Benno's Concise Study Notes
CFA Level II

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Study Session 1

Ethical and Professional Standards (Part 1)

1.1 Code of Ethics

LOS 1.1: The Code of Ethics establishes the framework for ethical decision making in the investment profession. The candidate should be able to state the four components of the Code of Ethics.

The four components of the code of ethics are:

- Act with integrity, competence, dignity, and in an ethical manner when dealing with the public, clients, prospects, employers, employees, and fellow members;
- Practice and encourage others to practice in a professional and ethical manner that will reflect credit on members and their profession;
- Strive to maintain and improve your competence and the competence of others in the profession;
- Use reasonable care and exercise independent professional judgment.

1.2 Standards of Professional Conduct

LOS 1.2: The AIMR Standards are organized into five categories:
Fundamental Responsibilities, Relationships with and Responsibilities to the Profession, Relationships with and Responsibilities to the Employer, Relationships with and Responsibilities to Clients and Prospects, Relationships with and Responsibilities to the Investing Public. Each category contains multiple concepts for which the candidate is responsible. The candidate should be able to identify the ethical responsibilities required by the Coda and Standards in these areas.

Standard I: Fundamental Responsibilities
Members shall:

1. *Maintain knowledge of and comply with all applicable laws, rules, and regulations (including AIMR's Code of Ethics and Standards of Professional Conduct) of any government, governmental agency, regulatory organization, licensing agency, or professional association governing the members' professional activities.*
2. *Not knowingly participate or assist in any violation of such laws, rules or regulations.*

Do

- check the governing law. If it is more strict than the code, the governing law applies; if it is less strict than the code, the code applies.

- go to the legal council/ supervisor whenever you suspect a violation by your employer, .
- If it becomes clear that your employer does violate the law, urge them to stop. If this does not help, you must dissociate (e.g. by resigning). You don't need to report legal violations to the authorities (but it may be a good idea anyway).
- keep informed on your legal obligations. Maintaining files on all applicable law, regulation etc. can help. Also update your procedures to keep them in line with the governing law.

Don't

- break the law.

Standard II: Fundamental Responsibilities

Standard II (A): Use of Professional Designation

1. *AIMR members may reference their membership only in a dignified and judicious manner. The use of the reference may be accompanied by an accurate explanation of the requirements that have been met to obtain membership in these organizations.*
2. *Those who have earned the right to use the Chartered Financial Analyst designation may use the marks 'Chartered Financial Analyst' or 'CFA' and are encouraged to do so, but only in a proper, dignified, and judicious manner. The use of the designation may be accompanied by an accurate explanation of the requrements that have been met to obtain the right to use the designation.*
3. *Candidates in the CFA Program, as defined in the AIMR Bylaws may reference their participation in the CFA Program, but the reference must clearly state that an individual is a candidate in the CFA Program and cannot imply that the candidate has achieved any type of partial designation.*

Do

- use the CFA designation if you have earned it, but only in a dignified way (the way defined by AIMR). You can explain to people you had to do to obtain the right to use the CFA designation, as long as you stick to statements of fact.
- tell people that you are a candidate in the CFA program, but be careful with the terms. You are a level II candidate only if a) you have enrolled in level II (and have obtained the confirmation from AIMR) and b) you have not yet received your results for level II. If you have passed level I but you are not yet candidate for level II, you may tell everybody that you have passed.

Don't

- use CFA as a noun (it is an adjective). Do not call somebody a CFA or a Chartered Financial Analyst, but a CFA charterholder. Be careful with spelling (C.F.A. and cfa are not permitted).
- claim to be a CFA charterholder, if this is not true. Note: you are not a CFA charterholder if you didn't pay this year's membership fee to AIMR, or if AIMR has kicked you out!
- use the CFA designation if you have not received the charter (even if you have passed all three exams).
- AIMR does not allow you to tell people that you have passed all three exams on the first try.
- use the CFA designation in the name of your company, or type it bigger or bolder than your own name on your business card.

Standard II (B): Professional Misconduct

1. *Members shall not engage in any professional conduct involving dishonesty, fraud, deceit, or misrepresentation or commit any act that reflects adversely ontheir honesty, trustworthiness, or professional competence.*
2. *Members and candidates shall not engage in any conduct or commit any act that compromises the integrity of the CFA designation or the integrity or validity of the examinations leading to the award of the right to use the CFA designation.*

Don't

- use drugs, drink excessively over lunch, drive like an idiot, fuck you bosses wife or cheat during a CFA exam.

Standard II (C): Prohibition against Plagiarism
Members shall not copy or use, in substantially the same form as the original, material prepared by another without acknowledging and identifying the name of the author, publisher, or source of such material. Members may use, without acknowledgment, factual information published by recognized financial and statistical reporting services or similar sources.

Do

- always acknowledge sources - in writing, in oral presentations, phone conferences ...

- use without acknowledgement information provided by Standard and Poors, Moody's, any Statistical office etc.
- maintain documentation of all your sources.
- If you represent your firm to a client, a summary attribution to your research staff is enough; if you represent yourself (e.g. as expert witness), a more precise attribution is necessary (also to show the limits of your expertise).

Don't

- use excerpts from others, either verbatim or with slight changes, without acknowledgement.
- cite with attribution to 'leading analysts' or 'investment experts'.
- omit qualifying statements when attributing analysis to somebody else.
- use charts or graphs without acknowledgement.
- copy spreadsheets or algorithms without authorization by the author.

Standard III: Relationships with and Responsibilities to the Employer

To determine whether somebody is your employer, look at:

- extent of employer's control and supervision
- kind of occupation / skills required
- responsibility for cost of operations
- payments and benefits arrangements
- length of job commitment

Standard III (A): Obligation to Inform Employer of Code and Standards
Members shall:

1. *Inform their employer in writing, through their direct supervisor, that they are obligated to comply with the Code and Standards and are subject to disciplinary sanctions for violations thereof.*
2. *Deliver a copy of the Code and Standards to their employer if the employer does not have a copy.*

Do

- inform your direct supervisor in writing (= anything that can be documented, like e-mail, letter etc.)

Don't

- assume that anybody else will inform your employer for you (even if your direct supervisor is a CFA charterholder).
- inform your employer, if he has adopted the standard as part of the firm's policies.

Standard III (B): Duty to Employer
Members shall not undertake any independent practice that could result in compensation or other benefit in competition with their employer unless they obtain written consent from both their employer and the persons or entities for whom they undertake independent practice.

Do

- be loyal to your employer.
- inform your employer and your other clients of the two arrangements.

Don't

- engage in competitive business without permission; however, you may prepare to begin such practice without permission.
- misappropriate trade secrets, misuse confidential information, conspire for mass resignation, solicitate employer's clients, appropriate a business opportunity for yourself or misappropriate client list when preparing your own competitive business.
- do not take anything with you that belongs to your employer (including the stuff you prepared for him).

Standard III (C): Disclosure of Conflicts to Employer
Members shall:

1. *Disclose to their employer all matters, including beneficial ownership of securities or other investments, that reasonably could be expected to interfere with their duty to their employer or ability to make unbiased and objective recommendations.*
2. *Comply with any prohibitions on activities imposed by their employer if a conflict of interest exists.*

Do

- report anything that reasonably can be expected to influence your decisions, e.g. beneficial ownership (= ownership by you or your wife or your dad) of a substantial amount of stock in a company, seats in a board, being a trustee, private referral arrangements.

Don't

- report insubstantial stuff like negligible holdings, jobs of more distant relatives, client relationships with a company etc.

Standard III (D): Disclosure of Additional Compensation Arrangements
Members shall disclose to their employer in writing all monetary compensation or other benefits that they receive for their services that are in addition to compensation or benefits conferred by a members's employer:

Do

- inform your employer about any direct or indirect compensation. That standard does not forbid such additional compensation, but your employer may forbid it if he thinks that an arrangement will violate his or his client's interest.

Standard III (E): Responsibilities of Supervisors
Members with supervisory responsibility, authority, or the ability to influence the conduct of others shall exercise reasonable supervision over those subject to their supervision or authority to prevent any violation of applicable statutes, regulations, or provisions of the Code and Standards. In so doing, members are entitled to rely on reasonable procedures designed to detect and prevent such violations.

Do

- make sure the employees below you do not violate the standard.
- As you can't oversee them all the time, you should do so by relying on rules and procedures that make sure the employees behave as they should. It is your responsibility that such rules and procedures are in place! If they are in place, and you can rely on a reasonable compliance system, you are not responsible for the violations of your employees. For this to be true, the rules must be disseminated among employees (in manuals and guidelines). Their scope and procedures must be clear. A compliance system is also necessary with procedures to report violations and sanctions against wrongdoers, a reviewing and enforcement procedure. If violations are detected, you must make sure that sanctions are imposed and that repeated violations are prevented.

- delegate supervisory duties. However, delegation does not relieve you from your supervisory responsibilities.

Don't

- accept supervisory power if no rules and procedures are put in place.
- rely on rules if you know that they are not followed.

Standard IV: Relationships with and Responsibilites to Clients and Prospects.

Standard IV(A.1): Investment Process - Reasonable Basis and Representations
Members shall:

1. *Exercise diligence and thoroughness in making investment recommendations or in taking investment actions.*
2. *Have a reasonable and adequate basis, supported by appropriate research and investigation, for such recommendations or actions.*
3. *Make reasonable and diligent efforts to avoid any material misrepresentation in any research report or inveestment recommendation.*
4. *Maintain appropriate records to support the reasonableness of such recommendations or actions.*

Do

- rely on your own diligent research or a reliable source both within or outside your firm.
- analyze basic characteristics of an instrument, analyze portfolio needs and maintain files to justify your conclusions.

Don't

- issue recommendations or take investment decisions if you do not have the time or capacities to do a thorough analysis.
- follow fads.

Standard IV(A.2): Investment Process - Research Reports
Members shall:

1. *Use reasonable judgment regarding the inclusion or exclusion of relevant factors in research reports.*
2. *Distinguish between facts and opinions in research reports.*
3. *Indicate the basic characteristics of the investment involved when preparing for public distribution a research report that is not directly related to a specific portfolio or client.*

Note: Reports include any kind of communication, including in-person recommendations, phone conversations, media broadcasts or internet messages. The nature of reports can range from a simply buy/sell recommendation to a detailed reports.

Do

- base your recommendations on reasonable judgment.
- explain basic characteristics of recommended instruments.
- explain the basis of your recommendations. If you use a model, explain the factors in it.
- tell readers of short reports (buy/sell) that more information is available.

Don't

- issue recommendations based on fads.
- mix past and future. Warn your readers that past data are not guarantee for the future.
- mix opinion with facts. Avoid sloppy language like 'based on the fact...', 'given that ...', when you are talking about assumptions.

Standard IV(A.3): Investment Process - Independence and Objectivity
Members shall use reasonable care and judgment to achieve and maintain independence and objectivity in making investment recommendations or taking investment action.

Do

- avoid anything that could appear of a conflict of interest.
- pay for your own travel, hotel, meals etc. if you are invited on a business trip. However, if the trip is purely for business, locations cannot be reached by normal means of transport and if the hotels are modest, you may accept an invitation. Pretty fuzzy standard!

- disclose all corporate relationships, personal or beneficial holdings.
- put in place a compliance system with restricted lists, restrictions on special cost arrangements and review of procedures.

Don't

- accept gifts exceeding 100$. If the gift comes from client, you may accept it, but you must disclose it to your employer.
- issue recommendations dictated by your boss.

Standard IV(B.1): Interaction with Clients and Prospects - Fiduciary Duties
In relationships with clients, members shall use particular care in determining applicable fiduciary duty and shall comply with such duty as to those persons and interests to whom the duty is owed. Members must act for the benefit of their clients and place their clients' interest before their own.

Do

- act only in the interest of those to whom you owe fiduciary duty.
- determine to whom you owe the duty. In case of pension funds, you owe it to the beneficiaries and not the management! If there is a conflict of interest between those that give you a mandate and the beneficiaries (e.g. takeover bids for a firm whose pension plan assets you manage), you must only follow the interest of the beneficiaries.
- always seek best price and execution.
- respect fiduciary duty in proxy votes. You must examine what votes are in your client's interest and vote accordingly (abstaining is not enough, since the proxy has economic value).

Don't

- buy something for yourself with client brokerage.

Special Case: ERISA

Under ERISA, the following applies:

- act only in the interest of the plan participants and beneficiaries;
- act with the care, skill, prudence and diligence of a prudent person acting in like capacity;

- diversify to protect assets from risk of substantial loss;
- respect the plan documents as long as they comply with ERISA;
- do not engage in prohibited transactions.

Special Topic: Soft Dollars

In order to deal with the fiduciary duty issues related to client brokerage, AIMR has formulated a voluntary Soft Dollar Standard. This standard has to be seen in the context of US Law. The SEC grants 'safe harbor protection' if an asset manager uses client brokerage to purchase research that 'provides lawful and appropriate assistance to an investment manager in the investment decision-making process'. The Soft Dollar Standard clarifies and further develops this safe harbor protection.

The following principles must be observed under the Soft Dollar Standard:

- Brokerage refers to what the broker retains on a trade. It can take the form of a broker commission (= agency trades) or of a spread (= principal trades; note that principal trades are not covered by the SEC safe harbor but it is covered by the AIMR standard). Part of brokerage is used to pay the broker for execution services. In addition to this, the brokers provide asset managers with research and other services. This research can be in-house research produced by the broker himself (not covered by SEC) or third-party research.
- Since you pay brokerage with client money, everything your receive from the broker is a property of the client and, by principle, must be used for the client. In order to be useful for the client, research and other services obtained for brokerage have to meet some criteria. Specifically, their primary use must be to assist the investment manager in its investment decision-making process and not in the management of the investment firm. Only then can you pay theses services with client brokerage.
- To test whether research meets these criteria, AIMR proposes a three-level analysis. Level 1: Define (narrowly) the product or service. For AIMR, components of research can go as far as a computer work station [sic!], but electricity to run the work station is no longer considered as research related product. Level 2: Determine the usage. Only products which are used for the management of the client portfolio are eligible. Level 3: Some research will be of mixed use (both to the client and to the asset manager). In this case, you must split the costs and pay the part that serves the asset manager with the asset manager's resources.
- A client may direct brokerage (= client-directed brokerage). In this case, the manager must still seek best price and execution and make sure that goods and services purchased with brokerage benefit the account beneficiaries (particularly under ERISA).

If possible, avoid client-directed brokerage arrangements that commit a certain percentage of trades to a particular counterparty.

- The SEC already requires the disclosure of all brokerage arrangements (= arrangement what the broker provides in excess of execution). The standard goes beyond these requirements. In particular, asset managers must disclose the types of research they receive, the extent of its use, the amount of brokerage generated (both on a firm and account basis).

- The standard requires that records are kept on everything related to client brokerage. Here, the idea is that claims on compliance with the standard can be verified by an audit.

- The standard has required and recommended parts. You can claim compliance if you comply with all required parts. A statement of compliance is always account specific, i.e. you can state that any brokerage arrangement with respect to that client's account comports with the mandatory provisions of the standard.

Special Topic: Corporate Governance

If you hold a stock for your client, you may also have to defend the client's interest as a shareholder by voting proxies proxies. Asset managers that have the responsibility to vote proxies must adopt procedures to ensure that issues are noted, analyzed and considered before voting.

There are many obstacles to an effective proxy voting procedure: lack of clear policy, the sheer number of routine proxy votes, the perception that passive funds are not responsible to vote (which is wrong), operational problems for voting abroad, the perception that delegation solves the problem (which is wrong: you still have to monitor the vote of your consultant).

To overcome these obstacles, AIMR recommends the following:

1. Designate a policy-making body that sets a policy or guideline and discusses the proxy votes at hand. It should also formulate a policy of when to consult with clients before proxy votes.

2. Identify major proxy issues by particular accounts. Note that sometimes proxy vote guidelines can be contradictory between accounts. In this case, the manager should do his best to reconcile...

3. Set up rules and procedures for the administration of proxy votes. Define who actually goes and votes. Design a system to monitor your custodians. Educate staff. Avoid conflicts of interest.

Standard IV(B.2): Interaction with Clients and Prospects - Portfolio Recommendations and Actions
Members shall:

1. *Make a reasonable inquiry into a client's financial situation, investment experience, and investment objectives prior to making any investment recommendations and shall update this information as necessary, but not less frequently than annually, to allow the members to adjust their investment recommendations to reflect changed circumstances.*

2. *Consider the appropriateness and suitability of investment recommendations or actions for each portfolio or client. In determining appropriateness and suitability, members shall consider applicable relevant factors, including the needs and circumstances of the portfolio or client, the basic characteristics of the investment involved, and the basic characteristics of the total portfolio. Members shall not make a recommendation unless they reasonable determine that the recommendation is suitable to the client's financial situation, investment experience, and investment objectives.*

3. *Distinguish between facts and opinions in the presentation of investment recommendations.*

4. *Disclose to clients and prospects the basic format and general principles of the investment processes by which securities are selected and portfolios are constructed and shall promptly disclose to clients and prospects any changes that might significantly affect those processes.*

Do

- make sure you fully understand your client's investment needs before you make an investment for her. Get information about: investment needs, risk tolerance, constrains. Repeat your inquiry at least annually.

- base your actions with a view to the entire portfolio.

- inform all your clients whenever you change your investment process or valuation models.

Don't

- invest before a thorough inquiry into your client's investment needs. Only exception: you have a new client, have not done yet the inquiry and a bond reaches maturity; in this case, invest the proceeds in a cash-equivalent form.

- treat two investors with different risk aversion the same.

Standard IV(B.3): Interaction with Clients and Prospects - Fair Dealing
Members shall deal fairly and objectively with all clients and prospects when disseminating investment recommendations, disseminating material changes in prior investment recommendations, and taking investment action Do

- ensure that information is disseminated in such a manner that all clients have a fair opportunity to act upon every recommendation.
- prorate oversubscribed issues to all subscribers (do not keep any for yourself or your family!); offer the issues to all clients for which they are appropriate.
- make bona fide public distributions of hot issue securities.
- inform all clients of changes in your strategy.
- put in place a compliance system that ensures fair dealing (limit access to information, shorten time between decision and dissemination, publish guidelines, ensure simultaneous dissemination, control trading, establish a procedure of how to deal with material changes, develop a trade allocation procedure, disclose to clients all levels of service.

Don't

- discriminate against any client (avoid favoritism); never give out information to only one group of clients if the information is relevant to other clients.
- treat your funds better than your clients.
- carry out cross-transactions without procedures that ensure best execution for both parties.

Standard IV(B.4): Interaction with Clients and Prospects - Priority of Transactions
Transactions for clients and employers shall have priority over transactions in securities or other investments of which a member is the beneficial owner so that such personal transactions do not operate adversely to their clients' or employer's interest. If members make a recommendation regarding the purchase or sale of a security or other investment, they shall give their clients and employer adequate opportunity to act on the recommendation before acting on their own behalf. For purposes of the Code and Standards, a member is a 'beneficial owner' if the member has:

1. *a direct or indirect pecuniary interest in the securities;*
2. *the power to vote or direct voting of the shares of the securities or investments;*
3. *the power to dispose or direct the disposition of the security or investment.*

Do

- trade only for your own account when you have given to your clients an adequate opportunity to act on your recommendation.
- treat family accounts that are firm accounts like any other account of the firm (no advantage or disadvantage from being a family account: parents are entitled to the same service as all the other clients); however, pre-clearance may still be required by your firm.

Standard IV(B.5): Interaction with Clients and Prospects - Preservation of Confidentiality
Members shall preserve confidentiality of information communicated by clients, prospects, or employers concerning matters within the scope of the client-member relationship unless the member receives information concerning illegal activities on the part of the client, prospect, or employer.

Note: you are bound by confidentiality only if
(1) you receive the information on the basis of your ability to conduct a portion of the client's business or personal affairs, and
(2) the information is connected to the portion of the client's business subject to your confidential relationship.

Do

- give all confidential information to AIMR under a Professional Conduct Program investigation: all information under the PCP is treated in strictest confidentiality. You are not even allowed to execute settlement agreements that prohibit any party to provide information to a PCP investigation.
- seek legal advice if you find something illegal in your confidential relationship.

Don't

- use confidential information to your own advantage.
- give confidential information away, even if nobody would be hurt.

Standard IV(B.6): Interaction with Clients and Prospects - Prohibition against Misrepresentation
Members shall not make any statements, orally or in writing, that misrepresent

1. *the services that they or their firm are capable of performing;*
2. *their qualifications or the qualifications of their firm;*
3. *the member's academic or professional credentials.*

Members shall not make or imply, orally or in writing, any assurances or guarantees regarding any investment except to communicate accurate information regarding the terms of the investment instrument and the issuer's obligations under the instrument.

Note: this standard applies to any form of communication (written and oral, disseminated or not).

Do

- clearly communicate capabilities and limits of your firm and yourself.

Don't

- pretend that you are qualified to provide a service if this is not true.
- overstate your qualifications.
- misrepresent the expected performance (e.g. by 'guarantee' a certain performance) or terms of an investment.

Standard IV(B.7): Interaction with Clients and Prospects - Disclosure of Conflicts to Clients and Prospects
Members shall disclose to their clients and prospects all matters including beneficial ownership of securities or other investments, that reasonable could be expected to impair the member's ability to make unbiased and objective recommendations. Do

- disclose everything, and in plain language, that may influence your recommendations (material ownership, underwriting or financial responsibilities, broker/ dealer/ market-making activities, membership in board of directors etc).
- even disclose relationships that only can give a wrong impression of bias.

Standard IV(B.8): Interaction with Clients and Prospects - Disclosure of Referral Fees
Members shall disclose to clients and prospects any consideration or benefit received by the member or delivered to others for the recommendation of any services to the client or prospect. Do

- inform all clients of any benefit received for referrals.

Standard V: Relationships with and Responsibilities to the Investing Public

Standard V(A): Prohibition against Use of Material Nonpublic Information
Members who possess material nonpublic information related to the value of a security shall

not trade or cause others to trade in that security if such trading would breach a duty or if the information was misappropriated or relates to a tender offer. If members receive material nonpublic information in confidence, they shall not breach that confidence by trading or causing others to trade in securities to which such information relates. Members shall make reasonable efforts to achieve public dissemination of material nonpublic information disclosed in breach of a duty.

If you are in doubt whether you can trade on a piece of information, ask yourself the following sequence of questions:

1. *Is the information public?* If yes, you can trade. Otherwise:
2. *Would the disclosure of the information have an impact on the price of a security?* If no, then the information is not material and you may trade. If the information is not material, but put together with other public information, a material conclusion can be drawn, then you may refer to the **mosaic theory** (= putting together material public and immaterial non-public information to draw a material conclusion; the mosaic theory is a valid defense against the accusation of insider trading) and trade. Otherwise:
3. *Does the information relate to a tender offer?* If yes, then you may not trade. Otherwise:
4. *Has somebody obtained the information by deceit?* For example, somebody could have stolen a file, a newspaper printer could have leaked the information, or a psychotherapist could have used the information obtained in the therapy of a CEO. If something like this is the case, then the information has been misappropriated and you may not trade on it. Otherwise:
5. *Are you an insider, i.e. you have received the information within a relationship of confidence?* If yes, then you are not allowed to trade. Otherwise:
6. *Have you received the information from an insider who breaches a duty by giving the information to you?* A good test is to ask whether the tipper personally benefits directly or indirectly from the disclosure. If this is the case, you may not trade (but try to achieve public dissemination). Otherwise, go ahead and trade.

Standard V(B): Performance Presentation

1. *Members shall not make any statements, orally or in writing, that misrepresent the investment performance that they or their firm have accomplished or can reasonably be expected to achieve.*
2. *If members communicate individual or firm performance information directly or indirectly to clients or prospective clients, or in a manner intended to be received by*

> *clients or prospective clients, members shall make every reasonable effort to assure that such performance information is a fair, accurate, and complete presentation of such performance.*

Special Case: AIMR Performance Presentation Standards

AIMR has formulated the PPS in order to achieve greater uniformity and comparability among performance presentations, to improve the service offered to investment management clients, to enhance the professionalism of the industry, and to bolster the notion of self-regulation. The standard has four sections:

1. Construction and Maintenance of Composites. All fee-paying discretionary accounts must be included in at least one composite which contains other accounts with a similar strategy or investment objective. Composite return is asset-weighted.
2. Calculation of Returns. Standard prescripes time-weighted total rate of return.
3. Presentation. AIMR sets some vague guidelines.
4. Firms have to disclose a number of things, like the calculation method.

A firm can only claim compliance with the PPS if it complies on a firmwide basis (i.e. not on a composite basis) and in all material respects (i.e. you cannot claim 'compliance, except...'). In addition to the PPS, AIMR works on a global standard (GIPS).

Do

- calculate composites as proposed in the PPS.
- include all accounts in your composites. Don't hide your bad accounts!

Don't

- promise future performance based on your (short) track record.
- claim compliance to the PPS if you don't meet all the requirements.
- use the performance an employee achieved with an other employer.
- use simulated performance results in performance presentations (except if you clearly identify them as such).

Preparing for the Prudent Investor Rule

LOS 1.4.a: Differentiate between the Prudent Man Rule and the Prudent Investor Rule by illustrating the underlying concepts of each.

Prudent Man Rule: Based on the *Harvard College Rule* that '... a fiduciary shall exercise the judgment and care [...] which men of prudence, discretion and intelligence exercise in the management of their own affairs, not in regard to speculation but in regard to the permanent disposition of their funds [...].' Hence, the rule precludes investments in assets that are considered speculative. Instead, a list of 'safe' assets is drawn that make sure no principal is lost. Some assets are imprudent per se.

Prudent Investor Rule: Based on modern portfolio theory. Instead of a list of eligible assets, the fiduciary must construct a portfolio that meets the risk/return profile of the trust.

LOS 1.4.b: Show how the principles of the Prudent Investor Rule relate to modern portfolio theory.

- Portfolio strategy is based on risk-and-reward objective. In order to meet a trust's objectives, some risk must be taken.
- Risk is defined from a portfolio perspective. Hence, covariances become at least as important as variances. Some assets, which were previously considered imprudent, actually reduce risk in a global portfolio context.
- Diversification is crucial for an efficient portfolio.

LOS 1.4.c: Identify violations of fiduciary duty.

Under the Prudent Investor Rule, fiduciary duty is violated if:

- The portfolio strategy is not in line with the trust's risk-and reward objectives, e.g. the risk is too low to achieve the return objective. Objectives must be reviewed on a regular basis.
- The portfolio manager takes investment decisions without analyzing the impact on total portfolio risk.
- The portfolio is not sufficiently diversified.

See also standard IV(B.1).

LOS 1.4.d: Discuss how the Prudent Investor Rule changes fiduciary responsibility with regard to investment policy.

- The rule is more dynamic than the prudent man. Needs of a trust must be updated regularly and the risk-and-reward objectives must be adjusted accordingly.
- More factors must be monitored and the fiduciary must take their interrelations into account.
- The rule permits and encourages the delegation of investment decisions to professionals.
- In order to achieve diversification, investments in mutual funds can be necessary.
- The rule requires a higher standard of documentation of investment decisions.

Study Session 2

Ethical and Professional Standards (Part 2)

2.1 Standards of Practice Casebook

LOS 2.1.A: Introduction to the Casebook

Keep in mind that in addition to the obvious sins, the following principles are often candidates for violations:

Fundamental Responsibilities: You must make sure that you know all the rules and regulations.

Professional Misconduct: Everything dishonest is a violation.

Duty to inform your employer: Make sure your employer knows that you are bound be the standard.

Responsibility of Supervisors: Whenever somebody violates the standard, a supervisor has generally not done his job. It is not enough to find and punish wrongdoers, but a system must be installed that prevents violations.

The introduction also briefly summarizes the disciplinary process. This process is based on three principles: fairness, confidentiality, and peer review (tell AIMR if anybody violates the standard). If you see a violation, inform the PCP. PCP staff under a designated officer and a professional standards and policy committee will then start an inquiry and determine if disciplinary action is warranted. Possible sanction: private censure, public censure, suspension of membership, revocation of membership, suspension or revocation of the CFA designation, suspension from participation in the CFA program.

LOS 2.1.B: The Glenarm Company

Issues touched upon in this case:

Informing the employer of code and standards: You must inform your employer that you are bound by the standard and provide a copy if he hasn't got one. Moreover, before you join a firm, make sure you will be able to obey to the standard (be careful if the company had legal problems in the past).

Solicitation of clients and prospects: While you are still employed, you owe loyalty to the employer. You must not solicit existing or potential clients of your current employer.

Misappropriation of employer property: Don't take with you anything that belongs to your employer, including the research you've done yourself, except if you have the explicit permission from the employer.

Disclosure of additional compensation: Any additional compensation arrangement must be disclosed in detail to your employer. If you don't, you will probably also violate your obligation to disclose sources of conflict and maybe your obligation of independence and objectivity.

LOS 2.1.C: Preston Partners

Issues touched upon in this case:

Reasonable basis and representations: You must make your own due diligence investigation before any recommendation or investment decision. A fad or a casual observation are not enough to justify a decision.

Portfolio investment recommendations and actions: Any recommendation or action must take into account the portfolio needs. If you buy a stock without differentiating, you violate the standard. Compliance procedures should include a written policy statement for each portfolio that is reviewed at least annually. As a compliance officer, make sure this review has been carried out.

Allocation of trades: Trades must be allocated fairly (not necessarily equally) to your clients. The fairest solution is to allocate trades immediately following each segment of a block trade on a pro rata basis. A asset management firm should formulate detailed guidelines on trade allocation that ensure (1) fairness to clients both in priority and price, (2) timeliness and efficiency in execution, and (3) accuracy in trade records. The procedures must be disclosed to the clients in writing.

LOS 2.1.D: Super Selection

Issues touched upon in this case:

Role of the compliance officer: A compliance officer should have the authority to hire, fire, reward and punish an employee. She must comply with the responsibilities of supervisors, i.e. do everything necessary to prevent violation of the standard. If the compliance officer finds a problem, she should recommend to senior management remedial action, including sanctions against any wrongdoer and adjustments to existing procedures. If no action is taken, the compliance officer should take additional steps which may include her resignation.

Disclosure of conflicts to the employer: Any substantial beneficial ownership must be disclosed to the employer.

Reasonable basis: Never ever issue a recommendation that does conflict with your own opinion! Instead, diligently research the issue and then formulate your recommendation based on the findings of your research.

Fiduciary duty: Your client's interest is the sole legitimate motivation for a trade in your client's portfolio. Anything else constitutes a breach of fiduciary duty. You must always identify to whom you owe fiduciary duty.

Priority of transactions: Don't trade in your account before you trade in client accounts. The firm should put in place procedures that ensure the priority of client transactions, like monitoring of personal accounts.

2.2 Trade Allocation: Fair Dealing and Disclosures

LOS 2.2.a: Demonstrate the violations of the Code and Standards that occur by entering into trading allocations on an ad hoc basis.

- Ad hoc allocations open the door to favoring one type of client (e.g. performance-based accounts) over another (e.g. asset-based accounts). In the case under review, this was done in normal trades and hot IPOs. Under ad hoc allocations, it is also possible to direct losses only to one type of account. All this is a violation to the fair dealing requirement (Standard IV.B.3) and of fiduciary duty (Standard IV.B.1).

- Trade allocation procedures should be disclosed to the clients. Failure to do so, represents a violation of the standard. Moreover, disclosure is required by US Law (even if US Law is less strict on fair dealing). Hence, if you don't disclose your procedures, you also violate fundamental responsibilities (Standard I).

LOS 2.2.b: Describe the steps necessary to ensure that adequate trade allocations practices are followed.

- Obtain advance indication of client interest.

- Allocate new issues by client rather than portfolio manager.

- Adopt a pro rata or other fair allocation method.

- Treat all clients fairly in terms of price and execution.

- Keep records and periodically review all accounts.

2.3 Changing Investment Objectives

LOS 2.3.a: Demonstrate the violations of the Code and Standards that occur through improper disclosure of investment product or style.

In the case at hand, an asset manager deviated from the investment policy recited in the prospectus without shareholder approval (he invested in securities of which he said he had no intention to invest in; this also changed the fund's characteristic of a low volatility investment). This is a violation of the obligation to disclose the basic format and principles of the investment process and also to disclose any significant change (Standard IV.B.2.d). Moreover, the behavior of the asset manager violated SEC regulation and therefore fundamental responsibilities (Standard I).

LOS 2.3.b: Describe the steps necessary to ensure adequate disclosure of the investment process.

- Make a reasonable inquiry into a client's financial situation, investment experience and objectives.
- Disclose the general format and principles of the investment process.
- Implement regular checks for each account if the investment policy is adhered to.
- Inform clients and prospects of any change.

2.4 Compensation for Trading Errors

LOS 2.4: Demonstrate how improperly attempting to compensate for trading errors may lead to potential violations of the Standards of Professional Conduct.

The article is about the practice that a broker takes losses produced by trading errors on his books and compensates them with future trades. This is a violation of SEC rules: 'if an investment manager makes an error while placing a trade for an account, then the investment manager [...] must bear any costs of correcting such trade.' The SEC even forbids arrangements that errors are paid by brokerage, basically because brokerage is a property of the client and such arrangements reduce the amount of services the that the broker would otherwise provide. Hence, the practice violates fundamental responsibilities (Standard I).

According to the box, the practice may violate other standards: in covering an error committed in a trade for one client with brokerage of another client, you may violate the fair dealing requirement (Standard IV.B.3)[1] and the act can be perceived as putting your own interest over that of your client (which violates Standard IV.A.3 - Independence and Objectivity).

2.5 Soft Dollars

LOS 2.5.a: State the two fundamental principles involved in evaluating any soft dollar arrangements.

1. All client commissions paid to a broker are the property of the client.
2. Investment managers have a duty to ensure the quality of transactions effected on behalf of their clients.

LOS 2.5.b: Identify four requirements for meeting fiduciary obligations with regard to soft dollar arrangements.

1. Always seek best execution.
2. Goods and services purchased with brokerage must directly benefit the client or the asset manager with the investment decision-making process.
3. Commissions paid must be reasonable in relation to the service provided.
4. All soft dollar practices must be fully disclosed.

LOS 2.5.c: Identify violations of the Standards of Professional Conduct through improper use of soft dollar arrangements.

Any use of client brokerage to purchase goods and services that benefit the asset manager rather than the client constitutes a breach of fiduciary duty. Failure to disclose any soft dollar arrangement violates the standard and, in addition, current SEC regulation.

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[1] AIMR is not very consistent on this point. If you have to pay an error yourself, then paying with brokerage of any client does not favor another client but only yourself.

Study Session 3

Quantitative Methods

3.1 Hypothesis Testing

LOS 3.1.A.a: Define a hypothesis and describe the steps of hypothesis testing.

A hypothesis is a statistically testable statement about the value of a parameter such as the mean of a population.

The steps in testing a hypothesis are:

1. state the hypothesis
2. identify the test statistic and its probability distribution
3. specify the significance level
4. state the decision rule
5. collect the data and perform the calculations
6. make the statistical decision
7. make the economic investment decision

LOS 3.1.A.b: Define and interpret the null hypothesis and alternative hypothesis.

The null hypothesis is the hypothesis to be tested. It is considered true unless rejected by a statistical test.

The alternative hypothesis is the hypothesis (provisionally) accepted if the null is rejected.

LOS 3.1.A.c: Discuss the choice of the null and alternative hypotheses.

The alternative hypothesis is what you suspect on the grounds of your theory. Chose the null hypothesis such that rejection of the null leads to acceptance of the alternative.

LOS 3.1.A.d: Distinguish between one-tailed and two-tailed hypothesis tests.

LOS 3.1.A.e: Define and interpret a test statistic.

A test statistic is a quantity calculated on the basis of a sample, whose value is the basis for deciding whether to reject or not reject the null hypothesis.

LOS 3.1.A.f: Define and interpret a significance level and explain how significance levels are used in hypothesis testing.

The significance level is the level of risk to commit a type I error (α) you are willing to accept when rejecting the null hypothesis. Basically, it intervenes at the level of the decision rule.

LOS 3.1.A.g: Define and interpret Type I and Type II error.

Type I error = reject the null although it is true.

Type II error = do not reject the null although it is wrong.

LOS 3.1.A.h: Define the power of a test.

The power of a test is the probability of correctly rejecting the null.

LOS 3.1.A.i: Define and interpret a decision rule.

A critical value for a test statistic is a value against which a test statistic is compared to decide whether to reject or not to reject the null hypothesis. The decision rule says at what values the test statistic can take for the null to be rejected or accepted. In other words, it defines the acceptance and rejection regions of the test statistic.

LOS 3.1.A.j: Explain the relationship between confidence intervals and tests of significance.

The confidence interval gives a range within which the population parameter will lay with a certain probability. Significance tests, in contrast, look at the probability that a test statistic lays outside a given range defined by the population (the acceptance region). In most practical tasks, the width of the two ranges is inversely related. This means: A $p\%$ significance level gives an acceptance region around H0 for the test statistic that corresponds to the width of a $(1-p)\%$ confidence interval around the value of the estimated parameter. Testing whether the test statistic lays within the acceptance region is then equivalent to testing whether HO lays within the confidence interval.

LOS 3.1.A.k: Distinguish between a statistical decision and an economic decision.

Statistical decision = decision based on statistical test.

Economic decision = decision if you can make money (after transaction costs) with the results of your analysis.

LOS 3.1.A.l: Discuss the p-value approach to hypothesis testing.

The p-value is the smallest level of significance at which the null hypothesis can be rejected. Use it to compare results of analyses with different levels of significance (one researcher with a low significance level will reach different conclusions than a researcher with a high level of significance; p-values don't care.)

LOS 3.1.A.m: Select the test statistic for a hypothesis test regarding the population mean of a normal distribution with known and unknown variance.

You would normally use the t-test,

$$\frac{\overline{x}-\mu_0}{s/\sqrt{n}} \quad or \quad \frac{\overline{x}-\mu_0}{\sigma/\sqrt{n}} \quad \sim t(n-1).$$

Use the left version if you don't know σ. The t-distribution is relatively robust to deviations from normality and can be used for small samples. If n gets big, the t-distribution will get close to the standard normal, and a z-test can be used instead:

$$\frac{\overline{x}-\mu_0}{s/\sqrt{n}} \quad or \quad \frac{\overline{x}-\mu_0}{\sigma/\sqrt{n}} \quad \sim z \equiv N(0,1)$$

LOS 3.1.A.n: Explain the use of the z-test in relation to the central limit theorem.

According to the CLT, the sampling distribution of the mean will approach a normal distribution with a mean of the population mean and a variance of σ^2/n. Because of normality, we can use the normal distribution to carry out test on the mean.

LOS 3.1.A.o: Formulate the null and an alternative hypothesis about a population mean and determine whether the null hypothesis is rejected at a given level of significance.

1. H0: $\mu_x = \mu_0$ versus H1: $\mu_x \neq \mu_0$
2. H0: $\mu_x \leq \mu_0$ versus H1: $\mu_x > \mu_0$

3. H0: $\mu_x \geq \mu_0$ versus H1: $\mu_x < \mu_0$

LOS 3.1.A.p: Identify the test statistic for a hypothesis test regarding the equality of two population means of two normally distributed populations based on independent samples.

There are two (nasty) versions of the t-test. If you can assume that the variance of the two populations are equal, use:

$$\frac{(\overline{x_1} - \overline{x_2}) - (\mu_1 - \mu_2)}{\sqrt{\frac{s_p^2}{n_1} + \frac{s_p^2}{n_2}}} \sim t(n_1 + n_2 - 2).$$

where $s_p^2 = \frac{(n_1-1)s_1^2+(n_2-1)s_2^2}{n_1+n_2-2}$. If the population variance cannot be assumed to be equal, the following test statistic must be used instead:

$$\frac{(\overline{x_1} - \overline{x_2}) - (\mu_1 - \mu_2)}{\sqrt{\frac{s_1^2}{n_1} + \frac{s_2^2}{n_2}}} \sim t\left(\frac{[s_1^2/n_1 + s_2^2/n_2]^2}{\frac{[s_1^2/n_1]^2}{n_1} + \frac{[s_2^2/n_2]^2}{n_2}}\right).$$

LOS 3.1.A.q: Formulate a null and an alternative hypothesis about the equality of two population means (normally distributed populations, independent samples) and determine whether the null hypothesis is rejected at a given level of significance.

1. H0: $\mu_1 - \mu_2 = 0$ versus H1: $\mu_1 - \mu_2 \neq 0$
2. H0: $\mu_1 - \mu_2 \leq 0$ versus H1: $\mu_1 - \mu_2 > 0$
3. H0: $\mu_1 - \mu_2 \geq 0$ versus H1: $\mu_1 - \mu_2 < 0$

LOS 3.1.A.r: Select the test statistic for a hypothesis test regarding the mean difference for two normal distributions (paired comparison test).

In a paired comparison test you have two samples. For each observation in the first sample, you have a corresponding observation in the other sample. The test allows for exogenous factors to influence both populations. Define the difference, $d = x_A - x_B$. You can then simply apply a t-test to the mean of d:

$$\frac{\overline{d} - \mu_{d0}}{s_d/\sqrt{n}} \sim t(n-1).$$

LOS 3.1.A.s: Formulate a null and an alternative hypothesis about the mean difference of two normal populations (paired comparison test) and determine whether the null hypothesis is rejected at a given level of significance.

1. H0: $\mu_d = \mu_{d0}$ versus H1: $\mu_d \neq \mu_{d0}$
2. H0: $\mu_d \leq \mu_{d0}$ versus H1: $\mu_d > \mu_{d0}$
3. H0: $\mu_d \geq \mu_{d0}$ versus H1: $\mu_d < \mu_{d0}$

LOS 3.1.A.t: Discuss the choice between tests of differences between means and tests of mean difference in relation to the independence of samples.

Differences between means = test if two populations have the same mean (a complicated form of t-test).

Mean difference = test if paired observations have a certain mean difference (t-test on the difference).

LOS 3.1.A.u: Select the test statistic for a hypothesis test regarding the variance of a normally distributed population.

Use the following χ^2-test:

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

Note: you will generally have to look at the two tails of the distribution!

LOS 3.1.A.v: Formulate a null and an alternative hypotheses about the variance of a normally distributed population and determine whether the null hypothesis is rejected at a given level of significance.

1. H0: $\sigma^2 = \sigma_0^2$ versus H1: $\sigma^2 \neq \sigma_0^2$
2. H0: $\sigma^2 \leq \sigma_0^2$ versus H1: $\sigma^2 > \sigma_0^2$
3. H0: $\sigma^2 \geq \sigma_0^2$ versus H1: $\sigma^2 < \sigma_0^2$

LOS 3.1.A.w: Select the test statistic for a hypothesis test regarding the equality of variances of two normal populations and, given the test statistic, determine whether the null hypothesis is rejected at a given level of significance.

Use the following F-test:

$$\frac{s_1^2}{s_2^2} \sim F(n_1-1, n_2-1),$$

where you should put the larger variance in the numerator.

LOS 3.1.A.x: Distinguish between parametric and nonparametric tests.

Parametric tests are concerned about the parameters (of a distribution) and will draw their conclusions based on assumptions concerning the type of the population distribution.

