac{1.01803}{1.00317} - 1\right) \times \frac{360}{90} = 5.926\%$$

Solution: Valuing an FRA (Steps 3 & 4)



$$(0.05926 - 0.0532) \times \frac{90}{360} \times \$1m = \$1,515$$

$$V_t = \frac{\$1,515}{\left(1 + \left[5.9\% \times \frac{110}{360}\right]\right)} = \$1,488$$

Derivatives

Pricing and Valuation of Forward Commitments

Pricing and Valuation of Currency Contracts

KAPLAN SCHWESER

Pricing Currency Forwards

- **Good news:**
  - Compared with FRAs, currency forwards are easy.
  - In fact, you've already seen currency forwards!
- Currency forwards are priced via **covered interest rate parity**.
- Be sure to understand the quotes, and remember the numerator/denominator rule.

Pricing Currency Forwards

- Recall the covered IRP equation:

$$FP(\text{currency forward contract})$$

$$= S_0 \times \frac{(1+R_P)^T}{(1+R_B)^T}$$

Economics readings use simple rates and 360 days; this reading uses effective and 365 days.

- Note that *FP* and *S* are quoted in Price (P)/Base (B)

Example: Pricing Currency Forwards

Risk-free rates are 6% in the U.S. and 8% in Mexico. The current spot rate is USD/MXN 0.0845. Calculate the 180-day forward rate.

$$FP = 0.0845 \times \frac{(1.06)^{180/365}}{(1.08)^{180/365}} = 0.0837$$

- 180 day rate is USD/MXN 0.0837

Valuing Currency Forwards

- The formula for valuation is **similar to the mark-to-market formula in Economics.**

$$V_t(\text{currency forward contract}) = \left[\frac{(FP_t - FP)(\text{contract size})}{(1+R_P)^{T-t}}\right]$$

Example: Valuing Currency Forwards

David Hastings entered into a 4-month forward contract to buy €10 million at a price of $1.112 per Euro. One month later, the 3-month forward price is $1.109 per Euro. The USD interest rate is 0.30% and the Euro interest rate is 0.40%. Calculate the value of Hastings' forward position.

$$V_t = \left[\frac{(1.109 - 1.112) \times (10{,}000{,}000)}{(1.003)^{0.25}}\right] = \text{-29,978 USD}$$

Derivatives

Pricing and Valuation of Forward Commitments

Pricing and Valuation of Interest Rate Swaps

KAPLAN SCHWESER

Swaps: Pricing vs. Valuation

- Pricing swaps requires the determination of the **swap fixed rate** (or swap rate).
  - The rate paid by the pay-fixed side
- **Principle** (at inception): $PV_{\text{fixed-payments}} = PV_{\text{floating-payments}}$
- **Swap value:** Difference in the value of the fixed payments and floating payments
  - Zero at initiation
  - Usually nonzero after initiation

Discount Factors

Consider a 1-year, quarterly swap. 90-day, 180-day, 270-day, and 360 day LIBORs are 3%, 3.5%, 4%, and 4.5% respectively. Calculate the DF for the 4 settlement dates.

$$DF = \left[\frac{1}{1 + (\text{LIBOR} \times \frac{\text{days}}{360})}\right]$$

Example: Discount Factor

$$DF_{90} = \left[\frac{1}{1 + (0.03 \times \frac{90}{360})}\right] = 0.99256 \qquad DF_{180} = \left[\frac{1}{1 + (0.035 \times \frac{180}{360})}\right] = 0.98280$$

$$DF_{270} = \left[\frac{1}{1 + (0.04 \times \frac{270}{360})}\right] = 0.97087 \qquad DF_{360} = \left[\frac{1}{1 + (0.045 \times \frac{360}{360})}\right] = 0.95694$$

The Swap Fixed Rate

Using the discount factor (DF) corresponding to each settlement date:

$$SFR = \left[\frac{1 - \text{last DF}}{\text{sum of DFs}}\right] \times \begin{array}{l}\text{settlement}\\\text{periods per}\\\text{year}\end{array}$$

Example: Swap Fixed Rate

- Calculate the swap rate and fixed payment on a **1-year, quarterly settlement** swap with notional principal of **$5m.**

Maturity	Annualized Rate	Discount Factor
90-day	3.0%	0.99256
180-day	3.5%	0.98280
270-day	4.0%	0.97087
360-day	4.5%	0.95694

Solution: Swap Fixed Rate

- Applying the formula for SFR,

$$\frac{1-0.95694}{0.99256+0.98280+0.97087+0.95694} \times 4$$

= 0.044 or 4.4%

Solution: Swap Fixed Rate

- The quarterly fixed-rate payment is:

$5,000,000 × (0.044 / 4) = $55,000

Notional principal

Valuing a Payer Swap (Settlement Date Only)

Immediately after settlement:

$$\text{Value}_{(\text{payer})} = \sum \text{DFs} \times \frac{(\text{SFR}_{\text{new}} - \text{SFR}_{\text{old}})}{\#\ \text{settlements/year}} \times \text{NP}$$

Example: Valuing a Swap

- Consider the same swap priced at 4.4%:
  - Assume 180 days have passed.
  - LIBOR curve indicates the new SFR = 3.5%
  - Note that the two remaining settlement dates are now 90 and 180 days away.

Maturity	Annualized Rate	Discount Factor
90-day	3.50%	0.9913
180-day	3.50%	0.9828

Solution: Valuing a Swap

$$\text{Value}_{(\text{payer})} = \sum \text{DFs} \times \frac{(\text{SFR}_{\text{new}} - \text{SFR}_{\text{old}})}{\#\text{settlements}} \times \text{NP}$$

$$\sum \text{DFs} = 0.9913 + 0.9828 = 1.9741$$

$$\text{Value} = 1.9741 \times \frac{(0.035 - 0.044)}{4} \times 5{,}000{,}000$$

$$= -\$22{,}209$$

Note: Rates decreased → fixed payer loses!

Derivatives

Pricing and Valuation of Forward Commitments

Currency Swaps

KAPLAN SCHWESER

Currency Swaps

- The interest rates used to price currency swaps are just the swap rates calculated from each currency's term structure.
- Principal amounts are exchanged at initiation (based on exchange rate at initiation).
- Periodic payments are based on each currency's fixed rate.

Example: Currency Swaps

Assume that the fixed rate on a 1-year quarterly $5m interest rate swap is 4.4%. The comparable set of U.K. rates are:

Maturity	Annualized Rate	Discount Factor
90-day	4.0%	0.99010
180-day	5.0%	0.97561
270-day	6.0%	0.95694
360-day	7.0%	0.93458

Solution: Currency Swaps

The fixed rate on a 1-year quarterly GBP interest swap is calculated as:

$$\frac{1-0.93458}{0.99010+0.97561+0.95694+0.93458} \times 4$$

$$= 0.068 \text{ or } 6.8\%$$

Solution: Currency Swaps

If the current spot rate is GBP/USD 0.50, determine the notional principal GBP amount and the quarterly cash flows on a pay USD fixed, receive GBP fixed currency swap.

Notional GBP: \$5,000,000 × 0.50 = £2,500,000

Solution: Currency Swaps

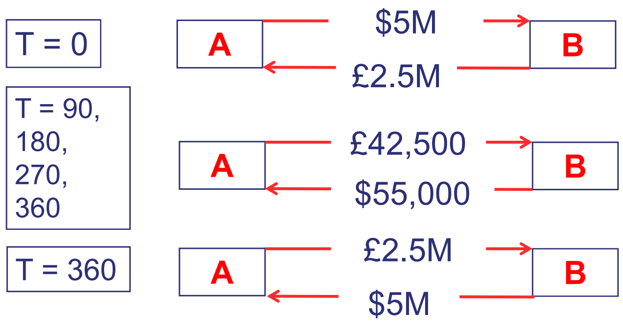
Quarterly GBP fixed payment:

$$= 6.8\% \times \frac{90}{360} \times 2{,}500{,}000$$
$$= \text{GBP } 42{,}500$$

Quarterly USD fixed payment:

$$= 4.4\% \times \frac{90}{360} \times 5{,}000{,}000$$
$$= \text{USD } 55{,}000$$

Solution: Currency Swaps



Currency Swap Valuation

- Using the DFs, one can calculate PV as:
  - PV (cash flows)= $\sum\{DF_i \times \text{cash flow}_i\}$
- Each cash flow corresponds to a settlement date.
- Value of swap = PV (cash inflows) – PV (cash outflows)
- For a currency swap, since cash flows are in different currencies, you must adjust one using the **current** exchange rate.

Example: Valuing a Currency Swap

Continuing with the USD GBP quarterly swap example, after 300 days the 60-day USD rate is 5.4% and the 60-day GBP rate is 6.6%. The exchange rate is now GBP/USD 0.52.

Calculate the value of the $5,000,000 quarterly swap for the USD fixed receiver (GBP fixed payer).

Solution: Valuing a Currency Swap

After 300 days, the remaining cash flows are the final interest payment and principal payments in 60 days. Relevant discount factors are:

$$\text{USD}: DF_{60} = \left[\frac{1}{1 + (0.054 \times \frac{60}{360})}\right] = 0.99108$$

$$\text{GBP}: DF_{60} = \left[\frac{1}{1 + (0.066 \times \frac{60}{360})}\right] = 0.98912$$

Solution: Valuing a Currency Swap

$$\text{Value}_{(\text{USD side})} = 0.99108 \times \$5{,}055{,}000 = \$5{,}009{,}909$$

$$\text{Value}_{(\text{GBP side})} = 0.98912 \times £2{,}542{,}500 = £2{,}514{,}838$$

Solution: Valuing a Currency Swap

Before the values can be netted, they must be converted to the same currency.

$$\text{Value in USD}_{(\text{GBP side})} = \frac{£2{,}514{,}838}{0.52} = \$4{,}836{,}227$$

$$\text{Value}_{(\text{receive \$ side})} = \$5{,}009{,}909 - \$4{,}836{,}227 = \$173{,}682$$

Derivatives

Pricing and Valuation of Forward Commitments

Equity Swaps

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Equity Swaps: Who Pays What?

Equity return payer

- Pays any positive return on equity
- Receives fixed-rate payment plus any negative equity return

Fixed-rate payer

- Pays fixed rate plus negative equity return
- Receives positive equity return

Equity Swaps

Valuation is similar:

- Value = PV (Cash inflows) – PV (cash outflows)
- PV (equity side cash flows)

$$= \frac{\text{current index level}}{\text{index level at last settlement}} \times \text{notional}$$

Example: Equity Swaps

A $10 million principal value equity swap has a fixed quarterly rate of 1.513% and the other side pays the quarterly return on an index. The index is currently trading at 985.

After 30 days have passed, the index stands at 996.

The value of the pay fixed side has been calculated as $0.993993 per $ of notional principal.

Calculate the value of the swap to the fixed-rate payer on day 30.

Solution: Equity Swaps

$$\text{Value}_{(\text{pay fixed})} = 0.993993 \times \$10{,}000{,}000 = \$9{,}939{,}930$$

$$\text{Value}_{(\text{pay equity})} = \$10{,}000{,}000 \times \frac{996}{985} = \$10{,}111{,}675$$

$$\text{Value}_{(\text{to fixed payer})} = \$10{,}111{,}675 - \$9{,}939{,}930 = \$171{,}745$$

Example: Equity for Equity Swaps

An investor is the Stock A return payer (and Stock B return receiver) in a $1 million quarterly-pay swap. After one month, Stock A is up 1.3% and stock B is down 0.8%. Calculate the value of the swap to the investor.

The investor pays the Stock A return and as the return on B is negative, also pays that.

Value = (– 1.3% – 0.8%) × $1,000,000 = – $21,000

Derivatives

Valuation of Contingent Claims

The Binomial Model

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Foundation Concepts

- **Call option**: The right, but not the obligation, to **buy** an asset at a fixed price at some point in the future
- **Put option**: The right, but not the obligation, to **sell** an asset at a fixed price at some point in the future
- **European option**: Can only be exercised at expiration
- **American option**: Can be exercised at any time prior to expiration

The Binomial Model

- In the binomial model, the underlying (e.g. stock price) will increase or decrease in value based on one of two possible values: U (up factor) or D (down factor).
- A binomial tree can be used to model stock price movements, and hence the value of call or put options on that stock.
- The size of, and spread between U and D will impact the option value.

Example: The Binomial Model

The binomial tree is constructed using the following data:

U = size of up-move = 1 + %up = 1.333

D = size of down-move = 1 – % down = 0.75

π_u = probability of up-move $= \dfrac{1+R_f-D}{U-D} = 0.55$

π_D = probability of down-move $= 1-\pi_u = 0.45$

Risk neutral probabilities

$R_f = 7\%$; $S_0 = \$30$

Example: The Binomial Model

- One-period binomial tree for stock price

$S^+ = \$30 \times 1.333 = \$40.00$

Up factor

$S_0 = \$30$

$S^- = \$30 \times 0.75 = \$22.50$

Down factor

Today

1 year

Example: The Binomial Model

- **Why create the tree?:** Given the evolution of the stock price, we can determine the payoff to an option in the two states
- Example (continued):
  - Consider a one-period call option with an exercise price of $30
  - What is the value of the option in each state of the world?

Solution: The Binomial Model

$S^+ = \$30 \times 1.1333 = \$40.00$

$\pi_U = 0.55$

$C^+ = \max(0, \$40.00 - \$30) = \$10.00$

$S_0 = \$30$

$S^- = \$30 \times 0.75 = \$22.50$

$\pi_D = 0.45$

$C^- = \max(0, \$22.50 - \$30) = \$0$

Today

1 year

The Binomial Model (cont.)

- Call value = PV of CFs (discounted at 7%):

$$C_0 = \frac{(\$10.00 \times 0.55) + (\$0 \times 0.45)}{1.07}$$

$$= \frac{\$5.50}{1.07} = \$5.14$$

- **Key intuition:** All binomial models calculate value as the expected outcome discounted back to present value at the appropriate interest rate.

Derivatives

Valuation of Contingent Claims

Put-Call Parity and Two-period Binomial Model

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European Put-Call Parity

- An arbitrage-derived relationship
  - Equates the value of calls, puts, the underlying asset, and a riskless bond
  - Same time to maturity and strike price for both options

$$\underbrace{C_0}_{\text{Call value today}} + \underbrace{PV(X)}_{\text{Present value of exercise price}} = \underbrace{P_0}_{\text{Put value today}} + \underbrace{S_0}_{\text{Stock value today}}$$

Put-Call Parity Other Synthetics

- Synthetic call: $C_0 = P_0 + S_0 - PV(X)$
- Synthetic stock: $S_0 = C_0 - P_0 + PV(X)$
- Synthetic put: $P_0 = C_0 - S_0 + PV(X)$
- Synthetic bond: $PV(X) = P_0 - C_0 + S_0$

Solve the parity equation for any component.

Example: Put-Call Parity

A 1-year call option on the common stock of Cross Reef, Inc. with an exercise price of $60 is trading for $8. The current stock price is $62 and the risk-free rate is 4%. Calculate the price of the put option implied by put-call parity.

Synthetic put: $P_0 = C_0 - S_0 + PV(X)$

$$P_0 = \$8 - \$62 + \frac{\$60}{1.04} = \$3.69$$

Example: The Binomial Model

The binomial tree is constructed using the following data:

U = size of up-move = 1 + % up = 1.333

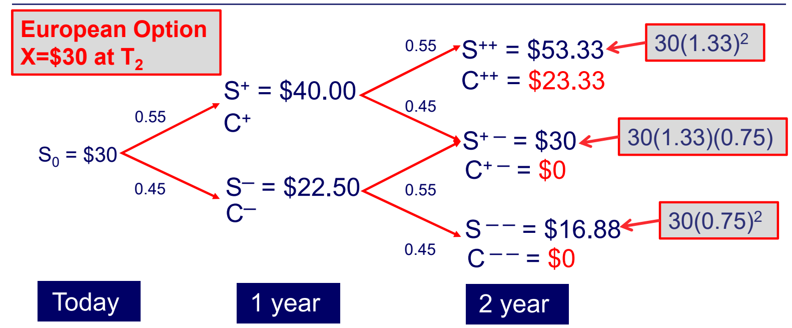
D = size of down-move = 1 − % down = 0.75

$$\pi_u = \text{probability of up-move} = \frac{1 + R_f - D}{U - D} = 0.55$$

π_D = probability of down-move = $1 - \pi_u = 0.45$

$R_f = 7\%$; $S_0 = \$30$

Two-Period Binomial Model



Two-Period Binomial Model (cont.)

$$C^{+} = \frac{(\$23.33 \times 0.55) + 0}{1.07} = \$11.99$$

$$C^{-} = \$0$$

$$C_0 = \frac{(\$11.99 \times 0.55) + 0}{1.07} = \$6.16$$

Derivatives

Valuation of Contingent Claims

American Options

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American Options

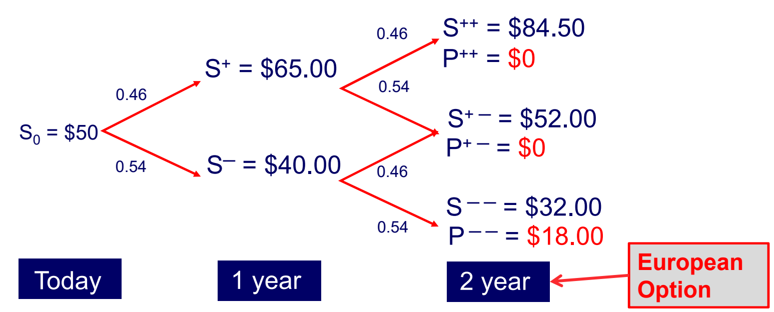
- American call options on non-dividend-paying stocks have same value as European options.
  - Interest on early payoff < time value lost
- Deep-in-the-money American puts may be worth more than corresponding European puts.
  - Interest on early payoff > time value lost
- Binomial tree: At each node, use the intrinsic value or calculated value—whichever is higher.

Example: Early Exercise

A stock is currently trading at \$50 and the periodically compounded interest rate is 3%. Using an up factor of 1.3 and down of 0.8, calculate the value of a two-period **European-style** put option with an exercise price of \$50.

$$\pi_u = \text{probability of up-move} = \frac{1.03 - 0.8}{1.3 - 0.8} = 0.46$$

Solution: Early Exercise

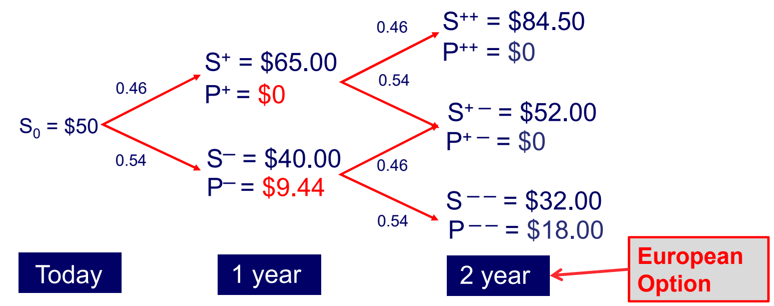


Solution: Early Exercise

$$P^{-} = \frac{(\$0 \times 0.46) + (\$18 \times 0.54)}{1.03} = \$9.44$$

$$P^{+} = \$0$$

Solution: Early Exercise



Solution: Early Exercise

$$P^{-} = \frac{(\$0 \times 0.46) + (\$18 \times 0.54)}{1.03} = \$9.44$$

$$P^{+} = \$0$$

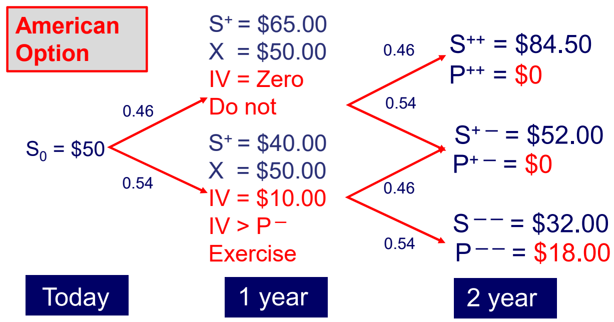
$$P_0 = \frac{(\$0 \times 0.46) + (\$9.44 \times 0.54)}{1.03} = \$4.95$$

Example: Early Exercise

A stock is currently trading at $50 and the periodically compounded interest rate is 3%.

Using an up factor of 1.3 and down of 0.8, calculate the value of a two-period **American-style** put option with an exercise price of $50.

Solution: Early Exercise



Solution: Value with Early Exercise

$$P_0 = \frac{(\$0 \times 0.46) + (\$10.00 \times 0.54)}{1.03} = \$5.24$$

Derivatives

Valuation of Contingent Claims

Hedge Ratio

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The Binomial Model

Continuing our original example:

$S^+ = \$30 \times 1.1333 = \$40.00$

$\pi_U = 0.55$

$C^+ = \max(0, \$40.00 - \$30) = \$10.00$

$S_0 = \$30$

$S^- = \$30 \times 0.75 = \$22.50$

$\pi_D = 0.45$

$C^- = \max(0, \$22.50 - \$30) = \$0$

Today

1 year

Option Valuation Using the Hedge Ratio

$$C_0 = hS_0 + \frac{(-hS^+ + C^+)}{(1+R_f)} = hS_0 + \frac{(-hS^- + C^-)}{(1+R_f)}$$

h is the hedge ratio: $h = \frac{C^+ - C^-}{S^+ - S^-}$

In our example: $h = \frac{10.00 - 0}{40.00 - 22.50} = 0.5714$

$$C_0 = 0.5714 \times 30 + \frac{(-0.5714 \times 40.00 + 10.00)}{(1.07)} = \$5.14$$

Example: Arbitrage Opportunity

- If the call is trading at \$6.50 (too high), write 100 calls and buy 57.14 shares. Net cash outflow → borrow!
- At t = 0: borrow (57.14 × \$30) – (100 x \$6.50) = \$1,064 @ 7%
- At t = 1: stock price is either \$40.00 or \$22.50
  - If S_1 = 40.00, value = (57.14 × \$40.00)–(100 × \$10.00) = \$1,286
  - If S_1 = 22.50, value = (57.14 × \$22.50)–(100 × \$0) = \$1,286
  - Repay loan = 1,064(1.07) = \$1,138
  - Arbitrage profit = \$1,286 – \$1,138 = \$148
  - PV of arbitrage = \$148/1.07 = \$138

Derivatives

Valuation of Contingent Claims

Interest Rate Options

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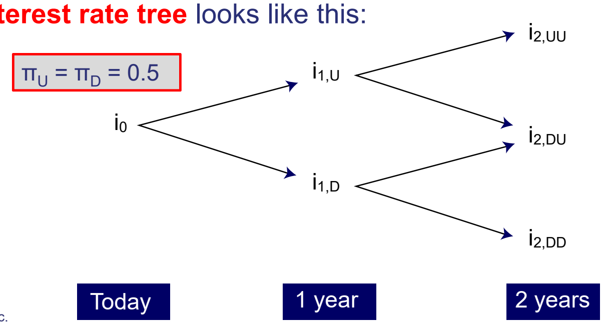
The Binomial Interest Rate Model

- The binomial interest rate model is used to generate an interest rate tree.
- Interest rate trees:
  - Based on assumptions about rate volatility
  - Yield a binomial lattice of possible interest rate paths
- You will not be generating interest rate trees on the exam (but must know how to use one).

The Binomial Interest Rate Model (cont.)

An **interest rate tree** looks like this:



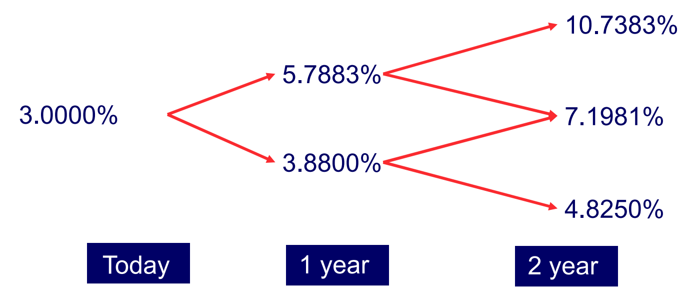
Interest Rate Options

- To calculate the value of an European interest rate option:
  - **Step 1**: Calculate the payoff at option expiry:
    - call payoff = notional principal ×
      [Max (0, reference rate – exercise rate)]
    - put payoff = notional principal ×
      [Max (0, exercise rate – reference rate)]
  - **Step 2**: Calculate expected value of payoffs in each terminal node
  - **Step 3**: Discount expected values back through tree

Example: The Binomial Interest Rate Model

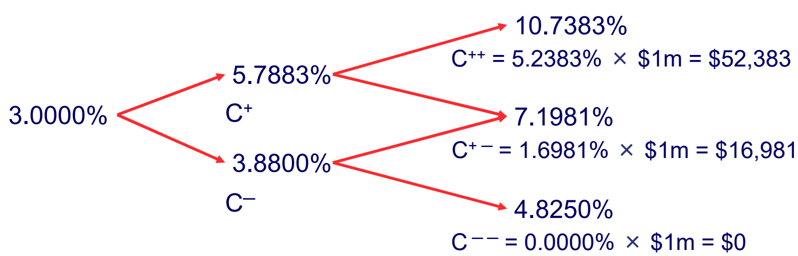
Given the two-period interest rate tree on the following slide, what is the value of a two-period European interest rate call option with an exercise rate of 5.5% and a notional principal of $1 million? (Assume that options settle at time t=2)

Example: The Binomial Interest Rate Model



Solution: The Binomial Interest Rate Model

X = 5.5% **NP = $1m**



Solution: The Binomial Interest Rate Model

$$C^{+} = \frac{(\$52,383 \times 0.50) + (\$16,981 \times 0.50)}{1.057883} = \$32,784$$

$$C^{-} = \frac{(\$16,981 \times 0.50) + (\$0 \times 0.50)}{1.038800} = \$8,173$$

$$C = \frac{(\$32,784 \times 0.50) + (\$8,173 \times 0.50)}{1.03} = \$19,882$$

Equivalencies in Interest Rate Derivatives

- Long FRA = long IR call + Short IR put
- Long cap = series of IR calls, useful for hedging floating rate liabilities
- Long floor = series of IR puts, useful for hedging long floating rate assets
- Long cap + short floor = Payer swap

Derivatives

Valuation of Contingent Claims

BSM and Swaptions

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Black-Scholes-Merton (BSM) Assumptions

- The underlying asset price follows a lognormal distribution; change in price is smooth.
- The (continuous) risk-free rate is constant and known.
- The volatility of the underlying asset is constant and known.
- Markets are “frictionless”
- Continuously compounded dividend yield is constant
- Options are European

BSM Model

Present value of the expected option payoff at expiration

Long stock, Short Bond → $C_0 = \left[S_0 e^{-\delta T} N(d_1)\right] - \left[X e^{-rT} N(d_2)\right]$

Long bond, Short stock → $P_0 = \left[X e^{-rT} N(-d_2)\right] - \left[S_0 e^{-\delta T} N(-d_1)\right]$

$N(d_2) = P(S_T > X)$, a risk-neutral probability

Black-Scholes-Merton Notation

where:

T = time to maturity (as % of 365-day year)

S_0 = asset price

X = exercise price

r, δ = continuously compounded risk-free rate, dividend yield

σ = volatility of underlying stock returns

$N(\bullet)$ = cumulative normal probability

BSM Interpretations

- Calls = leveraged investment in $N(d_1)$ units of stock using $e^{-rT}XN(d_2)$ of borrowed funds
- Puts = investment in $N(-d_2)$ units of bond using $N(d_1)$ short proceeds from stock
- Arbitrage similar to binomial model, using leveraged investment analogies

Example: BSM

Stock of XZ, Inc. is currently trading at \$50. Suppose that the return volatility is 25% and the continuously compounded risk-free rate is 3%. Calls and puts with a strike price of \$45 and expiring in six months are trading at \$7.00 and \$1.00, respectively.

If $N(d_1) = 0.779$ and $N(d_2) = 0.723$, calculate the value of replicating portfolios and any arbitrage profits on both options.

Solution: BSM

Replicating Portfolio: Call

Long 0.779 shares: Cost (0.779 × \$50) = \$38.95

Borrow \$45 × $e^{-0.03(0.5)}$ × (0.723) = \$32.05

Net cost: \$38.95 – \$32.05 = \$6.90

- Market price of the call is \$7.00 (too high)
- Write a call at \$7.00, buy the replicating portfolio for \$6.90 to yield an arbitrage profit of \$0.10 per call

Solution: BSM

Replicating Portfolio: Put

$N(-d_1) = 1 - N(d_1) = 1 - 0.779 = \mathbf{0.221}$

$N(-d_2) = 1 - 0.723 = \mathbf{0.277}$

Long bond \$45 × $e^{-0.03(0.5)}$ × (**0.277**) = \$12.28

Short **0.221** shares: Proceeds (\$50 × 0.221) = \$11.05

Solution: BSM

Replicating Portfolio: Put

Long bond $45 × $e^{-0.03(0.5)}$ × (**0.277**) = $12.28

Short **0.221** shares: Proceeds ($50 × 0.221) = $11.05

Net cost: $12.28 – $11.05 = $1.23

- Market price of the put option is $1.00 (too low)
- Sell the replicating portfolio for $1.23, buying put for $1.00, for an arbitrage profit of $0.23 per put

BSM Model for Currency Options

$$C_0 = \left[S_0 e^{-r(B)T} N(d_1)\right] - \left[X e^{-r(P)T} N(d_2)\right]$$

$$P_0 = \left[X e^{-r(P)T} N(-d_2)\right] - \left[S_0 e^{-r(B)T} N(-d_1)\right]$$

r(B), r(P) = continuously compounded base currency and price currency interest rates respectively

Carry benefit = base currency interest rate

Black Model for Options on Futures

$$C_0 = e^{-rT}\left[F_T N(d_1) - X N(d_2)\right]$$

Nothing new! Just substitute PV of F_T for S_0 in the BSM.

Swaptions

- Receiver swaption gives right to enter into a swap at a fixed rate as a receiver (benefits when rates go down)
- Payer swaption gives right to enter into a swap at a fixed rate as a payer (benefits when rates go up)
- Receiver swap
  = long receiver swaption + short payer swaption
- Long callable bond
  = long option-free bond + short receiver swaption

Derivatives

Valuation of Contingent Claims

Option Greeks and Dynamic Hedging

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The BSM Model and "Greek Risk"

- The BSM formula has five inputs:
  1. S, the asset price (Delta)
  2. σ, volatility (Vega)
  3. R_f, the interest rate (Rho)
  4. T, passage of time (Theta)
  5. X, the exercise price
- Changing an input will change the value of the option (call or put)
- Each sensitivity (except X) is a "Greek"

Key: Know how changing an input affects the option value.

The BSM Model and "Greek Risk" (cont.)

Sensitivity Factor ("Greek")	Input	Calls	Puts
Delta	Asset price (S)	Positively related Delta > 0	Negatively related Delta < 0
Vega	Volatility (σ)	Positively related Vega > 0	Positively related Vega > 0
Rho	Risk-free rate (r)	Positively related Rho > 0	Negatively related Rho < 0

The BSM Model and "Greek Risk" (cont.)

Sensitivity Factor ("Greek")	Input	Calls	Puts
Theta	Time to expiration (T)	Value → \$0 as call → maturity Theta < 0	Value usually → \$0 as put → maturity Theta < 0
	Exercise price (X)	Negatively related	Positively related

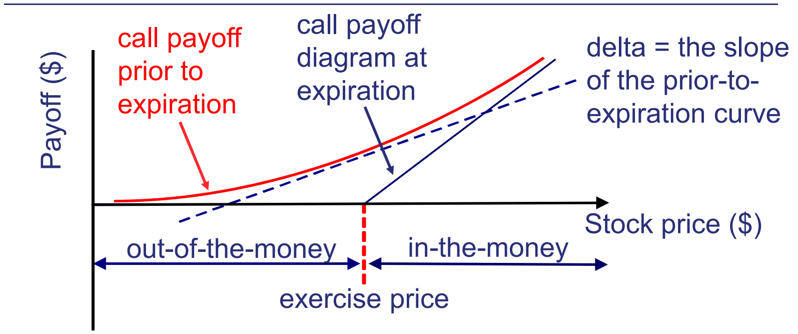
Delta and Dynamic Hedging

- **Delta**: Change in the price of an option for a 1-unit change in the price of the underlying stock

$$\text{Delta}_{call} = e^{-\delta T} N(d_1)$$ ← From BSM

$$\text{Delta}_{put} = -e^{-\delta T} N(-d_1)$$

A Graphical Depiction of Delta



Delta Summary

- Call deltas range from 0 to $e^{-\delta T}$:
  - Far out-of-the-money: Delta approaches 0
  - Far in-the-money: Delta approaches $e^{-\delta T}$
- Put deltas range from $-e^{-\delta T}$ to 0:
  - Far out-of-the-money: Delta approaches 0
  - Far in-the-money: Delta approaches $-e^{-\delta T}$

Example: Delta: Continuous-Time

$e^{-\delta T}N(d_1)$ from the BSM model is 0.58. Calculate the approximate change in the price of a call option on the stock if the stock price increases by $0.75.