Non-parametric tests rely on fewer assumptions and generally do not care about population parameters. They are used if data deviate strongly from normality, e.g. for rank or run data.

3.2 Correlation and Regression

LOS 3.1.B.a: Define and interpret a scatter plot.

LOS 3.1.B.b: Define and calculate the covariance between two random variables.

$$Cov(x,y) = \frac{\sum (x_i - \overline{x})(y_i - \overline{y})}{n-1} = \frac{\sum x_i y_i - \sum x_i \sum y_i}{n-1}$$

LOS 3.1.B.c: Define, calculate and interpret a correlation coefficient.

$$r = \frac{Cov(x,y)}{s_x \cdot s_y}$$

LOS 3.1.B.d: Describe how correlation analysis is used to measure the strength of a relationship between variables.

H0: $\rho = 0$ versus H1: $\rho \neq 0$ can be tested with

$$\frac{r\sqrt{n-2}}{\sqrt{1-r^2}} \sim t(n-2)$$

LOS 3.1.B.e: Formulate a test of the hypothesis that the population correlation coefficient equals zero and determine whether the hypothesis is rejected at a given level of significance.

$$r = \frac{Cov(x,y)}{s_x \cdot s_y}$$

LOS 3.1.B.f: Define an outlier and explain how outliers can affect correlations.

Outliers are small numbers of observations at either extreme of a sample. If the sample contains outliers,

- determine whether a computed sample statistic changes greatly be removing the outliers;
- and be careful when excluding outliers, because they may be part of the story rather than an exception.

LOS 3.1.B.g: Explain the nature of a spurious correlation.

Spurious correlation is correlation in the data without any causal relationship.

LOS 3.1.B.h: Explain the difference between dependent and independent variables in a linear regression.

Dependent variable = the variable to be explained (or predicted) by the independent variable. Also called endogenous or predicted variable.

Independent variable = the variable used to explain the dependent variable. Also called exogenous or predicting variable.

LOS 3.1.B.i: Distinguish between the slope and the intercept in a regression equation.

Intercept = the predicted value of the dependent variable when the independent variable is set to zero.

Slope = the unit change of the dependent variable for a unit change of the independent variable.

LOS 3.1.B.j: List the assumptions underlying linear regression.

1. A linear relation exists between y and x, i.e. the model $y_i = b_0 + b_1 \cdot x_i + \epsilon_i$ is well specified
2. x_i is not random
3. The error has an expected value of zero, $E[\epsilon_i] = 0 \, \forall \, i$

4. Homoscedasticity, $E[\epsilon_i^2] = \sigma_\epsilon^2 \,\forall\, i$
5. Independence of error terms, $E[\epsilon_i \epsilon_j] = 0 \,\forall\, i, j$
6. Errors are normally distributed, $\epsilon \sim N(0, \sigma_\epsilon^2)$ (this assumption is only necessary for inference).

LOS 3.1.B.k: Define and calculate the standard error of the estimate.

The standard error of the estimate tells us how far the true values of y_i are spread around their predicted value $\widehat{y}_i$. It is obtained by:

$$SEE = s_e = \sqrt{\frac{\sum (y_i - \widehat{y})^2}{n-2}} = \sqrt{\frac{SSE}{n-2}},$$

where SEE stands for standard error of the estimate and SSE for sum of squared errors.

LOS 3.1.B.l: Define and calculate the coefficient of determination.

The coefficient of determination is the fraction of the total variation that is explained by the regression:

$$\begin{aligned} R^2 &= \frac{Explained\ variation}{Total\ variation} = 1 - \frac{Unexplained\ variation}{Total\ variation} \\ &= \frac{SSR}{SST} = 1 - \frac{SSE}{SST} \\ &= \frac{\sum (\widehat{y}_i - \overline{y})^2}{\sum (y_i - \overline{y})^2} = 1 - \frac{\sum (y_i - \widehat{y}_i)^2}{\sum (y_i - \overline{y})^2} \end{aligned}$$

LOS 3.1.B.m: Calculate the confidence interval for a regression coefficient.

$$\widehat{b_1} \pm t_c s_{\widehat{b_1}}, \quad where \quad s_{\widehat{b_1}} = \sqrt{\frac{s_e^2}{\sum_{i=1}^n (x_i - \overline{x})^2}},$$

and t_c is the critical t-value with $(n - k - 1)$ degrees of freedom.

LOS 3.1.B.n: Identify the test statistic for a hypothesis test regarding the population value of a regression coefficient.

The hypothesis $\beta_1 = \overline{\beta_1}$ is tested with the help of a t-test:

$$\frac{\widehat{b_1} - \overline{\beta_1}}{s_{\widehat{b_1}}} \sim t(n-k-1), \qquad s_{\widehat{b_1}} = \sqrt{\frac{s_e^2}{\sum_{i=1}^n (x_i - \overline{x})^2}}.$$

LOS 3.1.B.o: Formulate a null and an alternative hypothesis regarding a population value of a regression coefficient and determine whether the null hypothesis is rejected at a given level of significance.

1. H0: $\beta_1 = \overline{\beta_1}$ versus H1: $\beta_1 \neq \overline{\beta_1}$
2. H0: $\beta_1 \leq \overline{\beta_1}$ versus H1: $\beta_1 > \overline{\beta_1}$
3. H0: $\beta_1 \geq \overline{\beta_1}$ versus H1: $\beta_1 < \overline{\beta_1}$

The three versions are tested with the t test of LOS 3.1.B.n.

LOS 3.1.B.p: Interpret a regression coefficient.

- The intercept is the value of y if $x = 0$
- The slope is the unit change in y for a unit change in x
- To determine if the relationship is important, you must look at significance test rather than b_1.

LOS 3.1.B.q: Calculate a predicted value for the dependent variable given an estimated regression model and a value for the independent variable.

Simply plug in the values.

LOS 3.1.B.r: Calculate and interpret a confidence interval for the predicted value of a dependent variable.

$$\widehat{\widehat{y_i}} \pm t_c s_f, \quad \textit{where} \quad s_f = s_e^2 \left[1 + \frac{1}{n} + \frac{(x_i - \overline{x})^2}{(n-1)s_x^2} \right]$$

and t_c is the critical t value for $n - k - 1$ degrees of freedom.

LOS 3.1.B.s: Describe the use of analysis of variance (ANOVA) in regression analysis.

An ANOVA table looks like this:

ANOVA	df	SS	MSS	F
Regression	k	$SSR = \sum_{i=1}^{n} (\widehat{y}_i - \overline{y})^2$	$\frac{SSR}{k}$	$\frac{SSR/k}{SSE/(n-k-1)}$
Error	n-k-1	$SSE = \sum_{i=1}^{n} (y_i - \widehat{y}_i)^2$	$\frac{SSE}{n-k-1}$	
Total	n-1	$SST = \sum_{i=1}^{n} (y_i - \overline{y})^2$		

In practice, ANOVA tables are useless because all the interesting information they contain is already extracted for the calculation of some test statistics. For example, the info is contained in

- $R^2 = SSR/SST$
- $SEE = \sqrt{SSE}$

LOS 3.1.B.t: Define and interpret an F-statistic.

The F statistic is calculated as the ratio of the mean regression sum of squares of the mean squared error,

$$\frac{MSR}{MSE} = \frac{\sum_{i=1}^{n} (\widehat{y}_i - \overline{y})^2 / k}{\sum_{i=1}^{n} (y_i - \widehat{y}_i)^2 / (n-k-1)} \sim F(k, n-k-1)$$

In a regression with just one independent variable, the F statistic is simply the square of the t statistic and therefore useless. In the more general context, the F test is used to determine whether at least one relationship in the regression equation is statistically significant.

LOS 3.1.B.u: Discuss the limitations of regression analysis.

- Relations can change over time (structural breaks).
- Lucas critique: if the public knows about a relation, it will break down.
- Regression is based on assumptions which are often violated.
- Regression relation is not causality.

3.3 Multiple Regression and Issues in Regression Analysis

LOS 3.1.C.a: Describe a multiple regression equation.

- A multiple regression equation shows the relationship between a single dependent variable and k independent variables.
- Each regression coefficient shows the unit change of the dependent variable for a unit change in the independent variable *holding all other independent variables constant.*

LOS 3.1.C.b: Write a multiple regression equation to describe the relationship between a dependent variable and several independent variables.

LOS 3.1.C.c: Determine whether each independent variable in a multiple regression is statistically significant in explaining the dependent variable.

H0: $\beta_i = 0$ versus H1: $\beta_i \neq 0$ can be tested with

$$\frac{\widehat{b_i}}{s_{\widehat{b_i}}} \ simt(n-k-1)$$

LOS 3.1.C.d: Formulate a null and an alternative hypothesis about the population value of a regression coefficient, calculate the value of the test statistic, and determine whether the null hypothesis is rejected at a given level of significance, using a one-tailed or two-tailed test.

1. H0: $\beta_i = \overline{\beta_i}$ versus H1: $\beta_1 \neq \overline{\beta_i}$
2. H0: $\beta_i \leq \overline{\beta_i}$ versus H1: $\beta_1 > \overline{\beta_i}$
3. H0: $\beta_i \geq \overline{\beta_i}$ versus H1: $\beta_1 < \overline{\beta_i}$

The three versions are tested with the t test

$$\frac{\widehat{b_i} - \overline{\beta_i}}{s_{\widehat{b_i}}} \ simt(n-k-1).$$

LOS 3.1.C.e: Calculate a confidence interval for the population of a regression coefficient in a multiple regression.

$$\widehat{b_i} \pm t_c s_{\widehat{b_i}},$$

where t_c is the critical t value with $(n-k-1)$ degrees of freedom.

LOS 3.1.C.f: List and explain the assumptions of a multiple regression model.

1. A linear relation exists between y and all x, i.e. the regression equation is well specified
2. No correlation between the error term and any independent variable.
3. The error has an expected value of zero, $E[\epsilon_i] = 0 \, \forall \, i$
4. Homoscedasticity, $E[\epsilon_i^2] = \sigma_\epsilon^2 \, \forall \, i$
5. Independence of error terms, $E[\epsilon_i \epsilon_j] = 0 \, \forall \, i, j$
6. Errors are normally distributed, $\epsilon \sim N(0, \sigma_\epsilon^2)$ (this assumption is only necessary for inference).

LOS 3.1.C.g: Discuss the residual and its relationship to the standard error of estimate.

The residual is the difference between the estimated value for y_i and y_i, i.e. $\epsilon_i = y_i - \widehat{y_i}$. The standard error of the estimate (SEE) is simply the standard error of the residual and calculated from the sum of squared residuals (SSE), $SEE = \sqrt{\frac{\sum \epsilon_i^2}{n-k-1}} = \sqrt{\frac{SSE}{n-k-1}}$.

LOS 3.1.C.h: Calculate the standard error of estimate, given the sum of squared residuals from the regression (SSE), the number of observations (n), and the number of independent variables (k).

$$SEE = \sqrt{\frac{SEE}{n-k-1}}$$

LOS 3.1.C.i: Calculate a predicted value for the dependent variable, given an estimated regression model and assumed values for the independent variables.

Simply plug in the values.

LOS 3.1.C.j: Discuss the two types of uncertainty involved in regression model predictions.

Standard error of estimate: Uncertainty because there is non-explained variation in the model (ϵ_i)

Standard error of the estimated parameters: Uncertainty because of sampling error in the parameter estimates ($s_{\widehat{b_i}}$).

LOS 3.1.C.k: Define, calculate, and interpret the F-statistic and discuss how it is used in regression analysis.

The F statistic is calculated as the ratio of the mean regression sum of squares of the mean squared error,

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

In a regression with just one independent variable, the F statistic is simply the square of the t statistic and therefore useless. In the more general context, the F test is used to determine whether at least one relationship in the regression equation is statistically significant.

LOS 3.1.C.l: Define and interpret the R^2 and adjusted R^2 in multiple regression.

$$R^2 = 1 - \frac{\textit{Unexplained variation}}{\textit{Total variation}} = 1 - \frac{SSE}{SST}$$

The R^2 is often interpreted as measure for the goodness of fit. The adjusted R^2,

$$\overline{R^2} = 1 - \left(\frac{n-1}{n-k}\right)\left(1 - R^2\right)$$

penalizes for the inclusion of additional variables. So, while R^2 will always increase with an additional variable included in the regression equation, $\overline{R^2}$ will only increase if the variable adds quite a bit of explanatory power.

LOS 3.1.C.m: Infer how well a regression model explains the dependent variable by analyzing the output of the regression equation and an ANOVA table.

Use two inforamtions from the ANOVA table:

- $R^2 = 1 - \frac{SSE}{SST}$ gives information on the goodness of fit.
- $\frac{MSR}{MSE} = \frac{RSS/k}{SSE/(n-k-1)} \sim F(k, n-k-1)$ can be used to test whether the equation contains at least one significant relationship.

LOS 3.1.C.n: Formulate a multiple regression equation using dummy variables to represent qualitative factors.

If you have a qualitative variable that can take q different values, add $q-1$ dummy variables (the variable takes the value of 1 if the qualitative variable of the observation has the particular value). Then simply carry out the regression.

LOS 3.1.C.o: Discuss the types of heteroskedasticity and the effect of conditional heteroscedasticity on statistical inference.

Heteroskedasticity is the violation of the assumption that the variance of the error term is constant. The two version of heteroskedasticity are:

Unconditional: heteroscedasticity is not related to the values of the indpendent variables.

Conditional: heteroscedasticity is related to the values of the independent (or dependent) variables.

In most applications, heteroscedasticity will lead to estimated standard errors that are too small and t-statistics that are too high. Therefore, you will tend to reject H0 albeit it is true (find a significant relationship although there is none).

LOS 3.1.C.p: Discuss the effect of serial correlation on statistical inference.

Serial correlation will lead the OLS standard error for the coefficient to underestimate the true standard error. Consequently, t-statistics will be too high, and you will tend to find significant relations when there are none.

LOS 3.1.C.q: Explain how to test and correct for heteroscedasticity and serial correlation.

Serial correlation

The most common test for serial correlation is the Durbin-Watson statistic,

$$DW = \frac{\sum_{t=2}^{T} \left(\widehat{\epsilon}_t - \widehat{epsilon}_{t-1} \right)^2}{\sum_{t=1}^{T} \widehat{\epsilon_t^2}}$$

The statitistic is centered around 2 and has two critical values (there is an inconclusive region in which we cannot say if we have serial correlation). To fix the problem by either adjusting the regression equation (not recommended) or by using standard errors that have been adjusted for serial correlation (the econometrics package will provide such things). In the latter case, simply use the more robust standard error and continue as before.

Heteroscedasticity

Breusch-Pagan simply regress ϵ^2 against the independent variables. Using the results of this auxiliary regression, evaluate $nR^2 \sim \chi^2(k)$. To fix the problem, either use robust standard errors (White) or apply generalized least squares to remove the problem altogether.

LOS 3.1.C.r: Calculate and interpret a Durbin-Watson statistic.

$$DW = \frac{\sum_{t=2}^{T} (\widehat{\epsilon_t} - \widehat{\epsilon_{t-1}})^2}{\sum_{t=1}^{T} \widehat{\epsilon_t^2}} = \frac{Var(\widehat{\epsilon_t}) - 2Cov(\widehat{\epsilon_t}, \widehat{\epsilon_{t-1}}) + Var(\widehat{\epsilon_{t-1}})}{Var(\widehat{\epsilon_t})}$$

From the expression to the right it becomes clear that when the variance of $\widehat{\epsilon_t}$ and $\widehat{\epsilon_{t-1}}$ are identical and their covariance is 0, DW will be 2. The practical problem of the DW is that there are no clear critical values. Instead we have a d_l and a d_u. Draw your conclusions as follows:

- If $DW < d_l$, reject hypothesis of no serial correlation.
- If $d_l < DW < d_u$, conclude that the test is inconclusive.
- If $DW > d_u$, accept hypothesis of no serial correlation.

LOS 3.1.C.s: Discuss the causes and effects of multicollinearity in regression analysis.

Multicollinearity is correlation between independent variables. It basically stems from the inclusion of variables that are either caused by the same excluded variable or one of the independent variables causes the others. Multicollinearity leads to low t-statistics for each single parameter, but to a high overall F statistic. So, you will find that the model in itself has a lot of explanatory power, but you are unsure which independent variable actually explains the dependent variable.

LOS 3.1.C.t: Discuss models for qualitative dependent variables.

Probit and logit models estimate the probability of the outcome of a qualitative variable. They are based on normal (probit) or logarithmic (logit) distributions and must be estimated by maximum likelihood procedures.

Discriminant analysis combines independent variables in a linear function to a score which is then used to classify the dependent variable.

LOS 3.1.C.u: Interpret the economic meaning of the results of multiple regression analysis.

Use your common sense.

3.4 Time Series Analysis

LOS 3.1.D.a: Calculate the predicted trend value for a time series, given the estimated trend coefficients.

Plot t into $y_t = b_0 + b_1 t + \epsilon$.

LOS 3.1.D.b: Discuss the effect of serially correlated errors on the choice of times series model.

If you find serial correlation in a model that already contains a trend, then the model is unable to capture all the dynamics. You then should try another model, either an exponential trend or ARMA models.

LOS 3.1.D.c: Discuss the factors that determine whether a linear trend or a log-linear trend should be used with a particular time series.

Use log-linear if theory suggests exponential growth.

LOS 3.1.D.d: Discuss the limitations of trend models.

The model may not capture all serial correlation. More fundamentally: instead of actually explaining the dependent variable, it simply forecasts its growth.

LOS 3.1.D.e: List the requirements for a time series to be covariance stationary.

A series is covariance stationary if its first two moments (mean, variance, and covariance of the variable with its lags) do not change. More formally:

- $E[y_t] = \mu, \quad |\mu| < \infty \quad \forall\, t$
- $Var[y_t] = \sigma^2, \quad |\sigma^2| < \infty \quad \forall\, t$
- $Cov[y_t, y_{t-q}] = \lambda_q, \quad |\lambda_q| < \infty \quad \forall\, t, q$

LOS 3.1.D.f: Discuss the structure of an autoregressive model of order p.

An AR(p) has the following structure:

$$y_t = b_0 + b_1 y_{t-1} + \ldots + b_p y_{t-p} + \epsilon_t$$

LOS 3.1.D.g: Explain how autocorrelations of the residuals from an autoregressive (AR) model can be used to test whether the AR model fits the time series.

Use a three-step procedure:

1. Estimate the AR model.
2. Compute the autocorrelations, $\widehat{\rho_k} = \frac{\sum_{t=k+1}^{T}(y_t-\overline{y})(y_{t-k}-\overline{y})}{\sum_{t=1}^{T}(y_t-\overline{y})^2}$
3. Test whether the autocorrelations are statistically significant. If they are, the AR model has not picked up all the dynamics and you should try another one.

LOS 3.1.D.h: Calculate a one-step-ahead forecast and a two-step-ahead forecast of a time series using an autoregressive model.

Recursively plug in the values of y_t.

LOS 3.1.D.i: Explain mean reversion and calculate the mean-reverting level for a series.

Mean reversion is a property of all covariance stationary variables. It describes that the variable tends to fall if it is above the mean and that it tends to rise when it is below the mean. The mean-reverting level can be obtained when we realise that a mean reverting variable will not change if we it is at the mean and we remove all shocks and that the mean itself does not change. Hence

$$y_t^* = b_0 + b_1 y_{t-1}^* \implies y_t^* = y_{t-1}^* = \frac{b_0}{1-b_1}$$

LOS 3.1.D.j: Distinguish between sample forecast and out-of-sample forecast.

Sample forecast: The forecast of data which are member of the sample that has been used to estimate the parameters for the forecast. The sample forecast error is nothing else than the residual of the model.

Out-of-sample forecast: The forecast of data which are not member of the sample that has been used to estimate the parameters.

LOS 3.1.D.k: Discuss the instability of coefficients of time-series models.

The true parameters can change over time either due to structural breaks or to changing regimes. The estimated parameters, in addition, can change because of inappropriate econometric techniques. Data snooping can lead to highly unstable estimates.

LOS 3.1.D.l: Define a random walk.

A random walk is a time series process with a unit root. If a time series follows a random walk, the best forecast of y_{t+1} is y_t. We can describe this as:

$$y_t = y_{t-1} + \epsilon_t, \quad E[\epsilon_t] = 0,\ E[\epsilon_t^2] = \sigma_\epsilon^2, E[\epsilon_t \epsilon_s] = 0\ for\ t \neq s$$

LOS 3.1.D.m: Discuss the implications of unit roots for time-series analysis and explain when they are likely to occur.

Unit roots are likely to occur in forex data. Consequences:

- The series is no longer covariance stationary (it has no unconditional mean or variance).
- Consequently, there is no mean reversion.
- The conditional variance is proportional to the forecast horizon. As t becomes large, the variance approaches infinity.
- You must not use standard regression techniques (risk of spurious regression).

LOS 3.1.D.n: Discuss how a time series with a unit root can be transformed so that it can be analyzed with an autoregressive model.

First-difference the series: $\Delta y_t = y_t - y_{t-1}$. This will have the properties of a covariance stationary variable, as the definition of $\Delta y_t = \epsilon_t$ in LOS 3.1.D.l is consistent with an AR(1) model with $b_0 = 0$ and $b_1 = 0$.

LOS 3.1.D.o: Calculate an n-period moving average of a time series.

$$n - period\ moving - average = \frac{y_t + y_{t-1} + \ldots + y_{t-n}}{n}$$

LOS 3.1.D.p: Discuss the structure of a moving-average model of order q.

An MA(q) has the following structure:

$$y_t = \epsilon_t + \theta_1 \epsilon_{t-1} + \ldots + \theta_1 \epsilon_{t-1}, E[\epsilon_t] = 0,\ E[\epsilon_t^2] = \sigma_\epsilon^2,\ E[\epsilon_t, \epsilon_s] = 0$$

LOS 3.1.D.q: Determine the moving-average (MA) order of a time series from the autocorrelations of that series.

Look if the first q autocorrelations are significant.

LOS 3.1.D.r: Distinguish between an autoregressive time series and a moving-average time series.

Look at the autocorrelations:

- If autocorrelations decline smoothly, it's an AR.
- If autocorrelations drop to zero after q lags, it's an MA.

LOS 3.1.D.s: Discuss how to test and correct for seasonality in a time-series model.

Test for seasonality by looking at the autocorrelations. If the fourth seasonal lag in quarterly data or the 12th in monthly data is significant, you can conclude that there is a seasonal effect.

Correct for seasonality by adding the lag with the significant autocorrelation. E.g. for a quarterly model add y_{t-4} to the AR(1) model: $y_t = b_0 + b_1 y_{t-1} + b_2 y_{t-4} + \epsilon_t$.

LOS 3.1.D.t: Calculate a forecast using an autoregressive model with a seasonal lag.

Simply plug the data in the model of LOS 3.1.D.s.

LOS 3.1.D.u: Discuss the limitations of ARMA models.

- Unstable parameters.
- The choice of p and q is more an art than a science.
- You will need long series to get meaningful results.
- The model remains a-theoretical.

LOS 3.1.D.v: Discuss how to test for autoregressive conditional heteroscedasticity.

Estimate $\widehat{\epsilon_t^2} = \alpha_0 + \alpha_1 \widehat{\epsilon_{t-1}^2} + u_t$ and test if α_1 is significantly different from zero.

LOS 3.1.D.w: Explain how to predict the variance of a time series using an autoregressive conditional heteroscedasticity (ARCH) model.

In the simple ARCH(1) model, the conditional variance at $t + 1$ is forecasted by $\widehat{\sigma_t}^2 = \widehat{\alpha_0} + \widehat{\alpha_1}\widehat{\epsilon_t}^2$.

Study Session 4

Economics for Valuation

4.1 Analyzing the Firm's Environment

LOS 4.1.a: Estimate the future relationship between GDP growth and industry sales, using historical data for each variable.

Simply run a regression of industry sales on GDP growth.

LOS 4.1.b: Forecast and interpret industry sales by applying the estimated relationship between GDP growth and industry sales to a forecasted GDP growth rate.

Plug in the data into the formula with the estimated parameters.

LOS 4.1.c: Interpret the results of a regression analysis of industry sales on an economic variable, such as annual changes in real GDP.

A regression will give you two things:

- a constant = the level of industry sales at zero growth.
- a regression coefficient = additional sales for each percent of growth.

LOS 4.1.d: Determine whether data measuring sales and other economic variables should include or exclude, depending on the purpose of the analysis, the effect of inflation or deflation, and calculate adjustments as appropriate.

- If you want to forecast real variables (e.g. number of cars), exclude the effect of inflation by using real data.
- If you want to calculate dollar values include inflation. The text recommends in this case to use real data for determining the relationship but to adjust the forecasted value by the formula $Sales_{current\,dollars} = Sale_{base\,dollars} \cdot \frac{CPI_{current}}{CPI_{base}}$

LOS 4.1.e: Infer industry and company performance under conditions specified in an economic forecast, using industry/company performance at various points in past business cycles.

Industries perform differently under certain macroeconomic conditions. Specifically:

- **Slowdowns:** Most industries suffer. However, demand for output of consumer staples industries is relatively independent of economic activity, and the industry does better than the others.

- **Start of recovery:** Most industries improve, in particular capital goods as industries start to build up capacity.
- **Expansion:** Most industries do well, especially luxury goods are the latest to join the party.

LOS 4.1.f: Differentiate between short-run (1-2 years) and long-run industry sales projections.

Short run: you can rely on leading indicators; but be careful as they are unable to explain all economic movements.

Long run: no reliable indicator available. Therefore, you must use long-term mean values.

LOS 4.1.g: Determine the current stage of a product's life cycle and infer implications for product sales, profits, and competition, using historical data and information about the product.

Development stage: Consumers unfamiliar with the product, low sales, few producers that have the knowledge, little competition.

Expansion: Consumer demand increases, rapid expansion, large profits of initial producers.

Maturity: Sales expand at slower pace, additional competitors enter the market, profits decrease.

Decline: Decreasing sales, consolidation, low profit margins.

LOS 4.1.h: Differentiate between a product's life cycle and broader industry trends in product development.

The point is about the difference between a single product and the whole industry. Each product (e.g. vinyl disks) follows the life cycle. However, a whole industry (e.g. music industry) has several products (vinyl disk, tapes, CDs, DVDs, ...). Nevertheless, the phenomenonon of 'regression toward the mean' [sic!] is also valid for the industry as a whole: if the industry generates large profits, it attracts additional competition, driving down profit margins.

LOS 4.1.i: Identify and discuss factors that may contribute to changes in a company's market share of an industry's sales.

- Changes in consumer tastes
- Entry or exit of firms from the industry
- Relative strength of the firm
- Shifts in aggregate demand
- Marketing by the firm and the competitors

LOS 4.1.j: Estimate how a company's market share is affected by changes in the company's marketing efforts and by changes in competition.

The text notes that *firm sales = industry sales · market share*. Accordingly, the growth in firm sales can be predicted by $(1 + \%\Delta\textit{firm sales}) = (1 + \%\Delta\textit{industry sales}) \cdot (1 + \Delta\textit{market share})$. Market share, in turn, is influenced by two factors:

Marketing efforts: Marketing modelds can be grouped into those that stress consumer attitudes and those that stress the sellers' efforts and characteristics. The text relies on the latter by mentioning a model in which market share of firm i, λ_i is proportional to its marketing efforts, M_i: $\lambda_i = \frac{M_i}{\sum_{j=1}^{N} M_j}$. There is also a slightly more sophisticated model, in which marketing efforts are scaled by an efficiency parameter, κ_i: $\lambda_i = \frac{\kappa_i \cdot M_i}{\sum_{j=1}^{N} \kappa_j \cdot M_j}$. In this model, the percentage change in a firm's market share will be proportional to the percentage change in its marketing efforts: $\frac{\Delta\lambda_i}{\lambda_i} \propto \frac{\Delta M_i}{M_i}$.

Competition: The text mentions no specific model, but increased competition will reduce market share.

4.2 The Brave New Business Cycle: No Recession in Sight

LOS 4.2.a: Relate macroeconomic trends to available data and information about business practices, technological and regulatory developments, and competitive and international factors.

Business practices: Business practices affect the way the economy reacts to shifts in aggregate demand or supply. In the text, just-in-time production reduces inventories and the reaction of production to declining demand. This, in turn, prevents major imbalances, and thereby protracted recessions.

Technological developments: Technology is a basis for new business practices (e.g. it made just-in-time production possible).

Regulatory developments: A change in regulation can change the whole economy. In the text, deregulation of the financial system is mentioned. Specifically, the removal of deposit rate ceilings led to a more responsive housing market - reducing the risk of boom and bust.

Competitive factors: Increased competition stimulates innovation and growth. Under fierce competition, capital is allocated more efficiently. Competitive pressure favors the adoption of new business practices.

International factors: Opening up an economy will stimulate competition. The text also mentions international diversification: foreigners now hold many US assets and US citizens hold many foreign assets; this will absorb some shocks if one country falls into recession.

LOS 4.2.b: Differentiate between the characteristics of past business cycles (i.e. peaks, troughs, variability, and duration) and the likely characteristics of future business cycles, based on current trends in economic variables.

- There will be fewer recessions and the recessions should be less severe. The text has four explanations for this: (1) because of increased competitive pressures and new business practices, firms now react more swiftly to shift in demand; this prevents the build-up of large and dangerous inventory overhangs; (2) just-in-time labour and capital (capital goods are shipped much more faster than in the past) prevents timing problems; (3) financial deregulation, particularly in the mortgage market, makes the economy more resilient to interest-rate increases; (4) international diversification of revenue base and supply lines absorbs shocks.
- Recessions will be more messy. That's the downside of the brave new world: financial leverage will increase, and therefore when the bubble bursts, you have quite a problem.
- Recoveries will be more subdued. Recessions will be the result of balance sheet problems, and fixing these problems takes quite some time. Burned children will be reluctant to re-launch the economy.

LOS 4.2.c: Determine important characteristics of the business cycle and infer implications for securities markets.

- Equity markets should rise because recoveries are longer and inflation will be lower.

- Real interest rates are likely to become more volatile because the economy is less responsive to changes in rates.
- Cyclical reductions in bond yields should last longer because disinflationary phases are longer.
- Because the risk of recession declines credit spreads decline as well. However, as firms may tend to increase leverage, the effect will be offset by higher risk.

LOS 4.2.d: Relate expectations for the economy to investors' expectations for the equity and fixed-income markets based on selected trends and underlying factors.

Bond investors: Real rates decrease during recessions and during early recovery. The latter will take longer, hence real rates are likely to decrease. The outcome is less clear for bond investors into credit as spreads could decrease (due to lower recession risk) or increase (due to increased leverage).

Equity investors: Equity investors expect good times. Firms generate highest profits at peak or near-peak times. As these periods take longer, profits will be higher. Cyclical companies should profit from reduced volatility in economic activity. Finally, lower inflation and real rates should drive up valuations.

LOS 4.2.e: Identify factors and potential developments that would alter investors' expectations.

1. Perceived overheating of the economy would increase the risk of a downturn in the near future.
2. External shocks (e.g. a hike in oil prices or the economic collapse of a trading partner) may be painful.

4.3 Foreign Exchange Markets and the Parity Condition

LOS 4.3.A.a: Distinguish between the spot and forward markets for foreign exchange.

Spot market = currencies are traded for immediate delivery (two business days after transaction)

Forward market = currencies are traded for delivery at a future date

LOS 4.3.A.b: Define direct and indirect methods/systems of foreign exchange quotations.

Direct quote = price of a foreign currency in home currency terms (e.g. 1 USD = 1.56 CHF is a direct quote in Switzerland)

Indirect quote = value of home currency in foreign currency terms (e.g. 1 GBP = 1.44 USD is an indirect quote in the UK)

American terms = price of a unit of a currency in USD = a direct quote in the US (e.g. 1 JPY = 0.009 USD)

European terms = value of 1 USD expressed in a currency = an indirect quote in the US (e.g. 1 USD = 1.56 CHF)

Note: $European_{bid} = \frac{1}{American_{bid}}$, therefore $American_{bid} < American_{ask}$ but $European_{bid} > European_{ask}$

LOS 4.3.A.c: Convert direct (indirect) foreign exchange quotations into indirect (direct) foreign exchange quotations.

$$direct_{ask} = \frac{1}{indirect_{bid}}; \quad indirect_{ask} = \frac{1}{direct_{bid}}$$

LOS 4.3.A.d: Calculate the spread on a foreign currency quotation.

$$spread = \frac{ask - bid}{ask}$$

LOS 4.3.A.e: Explain how spreads on foreign currency quotations can differ as a result of market conditions, bank/dealer positions, trading volume, and (for forward contracts) maturity/length of contracts.

Volatility in the market will push spreads up because dealers take higher risk in a transaction.

Bank/dealer positions can tilt a quote towards ask or bid.

Trading volume will reduce spreads as the cost of a transaction is more or less unrelated to size.

Maturity will increase spreads as there is an underlying short-term investment.

LOS 4.3.A.f: Calculate currency cross rates, given two spot or forward foreign exchange quotations involving three currencies.

Generally, cross rates can be obtained by multiplying an indirect and a direct quote to the dollar or by dividing two direct quotes.

$$\frac{CHF}{EUR} = \frac{CHF}{USD}\frac{USD}{EUR}, \quad \frac{CHF}{CAD} = \frac{CHF/USD}{CAD/USD}$$

If you want to integrate bid-ask spreads:

$$\frac{CHF}{EUR}_{bid} = \frac{CHF}{USD}_{bid}\frac{USD}{EUR}_{bid}, \quad \frac{CHF}{CAD}_{bid} = \frac{CHF/USD_{bid}}{CAD/USD_{ask}}$$

LOS 4.3.A.g: Calculate the profit on a triangular arbitrage opportunitiy, given three currency quotations.

A arbitrage opportunity exists if multiplying three direct quotes is bigger than one:

$$\mathit{profit} = \frac{CHF}{USD}_{bid}\frac{USD}{EUR}_{bid}\frac{EUR}{CHF}_{bid} - 1$$

LOS 4.3.A.h: Compute the effect of transaction costs (spreads) on a foreign exchange arbitrage opportunity.

You can immediately see the effect of transactions costs if you express the bid rates as mid rates minus a spread:

$$\mathit{profit} = \frac{CHF}{USD}(1 - s_1)\frac{USD}{EUR}(1 - s_2)\frac{EUR}{CHF}(1 - s_3) - 1$$

LOS 4.3.A.i: Define forward discount and forward premium.

Forward discount = forward rate expressed in USD is below spot rate.

Forward premium = forward rate expressed in USD is above spot rate.

LOS 4.3.A.j: Calculate a forward discount or premium and express either as an annualized rate.

$$\begin{array}{c}\textit{Forward premium or}\\ \textit{discount}\end{array} = \frac{\textit{Forward} - \textit{Spot}}{\textit{Spot}} \times \frac{360}{\begin{array}{c}\textit{Forward contract}\\ \textit{\# of days}\end{array}}$$

LOS 4.3.A.k: Explain the theory of interest rate parity (IRP).

IRP states that the currency with the lower interest rate should be at a forward premium in terms of the currency with the higher interest rate. IRP assumes no transaction costs and efficient markets. It results from a non-arbitrage argument: an investor with one unit of home currency has two option.

1. invest it at the home interest rate
2. exchange it at the spot rate, e_0, invest the proceeds at the foreign interest rate, r_f, and buy the foreign currency balance at the end of the period back at the forward rate f_1

Non-arbitrage requires that the two options give the same proceeds. Using direct quotes, we have

$$1 + r_h = \frac{f_1}{e_0}(1 + r_f).$$

Rearranging yields the IRP equation

$$\frac{1 + r_h}{1 + r_f} = \frac{f_1}{e_0} \quad \Longrightarrow \quad r_h - r_f \simeq \frac{f_1 - e_0}{e_0}.$$

With other words: high interest rates on a currency are offset by forward discounts and vice versa.

LOS 4.3.A.l: Explain and compute covered interest arbitrage.

An arbitrage opportunity exists if IRP is violated. Specifically, if

$$1 + r_h < \frac{f_1}{e_0}(1 + r_f).$$

you could make riskless profit by borrowing in the home currency, selling the home currency at the spot rate, invest the proceeds at the foreign interest rate and buy back the end-of-period balance of foreign currency at the forward rate. The inverse relationship holds if we change the the signs.

LOS 4.3.A.m: Determine whether or not an arbitrageur can profit from given interest rate and currency differentials.

Simply check the whether IRP holds.

LOS 4.3.A.n: Calculate a forward rate under an assumption of interest rate parity.

The n-day forward rate can be calculated by

$$f_1 = e_0 \frac{1 + r_h \frac{n}{360}}{1 + r_f \frac{n}{360}}.$$

LOS 4.3.A.o: Calculate a covered interest differential, taking into account transaction costs.

In reality, you can only borrow at the ask rate, convert home currency to foreign currency at the ask rate, invest foreign currency at the bid rate and buy it back forward at the bid rate,

$$f_{1,bid} = e_{0,ask} \frac{1 + r_{h,ask} \frac{n}{360}}{1 + r_{f,bid} \frac{n}{360}}.$$

To calculate an arbitrage profit, simply compare out the three transactions

$$\begin{matrix} \textit{profit from} \\ \textit{borrowing home} \end{matrix} = \frac{f_{1,bid}}{e_{0,ask}}(1 + r_{f,bid}) - (1 + r_{h,ask}).$$

LOS 4.3.B.a: Calculate, for a specified currency, the exchange rate implied by purchasing power parity (PPP).

In the absolute version of PPP, the exchange rate, e_0, simply reflects different price levels, i.e. $CPI_h = e_0 CPI_f$.

In the relative version of PPP, the change in the exchange rates is explained by different inflation rates, i.e.

$$\frac{e_t}{e_0} = \frac{(1 + i_h)^t}{(1 + i_f)^t} = \frac{CPI_{h,t}/CPI_{h,0}}{CPI_{f,t}/CPI_{f,0}}$$

Hence, PPP implies the exchange rate

$$e_{t,PPP} = e_0 \times \frac{(1+i_h)^t}{(1+i_f)^t} = e_0 \times \frac{CPI_{h,t}/CPI_{h,0}}{CPI_{f,t}/CPI_{f,0}}$$

LOS 4.3.B.b: Calculate a real (inflation-adjusted) exchange rate for a currency and compare that rate with the PPP-determined rate.

The real rate is the actual rate corrected for the effect of inflation, i.e.

$$e'_t = e_t \times \frac{(1+i_f)^t}{(1+i_h)^t} = e_t \times \frac{CPI_{f,t}/CPI_{f,0}}{CPI_{h,t}/CPI_{h,0}}$$

If PPP holds, $e_t = e_0 \times \frac{(1+i_h)^t}{(1+i_f)^t}$ and, therefore $e'_t = e_0$. This means that the real exchange rate is constant.

LOS 4.3.B.c: Determine the relative levels of inflation among countries, using observed spot and forward exchange rate relationships.

You can only answer this if you assume IRP and the Fisher effect hold. Then, the ratio of home to foreign interest rates is simply the ratio of home to foreign inflation rates, and the IRP formula reduces to

$$f_1 = e_0 \frac{(1+i_h)}{(1+i_f)} \quad \Longrightarrow \quad f_1 \simeq e_0 + (i_h - i_f) \quad \Longrightarrow \quad i_h - i_f \simeq e_0 - f_1.$$

LOS 4.3.B.d: Differentiate between capital market integration and capital market segmentation and infer the effects of each on a country's equilibrium interest rates and exchange rates.

Capital market integration = arbitrage is permitted to operate unhindered (low transaction costs, no restrictions). Interest rates are determined by the global supply of and global demand for funds.

Capital market segmentation = arbitrage is not permitted to operate (high transaction costs, restrictions). Interest rates are determined by local supply of and local demand for funds.

In a country with high supply of funds, capital market integration will lead to higher interest rates (example: Switzerland). A country with a high demand for funds will experience falling interest rates with integration (example: US).

LOS 4.3.B.e: Calculate the expected nominal and real interest rates produced by the Fisher effect.

The Fisher effect states that the nominal interest rate, r is composed of a required real component r^* and an inflation premium i, i.e.

$$1 + r = (1 + r^*)(1 + i) \quad \Longrightarrow \quad r \simeq r^* + i.$$

The generalized version states that real returns are equalized across countries. Therefore,

$$\frac{1 + r_h}{1 + r_f} = \frac{1 + i_h}{1 + i_f} \quad \Longrightarrow \quad r_h - r_f \simeq i_h - i_f.$$

Note that under the Fisher effect, real interest rates are equal for all countries and irrespective of the inflation rate.

LOS 4.3.B.f: Estimate a future exchange rate based on the international Fisher effect.

The international Fisher effect combines the generalized Fisher effect with PPP:

$$\begin{aligned} \frac{(1 + r_h)^t}{(1 + r_f)^t} = \frac{E_0[e_t]}{e_0} \quad &\Longrightarrow \quad \frac{1 + r_h}{1 + r_f} = \frac{E_0[e_1]}{e_0} \\ &\Longrightarrow \quad r_h - r_f \simeq \frac{E_0[e_1] - e_0}{e_0}. \end{aligned}$$

This means that currencies with high interest rates (driven by high inflation rates) will tend to depreciate and vice versa. Solving for the expected exchange rate, we obtain:

$$E_0[e_1] = e_0(\frac{1 + r_h}{1 + r_f}) \simeq e_0 + r_h - r_f.$$

LOS 4.3.B.g: Calculate an expected future spot exchange rate based on the unbiased forward rate relationship.

If the forward rate is unbiased, then it is the expected future spot exchange rate, i.e. $E_0[e_1] = f_1$

LOS 4.3.B.h: Compare market-based forecasts with model-based forecasts of foreign exchange rates.

Market based forecasts built upon IRP. For short horizons, simply take the forwards as unbiased forecasts. For longer horizons, derive forwards from the curves.

Model based forecasts try to outperform the market. Fundamental models generally build upon PPP or use current account data. Technical models exploit historical pattern.

Empirical evidence suggests that model based forecasts will not generate a lot of value. Where outperformance was claimed, it often resulted from using in-sample forecasts.

4.4 Stabilization Policy and Growth

LOS 4.4.A.a: Describe the two most widely used sources of information about the future direction of the economy.

Index of leading indicators. An index of 10 economic statistics (average workweek in hours, initial unemployment claims, new orders with manufacturers, speed of deliveries, orders for plant and equipment, housing starts, slope of the curve, consumer expectations, stock market performance, change in M2). Leads the cycle by about six months. Has forecasted all recessions, but it also forecasted recessions that did never take place.

Economic forecasting models. Complicated models based on past relationships, sometimes with hundreds of equations, allowing to forecast GDP and its components. Good performance in stable conditions, but unable to capture structural breaks and external shocks.

LOS 4.4.A.b: Discuss the timing problems associated with an activist strategy minimizing economic instabilities.

Discretionary fiscal and monetary policy runs into three timing problems:

Recognition lag = time between a change in the economy and the recognition by policy makers.

Administrative lag = time period before change in policy is instituted.

Impact lag = time period between policy measure and the effect on the economy.

Friedman and Gordon have estimated that the sum of the lags is about 12 months. Therefore, policy makers must act on anticipation of problems and not wait until it materializes. However, the political process, notably elections, lead to additional problems even if changes are anticipated.