Answer:

- $\Delta C \approx 0.58 \times \$0.75 = \$0.435$

Dynamic Hedging

- **Delta-neutral hedge**: Combination of **long stock and short calls** so the portfolio value doesn't change as stock price changes

$$\#\text{ of short calls needed} = \frac{\#\text{ shares hedged}}{\text{delta}_{\text{call}}}$$

Helpful hint: Delta < 1, so always need more calls than shares.

Dynamic Hedging: Example

Suppose you own 60,000 shares of Arthurall Company common stock that is currently selling for $50. A call option on Arthurall with a strike price of $50 is selling for $4 and has a delta of 0.60. Determine the number of call options necessary to create a delta-neutral hedge.

- Calculate the effect on portfolio value of a $1 increase in the price of Arthurall stock.

Dynamic Hedging: Solution

In order to determine the number of call options necessary to hedge against instantaneous movements in Arthurall's stock price, we calculate:

Number of options needed to delta hedge:

$$\#\text{options} = \frac{60{,}000}{0.60} = 100{,}000\text{ options}$$

- Because we are long the stock, we need to short the options.

Dynamic Hedging: Solution (contd.)

If the price of Arthurall stock increased instantly by $1.00, the value of the short call option position would decrease by $0.60. Therefore, the net impact of the price change on the value of the hedged portfolio would be zero:

- total change in value of stock = 60,000 × $1 = +$60,000
- total change in value of option =100,000 × –$0.60 = –$60,000
- total change in portfolio value = $60,000 – $60,000 = $0

Gamma (Another "Greek")

- **Gamma** = rate of change in delta as stock price changes
  - Positive for both calls and puts
  - Largest when option is at-the-money and close to expiration
  - Small for deep in-the-money and deep out-of-the-money options not close to expiration
- **Gamma risk**: when stock price jumps abruptly (a violation of BSM assumption)

Measuring Volatility of Stock Returns

- **Implied volatility** of continuous returns on underlying stock is "σ" from BSM model that makes model value = market price
  - The volatility (σ) "implied" by the option price
- Implied volatility is often used by traders to gauge market perceptions or to quote prices

Implied Volatility

Example: Suppose market price of 3-month 45 Vanilla Inc., call is $7.25.

Volatility Input	Value from BSM
25%	$6.11
30%	$6.44
35%	$6.79
40%	$7.17
45%	$7.59

Implied volatility is between 40% and 45%.

Example: Implied Volatility

Calls on Blue stock are currently trading at an implied volatility of 22%. A trader estimates that the future volatility will actually be closer to 25%. To capitalize on her beliefs, the trader should

A. change her model.

B. buy calls on Blue stock.

C. write calls on Blue stock.

Solution: Implied Volatility

Answer:

B. Based on the trader's beliefs, call options on Blue stock are underpriced in the market. Accordingly, she should buy the calls.

Keys to the Exam: Options Markets and Contracts

- Models: Binomial and BSM
- Put-call parity
- Interest rate options and equivalencies
- Greeks: Delta, gamma, vega
- Dynamic hedging

Alternative Investments

Private Real Estate Investments

Introduction and Commercial Property Types

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Basic Forms of Real Estate Investment

- Four basic forms:
  - **Private:** Direct investment, larger investments
  - **Public:** Pooled ownership of real estate assets, smaller investments (REITs and REOCs)
  - **Equity:** Control (leverage, management, exit strategy)
  - **Debt:** Mortgage lender or MBS investor

Real Estate Characteristics

- Heterogeneous asset type
- High unit value
- Active management
- High transaction costs
- Depreciation
- Values impacted by cost and availability of debt finance
- Illiquid
- Valuation subjectivity

REITs developed to overcome some of the problems of direct investment

Property Classifications

- Residential: Owner-occupied and multi-family properties (apartments)
- Ownership for income potential = commercial real estate property
- Nonresidential: Commercial properties other than multi-family properties, farmland, and timberland
- Commercial property: Classified by end user, more than one end user = mixed-use development

Commercial Property Types

- Office (single or multi-tenant)
- Industrial and warehouse (light and heavy manufacturing)
- Retail (shopping centers to small stores)
- Hospitality (hotels, motels, conference)
- Others: Restaurant, parking, recreational, etc.

Each have unique supply, demand, and intensity of property management.

Reasons to Invest in Real Estate

- Current income: Rents less operating expenses, finance costs, and taxes
- Capital appreciation
- Inflation hedge: Rents may rise with inflation
- Tax benefits in some countries
- Diversification: Not strongly correlated with other asset types

Risk Factors

1. Business conditions: Rents and property values dependent on national and local economic variables (GDP, inflation, interest rates, etc.)
2. New property lead time
3. Cost and availability of capital
4. Unexpected inflation (especially mortgage investors)
5. Demographics
6. Illiquidity

Risk Factors

7. Environment
8. Availability of information
9. Management: Asset management and property management
10. Leverage [loan-to-value (LTV), NOI/Interest, NOI/Total Debt Service]
11. Other risks: Unidentified risks

Role of Real Estate in a Portfolio

Both bond and stock characteristics

Leases: Contractual periodic fixed payments

At end of lease, uncertainty over renewal and future rental rates

Affected by competitors, tenant profitability, state of economy

Overall, risk, return profile falls between debt and equity

Commercial Property Types

- Location, location, location

1. Office:
   - Job growth
   - Space per employee/job flexibility: Home working
   - Lease length (variable internationally) in United States is 3–5 years, in United Kingdom is 10 years

Commercial Property Types

- Gross lease = owner incurs operating expenses
- Net lease = tenant
- Hybrid = pass through expense reimbursement
- Rent review frequency

Commercial Property Types

- Location, location, location

2. Industrial and warehouse:
   - Strength of economy and GDP growth
   - Import and export activity
   - Majority = net leases

Commercial Property Types

3. Retail:
   - Consumer spending: GDP growth, job growth, population, savings rates, etc.
   - Quality of property, size, and importance of tenant
   - *Percentage leases* common

Commercial Property Types

- Location, location, location

4. Multi-family:
   - Population growth
   - Age demographics of renters
   - Home ownership rates vary internationally

Commercial Property Types

- Ratio of home price to rental
- Interest rates affect home ownership
- Owner normally responsible for upkeep

Alternative Investments

Private Real Estate Investments

Valuation Approaches,
Direct Capitalization and NOI

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Real Estate Appraisals

Estimates of value:

- Market value = probable sales price
- Investment value = value given investor's motivations
- Value in use = value as part of a business
- Assessed value = tax authority's value
- Mortgage lending value = collateral value for loans

Valuation Approaches

1. Cost approach:
   - Cost of land purchase and comparable building construction less depreciation
   - Depreciation is difficult to measure (more useful for new property)
   - Maximum potential value

Valuation Approaches

2. Sales comparison:

   Sales prices of comparable properties adjusted for differences

Valuation Approaches

3. Income approach:
   - NPV approach
   - PV of future income discounted at investor's required return
   - Require property to generate income (i.e., commercial real estate transactions)

Valuation Approaches

4. Highest and best use

   Use of a vacant site that results in highest implied land value

Income Approach – Direct Capitalization

- Capitalization of year 1 NOI using capitalization rate

	$
Rental income if fully occupied	X
+ Other income	X
= Potential gross income	X
– Vacancy and collection loss	(X)
= Effective gross income	X
– Operating expense	(X)
= Net Operating Income (NOI)	X

Example: Net Operating Income NOI

Compute NOI using the following information:

- Property type: Office building
- Gross rental income = €25 per square foot
- Property size = 200,000 square feet
- Other income = €75,000

Example: Net Operating Income NOI

- Vacancy and collection loss = 5% of potential gross income
- Utilities and maintenance = €875,000 per year
- Property taxes and insurance = €350,000 per year
- Interest = €400,000 per year
- Income tax rate 40%

Solution: Net Operating Income NOI

	€
Rental income if fully occupied	5,000,000
+ Other income	75,000
= Potential gross income	**5,075,000**
– Vacancy and collection loss (@ 5%)	(253,750)
= Effective gross income	**4,821,250**
– Operating expenses	(1,225,000)
= Net Operating Income (NOI)	**3,596,250**

Note: Income tax and interest expense are not operating expenses

Alternative Investments

Private Real Estate Investments

Valuation using Stabilized NOI, Multipliers, DCF

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Direct Capitalization Method

The direct capitalization method calculates the PV of NOI using a Cap rate.

- Discount rate = **(r)**
- Growth rate in NOI = **(g)**
- Cap rate = **R_0 = (r – g)**

$$\text{Value} = \frac{NOI_1}{R}$$

Stabilized NOI if year 1 NOI is not representative: renovations, etc.

Initial cap rate, known as the "going-in cap rate."

Direct Capitalization Method

- Comparable properties may be used to calculate the going-in cap rate.

$$R = \frac{NOI_1}{\text{Comparable Property Sale Price}}$$

- When the tenant pays all expenses, value is calculated as:

$$\text{Value} = \frac{\text{Rent}_1}{\text{ARY}}$$

All Risk Yield

Example: Stabilized NOI

On January 1, renovations on a shopping center commenced. This year's NOI is forecast at $6m. In the absence of renovations, NOI was expected to be $10.0m. NOI is expected to grow at 4%.

Renovations will be completed at the seller's expense. Estimate the value of the apartment, assuming investors require a 12% return.

Solution: Stabilized NOI

$$\text{Value} = \frac{\text{Stabilized NOI}_1}{\text{Cap Rate}} = \frac{\$10{,}000{,}000}{(0.12 - 0.04)} = \$125{,}000{,}000$$

PV of temporary decline in NOI (assuming NOI arises at the end of the period):

N = 1, I/Y = 12, PMT = 0, FV = $4,000,000

CPT PV = $3,571,429

Solution: Stabilized NOI

Value of apartments post renovation:

Value	$125,000,000
Loss in value during renovation	($3,571,429)
Total value	$121,428,571

Gross Income Multiplier Technique

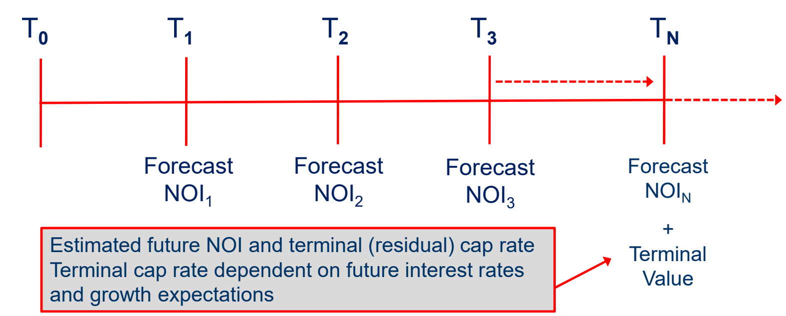
- **Calculate market value (MV)**

  MV = gross income × income multiplier (M)

$$\text{Gross Income Multiplier (M)} = \frac{\text{Sales Price}}{\text{Gross Income}}$$

- Determine gross income multiplier (M) from comparable properties

Discounted Cash Flow Method



Example: Valuation with Terminal Value

Because of existing leases, the NOI of a warehouse is expected to be $1 million per year over the next four years. Beginning in the fifth year, NOI is expected to increase to $1.2 million and grow at 3% annually thereafter.

Assuming investors require a 13% return, calculate the value of the property today, assuming the warehouse is sold after four years.

Solution: Valuation With Terminal Value

T_0	T_1	T_2	T_3	T_4
	$1.0m	$1.0m	$1.0m	$1.0m

$$TV = \frac{\$1.2m}{(0.13 - 0.03)} = \$12.0m$$

N = 4, PMT = $1m, I/Y = 13, FV = $12m, CPT PV = $10.33m

Total value $10.33m

Different Lease Structures

United Kingdom:

- Net leases common (tenant pays expenses)
- Cap rate = ARY
- Longer length than United States (United Kingdom is 10 years, United States is 3–5 years)
- Common: Rent reviews. Open market rent adjusted up to current market rent (reversionary potential).

Solution: Appraise rental period and reversion separately.

Example: Term and Reversion

A single-tenant office building was leased six years ago at £200,000 per year. The next rent review occurs in two years. The estimated rental value (ERV) in two years based on current market conditions is £300,000 per year.

The all risk yield (cap rate) for comparable fully let properties is 7%. Because of lower risk, the appropriate rate to discount the term rent is 6%. Estimate the value of the office building.

Solution: Term and Reversion Valuation

T_0	T_1	T_2	T_3
	£200,000	£200,000	£300,000

$$\text{ERV} = \frac{£300{,}000}{0.07}$$

$$\text{PV} = \frac{£4.28\text{m}}{1.07^2}$$

PV term rent (at 6%)	£0.37m
PV reversion to ERV	£3.74m
Total value	£4.11m

Example: Layer Approach

A single-tenant office building was leased six years ago at £200,000 per year. The next rent review occurs in two years. The estimated rental value (ERV) in two years based on current market conditions is £300,000 per year.

The all-risk yield (cap rate) for comparable fully let properties is 8%. Because of lower risk, the appropriate rate to discount the term rent is 7%. Estimate the value of the office building.

Solution: Layer Approach

T_0	T_1	T_2	T_3	T_4
	£200,000	£200,000	£200,000	£200,000…

$$\text{PV} = \frac{£200{,}000}{0.07}$$

= £2.86m

Treat term rent as a perpetuity

Solution: Layer Approach

T_0	T_1	T_2	T_3	T_4
			£100,000	£100,000…

$$\text{PV} = \frac{£1.25\text{m}}{1.08^2} \leftarrow £1.25\text{m} = \frac{£100{,}000}{0.08}$$

= £1.07m

Treat increase as a perpetuity starting at T_3

Total value =£2.86m + £1.07m = £3.93m

DCF Assumptions

1. Project income from existing leases (start, end dates, base rent, index adjustments, tenant expense reimbursement)
2. Lease renewal assumptions (probability based)
3. Operating expense assumptions (fixed and variable)
4. Capex assumptions (uneven cash flows vs. average capex)

DCF vs. Income Valuation

- DCF: Forecasts NOI, future capex, and terminal value
- Direct capitalization: Uses year 1 NOI
- DCF: Dependent on appropriate discount rate and terminal cap rate
- Direct capitalization: Cap rate from comparable transactions

DCF Assumptions

1. Vacancy assumptions
2. Estimated resale value/rent review
3. Appropriate discount rate (> mortgage rate)

DCF Common Errors

- Discount rate fails to capture risk
- Income growth exceeds expense growth
- Terminal cap rate and going-in cap rate inconsistent
- Terminal cap rate applied to atypical NOI
- Cyclicality of real estate markets ignored

Note: Rather than having two discount rates for term rent and terminal value a single discount rate/IRR (equivalent yield) can be calculated to give the same PV.

Alternative Investments

Private Real Estate Investments

Valuation using Cost Approach
and Sales Comparison

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Cost Approach

Land cost + construction cost – economic depreciation

- Land cost: Sales comparison approach often used
- Construction cost: Replacement cost = modern materials/methods; Reproduction cost = original materials/methods; Replacement cost is the norm
- Economic depreciation: Physical deterioration (curable and incurable items)
  - Functional obsolescence
  - Locational obsolescence
  - Economic obsolescence

Example: Cost Approach

Heavenly Towers is a 200,000-square-foot high-rise apartment building located in the downtown area. The building has an effective age of 10 years, while its total economic life is estimated at 40 years. The building has a structural problem that is not feasible to repair. The building also needs a new roof at a cost of €1,000,000. The new roof will increase the value of the building by €1,300,000.

The bedrooms in each apartment are too small and the floor plans are awkward. As a result of the poor design, rents are €400,000 per year lower than competing properties.