LOS 4.3.B.a: State the sources of economic growth and explain why some countries have rapid economic growth but others experience economic stagnation.

Empirical evidence (compare Hong Kong to Venezuela) suggests that natural resources do not contribute to rapid growth. On the other hand, the following three factors contribute to growth:

1. Investment in physical and human capital. Evidence shows that high levels of investment and a good educational system are conducive to growth.
2. Technological advancements. Technology improves the efficiency in the use of resources. Advancements come from two directions: invention (discovery of new products and processes) and innovation (practical and effective adoption of new technology). Poor countries can catch up by importing technology.
3. Institutions and policies consistent with efficient economic organization. This includes:
    - security of property rights and political stability - because confidence is important
    - competitive markets - to boost the invisible hand and because it forces companies to do their best
    - stable money and prices - to provide an environment for investing
    - free trade - to exploit comparative advantages and increase competition
    - open capital markets - to foster the efficient allocation of capital to productive use
    - avoidance of high marginal tax rates - to keep incentives for hard workers

LOS 4.3.B.b: Discuss the circumstances under which government can play a positive (negative) role in enhancing (restricting) economic growth.

See point 3 in LOS 4.3.B.a.

LOS 4.3.B.c: Discuss the factors that explain the expected relationship between the size of government and economic growth.

Government fulfills two core functions: protect individuals and their property rights (protective function) and produce public goods (productive function). Up to a certain size, government, by fulfilling these two functions, contributes to growth. However, from a certain level, the size of government will negatively affect growth for four factors:

1. Higher taxes and/or public borrowing will impose an increasing burden on the economy. Taxes will reduce incentives to work and borrowing will absorb resources that could be used more productively.

2. Growing government will lead to diminishing marginal returns for government activity. As it grows, it will get more and more active in areas where it is not productive (or where the private sector would be more productive).

3. The political process is less dynamic and there are fewer incentives to discover and remedy unproductive actions.

4. A growing government inevitably starts to redistribute income and regulate everything. This gives rise to rent-seeking activities and other unproductive activities (tax advisors).

Study Session 5

Financial Statement Analysis

5.1 Analysis of Intercorporate Investments

LOS 5.1.A.a: Determine whether a debt security or equity security should be classified as held to maturity, available for sale, or as a trading security.

The classification is largely subjective and therefore subject to management discretion. Nevertheless, some criteria are laid down in SFAS 115. Moreover, reclasssification is regulated quite strictly.

Held to maturity = debt securities which management has both the *ability* and *intent* to hold to maturity. Such securities can only be sold in exceptional circumstances: significant deterioration in credit rating, legal changes, major acquisitions. Held-to-maturity securities appear on the balance sheet at cost. On the income statement, premiums or discounts are amortized and interest enters as income. Only realized gains or losses enter the income statement.

Available for sale = securities that can be sold but are not used for short-term trading. Such securities are carried at market value. Only realized gains or losses enter the income statement; non-realized gains or losses appear as separate items on the balance sheet. Can be transferred at market value to held-to-maturity; in this case, unrealized gains on debt securities are amortized over the remaining life.

Trading = securities hold to generate trading gains. Such securities are carried at market value. Realized and unrealized gains and losses enter the income statement. If a security is re-classified as trading security, unrealized gains and losses must be restated and owners' equity must be adjusted accordingly.

LOS 5.1.A.b: Compute the effect of debt-security and equity-security classification on the financial statement and financial ratios.

For this, calculate the carrying value and the income statement effect of such securities.

Held to maturity are carried at cost plus amortized premium. Only realized gains or losses are recognized.

Available for sale: are carried at market value. Realized gains enter the income statement; unrealized gains affect the balance sheet as separate item.

Trading: are carried at market value. All gains or losses, realized or unrealized, enter the income statement.

LOS 5.1.A.c: Differentiate among the cost method, equity method, and consolidation method and compare the effects of using each method on a company's financial statements and fi-

nancial ratios.

Market/cost method: for holdings with insignificant influence. In this case, dividends (but not earnings) are treated as income. Use market price for determining the carrying value, except if no market exists (then use cost).

Equity method: for holdings with significant but not controlling influence. Under this method, earnings (not dividends!) enter pro-rata directly into the income statement..

Consolidation method: for holdings with a controlling influence. Under this method, the parent firm adds all the assets of the investee to its own balance sheet; to reflect the share of other parties, minority interest is credited to liabilites. Similarly, all earnings enter the parent's income statement, and minority interest is added to cost. Finally,

Classification has a huge influence on financial ratios. Under the equity method, only *net* assets/liabilities enter the balance sheet while under consolidation both assets and liabilities enter the equation. At the same time, earnings and equity are not affected. Consequently, consolidated accounts show lower ROA, identical ROE, lower interest coverage and higher leverage than the equity method.

LOS 5.1.A.d: Calculate the balance sheet carrying value of an investment, using the cost method, equity method, and consolidation method.

Cost method: Use cost to determine the carrying value and add/subtract any amortization of discounts/premiums. If the firm determines that an investment is impaired, it has to write it down. You can't recover a write-down under US GAAP.

Equity method: Calculate the carrying value as follows:

1. Start with cost
2. For each year, the carrying value is increased by the year's earnings (reflecting the increase in owner's equity)
3. For each year, the carrying value is reduced by the year's dividends (reflecting the decrease in owner's equity)

So, earnings enter the income statement, and the dividend policy shows the way earnings affect the balance sheet

Consolidation: Add all assets and liabilities to the balance sheet of the parent. Then credit minority interest (the share of *net* assets of other investors) to the parent liabilities.

If a security is first classified at the cost and then moves to the equity method, you must restate the value of the investment as if it fell under the equity method from the beginning.

LOS 5.1.A.e: Determine, given various ownership and/or control levels, whether the cost method, equity method , or consolidation method should be used.

Normally, carry securities representing share of ownership ¡20% with the cost/market method, 20-50% with the equity method, and ¿50% with consolidated accounts.

Although the share of ownership is generally a good guideline for classification, it is only an indicator of the degree of influence. If you increase ownership by 1%, you should realize that this will not fundamentally change the situation and it should not be a reason to change your classification, even if you cross the critical lines. Use the market method despite an ownership ¿20% if the investor is in litigation with the investee, if the investor is excluded from the board, if there is majority holder, or if there are other obstacles that prevent the investor from influencing the investee. On the other hand, an ownership ¿50% can call for the equity method, if control is only temporary or if government action precludes effective control.

LOS 5.1.A.f: Differentiate between the proportionate consolidation method and the equity method and compare the effects of using each method on a company's financial statements and financial ratios.

Both methods are used for non-controlling but significant influence:

Proportionate consolidation: Integrates are proportionate share of all balance-sheet and income-statement items - assets, liabilities, income, expenditures - to the accounts of the investor.

Equity method: Takes a proportionate share of *net* assets in the balance sheet and a proportionate share of *net* earnings in the income statement.

Under proportionate consolidation, assets and liabilities as well as income and cost will be higher. On the other hand, net earnings and equity are not affected. Consequently, ROA is lower while ROE is unchanged; interest coverage ratios tend to be lower, leverage higher.

LOS 5.1.A.g: Define a reportable segment, and discuss the uses and limitations of the data.

SFAS 14 defines reportable segments as components of the enterprise that account for at least 10% of either total revenues, operating profit or combined identifiable assets. It also explicitely states that there is no precise definition of a segment and provides plenty of room for management judgement. Nevertheless, it suggests that segmentation should consider the similarity of products, processes, markets and marketing methods. SFAS 14 further requires disclosure of foreign operations when significant.

Segment data have major shortcomings

- lack of information on liabilities (what debt finances what segment?)
- intersegment pricing and allocation of corporate overhead is pretty judgmental
- lack of cash flow data

Nevertheless, segment data are useful to analyze trends in the performance of segments and in general to understand the company's operations. Both the FASB and the IAS are about to change the disclosure requirement on segment data.

LOS 5.1.A.h: Analyze, prepare, and illustrate the disclosure requirements for a reportable segment.

For each reportable segment, firms must report sales (with intersegment sales shown separately, operating profit or some other measure of profitability, identifiable asset, and export sales from domestic operations (if greater than 10% of consolidated sales). In addition, plenty of information can be found in the management discussion section of the company reports.

5.2 Analysis of Business Combinations

LOS 5.1.B.a: Construct a consolidated balance sheet and income statement, using the purchase method.

Balance sheet

Add the fair value of all assets and liabilities of the target company to the balance sheet of the acquire company (in the table below, fair value is shown as the sum of book value plus a write-up adjustment). If the price paid for the target exceeds net assets, the difference appears as goodwill in assets.

	Acquire	Target		Consolidated
		book value	adjust	
Cash	100	75		175
Inventories	200	100	50	350
Receivables	200	75		275
PPE	500	250	100	850
Goodwill	-	-	70	70
Total assets	1,000	500	220	1,720
Current liabilities	250	100		350
Long-term debt	250	150	-20	380
Common stock	400	225	265	890
Retained earnings	100	25	-25	100
Total liabilities	1,000	500	220	1,720

Note:

- The table above assumes that the purchase is financed with new equity. Therefore, the total common stock is the acquire stock plus the market value of the target firm (retained earnings of the target company disappears). If the transaction were financed by debt, the increase on the liability side would be reflected by debt. Goodwill is calculated as Purchase Price - Net Asset Value (fair value basis).

- Retained earnings of the target firm is adjusted to zero (retained earnings of the consolidated account is always equal to retained earnings of acquiring firm).

Income statement

The income statement is adjusted from the date of purchase. For full-year consolidation, most of the items in the income statement have to be adjusted:

	Acquire	Target	Adjustment	Consolidated
Sales	1,000	726		1,726
Cost of goods sold	-600	-363	-20	-983
Various expenses	-130	-135	-2	-267
Depreciation	-50	-32	-10	-92
Interest expense	-20	-10	-22	-52
Pretax income	200	186	-54	332
Income tax	-68	-62	17	-113
Net income	132	124	-37	219

Explanation for the various adjustments:

- *COGS* is adjusted because inventory is restated at fair value. Under FIFO, goods sold are no longer hold at historical cost, therefore COGS increases by the same amounts as the write-up (so, increase COGS in the first year by this amount). Under LIFO, COGS is not affected (no adjustment under LIFO!).

- *Various expenses* - or whatever its name - includes amortization of goodwill. Note that goodwill can be amortized straight line over 40 years. So, add 1/40 of goodwill to the expense category.

- *Depreciation* generally increases because all assets are restated at fair value. Take $1/n$ of the adjustment to PPE, where n is the number of years used in straight-line depreciation (if n is not given explicitly, calculate it on the basis of depreciation expense over fixed assets).

- *Interest expense* will change for two reasons. (1) As liabilities are restated at fair value, you will have either a discount or a premium. Discounts will have to be amortized over the remaining live, which increases interest rate expenses (analogously, interest rates decrease with a premium). Discount amortization is treated in the same way as under issuance of new debt, i.e. straight-line for the remaining live. (2) Interest expenses can increase if the merger is financed by debt.

- *Income tax expense* will change because of the changes above. To calculate the effect add all adjustments *except amortization of goodwill* (goodwill amortization is not tax deducible) and multiply it with the marginal tax rate.

Note: if the purchase takes place during the year, income statements are consolidated from the date of the merger. Using annual accounts, use pro rata data.

LOS 5.1.B.b: Construct a consolidated balance sheet and income statement, using the pooling method.

Consolidation using the pooling method is very simple: add up everything. Moreover, past accounts are also restated, so intertemporal comparison is straightforward.

Balance sheet

All items are simply added; no adjustments (except for intercompany transactions[?]), no goowill.

	Acquire	Target		Consolidated
		book value	adjust	
Cash	100	75		175
Inventories	200	100		300
Receivables	200	75		275
PPE	500	250		750
Goodwill	-	-	-	-
Total assets	1,000	500		1,500
Current liabilities	250	100		350
Long-term debt	250	150		400
Common stock	400	225		625
Retained earnings	100	25		125
Total liabilities	1,000	500		1,500

Note that the table above assumes that the purchase is financed with new equity (which is the only situation under which the pooling method may be used).

Income statement

The income statement is consolidated for the whole year, even if the merger takes place during the year:

	Acquire	Target	Adjustment	Consolidated
Sales	1,000	726		1,726
Cost of goods sold	-600	-363		-963
Various expenses	-130	-135		-265
Depreciation	-50	-32		-82
Interest expense	-20	-10		-30
Pretax income	200	186		386
Income tax	-68	-62		-125
Net income	132	124		256

LOS 5.1.B.c: Compare the effects of the purchase method versus the pooling method on the income statement, the statement of cash flows, and various financial ratios.

Strictly speaking, a comparison does not make sense, because firms have no choice between the two methods. The pooling methods can only be used if 1) each of the combining companies is independent, 2) only voting common shares are issued, 3) no change in the capital structure takes place before the merger (no stock reacquisitions), 4) no special benefit tom some shareholders, and 5) no intention to sell significant portions of one participant in the merger, except duplicate facilities. If these conditions are met, the pooling method must be used. However, in practice, mergers can be tailored around the criteria, giving management a choice between the two methods. Differences then arise because of the adjustments under the purchase method.

Balance sheet effects

- Writing up assets and liabilities results in differences at various items. In general, assets will exceed book value, so the asset base under the purchase method tends to be larger.
- In the presence of goodwill, the equity base is larger under the purchase method. The influences leverage and profitability ratios.
- If the merger is financed by debt (only possible under the purchase method), leverage increases dramatically.

Income statement effects

- Writing up assets will increase depreciation expenses under the purchase method; in addition, goodwill leads to higher amortization expenses (sometimes reported in selling expenses); COGS will be affected under the purchase method if the consolidated firm uses FIFO (assuming inflation, COGS is lower under the pooling method); overall, the purchase method tends to report lower earnings and, therefore, lower profitability ratios.
- If the merger is financed by debt (only possible under the purchase method), leverage increases dramatically.
- The purchase method makes inter-temporal comparison very hard. Sales trends are greatly overstated; profitability or leverage trends are hard to interpret. On the other hand, the pooling method combines the performance of two managements.

Cash flow statement effects

- Under the pooling method, no cash flow is reported at all. The purchase method, on the other hand, subsumes cash flows related to the acquisition as cash for investment and the corresponding financing activities (issuance of stock or new debt) as cash from financing. This treatment leads to distortions in cash from operations data (the firm purchases inventories etc. that generate cash in CFO, but the corresponding charge goes to CFI).
- 'Real' cash flows are only affected because of income tax effects. Income tax is lower under the purchase method because of higher depreciation and possibly because of higher reported interest expenses (*not* because of amortization of goodwill!).

Effect on financial ratios

- Profitability ratios tend to be lower under the purchase method (higher asset/equity base plus lower net earnings).
- Leverage data tend to be lower under the purchase method (higher asset/equity base).
- Activity ratios are difficult to interpret under the purchase method (mix between historical and fair value in the asset base).
- Under the purchase method, any trend in financial ratios is hard to interpret (changing blend of two companies; re-valuation of some components etc.)

Why managers could prefer one method over another

pro purchase	pro pooling
• income maximization argument if book value exceeds purchase price: write-downs will increase future ROE, ROA and net earnings	• income maximization argument if purchase price exceeds book value: no write-ups that will depress future ROE, ROA and net earnings
• tax argument if target is asset rich: write-up leads to higher depreciation expenses, resulting in income tax gains	• tax argument if purchase price exceeds book value of equity: subsequent goodwill amortization will depress reported net earnings without a tax effect
• off-balance-sheet liabilities can be taken into account, increasing future reported net earnings	• if acquiring company does not want to or can't increase leverage
• no loss of control for existing shareholders	• if there are assets well above book value, they can subsequently be sold with a gain (increasing reported net income)
• bond covenants on leverage tend to favor purchase method	• pooling is non-taxable, therefore bid premia tend to be lower
	• compensation plans tens to favor effects of pooling

LOS 5.1.B.d: Describe goodwill and discuss its treatment for purposes of financial analysis.

Goodwill is the premium paid for the target's reputation, brand names, or other attributes that enable it to earn an excess return on investment. In practice, goodwill often turns out a big deception that must be written down sooner or later. Some analysts remove goodwill from balance sheets.

In the US, goodwill cannot be amortized for tax purposes. Therefore, goodwill is a non-event in the real world.

Study Session 6

Financial Statement Analysis: Global Issues

6.1 Measuring Accounting Exposure

LOS 6.1.a: Distinguish between a company's accounting (translation) exposure and economic (operating and transaction) exposure to exchange rate changes.

Translation/accounting exposure = degree to which the book value of assets and liabilities as well as income statement items are affected by exchange rate changes. Corresponding gains or losses are determined by accounting rules and are paper only. This kind of exposure is retrospective in nature. To calculate translation exposure, take the difference between exposed assets and exposed liabilities, where the term 'exposed' describes items that are translated at the current rate.

Operating exposure = degree to which future operating cash flows are affected by exchange rate changes. Gains or losses are determined by a firm's competitive position and are real (even a firm only operating in the domestic market has an operating exposure to the exchange rate).

Transaction exposure = degree to which the value of already existing contracts is affected by an exchange rate change. Gains or losses are real and certain, but they will only take place in the futur (when the cash flow associated with the transaction occurs).

LOS 6.1.b: Compare and contrast the four principal currency translation methods.

Current/noncurrent method: Current assets/liabilities are translated at the current rate; the rest is translated at its historical rate. Consequently, a foreign subsidiary's translation exposure is equal to its working capital.

Monetary/nonmonetary method: Monetary items (cash, accounts payable, receivables, debt) are translated at the current rate, other items (inventory, fixed assets, long term investments) at their historical rate.

Temporal method: Items that are valued at historical cost (fixed assets, long-term debt, maybe inventories) are translated at historical rates, items that are valued at market value (cash, payables and receivables, short-term investments etc.) are translated at current rate. In practice, the method will give very similar results as the monetary/nonmonetary method - only inventories are sometimes translated differently. The temporal method was the past standard of US GAAP.

(All) Current method: All items are translated at current rates, i.e. the balance sheet at the rate of period end, and income statement data at the average rate of the period. This method is now standard under US GAAP.

LOS 6.1.c: Compute a company's translation exposure and any resulting translation gain or loss.

1. Determine exposed items on the balance sheet.
2. $Translation\ exposure\ =\ Exposed\ assets - Exposed\ liablities$
3. $Translation\ gain/loss = Translation\ exposure \times FX\ change\ in\ \%$

LOS 6.1.d: Distinguish between the functional currency and the reporting currency.

This distinction was introduced by FASB-52.

Functional currency = the currency of the primary economic environment in which the affiliate generates and expends cash. Use the following criteria to determine whether the local currency is the functional currency:

- In which currency does cash flow occur?
- What currency determines sales prices?
- In what currency is the main market?
- In what currency are the firm's major expenses (labor, inputs)?
- What is the funding currency?
- Are there many intercompany transactions (if yes, this is an argument for using the parent company's currency as functional currency).

Reporting currency = the currency in which the parent company prepares its accounts.

Under current US GAAP, MNCs first calculate statements for all subsidiaries in the functional currency and then translate them in the reporting currency. Compared to the previous practice (all accounts in USD) this results in more stable accounts for the subsidiaries.

6.2 Analysis of Multinational Operations

LOS 6.2.a: Determine the impact of changes in local currency sales and changes in exchange rates on the translated sales of the subsidiary and parent company.

There are basically two effects:

1. *Flow effect:* If the currency of the subsidiary appreciates, all flow data (income statement data like sales and earnings) are inflated.
2. *Holding gain/loss effect:* If the currency of the subsidiary appreciates, all static data (balance sheet data like current assets or liabilities) increase in value compared to data of the previous period. These gains will affect the equity of the consolidated firm.

LOS 6.2.b: Distinguish between the all-current method and the temporal method, explain the effects of each on the parent's balance sheet and income statement, and determine which method is appropriate in various scenarios.

	temporal	all-current
situation	remeasurement: to convert items into the functional currency of the subsidiary	translation: to convert items from the functional currency into the reporting currency
monetary assets/ assets valued at market price	current rate	current rate
non-monetary assets/ assets valued at historic cost	historic rate	current rate
accounting exposure	net monetary assets	net assets
treatment of gains/ losses	all gains/losses on monetary assets explicitly stated in income statement; for other assets, only realized gains are recognized (implicitely)	all gains/losses enter in equity as cumulative translation adjustment

LOS 6.2.c: Calculate the translation effects and evaluate the translation of a subsidiary's balance sheet and income statement into the parent's currency using the all-current method and the temporal method.

All-current method

- Calculate the translation effect as the sum of (a) the appreciation/ depreciation of the assets that were already on the balance sheet at the beginning of the year and (b) the change appreciation/depreciation of the assets that were acquired or disposed of during the year.
- Translation gains go straight into the cumulative transaction adjustment on the equity side of the balance sheet.
- The income statement is affected by the flow effect.

Temporal method

- Remeasurement gains/ losses are only calculated on monetary assets. Again, sum the gains/ losses from (a) the appreciation/depreciation of the assets that were already on the balance sheet at the beginning of the year and (b) the change appreciation/depreciation of the assets that were acquired or disposed of during the year.
- Remeasurement gains/ losses enter the income statement as remeasurement below gross profits.
- In addition, the income statement is affected by the flow effect.

LOS 6.2.d: Determine how the translation of a subsidiary's financial statements will affect the subsidiary's financial ratios.

- Pure income statement ratios (e.g. gross margin) and pure balance sheet ratios are identical in both currencies.
- When income statement and balance sheet items are mixed, distortions arise because the end-of-period and the average rate do not change at the same rate.
- Exchange rate changes will affect the relative size of the subsidiary in the accounts of the parent. If the functional currency appreciates, the subsidiary will become more important and its financial characteristics will have a larger weight in the calculation of the financial ratios of the parent. This can make intertemporal comparisons very hard.

Note: the above assumes use of the all-current method. Under the temporal method, major differences arise because of the various historical rates used in the translation process.

LOS 6.2.e: Determine how using the temporal method versus the all-current method will affect the parent company's financial ratios.

The choice of the translation method will have *no effect on monetary items* (including sales, cash flows, current assets and liabilities) as both methods use the current or average rate. On the other hand, the choice affects many non-monetary balance sheet and income statement items:

- *Inventories*: FIFO under the temporal method leads to distorted COGS. An appreciating local currency will lead to higher *gross profit margings* under the temporal method.

- *Depreciation*: under the temporal method, depreciation is translated at a different rate than the corresponding sales. In addition to the COGS effect, an appreciating local currency will, therefore, lead to higher *operating profit margins* under the temporal method.
- *Profit margins*: are consequently distorted under the temporal method. For *net profit margins*, the problem is aggravated by the inclusion of holding gains/ losses in income. If the subsidiary has a net monetary liability position, an appreciating local currency could result in lower net profit margins under the temporal method.
- *ROE*: is distorted by the effects described. The different treatment of the denominator leads to additional distortions under the temporal method.
- *Turnover ratios*: are distorted because assets are translated at a historical rate but flow data are used at an average rate. If the functional currency appreciates, the temporal method will show higher turnover ratios. Only exception: receivable turnover ratio is identical under both methods.

LOS 6.2.f: Discuss alternative accounting methods for hyperinflationary subsidiaries.

Use the functional currency of the parent. Consequently, the carrying value of the subsidiary is neither affected by the inflation nor the accompanying depreciation of the currency. The method is advocated in US GAAP.

Translate indexed values of nonmonetary assets. The idea behind this method is to separate the real and nominal effects of exchange rate changes. The method is advocated by IASC.

The two methods are broadly similar, but there are some differences in reported income and equity. For foreign companies, the SEC does not require reconciliation with US GAAP.

6.3 Accounting Bulletin #81

LOS 6.3: Describe the difference between the IASC and US GAAP treatment of asset revaluation, pooling of interests, goodwill, cash flow statements, development costs, asset impairment, and intangible assets.

alternatives: In general, IAS allows alternative treatment to the preferred 'benchmark' method. US GAAP is more rigid.

revaluation: IAS allows revaluation of tangible and intangible assets; US GAAP does not. In practice, revaluation is only likely for tangible assets (except if there is an active market for the intangible assets). Revaluation gains and losses go straight into equity and IAS requires that if an asset is revalued, the entire class to be revalued.

pooling of interest: IAS permits pooling when no acquirer can be identified (which is rare); US GAAP has twelve tests and if they are met, pooling must be used. In practice, pooling is more frequent under US GAAP.

goodwill: Under IAS, goodwill should be amortized over a period not exceeding 20 years (except exceptional cases where a company can justify a longer life for goodwill); under US GAAP goodwill can be amortized over a 40-year period.

cash flow statements: Under IAS, interest paid and received can be classified as CFO, CFI or CFF; under US GAAP it is classified under CFO. Moreover, dividends paid and received can be classified as CFO or CFF under IAS, but only as CFF for dividends paid and CFO for dividends received under US GAAP.

development costs: IAS requires capitalization of development costs if certain recoverability criteria are met; US GAAP requires development costs to be expensed except for certain software development costs.

asset impairment: Under IAS, assets should be written down if the recoverable value is below the carrying value (where the recoverable value is the lower of the selling value or the discounted cash flows generated by the asset); under US GAAP, an asset should be written down if the company has the intention of selling it and the selling price is below carrying value or if the company has the intention to keep it but the undiscounted cash flows generated by the asset are below the carrying value. Revaluation of impaired assets is allowed under IAS, but not under US GAAP.

intangible assets: Under IAS, intangible assets should be amortized over a period not exceeding 20 years (unless a longer period can be justified); US GAAP allows for a 40-year amortization period. [See also comments on research and revaluation.]

6.4 Analysis of Business Combinations

LOS 6.4.a: Discuss international differences in acquisition accounting and the treatment of goodwill.

Acquisition accounting

- IAS 22 allows pooling only in exceptional circumstances (no acquirer can be identified). In practice, however, pooling is still used because the criteria for identifying the acquirer are provided only as background material.

- UK standards make pooling or merger accounting optional. Under the purchase method, goodwill will be greater than under US GAAP because (1) the method of allocating the purchase price to assets is not set out in as much detail and (2) goodwill is charged directly to equity through a reserve or goodwill account.
- Provisioning for future costs in a merger is not allowed under US GAAP but under IAS.
- In France, only the purchase method is used and a big part of the purchase price is allocated to goodwill for tax reasons. Goodwill is directly charged to equity.
- In Germany and the Netherlands, the purchase method is the norm with the pooling method used rarely. As the allocation of the purchase price and revaluation are not strictly regulated, management has ample room for earnings manipulations.

Goodwill

- IAS 20 permits amortization of goodwill over 5 years or the expected economic life (no longer than 20 years). Goodwill is not charged directly to equity, but written-down when it is not expected to provide further benefit.
- In the UK, the goodwill is amortized over the useful life up to 20 years; longer amortization is possible if the useful life exceeds 20 years and it is expected to be measurable.
- In Germany, the law specifies 4-year amortization, but 0-40 years are used in practice. Goodwill with indefinite life need not be amortized but is subject to annual review.

LOS 6.4.b: Compute the effects of international differences in acquisition accounting and the treatment of goodwill on the income statement, balance sheet, and various financial ratios.

International differences can have the following impacts:

- *Treatment of goodwill:* Some countries write off goodwill in the year of the acquisition. To compute the effect, first add goodwill back to equity, then calculate goodwill amortization and finally adjust the income statement and balance sheet with these figures.
- *Amortization of goodwill:* Amortization periods can vary between countries. To compute the effect, determine the amount of goodwill at the beginning of each period and then amortize under the two methods; adjust earnings by the difference.
- *Restructuring reserves:* Other countries than the US allow to charge restructuring costs to a special restructuring reserves account. To remove the effect: add all expenditures and revenues back to the income statement (adjust pretax income by the net effect)

- *Timing of the merger:* Under one method, income statements are restated for the whole year, under the other method, they are not. To compute the effect, get the information for the period before the merger and add it to the reported income statement.

Study Session 7

Financial Statement Analysis: Special Considerations

7.1 Retirement Benefit Accounting and Disclosures for Financial Analysis

LOS 7.1.a: Explain the differences in accounting for defined contribution and defined benefit pension plans.

Defined contribution. Company promises contribution to the plan in each period. Once the contribution is made, the company has no further assets or liabilities related to the plan. Employees bear all the risk for the performance of the assets.

Defined benefit. Company promises a certain pension at retirement. Both the risks and rewards of the performance of assets is born by the employer. This gives rise to complex liabilities or assets for the company.

LOS 7.1.b: Distinguish between pay-related and non-pay related pension plans.

Pay-related plans = benefit formula is based upon compensation. Final-pay plans tie pension to salary in last year; career-average-pay plans compute pension based on average salary over the whole employment period.

Non-pay related plans = benefit formula is not based upon compensation, e.g. a certain amount for each year of service.

LOS 7.1.c: Explain the following measures of defined benefit pension plan liabilities.

Projected benefit obligation (PBO) = estimate of the current liability (present value) of the company for future pension payments, including the impact of expected compensation increases. What is the plan's accumulated liabilities if all the employees worked until retirement and got their regular salary increases? Can be regarded as pension liability on a going concern basis.

Accumulated benefit obligation (ABO) = estimate of the current liability (present value) of the company for future pension payments, excluding the impact of expected compensation increases. What is the plan's accumulated liabilities if all the employees worked until retirement without any salary increase? (Or: if the company was liquidated today?) Can be regarded as pension liability on a current basis.

Vested benefit obligation (VBO) = estimate of the amount of the pension liability which employees have earned to date (present value) , based upon the company's vesting schedule. What is the plan's accumulated liabilities if all employees resigned today? (VBO is smaller than ABO because of the vesting schedule, i.e. if an employee quits before a certain number of service years he typically will not get the full amount for each year of service.)

LOS 7.1.d: Explain the following terms related to defined benefit pension plans and other retirement benefits and discuss the impact of each on expanses, assets and liabilities.

Service cost = portion of pension expense (= increase in pension liability) that arises from additional employee service during the period.

Interest cost = portion of pension expense (= increase in pension liability) that arises from passage of time, i.e. a shortening of the discount period.

Actual return on plan assets = return earned on pension plan assets during the year; reduces the firm's pension liability.

Expected return on plan assets = return expected to be earned on plan assets during the year; reduces the firm's pension expense.

Prior service cost and related amortization = increase in the pension liability arising from a plan amendment; amortized into the financial statements over time.

Net gains and losses = changes in pension liability resulting from changes in actuarial assumptions and differences between the actual and expected return on plan assets; once the gains or losses become big (fall outside a corridor of 10% of PBO), they are amortized into the financial statements. The idea of the corridor is to allow for fluctuations in the returns of plan assets without feeding trough into the income statement of the firm.

Transition liability = liability that resulted from the initial application of FAS #87; amortized into the financial statements over time.

Contributions = employer additions to the pension plan during the period; increase plan assets.

Benefits paid = payments to retired employees during the year; decrease plan assets.

Accumulated postretirement benefit obligation (APBO) = present value of all future postretirement benefits (mainly healthcare, therefore mainly determined by healthcare inflation rate).

LOS 7.1.e: Explain the effect of changes in the following pension and other retirement plan assumptions on measures of liability and expense, and on the financial statements and ratios.

Discount rate is used to convert future liabilities in current liabilities and expenses. The higher the discount rate, the lower the PBO, ABO, VBO. Pension expenses will only decrease if the present-value effect is not offset by higher interest costs.

Rate of compensation increase is used to estimate future liabilities. The higher the rate, the higher the PBO and pension expense (but no effect on the ABO, VBO).

Rate of return on plan assets is used to project the assets of the plan into the future. The higher the expected rate of return, the lower the pension expense for a given PBO.

Healthcare inflation rate will affect postretirement benefit obligations. The higher it is, the higher the accumulated postretirement benefit obligation (APBO). Note that post-retirement benefits are treated similarly as pensions, but the are generally not pay related.

LOS 7.1.f: Analyze the impact of pension accounting on reported financial statement results and on financial ratios.

The following items could be adjusted:

Off-balance sheet items: most importantly, actuarial gains or losses (gains or losses arising due to changes in actuarial assumptions) are kept off balance sheet and are amortized over time. Another detail: non-pay related defined benefit obligations are generally subject to future plan amendments; PBO should be adjusted upward.

Amortized items: The idea of amortized items is to smooth pensions costs and thereby avoid volatility in the income statement of the company. Sources for differences between the amount recognized in the financial statement and the economic liability are: unrecognized actuarial gains/ losses, unrecognized prior service costs, differences between expected and actual return on plan assets. For analysis it would be preferable to (1) add the adjustments to the net asset position of the plan and (2) similarly adjust equity and deferred taxes. On the income statement, adding back amortization of past costs gives a better picture of actual earnings.

Non-operating items: Pension accounting mixes gains and losses with other expenses. For analysis, it may be preferable to separate service costs from the rest. For this add the difference between reported pension expense and service cost (i.e. the non-service cost pension expense) back to the reported operating income.

7.2 Detecting Lower Earnings Quality

LOS 7.2: Identify and discuss accounting practices that contribute to a deterioration of *earnings quality.*

Management trick	Effect	Analyst
When you combine business, attribute a large part to *research and development in progress*, then write it off as soon as the combined unit operates.	Future profits will be inflated due lower amortization costs	Treat write-off as goodwill and subtract goodwill amortization from reported earnings.
From time to time, *restructure* your company and charge a huge amount to restructuring reserves. At the same time, you may recognize asset impairments.	The year of the restructuring will look bad, but future profits will be boosted.	Ask management for an explanation for any significant change in restructuring reserves. Remove restructuring reversals from reported earnings.
Pay management with *stock options*.	A company can report either the intrinsic value (generally zero) or the fair value (depends on a option pricing model). Use of the intrinsic value will inflate earnings.	Don't be fooled, calculate a fair value of all options.
For longer-term contracts*recognize income* immediately.	At least at the beginning, earnings will grow. Note that the FASB and AICPA have tried to curb the practice.	Watch for increases in accounts receivable.
For longer-term contracts *defer costs* as long as possible, even if the revenue stream associated with the costs is unlikely to materialize. If there is no clear revenue stream, capitalize your expenditures (e.g. advertizing costs).	At least at the beginning, earnings will grow. Note that the FASB has tried to curb the practice. Capitalization is only admissible for direct response advertizing.	Be wary of companies that increase capitalized costs.

Recognize tax assets and use book credits to lower tax expenses.	Earnings will increase.	Look out for changes in the 'valuation allowance' of tax assets. This valuation allowance is a reserve for future tax credits that have not been recognized because management believes it is more likely than not that they will not be able to realize these credits.
Classify expenditures as assets whenever you can.	Boost earnings and assets.	Look for changes in classification practices.
Use reserves to defer costs and smooth earnings.	Management can time earnings.	Look for changes in reserves.
Be optimistic in all accounting estimates. Avoid conservative estimates, practices and principles.	Current earnings will be boosted.	Scrutinize all estimates and practices. Compare with standards of the industry.

7.3 Analysis of Financial Statements: A Synthesis

LOS 7.3.a: Modify the balance sheet for assets and liabilities that are not recorded.

- *Leases and other off-balance sheet debt:* add assets and liabilities and separate amortization from interest expenses. Add explicit guarantees and similar arrangements as liabilities.
- *Consolidation of unconsolidated affiliates:* affiliates should be treated with proportional consolidation.
- *Goodwill and intangibles:* For analysis, it is preferable to exclude both.
- *Reclassifications:* Sometimes, the cost of a service is already incurred (e.g. broadcasting rights for a movie); in this case, unearned amount should be removed from

liabilities. Investment tax credits should be treated as unrecognized income rather than debt.

LOS 7.3.b: Modify the balance sheet for the current value of assets and liabilities.

- *Receivables:* reserves for losses should be realistic.
- *Inventories:* FIFO is the preferred method for balance sheet use. In order to obtain FIFO inventory, add the LIFO reserve to LIFO inventory. The difference is either credited to equity or split between income tax and equity (the latter is only realistic if you assume inventory liquidation).
- *Fixed Assets:* Mark to market whenever possible. Alternatively, use present value of income stream.
- *Long-term liabilities and debt:* Mark to market. Preferred stock should be reported at liquidation value, market value or assuming call.
- *Pension plans:* Replace reported pension plan accruals with actual status of the plan.

Once you have restated the balance sheet at current value, smoothing accounts (unrealized securites gains and losses, minimum pension liability or cumulative translation adjustments) are no longs meaningful. Instead sum up the net adjustments and add them to reported equity in order to re-establish the fundamental accounting identity.

LOS 7.3.c: Compute a company's normal operating earnings and comprehensive income.

'Normal operating earnings' refers to earnings adjusted for nonrecurring items and inadequate accounting choices:

- *Restructurings:* Allocate the cost over time in line with the balance sheet treatment.
- *Accounting changes:* Remove the effect from reported earnings (net of tax effects).
- *Early extinguishment of debt:* If not reported as extraordinary item, remove it from reported earnings (net of tax effects).
- *Income tax adjustments:* Remove it from reported earnings.
- *LIFO liquidations:* Remove the effect on reported earnings (net of tax) and estimate the effect on gross margins.
- *Realized gains and losses:* Remove the effect on earnings and try to estimate actual investment performance instead.

- *Capitalized interest:* Interest on fixed assets under construction should be expensed rather than capitalized.

To obtain *comprehensive income* take net income, subtract preferred dividends and add all valuation changes.

LOS 7.3.d: Determine and interpret the effects of accounting decisions, balance sheet modifications, and earnings normalization on a company's financial statements, financial ratios, and overall financial condition.

[Ignore that LOS, it's just too broad!]

LOS 7.3.e: Identify indicators of high and low earnings quality.

- Conservative revenue recognition (e.g. completed contract method)
- LIFO inventory
- High bad-debt reserves and provisions for lawsuits or other contingencies
- Accelerated depreciation
- Rapid write-off of goodwill and intangibles
- Minimal capitalization of interest, overhead, software costs
- Expensing of start-up costs
- Minimal use of off-balance sheet financing
- Absence of nonrecurring gains and noncash earnings
- Clear and adequate disclosure

Note that quality of earnings has nothing to do with predictability of earnings (in fact, predictability is often due to low quality manipulations).

LOS 7.3.f: Illustrate how accounting choices affect whether cash flows are classified as operating, financing or investing.

The following accounting choices affect the classification of cash flows:

- *Leases:* The treatment of operating and capital leases should be unified. Operating leases treat all flows as CFO, capital leases do not.

- *Capitalization:* Capitalization of fixed assets will lead to higher CFO. Research and development costs should be reclassified as CFO.

- *Affiliates:* Consolidation is preferred over the equity method.

- *Business combinations:* The purchase method treats everything as CFI; pooling would be better.

- *Nasty transactions:* Sale of receivables can boost CFO. This effect should be removed by treating the transaction as collateralized borrowing.

- *Other items to look at:* Cyclicality should be removed if possible; also try to estimate the effect of non-recurring items (like lawsuits).Interest expenses can be reclassified as CFF.

Study Session 8

Asset Valuation

8.1 Asset Valuation in the CFA Study Program

LOS 8.1.: Identify the unifying factor, [...] in the valuation of any asset class.

Asset valuation is all about determining the *intrinic value*, i.e. the value independent of the current market price, of a security. Graham and Dodd were the first that the most important factor for this was the *earning power* of the security. In addition, they stressed that an investment should also provide a *margin of safety.*

Today's texts in the CFA program often use a different terminology. For example, they focus on the *estimate of cash flows.* However, these concepts are still referring to Graham and Dodd's earning power which defines the intrinsic value.

8.2 Introduction to Investment Valuation

LOS 8.2.A: Explain the role that valuation plays in portfolio management, acquisition analysis, and corporate finance

Portfolio Management. Valuation is not very important for passive managers but crucial for the various types of active managers:

- *Fundamental analysts* relate value to underlying financial factors. They assume that the relationship is stable and that deviations are corrected in reasonable time.
- *Franchise buyers*, like Warren Buffet, concentrate on businesses they understand well. In fact, they assume they understand the business better than the market and that, in addition, their expertise can increase the value of the firm.
- *Chartists* may use valuation to determine support and resistance levels.
- *Information traders* focus on news and *changes* in value.
- *Market timers* may not be interested in the valuation of single stocks, but they care about over/undervaluation of the whole market.
- *Efficient marketers* will turn around valuation and deduce market assumptions from prices.

Acquisition analysis. Valuation is key in the decision on whether to acquire or not to acquire. For the bidder, valuation must give the value of the combined firm, taking into account increases in value through synergies and change in management. For the target, valuation will generally be biased to squeeze out the premium from the bidder.

Corporate finance. The objective of corporate finance is to maximize the firm value. Consulting firms make a living from giving advise on how to increase value (what projects to take on, how to finance them etc.).

8.3 Approaches to Valuation

LOS 8.2.B.a: Calculate the value of a share of equity, using a discounted cash flow approach with the cost of equity as the discount rate.

$$FV_{equity} = \sum_{t=n}^{\infty} \frac{CF_t \; to \; Equity}{(1+k_e)^t},$$

where CF_t *to Equity* is the expected cash flow to equity in period t and k_e the cost of equity.

LOS 8.2.B.b: Calculate the value of a company, using a discounted cash flow approach with the weighted-average cost of capital as the discount rate.

$$FV_{firm} = \sum_{t=n}^{\infty} \frac{CF_t \; to \; Firm}{(1+WACC)^t},$$

where CF_t *to Firm* is the expected cash flow to equity in period t and $WACC$ the weighted-average cost of capital. Note that $WACC$ is obtained by $WACC = \frac{D}{D+E} r_D(1 - T) + \frac{E}{D+E} k_e$

LOS 8.2.B.c: Identify the effects on the value of the company and the value of the company's equity from mismatching cash flows and discount rates.

In principle, the two approaches should give consistent results. This means that $FV_{equity} = FV_{firm} - FV_{other\ claims}$. However, if you use $WACC$ instead of k_e in the equation for FV_{equity}, the value will be biased upward because $k_e > WACC$. Similarly, the estimate of FV_{firm} will be biased downward if you use k_e instead of $WACC$.

LOS 8.2.B.d: Discuss the applicability and the limitations of the discounted cash flow approach.

Discounted cash flow valuation works fine for firms with a positive cash flow now, and a stable growth rate in the future. Deviations will cause trouble:

- *Firms in trouble* are currently making a loss. Valuation must take into account risk of bankruptcy and must built upon assumptions of when cash flows turn positive.

- *Cyclical firms* have fluctuating cash flows that must be smoothed if you don't want to rely on doubtful forecasts of future business cycles.
- *Firms with unutilised assets* require a valuation that adds the value of these assets to the value obtained from the cash flows generated with the other assets.
- *Firms with patents or product options* are harder to value. The best thing would be to value patens and options with option pricing models.
- *Firms involved in restructuring* are difficult to value because future cash flows are uncertain. You must guess the effect of the restructuring on cash flows.
- *Firms involved in acquisitions* are extremely hard to value. Add premium from synergies and management change to the value. On the other hand, risk is also affected by the way the take-over is financed.
- *Private firms* are difficult because risk parameters are unknown (they can't be calculated from historical values). You will have to rely on data from similar publicly traded firms.