Example: Cost Approach

When Heavenly Towers was originally built, it was located across the street from a park. Five years ago, the city converted the park to a sewage treatment plant. The negative impact on rents is estimated at €600,000 per year. Due to recent construction of competing properties, vacancy rates have increased significantly resulting in an estimated loss in value of €1,200,000.

The cost to replace Heavenly Towers is estimated at €400 per square foot plus builder profit of €5,000,000. The market value of the land is estimated at €20,000,000. An appropriate cap rate is 8%. Using the cost approach, estimate Heavenly Towers's value.

Solution: Cost Approach

Replacement cost including builder profit [(200,000 SF × €400 per SF) + 5,000,000]	85,000,000
Curable physical deterioration – new roof	(1,000,000)
Replacement cost after curable physical deterioration	€84,000,000

Solution: Cost Approach

Replacement cost after curable physical deterioration	**€84,000,000**
Incurable physical deterioration – structural problem [(10-year effective age / 40 year life) × 84,000,000]	(21,000,000)
Incurable functional obsolescence – poor design [400,000 lower rent / 8% cap rate]	(5,000,000)
Locational obsolescence – sewage plant [600,000 lower rent / 8% cap rate]	(7,500,000)
Economic obsolescence – competing properties	(1,200,000)
Market value of land	20,000,000
Estimated value using the cost approach	**€69,300,000**

Sales Comparison Approach

- Buyer’s max = price of similar property
- Issue = heterogeneous asset type
- Solution = adjust for differences

Sales Comparison Approach

- Differences include:
  - Location
  - Size
  - Features
  - Age
  - Condition
  - Market conditions at time of sale

Example: Sales Comparison Approach

An appraiser has been asked to estimate the value of a warehouse and has collected the following information:

		Comparable Transactions		
Unit of Comparison	Subject Property	1	2	3
Size, in square feet	30,000	40,000	20,000	35,000
Age, in years	5	9	4	5
Physical condition	Average	Good	Average	Poor
Location	Prime	Prime	Secondary	Prime
Sale date, months ago		6	18	12
Sales price		$9,000,000	$4,500,000	$8,000,000

Example: Sales Comparison Approach

- Properties depreciate at 2% per annum.
- *Condition adjustment*: Good: +5%, average: none; poor: –5%
- *Location adjustment*: Prime—none, secondary—10%
- Over the past 24 months, sales prices have been appreciating 0.5% per month.

Solution: Sales Comparison Approach

		Comparable Transactions		
Adjustments	Subject Property	1	2	3
Sales price		$9,000,000	$4,500,000	$8,000,000
Age		+$720,000	-$90,000	-
Condition		-$450,000	-	+$400,000
Location		-	+$450,000	-
Sale Date		+$270,000	+$405,000	+$480,000
Adjusted Sales Price		$9,540,000	$5,265,000	$8,880,000

Solution: Sales Comparison Approach

		Comparable Transactions		
Adjustments	Subject Property	1	2	3
Adjusted Sales Price		$9,540,000	$5,265,000	$8,880,000
Size, in square feet	30,000	40,000	20,000	35,000
Adjusted Price per Sq F		$238.50	$263.25	$253.71
Average Sales Price per Sq F	$251.82			
Estimated Value	$7,554,600			

Alternative Investments

Private Real Estate Investments

Due Diligence, Indices and Ratios

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Due Diligence

Includes:

- Lease review and rental history
- Confirmation of operating expenses
- Review of cash flow statements
- Environmental reports
- Physical/engineering inspections

Due Diligence

- Inspection of title/legal documentation
- Survey
- Check compliance with local law/codes/regulation
- Verify payments: Tax, insurance, etc.

Private Real Estate Indexes

NCREIF Property Index (NPI):
Fund manager data quarterly
Value weighted-average of property returns
Appraisal lags

$$\text{Capital Return} = \frac{\Delta \text{ mkt value} - \text{capex}}{\text{beg mkt value}}$$

$$\boxed{\text{Return} = \frac{\text{NOI} - \text{capex} + (\text{end mkt value} - \text{beg mkt value})}{\text{Beginning market value}}}$$

Holding Period Return

$$\frac{\text{NOI}}{\text{beg mkt value}} = \begin{array}{l}\text{Current yield}\\ \text{Income yield}\\ \text{Cap rate}\end{array}$$

Transaction Based Indices

- Repeat-sales index:
  - Multiple sales of the same property
  - Needs at least two sales
  - Regression allocates change in value per quarter
- Hedonic index:
  - Regression based of value based on constituent characteristics (location, size, use, age, etc.)

Financial Ratios

- Ratios that influence maximum loan amount:

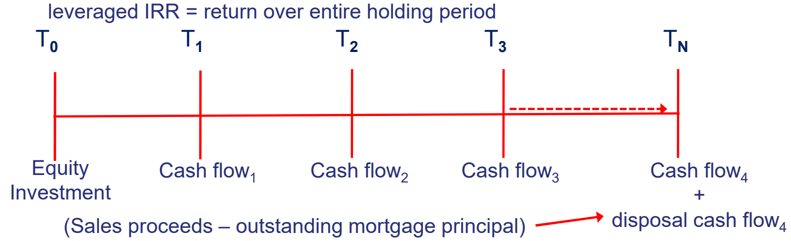
$$\text{DSCR} = \frac{\text{first-year NOI}}{\text{debt service}} \qquad \text{LTV} = \frac{\text{loan amount}}{\text{appraisal value}}$$

- Equity investors' return: NOI – debt service

$$\begin{array}{l}\text{equity dividend rate} = \\ \text{(cash-on-cash return)}\end{array} \frac{\text{first year's cash flow}}{\text{equity}}$$

Financial Ratios

- Equity investor's return:
  equity dividend rate = single period return
  leveraged IRR = return over entire holding period



Example: Financial Ratios

A real estate lender agreed to make a 10% interest-only loan on a property that was recently appraised at €1,200,000 as long as the debt service coverage ratio is at least 1.5 and the loan-to-value ratio does not exceed 80%.

Calculate the maximum loan amount and equity dividend rate assuming the property's NOI is €135,000. Assuming zero NOI growth calculate the unleveraged and leveraged IRR if the property is sold for €1,500,000 at the end of six years.

Solution: Maximum Loan

Max loan using LTV = 80% $\times$ 1,200,000 = €960,000

Max debt service using DSCR = $\frac{135{,}000}{1.5}$ = €90,000

Max loan (10% interest only) = $\frac{90{,}000}{0.10}$ = €900,000

Max loan (lower) = €900,000

Solution: Equity Dividend Rate

Year 1 CF = 135,000 – 90,000 = €45,000

Equity = 1,200,000 – 900,000 = €300,000

Equity Dividend Rate = $\frac{45{,}000}{300{,}000}$ = 15%

Solution: Unleveraged IRR

Equity			NOI			Sale
T_0	T_1	T_2	T_3	T_4	T_5	T_6
(€1,200,000)	€135,000	€135,000	€135,000	€135,000	€135,000	€135,000 €1,500,000

PV = -1,200,000 **PMT = 135,000 N = 6** **FV = 1,500,000**

CPT I/Y = 14.2%

Solution: Leveraged IRR

Equity			NOI – Debt Service			Sale – loan repayment
T_0	T_1	T_2	T_3	T_4	T_5	T_6
(€300,000)	€45,000	€45,000	€45,000	€45,000	€45,000	€45,000 €600,000

PV = -300,000 **PMT = 45,000 N = 6** **FV = 600,000**

CPT I/Y = 24.1%

Alternative Investments

Publicly Traded Real Estate Securities

Introduction to REOCs and REITs, Structures, Types

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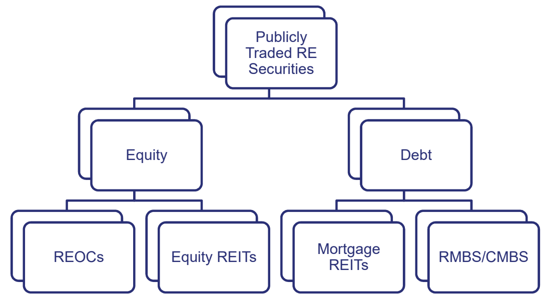
Types of Publicly Traded Real Estate Securities



Types of Publicly Traded Real Estate Securities

1. Real Estate Investment Trusts (REITs)

- Tax-advantaged companies (trusts)
- Exempt from corporate income tax
  - **Equity REITs** own and manage income-producing real estate
  - **Mortgage REITs** make loans that use real estate as collateral

Types of Publicly Traded Real Estate Securities

2. Real Estate Operating Companies (REOCs)

- Ordinary companies that own real estate
- **Not** tax-advantaged
- Ineligible to organize as REITs because:
  - May intend to develop and sell real estate rather than generating passive rental income
  - May be based in a country that simply does not allow tax-advantaged REITs

Advantages of Publicly Traded Real Estate Securities

REIT and REOC benefits vs. private real estate:

- **Superior liquidity:** Trade on a stock exchange
- **Lower minimum investment:** $, not $millions
- **Limited liability:** Limited to amount invested

Advantages of Publicly Traded Real Estate Securities

- **Access to premium properties:** Landmarks, etc.
- **Active professional management:** No skill required
- **Protections:** Publicly traded securities
- **Diversification:** Single property too expensive

Advantages of Investing in Real Estate Through Publicly Traded Securities

REIT-specific advantages (don't apply to REOC):

- **Exemption from taxation**
  - As long as certain requirements are met
- **Earnings predictability**
  - Consistent; rental income is fixed by contracts
- **High yield**
  - Most income is paid out → high, stable yields

Disadvantages of Investing in Real Estate Through Publicly Traded Securities

- **Taxes vs. owning direct:** Loss not deductible
- **Lack of control:** Regarding investment decisions
- **Cost of publicly traded corporate structure**
- **Priced by stock market:** Volatile price

Disadvantages of Investing in Real Estate Through Publicly Traded Securities

- **Structural conflicts of interest:** GP vs. shareholder
- **Limited potential for income growth**
- **Forced equity issuance** at a low price
- **Lack flexibility:** Investments, retaining income

REIT Shares

Economic Value Determinants of REIT shares:

	Population Growth	Job Creation	New Space Supply vs. Demand	Retail Sales Growth
Shopping/Retail	3	2	3	1
Office	3	1	2	4
Residential	1	1	3	4
Healthcare	1	3	2	4
Industrial	2	4	3	1
Hotel	3	1	2	4
Storage	1	2	3	4

Note: 1 = most important, 4 = least important

Adapted from: Exhibit 6, Level II 2013 Volume 5, Alternative Asset Valuation and Fixed Income. John Wiley & Sons (P&T), p. 92.

REIT Shares

Investment characteristics of REITs include:

- **Exemption from corporate-level income tax**
  - In exchange for distributing taxable income
- **High dividend yield**
  - Because of REITs' high income payout ratio

REIT Shares

- **Low income volatility**
  - REIT income comes from interest and rent
- **Secondary equity offerings**
  - Requirement to distribute most earnings means REITs issue equity more frequently

Due Diligence of REIT Shares

- **Remaining lease terms:** Short remaining lease → can raise rents in a good economy
- **Inflation protection** (i.e., leases have scheduled rent increases, or rents are indexed to inflation)
- **In-place rents vs. market rents:** Low in-place rent → opportunity to raise rent as leases expire
- **Costs to re-lease space** (e.g., lost rent, lease incentives, improvements, broker commissions)

Due Diligence of REIT Shares

- **Tenant concentration in the portfolio:** Those that are a high % of space rented or rent paid
- **Tenants' financial health:** The failure of its largest renters poses significant risk to a REIT
- **New supply vs. demand:** Assess the impact of buildings planned by rival developers

Due Diligence of REIT Shares

- **Balance sheet analysis:** Focus on the amount of leverage, the cost of debt, and debt's maturity
- **Quality of management:** Senior management's performance record, qualifications, and tenure

REIT Structures

Traditional REIT:

- REIT holds and operates properties directly

UPREIT: "**U**mbrella **P**artnership"

- REIT holds controlling interest in partnership
- REIT acquires properties with tax-efficiency
- Most common structure in the United States

REIT Structures

DOWNREIT: Like an UPREIT, but:

- REIT has ownership of >1 partnership
- REIT can own properties both at the partnership level and at the REIT level

Types of REITs

Several subtypes of equity REITs:

- **Retail or shopping center REITs:** Malls, etc.
- **Office:** Buildings for multiple business tenants
- **Industrial:** Manufacturing, warehouses, etc.
- **Multi-family/residential:** Rental apartments

Types of REITs

- **Storage REITs:** Lockers or mini-warehouses
- **Healthcare:** Leases to hospitals, nursing home
- **Hotel:** Leases to hotel management companies
- **Diversified:** Own multiple categories of REIT

Alternative Investments

Publicly Traded Real Estate Securities

REIT Valuation NAVPS

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Approaches to REIT valuation

1. **Net asset value**
   - Value of REIT assets to a private market buyer
2. **Price-to-funds from operations (P/FFO)**
   - Most common multiple used to analyze REITs
3. **Price-to-adjusted FFO (P/AFFO)**
   - AFFO is a better measure of economic income
4. **Discounted cash flow**
   - Applied in the same way as in other industries

NAVPS in REIT Valuation

NAVPS vs. BVPS:

Book value per share (BVPS)

- Based on reported accounting values
- Assets are carried at depreciated historical cost
- Often a poor representation of economic value

NAVPS in REIT Valuation

Net asset value per share (NAVPS)

- Based on assets’ market values
- NAVPS = REIT assets minus liabilities (per share)
- Better measure of fundamental value that BVPS
- Real estate can be valued by capitalizing NOI after adjusting for non-cash rent

NAVPS in REIT Valuation

Estimating NAVPS Based on Forecasted NOI

- First calculate the market required rate of return (cap rate), based on recent transactions:

$$\text{capitalization rate} = \frac{\text{net operating income}}{\text{property value}}$$

- Then capitalize the REIT's rental stream:

$$\text{property value} = \frac{\text{net operating income}}{\text{capitalization rate}}$$

Example: NAVPS in REIT Valuation

Vinny Cestone, CFA, is undertaking a valuation of the Anyco Shopping Center REIT, Inc. Given the following financial data for Anyco, estimate NAVPS based on forecasted cash net operating income.

Estimate of next 12 months growth in NOI	1.25%
Cap rate based on recent comparable transactions	8.0%
Shares outstanding	15

Example: NAVPS in REIT Valuation

Anyco Shopping Center REIT, Inc.	**($m)**
Last 12-months NOI	$80
Cash and equivalents	$20
Accounts receivable	$15
Total debt	$250
Other liabilities	$50
Non-cash rents	$2
Full-year adjustment for acquisitions	$1
Land held for future development	$10
Prepaid/Other assets (excluding intangibles)	$5

Solution: NAVPS in REIT Valuation

	($m)	
Last 12 months NOI	**$80**	
Non-cash rents	($2)	
Full-year adjustment for acquisitions	$1	
Pro forma cash NOI for last 12 months	**$79**	
Next 12 months growth in NOI (@1.25%/yr)	$1	79 × 1.0125
Estimated next 12 months cash NOI	**$80**	
Cap rate	8.0%	
Estimated value of operating real estate	**$1,000**	$\frac{\$80}{0.08}$

Solution: NAVPS in REIT Valuation

	($m)
Estimated value of operating real estate	**$1,000**
Cash and equivalents	$20
Land held for future development	$10
Accounts receivable	$15
Prepaid/other assets (excluding intangibles)	$5
Estimated gross asset value	**$1,050**

Solution: NAVPS in REIT Valuation

	($m)
Estimated gross asset value	**$1,050**
Total debt	$250
Other liabilities	$50
Net asset value	**$750**
Shares outstanding	15
Net asset value per share	**$50.00**

Alternative Investments

Publicly Traded Real Estate Securities

REIT Valuation FFO / AFFO, DCF

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Calculating FFO and AFFO

Adjustments to reported financial statements:

Accounting net earnings
+ Depreciation expense
+ Deferred tax charges (i.e., deferred tax expenses)
− Gains (losses) from sales of property and debt restructuring
= **Funds from operations**

↓

FFO (funds from operations)
− Noncash (straight-line) rent adjustment
− Recurring maintenance-type capex and leasing commissions
= **AFFO (adjusted funds from operations)**

Example: Calculating FFO and AFFO

Lucinda Crabtree, CFA, is an asset manager that is interested in diversifying the portfolio she manages through an investment in an office building REIT.