LOS 8.2.B.e: Describe relative valuation approaches that use company fundamentals (such as earnings growth rates) and comparables (such as P/E ratios)

The idea is to use variables like earnings cashflows, book value or revenues for valuation. The variables are then multiplied with corresponding multiples (e.g. book-to-market value). These are obtained in two ways:

Using fundamentals: Here, multiples depend on fundamentals. E.g. changing profit margins will influence P/E ratios. In the end, the analysis is equivalent to discounted cash flow analysis.

Using comparables: Here, you just look at the multiples of comparable firms. In theory, you should control for variables that affect the multiples.

LOS 8.2.B.f: Discuss the applicability and limitations of the relative valuation approach.

- Multiples are easy to use. They give quick results, especially if there is a large number of comparable firms being traded in the market.
- They are easy to manipulate. An analyst can easily chose the comparable firms that best confirm his own bias without explicitly stating his assumptions.
- If the market misprices a whole sector, the use of multiples from comparable firms will yield mispriced results.

8.4 Financial Forecasting

LOS 8.2.A.a: Calculate a pro forma income statement and balance sheet, using the percent-of-sales method

In the percent-of-sales method, most balance sheet and income statement data are assumed to move with sales. Complete accounts are obtained by a five-step procedure[1]:

1. Determine historical relationship between sales and the other items on the income and balance sheet statement.
2. Forecast sales.
3. Put the data into the accounts for the items that move with sales.
4. Put the data into accounts for the other items (except financing). In general, interest expenses, PP&E, dividends, depreciation will not move with sales. In the exam, data for them will be provided. In practice, interest expenses would have to be estimated recursively, as the depend on external financing which is not known at this stage.
5. Calculate the totals of the income statement, and adjust retained earnings accordingly. Also take the total of assets. You then simply have to find the value of external financing necessary, such that assets match liabilities.

LOS 8.2.A.b: Estimate the need for external funding from the pro forma statements.

This is obtained in step 5 of the calculation of the pro-forma statement. *Note: if the exam asks for additional funds required, you must look at the change in external financing!*

LOS 8.2.A.c: Describe sensitivity analysis, scenario analysis, and simulation in financial planning.

Sensitivity analysis: Looks how the accounts change if you change one variable.

Scenario analysis: Similar to sensitivity analysis, but instead of only looking at one variable, you examine the effect of a change in several variables due to a certain economic event (like the entry of a new competitor or a recession).

Simulation: For each variable, you assign a probability distribution together with a set of covariances between the variables. A computer then chooses several times a particular random value and calculates the effect on the accounts. This gives a whole distribution of outcomes.

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[1] Higgins only counts to three, but the last two items are part of the procedure

LOS 8.2.A.d: Explain why cash flow forecasts and cash budgets should produce the same estimate of external funding required as the pro forma method.

Cash flow forecasts: a listing of all anticipated sources of cash to and uses of cash by the company over the forecast period. Basically looks at *changes* in cash. It is obtained in the way of the indirect method of the statement of cash flows.

Cash budgets: a listing of all anticipated receipts of cash and disbursements of cash over the forecast period. Hence, it can be thought of a detailed cash flow forecast in which all traces of accrual accounting have been eliminated. This means, it is a statement of cash flows under the direct method. If you are asked to produce a cash budget (not likely), start with sales, then calculate cash collections for each period, then calculate cash disbursements, then take the sum of the two (= net cash receipts), and finally adjust borrowing to meet the stated cash requirements.

As mentioned, cash flow forecasts and budgets result in a statement of cash flows. While the former only looks at changes, the latter looks at levels. However, the inputs are exactly the same, and so the external funding required must be identical.

8.5 Managing Growth

LOS 8.2.B.a: Explain the concept of sustainable growth and identify its determinants.

If sales grow, assets supporting these sales (at least accounts receivable, inventory, cash but also long-term assets) will have to grow as well. This implies, that liabilities have to increase. Now, if management does not want to change the capital structure (i.e. the share of debt on the liability side), growth will finally be constrained by owner's equity. Sustainable growth refers to the *maximum rate of growth a firm can achieve under a given capital structure and dividend policy without selling additional equity.*

The determinants of sustainable growth enter the sustainable growth equation. Define g^* as the sustainable growth rate. By using the good old formula for ROE, we obtain:

$$\begin{aligned}
g^* &= \frac{\Delta equity}{equity_{\,beginning}} \\
&= \begin{matrix} \textit{Profit} \\ \textit{margin} \end{matrix} \times \begin{matrix} \textit{Retention} \\ \textit{rate} \end{matrix} \times \begin{matrix} \textit{Asset} \\ \textit{turnover} \end{matrix} \times \begin{matrix} \widehat{\textit{Financial}} \\ \textit{levarage} \end{matrix} \\
&= P \times R \times A \times \widehat{T} = PRA\widehat{T} \\
&= R \times \widehat{T} \times \begin{matrix} \textit{Return on} \\ \textit{assets} \end{matrix} = R\widehat{T} \times ROA,
\end{aligned}$$

where the hat over financial leverage indicates that we take the ratio of assets over the beginning-of-period equity ($\frac{assets_{end}}{equity_{beginning}}$ you can calculate the beginning-of-period equity by subtracting the change in retained earnings from equity at the end of the period.).

Note: Inflation is sometimes seen as a factor that reduces sustainable growth. The reason for this is that in an inflationary environment, additional cash is necessary to keep the real cash balances constant. However, inflation also decreases the real value of the liabilities. Therefore, on balance, inflation has only little effect on sustainable growth.

LOS 8.2.B.b: Calculate the sustainable growth of a company, given balance sheet and income statement data.

This is a simple application of the sustainable growth equation of LOS 8.2.B.b. Simply plug in the data for the retention rate, profit margin, asset turnover, assets and beginning-of-period equity or return on assets.

LOS 8.2.B.c: Describe the courses of action that a company could take when actual growth exceeds sustainable growth and the possible effects of those actions on the company.

Wait. If the problem is temporary, the firm can simply get more external financing until growth returns to sustainable levels. However, this only works as long as the firm can borrow additional funds.

Additional equity. In practice, this solution works well for 'story paper'. In general, however, firms are either unable (especially small firms) or unwilling to issue more equity. Reasons for the unwillingness: issuing equity is expensive, it may dilute EPS, management generally has a bias to think that the market under-values the stock, and volatile stock markets are a unreliable funding source.

Additional debt. Increasing leverage is not always possible as creditors will pose limits to debt. Moreover, increased leverage means a higher risk for shareholders.

Increase retention rate. Shareholders are only willing to forgo dividends if they believe that the funds are used productively (or if the dividend policy makes sense from a tax standpoint). Otherwise, dividend cuts will anger shareholders.

Sell marginal business. This solves the problem by directly providing cash and by reducing cash requirements. You can also get rid of the business with high inventories and accounts receivable.

Sourcing. By outsourcing some activities, you release assets that would otherwise be tied up. Example: franchisors source all capital-intensive activities.

Increase prices: Higher prices will reduce growth and increase profitability.

Merge with a cash cow: An extreme solution if everything else fails.

LOS 8.2.B.d: Describe the courses of action a company could take when sustainable growth exceeds actual growth and the possible effects of those actions on the company.

Wait. The firm can simply accumulate more and more cash. This poses a serious takeover risk to management. Management can reduce this risk by wasting money with unprofitable investments - provided the shareholder do not realize that this only masks the problem.

Return money to shareholders. Paying high dividens or repurchasing stock is the best solution. However, management is reluctant for several reasons: paying money back is not optimal from a taxation standpoint, management has a bias for growth (a manager prefers a large empire), and size is perceived as good because it provides some protection against the vagaries of the marketplace.

Buy growth. In theory, a merger with a fast-growing business would solve the problems of the two. However, in practice, investments like this do rarely pay off because the premium on high-growth firms leaves nothing for the cash cow.

Study Session 9

Equity Investments: Industry and Company Analysis

9.1 Competitive Strategy – The Core Concepts

LOS 9.1.a: Analyze the competitive advantage and competitive strategy of a company and the competitive forces that affect the profitability of a company.

Companies are affected by the competitive forces of their industry:

- *Threat of new entrants.* Factors for entry barriers: economies of scale, differentiation, brands, learning curves, regulation.
- *Bargaining power of suppliers.* Factors: input differentiation, substitute inputs, supplier concentration, threat of forward integration, share of inputs in output price.
- *Threat of substitutes.* Factors: relative price of substitutes, switching costs.
- *Bargaining power of buyers.* Factors: bargaining leverage (concentration, volume, switching costs) and price sensitivity (affected also by differentiation, brands, buyer's profits, incentives of decision makers)
- *Intensity of rivalry.* Factors: competitive strategy of rivals, concentration.

The competitive strategy is the search for a favorable competitive position in the industry. It aims to establish a profitable and sustainable postion (i.e. a competitive advantage) against the competitive forces. A competitive strategy can be analyzed by classifying it as one of the three generic competitive strategies (cost leadership, differentiation, focus).

LOS 9.1.b: Analyze basic types of competitive advantage that a company can possess and the generic strategies for achieving a competitive advantage.

Firms create value for their buyers in excess of their costs. A firm has a competitive advantage if it can keep a large part of this difference for itself. The basic types of competitive advantage are cost leadership (charge normal prices, but produce at low costs) and differentiation (produce at normal costs but charge a higher price). Accordingly, firms may chose from the following generic strategies:

- *Cost leadership.* Set out to become *the* price leader in the industry. Low-cost production can pursue economies of scale, proprietary technology, preferential access to raw materials and other factors. If the low-cost producer can command prices at or near industry average (for this, a minimum of differentiation is necessary! = idea of differentiation parity), it will achieve above-average performance.
- *Differentiation.* Seek to be unique in the industry along some dimension that is valued by buyers (product quality, marketing strategy, product delivery). If the strategy is successful, the firm may charge a premium price. If there are other firms

seeking differentiation, the firm should chose a *different dimension*; nevertheless, there can be more than one firm seeking differentiation in the industry. The strategy is successful if the premium exceeds the cost of differentiation (idea of cost parity).

- *Focus.* Try to achieve a competitive advantage in only a segment of the industry. If broad-based competitors are underperforming (not enough differentiation because broad-based competitors are not able to provide differentiated products at competitive prices) in the segment, a *differentiation focus* can add value. On the other hand, if broad-based competitors are overperforming (highly differentiated products at high prices), the firm should adopt a *cost focus*. The focus strategy is successful if the segment can be separated from the rest of the industry and if it is structurally attractive

LOS 9.1.c: Analyze the risks associated with each of the generic strategies.

- *Cost leadership.* If more than one firm adopts the strategy, it will end in disastrous price wars. If the proximity in differentiation is lost, buyers will walk away. Cost leadership can be lost if technology changes, other bases for cost leadership erode, or cost focusers eat away segments of the industry.
- *Differentiation.* If differentiation increases prices too much, buyers will walk away. Differentiation can be lost if competitors imitate, the dimension of differentiation becomes less valued by buyers, or if differentiation focusers eat away segments of the industry.
- *Focus.* Broadly-targeted competitors can take away the segment if the segment's differences with the rest of the industry narrow or if the advantages of broader production increase. The segment may become less attractive because the structure erodes or demand disappears (a broad strategy is more diversified). Other firms with a focus strategy may reduce the competitive advantage.

LOS 9.1.d: Discuss the difficulties and risks of simultaneously using more than one of the generic strategies.

The use of more than one generic strategy is often a manifestation of a firm's unwillingness to make choices. This can lead to the following problems:

- The firm can become stuck in the middle. This leaves it exposed to competitors which adopt a clear strategy.
- A firm that originally follows a focus strategy will loose the advantages of focus if it tries to expand its operations.

- Each strategy requires a certain type of corporate culture; mixing cultures often turns out impossible.
- Following two cultures could be possible if two business units are run separately. However, the corporate center has to be able to manage such a mix.

There are some exceptional circumstances in which a firm can prosper despite of the use of more than one strategy. If competitors are also stuck in the middle, the firm can pursue cost reduction and differentiation. However, the entrance of new competitors can change the picture. If cost mainly depends on market share, the gain of market share via differentiation can lead to lower costs. Nevertheless, the firm remains vulnerable to new entrants with a clear strategy. Finally, a firm that pioneers a major innovation can achieve both goals as long as no competitor has access to the same technology.

Conclusion: You must chose a competitive strategy and then, within the strategy, pursue every possibility of cost reduction and differentiation.

9.2 Industry Analysis

LOS 9.2.a: Discuss the factors that should be included in an industry analysis model.

Industry classification: To get the broad picture, classify the industry according to life cycle or business cycle sensitivity.

External factors: technology, government, social factors, demography, and foreign influences.

Demand factors: economic activity, end user demand, business cycle.

Supply factors: degree of concentration, ease of entry, industry capacity.

Profitability: supply/demand analysis, cost and pricing factors.

LOS 9.2.b: Illustrate the life cycle of a typical industry.

Pioneer: High risk phase in which the industry struggles to establish a market for its products. Substantial cash needs, but firm is not yet profitable. Few players (and most of them fail).

Growth: Product acceptance is established and sales grow very fast. High profitability will attract new entrants. Investors like to pick firms in early growth phase.

Mature: Entrance of new competitors has reduced profitability to normal levels. Growth slows to nominal GDP growth, although some players may still grow faster than average. Competitors fight for market share.

Decline: Demand for the industry decreases while low margins depress profits. Firms exit the sector or diversify their activities.

LOS 9.2.c: Analyze the effects of business cycles on industries (growth, defensive, cyclical).

Growth: Above-normal expansion in sales and profits occurs independent of business cycle (technology in the 90s).

Defensive: Performance unrelated to business cycle (stable cash cows like utilities, telecoms or government contractors).

Cyclical: Performance tracks the business cycle or some other economic variable (auto sector follows personal income, brokerage follows stock market).

LOS 9.2.d: Analyze the impact of external factors (such as technology, government, foreign influences, demography, and social changes) on industries.

Technological change: Innovations can create an industry (cellular phones), enhance it (internet business) or make it obsolent (computers killed the typewriter industry).

Government: Government affects industries by regulation, taxation and tax code loopholes, import regime, competition policy, and public procurement.

Foreign influences: Foreign entities enter the equation as competitors, suppliers or clients. International political events can have an impact on the industry.

Demography: The growth of the population and the composition of the age structure affect many industries (nursing homes, beer sales)

Social change: Lifestyle (from traditional family to single-parent households) and fashion affect sales.

LOS 9.2.e: Illustrate the inputs and methods used in preparing an industry demand-and-supply analysis.

Demand analysis

- *Top-down economic analysis* models the relationship between sales and some economic variables (e.g. GDP determining the sale of cement). Inputs: some economic variable.
- *Industry life cycle analysis* predicts sales growth as a consequence of the industry classification (sales of growth industry will grow rapidly, sales of mature industry will grow less rapidly). Input: life cycle classification.
- *External factors analysis* will generally build upon the top-down economic analysis but considers additional external factors and their impact on sales. Inputs: External factor variables (some of them qualitative). For each external factors, analysts will define threats and opportunities.
- *Customer studies* provide a more detailed analysis of demand. Customers are segmented for their characteristics (geographically, by type of business, size of firm, lifestyle, sex, age, occupation) or by product-related variables (user type, usage, price sensitivity, brand loyalty). Analyst will use a segmentation depending on the industry life cycle. Inputs: data or estimations for the relevant customer segment.
- *Input/Output forecasts* analyze the flows of goods through the production process. Input: data for the different production steps and a model of how the goods flow through the process.

Supply analysis

Forecasting supply is practically impossible, except if the time horizon is shorter than the production lead, if there are few competitors, and if no external competitor can reasonably be expected to enter the market.

LOS 9.2.f: Explain factors that affect industry pricing practices.

- product segmentation
- degree of industry concentrations
- barriers of entry
- input prices

LOS 9.2.g: Analyze the effects of international competition on industries.

International competition increases competition at home. On the other hand, companies can compete abroad. For the analyst, companies operating internationally require an analysis that goes beyond the border of his country.

9.3 Analysis of Financial Statements

LOS 9.3.A.a: Describe some of the important accounting choices (typically explained in the footnotes of financial statements) that companies must make when constructing financial statements using generally accepted accounting principles (GAAP).

- inventory accounting (FIFO, LIFO)
- income recognition
- depreciation and amortization methods and assumptions regarding the useful life
- timing of asset impairment
- off-balance sheet financing (leases)
- capitalization of certain expenses
- consolidation of subsidiaries
- purchase or pooling method in mergers (not strictly a choice, but a choice in practice)

LOS 9.3.A.b: Describe how a companys accounting choices make comparability among companies difficult.

In order to compare apples with apples, the analyst must adjust the data to a common ground, based on the information in footnotes. This is not always possible and requires, in any case, a lot of tedious work.

LOS 9.3.A.c: Describe the contents of the three major financial statements.

Balance sheet: shows what resources the firm controls and how these resources are financed.

Income statement: contains information about the profitability of the firm during a period of time.

Statement of cash flows: shows the sources and uses of cash during a period of time.

LOS 9.3.A.d: Distinguish among 'cash flows from operating activities' (from the statement of cash flows), 'cash flows from operations', and 'free cash flow'.

Cash flow from operating activities / operations (CFO) is listed in the statement of cash flows. It shows the sources and uses of cash from the normal operations of the firm and can be calculated from net income by adding noncash expenses, subtracting noncash revenues and changes in net working capital items.

Free cash flow: cash available once all the expenses for keeping the business running are made. It is obtained from CFO by subtracting net capital expenditures (some authors, including R&B also subtract dividends)

LOS 9.3.A.e: Explain why analysts use financial ratios.

Analysts use ratios because absolute numbers (e.g. the dollar amount of profits) must be put into perspective. Ratios allow them to compare companies of different size (cross-sectional) and over time (time-series or longitudinal).

LOS 9.3.A.f: Calculate financial ratios in the following categories: common size, internal liquidity, operating efficiency, operating profitability, business risk, financial risk, growth, and external liquidity.

Common size: Divide all balance sheet items by total assets; divide all income statement items by sales.

Internal liquidity ratios are a measure of the firm's ability to honor short-term financial obligations.

- $Current\ ratio = \dfrac{Current\ assets}{Current\ liabilities}$
- $Quick\ ratio = \dfrac{Cash + Marketable\ securities + Receivable}{Current\ liabilities}$
- $Cash\ ratio = \dfrac{Cash + Marketable\ securities}{Current\ liabilies}$
- $Receivables\ turnover = \dfrac{Net\ annual\ sales}{Average\ receivables}$
- $Receivables\ collection\ period = \dfrac{365}{Receivables\ turnover}$
- $Inventory\ turnover = \dfrac{COGS}{Average\ inventory}$
- $Inventory\ processing\ perio = \dfrac{365}{Inventory\ turnover}$
- $Payables\ turnover = \dfrac{COGS}{Average\ trade\ payables}$

- $\begin{matrix}\textit{Cash conversion}\\ \textit{cycle}\end{matrix} = \begin{matrix}\textit{Receivables}\\ \textit{collection}\end{matrix} + \begin{matrix}\textit{Inventory}\\ \textit{processing}\end{matrix} - \begin{matrix}\textit{Payables}\\ \textit{payment}\end{matrix}$

Operating efficiency ratios show how management uses its assets and capital to generate business.

- $\textit{Total asset turnover} = \dfrac{\textit{Net sales}}{\textit{Average total net assets}}$
- $\textit{Fixed asset turnover} = \dfrac{\textit{Net sales}}{\textit{Average net fixed assets}}$
- $\textit{Equity turnover} = \dfrac{\textit{Net sales}}{\textit{Average equity}}$

Operating profitability ratios show how management translates sales into earnings.

- $\textit{Gross profit margin} = \dfrac{\textit{Net sales} - \textit{COGS}}{\textit{Net sales}}$
- $\textit{Operating profit margin} = \dfrac{\textit{Operating profit or EBITDA}}{\textit{Net sales}}$
- $\textit{Net profit margin} = \dfrac{\textit{Net earnings}}{\textit{Net sales}}$
- $\textit{Return on total capital} = \dfrac{\textit{Net income} + \textit{interest expense}}{\textit{Total assets}}$
- $\textit{Returns on total equity} = \dfrac{\textit{Net earnings}}{\textit{Average total equity}}$
- $\textit{Return on owner equity} = \dfrac{\textit{Net earnings} - \textit{preferred dividends}}{\textit{Average common equity}}$

Business risk ratios show the sensitivity of EBITDA to external factors.

- $\textit{Business risk} = \dfrac{\textit{Standard deviation of EBITDA}}{\textit{Mean of EBITDA}}$
- $\textit{Sales volatility} = \textit{Standard deviation of sales}$
- $\textit{Operating leverage} = \dfrac{\%\Delta \textit{EBITDA}}{\%\Delta \textit{sales}}$

Financial risk ratios show how changes in EBITDA translate into changes in earnings and whether the company is likely to meet its financial obligations.

- $\textit{Debt to equity ratio} = \dfrac{\textit{Total LT debt}}{\textit{Total equity}}$
- $\textit{LT debt to LT capital} = \dfrac{\textit{Total LT debt}}{\textit{Total LT capital}}$

- $Interest\ coverage = \dfrac{EBIT}{Interest\ expense}$
- $Fixed\ financial\ cost\ coverage =$
$$\frac{EBIT}{Interest\ expense + 1/3\ of\ lease\ payments}$$
- $Fixed\ charge\ coverage =$
$$\frac{EBIT}{Interest + lease\ payments + \frac{preferred\ dividends}{1-tax\ rate}}$$
- $Cash\ flow\ to\ LT\ debt = \dfrac{CFO}{Long - term\ debt}$

Growth ratios show how fast a firm can grow

- $Sustainable\ growth = Retention\ rate \times ROE$
- $Retention\ rate = 1 - \dfrac{Dividends\ declared}{Netearnings}$

External liquidity refers the ability to sell or buy an asset without loss of value. It can be assessed from the number of shares outstanding, the number of owners and the trading turnover (shares traded during a period of time).

LOS 9.3.A.g: Compute return on equity (ROE) using the duPont system and the extended duPont system.

The original duPont system:

$$\begin{aligned} ROE &= \left(\frac{Net\ income}{Net\ sales}\right) \times \left(\frac{Net\ sales}{Total\ assets}\right) \times \left(\frac{Total\ assets}{Equity}\right) \\ &= \begin{matrix} Profit \\ margin \end{matrix} \times \begin{matrix} Asset \\ turnover \end{matrix} \times \begin{matrix} Financial \\ leverage \end{matrix} \end{aligned}$$

The extended duPont system:

$$\begin{aligned} ROE &= \left[\left(\frac{EBIT}{Sales}\right) \times \left(\frac{Sales}{Assets}\right) - \left(\frac{Interest}{Assets}\right)\right] \cdot \left(\frac{Assets}{Equity}\right) \times (1 - tax\ rate) \\ &= \left[\begin{matrix} EBIT \\ margin \end{matrix} \cdot \begin{matrix} Asset \\ turnover \end{matrix} - \begin{matrix} Interest \\ expense \end{matrix}\right] \begin{matrix} Financial \\ leverage \end{matrix} \cdot \begin{matrix} Tax \\ retention \end{matrix} \end{aligned}$$

LOS 9.3.A.h: Use financial ratios for comparative analysis of a company over time and relative to its industry or to the market.

Compare changes in financial ratios as well as financial ratios of different companies in the same sector.

LOS 9.3.A.i: Discuss the challenges of international ratio analysis.

There are basically three problems:

1. Accounting statement formats differ. Nonoperating income and expenses may be treated differently in different countries.
2. Accounting principles differ. All the problems of inventory accounting, depreciation, capitalization etc. may differ between countries.
3. There are cultural and structural differences that explain different financial policies.

LOS 9.3.A.j: Contrast the ratios that are most likely to be useful for valuing stock, predicting bond ratings, and forecasting bankruptcy.

Stock valuation models focus on earnings growth and the required rate of return. Ratios used:

- ROE
- leverage ratios
- interest coverage
- dividend payout and retention rate
- price-to-book ratio
- coefficient of variation of net income
- systematic risk (β)

Bond ratings focus on the ability to meet financial obligations. Ratios used:

- debt/asset ratios
- interest coverage, fixed-charge coverage
- cash-flow/debt ratios
- working capital, current ratio
- market value of stock to book value of bonds

- ROA, ROE
- coefficient of variation of net income

Bankruptcy models focus on cash squeezes. Ratios used:

- CFO to total or long-term debt
- asset turnover
- ROA, EBIT to assets
- working capital and current ratio

LOS 9.3.A.k: Explain limitations of ratio analysis.

- Ratios are always relative, i.e. they must be compared with the relevant industry.
- Adjustments are needed for different accounting treatments.
- Some firms are heterogeneous (several divisions with different profiles).
- A single ratio alone gives no clear picture; always look at a set of ratios and check if they are consistent.
- It is necessary to define a range for the ratio within a given industry; if the ratio falls outside, this signals a problem.

9.4 Company Analysis and Stock Selection

LOS 9.3.B.a: Demonstrate why the common stock of a profitable company will not always be a good investment.

Good investments are those for which (1) the *market value is below the intrinsic value* and, consequently, (2) the *expected rate of return is above the required rate of return.* A profitable company may generate a return, but if the return is below the required rate - the market price of the stock is too high - it is not a good investment.

As an investor, you should look for growth *stocks* (= companies whose stock offers a high rate of return). Growth *companies* (= companies with a high growth rate in sales) rarely qualify because their stock tends to be expensive. Cyclical companies (high-β stocks) may be profitable in one year, but they are only a good investment if their return over the cycle is above their required rate. Finally, speculative companies may be highly profitable;

however, their required rate is higher, too.

LOS 9.3.B.b: Demonstrate techniques for estimating future earnings per share for a company, the earnings multiplier for a company, and the future value of a companys shares.

Estimating earnings per share (EPS)

1. *Estimate sales* (per share): use sector forecasts, GDP forecasts, industry classifications or whatever data available
2. *Estimate profit margins:* analyze the firms competitive strategy (price leadership or differentiation), its internal performance (cost management), and industry factors (competitive pressure on prices, other competitive forces).
3. *Estimate EPS:* $EPS = Sales\ per\ share \times Net\ profit\ margin$

Estimating earnings multipliers (P/E)

Basically, there are two possible avenues :

- *Macroanalysis:* Use the industry average, adjusted for some specifics of the company.
- *Microanalysis:* Determine P/E from its components.
  1. Estimate dividend payout (D/E) based on past data and management strategy.
  2. Estimate the required rate of return (k). Two ways: (a) estimate a risk premium, based on industry data adjusted for specifics of the company: $k = r_{free} + \varphi_{risk}$, and/or (b) use CAPM: $k = r_{free} + \beta(r_{market} - r_{free})$
  3. Estimate return on equity (ROE) with help of the DuPont formula: $ROE = \frac{Earnings}{Sales} \times \frac{Sales}{Assets} \times \frac{Assets}{Equity} = ROA \times \frac{Assets}{Equity}$
  4. Calculate the growth rate (g): $g = (1 - D/E) \times ROE = b \times ROE$, where b stands for the retention rate.
  5. Summarize: $P/E = \frac{D/E}{k-g}$

Estimating the future value of a company's shares

Put the EPS and P/E estimate together:

$$P^* = EPS \times \frac{P}{E} = \frac{D}{k-g}$$

LOS 9.3.B.c: Compute and analyze the relative valuation ratios that analysts use to evaluate equity investments.

Price/earnings (P/E): Most popular measure for determining the value of a company. Can be calculated from the DDM: $P/E = \frac{D/E}{k-g}$. The P/E ratio will be higher for high-growth (high g) companies. Dividend payout policy affects the numerator and denominator.

Price/book value (P/BV): Based on the idea that the value of a firm stems from its assets. Particularly useful for firms with negative cash flows and consistent accounting.

Price/cash flow (P/CF): Basically used as a check for the P/E ratio (cash flows are more difficult to manipulate).

Price/sales (P/S): Based on the idea that first are sales, then there are profits. Has the advantage that sales data are some of the purest accounting figures.

LOS 9.3.B.d: Use valuation methods to infer whether a particular stock is an attractive investment.

1. Compare the intrinsic value $P^* = EPS \times \frac{P}{E}$ to the market value, P. If $P^* > P$, the stock is attractive.
2. Compare the expected return $E[r] = \frac{P^*_{t+1} - P_t + D}{P_t}$ to the required rate $k = r_{free} + \beta(r_{market} - r_{free})$. If $E[r] > k$, the stock is attractive.
3. Compare the required rate implied by your dividend and growth estimate $k_{implied} = \frac{D}{P_t} + g$ to the required rate k. If $k_{implied} > k$, the stock is attractive.

LOS 9.3.B.e: Distinguish between economic value added (EVA) market value added (MVA), and the franchise factor concept.

Economic value added (EVA) = an internal measure of performance that compares the Net Operating Profit Less Adjusted Taxes (NOPLAT) to the firm's total cost of capital. If the difference between the two (EVA = NOPLAT - WACC · Capital) is positive, management has added value. You can compare EVA to capital to obtain the economic profit per dollar of capital. This measure is directly linked to the difference between return on capital and the average cost of capital.

Market value added (MVA) = an external measure of performance that compares the market value of the firm (adjusted for the market value of debt) to capital invested in the firm. Because this measure is highly influenced by movements of the overall stock market, MVA should be evaluated relative to the market.

Franchise factor = a measure for the relative rate of return on new business opportunities. The approach tries to break the observed P/E down in two factors: (1) the base P/E that is based on the P/E of the firm's ongoing business and (2) the franchise P/E the market assigns to the *expected value of new and profitable business opportunities.* The factors that determine the franchise factor can be derived from the simple growth model: the return on new business opportunities relative to the required rate ($\frac{r}{k}$) and the growth factor (g, determined by the retention rate, b).

LOS 9.3.B.f: Illustrate why the standard dividend discount model (DDM) may be inappropriate for valuing a growth company.

1. Growth above average is not sustainable indefinitely.
2. Earnings data for growth companies are generally unsustainable. If the company is unable to capitalize expenses that are needed to feed growth, earnings are negative. If the company operates in a highly profitable growth sector, high profit margins will attract new competitors.

LOS 9.3.B.g: Compare the alternative growth models and their underlying assumptions.

No-growth model: Assumes no retention of earnings, $D = E$. Consequently, $g = 0$, i.e. earnings will not change. Valuing the firm as the present value of the earnings stream, discounted at k, gives the valuation formula $P^* = \frac{E}{k}$. If the firm trades at its intrinsic value, investors will earn a constant rate of k.

Simple growth model: Assumes a retention rate $b > 0$. Retained earnings ($E \cdot b$) are invested in assets that do not generate additional earnings but a rate of return r based on capital gains.[1] Because earnings are constant, the company acquires every year for a price of $E \cdot b$ assets worth $E \cdot b \cdot \frac{r}{k}$. The total value of the firm then consists of two parts: (1) the discounted value the dividends, $\frac{E(1-b)}{k}$ and (2) the present value of growth investment, $\frac{E \cdot b \cdot \frac{r}{k}}{k}$. Summing up and re-arranging yields the valuation formula

$$P^* = \frac{E}{k} + \frac{E \cdot b \cdot (\frac{r}{k} - 1)}{k}$$

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[1] An alternative description: The company invests in projects that generate additional earnings, but these earnings are all distributed to the shareholders.

Note the difference to the no-growth model: the second part on the right-hand side, $\frac{E \cdot b \cdot (\frac{r}{k} - 1)}{k}$, represents the *present value of excess earnings from growth investments.* As long as $\frac{r}{k}k$, the term is positive because every single investment is worth more than it costs. In other words, the company has the opportunity to invest in assets that have a higher rate of return than the required rate.

Expansion model: A variant of the simple growth model with $r = k$, i.e. the firm invests in assets that have a rate of return equal to the cost of capital. Under this assumption, the simple growth model collapses into the no-growth model.

Negative growth model: A variant of the simple growth model with $r < k$, i.e. the firm invests in assets that have a rate of return below the cost of capital. Under this assumption, the simple growth model collapses into the no-growth model.

Dynamic true growth model: Contrary to the simple growth model, the firm invests in assets that generate additional earnings of which a share b is retained and reinvested. In this model, earnings and investments grow exponentially and the model becomes the standard DDM: $P^* = \frac{D}{k-g}$.

LOS 9.3.B.h: Calculate the value of a company using the DDM.

$$P^* = \frac{D}{k - g}$$

LOS 9.3.B.i: Analyze the factors that should be considered when evaluating a company on a global basis.

- Accounting conventions differ between countries. Earnings data should be adjusted before any comparison. Because of the tendency towards global accounting standards, differences should decline.
- Social attitudes lead to different valuations. Global capital market integrations should lead to more similar patterns.
- Stock market cycles are not completely synchronous.
- k may differ from one market to the other.

Study Session 10

Equity Investments: Valuation Models

10.1 Dividend Discount Models

LOS 10.1.A.a: Explain and calculate the value of a companys equity using the dividend discount model (DDM), the Gordon growth model, the two-stage DDM, the H model, and the three-stage DDM.

All dividend discount models have in common that they value equity as the present value of the dividend stream, $P* = \sum_{t=1}^{\infty} \frac{D}{(1+k_e)^t}$. The difference lies in the pattern of growth in the next couple of years.

Gordon growth model. Assumes a stable growth rate and cost of equity capital.

$$P_0^* = \frac{D_1}{\overline{k_e} - \overline{g}}$$

Two-stage DDM. Assumes two periods: (1) a period of n years with extraordinary growth and (2) a period with stable growth $\overline{g}$. The transition between the two is immediate.

$$P_0^* = \sum_{t=1}^{n} \frac{D_t}{(1+k_{e,1})^t} + \frac{1}{(1+k_{e,1})^n} \cdot \frac{D_{n+1}}{\overline{k_e} - \overline{g}}$$

If the growth and payout rates in the first period are stable, the formula simplifies to:

$$P_0^* = \left[1 - \left(\frac{1+g_1}{1+k_{e,1}}\right)^n\right] \cdot \frac{D_0 \cdot (1+g_1)}{k_{e,1} - g_1} + \frac{1}{(1+k_{e,1})^n} \cdot \frac{D_{n+1}}{\overline{k_e} - \overline{g}}$$

H-model. Assumes two periods: (1) a period that starts with a given growth rate, but where this growth rate linearly converges to the stable rate ($H = 2n$), and (2) a period with stable growth.

$$P_0^* = \frac{D_0(1+\overline{g})}{k_e - \overline{g}} + \frac{D_0 \cdot 2n \cdot (g_1 - \overline{g})}{\overline{k_e} - \overline{g}}$$

Three-stage DDM. Assumes three periods: (1) a period with extraordinary growth, (2) a period of linear convergence to the stable rate, and (3) a period with stable growth.

$$P_0^* = \sum_{t=1}^{n_1} \frac{D_0(1+g_1)^t}{(1+k_{e,1})^t} + \frac{1}{(1+k_{e,1})^{n_1}} \cdot \sum_{t=n_1+1}^{n_2} \frac{D_t}{(1+k_{e,2})^{t-n_1}}$$
$$+ \frac{1}{(1+k_{e,1})^{n_1}(1+k_{e,2})^{n_2-n_1}} \frac{D_{n_2}(1+\overline{g})}{\overline{k_e} - \overline{g}}$$

$$\begin{aligned} \textit{where } D_t &= \textit{dividend at } t \\ k_{e,p} &= \textit{cost of equity in period } p \\ g_p &= \textit{growth rate in period } p \\ n_p &= \textit{end of period } p \\ d_p &= \textit{dividend payout ratio in period } p \end{aligned}$$

Note that to get an estimate of g, you may use the formula

$$g = b \times \left[ROA + \frac{debt}{equity} \left(ROA - interest - expense \cdot (1 - tax\ rate) \right) \right]$$

LOS 10.1.A.b: Explain the assumptions that underlie each of these models.

Since the three models all build upon the same principle, most assumptions are identical:

- After some time, the firm grows at a stable rate $\overline{g}$. This rate must exist and in order to give reasonable results, it should be below the required rate k_e.
- However, over the next couple of years, growth assumptions differs between the models. The Gordon model assumes stable growth from today. The two-stage model assumes two periods with an immediate transition between the two. The H-model also assumes two periods, but the first period is only a linear transition period towards the second period. Finally, the three-stage model assumes first a period with abnormal growth, then a period of linear convergence and finally a third period of stable growth.
- The H-model makes the additional assumption that dividend payout is constant over time. While this is convenient, it is also quite restrictive and not very realistic.

LOS 10.1.A.c: Compare the limitations of each model.

Since the three models all build upon the same principle, they have most limitations in common:

- All dividend discount models are sensitive to the input. In particular, a value of $\overline{g}$ close to k_e results in an infinite terminal value.
- The models depend on their specific growth pattern. The Gordon-model is the most restrictive, but even the three-stage model assumes a very specific growth pattern for the next couple of years. The more complex the model, the more assumptions have to be made (length of the periods, type of convergence). Complex models also mean more work.

- The H-model suffers under the assumption that the payout ratio is constant. However, in reality, firms with high growth rate generally have low payout ratios and vice versa.
- All dividend discount model assume a sustainable dividend policy. If this is not the case, cash flow models should be used. Alternatively, adjusting growth rates to take into account the dividend policy (e.g. high growth rates for firms that do not pay dividends) can solve the problem.
- If the firm has unutilized assets, their value should be added.

LOS 10.1.A.d: Describe potential problems that may be encountered when using each model and discuss solutions to these problems.

- The price may be too low because the payout ratio is too low. Increase the payout ratio or adjust $\overline{g}$.
- The price may be too low because $\overline{k_e}$ is too high. Adjust $\overline{k_e}$, e.g. by assuming a lower β.
- The price is too high because $\overline{g}$ is too close to $\overline{k_e}$. Chose $\overline{g}$ closer to the growth rate of GDP.

LOS 10.1.A.e: Discuss what type of company each model is best suited to analyzing.

- *Gordon growth model.* Firms in mature industries and with a stable dividend policy.
- *Two-stage DDM.* Firms with patent rights; firms in industries with super-normal growth.
- *H-model.* Firms with growth rates that can be expected to gradually decline. Also requires high payouts in the high growth period.
- *Three-stage DDM.* Firms which can be expected to maintain their extraordinary growth rates for some time.

10.2 Free Cashflow to Equity Discount Models

LOS 10.1.B.a: Describe the stable-growth free cash flow to equity (FCFE) model, the two-stage FCFE model, and the E model, and explain the assumptions made in each of these *models.*

All free cash flow to equity (FCFE) models have in common that they value equity as the present value of the free cash flow stream, $P* = \sum_{t=1}^{\infty} \frac{F_e}{(1+k_e)^t}$. The difference lies in the pattern of growth in the next couple of years.

Stable growth FCFE model. Assumes a stable growth rate and cost of equity capital, i.e. the firm is in the steady state.

Two-stage FCFE model. Assumes two periods: (1) a period of n years with extraordinary growth and (2) a period with stable growth $\overline{g}$. The transition between the two is immediate.

E-model. Assumes three periods: (1) a period with extraordinary growth, (2) a period of linear convergence to the stable rate, and (3) a period with stable growth.

LOS 10.1.B.b: Calculate the value of a company using the FCFE model, the two-stage FCFE model, and the E model (three-stage FCFE model).

Stable growth FCFE model. $$P_0^* = \frac{F_{e,1}}{\overline{k_e} - \overline{g}}$$

Two-stage FCFE model. $$P_0^* = \sum_{t=1}^{n} \frac{F_{e,t}}{(1+k_{e,1})^t} + \frac{1}{(1+k_{e,1})^n} \cdot \frac{F_{e,n+1}}{\overline{k_e} - \overline{g}}$$

E-model.

$$\begin{aligned} P_0^* = & \sum_{t=1}^{n_1} \frac{F_{e,t}}{(1+k_{e,1})^t} + \frac{1}{(1+k_{e,1})^{n_1}} \cdot \sum_{t=n_1+1}^{n_2} \frac{F_{e,t}}{(1+k_{e,2})^{t-n_1}} \\ & + \frac{1}{(1+k_{e,1})^{n_1}(1+k_{e,2})^{n_2-n_1}} \frac{F_{e,n_2+1}}{\overline{k_e} - \overline{g}} \end{aligned}$$

where $F_{e,t}$ = *free cash flow to equity at t*
$k_{e,p}$ = *cost of equity in period p*
g_p = *growth rate in period p*
n_p = *end of period p*

Note that $F_{e,t}$, is defined as:

$$\begin{aligned} F_{e,t} = & \textit{ Net income} + \textit{Depreciation} - \textit{Capital spending} \\ & - \Delta \textit{ Working capital} - \textit{Principal repayments} + \textit{New debt issuance} \end{aligned}$$

If the debt rate is kept constant at δ and principal repayments are made from new debt issuance, $F_{e,t}$ can be calculated from:

$$\begin{aligned} F_{e,t} &= \textit{Net income} + (1-\delta)(\textit{Depreciation} - \textit{Capital spending}) \\ &\quad -(1-\delta)(\Delta\,\textit{Working capital}) \end{aligned}$$

LOS 10.1.B.c: Describe the type of company that each model is best suited to analyze.

- *Stable growth FCFE model.* Firms in mature industries (growing at or below the nominal rate of the economy) and with a stable dividend policy.
- *Two-stage FCFE model.* Firms with currently high growth rates; the growth rate will suddenly drop to normal in a couple of years.
- *E-model.* Firms with currently high growth rates and probably an unsustainable dividend policy.

LOS 10.1.B.d: Describe potential problems that may be encountered when using each FCFE model and discuss solutions to these problems.

- The price may be too low because capital expenditures are too high relative to depreciation. Use lower capital expenditures.
- The price may be too low because working capital is set too high. Normalize it to historical averages.
- The price may be too low because k_e is too high. Adjust k_e, e.g. by assuming a lower β.
- The price may be too high because $\overline{g}$ is too close to k_e. Chose $\overline{g}$ closer to the growth rate of GDP.
- The price may be too high because working capital is negative. Set it equal to 0.
- The price may be wrong because cyclical effects distort earnings. Use normalized earnings instead.
- The inputs may be inconsistent. Check, that capital spending and depreciation are consistent with growth (high capital spending in high growth periods). Also check that the cost of equity is consistent with the growth pattern (β converges to 1 as firm grows).

LOS 10.1.B.e: Explain the difference between dividends and free cash flow.

- Free cash flow to equity is a measure of what the firm could afford to pay out as a dividend. The dividend, in contrast, is what the firm decides to pay out.
- Dividends may differ from free cash flow because management would like to keep dividends relatively stable, because the firm would like to retain some earnings to finance new business opportunities, because dividends are taxed, and because the dividend policy is used as a signal to potential investors.

LOS 10.1.B.f: Compare and contrast dividend discount models and FCFE models.

- Models give the same results if either dividends are equal to free cash flow or if the excess cash flow is invested in projects with net present value of 0 (e.g. investments in financial assets that are fairly priced).
- Models based on cash flows provide better results for firms with unsustainably high or low dividends.
- In general, free cash flow models give higher values. The difference can be interpreted as the value of control over the firms cash flows.

10.3 The Free Cashflows to the Firm Approach

LOS 10.1.C.a: Explain how free cash flows to the firm (FCFF) is measured.