Crabtree wants to value the potential investment using the following approaches as of the end of 2013:

Approach 1: Price-to-FFO

Approach 2: Price-to-AFFO

Example: Calculating FFO and AFFO

Estimated 12 months cash net operating income (NOI)	$80
Last year's actual funds from operations (FFO)	$70
Non-cash rents	$5
Recurring maintenance-type capital expenditures	$15
Shares outstanding	10 million shares
Office subsector average P/FFO multiple	10×
Office subsector average P/AFFO multiple	14×

Solution: Calculating FFO and AFFO

Funds From Operations

Funds from operations (FFO)	$70
Shares outstanding (millions)	10
FFO / share = $70 million / 10 million shares	$7.00

Applying the office subsector average P/FFO multiple of 10× yields a value per share of:

$7.00 × 10 = $70.00

Solution: Calculating FFO and AFFO

Adjusted Funds From Operations

Funds from operations (FFO)	$70
Subtract: non-cash rents	($5)
Subtract: recurring maintenance-type capital expenditures	($15)
AFFO	**$50**
Shares outstanding (million)	10
AFFO / share = $50 million / 10 million shares	**$5**

Solution: Calculating FFO and AFFO

Adjusted Funds From Operations

AFFO / share = $50 million / 10 million shares	**$5**
Property subsector average P/AFFO multiple	14×

Applying the office subsector average P/AFFO multiple of 14× yields a value per share of:

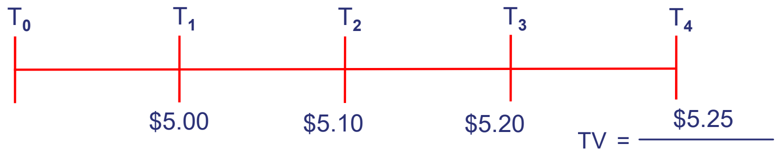
$5 × 14 = $70

Example: Discounted Cash Flow

Lucinda Crabtree, CFA, is an asset manager that is interested in diversifying the portfolio she manages through an investment in an office building REIT.
Crabtree wants to value the potential investment using a DCF approach and the following information as at the end of 2013:

Expected annual dividend next year (2014)	$5.00
Dividend growth rate in 2015 and 2016	2%
Dividend growth rate (from 2017 into perpetuity)	1%
Required return on equity	9%

Solution: Discounted Cash Flow



$$TV = \frac{\$5.25}{(0.09 - 0.01)}$$

$$PV = \frac{\$65.63}{1.09^3}$$

PV forecast Dividends	$12.90
PV of terminal value	$50.68
Total value	$63.58m

Alternative Investments

Private Equity Valuation

Valuation Issues

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Possible Sources of Value Creation in Private Equity

- **Reengineer firm** for more efficient operations—bring expertise
- Obtain **lower cost debt financing** via access to cheap credit and few covenants
- Parallel **goal alignment** between management and private equity owners

Alignment of Economic Interests

- Managers focus on long-term performance over short-term (publicly traded firms)
- Mechanisms to align interests of private equity firm and portfolio company managers specified in term sheet
- Examples of control mechanisms specified in term sheet:
  - Compensation: Closely linked to performance and promote goal achievement
  - Tag along clause: Management has exit rights if PE firm sells its stake

Valuation Characteristics of Venture Capital Investments

- Cash flow: Unpredictable
- Product: Uncertain future based on new technology
- Asset base: Weak
- Management team: Strong entrepreneurial record
- Leverage: Little debt, mostly equity
- Risk assessment: Difficult to measure

Valuation Characteristics of Venture Capital Investments

- Exit strategy: Unpredictable (IPO or firm sale)
- Operations: High cash burn rate
- Capital required in growth phase
- Returns from few highly successful investments with write-offs from many failures

Valuation Characteristics of Venture Capital Investments

- Not active in public capital markets
- Future funding: Less scalable
- Carried interest most common, no transaction and monitoring fees

Valuation Characteristics of Buyout Investments

- Cash flow: Stable and predictable
- Established products
- Substantial asset base
- Experienced management team
- Highly levered with senior debt
- Risk can be assessed from mature operations

Valuation Characteristics of Buyout Investments

- Exit strategy is predictable
- Reduction in operational inefficiencies
- Low working capital requirements
- Low variability in success, rare failures
- Active in public capital markets
- Subsequent funding easy with strong performance
- Carried interest, transaction, and monitoring fees

Valuation Issues in Private Equity

Valuation Issue	*Buyout*	*Venture Capital*
Use of DCF	Frequently used	Uncertain cash flow
Relative value	Validates DCF	No comps
Use of debt	High	Low, more equity
Key return drivers	EPS growth, P/E expansion, debt reduction	Pre-money valuation, future dilution

Components of Performance From a Leveraged Buyout

- **Exit value =** investment cost + earnings growth + multiple expansion + reduction in debt
- Earnings growth due to operational efficiencies
- Increase in price multiple due to increased growth
- Apply scenario analysis to forecasts

Alternative Investments

Private Equity Valuation

Exit Routes, Costs, Risks and
Financial Performance Ratios

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Exit Routes and PE Value

1. **Initial Public Offering (IPO):**
   - **Pros**: Highest exit value, higher liquidity, access to capital, and attract good management
   - **Cons**: Less flexible, more costly, and complex
   - **When to use**: Strong growth prospects, operating history, size
   - Timing is key!

Exit Routes and PE Value

2. **Secondary market sale:** Sale from one firm to another for strategic reasons
   - Pros: Second highest valuation
3. **Management buyout:** Firm sold to management with significant use of leverage
4. **Liquidation:** Outright sale of firm's assets, firm no longer viable
   - Con: Lowest valuation, negative public perception

Private Equity Details

- **Structure**: Limited partnership (LP) provides funding, no active role, limited liability. GP liable for all debts and unlimited liability, 10–12 year lives.
- **Terms**: *Qualified* investors only with > $1.0 mm in assets
  - **Management fees**: 2.0%
  - **Carried interest**: GP's share of profits
  - **Ratchet**: Allocation of portfolio company equity between shareholders and management

Private Equity Details

- **Hurdle rate**: IRR target before GP can receive carried interest (7%–10%)
  - **Target fund size**: Signals GP's ability to raise funds, below is negative signal
  - **Vintage**: Year fund was started
- **Valuation**: NAV with frequent adjustments
- **Due diligence**: Evaluation of past performance, trends, and magnitude

Example: Carried Interest

A fund has committed capital of $100 million, carried interest of 20%, and a hurdle rate of 9%. The firm called 80% of its commitments in the beginning of Year 1. Of this, $50 million was invested in Company A and $30 million in Company B.

At the end of Year 2, a $7 million profit is realized on the exit from Company A. The investment in Company B is unchanged. The carried interest is calculated on a deal-by-deal basis (i.e., the IRR for determining carried interest is calculated for each deal upon exit).

Determine the theoretical carried interest and the actual carried interest.

Solution: Carried Interest

Theoretical carried interest:

20% × $7,000,000 = $1,400,000

IRR for Company A:

PV = –$50; FV = $57; N = 2; CPT I/Y ⇒ 6.8%

Because the 6.8% IRR is less than the hurdle rate of 9%, no carried interest is actually paid.

Risks in Private Equity Investing

- **Liquidity risk**: Not publicly traded
- **Competitive environment risk**: Fewer deals with good prospects at low cost
- **Agency risk**: Principal agent conflict
- **Capital risk**: Withdrawal of capital due to increase in business and financial risk
- **Regulatory risk**: Adverse government regulation

Risks in Private Equity Investing

- **Tax risk**: Treatment of returns changes
- **Valuation risk**: Reflects subjective judgment
- **Diversification risk**: Poorly diversified across stage, vintage, and strategy
- **Market risk**: Long-term factors such as interest rates and exchange rates

Costs of Private Equity Investing

- **Transaction costs**: Due diligence, bank financing, legal fees
- **Fund set up costs**: Usually amortized over life of fund
- **Administrative costs**: Custodian, transfer agent, and accounting costs charged yearly
- **Audit fees**

Costs of Private Equity Investing

- **Management fee** = 2% (typical)
- **Performance fee** = 20% (typical)
- **Dilution costs**: Resulting from additional rounds of financing and stock options
- **Placement fees**: As much as a 2% up-front fee or annual trailer paid to placement agents

Alternative Investments

Private Equity Valuation

Fee and Distribution Calculations

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Financial Performance of Private Equity Funds

- **Recommended:** GIPS since inception IRR
  - SI-IRR is a money-weighted return
  - Assumes intermediate cash flows reinvested at IRR but PE funds tend to be illiquid
  - Gross or net of fees
  - Considers time value of money

Financial Performance of Private Equity Funds

- **Multiples:** Popular, simple, easy to use, and differentiates between realized and unrealized returns, specified by GIPS
  - Paid-in capital (PIC): Percent of capital used by GP
  - Distributed to PIC (DPI): Measures LP's realized return, cash-on-cash return
  - Residual value to PIC (RVPI): Measures LP's unrealized return
  - Total value to PIC: Measures LP's realized and unrealized return, sum of DPI, and RVPI

Calculations for Private Equity Funds

- The GP of a PE Fund charges a management fee of 2% and carried interest of 20%, which is paid after the portfolio's value exceeds the committed capital of $150m.

Year	Called Down Capital	Paid In Capital	Mment Fee 2%	Operating Results	NAV Before Distributions	Carried Interest 20%	Distributions	NAV After Distributions
2011	50.0	50.0	(1.0)	(10.0)	39.0	0.0	0.0	39.0
2012	20.0	70.0	(1.4)	(25.0)	32.6	0.0	0.0	32.6
2013	30.0	100.0	(2.0)	25.0	85.6	0.0	0.0	85.6
2014	20.0	120.0	(2.4)	50.0	153.2	(0.6)	(20.0)	132.6
2015	10.0	130.0	(2.6)	60.0	200.0	(9.4)	(40.0)	150.6
2016	10.0	140.0	(2.8)	110.0	267.8	(13.6)	(80.0)	174.2

Calculations for Private Equity Funds

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2011	50.0	50.0	(1.0)	(10.0)	39.0	0.0	0.0	39.0
2012	20.0	**70.0**	**(1.4)**	(25.0)	32.6	0.0	0.0	32.6
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Paid-in capital: This is just the cumulative sum of the capital called down. E.g., in 2012, it is the sum of the capital called down in 2011 and 2012:

$50 + $20 = $70

Management fees: In each year, these are calculated as the percentage fee (here 2%) multiplied by the paid-in capital. For example, in 2012:

2% × $70 = $1.4

Calculations for Private Equity Funds

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2016	10.0	140.0	(2.8)	110.0	267.8	(13.6)	(80.0)	174.2

Carried interest: Paid when NAV before distributions > committed capital, which first occurs here in 2014. Carried interest is 20% multiplied by the NAV before distributions minus the committed capital:

20% × ($153.2 – $150) = $0.6

Subsequently, calculate using the increase in the NAV before distributions. E.g., in 2015: **20% × ($200 – $153.2) = $9.4**

Calculations for Private Equity Funds

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NAV before distributions:

Prior yr NAV after distbns + capital called down – mmt fees + operating results

For example in 2015:

$132.6 + $10 – $2.6 + $60 = $200

Calculations for Private Equity Funds

Year	Called Down Capital	Paid In Capital	Mment Fee 2%	Operating Results	NAV Before Distributions	Carried Interest 20%	Distributions	NAV After Distributions
2011	50.0	50.0	(1.0)	(10.0)	39.0	0.0	0.0	39.0
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NAV after distributions:

NAV before distributions – carried interest – distributions

For example in 2015, NAV after distributions is:

$200 – $9.40 – $40 = $150.60

Calculations for Private Equity Funds

2016 DPI

Calculated as the cumulative distributions divided by the cumulative paid-in capital:

$$\text{DPI} = \frac{(20 + 40 + 80)}{140} = 1.0$$

This indicates that, in terms of distributed returns, the fund has returned every dollar invested.

Calculations for Private Equity Funds

2016 RVPI

Calculated as the NAV after distributions divided by the cumulative paid-in capital:

$$\text{RVPI} = \frac{174.2}{140} = 1.24$$

This indicates that, although the distributed returns are not impressive for this fund, the fund has unrealized profits that should accrue to LPs as investments are harvested.

Calculations for Private Equity Funds

TVPI

The TVPI multiple is simply the sum of the DPI and RVPI:

$$\text{TVPI} = 1.0 + 1.24 = 2.24$$

This indicates that on a realized and unrealized basis, the GP has more than doubled the investment of the LPs.

Alternative Investments

Private Equity Valuation

Venture Capital Funding - Single Round

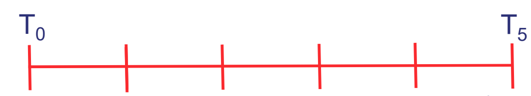
A Note on the Valuation of Venture Capital Deals: Appendix

Venture Capital Method: Single Financing Round

Ponder Tech is a biotech company. Ponder's founders believe they can sell the company for $40 million in five years. They need $5 million in capital now, and the entrepreneurs currently hold 1 million shares.

A venture capital firm, VC Investors, decides that given the high risk of this company, a discount rate of 40% is appropriate. Calculate the pre-money valuation, post-money valuation, ownership fraction, and price per share, applying the NPV venture capital method.

The Venture Capital Method and a Single Financing Round



($5m) $40m

INV_1

$$Post_1 = \frac{\$40{,}000{,}000}{1.4^5} = \$7{,}437{,}377$$

Exit value

Value of firm immediately after the investment

The Venture Capital Method and a Single Financing Round

Pre-money valuation:

$$\text{Pre}_1 = \$7,437,377 - \$5,000,000 = \$2,437,377$$

INV_1

The Venture Capital Method and a Single Financing Round

Required fractional ownership (f):

$$f = \frac{\text{Investment}}{\text{Post}}$$

$$f = \frac{\$5,000,000}{\$7,437,377} = 67.23\%$$

The Venture Capital Method and a Single Financing Round

Shares required for VC firm: $S_{VC} = S_e\left[\frac{f}{(1-f)}\right]$

$$S_{VC} = 1,000,000\left[\frac{0.6723}{(1-0.6723)}\right] = 2,051,572$$

Price per share: $\frac{\$5,000,000}{2,051,572} = \$2.44$

Alternative Investments

Private Equity Valuation

Venture Capital Funding - Multiple Rounds

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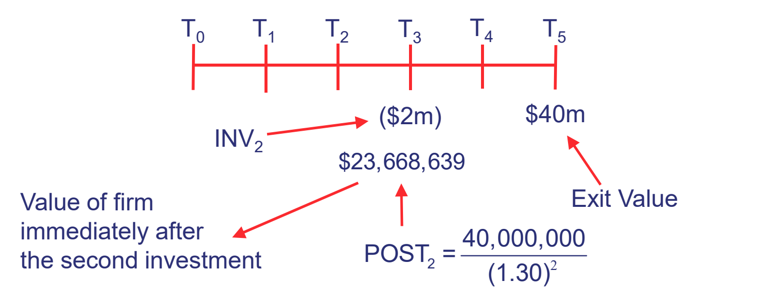
The Venture Capital Method Multiple Financing Rounds

A company needs \$3 million in the first round of financing and a second round of financing (three years later) of \$2 million to finance company expansion to the size expected at exit. Use a discount rate of 40% for the first three years and 30% for the last two years. The company is expected to be worth \$40 million after five years, and founders will hold 1 million shares.

Calculate pre- and post-money valuation, ownership fraction, and price per share using NPV method.

The Venture Capital Method and Multiple Financing Rounds



The Venture Capital Method

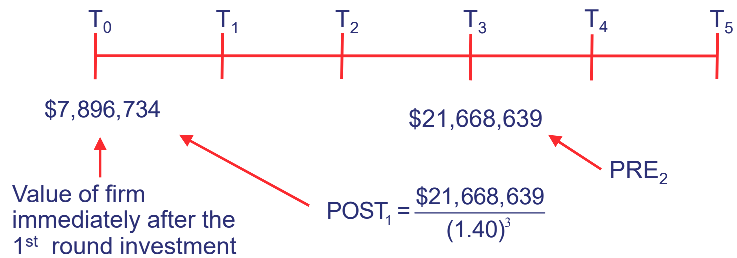
Pre-money valuation at second financing round:

$$PRE_2 = POST_2 - INV_2$$

$$PRE_2 = 23{,}668{,}639 - 2{,}000{,}000 = 21{,}668{,}639$$

The Venture Capital Method

Post-money valuation at first financing round:



The Venture Capital Method

Required ownership for first-round investors:

$$f_1 = \frac{INV_1}{POST_1} \qquad f_1 = \frac{3,000,000}{7,896,734} = 38\%$$

Required shares for first-round investors:

$$S_{pe1} = S_e\left[\frac{f_1}{(1-f_1)}\right] \qquad S_{pe1} = 1,000,000\left[\frac{0.38}{(1-0.38)}\right] = 612,903$$

The Venture Capital Method

Stock price after the first financing round:

$$P_1 = \frac{INV_1}{S_{pe1}} \qquad P_1 = \frac{3,000,000}{612,903} = \$4.89$$

The Venture Capital Method

Required ownership for second-round investors:

$$f_2 = \frac{INV_2}{POST_2} \qquad f_2 = \frac{2,000,000}{23,668,639} = 8.45\%$$

Required shares for second-round investors:

$$S_{pe2} = \left(S_e + S_{pe1}\right)\left[\frac{f_2}{(1-f_2)}\right] \qquad S_{pe2} = (1,000,000 + 612,903)\left[\frac{0.0845}{(1-0.0845)}\right] = 148,870$$

The Venture Capital Method

Stock price after second financing round:

$$P_2 = \frac{INV_2}{S_{pe2}} \qquad P_2 = \frac{2{,}000{,}000}{148{,}870} = \$13.43$$

After the second round, the first-round investor's share dilutes from f_1 to $f_1(1 - f_2)$.

In this example, the dilution takes the investor's share from 38% to 0.38(1 – 0.0845) = 0.3479, or 34.79%.

Adjusting for Risk in a Venture Capital Investment

- **Example:** Assume that a private equity investor has a discount rate of 30%. Probability of failure in any given year is 25%. Compute the discount rate adjusted for probability of failure.

$$r^* = \left[\frac{1+r}{1-q} - 1\right] = \left[\frac{1+0.30}{1-0.25} - 1\right] = 73.33\%$$

Alternative Investments

Introduction to Commodities and Commodity Derivatives

Introduction and Theories of Return

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Characteristics of Commodity Sectors

Crude oil — Shipped/stored in natural form, later refined

Natural gas — Must be liquefied to ship overseas

Metals — Storable; demand varies w/ business cycle

Grains and softs — Production sensitive to weather, disease

Livestock — Supply sensitive to price of feed grains

Life Cycle of Commodities

- **Energy**
  - **Oil**—Stored briefly before refined, transported
  - **Natural gas**—Little processing; ship by pipeline
- **Grains**—Production is seasonal but storable
- **Metals**—Require large plants; storable
- **Livestock**—Production cycles vary with animal size
- **Softs**—Cash crops; produced in warm climates

Valuation of Commodities

- No cash flow—cannot use DCF
- Commodity prices based on supply vs. demand

Commodity spot price ≈ PV (future selling price)

- Storage costs cause forward price > spot price

Commodity Futures Markets Participants

1. **Informed investors** (hedgers and speculators) have information about the commodity they trade.
   - Hedgers can be producers or consumers.
   - Speculators provide liquidity to the market and seek to profit from information advantage.
2. **Arbitrageurs**
   - Seek to profit from mispricing in forward/spot markets

Commodity Futures Markets Participants

3. **Exchanges**
   - Provide venue, performance guarantees
4. **Analysts**
   - Perform analysis for data firms, government, forecasters, etc.
5. **Regulators**
   - Example: CFTC

Spot Prices vs. Expected Futures Prices

- **Contango:** Futures prices > spot prices
- **Backwardation:** Futures prices < spot prices
- **Basis** = spot price – futures price
- **Calendar spread:** Difference between futures prices for contracts with different expiration dates
  - Calendar spreads and basis are negative in contango and positive in backwardation.

Theories of Commodity Futures Returns

1. **Insurance Theory:** Longs rewarded for providing protection to producers
   - Implies backwardation is a normal condition
2. **Hedging Pressure Hypothesis:** Expands on insurance theory by including long hedgers
3. **Theory of Storage:** Futures prices relate to spot prices through storage costs and convenience yield

Alternative Investments

Introduction to Commodities and Commodity Derivatives

Analyzing Returns and Index Construction

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Fully Collateralized Futures Contract

The components of total return for a fully collateralized commodity futures contract consist of:

Collateral return → yield on securities deposited
\+ Price return → from change in spot prices
\+ Roll return → opening longer-dated contracts

= Total Return

Roll Return: Contango/Backwardation

- Roll return is positive for market backwardation.
  - Long holder will buy longer-dated contracts that are priced lower than the expiring contracts.
- Roll return is negative when market is in contango.
  - Long-dated contract priced higher than expiring.

Exposure to Commodities via Swaps

1. **Total return swap:** Variable payments are based on the change in price of a commodity.
2. **Excess return swap:** Payments on difference between commodity price and benchmark value.
3. **Basis swap:** The variable payments are based on the difference in prices of two commodities.
4. **Volatility swap:** Based on volatility of price

Index Construction vs. Return

Key characteristics distinguishing commodity indices:

1. Breadth and selection methodology
2. Weightings on each component/commodity
3. Methodology for rolling futures contracts
4. Method of rebalancing commodities and sectors

Index Construction vs. Return

- Greatest influences on the index return:
  - Index components
  - Weighting method
- Rolling methodology may be passive or active.
- Frequent rebalancing of portfolio weights:
  - Decreases index returns in trending markets
  - Increases index returns in choppy markets

Portfolio Management (1)

Exchange-Traded Funds: Mechanics and Applications

ETF Mechanics and Tracking Error

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ETF: Introduction

- Typically track an index and trade on secondary markets.
- **Authorized Participants (APs):** Market makers authorized to create new shares or redeem shares. (Both transactions are in-kind.)
- **Creation basket:** Provided by ETF manager; lists securities that are needed to create new shares.
- **Creation Unit:** Lot size of these primary market dealings.

Purposes of Creation/Redemption Process

- **Lower cost:** In-kind creation/redemption eliminates transaction cost.
- **Tax efficiency:** Creation/redemption is not a taxable event. Also, redemption basket may specify low basis stock to boost the tax efficiency of the fund.
- **Market prices in line with NAV:** APs can arbitrage away any price discrepancy.

Arbitrage Gap

- APs incur transaction costs and service fees for creation/redemption. These are passed on as bid-ask spreads (and borne only by transacting shareholders).
- Hence, ETFs should trade within a band of the NAV, known as the **arbitrage gap**.
- Arbitrage gap is wider for ETFs with:
  - Illiquid holdings.
  - Holdings trading on exchanges in different time-zones.

Secondary Markets

- Exchange trades guaranteed by clearing house (e.g., NSCC in the U.S.)
- **DTC** (a subsidiary of NSCC) records the transfer.
- Two-day settlement period (up to six days for APs).
- European markets tend to be fragmented, with 29 depositories—mostly institutional investors.
- Most trades are OTC with no live price data; most ETFs are listed on multiple exchanges. May widen spreads.

Tracking Error

- **Tracking difference** between NAV and benchmark return.
- *Annualized* standard deviation of the daily tracking difference is known as **tracking error.**
- Rolling holding periods: Cumulative effect of management fees and expenses over longer time.
- Annual rolling holding period can be compared to an ETF's expense ratio.

Tracking Error: Sources

- ETF fees and expense
- Sampling and optimization
- Depository receipts/other sector ETFs
- Index changes
- Regulatory and tax requirements
- Fund accounting practices
- Asset manager operations

Portfolio Management (1)

Exchange-Traded Funds: Mechanics and Applications

Spreads, Pricing Relative to NAV, and Costs

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Spreads

- Mostly determined by liquidity and market structure of fund holdings. Thinly traded ETFs have wider spreads.
- Spreads on fixed-income ETFs are higher than on large-cap equity ETFs.
- When ETF and underlying trade in markets with different time zones, spreads narrow during the overlapping period.
- Specialized ETFs (e.g., commodities, volatility futures, small-cap stocks) tend to have wider spreads.

Spreads (cont.)

Maximum spread =

creation/redemption fees plus other trading costs

\+ spread of the underlying securities

\+ risk premium for carrying until close of day

\+ AP's normal profit margin

– discount based on probability of offsetting the trade in secondary market

ETF Premium/Discount

- ETFs trading at a price above (below) NAV trade at a premium (discount).
- ETF premium (discount) % = (ETF price – NAV) / NAV
- Sources of premium discount include:
  - Timing difference (e.g., when underlying trades in foreign markets, OTC bonds).
  - Stale pricing for infrequently-traded ETFs.

ETF Costs

- **Management fees** charged by ETF manager.
- **Trading cost** such as commissions/brokerage and spread, premium/discount to NAV (if reversed).
- Round-trip trading cost = round-trip commission + spread
- Total cost = round-trip trading cost + management fees
- Long-term buy and hold investors are more concerned about management fees, while short-term tactical investors are more concerned about trading cost.

Example: ETF Cost

- Z&E ETF is quoted at a bid-ask spread of 0.15%. ETF commissions are 0.10% of the trade value. Management fees are 0.08% per year.
- **Calculate** the cost of holding the ETF for 3 months, for 1 year, and for 5 years. For the 5-year holding period, also calculate the average annual total cost.

Solution: ETF Cost

- Round-trip commission = 2 × 0.10% = 0.20%
- Round-trip trading cost = round-trip commission + spread
  = 0.20% + 0.15% = 0.35%
- Holding cost for 3 months = round-trip trading cost + management fees
  = 0.35% + (3/12) × 0.08% = 0.37%
- Holding cost for 1 year = 0.35% + 0.08% = 0.43%
- Holding cost for 5 years = 0.35% + (5 × 0.08%) = 0.75%.
- Average annual cost (for 5-year holding period) = 0.75% / 5 = 0.15%

Portfolio Management (1)

Exchange-Traded Funds: Mechanics and Applications

ETF Risks and Portfolio Applications

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ETF Risks

- Counterparty risk
  - ETNs
  - Settlement risk
  - Security lending
- Fund closures
  - Creation/redemption halts
- Expectation-related risk

Portfolio Uses of ETFs

- Efficient portfolio management
  - Portfolio liquidity management
  - Portfolio rebalancing
  - Portfolio completion
  - Transition management
- Asset class exposure management
  - Core exposure
  - Tactical strategies

Portfolio Uses of ETFs (cont.)

- Active investing
- Factor (smart beta) ETFs
- Risk management
- Alternatively-weighted ETFs
- Discretionary active ETFs
- Dynamic asset allocation and multi-asset strategies

Portfolio Management

Using Multifactor Models

Multifactor Models

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A Brief History

1958 Markowitz Mean – Variance Framework:

- Portfolio concept: Diversification
- Diversification if return correlations < +1
- Portfolio returns: Multivariate normal distribution
  1. E(R) Expected returns
  2. σ^2 Return variances
  3. ρ Return correlation

A Brief History

1964 Sharpe's Capital Asset Pricing Model (CAPM):

- Based on mean, variance framework
- Assets return based on risk-free rate and priced risk
- Stock specific, unsystematic risk can be diversified (nonpriced)
- Systematic risk (nondiversifiable) priced risk
- Single factor = market portfolio
- β measure of stocks exposure to the factor

Priced Risk

- A risk that does not affect many assets (i.e., unsystematic) can be diversified and is not priced
- Investors should not be rewarded (i.e., no return) for nonpriced risks
- Risks that affect all assets are systematic risk factors and should be priced
- Investors should earn a return for nondiversifiable priced risk (factor risk)

Arbitrage Pricing Theory (APT)

1976 Ross APT

- E(R) linear function of a set of factors capturing systematic risk
- Identity and number of factors not identified (unlike CAPM)
- Multiple-priced factors (CAPM single-priced factor)

Arbitrage Pricing Theory (APT)

Describes the equilibrium relationship between expected returns for well-diversified portfolios and their multiple sources of systematic risk

Risk premiums

$$E(R_P) = R_F + \beta_{P1}(\lambda_1) + \beta_{P2}(\lambda_2) + \ldots + \beta_{Pk}(\lambda_k)$$

Portfolio factor betas or *loadings*

APT Assumptions

CAPM

Makes **many** (implausible) assumptions (homogenous expectations and the market portfolio)

APT

Assumes:

- Returns derived from multifactor process
- Unsystematic risk can be diversified away
- No arbitrage opportunities (asset returns correctly reflect risk)

Roll, Ross 2001
1–3% of portfolio variance due to nonsystematic factors

Arbitrage Opportunity Example

Arbitrage:

- No risk
- No net investment
- Positive profit

Arbitrage = free lunch

Portfolio A,B,C = single factor portfolios

	Expected return	Factor sensitivity
Portfolio A	10%	1.0
Portfolio B	20%	2.0
Portfolio C	13%	1.5

Arbitrage Opportunity Solution

Create portfolio (D) equally weighted to A and B

$E(R_D)$ = 15%   Factor sensitivity (β) = 1.50

$$\left(\frac{1}{2}\times 10\%\right)+\left(\frac{1}{2}\times 20\%\right) \qquad \left(\frac{1}{2}\times 1\right)+\left(\frac{1}{2}\times 2\right)$$

Arbitrage opportunity:
Long D, Short C:
Profit = $E(R_D) – E(R_C)$ = 2%

Portfolio C does not generate sufficient return for its factor risk (market not in equilibrium)

Example: APT

An investment firm employs a two-factor APT model.

- Risk-free rate of 5%

Factor	Factor 1	Factor 2
Invest Fund factor betas	1.50	2.00
Factor risk premiums	0.0300	0.0125

The expected return for the Invest Fund (IF) equals:

$E(R_{IF})$ = 0.05 + 1.5(0.03) + 2(0.0125) = 0.12 **= 12%**

Portfolio Management

Using Multifactor Models

Macroeconomic, Fundamental,
and Statistical Factor Models

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Three Types of Multifactor Models

1. Macroeconomic factors

   Surprises in macro variables that explain differences in stock returns

   Interest rates, inflation, business cycle, credit spreads, etc.

2. Fundamental factors

   Attributes of stocks that are important in explaining cross-sectional differences in returns

   B/M, market cap., P/E, leverage, etc.

Three Types of Multifactor Models

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   B/M, market cap., P/E, leverage, etc.