The free cashflows to the firm are the sum of the cashflows to all claimholders. It can be measured in two ways:

$$\begin{aligned} F_{f,t} &= F_{e,t} + \mathit{Interest\ expense} \cdot (1 - \mathit{tax\ rate}) \\ &\quad + \mathit{Principal\ repayments} - \mathit{New\ debt\ issuance} \\ &\quad + \mathit{Preferred\ dividends} \\ &= \mathit{EBIT} \cdot (1 - \mathit{tax\ rate}) + \mathit{Depreciation} \\ &\quad - \mathit{Capital\ expenditures} - \Delta \mathit{Working\ capital} \end{aligned}$$

LOS 10.1.C.b: Explain the stable-growth FCFF model and the two-stage FCFF model and use each model to calculate the value of a company.

In contrast to DDM and FCFE models which are used to value equity, FCFF models provide a value for the firm.

Stable growth FCFF model. Assumes that the firm grows at a stable rate and generates stable cashflows.

$$P_0^* = \frac{F_{f,1}}{\overline{k_w} - \overline{g}}$$

Two-stage/general FCFF model. Assumes two periods: (1) a period of extraordinary growth and (2) a period of stable growth.

$$P_0^* = \sum_{t=1}^{n} \frac{F_{f,t}}{(1+k_{w,1})^t} + \frac{1}{(1+k_{e,1})^n} \cdot \frac{F_{f,n+1}}{\overline{k_w} - \overline{g}}$$

where $F_{f,t}$ = *free cash flow to firm at t*
$k_{w,p}$ = *weighted average cost of capital in period p*
g_p = *growth rate in period p*
n_p = *end of period p*

Recall that k_w is defined as:

$$k_w = \frac{Debt}{Capital} k_d + \frac{Common\ stock}{Capital} k_e + \frac{Preferred\ stock}{Capital} k_p$$

LOS 10.1.C.c: Describe the type of company that each model is best suited to analyze

In general FCFF models are well suited to deal with firms that either run a high level of leverage or are about to change their capital structure.

- *Stable growth FCFF model.* Firms in mature industries (growing at or below the nominal rate of the economy) and with a stable dividend policy.
- *Two-stage FCFF model.* Firms with currently high growth rates; the growth rate will suddenly drop to normal in a couple of years.

LOS 10.1.C.d: Compare company value with equity value.

Company value refers to the value of all assets while equity value refers to the value of assets net of claims by debtholders and preferred stock. You can calculate the equity value by subtracting the value of debt and preferred stock from the company value.

LOS 10.1.C.e: Illustrate the effects of leverage on company value.

Company value is maximized when the weighted average cost of capital is minimized. The effect of leverage on the cost of capital is non-linear:

1. At low levels of leverage, debt is cheaper than equity capital because of the tax shield on interest payments.
2. At higher levels of debt, borrowing costs will increase and offset the effect of the tax shield.
3. Higher levels of leverage will also drive up the cost of equity because highly leverage firms have higher βs.
4. Finally, if leverage becomes excessive, bancruptcy costs (a firm that goes bust will have to sell its assets below fair value) and missed business opportunities (clients will be reluctant to make business with a highly indebted firm) drive up the cost of debt.

Therefore, the firm should chose the level of leverage at which the marginal cost of debt is equal to the average cost of capital.

10.4 Price/Earnings Multiples

LOS 10.1.D.a: Calculate a price-to-earnings ratio (P/E) for a stable company based on the fundamental data used in the dividend discount model (DDM).

$$P_0^* = \frac{D_0 \cdot (1+\overline{g})}{\overline{k}_e - \overline{g}} = \frac{E_0 \cdot p \cdot (1+\overline{g})}{\overline{k}_e - \overline{g}} \Leftrightarrow \frac{P_0^*}{E_0} = \frac{p \cdot (1+\overline{g})}{\overline{k}_e - \overline{g}},$$

where p is the payout ratio. P_0^*/E_0 is known as the *P/E ratio based on fundamentals.* Alternatively, the P/E ratio can be stated in terms of next year's earnings:

$$\frac{P_0^*}{E_1} = \frac{\overline{p}}{\overline{k}_e - \overline{g}}.$$

LOS 10.1.D.b: Calculate a P/E for a high-growth company based on the fundamental data used in the two-stage DDM

.

$$\begin{aligned} P_0^* &= \left[1 - \left(\frac{1+g_1}{1+k_{e,1}}\right)^n\right] \cdot \frac{E_0 \cdot p_1 \cdot (1+g_1)}{k_{e,1} - g_1} + \frac{1}{(1+k_{e,1})^n} \cdot \frac{E_0 \cdot \overline{p}(1+g_1)^n(1+\overline{g})}{\overline{k}_e - \overline{g}} \\ \Leftrightarrow \quad \tfrac{P_0^*}{E_0} &= \quad \left[1 - \left(\frac{1+g_1}{1+k_{e,1}}\right)^n\right] \cdot \frac{p_1 \cdot (1+g_1)}{k_{e,1} - g_1} + \frac{1}{(1+k_{e,1})^n} \cdot \frac{\overline{p}(1+g_1)^n(1+\overline{g})}{\overline{k}_e - \overline{g}} \end{aligned}$$

LOS 10.1.D.c: Analyze the effects of growth rates, risk, payout ratios, and interest rates on P/E multiples.

Recalling the fundamental formula for the P/E ratio, $\frac{P_0^*}{E_0} = \frac{\overline{p}\cdot(1+\overline{g})}{\overline{k}_e - \overline{g}}$, the effects are:

- increase in growth rate: $\overline{g} \uparrow \quad \Rightarrow PE \uparrow$
- increase in payout ratio: $\overline{p} \uparrow \quad \Rightarrow PE \uparrow$
- increase in risk: $\overline{k_e} \uparrow \quad \Rightarrow PE \downarrow$
- increase in interest rate: $\overline{k_e} \uparrow \quad \Rightarrow PE \downarrow$

LOS 10.1.D.d: Calculate a P/E for the market as a whole and analyze the effects of changes in each of the components on the P/E.

The calculation uses the fundamental formula for the P/E ratio, $\frac{P_0^*}{E_0} = \frac{\overline{p} \cdot (1+\overline{g})}{\overline{k_e} - \overline{g}}$. The following inputs are used:

- Nominal GDP growth (real growth + inflation rate) is used as proxy for $\overline{g}$.
- The average payout ratio of the index is used for $\overline{p}$
- To get a proxy for $\overline{k_e}$ add the average equity premium (long-term outperformance of stocks) to the current nominal interest rate of bonds. This can be justfied by the CAPM ($\beta = 1$ for the market).

LOS 10.1.D.e: Explain why differences or changes in such economic factors as interest rates, real GNP growth, and country risk can cause P/Es to differ among countries at any one time or within one country over different time periods.

- Differences in *interest rates* will affect k_e. P/E ratios in countries with high interest rates, e.g. because of high inflation, will tend to have lower P/E ratios. Investors receive higher expected returns on equity investments that offset higher funding costs (analogously to different risk-free bond yields).
- Differences in *country risk* also affect k_e. P/E ratios in countries with high risk will tend to have lower P/E ratios. Investors receive higher expected returns on equity investments that offset the risk they incur by investing in this country.
- Differences in *growth rates* affect P/E directly by g. High growth leads to high P/E ratios. In this case, growth potential is reflected in the payout rate of the companies in this country.

LOS 10.1.D.f: Compare and contrast the value of a companys equity using discounted cash flow valuation versus P/E multiples.

Valuation models based on cash flows can be used in a similar way to the dividend discount model:

P/E ratio: based on the (two-stage) dividend discount model. Suitable for firms with positive earnings and a stable dividend policy. Subject to accounting manipulations.

$$\frac{P_0^*}{E_0} = \left[1 - \left(\frac{1+g_1}{1+k_{e,1}}\right)^n\right] \cdot \frac{p_1 \cdot (1+g_1)}{k_{e,1} - g_1} + \frac{1}{(1+k_{e,1})^n} \cdot \frac{\overline{p}(1+g_1)^n(1+\overline{g})}{\overline{k_e} - \overline{g}}$$

P/FCFE ratio: based on the (two-stage) free cashflow to equity model. Suitable for firms with positive cashflows (but not necessarily positive earnings). Less subject to accounting manipulations.

$$\frac{P_0^*}{F_{e,0}} = \left[1 - \left(\frac{1+g_1}{1+k_{e,1}}\right)^n\right] \cdot \frac{(1+g_1)}{k_{e,1} - g_1} + \frac{1}{(1+k_{e,1})^n} \cdot \frac{(1+g_1)^n(1+\overline{g})}{\overline{k_e} - \overline{g}}$$

P/FCFF ratio: based on the (two-stage) free cashflow to the firm model. Suitable for firms with high leverage or changing capital structure.

$$\frac{P_0^*}{F_{f,0}} = \left[1 - \left(\frac{1+g_1}{1+k_{w,1}}\right)^n\right] \cdot \frac{(1+g_1)}{k_{w,1} - g_1} + \frac{1}{(1+k_{w,1})^n} \cdot \frac{(1+g_1)^n(1+\overline{g})}{\overline{k_w} - \overline{g}}$$

LOS 10.1.D.g: Illustrate the relationship among dividend yield, the Treasury bond rate, the expected growth rate in dividends, and the equity risk premium.

Dividend yield (D_1/P_0) can be calculated from the dividend discount model:

$$P_0^* = \frac{D_1}{\overline{k_e} - \overline{g}} \Rightarrow \frac{D_1}{P_0^*} = \overline{k_e} - \overline{g}$$

Replacing $\overline{k_e}$ with the risk-free rate, r_f and the risk premium on equity φ_e, yields, after re-arranging:

$$\textit{Dividend yield} - r_f = \varphi_e - \overline{g}$$

In other words: The difference between the dividend yield and the risk-free bond rate is equal to the risk premium, adjusted for the growth rate.

10.5 Price/Book Value Multiples

LOS 10.1.E.a: Explain the advantages and disadvantages of using price-to-book value (PBV) multiples in stock valuation.

Advantages:

- Book value is relatively stable and intuitive; it does not rely on dubious inputs of $\overline{g}$ or $\overline{k_e}$.
- For comparable accounting standards, P/B values can be easily used
- The measure gives meaningful results even if a firm has negative earnings.

Disadvantages:

- Accounting decisions (depreciation, inventory accounting) affect book value.
- Book value has little value for service firms with few assets.
- Book value can be negative after some years of negative earnings.

LOS 10.1.E.b: Calculate the PBV multiple for a stable company, using fundamental data from a single-stage dividend discount model (DDM).

$$P_0^* = \frac{D_0 \cdot (1+\overline{g})}{\overline{k_e} - \overline{g}} = \frac{BV \cdot ROE \cdot p \cdot (1+\overline{g})}{\overline{k_e} - \overline{g}} \Leftrightarrow \frac{P_0^*}{BV_0} = \frac{ROE \cdot p \cdot (1+\overline{g})}{\overline{k_e} - \overline{g}}.$$

P_0^*/BV_0 is known as the *P/BV ratio based on fundamentals.* Alternatively the P/BV ratio can be estimated from return differentials:

$$\frac{P_0^*}{BV_0} = \frac{ROE - \overline{g}}{\overline{k_e} - \overline{g}}.$$

Note that the two estimates give different results.

LOS 10.1.E.c: Explain the process of calculating the PBV multiple for a high growth company, using fundamental data from a two-stage DDM.

For high-growth companies, P_0^* is estimated as the sum of (1) the present value of dividends during the high-growth period and (2) the present value of the terminal price. Substituting $BV \cdot ROE \cdot p$ for D in the two-stage dividend discount model and dividing by BV yields a fair P/BV ratio:

$$\frac{P_0^*}{BV_0} = \left[1 - \left(\frac{1+g_1}{1+k_{e,1}}\right)^n\right] \cdot \frac{ROE_1 \cdot p_1 \cdot (1+g_1)}{k_{e,1} - g_1} + \frac{1}{(1+k_{e,1})^n} \cdot \frac{\overline{ROE} \cdot \overline{p} \cdot (1+g_1)^n (1+\overline{g})}{\overline{k_e} - \overline{g}}$$

The formula shows all the elements that influence P/BV.

LOS 10.1.E.d: Explain the relationship between the PBV multiple and return on equity, risk factors, growth rate, and payout ratio.

Recalling the fundamental formula for the P/BV ratio, $\frac{P_0^*}{BV_0} = \frac{ROE \cdot \overline{p} \cdot (1+\overline{g})}{\overline{k_e} - \overline{g}}$, the effects are:

- increase in return on equity: $ROE \uparrow \quad \Rightarrow PE \downarrow$
- increase in growth rate: $\overline{g} \uparrow \quad \Rightarrow PE \uparrow$
- increase in payout ratio: $\overline{p} \uparrow \quad \Rightarrow PE \uparrow$
- increase in risk or interest rate: $\overline{k_e} \uparrow \quad \Rightarrow PE \downarrow$

LOS 10.1.E.e: Discuss how the P/BV model can be applied in various investment strategies.

- You can simply buy companies with low P/BV ratios. Fama and French have shown that this works. However, low P/BV stocks could simply be the ones with high risk; hence, the strategy outperforms because it takes high riks.
- You can compare the actual P/BV to the fair P^*/BV.
- You can scale P/BV by ROE. [Probably, this gives P/E]

LOS 10.1.E.f: Discuss two variations of the P/BV model (Tobins Q and Esteps T) and calculate each measure.

Tobin's Q: Compares the market value of the firms assets to their replacement value. In high inflation environment, the replacement value rises faster, so Q decreases. Problems: replacement value can be difficult to estimate and Q requires much more information than P/BV. [Looks as if the text uses the term 'market' value for book value]

$$Q = \frac{Market\ value\ of\ assets}{Replacement\ value\ of\ assets}$$

Estep's T: Decomposes returns in three components (growth, cashflow yield, and valuation change). Estep claims that firms with a high T outperform the market.

$$T = g + \frac{ROE - g}{P/BV} + \frac{\Delta P/BV}{P/BV}(1+g)$$

10.6 Price/Sales Multiples

LOS 10.1.F.a: Explain the advantages and disadvantages of using price-to-sales (PS) multiples in stock valuation.

Advantages:

- Sales are not really subject to accounting manipulations
- Sales will (almost) always be positive.
- P/S multiples are very stable.

Disadvantages:

- Stability of P/S ratio can hide problems in cost control.
- It may be the wrong focus for investors.

LOS 10.1.F.b: Calculate the P/S multiple for a stable company, using fundamental data from a single-stage dividend discount model (DDM).

$$P_0^* = \frac{D_0 \cdot (1+\overline{g})}{\overline{k}_e - \overline{g}} = \frac{S_0 \cdot \overline{\pi}_0 \cdot \overline{p} \cdot (1+\overline{g})}{\overline{k}_e - \overline{g}} =\Leftrightarrow \frac{P_0^*}{S_0} = \frac{\overline{\pi} \cdot \overline{p} \cdot (1+\overline{g})}{\overline{k}_e - \overline{g}},$$

where $\overline{\pi}$ is the net profit margin. P_0^*/S_0 is known as the *P/S ratio based on fundamentals.* Alternatively the P/S ratio can be estimated with a strange expected profit margin:

$$\frac{P_0^*}{S_0} = \frac{\pi_x \cdot \overline{p}}{\overline{k}_e - \overline{g}}, \quad \pi_x = E_1/S_0 = \overline{\pi} \cdot (1+\overline{g}).$$

LOS 10.1.F.c: Explain the process of calculating the PS multiple for a high-growth company, using fundamental data from a two-stage DDM.

For high-growth companies, P_0^* is estimated as the sum of (1) the present value of dividends during the high-growth period and (2) the present value of the terminal price. Substituting $S \cdot \pi \cdot p$ for D in the two-stage dividend discount model and dividing by S yields a fair P/BV ratio:

$$\frac{P_0^*}{S_0} = \left[1 - \left(\frac{1+g_1}{1+k_{e,1}}\right)^n\right] \cdot \frac{\pi_1 \cdot p_1 \cdot (1+g_1)}{k_{e,1} - g_1} + \frac{1}{(1+k_{e,1})^n} \cdot \frac{\overline{\pi} \cdot \overline{p} \cdot (1+g_1)^n (1+\overline{g})}{\overline{k}_e - \overline{g}}$$

The formula shows all the elements that influence P/BV.

LOS 10.1.F.d: Explain the relationship between the PS multiple and profit margin, risk factors, growth rate, and payout ratio.

Recalling the fundamental formula for the P/BV ratio, $\frac{P_0^*}{S_0} = \frac{\pi_0 \cdot \overline{p} \cdot (1+\overline{g})}{\overline{k_e} - \overline{g}}$, the effects are:

- increase in profit margin: $\overline{\pi} \uparrow \quad \Rightarrow PE \downarrow$
- increase in growth rate: $\overline{g} \uparrow \quad \Rightarrow PE \uparrow$
- increase in payout ratio: $\overline{p} \uparrow \quad \Rightarrow PE \uparrow$
- increase in risk or interest rate: $\overline{k_e} \uparrow \quad \Rightarrow PE \downarrow$

LOS 10.1.F.e: Discuss how the P/S model can be used to analyze the value of a company that adopts either a differentiation (high-margin, low-volume) strategy or a cost-leadership (low-margin, high-volume) strategy.

The P/S ratio directly tells you whether the firm follows a differentiation (high P/S) or cost-leadership (low P/S) strategy.

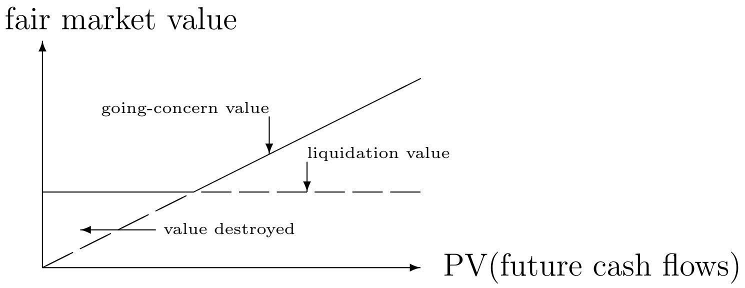
10.7 Business Valuation

LOS 10.2.a: Illustrate the relationships among fair market value, going-concern value, and liquidation value.

Going-concern value. Present worth of expected future cash flows generated by a business.

Liquidation value. The cash generated by terminating a business and selling its assets individually.

Fair market value. Price at which the asset would trade between two rational individuals, each in command of all the information necessary to value the asset and neither under any pressure to trade; normally, the higher of going-concern value and liquidation value.



LOS 10.2.b: Demonstrate the difference between the market value of equity and the market value of the company.

(Market) value of the firm. Based on the definition of the going-concern value in LOS 10.2.a, the fair market value of the firm can be defined as the *present value of expected aftertax cash flows to owners and creditors.* The discount rate used in the calculation of the present value should be the company's average cost of equity capital.

(Market) value of equity. This is simply given by

$$\text{Value of equity} = \text{Value of firm} - \text{Value of debt}$$

.

Note that one indicator of the market value of equity is the price of one share multiplied by the number of shares outstanding (add total debt to obtain an indicator of the market value of the firm). However, this indicator will be imprecise as the stock price only reflects the worth of the business to a *minority* shareholder. Controlling interest, however, contains the premium you - or the seller - attribute to the control of the firm.

LOS 10.2.c: Calculate the components of free cash flow.

$$\begin{matrix}\textit{Free cash}\\ \textit{flow}\end{matrix} = EBIT(1 - \textit{Tax rate}) + \textit{Depreciation} - \begin{matrix}\textit{Capital}\\ \textit{expenditures}\end{matrix} - \begin{matrix}\textit{Increase in net}\\ \textit{working capital}\end{matrix}$$

LOS 10.2.d: Estimate the fair value of a company, using the discounted free cash flow approach.

1. Estimate the free cash flow for the next n ($n \approx$ 5-15) years, using the formula in LOS 10.2.c.
2. Estimate a terminal value using one of the following approaches:

Liquidation value: if the business is going to be liquidated after n years.

Book value: for a conservative estimate.

Warranted P/E multiple: estimate earnings at the end of n years and take a multiple that is representative in this industry.

Perpetual growth: use the standard formula

$$\begin{matrix}\textit{Terminal value of} \\ \textit{perpetualy growing firm}\end{matrix} = \frac{FCF_{n+1}}{k-g}$$

.

No-growth perpetuity: same formula with $g = 0$. This may look overly conservative. However, since g only adds value when it generates returns above capital costs. So, if the market is competitive, setting g to zero gives realistic results.

3. Calculate the value of the firm by

$$\begin{matrix}\textit{Fair market} \\ \textit{value of firm}\end{matrix} = \sum_{i=1}^{n} PV\left(FCF_i\right) + PV\left(\textit{Terminal value}\right)$$

LOS 10.2.e: Estimate the fair market value of a company's equity, given dividend data and the company's cost of equity capital.

This LOS is simply an application of LOS 10.2.d.

LOS 10.2.f: Discuss the practical problems presented with present-value approaches to valuation.

There are basically two problems:

1. The present-value approach is conceptually correct for investment opportunities; but a firm is not a typical investment opportunity:
    - Contrary to the finite horizon of an investment opportunity, the life of the company is infinite. This becomes a problem when cash flows grow.
    - Cash flows tend to decrease in typical investment opportunities, but increase (due to re-investments) for firms.
    - Cash flows in companies do not necessarily go to the investor (only if managements decides so).
2. The analysis is highly sensitive to the cost of capital and the assumed growth rate. Small errors in the assumptions can result in huge differences in the fair value estimate.

LOS 10.2.g: Estimate the fair market value of a company's stock, given data for comparable public companies.

The idea is to find comparable companies and to use their price multiples (below in []) to determine the price of the target company. The following multiples are used:

$$A.\ P_e^* = \left(\left[\frac{P_f}{EBIT \cdot (1 - Tax\ rate)}\right] \cdot EBIT \cdot (1 - Tax\ rate)\right) \frac{1}{\#shares}$$

$$B.\ P_e^* = \left[\frac{P}{E}\right] \cdot \frac{Net\ income}{\#shares}$$

$$C.\ P_e^* = \left[\frac{P_e}{BV_e}\right] \cdot \frac{BV_e}{\#shares}$$

$$D.\ P_e^* = \left(\left[\frac{P_f}{BV_f}\right] \cdot BV_f - Debt\right) \cdot \frac{1}{\#shares}$$

where P_e and P_f are the market price of equity and the firm, respectively, BV is the book value and P_e^* is the fair value of equity. To determine the fair value of the target company, follow the following steps:

1. Calculate the four multiples for comparable companies.
2. Determine the appropriate multiple for the target company, based on the values of the other companies. Some adjustments may be warranted: If earnings for a given year look unsustainable, adjust the ratios (note: this is not necessary for C and D). Also, higher growth rates than the industry should be reflected in higher ratios (A and B).
3. Plug the multiples and the other variables into the formulas above to find four estimates of the fair value of the firm.
4. From the results, chose a value that looks right. In general A gives better estimates than B, and B is better than C and D.

LOS 10.2.h: Demonstrate how marketability and control affect the value of a company.

Marketability: If equity is marketable, you can sell it quickly without loss of value. Marketability has an economic value. Accordingly, a representative lack of marketability should be punished with a discount in the order of 25%.

Control: Quoted prices refer to minority interest. If you buy a whole company, you also buy control. Control is valuable, and it is therefore necessary to add a premium over the quoted prices. The value of control stems from the *enhancements* the aquirer can bring to the business. Enhancements are here defined as the present value of all value-increasing changes due to changes in control. The maximum premium for control corresponds to these enhancements. But how should a change in control affect the fair market value of a firm? Three explanations

1. Tax shields arise if a take-over is financed by leverage.
2. Control can change the incentives of management (in particular under a leveraged management buyout)
3. Shareholders may gain control over the way cash flows are allocated.

Study Session 11

Equity Investments: Special Valuation Cases

11.1 Valuation Outside of the United States

LOS 11.1.a: Demonstrate the problems associated with using ratios for cross-border valuations.

- Accounting standards are different. Consequently earnings data can be hard to compare.
- Ratios are not very instructive about what's going on. A discounted cash flow analysis is always better and works everywhere in the world.

LOS 11.1.b: Illustrate how differences in accounting standards among countries can affect cash flow estimates.

There are six problematic areas:

Consolidation of subsidiaries: EU now requires consolidation, but some other standards (Switzerland) still don't.

Reserves: Reserves for the smoothing of earnings are not always transparent (Portugal).

Asset write-up: Many systems (France) allow write-up of assets to replacement value. Assets and depreciation will increase.

Deferred taxes: Countries like Germany do not allow separate books for reporting and taxes. Deferred tax will then be zero.

Leases: The classification of operating and capital leases varies.

Goodwill: Treatment of goodwill varies between US GAAP and IAS.

LOS 11.1.c: Describe how cultural differences can affect company value.

- Cross-holdings of shares can be cultural phenomenon (Japan). Consequently, a large part of firm asset consists of marketable securities.
- Real estate holdings can be high because of cultural (the people like it) or institutional (the banks want it as collateral) factors.

LOS 11.1.d: Demonstrate why cost of capital is unlikely to vary among developed countries.

- Government debt tends to pay the same real rate in all industrialized countries. Covered interest rate parity prevents large differences.
- Corporate debt has a similar price after adjusting for liquidity, structure of the debt (warrants), covenants, credit risk of the borrower and informational asymmetries. Today, the possibility to asset-swap corporate debt removes major arbitrage opportunities.
- The cost of equity is very similar. There are no significant differences in stock prices for companies quoted on more than one exchange (differences are taken care of by arbitrageurs).
- Capital structures do not differ that much between countries after adjusting for growth, profitability, risk, size and industry effects.

LOS 11.1.e: Explain some of the adjustments necessary to estimate the cost of capital in developing countries.

Inflation effects: Developing markets tend to have high and volatile rates of inflation. To control for this effect, translate everything at historical rates in a stable currency, value the company in the stable currency, and then translate the value at the current exchange rate back into the original currency.

Required rates: Sometimes it may be hard to get an estimate for the required rate, e.g. because there is no risk-free rate. You can get an estimate by adding a typical industry-wide real rate to the country's inflation rate. To capture the effect of leverage, the Modigliani-Miller formula can be used (it factors the cost of debt out of the weighted average cost of capital to give the cost of capital for the unlevered firm).

Distortions from government intervention: Governments can put a ceiling on nominal rates or manipulate exchange rates.

11.2 Minority Interest Discounts, Control Premiums, and Other Discounts and Premiums

LOS 11.2.A.a: Describe the concept and importance of control.

Control refers to the power to influence important decisions in the management of the firm. The prerogatives of control include: appointment of management, determination of management compensation, setting of policy and strategic objectives of the firm, acquisitions, liquidation, share repurchases, dividend policy, changes in the articles and bylaws, and veto rights in all these areas.

Control gives rights, and these rights have an economic value. The additional considaration an investor would pay over a marketable minority equity value in order to own a controlling interest int the company is called the *control premium.* The magnitude of the premium depends on:

- nature and magnitude of nonoperating assets
- nature and magnitude of discretionary expenses
- quality of management
- unexploited business opportunities
- articles of incorporation, bylaws and shareholder agreements
- outstanding stock options that could lead to dilution of control
- preemptive rights (= stockholders privilege to subscribe to new issues of voting stock)
- contractual restrictions (e.g bond covenants)
- potential synergies for the acquiring firm
- government regulation
- financial condition of the business

LOS 11.2.A.b: Discuss how the valuation approaches used may impact the control premium / minority interest discount issue.

The choice of the valuation approach determines what base value is used:

- *Income approach ⇒ base = value of controlling interest.* To obtain the value of a minority interest, the minority discount must be subtracted. In the dividend discount model, the main difference between minority and controlling interest is related to economic income (the numerator), although sometimes a case can be made for a different risk premium (in the denominator).
- *Price multiples (guideline company / capital market) approach ⇒ base = value of minority interest.* To obtain the value of a controlling interest, the control premium must be added.
- *Merger and acquisition approach ⇒ value of controlling interest.* To obtain the value of a minority interest, the minority discount should be subtracted. Moreover, if the value obtained by this approach contains synergie gains, they should be factored out for minority interest.

- *Adjusted net value and excess earnings approach ⇒ value of controlling interest.* To obtain the value of a minority interest, the minority discount should be subtracted.

Note that in addition to the minority discount, a discount for lack of marketability may be warranted. Other possible discounts:

- key person discount: if the business depends on a few key persons
- blockage: if the block of shares is so big, that it's sale would have a big market impact (ignoring the issue of control)
- portfolio discount: if the firm consists of a heterogeneous portfolio of business lines (diversification is non-fashionable)
- non-voting shares: non-voting shares have an additional discount of 5-10%

LOS 11.2.A.c: Discuss the selection of a standard value and how the selection affects minority discounts or control premiums.

Fair market value = price at which an arm's-length transaction would be expected to occur between normally motivated investors in an open market. ⇒ Minority interest is generally much lower than fair market value.

Investment value = value to a particular investor, due to some specific characteristics. ⇒ Investment value of minority interest can be much smaller or much bigger than market value.

Intrinsic value = value inherent in the investment itself. The definition is very vague. Often it is used to directly determine the minority interest (add a control premium for controlling interest).

Fair value = a term that often describes the fair market value of a minority interest.

LOS 11.2.A.d: Discuss the impact of state statute provisions on minority versus control value.

State statutes provide protection to minority shareholders. The degree of protection varies from one state to another, but they all decrease the minority discount:

- Requirements for supermajority votes: e.g. a 3/4 majority for changes in bylaws.
- Dissenting stockholder appraisal rights: dissenting stockholders may have their shares appraised an be paid that value in cash) reduce the minority discount.

- Rights to dissolution or sale of stock: united minority stockholders may force dissolution of the firm or to be paid out the fair value of their shares.

LOS 11.2.A.e: Discuss the top down, horizontal, and bottom up approaches for valuing minority interests.

Top down: Determine the control value, calculate the minority pro rata interest and subtract the minority discount and (if applicable) other discounts. Note that discounts are not additive but multiplicative (e.g. the total discount for a minority discount of 30% plus a discount for lack of marketability of 40% is equal to $1 - (1 - 30\%) \cdot (1 - 40\%) = 58\%$.

Horizontal: Compare the minority interest to other minority interest transactions. For this, focus on dividends rather than earnings or assets.

Bottom up: Project the cash-flow stream to minority shareholders plus the terminal value, then calculate the present value, using an appropriate discount rate.

LOS 11.2.A.f: Discuss the market evidence with respect to control premiums and minority discounts.

- Premiums paid in mergers and acquisitions were around 30-40% of market price for minority interest (compared to closing price before announcement).
- Studies on holding companies show slightly smaller control premiums. In the case of REITs, the minority discount is relatively small because the law states that cash flow generated goes to shareholders.
- Studies on trading in limited partnerships shows a discount of 40% against adjusted net asset value. This discount, however, also includes a discount for lack of marketability.
- Studies on trust and estate sales show that holders of minority interest are paid out with a minority discount of 20-50%. Similarly, minority owners in real estate typically give up a discount of 35%.

11.3 Discounts for Lack of Marketability

LOS 11.2.B.a: Discuss the importance of marketability.

Marketability = *ability to convert the property the cash quickly, with a minimum transaction and administrative costs, and with a high degree of certainty of realizing the expected amount of net proceeds.*

In practice, the lack of marketability leads to a discount in the order of 35-50%.

LOS 11.2.B.b: Discuss the general results of the studies of private stock transactions.

- *Studies on prices of restricted stocks* examine the difference between the price of a stock in the open market and the price of restricted stock (= 'letter stock'; stock with the only difference that it cannot be traded in the open market for a certain time, typically 2 years). Restricted stock is traded in private transactions with a typical discount of 30-40%. The classics: Gelman (1972), Moroney (1973), Maher (1976), Silber (1991)
- *Studies on IPOs* examine the difference between the price of a stock before and after an initial public offering (IPO). The studies generally use SEC filings or the prospectus of the offering. Typically, the price of minority interest after the IPO is 40-60% higher than the price of the stock in private transactions before the IPO. The classics: Emory (1981-93), Willamette Management Associates (1975-92).
- Evidence on regulation S (companies can sell their stock offshore without registration) strongly supports the presence of the marketability premium: despite a prescribed holding period of only 40 days, several transactions traded at a discount of 30%.
- The Mergerstat data show that acquisitions of privately held companies are done at lower P/E values than those for publicly traded companies. However, the differences can also be explained by: exposure to market (higher coverage and better information), the quality of reported earnings data, and the size effect (private companies tend to be small and risky).

LOS 11.2.B.c: Discuss the transactional considerations encountered when attempting to liquidate a controlling interest in a closely held company.

- Time horizon: it can take long to conclude transaction (cash flows from the firm may mitigate the problem.
- Costs: selling a closely-held company can be expensive (auditing and accounting fees, legal costs of the transaction, administrative costs, transaction costs, fees to the broker and underwriter)

- Risk: business valuation is uncertain, market conditions can change, finding a buyer can turn out difficult
- Form of proceeds: even if the sale is successful, proceeds may not be in cash
- Inability to hypothecate: if the seller needs the cash urgently, he may find himself unable to use a private company as collateral

LOS 11.2.B.d: Describe the major factors affecting the discount for lack of marketability.

- *Put rights:* the right to sell the stock to someone.
- *Dividend paymens:* marketability is less important for stocks with high dividends.
- *Potential buyers:* dampen the discount for lack of marketability (in fact, the make the stock de-facto marketable)
- *Size of the block:* control apart, a large block is even harder to sell than a big one.
- *Prospect of an IPO:* if it is credible, the lack of marketability should disappear (but having the 'intention to go public' is not enough).
- *Information:* reliable accounting data reduces the discount.
- *Restrictive transfer provisions:* further increase the discount.

11.4 Mergers, LBOs, Divestitures, and Holding Companies

LOS 11.3.a: Analyze rationales for a potential merger.

Synergy = condition wherein the whole is greater than the sum pf its parts (the post-merger value exceeds the sum of the value of the two companies). This is generally the 'official' justification for a merger.

Tax considarations. Tax gains can arise if a profitabe firm takes over a firm with high accumulated tax losses (they can be turned into tax savings rather than carry them forward for an uncertain time). Tax gains to shareholders are also possible if the acquisition absorbs cash earned that otherwise would have to be paid out in (taxable) dividends.

Purchase of assets below market value. It may be cheaper the buy a whole firm with their assets than these assets (example: oil companies acquired competitors with nice oil fields).

Diversification. Smooth you cash-flow stream. This motivation is flawed because investors could get diversification themselves.

Gains from breakup. If the breakup value of a firm is bigger than the price of the firm, buy it, sell the assets and keep the profit.

Managers personal utility. Managers often gain from mergers (bigger firm to run, bigger salary). No manager would admit it, but in practice, this is probably the single most important motivation.

LOS 11.3.b: Analyze and differentiate among sources of synergistic effects from mergers.

Operating economies = economies of scale in production, marketing and management

Financial economies = lower funding and transaction costs

Differential efficiency = the better management takes control

Increased market power = better buying and selling powe (an argument that should not be pushed too far if the Justice Department is to give its approval)

LOS 11.3.c: Differentiate among horizontal, vertical, congeneric and conglomerate mergers.

Horizontal merger = a combination of two firms that produce the same type of good or service.

Vertical merger = a merger between a firm and one of its suppliers or customers.

Congeneric merger = a merger of firms in the same general industry, but for which no customer or supplier relationship exists.

Conglomerate merger = a merger of companies in totally different industries.

LOS 11.3.d: Differentiate between financial and operating mergers.

Financial merger = a merger in which the firms involved will not be operated as a single unit and from which no operating economies are expected.

Operating merger = a merger in which operations of the firms involved are integrated in hope of achieving synergistic benefits.

LOS 11.3.e: Determine the value to the acquiring company of a potential acquisition target company.

The value can be determined in two ways:

Discounted cash flow analysis: Forecast the additional free cash flow to equity and discount it back to present value. The difficulty lies in forecasting the additional free cash flow, because it includes an estimate of synergistic effects.

Market multiple analysis: Estimate additional earnings (smoothed over a certain period) and multiply the by P/E multiple of the sector.

LOS 11.3.f: Evaluate a potential merger using discounted cash flow analysis and market multiple analysis.

1. Value the potential merger with the discounted cash flow (present value of forecasted free cash flow to equity) or market multiple analysis (P/E ratio of the industry times forecasted and smoothed earnings)
2. Determine the bid price the acquirer can ask. The bid price must lie above the current market price of the company and should lie below the value of the firm to the acquiring firm (the position in the bargaining range is largely determined by the presence or absence of other bidders).
3. Solve the postmerger control / employment situation. In practice, this is the most critical factor.

LOS 11.3.g: Discuss the role of investment bankers in mergers.

- Help arrange mergers: find potential targets, bring the parties together, set up packages for raiders (sometimes, they even helped raiders to get around regulation).
- Develop defensive tactics.
- Establish fair value: used by the two parties in a friendly merger even if management can agree (in order to prevent law suits of minority shareholders against directors).

- Finance mergers: provide bridge loans in the beginning, underwrite and place debt or equity.
- Play with potential mergers: some investment bankers try to make money with risk arbitrage (invest in potential targets in order to profit from takeover bids).

LOS 11.3.h: Discuss the defensive tactics that a target company can use against the threat of a hostile takeover.

- change the bylaws of the firm (require super-majority for mergers)
- convince shareholder that the bid is too low
- raise antitrust issues
- push the price of equity up (e.g. by acquisition of treasury stock)
- get a white knight (= a company that is acceptable to the management)
- get a white squire (= an friendly investor that buys a blocking share)
- use the friendly attitude of the employee stock ownership plan
- take a poison pill (= an action that will seriously hurt a company if it is acquired by another; e.g. debt covenants, golden parachutes for executives)

Management should not go too far, as shareholders may sue directors if their interest is clearly hurt (notable with poison pills).

LOS 11.3.i: Differentiate among mergers, corporate alliances, and leveraged buyouts.

Merger = a combination of two businesses.

Corporate alliance = a cooperative deal that stops short of a merger. Corporate alliances generally focus on specific business lines with particular synergies (e.g. marketing agreements, joint ownership of some operations). Joint ventures are a special form of corporate alliance, in which two or more independent companies combine their resources to achieve a specific, limited objective.

Leveraged buyout = a situation in which a small group of investors (often the managers) borrow heavily to bay all the shares of a company. Generally, they would like to run the company for a while, restructure it, and the go public again with a huge gain.

LOS 11.3.j: Discuss the different forms a divestiture may take and the reasons for divestitures.

Sale to another firm: generally sale of an entire division or unit for cash or equity.

Spin-off: a division of the firm becomes a separate company, with it's own board of directors. Shareholders of the original firm receive shares of the spin-off (now, they hold two different shares).

Liquidation: assets of a firm are sold off piecemeal rather than as an operating entity.

The reasons for divestitures include:

- focus on core business (sometimes after failed diversification)
- simplify operations (for management and security analysts)
- need for cash
- get rid of loosing assets
- antitrust settlements

LOS 11.3.k: Define a holding company and list advantages and disadvantages of this organizational form.

Holding company = *a corporation that owns sufficient common stock of another firm to achieve working control over it.*

Advantages:

- Control with fractional ownership: sometimes, a 5% holding is enough to effectively control a company.
- Isolation of risks: an operating company can go bust without affecting the holding parent. In practice, isolation is not so clear cut, as parents may feel obligated to bail out the operating company for its reputation or the protection of its investments, or because the parent is bound by an explicit guarantee.
- Hide and increase leverage: In the past, several layers of holding companies were used to boost leverage (each level only holds the net value as asset and levers the investment with additional debt). These structures were one of the reasons for the crisis in the 1920s and 1930s.

Disadvantages:

- Partial multiple taxation: Only dividends on holdings over 80% are completely tax-exempt. If less than 80% is owned, 20% of the dividends are taxable.
- Ease on enforced dissolution: Antitrust measures are easy to implement against holding companies.

Study Session 12

Equity Investments: Valuation Perspectives

12.1 Two Illustrative Approaches to Formula Valuations of Common Stock

LOS 12.1.a: Explain the stock valuation model and the earnings growth model.

Stock valuation model relates the price of a stock solely to past data. The model proposed by Graham (1957) consists of four quality factors (profitability measured by return on capital, growth in earnings per share, stability measured by the maximum decline in profits over a certain period, and the payout ratio; the quality factors are all normalized to a stock index) plus net assets. The total five factors are equally weighted.

Earnings growth model derives the implied growth rate from actual price/ earnings ratios, where a long-term average of earnings is taken. Graham (1957) uses the formula $Price = 8 \cdot growth^2 \cdot earnings$.

LOS 12.1.b: Analyze the basic conclusions about formula stock valuation models.

The difference between the two measures come from the growth factor, but not because it is not given enough weight but rather because the market sometimes anticipates growth patterns that are not visible in past data. Discrepancies can be used by the analyst as point of departure (is the market right to assume a change in growth?).

12.2 Company Performance and Measures of Value Added

LOS 12.2.a: Calculate the traditional measures of performance.

Return-investment ratios

- $Basic\ earnings\ power\ ratio = \dfrac{EBIT}{Total\ assets}$
- $Return\ on\ assets = \dfrac{Net\ earnings}{Total\ assets}$
- $Return\ on\ equity = \dfrac{Net\ earnings}{Equity}$

Tobin's Q

- $$Q = \frac{Market\ value\ of\ assets}{Replacement\ costs\ of\ assets}$$
- $$Q\ proxy = \frac{\substack{Book\ value \\ of\ debt} - \substack{Liquidating\ value \\ of\ preferred\ stock} - \substack{Market\ value\ of \\ common\ stock}}{Total\ assets}$$

LOS 12.2.b: Analyze the advantages and disadvantages of using return on investment ratios and Tobin's Q as measures of company performance.

Advantages:

- ease of calculation
- interpretation is straightforward
- can be decomposed to reveal sources of change (duPont analysis)

Disadvantages:

- sensitive to accounting choices
- historical cost base over different time periods
- backward looking
- no adjustment for risk
- no adjustment for factors that are not under the control of management

LOS 12.2.c: Distinguish between economic profit and accounting profit and relate economic profit to net present value.

Accounting profit = net earnings shown in the income statements. Subject to accounting choices and manipulation by management. Does not take into account the (opportunity) cost of capital.

Economic profit = the difference between revenues and cost, where cost includes not only expenses but also the cost of capital. Basic differences to accounting profit: (1) cost of capital is included in costs, (2) economic profit is based on cash accounting while accounting profit is based on accrual accounting.

Net present value calculations are used to determine the value of a single project. Economic profit calculations apply the technique to the whole firm. As such it is subject to the same problems, notably the sensitivity to assumptions concerning the cost of capital.

LOS 12.2.d: Calculate economic value added (EVA) and market value added (MVA).

Calculation of EVA

$$EVA = NOPAT - k_w \cdot Capital = (Return\ on\ capital - k_w) \cdot Capital$$

where the inputs are obtained:

- Calculation of cost of capital (WACC):

  $k_w(WACC) = w_d k_d + w_e k_e + w_p k_p$

- Calculation of Capital:

Asset approach		*Source of financing approach*	
	Net operating assets		Equity
+	Plant and equipment		
+	Other assets		
+	Goodwill		
+	Bad-debt reserves		
+	Capitalized R&D		
+	Cumulative write-offs		
		+	Preferred stock
		+	Minority interest
		+	Deferred taxes
		+	Debt
+	Accumulated goodwill amortization	+	Accumulated goodwill amortization
+	Present value of non-capitalized leases	+	Present value of non-capitalized leases
+	LIFO reserve	+	LIFO reserve
=	Capital	=	Capital

- Calculation of net operating profit after taxes (NOPAT):

	Bottom-up		*Top-down*
	Operating profit after depreciation and amortization		Sales
		+	Other income
		-	COGS
		-	Selling, general, administrative expenses
		-	Depreciation
+	Goodwill amortization		
+	Δ capitalized R&D		
+	Δ bad-debt reserves		
+	Interest expense on operating leases	+	Interest expense on operating leases
+	Δ LIFO reserve	+	Δ LIFO reserve
=	Adjusted operating profit before taxes	=	Adjusted operating profit before taxes
-	Cash operating taxes	-	Cash operating taxes
=	NOPAT	=	NOPAT

- Calculation of cash operating taxes:

	Income tax expense
+	Tax benefit from interest expense and leases ($= Interest\ expense \cdot Marginal\ tax\ rate$)
-	Δ deferred taxes
-	Taxes on nonoperating income
-	Taxes on special items
=	Cash operating taxes

Calculation of MVA

$$MVA = Market\ value\ of\ the\ firm - Capital,$$

where market value of the firm is obtained by adding the market value of debt to the market value of equity and capital is obtained as in the EVA calculation above. Note that in practice, the book value of debt is often used as a proxy for the market value of debt.

LOS 12.2.e: Describe the process for determining cash flow return on investment (CFROI).

1. Calculate the life of the assets: As an approximation, use the formula $remaining\ life \approx \frac{depreciable\ assets}{yearly\ depreciation}$
2. Calculate gross cash flows:

Net income after tax before extraordinary items
+ Depreciation and amortization
+ Interest expense
+ Operating rental expense
+ Deferred taxes
- Special items net of tax effect
= Gross cash flow

3. Calculate gross cash investment:

Gross plant, property and equipment
+ Present value of operating leases
+ Goodwill
+ Accumulated goodwill amortization
= Gross cash investment

4. Calculate the non-depreciating assets:

Land
+ Net working capital
+ Other nondepreciating assets
= Nondepreciating assets

5. Solve for the cash flow return on investment (CFROI): The CFROI is the internal rate of return obtained from:

N = Remaining life of assets
PV = - Gross cash investment
FV = Nondepreciable assets
PMT = Gross cash flow

6. Compare the CFROI with a benchmark: Note that the CFROI is based on *real* data (no discounting is used in cash flows); therefore, the benchmark must take this into effect. The details for the adjustment to inflation are of proprietary nature (CFROI belongs to HOLT Value Associates).

LOS 12.2.f: Demonstrate the link between EVA and MVA.

Both measures are designed to help evaluate the performance of a firm, taking into account the opportunity cost of capital. In theory, MVA should be equal to the present value of the future EVA, discounted at the cost of capital. Assuming constant EVA streams, MVA can be expressed as a perpetuity:

$$MVA = \frac{EVA}{WACC}$$

In practice, this equation does rarely hold:

- EVA can not be expected to be positive for an infinite time (only as long as the firm has a competitive or comparative advantage).
- EVA is just an estimate with a lot of assumptions and uncertainties.
- EVA is estimated on a single period while MVA is forward-looking.
- Stock markets sometimes follow other laws (MVA can be positive in a given year while EVA calculations show negative results)

LOS 12.2.g: Explain the differences among EVA, MVA, and CFROI.

	MVA	*EVA*	*CFROI*
data	market (expectations)	accounting (historical)	accounting
result	currency units	currency units	rate
basis	nominal	nominal	real
depreciation	treated as cost	treated as cost	added back
amortization of goodwill	added back	added back	added back
taxes	adjusted	adjusted	cash taxes unadjusted
interest on operating leases	added back to NOPAT	added back to NOPAT	treated as cost

LOS 12.2.h: Compare the empirical relationship between stock returns and value-added measures with the empirical relationship between stock returns and more traditional valuation measures.

- Traditional valuation measures and more modern value-added measures both show a strong positive correlation with actual stock returns. However, despite the positive overall picture, the correlation is negative in some years.
- Value-added measures are slightly more correlated with stock returns (as one would expect on theoretical grounds). The difference is disappointingly small, though. For measures based on market value (MVA), the correlation is basically strong by construction.
- Enhancements to control for size effects improve the performance of both types of measures.

12.3 An Analysis of EVA

LOS 12.3.a: Briefly explain EVA and MVA and the connection between the two concepts.

EVA is the difference between the company's net operating profit after taxes (NOPLAT) and its after-tax cost of capital: $EVA = NOPAT - k_w \cdot Capital$

MVA is the difference between cpaital invested and the market value of the firm.

In theory, MVA is the present value of future EVA discounted at the cost of capital,

$$\left(MVA = \sum_{t=0}^{\infty} \frac{EVA_t}{(1+k_w)^t} \right)$$

.

LOS 12.3.b: Demonstrate how EVA can be used as a criterion for selecting stocks.

1. Select a universe of stocks and get their EVA and MVA.
2. Build a portfolio of stocks with high EVA or MVA.
3. Track the performance of the portfolio.
4. Compare the performance of the portfolio to the performance of the index.
5. To take into account different risk characteristics of your portfolios, draw a line in the risk-return space from the risk-free bond return to the return of the index. Only strategies above the line beat the benchmark on a risk-adjusted basis.

In practice, portfolios based on EVA or MVA do not outperform the market on a risk-adjusted basis. So, although EVA can be used as a criterion for stock selection, it's a bad idea. Moreover, since the calculation of EVA and MVA is quite time consuming, the approach is impractical.

LOS 12.3.c: Discuss the risk-return results of selection strategies based on EVA and MVA as well as several other traditional measures of valuation.

- Portfolios consisting of stocks with a high EVA tend to underperform the market both in absolute and risk-adjusted terms.

- Portfolios consisting of stocks with a high MVA outperformed their benchmark. However, compared with other strategies, the outperformance was unimpressive. On a risk-adjusted basis, MVA did not dominate the benchmark.
- Traditional measures of valuation did better than EVA and MVA. Strategies based on ROA and ROE both outperformed the MVA portfolio. ROE even outperformed the benchmark on risk-adjusted terms.
- Portfolios consisting of stocks with positive EPS surprises did best of all strategies. This contradicts claim by the advocates of EVA that earnings are irrelevant.

12.4 An Analysis of EVA - Part II

LOS 12.4: Explain why investment strategies based on the growth in EVA and /or the growth in MVA might be more closely related to future stock performance than strategies based on the absolute levels of EVA and / or MVA.

The argument is purely intuitive: a company that improves its EVA and/or MVA should attract investors and its performance should go up. Empirical test show, however, that this is not generally true. Portfolios based on changes in EVA perform even worse than portfolios based on the level of EVA. On the other hand, portfolios based on changes in MVA do outperform portfolios based on the level of MVA. They also outperform the market both on an absolute and risk-adjusted basis. However, this seems to be related to a size effect (MVA chooses stocks with a high market capitalization).

12.5 Valuing Zero-Income Stocks: A Practical Approach

LOS 12.5.a: Explain why a bimodal distribution better characterizes the prospects of a high-growth / high-risk company, such as an Internet-related company.

Binomial distributions represent the prospects of a high-growth / high-risk company: either boom or bust.

LOS 12.5.b: Discuss why it is difficult to apply a traditional present value model to the valuation of high-growth / high-risk companies because of discount rate and fade rate problems.

Present value models are difficult to apply to high-growth / high-risk companies because of three problems:

Wide range of critical values: Critical variables – such as revenue growth, margins, working capital, capital expenditures – are intrinsically difficult to forecast for these companies. As even small errors sometimes have a great influence on valuation, the exercise becomes somewhat elusive.

Uncertain discount rate: Simply increasing the risk premium does not work in practice. It cannot account for the extraordinary increase in uncertainty that results from the bimodal distribution typical of high-growth / high-risk companies.

Uncertain fade rate: The analyst must have a view at what speed the company will converge towards a long-term, sustainable growth rate. Small differences in the assumptions on the fade rate can have large consequences for valuation.

LOS 12.5.c: Describe how a multiple-scenario DCF method combined with reality checks (such as price-to-earnings ratios and market capitalization) can improve an analyst's ability to value high-growth / high-risk companies.

A multiple-scenario DCF method simply values a company under a set of different assumptions, typically a best, base and worst case (for high-growth / high-risk companies, the base case often has the lowest probability). The analyst then should focus on the *reason for the probabilities assigned to each scenario* rather than simply calculation the weighted average.

Reality checks further improve the analysis if they are used in a flexible and reasonable way. P/E ratios should be used with care. For companies with P/E ratios close to the market average, they are very useful for assessing the valuation. For companies way off the market average, they do not add much information. Reality checks on market capitalization provide starting points for questions like: does it make sense that AOL's market cap is higher than that of CBS?

Study Session 13

Equity Investments: Applications

13.1 Merck & Company: A Comprehensive Equity Valuation Analysis

LOS 13.1.a: Analyze a company's competitive strategy.

Classify the competitive strategy in one of the following and justify your classification:

- Cost leadership
- Differentiation
- Focus (either cost focus or differentiation focus)

LOS 13.1.b: Analyze an industry's competitive structure.

Analyze the industry with respect to Porter's five competitive forces:

- Bargaining power of buyers: Fragmentation or concentration? Structural effects on their power?
- Threat of substitutes: Availability of substitues (e.g. generica)? New products that can become substitutes? Elasticity of demand?
- Rivalry among competitors: Current competition? Consolidation or alliances / joint ventures?
- Threat of new entrants: Who could enter (attractiveness of the sector for new entrance)? Barriers to entry (e.g. large marketing or R&D costs, patent protection)?

LOS 13.1.c: Evaluate a company's return on equity performance, using the duPont approach

Decompose ROE by one of the following duPont formulas:

$$\begin{aligned}
ROE &= \left(\frac{\textit{Net income}}{\textit{Net sales}}\right) \times \left(\frac{\textit{Net sales}}{\textit{Total assets}}\right) \times \left(\frac{\textit{Total assets}}{\textit{Equity}}\right) \\
&\equiv \begin{matrix}\textit{Profit}\\ \textit{margin}\end{matrix} \times \begin{matrix}\textit{Asset}\\ \textit{turnover}\end{matrix} \times \begin{matrix}\textit{Financial}\\ \textit{leverage}\end{matrix} \\
&= \left[\left(\frac{\textit{EBIT}}{\textit{Sales}}\right) \times \left(\frac{\textit{Sales}}{\textit{Assets}}\right) - \left(\frac{\textit{Interest}}{\textit{Assets}}\right)\right] \cdot \left(\frac{\textit{Assets}}{\textit{Equity}}\right) \times (1 - \textit{tax rate}) \\
&\equiv \left[\begin{matrix}\textit{EBIT}\\ \textit{margin}\end{matrix} \cdot \begin{matrix}\textit{Asset}\\ \textit{turnover}\end{matrix} - \begin{matrix}\textit{Interest}\\ \textit{expense}\end{matrix}\right] \cdot \begin{matrix}\textit{Financial}\\ \textit{leverage}\end{matrix} \cdot \begin{matrix}\textit{Tax}\\ \textit{retention}\end{matrix}
\end{aligned}$$

Then evaluate how the components evolve over time and how they compare to the competitors.

LOS 13.1.d: Calculate a company's intrinsic value, using a two-stage dividend discount model and free cash flow.

You may be asked to carry out this calculation in the following ways:

- Use the two-stage dividend discount model with constant growth rates in the first n years with the terminal price, P_n:

$$P_0^* = \left[1 - \left(\frac{1+g_1}{1+k_{e,1}}\right)^n\right] \cdot \frac{D_0 \cdot (1+g_1)}{k_{e,1} - g_1} + \frac{P_n}{(1+k_{e,1})^n}$$

- Use the two-stage dividend discount model with constant growth rates in the first n years without the terminal price:

$$P_0^* = \left[1 - \left(\frac{1+g_1}{1+k_{e,1}}\right)^n\right] \cdot \frac{D_0 \cdot (1+g_1)}{k_{e,1} - g_1} + \frac{1}{(1+k_{e,1})^n} \cdot \frac{D_{n+1}}{\overline{k_e} - \overline{g}}$$

- Use the H-model in which growth converges over $n = H/2$ periods from g_1 to $\overline{g}$:

$$P_0^* = \frac{D_0(1+\overline{g})}{k_e - \overline{g}} + \frac{D_0 \cdot 2n \cdot (g_1 - \overline{g})}{\overline{k_e} - \overline{g}}$$

- Use the two-stage Free Cash Flow to Equity model:

$$P_0^* = \sum_{t=1}^{n} \frac{F_{e,t}}{(1+k_{e,1})^t} + \frac{1}{(1+k_{e,1})^n} \cdot \frac{F_{e,n+1}}{\overline{k_e} - \overline{g}}$$

- Use the two-stage Free Cash Flow to the Firm model:

$$P_{f,0}^* = \sum_{t=1}^{n} \frac{F_{f,t}}{(1+k_{w,1})^t} + \frac{1}{(1+k_{e,1})^n} \cdot \frac{F_{f,n+1}}{\overline{k_w} - \overline{g}}$$

The inputs for the calculations above can be obtained by the usual approximations:

$$\begin{aligned} g &= ROE(1 - \mathit{retention\ rate}) \\ k_w &= w_e k_e + w_d k_d + w_p k_p \\ k_e &= r_f + \beta \cdot (r_{market} - r_f) \end{aligned}$$

LOS 13.1.e: Determine whether a company's stock is under- or overvalued.

Compare the valuation obtained by your calculations with the market price. If $P^* > P$, the stock is undervalued and vice versa.

LOS 13.1.f: Identify, using sensitivity analysis, the variables with the greatest effect on the valuation results.

Plug in different values in your valuation model and check how much P^* changes. The variable for which a percentage point change produces the biggest change in P^* has the greatest effect.

LOS 13.1.g: Relate economic, regulatory, and demographic factors to the demand for, and the elasticity of demand for, a company's products.

The following factors are mentioned in the text:

- Economy: Seems not to be very important for Merck (Pharmaceutical products seem to be inelastic to changes in income). Economic activity is very important for other products.
- Demography: The aging of the population is highly relevant for Merck (old people want Merck's products). Other industries depend on other groups (beer sales increase with the young).
- Regulation: Government action can directly influence prices, competition or the bargaining power of one or another group. Merck is sensitive to patent protection and FDA policy.
- Other factors: Fashion, social factors, substitute goods etc., etc.

LOS 13.1.h: Analyze the effects of economies of scale and customer's buying power on a company's product-pricing strategy.

- If economies of scale are present, market share is crucial. Under normal circumstances, a price leadership policy is most effective, but some sectors (e.g. cars) will try to combine differentiation with a big market share.
- Customer's buying power will put pressure on prices and margins. Normally, the company will be forced to follow a low-margin pricing policy.

LOS 13.1.i: Analyze foreign exchange effects on a company's sales and operations.

The following aspects must be considered in the analysis:

Short-run risk: Currency fluctuations affect open contracts to sell or buy goods and can turn a profitable deal in a loss. Short-run risk can be hedged by currency contracts or by matching assets and liabilities in each currency. Hedging can be expensive in some illiquid markets.

Long-run risk: Currency fluctuations can affect the competitive advantage of a firm compared to firms operating in another currency. An appreciation of the domestic currency can lead to a loss in market share abroad and to the entry of foreign competitors on the home market. Currency futures are not a good hedge for long-run risk. Matching the sources of revenues and costs is more effective (e.g. Japanese car companies produce in the US).

Translation risk: Currency fluctuations lead to accumulated gains and losses from currency translation and thereby to fluctuations in equity. Net earnings from operations are translated into the home currency, thereby affecting the evolution of earnings over time.

Coordination / pooling of risk management: Large companies have various operations that are subject to different and sometimes offsetting sources of currency risk. Each company has its own approach for coordinating the management of multiple sources of exchange rate risk.

13.2 Dell Computer

LOS 13.2.a: Identify and analyze the most critical factors affecting a company.

Get the most important factors out of the following analysis:

1. Determine the growth prospects of the industry and the demand for its products.
2. Determine the competitive factors of the industry.
3. Determine the prospects for the company, given its competitive strategy.

LOS 13.2.b: Analyze a company's competitive advantage relative to its competition (e.g. cost leadership).

The competitive advantage of a company is based on one of the competitive strategies (cost leadership, differentiation, or focus). Find the type of strategy adopted by the company and make a case for it.

LOS 13.2.c: Identify the method used to value Dell stock.

The following methods are used in practice:

- discounted dividend models
- discounted cash flow models
- earnings multipliers (P/E, this is the case for Dell)

LOS 13.2.d: Discuss the valuation methods used, including earnings per share growth and the price-to-earnings ratio.

PEG ratio: Compares EPS growth to P/E ratio. A low PEG ratio is supposed to be an indicator of high return in the future.

Price-to-earnings ratio: The method sets a target P/E ratio and multiplies it with expected earnings. The analyst in the text argues that Dell merits a higher P/E ratio than its competitors because of above-average ROA.

13.3 Star Cruises: Fair winds for a young star

LOS 13.3.a: Discuss the factors influencing demand, supply, and growth potential for the leisure cruise industry in Asia.

Factors mentioned in the text:

- Shifts in buying power and taste have increased demand.
- Supply growth is strong, most of it coming from Star Cruises.
- Additional supply pressures are expected to be weak (bottleneck in the production of cruise ships, poor infrastructure, high entry barriers for competitors).

LOS 13.3.b: Analyze the barriers to entry in the leisure cruise in Asia and discuss the effects of entry barriers on the industry's competitive environment.

The competitive environment is very benign for Star Cruises for the next couple of years. The following barriers are likely to prevent the entry of a major competitor:

- bottleneck in the production of cruise ships

- huge marketing costs to get a foothold
- exclusivity clauses with travel agencies
- entering Asia would lead to cannibalization in the competitors home market
- poor infrastructure; Star has built its own exclusive infrastructure
- non-homogeneous customer base makes the relocation of ships in more than one region very expensive (you must adjust food and beverages and recreational activities to the Asians)
- Western cruise lines would still have higher costs than Star because they are bound by union agreements (e.g. Star sleeps four crew per cabin while Carnival only sleeps two)
- huge amount of capital needs unlikely to be met in a market already dominated by Star

The barriers to entry mostly apply to the 'big' competition. Small local competition may still enter the market.

LOS 13.3.c: Compare and contrast the methods used to value Star Cruises.

The following methods are used:

- Equity value of berths: Compare the equity price of competitors divided by the number of berths with the number of berths of Star (adjust for debt).
- PEG ratio
- P/BV

LOS 13.3.d: Analyze the component sources of return on equity (ROE) for Star Cruises.

Apply a duPont analysis and analyze the components over time and relative to the competition.

LOS 13.3.e: Compare the ROE components of Star Cruises with those of Royal Caribbean and Carnival.

Compare the components of ROE obtained from the duPont analysis with that of the competition. For this, you may have to take into account some distortions (in the text, the revenue base of Star has to be adjusted for leases and the assets include non-revenue earning deposits for new ship orders).

LOS 13.3.f: Critique the research report's buy recommendation based on the analyses contained in the report.

Check if the recommendation is in line with the results of the valuation model. The buy recommendation in the text looks ok.

Study Session 14

Debt Investments: Credit Analysis

14.1 Evaluating Financial Performance

LOS 14.1.A.a: Explain the deficiencies of ROE as a measure of financial performance.

- timing problem: ROE is backward-looking and focused on a single period
- risk problem: ROE ignores the risk a company has taken to generate earnings
- value problem: ROE is based on book rather than market value. From a shareholder point of view, book value is highly irrelevant. Note, however, that there are also good argument against the use of market value: no direct link between operating decisions and market value, management would be judged by a less informed market, depends on factors outside the control of management.

LOS 14.1.A.b: Calculate return on invested capital (ROIC).

$$ROIC = \frac{EBIT(1 - tax\ rate)}{Interest - bearing\ debt + Equity}$$

LOS 14.1.A.c: Differentiate among ROIC, ROA, and ROE and state the benefits of ROIC compared to ROA and ROE.

ROIC is the rate of return earned on the total capital invested without regard to the capital structure.

ROA compares earnings available to shareholder with total assets. Difference to ROIC: numerator is smaller because of interest and tax.

ROE compares earnings available to shareholder with equity. Difference to ROIC: numerator and denominator are smaller.

The key advantage of ROIC is that it is independent of the capital structure. It focuses on the pie, independent of the way it is sliced.

LOS 14.1.A.d: Explain the difference between ROE and earnings yield and the relationship between earnings yield and the price of earnings ratio.

ROE is earnings divided by the book value. Earnings yield is earnings divided by the market value.

The P/E ratio is the inverse of the earnings yield.

14.2 The Financing Decision

LOS 14.1.B.a: Explain the concept of financial leverage and its potential effect on bondholders and the return to shareholders.

Financial leverage is a financing option that tries to increase owner's return by substitution of fixed-cost debt for owner's equity. As long as ROIC is higher than the cost of debt, it increases ROE. At the same time, however, it increases the volatility of earnings. Financial leverage also increases the risk for bondholders, as the probability of default rises.

LOS 14.1.B.b: Discuss the effect of increased financial leverage on ROE given the relationship between ROIC and the interest rate on debt.

$$ROE = ROIC + [ROIC - interest\ rate \cdot (1 - tax\ rate)] \cdot \frac{Debt}{Equity}$$

Accordingly, financial leverage increases ROE if ROIC is bigger than the after-tax cost of debt.

LOS 14.1.B.c: Calculate the pro forma EPS, using alternative mixes of bond and stock financing.

For this, note that EBIT is unaffected by the financing decision. Pro forma EPS can then be calculated by:

$$EPS = \frac{(1 - tax\ rate) \cdot [EBIT - i \cdot Debt]}{\#\ of\ shares}$$

Note that the above equation implies that EPS is linear in EBIT. For a given level level of leverage, you can therefore draw a diagram of EPS against EBIT. The higher the degree of leverage, the steeper the schedule. There is also a point, where the two schedules of two different degrees of leverage cross. If EBIT falls below this point, leverage will decrease EPS.

LOS 14.1.B.d: Calculate key coverage ratios resulting from alternative mixes of bond and stock financing and interpret consequences for Standard & Poor's Corporation debt ratings.

Key coverage ratios include times interest earned ($\frac{EBIT}{Interest\ expense}$), EBITDA interest coverage ($\frac{EBITDA}{interest\ expense}$), CFO to total debt, pretax return on permanent capital ($\frac{pretax\ income}{permanentcapital}$, where permanent capital includes equity, long-term debt and minority interest), and long-term debt to capital ($\frac{Long-term\ debt}{Total\ assets}$).

Coverage ratios are an indicator for the ratings of a company. However, the relationship between the ratios and the rating is not made in steel.

LOS 14.1.B.e: Identify three company-specific factors to be considered when making financing choices.

1. *The ability to use the interest tax shield over the life of the debt.* Profitable companies can deduct interest payments from taxable income.
2. *The increased risk of bankruptcy created by leverage.* Leverage constrains financial flexibility and the volatility of net earnings.
3. *Costs of financial distress.* If the assets of a firm have to be liquidated in a hurry, losses will occur. The losses will be low if the assets are marketable (e.g. property); they will be high for intangibles without a market (e.g. brands).

LOS 14.1.B.f: Relate the financing decision to sustainable growth by discussing why rapidly growing companies might have debt levels that are different from those of low-growth companies.

The link between leverage and growth is given by:

$$\begin{matrix} Sustainable \\ growth \end{matrix} = \begin{matrix} Profit \\ margin \end{matrix} \times \begin{matrix} Asset \\ turnover \end{matrix} \times \begin{matrix} Financial \\ leverage \end{matrix} \times \begin{matrix} Retention \\ ratio \end{matrix}$$

In order to achieve a given growth rate, with a given profit margin and asset turnover, companies can must chose their dividend policy and financial decision.

Rapidly growing firms would need a lot of funds. However, they face the challenge of maintaining financial flexibility (which is hard for them because growth needs a lot of cash) and don't want to give wrong signals by issuing equity. Their first choice of finance is to keep a high retention ratio and absorb temporary liquidity needs with short-term facilities. If these funds are not sufficient, they may tap bond markets. Equity would only be issued as last recourse.

Low-growth firms generate more funds than they need (i.e. financial flexibility is often no problem). With stable, albeit low, earnings, they could fully take advantage of the tax shield of debt financing. Consequently, low-growth firms often like to increase leverage.

LOS 14.1.B.g: Infer the effect of higher financial leverage on the market value of high-growth and slow-growth companies.

The value of high-growth firms could increase or decreases with leverage: their financial flexibility is constrained by debt financing, but on the other hand, if internal funds are not sufficient to finance investments in promising opportunities, leverage is still better than the diluting issuance of equity. The tax shield argument is probably not very strong for rapidly growing firms.

The value of slow-growth firms should increase because they fully profit from the tax shield provided by debt financing. They generally do not loose too much financial flexibility by issuing debt. Stock buybacks will generally be welcomed by the markets.

LOS 14.1.B.h.: Discuss the chief advantages and disadvantages of debt financing.

The irrelevance proposition states that in the absence of tax shields and bankruptcy costs, the mix of debt and equity is irrelevant for the value of a firm (an investor can achieve the same exposure by mixing the stock with debt). In practice, there are disadvantages and advantages of debt financing.

advantages

- boost ROE for given EBIT (and thereby management bonus)
- tax shield (basically, debt financing is subsidized by the Treasury)
- signaling (issuance of equity signals that management believes the stock is overpriced)

disadvantages

- distress costs (in case of bankruptcy, assets will have to be sold below their intrinsic value; this reduces the expected payoff)
- clients may not make business with a firm that stands on shaky financial grounds; this may lead to loss of profit opportunities
- reduced financial flexibility (as leverage increases, access to additional funds becomes more difficult and expensive)
- conflicts of interest between creditors and shareholders (management is likely to make more risky investments, even without sufficient compensation for risk, if the downside is born by creditors)

14.3 General Principles of Credit Analysis

LOS 14.2.a: Distinguish among default risk, credit spread risk, and downgrade risk.

Default risk = risk that the borrower will fail to satisfy the terms of the obligation with respect to the timely payment of interest and principal.

Credit spread risk = risk that an issuer's debt obligation will decline in value due to an increase in the credit spread.

Downgrade risk = risk that an issuer's debt obligation will decline in value due to an increase in the credit spread, triggered by an unanticipated downgrade.

LOS 14.2.b: Explain how credit analysis encompasses examination of the borrowers character, the borrowers capacity to repay, the issues underlying collateral, and the issues *covenants.*

Character = reputation, qualification, track record of management.

Capacity = ability of an issuer to generate the funds necessary to make the payments.

Collateral = assets pledged to secure the debt as well as quality and value of unpledged assets controlled by the issuer.

Covenant = terms and conditions of the lending agreement.

LOS 14.2.c: Identify the factors considered by rating agencies in assessing the quality of management and explain the importance of these factors.

- strategic direction
- financial philosophy
- conservatism
- track record
- succession planning
- control systems

LOS 14.2.d: Discuss sources of liquidity for a company and the importance of these sources in the credit analysis process.

Liquidity is generated from revenues and reduced by the cost of operations. Consequently, ability to pay can be determined from income statement data. Factors to be taken into account for the prediction of the cash generating ability are:

- industry trends
- regulation
- cyclicality of the industry and sensitivity to cycles
- competition
- financial and liquidity position; capacity to obtain additional financing (e.g. via securitization) and back-up credit facilities (e.g. credit lines); for back-up credit facilities, analysts should be concerned with *material averse change clauses* (=clause giving the bank the right to refuse the company to draw funds from an existing credit line if financial conditions have deteriorated)

- company structure
- parent company support agreements or third-party guarantees
- event risks

LOS 14.2.e: Explain the key ratios used by credit analysts to assess the ability of a company to satisfy its debt obligations (short-term solvency ratios, capitalization ratios, and coverage ratios) and discuss the importance of these ratios.

Short-term solvency ratios are used to judge adequacy of liquid assets for meeting short-term obligations as they come due. The *current ratio* (currents assets over current liabilities) is used quite often. However, it includes inventories which are difficult to convert in cash if current liabilities have to be met. The *acid test* or *quick ratio* overcomes this problem by subtracting inventories, accruals and prepaid items from current assets.

Capitalization ratios are used to determine the extent of financial leverage (they are also called *financial leverage ratios*). Traditionally, rating agencies and credit analysts have focused on *long-term debt to capitalization.* However, many companies now finance their capital via short-term debt. *Total debt to capitalization* is then the more appropriate measure.

Coverage ratios are used to test the adequacy of cash flows generated through earnings for purposes of meeting debt and lease obligations. The most common ratios include the *EBIT and EBITDA interest coverage*, *funds from operations to total debt*, and *free operating cash flow to total debt* ratios.

LOS 14.2.f: Compute the ratios explained in (e) above and use their level and trend to evaluate an issuers potential credit rating.

- $Current\ ratio = \frac{Current\ assets}{Current\ liabilities}$
- $Quick\ ratio = \frac{Current\ assets - inventories - accruals - prepaid\ items}{Current\ liabilities}$
- $Long - term\ debt\ to\ capitalization = \frac{Long-term\ debt}{Total\ Assets}$
- $Total\ debt\ to\ capitalization = \frac{Total\ debt}{Total\ Assets}$
- $EBIT\ interest\ coverage = \frac{EBIT}{Gross\ interest}$
- $EBITDA\ interest\ coverage = \frac{EBITDA}{Gross\ interest}$
- $Funds\ from\ operations\ to\ debt = \frac{CFO}{Total\ debt}$

In order to determine an issuer's potential credit rating, compare the issuer's ratios with the averages of various rating classes.

LOS 14.2.g: Explain the limitations of traditional ratios.

- Ratios are backward-looking; they do not reflect the future financial position.
- In general, it is not possible to compare the ratios across the board; industry-specific factors should be taken into account. Compare ratios of companies in the same sector.
- Capitalization ratios must be adjusted in order to account for leases, non-funded pension liabilities and other off-balance sheet items.
- Coverage ratios must be interpreted with care for cyclical companies.
- Studies have demonstrated that profitability ratios, turnover ratios, liquidity ratios may show a trend but are generally unable to predict imminent defaults (look at cash flows for this).

LOS 14.2.h: Discuss why and how cash flow from operations is used to assess the ability of an issuer to service its debt obligations and to assess the financial flexibility of a company.

CFO often gives a good warning signal if a company is in imminent trouble. The statement of cash flows can be recast to provide information about the *financial flexibility* (= ability to sustain operations should there be a down turn in business: could the company fund its operations if external sources of capital become too expensive? and could it satisfy its obligations if business operations decline?). From the basic cash flow, the nondiscretionary cash needs are subtracted to determine discretionary (free) cash flow. This measure tells the analyst how much money remains on the table once the company has funded its basic operating requirements. The cash flow to capital expenditures ratio gives an analyst information about the financial flexibility of the company, particularly for capital-intensive firms and utilities. Declining ratios imply either difficulty in funding growth through operations or consolidation after a period of high investments.

Note that the level of cash flows can be less important than its predictability. Stable cash cows enhance financial flexibility.

LOS 14.2.i: Describe the various covenants and discuss their importance in assessing credit risk for both investment grade and non-investment grade companies.

Affirmative covenants specify what the issuer has to do: pay interest in time, pay taxes, maintain all assets in good condition, regularly submit certificates to the trustee that the covenants are respected.

Negative covenants specify limitations on the issuer's activities. Tests the issuer must meet include:

- maintenance tests: specifies a minimum of earnings available to pay debt and maintenance costs
- debt incurrence test: defines the conditions under which the company may incur additional debt (in general a minimum level for a coverage ratio)
- cash flow tests
- working capital maintenance provisions
- prohibitions on subsidiaries to borrow from other sources except the parent company (under such covenants, consolidated subsidiaries are treated as restricted subsidiares and other subsidiaries as unrestricted subsidiaries)
- limitations on dividends and stock repurchases

The analysis of covenants is important because covenants provide protection to bondholders. Moreover, covenants and their loopholes often provide clues about managment's funding strategy (in particular for high-yield issuers).

LOS 14.2.j: Explain the typical elements of the debt structure of a high-yield issuer, the interrelationships among these elements, and the impact of these elements on the risk position of the lender.

- *Bank debt* is used extensively by high-yield issuers. Unfortunately for bond holders, bank debt is senior to all the rest. Hence even the term 'senior debt' becomes misleading. Moreover, bank debt is generally short-term or floating, adding interest and refinancing risk that is difficult to predict.

- *Broker loans or bridge loans* are used when bank loans are unavailable.

- *Reset notes* also tend to be issued if bank loans are unavailable. They expose the issuer to high interest rate and spread risks. To pay higher interest in the future, the issuer could sell assets which, in turn, reduces the capacity to pay off other creditors.

- *Senior debt* could finally see nothing of the assets. If the issuer has zero-coupon senior debt, the value of this debt increases over time (this is a problem for subordinated debt).

- *Senior subordinated debt* fares even worse.

- *Subordinated debt* (payment in kind bonds) could be paid off with more worthless bonds.

LOS 14.2.k: Explain the importance of the corporate structure of a high-yield issuer that has a holding company.

Even if accounts are consolidated, the parent company may not have access to the funds generated by the subsidiaries. Subsidiaries may be prevented from making payments to the parent by covenants in bridge loans or other bonds.

LOS 14.2.l: Explain why some investors advocate using an equity perspective when analyzing the credit worthiness of high-yield issues.

- The risk-return structure of high yield bonds is somewhere between debt and equity.
- A combination of a stock future with a treasury future empirically provides the better hedge than treasury futures alone.
- Equity analysis can give different signals; this would push the analyst to dig further and detect problems normal credit analysis would not have brought up.
- Equity is a cushion for bondholders (in the Merton framework: as the price of equity goes up, the put option goes out of the money, its value goes down, hence the price of the bond goes up).

LOS 14.2.m: Discuss the factors considered by rating agencies in rating asset-backed securities such as collateral credit quality, seller/ servicer quality, cash flow stress and payment structure, and legal structure.

Credit quality of the collateral. The analysis will depend on the asset class (credit cards, auto loans, pub revenues ...). In general, the experience of the originator with the type of collateral, the concentration of assets, and the level of credit enhancements are examined.

Quality of the seller and servicer. In theory, the seller (or issuer) itself may be only a legal entity with assets and liabilities but no staff. The administration of the portfolio (including the collection of payments) is delegated to the servicer. In practice, servicer and seller are often the same entity. The quality of the servicer is crucial for an ABS. In *true securitizations*, the task of the servicer is purely administrative. Rating agencies look at the following factors:

- servicing history
- experience
- underwritng standard for loan origination
- servicing capabilities
- human resources
- financial conditions (the servicer may have to make advances to bond holders if there are delinquencies)
- growth, competition and business environment

In *hybrid transactions*, the servicer manages the asset pool. Rating agencies then blend the ABS analysis with a quasi-corporate analysis of the issuer.

Cash flow stress and payment structure. Rating agencies analyze the cash flow stream generated by the collateral: Does it match the payments of the bonds? And how sensitive are the different tranches to changes in some variables? For the latter, the payment structure (allocation of cash flows to the different tranches) must be scrutinized.

Legal structure. If the issuer goes bust, creditors will try to get their hands on the assets in the collateral pool. Therefore, the ABS must be structured in a way that prevents this. In general, a bankruptcy-remote special purpose vehicle (SPV) is created.

LOS 14.2.n: Explain how the credit worthiness of municipal bonds is assessed, and compare the analysis of tax-backed debt with the analysis of revenue obligations.

Tax-backed debt: The analysis of of tax-backed debt is very similar to corporate bonds. Factors considered:

- overall debt level
- ability and political discipline to maintain sound budgetary policy
- revenue-generating capacity (local taxes, intergovernmental revenues, tax collection rates, dependence on specific revenues)
- overall socioeconomic environment (unemployment, demography, real estate valuation)

Revenue bonds: Rating agencies try to assess whether the the project being financed will generate sufficient cash flows to satisfy the obligations due bondholders. Factors considered:

- limits of the basic security (Local or federal law may negatively affect the income from the project available to bondholders)

- flow of funds structure (How are the funds generated by the project distributed? Before going to bondholders, funds can be attributed to: costs of running the project, renewal and replacement fund, maintenance fund, general obligations of the municipality, or other uses.)
- user-charge or rate covenants (defines the charges that will be set on products generated by the project, e.g. water prices)
- priority-of-revenue claims (Can others tap the revenues?)
- additional bonds test covenants (Can the issuer more debt with a lien to the revenues?)
- other covenants (obligation to have an insurance, accounting issues, review by outside engineers, maintenance requirements)

LOS 14.2.o: Discuss the key economic and political risks considered by Standard & Poors in assigning sovereign ratings.

Economic risk requires an assessment of the ability of a government to satisfy its obligations. S&P consider the income and economic structure (GDP, regulation, resource endowment), growth prospects, fiscal flexibility, debt burden (degree of indebtedness, currency composition and maturity structure of debt, external debt, contingent liabilities), price stability, monetary policy, balance of payments and international reserves.

Political risk requires an assessment of the willingness of a government to satisfy its obligations. S&P consider the form of government, adaptability of political institutions, extent of political participation, orderliness of leadership succession, degree of consensus in the political system, integration in world economy, internal and external security risks.

LOS 14.2.p: Explain why two ratings are assigned to each national government and discuss the key factors emphasized by Standard & Poors for each rating.

Two ratings are necessary because defaults are more frequent on foreign currency denominated debt. Explanation: By controlling the financial system (at the limit, print money) and raising taxes, the government is always able to generate funds. On the other hand, to honor foreign-currency denominated debt, it needs foreign currency (implying exchange rate risk). S&P looks at the following factors:

Local currency denominated debt: focus on orderly fiscal balance

- stability of political institutions (including degree of popular participation)

- income and economic structure
- fiscal policy and budgetary discipline
- monetary policy and inflation
- indebtedness and debt service track record

Foreign currency denominated debt: focus on balance of payments and structure of external balance

- net public debt
- total net external debt
- net external liabilities (reserves and liabilities)

LOS 14.2.q: Contrast the credit analysis required for corporate bonds, asset-backed securities, municipal securities, and sovereign debt.

The analysis of all these classes is quite similar. Therefore, an analyst familier with one type can use a similar structure of analysis for other types of bonds. In all cases, the analyst must consider the four C:

Character: For all types of bonds, the analysis of character requires non-quantitative data and judgement. An analysis of management is crucial for corporate bonds. For ABS, the servicer is important for its administrative capacities, but management only enters the equation for hybrid transactions (= ABS with managed collateral pools; in fact, for hybrid transactions, rating agencies will combine ABS and quasi-corporate analysis). For sovereign bonds, political risk must be analyzed.

Capacity: Capacity is important for corporate bonds (Is the issuer able to generate the funds?), tax-backed debt (Is the municipality able to generate the funds?), revenue bonds (Basically the same questions as for a corporate bond: Is the project likely to generate the revenues to pay interest and principal?) and sovereign bonds (Is the economy able to generate the funds and is the government able to raise the money?).

Collateral: An analysis of collateral is particularly important for ABS. It is probably less important for sovereign (although reserves are essential) and tax-backed bonds.

Covenant: Covenants are most important for corporate bonds, ABS (make them bankruptcy-remote) and revenue bonds. For sovereign bonds, willingness is more important than any legal restriction (sovereigns make their own law).

Data problems are common to all types of bonds. While US firms are subject to US GAAP and their accounts are audited (US analyst find this comforting), other firms are subject to other accounting standards. Public statistics and financial data are a priori neither better nor worse than company accounts.

14.4 Credit Analysis for Corporate Bonds

LOS 14.3.a: Discuss industry considerations - including economic cyclicality, growth prospects, competition, sources of supply, expenses, regulation, labor, and accounting - in analyzing corporate debt.

Economic cyclicality. Analyze if the industry follows the growth patterns of GDP or other cyclical factors (e.g. sensitivity to interest rate fluctuations. Compare a company with its peers from the same industry.

Growth prospects. What are the growth prospects of the industry (expansion, consolidation, decline)?

Competition. Analyze the effect of competition on margins in an industry. What is the market structure (a comfortable monopoly or tough competition)? Watch out for overcapacity. What is the competitive edge of the company?

Sources of supply. If the industry is not self-sufficient (i.e. it depends on inputs where the firms have no buying power), it will be sensitive to external shock, except if it can pass on price increases to its clients.

Expenses. Check if the company invests enough in R&D to maintain its competitive edge. Also analyze if the money is spent efficiently and in the right areas. Watch out for excessive capital build up.

Regulation. Regulation sometimes helps to keeps high margins, sometimes it makes profits impossible. Focus on the direction of changes in regulation.

Labor. The more labor intensive an industry, the more significance the labor situation assumes. Higher labor costs directly translates into fewer money available for stock and bondholders. Union power is a negative factor, and the bargaining power of unions increases with just-in-time production.

Accounting. Some industries have special accounting practices an analyst should be familiar with. Pay particular attention to differences in international accounting practices.

LOS 14.3.b: Explain and compute traditional financial ratios, and indicate which ratios are or are not relevant in a particular industry.

Interest Coverage Ratios. Coverage ratios show if a company can pay its debt from operting income. If the company has no other significant fixed obligations, the analyst can use the pretax interest coverage ratio ($\frac{\textit{Pretax income from continuing operations+Interest expense}}{\textit{Gross interest}}$). If rents are a high component, they should be added to both the numerator and denominator ($\frac{\textit{Pretax income from continuing operations+Interest expense+Gross rents}}{\textit{Gross interest+Gross rents}}$). Sometimes, EBITDA coverage ($\frac{EBITDA}{\textit{Gross interest}}$) may be of interest. Coverage ratios, in general, are not very useful if the company has outstanding guarantees (e.g. the insurance industry guarantees other companies' debt).

Leverage Ratios. Leverage is generally defined as long-term debt over total capitalization ($\frac{\textit{Long}-\textit{term debt}}{\textit{Total assets}}$); sometimes, total debt is used ($\frac{\textit{Total debt}}{\textit{Total assets}}$). The higher the level of debt, the higher the cost of debt eating away operating income. Leverage ratios must be interpreted with an eye on the market price of equity; if the stock sells below book value, leverage is understated. Leverage varies widely among industries with finance companies showing leverage of 10:1. Maturity, share of floating debt unamortized discounts, terms of bank lines should be taken into account. Leverage ratios are inappropriate in the presence of material operating leases (capitalize them for analysis).

Cash-flow Ratios. Cash-flow data are an indicator of the liquidity of the company. Focus on CFO ($\frac{CFO}{\textit{Total debt}}$) and free cash flow $\frac{\textit{Free cash flowt}}{\textit{Total debt}}$. For analysis, exclude all extraordinary sources of cash and noncash contributions from subsidiaries.

Net Assets Ratios. Net asset ratios ($\frac{\textit{Net assets}}{\textit{Total debt}}$) are relevant for determining recovery values. Use liquidation value for analysis, hence the ratio is not very meaningful for a nuclear power plant. Watch out for subordination (net asset ratios are not meaningful for subordinated debt).