Three Types of Multifactor Models

3. Statistical factors

   Principal components models

   Factors are portfolios of securities that best reproduce historic return variances

   Factor analysis models

   Factors are portfolios of securities that best reproduce historic return covariances

   Issue = attaching economic meaning to statistical factors difficult

Macroeconomic Factor Model

ex-ante return (no surprises)

Sensitivity to INT surprises

Interest rate surprise actual – consensus predicted

Two-factor example: $R_i = E(R_i) + b_{i1}F_{GDP} + b_{i2}F_{INT} + \varepsilon_i$

Sensitivity to GDP surprises

GDP surprise actual – consensus predicted

Company-specific surprise return*

**Assuming all sources of common risk (risk factors) have been included*

Fundamental Factor Model

- Factors are returns, not surprises
- Intercept ≠ expected return
- Factor sensitivities are standardized:

Think Z statistic

$$\beta_i = \frac{\text{value of attribute k for asset i} - \text{average value of attribute k}}{\sigma(\text{values of attribute k})}$$

- Scaling allows all factor sensitivities to be interpreted similarly regardless of units of measurement

Fundamental Factor Model

Two-factor example: $R_i = a_i + b_{i1}F_{P/E} + b_{i2}F_{SIZE} + \varepsilon_i$

	Interpretation
a_i	Intercept
β_{i1}	Standardized P/E for Stock i $\rightarrow \beta_{i1} = \frac{P/E_i - \overline{P/E}}{\sigma_{P/E}}$
β_{i2}	Standardized SIZE for Stock i $\rightarrow \beta_{i2} = \frac{SIZE_i - \overline{SIZE}}{\sigma_{SIZE}}$
$F_{P/E}$	Return difference between high and low P/E stocks
F_{SIZE}	Return difference between high and low SIZE stocks

Macro Versus Fundamental Models

	Macro Factor Model	Fundamental Factor Model
Regression	Time series of surprises	Cross sectional asset returns
Factor sensitivity (β)	Regression based	Standardized from attribute data
Factor returns (F)	Surprises in macro variables	Computed from multiple regression
Intercept	Expected return	Undefined

Multifactor Models in Return Attribution

Fundamental Factor Model

Use = decompose sources of an asset manager's return relative to a benchmark

Model uses easily understood and communicated factors

Can express investment style choices and security characteristics in detail

More commonly used than macro or statistical factor models

Portfolio Management

Using Multifactor Models

Multifactor Model Risk and Return

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Active Risk and Return

Active return is the difference between the portfolio return (P) and its benchmark (B):

$R_P - R_B$

Active risk (tracking error/risk) is the standard deviation of the active return:

$$TE = \sigma(R_P - R_B) = \sqrt{\frac{\sum (R_{Pt} - R_{Bt})^2}{n-1}}$$

Information Ratio

- Active return per unit of active risk (standardized measure)
- Measures manager's consistency in generating active returns

$$IR = \frac{(\overline{R}_P - \overline{R}_B)}{\sigma(\overline{R}_P - \overline{R}_B)}$$

Similar to Sharpe ratio

Sources of Active Return

Active return = factor return + security selection return

Product of managers' factor tilts and factor returns

$$\sum_{k=1}^{k}\left[\left(\text{Portfolio}\beta - \text{Benchmark}\beta\right)\times \lambda_k\right] + \text{Security selection}$$

Managers' skill in individual asset selection (residual)

Active Risk Decomposition

Active risk squared:

$$\sigma^2(R_P - R_B) = \text{active factor risk} + \text{active specific risk}$$

Active risk attributable to factor tilts

Active risk attributable to stock selection

$$\text{Active specific risk} = \sum_{i=1}^{n}\left(W_{Pi} - W_{Bi}\right)^2 \sigma^2_{\varepsilon i}$$

Residual risk of the i^{th} asset

Active factor risk = residual

Factor Models in Portfolio Construction

1. Passive management: Use multifactor models to ensure portfolio replicates an index's factor exposures.
2. Active management: Rely on multifactor models to predict alpha generated from active bets on certain factors while hedging others. In constructing portfolios, multifactor models are used to establish desired risk profiles.
3. Rules-based algorithmic active management (alternative indices): Use rules to make factor tilts. Low cost transparent capture of some alpha.

Strategic Portfolio Decisions

Two questions for investors:

1. What kind of risk do I have a competitive advantage in bearing?
2. What kind of risk do I have a comparative disadvantage in bearing?

Examples: Pension funds have long investment horizons and as a result are not exposed to liquidity risk.

An employed worker reliant on income is exposed to business cycle risk.

Strategic Portfolio Decisions

- CAPM leaves the investor with a choice between a riskfree asset and the market portfolio.
- Multifactor models:
  - Better describe portfolio characteristics
  - Provide better diversification/risk management possibilities
  - Provide more efficient portfolios if asset returns are better described by multifactor models

Portfolio Management

Measuring and Managing Market Risk

Value at Risk (VaR)

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Defining Value at Risk (VaR)

Definition

VaR measures the downside risk of a portfolio. It has three components: the loss size, the probability of loss, and a time frame.

Example

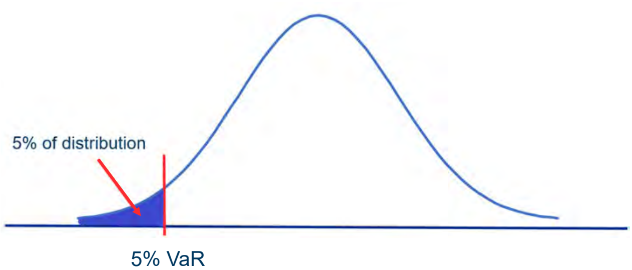
Can be referred to as a 95% confidence

Can be expressed as a % or a $ amount

Specified loss is the **minimum** loss over the period

"5% probability that a portfolio will experience loss of $25,000 or more in any given month"

Defining Value at Risk (VaR)



Defining Value at Risk (VaR)

- Note that $25,000 is a *minimum* loss amount, so we can state, "5% of the time the minimum monthly loss that the company will experience is $25,000."
- To estimate a VaR, we must specify the time period and the size of loss, so significant judgement is involved in VaR estimation.
- If we choose the size of the loss, we will estimate the probability of losses of that size or larger.
- If we choose the probability of the loss, we will estimate the minimum size of the losses that will occur with that probability.

Estimating VaR

- Step 1: Identify risk factors (e.g., market, interest rate, currency)
- Step 2: Choose from different approaches to estimate VaR:
  - Parametric (variance-covariance) approach
  - Historical simulation
  - Monte Carlo simulation

VaR Using Parametric Method

- Each risk factor is assigned a distribution, often assumed to be normal to avoid complications of skew and kurtosis.
- Only mean and variance of normal distribution are needed.
- Parameters are based on data over a lookback period.
- VaR can then be calculated from the normal distribution.
  - For example, 5% VaR represents 1.65 standard deviations below the mean point.

Example: Estimating VaR

- Imagine that we are provided the following information about two assets, Security A and Security B:

Security	Standard deviation of daily returns	Mean daily return	Covariance of daily returns
A	0.0158	0.0004	0.000106
B	0.0112	0.0003	

- How would we use this information to estimate the 5% annual VaR for a portfolio that is 60% invested in Security A and 40% invested in Security B?

Example: Parametric Method

Mean daily portfolio return = 0.6 × (0.0004) + 0.4 × (0.0003) = 0.00036

Variance of portfolio return

$= (0.6)^2(0.0158)^2 + (0.4)^2(0.0112)^2 + 2(0.4)(0.6)(0.000106) = 0.000161$

Standard deviation of portfolio returns = $\sqrt{0.000161}$ = 0.012682

5% daily VaR = 0.00036 – 1.65×(0.012682) = –0.0206

For 250 trading days per year, annual mean return = 250(0.00036) = 0.09

Annual standard deviation = $\sqrt{250}$ × (0.012682) = 0.20052

5% annual VaR = 0.09 – 1.65 × (0.20052) = –0.2409

5% daily VaR = $10 million × (0.0206) = $206,000

5% annual VaR = $10 million × (0.2409) = **$2,409,000**

Weaknesses of Parametric Method

- Estimates are only as good as inputs (mean, variance, covariance).
- The length of the lookback period will affect the parameter estimates.
- In cases where normality cannot be reasonably assumed, such as when the portfolio contains options, the parametric method has limited usefulness.

VaR Using Historical Simulation Method

- Periodic returns over a lookback period are compiled.
- The returns are then ordered from smallest to largest.
- The 5% VaR is the value beyond the 5th percentile.
- For 200 observations, this would be approx. the 10th smallest return.

Example: Historical Simulation Method

Sorted Monthly Returns (N = 100)

−0.83%	−0.58%	−0.42%	−0.25%	−0.17%	−0.08%	0.17%	0.33%	0.42%	0.75%
−0.83%	−0.50%	−0.42%	−0.25%	−0.17%	0.00%	0.17%	0.33%	0.50%	0.75%
−0.75%	−0.50%	−0.33%	−0.25%	−0.08%	0.00%	0.17%	0.33%	0.58%	0.75%
−0.75%	−0.50%	−0.33%	−0.25%	−0.08%	0.00%	0.25%	0.33%	0.58%	0.75%
−0.75%	−0.42%	−0.33%	−0.17%	−0.08%	0.08%	0.25%	0.33%	0.58%	0.75%
−0.67%	−0.42%	−0.33%	−0.17%	−0.08%	0.08%	0.25%	0.33%	0.58%	0.75%
−0.58%	−0.42%	−0.33%	−0.17%	−0.08%	0.08%	0.25%	0.33%	0.58%	0.75%
−0.58%	−0.42%	−0.33%	−0.17%	−0.08%	0.08%	0.25%	0.42%	0.58%	0.83%
−0.58%	−0.42%	−0.33%	−0.17%	−0.08%	0.17%	0.33%	0.42%	0.67%	0.83%
−0.58%	−0.42%	−0.25%	−0.17%	−0.08%	0.17%	0.33%	0.42%	0.67%	0.83%

Strengths/Weaknesses of Historical Simulation

- No need to assume a distribution
- Historical simulation method can be used to estimate the VaR for portfolios that include options
- VaR based on an unusually volatile (stable) lookback period will yield overestimates (underestimates) of VaR

VaR Using Monte Carlo Simulation

- A probability distribution of and correlations between each risk factor is assumed (key step!).
- Software generates random values for each risk factor based on above and computes periodic returns based on these values.
- As in historical simulation, VaR estimated from sorted outcomes.
- The Monte Carlo and parametric methods should produce identical results if the distribution and parameters are the same.

Portfolio Management

Measuring and Managing Market Risk

Using VaR

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Advantages of VaR

- The concept of VaR is simple and easy to explain.
- VaR allows the risk of different portfolios/asset classes to be compared.
- VaR can be used for performance evaluation.
- Optimal allocation of capital is based on VaR (risk budgeting).
- It is accepted by global banking regulators.
- It is verified via backtesting.

Limitations of VaR

- VaR estimation requires many choices.
- Usual assumption of normality leads to underestimates of downside (tail) risk.
- VaR does not account for liquidity risk or risk of changing correlations (which increases during severe downturns).
- VaR focuses only on downside risk.

Extensions of VaR

Conditional VaR (CVaR)

- CVaR is the expected loss, given that the loss is equal to or greater than VaR. CVaR is also referred to as the *expected tail loss* or *expected shortfall.*
- When VaR is estimated using the historical simulation method or Monte Carlo simulation, all values equal to or less than the VaR loss are known, so it is straightforward to average these to get the CVaR.
- With the parametric method, the magnitude of losses greater than the VaR are not known, so calculating the expected loss in the left-hand tail is mathematically complex.

Extensions of VaR

Incremental VaR (IVaR)

- IVaR is the change in VaR from a change in the portfolio allocation to a security.

Example

- A 2% increase in the weight of a security in the portfolio increases the portfolio's VaR from $1,345,600 to $1,562,400.
- IVaR for the 2% increase in the portfolio weight of the security is 1,562,400 – 1,345,600 = $216,800.

Extensions of VaR

Marginal VaR (MVaR)

- MVaR is the slope of the tangent at a point in the VaR versus security weight curve.
- MVaR is based on calculus (i.e., applicable for a small change in security weight).
- It is inaccurate to interpret it as the change in VaR for a 1% increase in the security's weight.
- A reasonable approximation of the sensitivity of VaR to a 1% change in portfolio weight of a security; thus, both the MVaR and IVaR are similar.

Extensions of VaR

Ex ante tracking error (or Relative VaR)

- It measures the VaR of the difference between the return on a portfolio and the return on its benchmark.
- A 5% monthly relative VaR of 2.5% implies that 5% of time the portfolio's relative underperformance will be at least 2.5%.
- The relative VaR can be calculated as the VaR of a combination of the subject portfolio and a short position in the benchmark portfolio.

Sensitivity and Scenario Risk Measures

Sensitivity Analysis

- Sensitivity analysis focuses on the impact on value of a given small change in one risk factor.
- Sensitivity analysis complements VaR in understanding portfolio risk, but, unlike VaR, it does not involve any prediction of the probability of losses of any specific amount.

Scenario Analysis

- Scenario analysis provides an estimate of the impact (usually negative) on value of a set of changes of significant magnitude in multiple risk factors. A **historical scenario** approach uses a set of changes in risk factors that actually occurred (e.g., during the sub-prime mortgage crisis of 2008), as opposed to a **hypothetical scenario** approach.
- **Stress tests** examine the effect on value (or solvency) of a scenario of extreme risk-factor changes.

Measures of Risk for Different Asset Classes

Equities

- The risk factor most often used for equities is **beta**.

Fixed Income

- **Duration** provides an estimate of how fixed income instruments are affected by changes in interest rates (yields to maturity). For larger changes in interest rates, including the effects of **convexity** on fixed income security values improves sensitivity estimates.

$$\text{change in price} = -\text{duration}\ (\Delta Y) + \tfrac{1}{2}\ \text{convexity}\ (\Delta Y)^2$$

Measures of Risk for Different Asset Classes

Options

Several risk factors affect the values of options positions:

- **Delta** is an estimate of the sensitivity of options values to changes in the value of the underlying asset. (e.g., a call delta of 0.6 means that for every $1 increase in the price of the underlying asset, the call value increases by $0.60.)
- **Gamma** is an estimate of how delta changes as the price of the underlying asset changes and is calculated as the ratio of the *change in delta* to a change in the price of the underlying asset.
- **Vega** is a measure of the sensitivity of option values to changes in the expected volatility of the price of the underlying asset. We can incorporate all three of these option risk measures in the following equation:

$$\text{change in call price} = \text{delta}\ (\Delta S) + \tfrac{1}{2}\ \text{gamma}\ (\Delta S)^2 + \text{vega}\ (\Delta V)$$

Portfolio Management

Measuring and Managing Market Risk

Sensitivity and Scenario Risk Measures

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Uses of Sensitivity and Scenario Risk Measures

- **Sensitivity risk** measures can inform a portfolio manager about a portfolio's exposure to various risk factors to facilitate risk management. Managers may choose to hedge risks perceived as being excessive.
- When using **scenario analysis** for a portfolio that contains options or fixed income securities with embedded options, the individual options and bonds must be valued with a pricing model using scenario values for the risk factors.
- Factor sensitivities can be used to estimate the effects of small changes in risk factors for these securities, but for larger risk factor changes, pricing models for portfolio securities must be used.
- Even combining first-order and second-order effects, such as duration and convexity, only provides an approximation of the change in value that would result from a relatively large change in a risk factor.

Uses of Sensitivity and Scenario Risk Measures

- Scenario analysis can be performed as if the scenario changes are instantaneous, or as incremental changes where a portfolio manager can respond by reducing/closing or hedging positions.
- Analyzing instantaneous changes is considered more conservative and more realistic in circumstances where counterparties are unable/unwilling to provide additional collateral required or where lack of liquidity makes changing portfolio positions very costly or impossible.
- In **reverse stress testing**, the first step is to identify a portfolio's largest risk exposures and determine an unacceptable outcome (usually one that would threaten the survival of the organization) and to identify scenarios of changes in risk factors that would result in such an outcome.
- The key question is then how likely such scenarios are.

Uses of Sensitivity and Scenario Risk Measures

- Scenario analysis can be seen as the final step in the risk assessment and management process, after performing sensitivity analysis.
- For a firm that has limited its risk through a maximum VaR, limits on position sizes, limits on specific risk exposures, and so on, scenario analysis can provide additional information on a portfolio's vulnerability to a set of events or changes in correlations that would significantly reduce the value of the portfolio.
- Firms that use leverage, especially banks and hedge funds, often use stress tests involving a single risk factor to determine the size of change in that factor that could cause such losses that the firm's sustainability is compromised.

Uses of Sensitivity and Scenario Risk Measures

VaR, sensitivity analysis, and scenario analysis complement each other, and a risk manager should not rely on only one of these measures.

- VaR provides a probability of loss.
- Sensitivity analysis provides estimates of the relative exposures to different risk factors, but provides no estimate of the probability of any specific changes in risk factors.
- Scenario analysis will provide information about exposure to simultaneous changes in several risk factors or changes in risk correlations, but there is no probability associated with a specific scenario (other than the empirical probability of a historical scenario over the lookback period).

Uses of Sensitivity and Scenario Risk Measures

Example: A bond manager controls two separate bond portfolios, both with a duration equal to 3.2.

- With equal duration, the predicted change in value for a change in yield will be equal for each portfolio.
- However, the yield volatility of the two portfolios (e.g., government bonds versus high-yield bonds) may be significantly different leading to a different likelihood of that change in value.
- The same limitation applies to option delta (or gamma).
- Option delta/gamma may be an appropriate measure of the risk for small changes in the price of the underlying, but the volatility of the prices of the underlying may be quite different for different options.

Portfolio Management

Measuring and Managing Market Risk

Applications of Risk Measures

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Applications of Risk Measures

Risk measures used by an organization are dictated by:

- The types of risks it is exposed to
- The regulations that govern it
- Whether the organization uses leverage

These factors can be used to identify risk measures used by:

- Banks
- Asset managers
- Pension funds
- Insurers

Applications of Risk Measures

Banks

- Typically use sensitivity measures (duration of held-to-maturity securities and foreign exchange risk exposure)
- Scenario analysis and stress testing (for their full balance sheets)
- Leverage risk measures and VaR (especially for trading securities)

Banks also estimate risk from asset-liability mismatches, estimate VaR for economic capital, and disaggregate risk by both geographic location and business unit type.