Working Capital ($\textit{Current assets} - \textit{Current liabilities}$) is considered a primary measure of a company's liquidity. Other measures include the current ratio ($\frac{\textit{Current assets}}{\textit{Current liabilities}}$) and the acid test ($\frac{\textit{Current assets}-\textit{Inventories}}{\textit{Current liabilities}}$). The stronger company's liquidity measures, the less problems it will have to service debt even in a downturn. Watch out for sale of receivables and increasing demand for working capital (Automobile industry needs higher working capital in an upturn).

LOS 14.3.c: Analyze the components of a companys return on equity (ROE) and explain the importance of expected earnings growth and ROE in determining credit quality.

$$ROE = \begin{pmatrix} Pretax \\ Margin \end{pmatrix} \times \begin{pmatrix} Asset \\ Turnover \end{pmatrix} \times \begin{pmatrix} Financial \\ Leverage \end{pmatrix} \times (1 - \textit{Tax Rate})$$

Analysis of ROE is important because it gives necessary insights into the components of ROE and indication of the sources of future growth. Differences in the components are often the result of different management philosophy. Analyze the progression of each of the components over the cycle (at least 5 years) and compare it to those of the peers in the industry.

LOS 14.3.d: Describe nonfinancial factors to be considered in analyzing a bond.

Degree of foreign exposure is relevant two respects: (1) instability (political or legal) of revenue sources, (2) exposure to possible nationalization, and (3) currency risk for companies whose revenues are denominated in a foreign currency.

Quality of management is important but difficult to assess. A management is good if it increases earnings and if there is a large management base with planned successions. It is probably not so good, if there is a single person at the top (possibly without successor) or if there have been numerous management changes in the recent past.

Ownership is an indicator for the financial policy that can be expected from the company.

LOS 14.3.e: Explain the most common indenture provisions.

An indenture is a legal document that defines the rights and obligations of the borrower and the lender with respect to a bond issue. Some of the most common indentures are:

Negative pledge clause: Limits the percentage of consolidated net tangible assets (CNTA) the company can use as security to other creditors. More generally, limitations on liens restrict liens to other creditors. Pay particular attention to the clause that specifies the conditions under which collateral may either be released or substituted (the release and substitution clause).

Debt tests: Specify the conditions under which the company may issue additional bonds, generally based on a debt (e.g. max % of assets) or earnings (e.g. coverage ratios) test.

Limitation on sale and leaseback transactions: Economically, a lease is a secured credit. Therefore, these clauses are similar to negative pledge clauses.

Provisions on sale or merger: In these events, typical clauses state that debt must be retired. Often used as poison pills.

Dividend tests: Limit dividends to shareholders, generally as a percentage of earnings.

Maintenance and replacement fund: In order to ensure that mortgaged property remains in good condition, the company must pay a certain amount (a percentage of operating profits or outstanding debt) to a trust.

Redemption provisions: Specify during what period and at what prices a company may call its bonds.

Refunding provisions: Refunding protection protects against the replacement of outstanding debt with another debt issue sold at a lower interest expense.

Sinking fund provisions: The issuer pays every period a certain amount to the trustee. This requirement can often be met with actual bonds or with the pledge of property.

LOS 14.3.f: Discuss why an analyst should focus on restrictive covenants.

Restrictive covenants sometimes make the management of a company very hard. Examples:

- Old outstanding bonds with complex security indentures can make it hard for a company to manage debt; some companies retire debt for this reason.
- Some indentures prescribe the use of the funds. If some external factors make the prescribed use impossible (e.g. if a licence for construction is delayed), the company has a problem.
- Write-downs mandated by SFAS 90 can lead to conflicts with earnings tests. One measure out of such problems is reorganization (write-down some assets while writing up some other assets).
- Maintenance and replacement funds can lead to calls if the cost of these funds increase for external reasons (e.g. oil price).
- Redemption provisions are always critical for bondholders. Companies are tempted to redeem whenever the conditions are advantageous for them.

14.5 Role of Trust Indenture Covenants

LOS 14.4: Describe the purpose and structure of a negative pledge clause, a limitation on additional indebtedness, a limitation on asset sales, and a limitation on restricted payments.

Negative Pledge Clause limits the amount of new debt with a higher priority. It is a promise by the issuer not to pledge assets as security for new debt. A weak negative pledge clause may lead to senior debt becoming effectively subordinated. Typical elements of the clause:

- *Prohibition:* The clause applies to the company and all restricted subsidiaries (either consolidated or listed). It prohibits security interest on any asset. Hence, the assets may to be pledged to provide collateral for borrowings, to defer the price of a purchase, or to protect the future payment of lawful claims.

- *Unless clause:* The unless clause has the sole aim to prevent default when circumstances require the use of an instrument that is otherwise forbidden by the negative pledge clause. It generally allows liens arising by operation of law (= liens that result from the rights of public authorities; the issuer has no control over these liens) or purchase money security interest (PMSI = indebtedness incurred as the cost of acquiring property; if the property is acquired after the issuance of the bond, such operations are not detrimental to bond holders).
- *Exceptions:* Generally, the clause lists some specific exceptions.

Limitations on Additional indebtedness avoid dilution of the priority class. They should provide protection against illiquidity (inability to meet short-term obligations) and insolvency (negative net asset position). Typical elements of the clause:

- *Prohibition:* The issuer promises to keep indebtedness below a certain level. indebtedness generally refers to all debt, interest-bearing liabilities, obligations under leases, and guarantees. It does generally not include trade payables and current accrued liabilities.
- *Ratio:* Ratios provide the test to determine whether the issuer may issue more debt. To ensure liquidity, interest coverage ratios are used. To ensure solvency, either fixed charge coverage or debt to asset ratios are used.
- *Permitted indebtedness:* Exceptions are listed under the definition of permitted indebtedness.

Limitations on asset sales ensure that management will maintain the asset base of the company. They prevent the sale of assets (probably at discount prices) in times of liquidity problems and the transfer of value to other entities. Typical element of the clause:

- *Prohibition:* The clause prohibits an asset sale. Asset sales are defined as any sale of assets with value exceeding a certain amount, as well as the entirety of a business line or division.
- *Conditions:* The exceptions must meet certain conditions.
- *Use of proceeds:* The use of proceeds clause is a compromise between the issuer and bondholders because it gives management the right to sell assets but defines what the proceeds must be used for. The objective of this part is to ensure that risk profile of the firm remains substantially unchanged. It lists how and in what order the proceeds are to be applied.

Limitation on restricted payments prevents management from making payments to other stakeholders, mainly through dividend payments or share buybacks. In cases of financial distress it prohibits liquidation of the firm via dividend payments to the detriment of bondholders. It can be seen as the counterpart to the negative pledge clause by protecting senior bondholders against discretionary payments to junior stockholders (or other stakeholders). Typical elements of the clause:

- *Prohibition:* The clause restricts discretionary payments to other stakeholders.
- *List of restricted payments:* Restricted payments generally include dividends, share repurchases, optional redemption of subordinated debt, payments to affiliates.
- *Financial tests:* Payments can be made if certain tests are met (typically debt to EBITDA or absolute amount tests).
- *List of permitted distributions:* Some payments are discretionary in a legal sense but less so in practice. Therefore, the clause generally allows preferred share dividend, share repurchases in employee share ownership plans, or the redemption of dept upon the issuance of new debt.

14.6 Sovereign Credit Ratings - A Primer

LOS 14.5.a: Discuss the key economic and political risks that Standard & Poors Corporation considers in rating sovereign debt.

Economic risk refers to the ability of the sovereign to repay its obligations. Political risks refers to its willingness to repay the obligations. The key factors considered by S&P are:

- The stability of political institutions and degree of popular participation in the political process (Are political errors identified and corrected? Is decision-making transparent and predictable?)
- Economic growth prospects
- GDP and economic structure (Market economy? Property rights?)
- Fiscal political and budgetary flexibility (What is the purpose of public debt? Does it restrain growth? Has it an impact on inflation?)
- Monetary policy and inflation pressures (Monetization of debt fuels inflation; S&P consider the inflation rate as the single most important leading indicator of sovereign local currency credit trends.)
- Public debt burden and debt service track record (Defaulted in the past? How big is debt relative to GDP?)
- Balance of payments flexibility

- External debt and liquidity

LOS 14.5.b: Differentiate between quantitative and qualitative aspects of credit analysis.

Quantitative: based on a statistic. Economic risk is to a large part quantifiable.

Qualitative: based on judgement. Political risk is mainly qualitative.

LOS 14.5.c: Discuss the factors that cause local currency ratings and foreign currency ratings to differ.

- high foreign currency indebtedness
- a history of defaults on foreign currency debt

LOS 14.5.d: Identify the categories that a rating agency might use in assessing the credit rating of a sovereign issuer.

- ratings are based on a 3-5 year horizon with best and worst case scenarios
- changes occur when new information changes S&P's view of future developments

LOS 14.5.e: Contrast the credit analysis required for corporate bonds, municipal bonds, and sovereign bonds.

Sovereigns are more important than corporates because the default of the sovereign may lead to defaults of corporates in the jurisdiction. Sovereigns have first claims on a country's foreign currency resources, they can restrict capital flows, control tax and the local financial system, and they can print money to pay off their debt. Consequently, non-sovereigns are generally rated below their sovereign (except if their stand-alone characteristics mitigate the situation).

Study Session 15

Debt Investments: Valuation Issues

15.1 Introduction to the Valuation of Fixed Income Securities

LOS 15.1.A: Compute the value of a bond, given the expected cash flows and the appropriate discount rates.

$$P^* = \sum_{\tau} \frac{CF_\tau}{(1+\frac{y}{k})^{k\tau}}$$

Using a calculator:
N = time to maturity (k × number of years)
I/Y = discount rate (y / k)
PMT = coupon per period
FV = face value (100)
⇒ Compute PV

15.2 Introduction to the Measurement of Interest Rate Risk

LOS 15.1.B.a: Compute the duration of a bond, given information about how the bonds price will increase and decrease for a given change in interest rates.

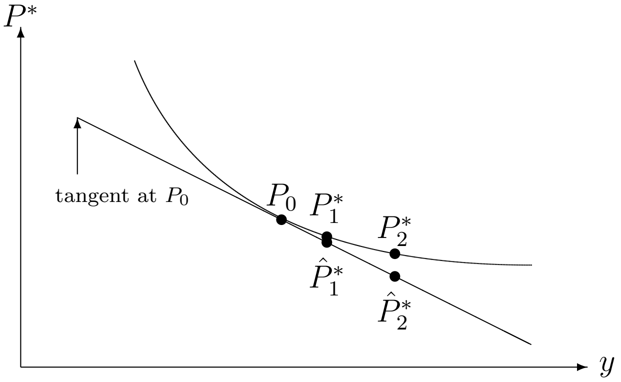
$$D_{effective} = \frac{P_- - P_+}{2 \cdot \Delta y \cdot P_0}$$

LOS 15.1.B.b: Compute the approximate percentage price change for a bond, given the bonds duration and a specified change in yield.

$$\frac{\Delta P}{P_0} \approx -D_{effective} \cdot \Delta y$$

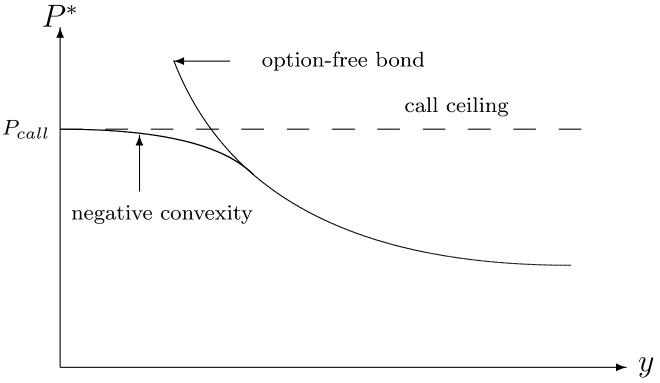
LOS 15.1.B.c: Explain, using both words and a graph of the relationship between price and yield for an option-free bond, why duration does an effective job of estimating price *changes for small changes in interest rates but is not as effective for a large change in rates.*

Graphically speaking, the duration approximates the shape of the price/ yield relationship by the tangent line at P_0. For small differences, this is pretty accurate ($P_1^* - \hat{P}_1^* \approx 0$). However, for bigger differences, the convex shape of the curve moves away from the tangent line and the difference becomes increases in size ($P_2^* - \hat{P}_2^* > 0$).



Mathematically speaking, the approximation formula using the duration represents a first-order Taylor expansion of a general formula $P^* = P(y)$. Taylor expansions are fine for small changes from the origin but not for large changes.

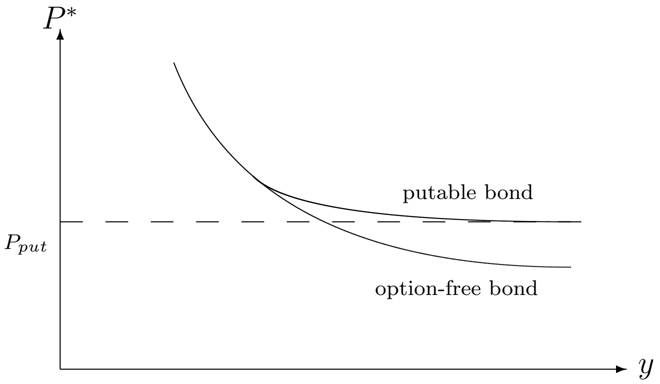
LOS 15.1.B.d: Draw and interpret a graph of the relationship between price and yield for a callable and prepayable security and use the graph to explain what is meant by negative convexity.



For callable bonds or prepayable securities, the call price effectively acts as a ceiling on the bond price. Once the the price of the callable bond approaches the call price, its elasticity to changes in the yield drops dramatically. This is captured by the negative convexity part.

LOS 15.1.B.e: Draw and interpret a graph of the relationship between price and yield for a putable bond.

For putable bonds, the put price acts as a floor below which the bond price cannot fall. You can imagine a putable bond as an option-free bond plus a put option. Both bonds and put options have a price that is convex with respect to yield. Consequently, the price / yield relationship for a putable bond is more convex than that of an option-free bond.



LOS 15.1.B.f: Explain how rate shocks for interest rates used to compute duration may affect the duration calculation.

- For option-free bonds, the size of the yield shock on the estimate of the slope of the tangent line is relatively limited. In fact, it is a third-order effect (how much does convexity, or curvature, change with yield?). You can see this by looking at a price/ yield graph and observing that the schedule parts almost symmetrically from the tangent line.
- The situation is much more complicated for bonds with embedded options. For callable options, convexity turns from positive to negative. If you draw a price / yield schedule for a callable bond and start from a price close to the call price, you will see that the size of the shock greatly changes the estimated slope. An analogous argument holds for putable bonds.

LOS 15.1.B.g: Distinguish between modified duration and effective (or option-adjusted) duration.

Effective (option-adjusted) duration: A measure of sensitivity of the bonds price with respect to a change in yields that *allows for a change in expected cash flows.*

Modified duration: A measure of sensitivity of the bonds price with respect to a change in yields, that has been derived from the Macaulay duration. It *assumes that yield changes do not change the expected cash flows.*

LOS 15.1.B.h: Explain why effective duration, rather than modified duration, should be used for bonds with embedded options.

Embedded options mean that expected cash flows are related to the yield level. The *modified duration assumes that cash flows do not change with yields.* Effective duration is more general and allows for a change in cash flows.

LOS 15.1.B.i: Explain the relationship between modified duration and Macaulay duration and the limitations of using either duration measure for measuring the interest rate risk for bonds with embedded options.

$$\begin{aligned}
D_{Macaulay} &= \frac{1}{P^*} \cdot \sum_\tau \frac{\tau \cdot CF_\tau}{(1+\frac{y}{k})^{k\tau}} \\
D_{modified} &= \frac{1}{(1+\frac{y}{k})} \cdot \frac{1}{P^*} \cdot \sum_\tau \frac{\tau \cdot CF_\tau}{(1+\frac{y}{k})^{k\tau}} \\
&= \frac{D_{Macaulay}}{(1+\frac{y}{k})}
\end{aligned}$$

The Macaulay duration was developed as a measure of average time to maturity. Therefore, it is not really a measure of the sensitivity of the bond price with respect to yield, even for option-free bonds.

The formula of the modified duration is derived as the first derivative of the price formula $\left(P^* = \sum_\tau \frac{CF_\tau}{(1+y/k)^{k\tau}}\right)$ with respect to yield. Therefore, it is a measure of the sensitivity of the bond price with respect to yield. However, the formula assumes that cash flows do not change. Consequently, modified duration should not be used for bonds with embedded options.

LOS 15.1.B.j: Describe the various ways that duration has been interpreted and why duration is best interpreted as a measure of a bond or portfolios sensitivity to changes in interest rates.

Measure of time: The Macaulay duration is calculated as a weighted average of time to cash flow (τ), with the weights proportional to the present value of each cash flow in the total value of the bond. In practice, the interpretation of general duration measures in terms of time has two difficulties: (1) you should focus on interest sensitivity; so, interpreting duration in terms of time means that a 4-year duration bond has the sensitivity of a 4-year zero; (2) the time interpretation breaks down for complex securities (e.g. interest-only securities have negative duration, floaters have long maturities but low duration)

First derivative with respect to yield: Mathematically, duration is the first derivative of a price formula (with or without options) with respect to yield. However, in practice, this interpretation does not make much sense to clients who do not know the maths.

Sensitivity with respect to a one-percentage change: That's the best interpretation. Even people without the technical skills to grasp the derivative definition will feel comfortable with it.

LOS 15.1.B.k: Compute the duration of a portfolio, given the duration of the bonds comprising the portfolio, and discuss the limitations of portfolio duration.

$$D_{portfolio} = \sum_{i=1}^{\#\ of\ bonds} w_i D_i$$

LOS 15.1.B.l: Compute the convexity of a bond, given information about how the price will increase and decrease for a given change in interest rates.

$$Convexity = \frac{P_+ + P_- - 2P_0}{2P_0(\Delta y)^2}$$

LOS 15.1.B.m: Compute the convexity adjustment to the duration estimate of a bonds percentage price change, given the convexity measure and a specified change in interest rates.

$$Convexity\ adjustment = Convexity \cdot (\Delta y)^2$$

LOS 15.1.B.n: Compute the estimate of a bonds percentage price change, given the bonds duration and convexity and a specified change in interest rates.

$$\frac{\Delta P}{P_0} \approx -Duration \cdot \Delta y + Convexity \cdot (\Delta y)^2$$

LOS 15.1.B.o: Explain why convexity measures will differ among dealers and venders of analytical services because of differences in scaling.

Dealers use different formulas for calculating convexity. Differences:

- Quotation of percentage change. You can use decimal quotation ($6\% = .06$) or quotations as percentage points ($6\% = 6$). Because the percentage change is squared, measures can be 10'000 times smaller.
- The Fabozzi formula has a 2 in the denominator. Some venders use a convexity formula without the 2 (their convexity is the second derivative). Depending on whether you have the 2 in the formula, you will have to use it in the formula for the convexity adjustment.

LOS 15.1.B.p: Explain the difference between modified convexity and effective convexity.

Modified convexity: Can be derived as the second derivative of a bond with known cash flows. Cannot be used for bonds whose cash flows change with the yield level.

Effective convexity: Convexity measure for all bonds (including bonds whose cash flows change with the yield level).

LOS 15.1.B.q: Compute the price value of a basis point of a bond.

$$PVBP = \mid P(y_0) - P(y_0 \pm 1\ basis\ point) \mid$$

LOS 15.1.B.r: State the relationship between duration and the price value of a basis point.

The PVBP is the dollar equivalent of duration:

$$PVBP = \frac{P_0 \cdot D_{effective}}{10000}$$

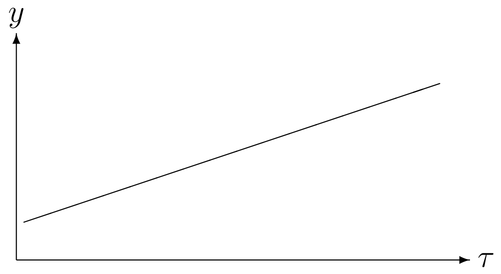
LOS 15.1.B.s: Explain the importance of yield volatility in measuring the exposure of a bond position to interest rate risk.

The exposure of the bond interest rate risk is determined by two factors: the interest rate volatility (σ_y) and the bonds sensitivity to changes in the interest rate ($\approx D$). Approximating $\Delta P \approx -D \cdot y$, it can be seen immediately that $\sigma_P \approx D\sigma_y$. In other words, volatility in yields drives volatility in prices. This means that if volatility is low, even a bond with a high duration may have relatively little risk. On the other hand, a high volatility in yields can lead to high risk even for bonds with a low duration.

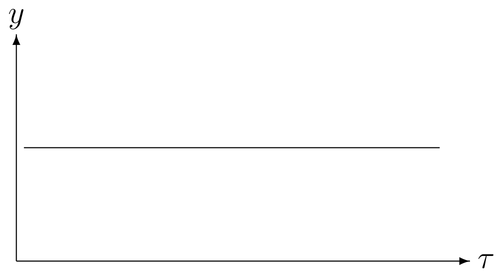
15.3 The Term Structure and the Volatility of Interest Rates

LOS 15.1.C.a: Describe and interpret the different shapes that have been observed for the Treasury yield curve.

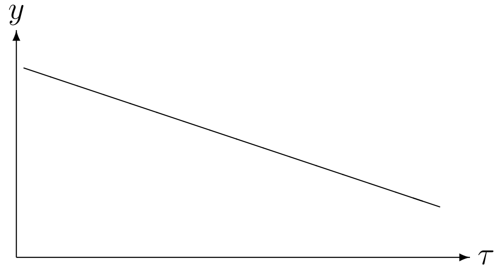
Normal (positively sloped) yield curve = yields increase with time to maturity



Flat yield curve = yields are approximately equal for all maturities.



Inverted yield curve = yields decrease with time to maturity.



LOS 15.1.C.b: Explain the concept of the slope of the yield curve.

Slope of the yield curve = *the spread between the yields for two maturities.* There is no industry standard as to what two maturities to use. Some market participants use the 30-year bond over the 3-month rate, other participants use the spread between the 10-year and the 2-year yield.

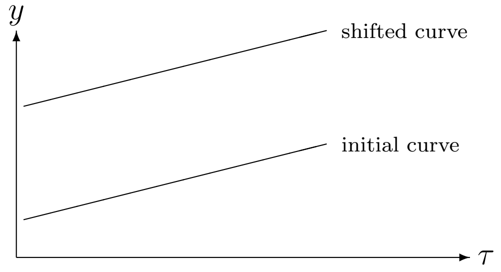
LOS 15.1.C.c: Illustrate and explain a parallel and a nonparallel shift in the yield curve.

Parallel shift in the yield curve = a shift in which the change in the yield is the same for all maturities (e.g. all yields go up by 20 basis points).

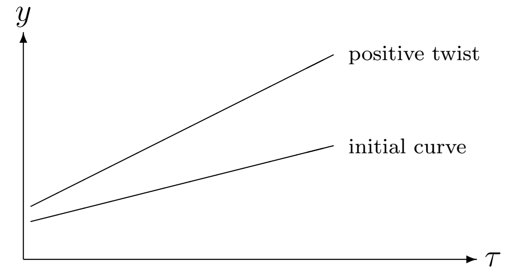
Nonparallel shift in the yield curve = a shift in which the change in the yield is *not* the same for all maturities (e.g. the curve steepens by 20 basis points).

LOS 15.1.C.d: Illustrate and explain a yield curve twist and a change in the curvature of the yield curve (i.e., butterfly shift).

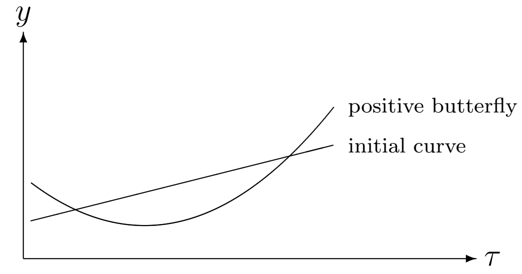
Shift = a parallel movement of the curve.



Twist = a steepening (positive twist) or flattening (negative twist) of the curve.



Butterfly = an increase (positive butterfly) or decrease (negative butterfly) of the long and short rates relative to the intermediate part of the curve.



LOS 15.1.C.e: Describe and explain the factors that have been observed to drive Treasury security returns and the importance of each factor.

The following factors together explain more than 95% of the variability in returns:

1. *Changes in the level of interest rates (Shift)* account for 80-95% of variance.
2. *Changes in the slope of the yield curve (Twist)* account for another 5-15%.
3. *Changes in the curvature (Butterfly)* account for a final 0-5%.

LOS 15.1.C.f: Explain the various universes of Treasury securities that are used to construct the theoretical spot rate curve and discuss their advantages and disadvantages.

1. On-the-run treasuries = the most recently issued treasury securities. This universe consists of a small number of very liquid securities that trade close to par. Bootstrapping can be used to obtain a par curve. Because the bonds trade close to par, there are little distortions from tax effects. On the other hand, there are only a few on-the-run securities, so the missing gaps must be filled with some kind of interpolation.

2. On-the-run treasuries plus selected off-the-run treasuries: Selected off-the-run treasuries can be used to fill the gaps in the on-the-run curve. Bootstrapping can still be used.
3. All treasury coupon securities and bills. This universe contains additional information on the yield curve. On the other hand, tax effects and call features must be taken into account. Yield curves are obtained by some statistical smoothing technique.
4. Treasury coupon strips: Strips provide a spot curve without the need of bootstrapping. However, strips are often illiquid, their tax treatment is different from that of other bonds, and non-US investors may use strips to get some strange tax advantages.

LOS 15.1.C.g: Explain the various forms of the expectations theory (pure expectations theory, liquidity theory, and preferred habitat theory) and the implications of each theory for the shape of the yield curve.

Pure expectations theory: According to the pure expectations theory, forward rates exclusively represent expected future spot rates. Hence, expectations can be directly read off the curve (i.e. the forward rates). The problem with this theory is that it neglects risk. The first type of risk arises from price uncertainty at the end of the holding period. Bonds with longer maturity will be exposed to such risk and investors would like to be compensated for taking this risk. The second type of risk results from uncertain reinvestment rates.

Liquidity theory: The liquidity theory interprets interest rates in terms of expectations plus a liquidity (risk) premium. If one accepts the presence of risk premia, forward rates no longer reflect pure market expectations.

Preferred habitat theory: This theory assumes that investors have preferences with respect to the segment of the curve in which they would like to invest. If the balance between demand and supply do not match, investors will have to be attracted out of their preferred habitat by yield premium. Hence, the theory proposes that the curve is driven by expectations and premiums to induce market participants to shift out of their preferred habitat.

LOS 15.1.C.h: Interpret forward rates in the context of the theories of the term structure.

The pure expectations theory suggests two interpretations for the forward rates:

Broad interpretation: Investors expect the return *for any investment horizon* to be the same, regardless of the maturity strategy. Problem with this interpretation: there is no risk premia for the price uncertainty at the end of the investment horizon.

Local expectations interpretation: Investors expect the return *for a short investment horizon* to be the same, regardless of the maturity strategy. If the forward rates materialize, all bonds will have a holding-period return equal to the short rate at the beginning of the holding period.

LOS 15.1.C.i: Explain two interpretations of forward rates based on arbitrage arguments.

Break-even rates: A forward rate, $f_{1,2}$ is the rate that makes you break even between (1) a two-period investment at the spot rate s_2 and (2) a one-period investment at the spot rate s_1 plus a forward investment at the rate $f_{1,2}$. In other words, (1) investing long term or (2) investing short-term and rolling forward should break even.

Lock-in rates: A forward rate, $f_{1,2}$ is locked in by making a two-period investment at s_2 rather than investing just one period at s_1 and rolling in the future at the then available spot rate.

LOS 15.1.C.j: Explain the market segmentation theory of the term structure of interest rates.

According to the market segmentation theory, investors and borrowers have a particular segment of the curve at which they want to invest or borrow (e.g. for asset-liability managment). Contrary to the preferred habitat theory, market segmentation pretends that neither investors nor borrowers are willing to shift from their respective segment. Therefore, in each segment, interest rates are driven by demand-supply dynamics.

LOS 15.1.C.k: Describe how to measure and compute the effects of the yield curve risk of a security or a portfolio, using key rate duration.

1. Define what key rates to use (e.g. 3-month, 1-year, 3-year, 5-year, 10-year, 30-year). All key rates refer to spot rates!
2. Decompose your portfolio in cash flows (not necessary for zero bonds).
3. For each key rate, calculate how the present value of each cash flow is affected by a change in the key rate. *As an approximation, you can use the tenor of the key rate* (e.g. the 3-year key rate duration of a 3-year zero bond is 3). The effect on cash flows between the tenor of two key rates is calculated found by interpolation.
4. Aggregate over the portfolio. Calculate the share of each cash flow in the value of the portfolio. Multiply this share with the key rate duration. Sum over all cash flows.

LOS 15.1.C.l: Compute and interpret yield volatility, given historical yields.

We are more interested in relative changes rather than absolute volatility.

1. Calculate relative changes with help of the logarithmic formula $x_t = \ln y_t - \ln y_{t-1} = \ln y_t/y_{t-1}$
2. Calculate the sample volatility, $\sigma^2 = \sum_{i=1}^{n} \frac{(x_i-\bar{x})^2}{n-1}$. Note that theoretically, $\bar{x} = 0$.
3. Adjust the time horizon, e.g. annualize daily data.

LOS 15.1.C.m: Explain the issues associated with calculating yield volatility (i.e., the number of observations to use and the annualizing of daily yield volatility).

- The appropriate number of observations to use depends on the situation. Traders will be concerned by the most recent period (e.g. 10 days) while portfolio managers look at a longer history (e.g. 25 days).
- Daily volatility can be annualized by using the formula

  $$\sigma_{annual} = \left(\sigma_{daily}\right)^{1/\#\ of\ days\ per\ year},$$

  where the number of days per year is either the number of trading days (250), the number of week days (260), or the number of days (365).

LOS 15.1.C.n: Distinguish between historical yield volatility and implied yield volatility.

Historical yield volatility = volatility obtained by calculating the standard deviation of historical yield data.

Implied yield volatility = the volatility that, when plugged into an option-pricing model, gives the market price of the option. Problems with implied volatility: (1) it depends on a model that may be wrong, and (2) it assumes that volatility is constant over time.

LOS 15.1.C.o: Explain how yield volatility is forecasted.

Assuming $\bar{x} = 0$, there are three degrees of sophistication:

1. Use equally-weighted historical data, $\sigma^2 = \sum_{i=1}^{n} \frac{x_t^2}{n-1}$

2. Use weighted historical data, $\sigma^2 = \sum_{i=1}^{n} w_i x_i^2$, where $\sum_{i=1}^{n} w_i = 1$ and w_t gives more weight to the most recent data.[1]

3. Use a sophisticated econometric model like ARCH, GARCH or stochastic volatility.

15.4 Understanding the Yield Curve

LOS 15.2.a: Explain the three main influences on the shape of the yield curve: market expectations, bond risk premia, and convexity bias.

Market expectations: According to the pure expectations theory, market expectations are the only driver of the yield curve. Why? Because risk-neutral traders will remove expected return differentials across bonds. For this forward rates must move to expected rates (if forward rates are realized, all maturities will earn the same return). The influence on the yield curve is as follows:

- If the market expects a parallel rise in rates, the yield curve will steepen (capital losses increase with duration and have to be offset with a higher carry).
- If the market expects a bearish flattening, the curve will steepen and become more concave.

Risk premia: For various reasons (notably higher volatility in the return of longer-term bonds), investors will require different expected returns for different maturity sectors. Empirically, this risk premia increases steeply with duration at the front end of the curve and becomes almost flat at the very long end.

Convexity bias: Given a change in yield, the convexity adjustment is always positive. Because convexity is positive, bonds with high convexity can be expected to have lower yields than less convex bonds with the same duration. Moreover, the convexity bias should be a function of the volatility of yields.

LOS 15.2.b: Discuss why using the yield-to-maturity curve to evaluate a coupon bond is difficult unless the yield curve is flat.

1. Cash flows are discounted at an 'average' rate that is inappropriate for each cash flow taken separately.

2. Reinvestment rates can vary.

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[1] Fabozzi (and the Schweser Notes...) gives the wrong formula $\sigma^2 = \sum_{i=1}^{n} \frac{w_i x_i^2}{n-1}$. The division by $n-1$ is non-sensical as the weights are already constructed in a way that they sum up to 1.

LOS 15.2.c: Compute spot rates and forward rates from the par yield curve.

1. The s_1 is the one-period par-rate, p_1.
2. Set $n = 2$
3. Strip the n-period par bond in its cash flows.
4. Calculate the value of the cash flow at the end of period n as:

$$PV_i = P_n - \sum_{i=1}^{n-1} \frac{CF_i}{(1+s_i)^i}$$

5. Find the discount rate that sets the present value of CF_n to PV_i:

$$s_n = \left(\frac{CF_n}{PV_i}\right)^{1/n} - 1$$

6. Set $n = n + 1$ and go back to step 3.

LOS 15.2.d: Compute spot rates given forward rates, and compute forward rates given spot rates.

$$\begin{aligned} f_{m,n} &= \left[\frac{(1+s_n)^n}{(1+s_m)^m}\right]^{1/n-m} - 1 \approx \frac{ns_n - ms_m}{n-m} \\ s_n &= (1+s_m)^m \cdot (1+f_{m,n})^{n-m} - 1 \\ s_m &= \left[\frac{(1+s_n)^n}{(1+f_{m,n})^{n-m}}\right]^{1/m} - 1, \end{aligned}$$

where $m < n$, $f_{m,n}$ is the forward rate for the period starting at m and ending at n and s_m represents the m-period spot rate.

LOS 15.2.e: Interpret forward rates under the pure expectations hypothesis.

The pure expectations hypothesis states that all government bonds have the same near-term expected return. This will be the case, if all forward rates materialize.

LOS 15.2.f: Diagram and explain the relationship among yield to maturity, spot rates, and forward rates under various yield curve shapes.

Spot rates are an 'average' of forward rates $\left(s_n = [\prod_{i=1}^{n}(1 + f_{i-1,i})]^{1/n} - 1\right)$. Similarly, par rates are an 'average' of spot rates. Therefore, the spot curve magnifies any variation in the par curve, and the forward curve magnifies any variation in the spot curve:

- When the curve is upward-sloping, the spot curve lies above the par curve, and the forward curve liew above the spot curve.
- When the curve is downward-sloping, the forward curve lies below the spot curve, and the spot curve lies below the par curve.
- When the curve is flat, forward, par, and spot curve will be identical.

LOS 15.2.g: Demonstrate how forward rates are used as breakeven rates.

If forward rates materialize, all maturities will earn the same return. On the other hand, if yields rise more than implied by the forward rates, bearish positions are profitable; if yields rise less than implied by the forward rates, bullish positions pay off. Consequently, portfolio managers can invest according to the differences between their interest rate scenarios and observed forward rates.

LOS 15.2.h: Compute the holding-period return on a zero-coupon bond if the yield curve remains unchanged.

Assuming no change in the yield curve, the return on a n-period zero over a period of h is simply the forward return from $n - h$ to n:

$$\pi_{n,h} = (1 + f_{n-h,n})^h - 1 = \frac{(1 + s_n)^n}{(1 + s_{n-h})^{n-h}} - 1 = \frac{\left[\frac{100}{(1+s_{n-h})^{n-h}}\right]}{\left[\frac{100}{(1+s_n)^n}\right]} - 1 = \frac{P_h}{P_0} - 1$$

LOS 15.2.i: Evaluate the pure expectations hypothesis in terms of forward rates being viewed as breakeven rates.

[Maybe I'm stupid, but this LOS simply doesn't make sense to me.]

LOS 15.2.j: Explain why the bond risk premium appears to behave countercyclically with respect to economic conditions.

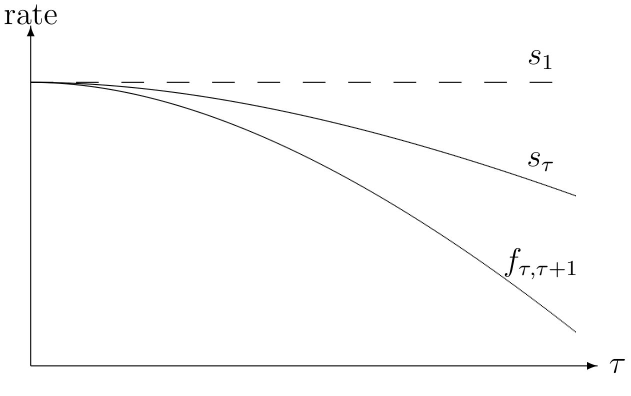
Investors become more risk averse when their wealth is low. Therefore, after periods of poor economic conditions, they will require high risk premia.

LOS 15.2.k: Explain how the convexity of a bond influences the yield on the bond.

- All non-callable bonds exhibit positive convexity.
- Because of positive convexity, expected returns on a bond are bigger than the returns at the expected interest rates (given some volatility in rates).
- The longer the maturity of a bond, the higher this convexity effect.
- Investors are willing to pay a premium for this convexity effect. This premium increases with maturity and explains the typical concave shape of the curve.

LOS 15.2.l: Diagram and explain, with and without the influence of the convexity bias, the spot and one-year forward rate curves when all bonds have the same expected return and short-term rates are expected to remain at the current level.

Without the convexity bias, if spot and forward rates are expected to remain at the current level and earn the same return, the curve would be flat. Adding the convexity bias increases the expected return, in particular for high-convexity (high maturity, τ) bonds. This means that current spot yields can be lower to earn the same expected return. Consquently, spot and forward rates decrease, especially for bonds with high τ.



LOS 15.2.m: Discuss the effects of yield volatility on the value of convexity, the corresponding yield, and the shape of the yield curve.

- Because convexity is always positive, rising volatility increases the value of convexity.
- As convexity increases with maturity, longer bonds profit more from convexity (their yield should decrease).
- The result of rising convexity is an increased concavity in the curve. Maybe, convexity is the main reason for the typical concave shape.

LOS 15.2.n: Explain the difficulty in decomposing the shape of the yield curve into its components.

The problem is that the three components are not directly observable and vary over time.

LOS 15.2.o: Demonstrate and explain how forward rates can be used to identify cheap maturity sectors.

Forward rates magnify variations in spot and par rates. Therefore, they help you to spot pricing anomalies on the curve.

LOS 15.2.p: Compute the breakeven yield change necessary for zero-coupon bonds with different maturities to earn the same return.

All zeros earn the same return if the *forward materializes*. Therefore, the yield change necessary is the difference between the forward rate and the current spot rate, $f_{n,n+1} - s_n$.

LOS 15.2.q: Compare the pure expectations hypothesis with the risk premium hypothesis in terms of expected spot rate changes and bond risk premiums.

Pure expectations hypothesis: Spot rates will move to the forward rates. There is no risk premium.

Risk premium hypothesis: Spot rates will not change. The difference between forwards and spots reflects a risk premium.

Assuming a holding period of 1, the hypotheses can be combined to $f_{1,n} - s_{n-1} \approx E(\Delta s_{n-1}) + \frac{\varphi_n}{n-1}$, where φ_n represents the risk premium on a n-period zero. In words, the equation tells you that the curve steepness is a combination of market expectations (the risk premium hypothesis assumes that this $E(\Delta s_{n-1}) = 0$) and a risk premium (the pure expectations hypothesis assumes that this $\varphi_n = 0$).

LOS 15.2.r: Evaluate the differences between the two versions of the pure expectations hypothesis (unbiased expectations and local expectations) in terms of the convexity bias.

The unbiased expectations hypothesis states that forward rates are unbiased forecasts of future rates.

The local expectations hypothesis states that all bonds have the same near-term expected return.

The point is, that the two hypotheses are incompatible because of the convexity bias. In the presence of yield volatility, expected returns will be higher than returns at the expected yield. The effect is bigger for bonds with bigger convexity, i.e. bonds with longer maturities.

15.5 Risks Associated with Investing in Bonds

LOS 15.4.A.a: Explain the interest rate risk of a floating-rate security and why such a securitys price may differ from par value.

The risk stems from

- changes in the short-term rate until the next reset date;
- changes in the required margin (spread risk);
- caps on the floating rate coupon.

LOS 15.4.A.b: identify the factors that affect the reinvestment risk of a security

Reinvestment risk = *the risk that proceeds available for reinvestment must be reinvested at a lower rate than the instrument that generated the proceeds.* If cash flows are known in advance, the reinvestment risk is directly related to the amount of cash flows (high coupon = high reinvestment risk; zero coupon = no reinvestment risk). For bonds with uncertain cash flows, reinvestment risk is often aggravated by the fact that cash flows increase when rates are low (amortizing securities).

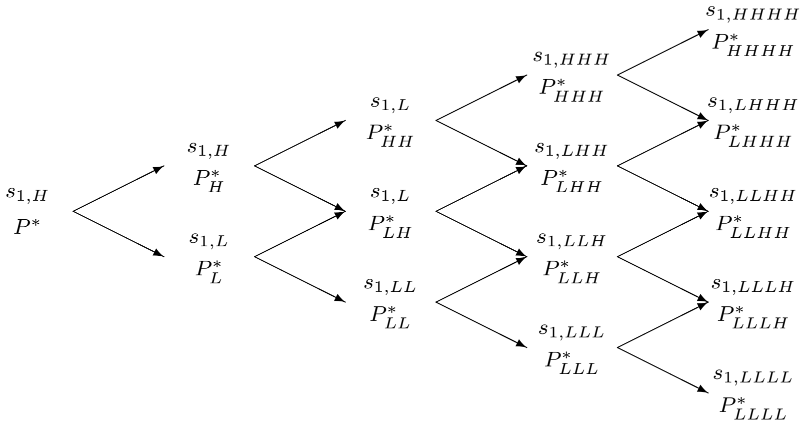
15.6 Valuing Bonds with Embedded Options

LOS 15.4.B.a: Explain the concept of an interest rate model.

Interest rate model = *a probabilistic description of how interest rates can change over the life of a bond.* Interest rate models formalize the stochastic process that drives the short rates (generally based on assumptions on the relationship between the level of the short rate and its volatility). A one-factor model models only one rate (typically the short rate) while two-factor models model two interest rates at the same time. Models that allow, for a given interest rate now, only two different rates next period, are called binomial models.

LOS 15.4.B.b: Explain the concept of an interest rate tree.

Interest rate tree = *a collection of all possible paths interest rates can follow over time.* Typically, an interest rate tree is built upon a binomial model. From the current rate, interest rates can move either up or down. The same holds at the next node, etc. The graphical representation of an interest rate tree actually resembles a tree:



LOS 15.4.B.c: Explain the backward induction valuation methodology within the binomial interest rate tree framework.

In a binomial model, an interest rate tree defines all possible paths interest rates can follow over time. To value an option (or a bond with an embedded option), you start with the last node. Because you know the payoff of the option, you know the theoretical value of the option at the last node. Then you go back one level. You will see that from each node, interest rates can go either up or down, and you know the value of your option at the end of the two paths. You can, therefore, value the option at this node by attaching to each of the two paths a (risk-neutral) probability, e.g. 50% and then calculating the probability-weighted expected value. Once you've done this for all the nodes at this level, you go another level back, until you finally arrive at the first node of the tree.