Applications of Risk Measures

Traditional (long-only) asset managers

- Typically focus on relative risk measures unless their goal is an absolute return target
- Typical risk measures used include the following:
  - The size of positions
  - Sensitivity measures of interest rate and market risk
  - Historical and hypothetical scenario analysis
  - Options risk

Applications of Risk Measures

Traditional (long-only) asset managers (cont.)

- A risk measure more specific to asset management is **active share**, the difference between the weight of a security in the portfolio and its weight in the benchmark.
- **Ex-post tracking error** (backward looking) over a lookback period is typically used for performance attribution.
- **Ex-ante tracking error** (forward looking) focuses on the potential underperformance. Managers with an absolute return target may use VaR instead.

Applications of Risk Measures

Hedge funds

- Risk measures used depend to some extent on the strategy employed. For hedge funds in general, the risk measures used include sensitivity analysis, leverage measures, scenario analysis, and stress tests.
- Funds with both long and short positions will estimate risk measures for long positions, short positions, as well as for the overall portfolio (gross exposure). Hedge funds that use VaR focus on VaR measures of less than 10% for short periods.
- Hedge funds with significantly non-normal returns distributions use a risk measure referred to as *maximum drawdown*, the largest decrease in value over prior periods of a specific length.
- Sensitivity measures based on standard deviation or beta may be misleading for large changes in risk factors when returns are non-normal.

Applications of Risk Measures

Defined benefit pension funds

- Benefit pension funds are concerned with the difference between the value of assets (market values) and the present value of estimated future liabilities (payments to retirees and heirs).
- A key risk measure used by pension funds is **surplus-at-risk**, a VaR for plan assets minus liabilities. A negative surplus must be made up by the firm if higher-than-expected asset returns do not reduce it significantly over time.
- A **glide path** refers to a multi-year plan for adjusting pension fund contributions to reverse a significant overfunded or underfunded status.
- To reduce surplus uncertainty, a pension fund may match its assets to its liabilities. A related risk measure is an estimate of the hedged exposure and unhedged (returns generating) exposure of the fund.

Applications of Risk Measures

Insurance companies

- **Property and casualty insurers** sell auto, home, boat, liability, and health insurance. The insurance risks of a P&C company have low correlation with the market risk of their investments.
- **Life insurers** primarily sell life insurance policies and annuities, some of which make payments until the annuity owner's death.
- Insurance risks are reduced by purchasing reinsurance (from another insurance company) and by geographical diversification.

Applications of Risk Measures

Property and casualty insurers

- P&C insurers use sensitivities of their exposures to market risk factors in their investment portfolios for risk management. Premium income is expected to cover the cost of insurance claims in a typical year, with the investment portfolio available to cover extraordinary claim losses.
- VaR and capital at risk are used as measures of risk exposure in investment accounts. Scenario analysis is also used, often combining portfolio risk factors and insurance risk factors in a scenario.
- Regulations may require specific amounts of reserves (based on policies issued), and regulators discount the values of riskier assets held as reserves in determining their adequacy.

Applications of Risk Measures

Life insurers

- The insurance risk of life insurers is more highly correlated with the market risk exposures of their investment portfolios than it is for P&C insurers.
- Annuities pay over relatively long periods into the future, and present values are sensitive to discount factors used and also have significant mortality risk.
- Life insurers therefore estimate sensitivities to market risk factors for both investment portfolios and for annuity liabilities.
- Because life insurers are able to somewhat match the market risk of their portfolio assets to their liabilities, they must consider the risk of the remaining mismatch between assets and liabilities. Life insurers also use scenario analysis that includes both non-market (insurance) risk factors and market risk factors.

Portfolio Management

Measuring and Managing Market Risk

Constraints and Capital Allocation Decisions

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Constraints

- Risk measurements alone cannot effectively manage risk. They must be combined with constraints. If constraints are too loose, the firm may experience financial stress, corporate reorganization, or bankruptcy.
- If constraints are too restrictive, profitability is impaired. Imposing restrictions at the business unit level may be too restrictive to the extent diversification benefits or offsetting positions across business units are not taken into account. Common constraints include:
  - Risk budgeting
  - Position limits
  - Scenario limits
  - Stop-loss limits

Constraints

Risk budgeting

- A risk management process that first determines the acceptable total risk for an organization, and then allocates that risk to different activities, strategies, or asset classes as appropriate
- For example, determining the maximum allowable 5% VaR amount and then allocating that VaR across various business units
- A portfolio manager may set a limit for total risk relative to a benchmark and then allocate that risk to deviations from the portfolio's target asset allocations, deviations from benchmark weights in specific industries, and deviations from benchmark weights for firms in a specific industry.

Constraints

Position limits

- Limits risk by ensuring some minimum level of diversification
- Example: limits on allocations to individual securities within an asset class, or the differences between long and short positions for a hedge fund manager
- Position limits can be expressed as currency amounts or as percentages of a portfolio's value.
- Position limits can also be based on a liquidity measure, such as average daily or weekly trading volume.

Constraints

Stop-loss limits

- These require that a risk exposure be reduced if losses exceed a specified amount over a certain period of time.
- A simple stop-loss limit reduces the portfolio allocation to a stock or asset class (by a given amount) if it declines in value by more than a specified percentage (or currency amount).
- A slightly more complex type of stop-loss limit is a requirement that a risk exposure be hedged as the value of a security or index falls. This is referred to as **portfolio insurance** when the value of a portfolio is hedged by index puts.
- **Scenario limits** are limits on expected loss for a given scenario.

Risk Measures in Capital Allocation

- **Capital allocation** refers to how the capital of a firm is used to fund its various business units or activities (analogous to asset allocation for a portfolio manager).
- Risk management requires that the risk exposure for each use of firm capital be considered.
- One way to introduce risk exposures to various activities into the capital allocation decision is to limit the overall risk of all the activities.
- By calculating a VaR for each activity or business unit, the maximum acceptable VaR can be allocated across the activities or business units in a process similar to risk budgeting for a portfolio manager.

Portfolio Management (2)

Economics and Investment Markets

Valuation and Interest Rates

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Valuation

- Value of any asset = PV (estimated future cash flows)
- Discount rate includes real risk-free rate, expected inflation, and risk premiums as applicable.
- Changes in value occur due to changes in estimates of cash flows or discount rate elements. Existing expectations are already priced.

Real Short-Term Interest Rates

$$\text{Inter-temporal rate of substitution} = m_t = \frac{\text{marginal utility of consuming 1 unit in the future}}{\text{marginal utility of current consumption of 1 unit}} = \frac{u_t}{u_0}$$

$u_0 > u_1$ and $m_t < 1$

- P_0 = price of zero-coupon, $1 par inflation indexed risk-free bond = $E(m_t)$
- R = real risk-free rate = $\frac{1 - P_0}{P_0} = \left[\frac{1}{E(m_t)} - 1 \right]$
- Due to diminishing marginal utility, utility of consumption is higher during periods of scarcity (e.g., economic contractions).

Real Short-Term Interest Rates

- If investors expect higher incomes in future, utility of consumption in future relative to current consumption is lower and real rates will be higher.
- Investors increase their savings rate when (a) expected returns are high or (b) when uncertainty about future income increases.

Long-Dated Bonds

- For a risk-free, inflation-indexed zero-coupon bond with long-dated maturity:

$$P_0 = \frac{E(P_1)}{(1+R)} + \text{cov}(P_1, m_1)$$

- The uncertainty of price at t = 1 introduces a risk premium, which is captured by the covariance term.
- For risk-averse investors, the covariance between the future price of the bond and the inter-temporal rate of substitution is negative.
- When future price is higher, the utility of future consumption relative to current consumption is low.

Short-Term Rates

- If GDP growth rates are forecast to be high:
  - Investors expect higher incomes in the future and hence prefer current consumption relative to future consumption.
  - Inter-temporal rate of substitution will be low and interest rates high.
- This is evidenced in rapidly growing developing countries.
- Due to risk premium, interest rates are also higher if the expected volatility in GDP growth rate is higher.

Nominal Risk-Free Rates

- r(short-term) = $R + \pi$
- r(long-term) = $R + \pi + \theta$
  - R = real risk-free rate
  - π = expected inflation
  - θ = risk-premium for inflation uncertainty
- Per Taylor rule, short-term, policy rates are positively related to inflation gap (π-π*) and output gap (y-y*).

Yield Curve and Business Cycle

- Short-term rates are low during recessions and due to expectations of higher GDP growth and inflation in the future as the economy expands, longer-term rates are high.
- Hence, positively sloped yield curve is common during recessions.
- Similarly, inverted yield curve is indicative of late stages of economic expansions and is often considered a predictor of future recessions.

Term Spread

- Term spread
  = yield on longer-term bond – yield on shorter-term bond
- Normal term spread is positive and is attributable to risk premium for uncertainty in inflation (θ)
- θ is higher for longer maturities

Break-Even Inflation Rate (BEI)

- BEI = nominal yield on default-free bond nominal – real yield on default-free bond
- BEI = $\pi + \theta$

Expected inflation

Risk premium for inflation uncertainty

Credit Spread on Risky Bonds

- γ = additional risk premium for credit risk = credit spread
- Credit spreads rise during economic downturns due to increased probability of default and lower recovery rates
- When spread narrows, lower rated bonds outperform higher rated (and default free) bonds
- When spread widens, opposite occurs

Portfolio Management (2)

Economics and Investment Markets

The Business Cycle

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Company Products and Credit Risk

- Differences in credit spread among sectors due to:
  - differences in products produced; and
  - typical leverage used in the sector.
- Spreads for issuers in consumer cyclicals rise during downturns relative to consumer noncyclicals.

Business Cycle and Corporate Earnings

- Earnings of companies in cyclical industries tend to be more sensitive to business cycle.
  - Example: durable goods, consumer discretionary
- Earnings of companies in defensive industries tend to be relatively stable and immune to changes in business cycle.
  - Example: consumer staples/consumer nondiscretionary

Equity Risk Premium

- Equity is more risky than debt and hence an additional risk premium is needed.
- Corporate earnings and equity prices tend to rise during economic expansions.
- Equity provides a poor hedge against bad consumption outcomes (i.e., pays poorly in bad states of the economy).
- Poor consumption hedging property causes equity risk premium to be positive.

Business Cycle and Price Multiples

- Price multiples are positively related to earnings growth and negatively related to real rate, expected inflation, and equity risk premium.
- Price multiples rise during economic expansions → equity risk premium declines during economic expansions.
- Shiller's real cyclically adjusted P/E ratio (CAPE) uses inflation adjusted prices and 10-year moving average of real earnings to reduce the volatility in the P/E multiple.

Business Cycle and Style

- Growth stocks are characterized by high price multiples, low dividend yields, and immature markets.
- Value stocks tend to be characterized by low price multiples, high dividend yields, and mature markets.
- Value strategy performs well during recessions, and growth strategy performs well during economic expansions.
- Another style strategy is based on company size.

Sector Rotation Strategy

- There are periods during which certain sectors outperform other sectors.
- Understanding the relationship between business cycle and performance of different sectors can help in sector rotation strategies.
- Timing is the key though (and the most difficult part).

Real Estate

- There is additional risk premium for lack of liquidity.
- Commercial real estate with long-term leases have bond-like characteristics due to stable cash flows.
- The uncertainty in the value of real estate at the end of the lease term gives it an equity-like character .
- Similar to equities, real estate tends to be a poor hedge for bad consumption outcomes (i.e., has higher value during economic expansions).

Portfolio Management (2)

Analysis of Active Portfolio Management

Value Added by Active Management

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Background

- Reading focuses on Grinold (1989) "Fundamental Law of Active Management"
- Further developed by Clarke, de Silva, and Thorley (2002)
- Focus: How an investor should construct a portfolio given an assumed competitive advantage in predicting returns
- Relies on the assumption that financial markets are not perfectly efficient

Active Management and Value Added

- Objective: Beat the benchmark
  - Portfolio return > benchmark = +ve value added
  - Portfolio return < benchmark = –ve value added
- Passive investing = holding benchmark portfolio

Benchmark Qualities

- Benchmark qualities:
  1. Benchmark is representative of the assets from which the investor will select.
  2. Positions in the benchmark can be replicated at low cost.
  3. Benchmark weights are verifiable ex-ante and return data timely ex-post.

Measuring Value Added

Expected active return $E(R_A) = E(R_P) - E(R_B)$

Risk adjusted active return (alpha)=

$$\alpha_P = R_P - \beta_P R_B$$

Can be computed ex-ante or ex-post

Incorporating the managed portfolio's systematic risk relative to the benchmark if different (we will assume systematic risk of the portfolio is the same as the benchmark in this reading)

Measuring Value Added

Active return (value added)

$$E(R_A) = \sum_{i=1}^{N} \Delta W_i \times E(R_i)$$

Active weight = $W_{Pi} - W_{Bi}$

Sum of active weights = zero

Positive active returns: Generated by overweighting assets with higher returns and underweighting those with lower returns

Measuring Active Return Example

Security	Portfolio Wt W_{Pi}	Bmark Wgt W_{Bi}	Return $E(R_i)$	Active Wt ΔW_i
A	22%	25%	12%	–3%
B	20%	25%	–6%	–5%
C	21%	25%	4%	–4%
D	37%	25%	19%	+12%

$E(R_P) = \Sigma w_{Pi}(R_i)=(0.22)(0.12) + (0.20)(-0.06) + (0.21)(0.04) + (0.37)(0.19) = 9.31\%$

$E(R_B) = \Sigma w_{Bi}(R_i)=(0.25)(0.12) + (0.25)(-0.06) + (0.25)(0.04) + (0.25)(0.19) = 7.25\%$

Active Return = $E(R_A) = E(R_P) - E(R_B) = 9.31\% - 7.25\% =$ **2.06%** …Alternatively…

$E(R_A)=\Sigma \Delta w_i E(R_i)=(-0.03)(0.12) + (-0.05)(-0.06) + (-0.04)(0.04) + (0.12)(0.19) =$ **2.06%**

Value Added

Active return (value added)

Benchmark weighting for asset class j

Benchmark return for asset class j

$$E(R_A) = \sum_{j=1}^{M} W_{Pj} \times E(R_{Pj}) - \sum_{j=1}^{M} W_{Bj} \times E(R_{Bj})$$

Portfolio weighting for asset class j

Portfolio return for asset class j

Decomposition of Value Added

Decomposition into **asset allocation** and **stock selection**:

Active return (value added)

Return differences in an asset class $E(R_{Pi}) - E(R_{Bi})$

$$E(R_A) = \underbrace{\sum_{j=1}^{M} \Delta W_j \times E(R_{Bj})}_{\text{Active return from asset allocation}} + \underbrace{\sum_{j=1}^{M} W_{Pj} \times E(R_{Aj})}_{\text{Active return from stock selection}}$$

Decomposition Example

Optoma Fund invests in three asset classes: U.S. equities, U.S. bonds, and international equities, as shown below.

Asset Class	Portfolio Weight (W_{Pi})	Benchmark Weight (W_{Bi})	Portfolio Return $E(R_{Pi})$	Benchmark Return $E(R_{Bi})$
U.S. Equity	45%	40%	11%	12%
U.S. Bonds	30%	30%	6%	5%
Int'l Equity	25%	30%	14%	12%

Calculate the expected active return.

Decomposition Example

Asset Class (i)	Active Weight ΔW_i	$(\Delta W_i) \times E(R_{Bi})$	$E(A_i) = E(R_{Pi}) - E(R_{Bi})$	$(W_{Pi}) \times E(A_i)$
U.S. Equity	+5%	0.60%	–1%	–0.45%
U.S. Bonds	0%	0.00%	1%	0.30%
Int'l Equity	–5%	–0.60%	2%	0.50%
Total		0.00%		0.35%

$E(R_A) = \Sigma w_{P,i} E(R_{P,i}) - \Sigma w_{B,i} E(R_{B,i}) = 10.25\% - 9.90\% = 0.35\%$

$E(R_A) = \Sigma \Delta w_i E(R_{B,i}) + \Sigma w_{P,i} E(R_{A,i}) = 0.00\% + 0.35\% = 0.35\%$

So, all expected active return is attributable to *security selection*.