LOS 15.4.B.d: Compute the value of an option-free bond, using an interest rate tree.

1. Define an interest rate model. Fabozzi proposes a binomial model based on a log-normal random walk. In this model, the relationship between $s_{1,L}$ and $s_{1,H}$ is given by

$$s_{1,H} = s_{1,L} e^{2\sigma}.$$

2. Get a term structure of volatility.
3. Fit the interest rate tree to the on-the-run treasuries. For this, assume the lowest part of the interest rate tree, and adjust it until the theoretical price for treasury bonds obtained by backward induction fits the actual market price. This computationally intensive job is done by vendors.
4. Once you have the interest rate tree, calculate the theoretical price of your bond by backward induction. Start at the end, because you know the value of your bond at maturity. Then, go back one level and calculate the theoretical price at each node by the equally weighted formula

$$P^*_{\ldots} = \frac{1}{2}\left[\frac{P_{\ldots H} + coupon}{1 + s_{1,\ldots}} + \frac{P_{\ldots L} + coupon}{1 + s_{1,\ldots}}\right].$$

   Continue until you reach P^*.

LOS 15.4.B.e: Compute the value of a callable bond from an interest rate tree, given the call schedule and the rule for calling a bond.

The only difference to the calculation of P^* for an option-free bond is this: At each node, you must decide whether the bond is called. If the bond is not called, P^* remains unchanged. On the other hand, if the bond is called (P^* obtained by the valuation formula exceeds the call price), P^* must be replaced by the call price.

In other words, at each node, the theoretical price at each node is found by:

$$P^*_{\dots} = \min\left(Call\ price, \frac{1}{2}\left[\frac{P_{\dots H} + coupon}{1 + s_{1,\dots}} + \frac{P_{\dots L} + coupon}{1 + s_{1,\dots}}\right]\right).$$

LOS 15.4.B.f: Explain how the value of the embedded call option is determined.

An investor in a callable bond is basically long an option-free bonds and short a call on the bond. Therefore,

$$P^*_{call\ option} = P^*_{option\ free\ bond} - P^*_{callable\ bond}.$$

LOS 15.4.B.g: Explain the relationship among the values of a callable (putable) bond, the corresponding option-free bond, and the embedded option.

An investor in a putable bond is basically long an option-free bonds and long a put on the bond. Therefore

$$P^*_{putable\ bond} = P^*_{option\ free\ bond} + P^*_{put\ option}$$

LOS 15.4.B.h: Explain how option-adjusted spread is calculated using the binomial model.

Option-adjusted spread = *the constant spread that when added to all the 1-period rates on the binomial interest rate tree will make the theoretical (arbitrage-free) value equal to the market price.* To obtain the OAS, add an arbitrary constant to all spot rates ($s_{1,\dots}$) on the interest tree, and calculate P^*. If $P^* > P$ increase the constant and vice versa. Continue until you find a constant such that $P^* = P$ (in practice, computers will use a Newton-type algorithm to find the constant with a minimum of computation).

LOS 15.4.B.i: Interpret an option-adjusted spread with respect to a nominal spread and to benchmark interest rates.

Nominal spreads over the benchmark interest rates are due to three factors:

1. credit risk
2. liquidity risk
3. option risk

The option-adjusted spread controls for the last source of spread (hence, it reflects credit and liquidity risk).

LOS 15.4.B.j: Explain how effective duration and effective convexity are calculated using the binomial model.

1. Set up your interest rate tree, fit it to the treasury curve, and calculate the OAS.
2. Shift the treasury curve up and down by a constant amount Δy.
3. Construct a binomial tree for the up and down scenario.
4. To each of the binomial trees, add the OAS obtained in step 1.
5. Calculate P_-^* and P_+^* from the two binomial trees.
6. Calculate duration:

$$effective\ duration = \frac{P_- - P_+}{2 \cdot P_0 \Delta y}$$

7. Calculate convexity:

$$effective\ convexity = \frac{P_- + P_+ - 2P_0}{2 \cdot P_0 (\Delta y)^2}$$

LOS 15.4.B.k: Compute the value of a putable bond, using an interest rate tree.

The only difference to the calculation of P^* for an option-free bond is this: At each node, you must decide whether it makes sense to put the bond. If the bond is not put, P^* remains unchanged. On the other hand, if the bond is put (P^* obtained by the valuation formula falls below the put price), P^* must be replaced by the put price.

In other words, at each node, the theoretical price at each node is found by:

$$P_{\dots}^* = \max\left(Put\ price, \frac{1}{2}\left[\frac{P_{\dots H} + coupon}{1 + s_{1,\dots}} + \frac{P_{\dots L} + coupon}{1 + s_{1,\dots}}\right]\right).$$

LOS 15.4.B.l: Explain how the binomial model can accommodate multiple embedded options.

The method is analogous to the valuation of put and call options. At each node, determine whether one of the options becomes effective. If this is the case, adjust the theoretical value of the bond at this note to reflect it.

LOS 15.4.B.m: Explain how the binomial model can be used to value a step-up callable note and a capped floater.

Step-up note: In a step-up note, the coupon steps up after a certain number of periods. This is easily integrated in the valuation formula by adjusting the coupon payment. If the step-up is callable, you must decide at each node if the bond is called.

Floater: In a floater, the coupon payment simply depends on the short rate. Again, you can value floaters by making the coupon dependent on s_1. If the floater is capped, the coupon will be the minimum of the short rate plus the spread and the cap.

LOS 15.4.B.n: Formulate the appropriate 'nodal decision' within the backward induction methodology of the interest rate tree framework for each of the following bonds: putable bond, callable bond, putable/callable bond, multiple step-up callable bond, and a floater with a cap.

Suppose the theoretical price of an option-free bond at a certain node is given by $\tilde{P}^*$, then the nodal decisions for bonds with embedded options are defined for

- putable bonds: $P^* = \max\left(\tilde{P}^*, \textit{put price}\right)$
- callable bonds: $P^* = \min\left(\tilde{P}^*, \textit{call price}\right)$
- putable/callable bonds: $P^* = \max\left[\min\left(\tilde{P}^*, \textit{call price}\right), \textit{put price}\right]$
- step-up callable bond: $P^* = \min\left(\tilde{P}^*, \textit{call price}\right)$, where the step-up feature is reflected by the coupon used to calculate $\tilde{P}^*$
- floater with cap: $P^* = \tilde{P}^*$, where the floating rate cap is reflected by the coupon used to calculate $\tilde{P}^*$

LOS 15.4.B.o: Describe the basic features of a convertible bond.

Convertible security = *a security with an embedded call option to buy the common stock of the issuer.* The number of shares the security holder receives when exercising the call option is defined by the conversion ratio. The conversion price is the implied price the investor pays for one stock, i.e. the par price divided by the conversion ratio. Exchangeable securities are similar to convertible securities, but instead of a call on the issuer stock, they embed a call on a stock other than that of the issuer (e.g. Ford Motor Credit exchangeables embed a call on Ford Motor Company).

Almost all convertibles are callable, and some of them are putable.

LOS 15.4.B.p: Compute the value and explain the meaning of the following for a convertible bond: conversion value, straight value, market conversion price, market conversion premium per share, market conversion premium ratio, premium payback period, and premium over straight value.

Conversion value = value of the security if it is converted immediately,

$$\begin{array}{c}\textit{conversion}\\\textit{value}\end{array} = \begin{array}{c}\textit{market price}\\\textit{of stock}\end{array} \times \begin{array}{c}\textit{conversion}\\\textit{ratio}\end{array}.$$

Straight value = value of a convertible without the call feature (i.e. the value a convertible would have if it were a straight bond).

Market conversion price = price an investor effectively pays for a stock if the convertible is purchased and immediately converted into stock,

$$market\ conversion\ price = \frac{market\ price\ of\ convertible}{conversion\ ratio}.$$

Market conversion premium per share = the premium paid by buying the stock via a convertible instead of buying it directly,

$$\begin{array}{c}\textit{market conversion}\\\textit{premium per share}\end{array} = \begin{array}{c}\textit{market conversion}\\\textit{price}\end{array} - \begin{array}{c}\textit{market price}\\\textit{of stock}\end{array}.$$

Premium payback period = the time it takes to recover the premium per share,

$$\begin{array}{c}\textit{premium}\\\textit{payback period}\end{array} = \frac{market\ conversion\ premium\ per\ share}{favorable\ income\ differential\ per\ share},$$

where the favorable income differential per share is given by:

$$\begin{array}{c}\textit{favorable income}\\\textit{differential per share}\end{array} = \frac{coupon}{conversion\ ratio} - \begin{array}{c}\textit{dividend}\\\textit{per share}\end{array}.$$

Premium over straight value = a measure of the downside risk of a convertible bond, defined by

$$\begin{array}{c} \textit{premium over} \\ \textit{straight value} \end{array} = \frac{market\ price\ of\ convertible}{straight\ value} - 1,$$

Unfortunately, the use of the premium over straight value as a worst-case value is flawed because interest rates can lead to fluctuations in the straight value.

LOS 15.4.B.q: Discuss the components of a convertible bonds value that must be included in an option-based valuation approach.

In the most general form, the value of a convertible bond, the following components must be included:

$$\begin{aligned} value\ of\ convertible &= straight\ value \\ &\quad +value\ of\ call\ on\ stock \\ &\quad -value\ of\ call\ on\ bond \\ &\quad +value\ of\ put\ on\ bond \end{aligned}$$

Note that simple option pricing models (like the Black-Scholes model) are unable such multiple options.

LOS 15.4.B.r: Compare the risk return characteristics of a convertible bond with the risk return characteristics of ownership of the underlying common stock.

- If the stock goes bust, the issuer will default on the convertible. However, the convert should get a higher recovery value than the stock.
- If the stock price declines or does not change, the convertible outperforms the stock because of coupon payments and the floor on the price.
- If the stock rises, the convertible will not fully participate. That's the price it has to pay for the protection on the downside.

Conclusion: you give up some upside, but get some protection on the downside.

15.7 Valuation of Interest Rate Derivative Instruments

LOS 15.4.C.a: Explain how the theoretical price of a futures contract is determined.

The theoretical price of a futures contract is determined on the basis of a no-arbitrage argument. Specifically, consider the following carry trade: (1) Sell a futures contract and (2) buy the underlying bond, using borrowed funds. Without loss of generality, we can assume a conversion rate of 1, financing costs of s, time to delivery of τ and a cash market price for the bond of P. A carry trade will yield a profit as long as interest earned plus capital gains is exceeds financing costs. Capital gains are locked in with the futures contract. Therefore, the carry trade is profitable, as long as

$$c \cdot \tau \cdot P + [F - P] > s \cdot \tau \cdot P$$

Because the carry trade is risk-free and no capital is invested, no-arbitrage requires that no profit is possible and therefore the > above should be replaced with a =. Solving for F then yields:

$$F = P + P \cdot \tau \cdot (s - c)$$

LOS 15.4.C.b: Compute the theoretical price of a Treasury futures contract.

Plug the bond price P, the financing rate s, the coupon rate c, and the time to delivery τ in the valuation formula

$$F = P + P \cdot \tau \cdot (s - c).$$

LOS 15.4.C.c: Explain how the theoretical price of a Treasury bond futures contract is affected by the delivery options.

The delivery (quality) option allows the short to chose from among a basket of bonds she can deliver. As market prices of the bonds in the basket do not move proportionately, this option has a value. The option is granted by the long to the short. Therefore, the value of a long futures contract is adjusted as

$$F = P + P \cdot \tau \cdot (s - c) - \textit{value of quality option}.$$

LOS 15.4.C.d: Explain the complications in extending the standard arbitrage pricing model to the valuation of Treasury bond and note futures contracts.

Standard arbitrage arguments are complicated in the case of futures because of

- the quality option: a choice among a basket of deliverable bonds
- the timing option: a choice of the delivery date
- the wildcard option

LOS 15.4.C.e: Compute the floating-rate payments for a swap.

$$\begin{array}{c}\textit{floating rate}\\ \textit{payment}\end{array} = \begin{array}{c}\textit{notional}\\ \textit{amount}\end{array} \times \begin{array}{c}\textit{3 month}\\ \textit{LIBOR}\end{array} \times \frac{\begin{array}{c}\textit{\# of days}\\ \textit{in period}\end{array}}{360}$$

LOS 15.4.C.f: Explain how the swap rate and swap spread are determined.

1. Calculate the cash flow stream of the floating leg. The cash flow stream can be estimated with the help of CD futures. For this, take the forward rate implied by the price of a CD futures contract ($f_{\tau-1,\tau} = \frac{100 - price\ of\ CD\ contract}{100}$). The future floating rate payment is then calculated by

$$\begin{array}{c}CF_{\tau,\textit{floating}}\\ =\end{array} \begin{array}{c}\textit{notional}\\ \textit{amount}\end{array} \times f_{\tau-1,\tau} \times \frac{\begin{array}{c}\textit{\# of days}\\ \textit{in period } \tau\end{array}}{360}$$

2. Calculate the discount factor to be used for each payments:

$$\delta_\tau = \prod_{t=1}^{\tau} \frac{1}{1 + f_{t-1,t}}$$

3. Determine the present value of all floating rate payments.

$$PV_{floating} = \sum_{t=1}^{\tau} \delta_\tau \cdot CF_{\tau,floating}$$

4. Calculate the swap rate by dividing the present value of all floating rate payments by the present value of a fixed 1% payment:

$$\begin{array}{c}\textit{swap}\\ \textit{rate}\end{array} = \frac{PV_{floating}}{\sum_{t=1}^{\tau} \left(\begin{array}{c}\textit{notional}\\ \textit{amount}\end{array} \times \frac{\begin{array}{c}\textit{\# of days}\\ \textit{in period } t\end{array}}{360} \times \delta_\tau \right)}$$

5. Calculate the swap spread

$$\begin{matrix}\textit{swap}\\\textit{spread}\end{matrix} = \begin{matrix}\textit{swap}\\\textit{rate}\end{matrix} - \begin{matrix}\textit{yield on comparable}\\\textit{treasury bond}\end{matrix}$$

In other words, the swap rate is found by equalizing the present value of the fixed leg with the present value of the floating leg. Also note that in theory, the present value of the floating leg should be zero at each reset date.

LOS 15.4.C.g: Describe how the value of a swap is determined.

A swap is valued by calculating the present value of all projected cash flows, i.e.

$$\begin{matrix}\textit{value of}\\\textit{swap}\end{matrix} = \begin{matrix}\textit{present value of}\\\textit{floating rate payments}\end{matrix} - \begin{matrix}\textit{present value of}\\\textit{fixed rate payments}\end{matrix}$$

LOS 15.4.C.h: Calculate the swap rate, swap spread, and value of a swap.

To calculate the swap rate and the swap spread, follow the procedure of LOS 15.4.C.f. For the value of the swap, use the formula of LOS 15.4.C.g.

LOS 15.4.C.i: Explain the two components of the option price and the factors that affect the value of an option.

Intrinsic value = the economic value of an option if it is exercised immediately. The intrinsic value is zero for options at and out of the money. It is positive for options in the money.

Time value = the difference between the price of the option and the intrinsic value. The time value is positive because the holder of an option has the hope that the underlying will move to the option's advantage.

Factors that affect the value of an option are:

- *Price of the underlying security:* the price of the underlying security directly affects the intrinsic value of the option.
- *Strike price:* the strike price determines the intrinsic value. The lower the strike price, the higher the intrinsic value of a call option.

- *Time to expiration:* the longer the time to expiration, the higher the time value of the option (the underlying security may move to the option's advantage).
- *Volatility:* the higher the volatility, the bigger the probability that the price of the underlying security will move in favor of the option.
- *Risk-free rate:* the higher the interest rate, the more attractive is it to hold an option rather than the underlying security; therefore, the higher the short-term interest rate, the higher the price of the option.
- *Coupon payments:* coupons represent negative cost of carry and drive down the price of an option.

LOS 15.4.C.j: Identify the limitations of using the Black Scholes option pricing model to value interest rate options.

- The price of the underlying in the Black-Scholes model is unbounded while interest rates are unlikely to fall below zero.
- The Black-Scholes model assumes constant interest rates, but changes in short-term rates are the driver of bond prices.
- The Black-Scholes model assumes constant volatility, but the volatility of a bond decreases as the bond approaches maturity.

LOS 15.4.C.k: Compute the price of an option on a bond using the arbitrage-free binomial model.

The procedure is very similar to the valuation of bonds with embedded options:

1. Start with an interest rate tree.
2. Determine the value of the option at the last node. This is simple for call (max[0, *end price of unde* *strike price*]) and put (max[0, *end strike price* − *price of underlying*]) options.
3. Then go one level back and calculate the probability-weighted present value of the preceding node. Attaching a 50% risk- neutral probabilities to each path, the theoretical price at each node can be calculated as

$$P^*_{\dots} = \frac{1}{2} \cdot \left[\frac{P^*_{\dots L}}{1 + s_{1,\dots}} + \frac{P^*_{\dots H}}{1 + s_{1,\dots}} \right]$$

4. Continue until you reach P^*.

LOS 15.4.C.l: Discuss the Black model for valuing options on futures.

The Black model is the most popular model for pricing short-dated options on treasury futures. Unfortunately, the model was not developed for this use but rather for valuing commodity futures. Using it in the context of treasury futures, it has the following problems:

- Like the Black-Scholes model, it relies on a constant short rate and volatility.
- The Black model has been developed for European style options while treasury options are American style.

LOS 15.4.C.m: Explain how to measure the sensitivity of an options value to the changes in the factors that affect the options value.

The sensitivity of an option's value is measured by the Greeks:

Delta measures the sensitivity of the option with respect to the underlying. It can be thought of as an equivalent to duration. The delta of a call is always positive and the delta of a put always negative. If the option is far out of the money, delta will be close to zero; if the option is deep in the money, it will be close to one.

$$\delta = \frac{\partial P^*_{option}}{\partial P_{underlying}} = \frac{change\ in\ option\ price}{change\ in\ price\ of\ underlying}$$

Gamma measures the sensitivity of delta with respect to the underlying. It can be thought of as a convexity measure.

$$\gamma = \frac{\partial^2 P^*_{option}}{\partial P^2_{underlying}} = \frac{change\ in\ delta}{change\ in\ price\ of\ underlying}$$

Theta measures how much the (time) value of the option declines as the time to the exercise date declines. A high theta is bad for the investor.

$$\theta = \frac{\partial P^*_{option}}{\partial t} = \frac{change\ in\ option\ price}{change\ in\ time}$$

Kappa alias vega measures the sensitivity of the option price with respect to changes in volatility. Kappa will always be positive.

$$\kappa = \frac{\partial P^*_{option}}{\partial \sigma} = \frac{change\ in\ option\ price}{1\%\ change\ in\ volatility}$$

LOS 15.4.C.n: Compute the value of an interest rate cap or floor using the arbitrage-free binomial model.

1. Strip the n-period interest cap or floor in n caplets or floorlets.
2. Determine the value of each caplet or floorlet at the last node of an interest rate tree.

$$P^{(i)}_{\dots} = \begin{cases} \mathit{notional} \cdot [\max(\mathit{0}, \mathit{floor} - s_{\dots})] & \mathit{for\ floorlets} \\ \mathit{notional} \cdot [\max(\mathit{0}, s_{\dots} - \mathit{cap})] & \mathit{for\ caplets} \end{cases}$$

3. Determine the theoretical value of each caplet or floorlet with by backward induction.

$$P^{(i)}_{\dots} = \frac{1}{2} \cdot \left[\frac{P^{(i)}_{\dots L}}{1 + s_{1,\dots}} + \frac{P^{(i)}_{\dots H}}{1 + s_{1,\dots}} \right]$$

   Continue until you reach $P^{(i)}$.

4. The value of the cap or floor is the sum of the caplets or floorlets, respectively.

$$P^{*} = \sum_{i=1}^{n} P^{(i)}$$

Study Session 16

Debt Investments: Structured Securities and Trading Strategies

16.1 Mortgage-Backed Securities

LOS 16.1.A.a: Describe a mortgage loan.

Mortgage loan = *loan secured by the collateral of some specified real estate property.*

If the borrower defaults, the holder of the mortgage loan may 'foreclose' on the loan and seize the property in order to ensure that the debt is paid off. Conventional mortgages are those in which the conditions are based on the credit quality of the borrower and the collateral.

Various mortgage designs exist, but the most common version is the fixed-rate, level-payment, fully amortized mortgage.

LOS 16.1.A.b: Describe the cash flow characteristics of a fixed-rate, level payment, fully amortized mortgage loan.

Under a fixed-rate, level payment, fully amortized mortgage loan, the borrower pays equal installments over the term of the mortgage. Each payment can be separated into:

- Interest on the outstanding balance (monthly 1/12 of the annual rate).
- A partial repayment of principal (= scheduled amortization).

Over time, the partial repayments lead to a decline in the outstanding amount. Therefore, the interest part declines and the share of the repayment increases accordingly.

LOS 16.1.A.c: Describe prepayments and how they result in prepayment risk.

Prepayments are payments in excess of the monthly mortgage payments. Homeowners often repay part or all of their mortgages prior to maturity date. A prepayments of less than the total outstanding mortgage is called a curtailment.

For the loan holder, prepayments make the cash flow stream (timing and amount) uncertain. This uncertainty is called prepayment risk.

LOS 16.1.A.d: Explain the investment characteristics of mortgage passthrough securities.

Mortgage passtrough securities are shares in a pool of mortgages. Such pools typically consist of hundreds or thousands of mortgages. By inclusion in a mortgage pool and the issuance of tradable shares, mortgages are securitized.

¿From an investment perspective, mortgage passtrhough securities are diversified investments in mortgages. The investment is still subject to unmitigated prepayment risk.

The investor will receive a passthrough coupon rate that is equal to the mortgage rate of the underlying pool minus servicing (cost of administrating the pool) and guaranteeing (insurance cost against houseowner defaults) fees.

LOS 16.1.A.e: Explain the importance of prepayments to the estimation of the cash flow of a mortgage-backed security.

Prepayments effectively shorten the timing of payments. They are, to a high degree, uncertain. In order to know the cash flow stream of a mortgage-backed security, assumptions about prepayments have to be made.

LOS 16.1.A.f: Compute the weighted average coupon and weighted average maturity of a mortgage pool.

$$Weighted\ average\ coupon\ (WAC) = \sum_{i=1}^{\#\ of\ mortgages} \frac{Coupon_i \cdot Balance_i}{Total\ balance\ of\ pool}$$

$$Weighted\ average\ maturity\ (WAM) = \sum_{i=1}^{\#\ of\ mortgages} \frac{Maturity_i \cdot Balance_i}{Total\ balance\ of\ pool},$$

where maturity is generally measured in months to maturity.

LOS 16.1.A.g: Explain a conditional prepayment rate and a single monthly mortality rate.

Conditional prepayment rate (CPR) = *the assumed prepayment rate of a pool, based on its characteristics (e.g. historical prepayment experience) and the current and expected future economic environment.*

CPR is an annual prepayment rate. To convert it into its monthly analog, the single-monthly mortality rate (SMM), use the formula

$$SMM = 1 - (1 - CPR)^{1/12}$$

LOS 16.1.A.h: Describe the Public Securities Association (PSA) prepayment benchmark and its relationship to the conditional prepayment rate.

The PSA prepayment benchmark provides an assumed prepayment structure against which actual prepayments of a pool can be compared. It assumes the following:

- if $t < 30$, $CPR_{PSA} = .2\% \cdot t$
- if $t \geq 30$, $CPR_{PSA} = 6\%$

where t is the number of months since inception of the pool. In words: the PSA assumes that the CPR increases by 0.2% per month until it reaches 6% after five years; it stays at this level until final maturity.

The conditional prepayment rate of a mortgage pool can be calculated on the basis of PSA. For example, a pool with 150% PSA has a $CPR_{150\%} = 1.5 \cdot CPR_{PSA}$

LOS 16.1.A.i: Calculate the prepayment amount for a month, given the single monthly mortality rate.

$$prepayment_t = SMM_t \cdot [Balance_{t-1} - Scheduled\ amortization_t]$$

LOS 16.1.A.j: Identify the factors that affect prepayments.

Prevailing mortgage rate: If the mortgage rate falls, the incentive to refinance increases. Homeowners will refinance their mortgage (repay their mortgage and get a new and cheaper one) if the spread between new and old rates exceeds the legal and administrative cost of the refinancing exercise (in practice about 300 bps). The path mortgage rates have taken is also important (if mortgage rates were low in the past, houseowner who can afford it may already have refinanced their mortgages (= refinancing burnout). Finally, the mortgage rate affects housing turnover. A low rate increases turnover and thereby prepayments.

Characteristics of the pool: Prepayment rates depend on the contract rate, the degree of agency guarantee, seasoning, the type of the loan and the geographical location of the houses.

Seasonal factors: Because of home buying activities, prepayments are low in the winter and high in late summer.

Economic activity: When GDP grows fast, homeowners will move into bigger houses and repay their mortages

LOS 16.1.A.k: Explain contraction and extension prepayment risks and why they occur.

Contraction risk: When interest rates fall, prepayments increase, basically shortening the 'duration' of the security when it would be nice to have a long 'duration'. At the same time, prepayments must be invested at a lower rate.

Extension risk: When interest rates rise, prepayments slow down, basically extending the 'duration' of the security when it is most harmful. Cash flows occur further in the past and have to be discounted at a higher interest rate.

LOS 16.1.A.l: Explain why the average life of a mortgage-backed security is a more relevant measure than the securitys maturity.

$$Average\ life = \sum_{t=1}^{T} \frac{t \times Projected\ principal\ received\ at\ t}{12 \times Total\ principal}$$

Average life is a more useful measure than maturity because it takes into account projected prepayments.

LOS 16.1.A.m: Explain why and how a collateralized mortgage obligation (CMO) is created and distinguish among the different types of CMO structures (including sequential-pay tranches, accrual tranches, floater tranches, inverse floater tranches, planned amortization class tranches, support tranches, and support tranches with schedules).

Collateralized mortgage obligations (CMO) are created in order to redirect cash flows of mortgage-related products in way that the resulting security better corresponds to the needs of potential investors. CMOs do not eliminate repayment risk, they just redistribute it among different classes of bondholders. The most common classes include:

Sequential pay tranches: The pool issues a sequence of tranches. All repayments first flow to the first tranche until it is fully repaid. Then, all repayments go to the second tranche, and so on. The period during which a tranche receives disbursements from repayments is called the principal pay down window. For the investor, uncertainty as to repayments is somewhat reduced, but not eliminated: he knows the rules of disbursements, but actual cash flows still depend on uncertain repayments.

Accrual tranches (Z-bonds): Instead of receiving interest each month, interest on accrual tranches is added to the principal. The cash saved this way is paid to the other tranches. The inclusion of an accrual tranche in a CMO allows to shorten effective average life of the other tranches.

Floating and inverse floating tranches: Fixed-rate tranches can be split into a floating tranche and an inverse floating tranche (any change in interest rates is absorbed by the offsetting effect on the two tranches). Compared to a normal floater, floating and inverse floating tranches in CMOs have declining principal balances and are subject to repayment risk.

Planned amortization class (PAC) tranches: For a given range of the prepayment speed (e.g. PSA 90-300), a minimum principal payment can be calculated. It is then possible to define a tranche with an amortization schedule within the limits set by these minimum principal payments. This planned amortization class has priority over all other tranches in the CMO. As long as the speed of repayment remains within the limits of the PSA range (known as the inital collar) the planned amortization will be satisfied. The shorter the PAC window (the period in which the PAC receives principal repayments), the more it resembles a normal bond.

Support tranches: The downside of the PSA construction is that other tranches have to carry the repayment risk within the PSA range. These support tranches are subject to increased repayment risk, in particular within the initial collar of the PAC.

Support tranches with schedules: Within the support tranches, it is possible to redistribute repayment risk analogously as in the overall structure. Like the PAC supported by the support tranche, additional layers of PAC structures within the support tranche are created. These are normally called PAC II tranche or Level II PAC tranche or scheduled tranche. Level III works accordingly.

LOS 16.1.A.n: Describe how a CMO distributes prepayment risk among tranches so as to create products that provide a better matching of assets and liabilities for institutional investors.

CMOs distribute prepayment risk by establishing rules for the disbursement of repayments among tranches. Institutional investors with long-term liabilities are unhappy with the contraction risk in passtroughs. They prefer the later sequential-pay tranches because a lot of the accelerated prepayment is absorbed by the first tranches. Similarly, institutional investors with short-term liabilities prefer the first sequential-pay tranche because it contains little extension risk.

LOS 16.1.A.o: Explain, for planned amortization class (PAC) tranches, the initial PAC collar and the effective collar.

Initial collar = the collar used in the initial calculation of the PAC. It gives a range for the repayment speed (e.g. PSA 90-300) for which minimum principal repayments are sufficient to meet the amortization schedule of the PAC. As long as repayments over the life of the structure remain in the PAC, amortizations will be distributed as planned. However, this is only true if the amortization speed does not change! If repayments fluctuate within the band of the initial collar, principal repayments in a given period may fall below the minimum required to meeet the amortization schedule of the PAC.

Effective collar = the range within which repayment speeds can fall before repayments fall below the minimum required by the PAC. The effective collar differs from the initial collar for the following reason

- Several layers of PACs (PACs with different PAC windows) give additional protection for the shorter PACs: the support tranches in the initial collar are calculated for all tranches.
- Past repayment patterns affect the size of the support tranche and thereby the effective protection provided.
- If a high repayment speed in the past has eliminated all support tranches, the effective collar has disappeared and the PAC is said to be bused or broken.

LOS 16.1.A.p: Explain why the support tranches have the greatest prepayment risk in a CMO structure.

PAC structures effectively transfer repayment risk from the PAC to the support tranches. This is because the PAC has priority in the disbursement of all principal payments. The support tranches only get the residual value.

LOS 16.1.A.q: Explain stripped mortgage-backed securities, principal mortgage strips (principal-only securities), and interest mortgage strips (interest-only securities).

Stripped mortgage backed securities divide the mortgage payments in their two parts:

- All principal payments (scheduled and prepayments) go to the holders of principal-only securities.
- All interest payments go to the holders of interest-only securities.

LOS 16.1.A.r: Explain the investment characteristics of principal-only and interest-only mortgage strips.

Principal-only (PO) securities receive all principal payments from a mortgage pool. Setting defaults aside, the absolute non-discounted value of the cash flows is known in advance (the total principal). Prepayments only affect the timing of the cash flows. Principal-only securities react particularly strongly to a fall in interest rates: (1) A fall in interest rates leads to faster repayments. If the prepayment speed increases, cash flows come in earlier. (2) All cash flows can be discounted at a lower rate. The two effects together lead to a higher present value of the cash flow stream.

Interest-only (IO) securities receive all interest payments from a mortgage pool. Interest payments only accrue as long as the principal is not repaid in full. If the repayment speed increases, the absolute non-discounted cash payments are reduced. Consequently, the price of IO increases when interest rates increase.

LOS 16.1.A.s: Compare and contrast agency and nonagency mortgage-backed securities.

Agency mortgage-backed securities = MBS issued by federal agencies: Government National Mortgage Association (Ginnie Mae), Federal Home Loan Mortgage Corporation (Freddie Mac), and Federal National Mortgage Association (Fannie Mae). In order to be included in an agency MBS, mortgages must be conforming, i.e. they must meet certain criteria concerning the maximum loan-to-value ratio, the payment-to-income ratio and the loan amount.

Nonagency mortgage-backed securities = mortgage-backed securities issued by entities other than federal agencies. The mortgage loans in these pools are generally nonconforming. From an investor standpoint, the biggest difference to an agency MBS is the *absence of explicit or implicit government guarantee.* To overcome this lack of guarantee, nonagency securities are credit enhanced.

16.2 Asset-Backed Securities

LOS 16.1.B.a: explain the difference between amortizing assets and non-amortizing assets and why the former may have prepayments.

Amortizing assets = loans with regular interest and principal repayments (the balance declines over time). The schedule of repayments is called the amortization schedule. Payments made in excess of the amortization schedule are called prepayments. Curtailments are prepayments of only a part of the outstanding balance. Prepayments occur because the borrower (usually mortgages, auto-loans or home-equity loans) have a right to pay back the loan before maturity and in the case defaults (involuntary payments = proceeds recovered in the event of a default prior to the scheduled principal repayment).

Non-amortizing assets = loans without an amortization schedule. Instead, the borrower makes a minimum periodic payment. Examples include credit card receivables and some home-equity loans.

LOS 16.1.B.b: Explain the difference between an external and internal credit enhancement.

All asset-backed securities are credit enhanced.

External credit enhancements = third-party guarantees that provide protection against a loss up to a specified level (e.g. 10%). External credit enhancements provide 'first loss protection' before internal protection is used. They include corporate guarantees, letters of credit and bond insurance.

Internal credit enhancement = enhancements in the credit quality of an issue by the structure of the issue. The most common forms are reserve funds and senior-subordinated structures.

LOS 16.1.B.c: Explain the different types of external credit enhancements (corporate guarantees, letter of credit, and bond insurance) and the problems associated with enhancing by means of third-party guarantors.

External credit enhancement takes the forms:

- corporate guarantee (a guarantee, generally by the sponsor, to assume a certain amount of losses)
- letter of credit from a bank
- bond insurance (similar to municipal bonds, but only for a certain part of the issue)

With external credit enhancements, the credit quality of the issue will depend on the credit quality of the guarantor. Rating agencies use a weak link test according to which the credit quality of the issue is only as good as the weakest link in credit enhancement, regardless of the quality of underlying loans.

LOS 16.1.B.d: Explain the different types of internal credit enhancements (reserve accounts and senior-subordinated structures).

Reserve accounts = funds set aside to ensure payment of principal and interest. The two most common forms are cash reserve funds (straight deposits of cash generated by issuance proceeds) and excess servicing spread accounts (an excess servicing spread between gross weighted average coupon and net weighted average coupon, net of servicing and other fees, is levied and put aside in a reserve account).

Senior-subordinated structures = non-senior tranches absorb all losses before the senior tranches suffer. In practice, non-senior tranches consist of several levels of subordination. The lowest level is called the first loss tranche. Because of prepayments, protection can change over time; for this reason, a shifting interest mechanism is used in order to ensure the protection of senior tranches. Senior-subordinated structures distribute credit risk among different tranches.

LOS 16.1.B.e: Describe, and explain the purpose of, a shifting interest mechanism in a senior-subordinated structure.

Because of prepayments, protection can change over time. The shifting interest mechanism should ensure that the protection of the senior tranches is ensured, i.e. that the distribution of prepayments does not reduce the amount of protection.

The mechanism works as follows. A senior prepayment percentage (= the percentage of prepayments paid to senior tranches) is defined. The prospectus defines a base schedule for the senior prepayment percentage. If level of subordination (= subordinate interest; balance of of subordinate tranche relative to the balance of the entire deal) deteriorates, the base is overridden and a higher allocation is made to senior tranches.

The presence of a shifting interest mechanism results in a trade-off between credit risk and contraction risk protection for the senior tranche.

LOS 16.1.B.f: Distinguish between a pass-through structure and a pay-through structure.

Pass-through structure = structures in which each certificate holder receives a pro rata share of cash flows from the underlying pool of loans or receivables.

Pay-through structure = structures with different tranches and seniority. Tranches can be structures to distribute credit risk (senior-subordinated) or prepayment risk (PAC, support tranches).

LOS 16.1.B.g: Describe the cash flow for securities backed by closed-end home equity loans, open-end home equity loans, manufactured housing loans, student loans, and Small Business Administration loans.

Closed-end home equity loans = loans collateralized by proprerty, that do not conform to Ginnie Mae, Fannie Mae, or Freddie Mac, because of an impaired credit history of the borrower or because of the borrower's payment-to-income ratio. Closed-end home equity loans generally have lower prepayments than conforming mortgages.

Open-end home equity loans = credit lines collateralized by property. The borrower, rather than receiving cash, receives a credit line that he can draw upon (e.g. by credit card or checks). Open-end home equity loans are revolving lines.

Manufactured housing loans = loans backed by manufactured homes. ABS based on manufactured housings are issued by Ginnie Mae vie the Federal Housing Administration or the Veterans Administration (both are government guaranteed). Other loans, called conventional manufactured housing-backed securities, are issued by private entitities.

Student loans = loans made to cover college cost and vocational training. Most of the securitized student loans are guaranteed by the Federal Family Education Loan Program (FFELP) and therefore virtually free of default risk. Student loans have a deferment period (during study program), a grace period (just after completion of studies), and a pay down period. Prepayments occur due to defaults or loan consolidation (students with more than one loan outstanding combine them into a single loan). Student loan prepayments are quite insensitive to the level of interest rates.

Small Business Administration (SBA) loans = loans approved by the SBA. They are guaranteed by the US government. SBA-backed securities receive monthly payments (interest, scheduled amortization and prepaymens). The level of prepayments is highest for short maturities.

LOS 16.1.B.h: Explain a prospectus prepayment curve for home equity loan-backed securities.

The prospectus prepayment curve (PPC) has a similar function as the PSA benchmark for mortgage backed securities: it is used as a base case prepayment assumption against which actual prepayments can be measured and for the structure of PAC tranches. CPRs can be expressed relative to the PPC (e.g. 150% PPC) and be translated into monthly prepayment rates.

Contrary to the PSA, the PPC is not generic but specific to the issue. It is based on borrower characteristics and the seasoning process.

LOS 16.1.B.i: Explain why an available funds cap exists when securities are backed by adjustable-rate home equity loans.

- Mismatch in reference rate: Home equity loans that pay a floating rate, generally have reference rates of 6-month LIBOR, but the security is referenced to 1-month LIBOR in order to attract institutional investors.

- Caps on underlying loans: Home equity loans generally have caps on their rates.

Contrary to normal caps, the effective periodic and lifetime cap (= available funds cap) of a HEL floater is variable, depending on the net funds generated by the pool.

LOS 16.1.B.j: Describe a non-accelerating senior tranche and a planned amortization class tranche in a home equity loan-backed structure.

Non-accelerating senior tranche = tranche that receives an increasing share of principal payments. A schedule defines the evolution of the share over time (e.g. 0% of all prinicpal payments the first 36 months, 45% the next 24 months etc.). The fast repayment in later tranches reduces contraction risk.

Planned amortization class (PAC) = tranche with priority on principal payments over all other classes. The presence of support tranches effectively ensure that the planned amortization is possible within a certain band of amortization speed (the initial collar). Over time and several layers of PACs lead to differences in between initial and effective collars. If a high speed of amortization in earlier periods has eliminated the support tranches, the PAC is said to be broken.

LOS 16.1.B.k: Explain why prepayments that result from refinancing may not be significant for manufactured housing-backed securities and automobile loan-backed securities.

Repayments on manufactured housing-backed loans and auto loans are not sensitive to refinancing. Explanation:

- Loan balances are small. Therefore, refinancing gains are small relative to administrative and legal costs.
- Depreciation on manufactured homes and cars is high. Therefore, it will be hard to use them as collateral in a refinanced loan.
- The credit quality of a typical manufactured house buyer is generally low.

LOS 16.1.B.l: Explain an absolute prepayment rate and a conditional prepayment rate.

Conditional prepayment rate (CPR) = prepayment rate based on the prior months balance. The monthly SMM is normally derived from the annual CPR.

Absolute prepayment speed (ABS) = monthly prepayment expressed as a percentage of the original collateral amount. The link between ABS and SMM is given by

$$SMM = \frac{ABS}{1 - [ABS \cdot (M-1)]} \Leftrightarrow ABS = \frac{SMM}{1 + [SMM \cdot (M-1)]},$$

where M denotes the number of months after loan origination.

LOS 16.1.B.m: Describe the structure of a credit card receivable-backed security, including the lock-out period and the principal-amortization period.

Banks (VISA, MasterCard), Retailers (JC Penny) and travel and entertainment companies (American Express) transfer their credit card receivables to a master trust. For this, they randomly select receivables from their entire portfolio of receivables. Each trust can have several series of credit card receivables-backed securities outstanding. The series share in the cash flow from the pool of receivables. Each time a new series is issued, more receivables are randomly selected and added to the trust.

The pool of receivables generates cash flows in the form of interest, fees and principal. The trust uses the cash to pay periodic interest to security holders.

Principal payments are treated as follows

- In the *lockout / revolving period*, principal payments are retained by the trustee and reinvested in additional receivables. The lockout period can vary from 18 months to 10 years. A credit card receivable-backed security is nonamortizing in this period.
- In the *principal-amortization period*, principal is no longer reinvested but paid to investors. Amortization can take several forms: In a passthrough structure, cash flows are paid out on a pro rata basis. In a controlled-amortization structure, a scheduled principal amount is established, similar to a PAC. Finally, in a bullet-payment structure, security holders receive the entire amount in one distribution. In order to meet the cash flow needs for a bullet structure, the trustee places principal payments in an accumulation period (a couple of months before principal is due on the security) into an account. This structure is also called a soft bullet.

LOS 16.1.B.n: Explain the early amortization trigger for a credit card receivable-backed security.

Early amortization or rapid amortization provisions provide for early amortization in order to safeguard the credit quality in the event of a poor performance of the pool of receivables. Typically, early amortization allows for the rapid return of principal if 3-month average excess spread earned on receivables falls to zero or less. When early amortization occurs, the most senior tranche is paid out first.

LOS 16.1.B.o: Describe the basic structure of a collateralized bond obligation (CBO), including the types of bonds used as collateral and the types of tranches created.

A collateralized bond obligation (CBO) is an ABS backed by a diversified pool of non-investment grade bonds, emerging market bonds, and / or bank loans. CLOs are a subgroup of CBO, backed by loans. Typically, CBOs are structured in a senior tranche (normally floating), different layers of subordinate or junior tranches (normally fixed), and an equity piece.

An asset manager is responsible for the managing the CBO. In order to maintain a given rating, restrictions are imposed as to what the asset manager may do and what he may not do. Over the life of the CBO, the asset manager must ensure that certain test or covenants are met.

LOS 16.1.B.p: Explain why the manager of a CBO must use interest rate derivatives.

Interest rate swaps are used to match the fixed / floating structure of the CBO with the cash flow generated by the collateral. In a typical CBO, the collateral pays a fixed rate. On the liability side, while junior tranches pay fixed, senior tranches generally pay floating. If the CBO did not use swaps, it would be subject to variations in the reference rate for the senior tranche. The interest swap is a hedge against such fluctuations.

Example: Use collateral yielding 10% (= Swap + 450 bps). 80% senior tranche LIBOR + 50 bps, 20% junior tranche 9%; use a swap, notional equal to the size of the senior tranche, pay fixed, receive floating → margin on transaction $= 80\% \cdot (450 - 50) + 20\% \cdot 100 = 52bps$. As long as defaults are below .52%, equity is positive.

LOS 16.1.B.q: Explain the different periods in the life of a CBO: start-up phase, reinvestment phase, and pay down phase.

In the past, CBOs were often based on an active trading of bonds. In the late 1980s and early 1990s, the high-yield sector performed very poorly. This created problems for the old CBO structures. Today, CBO structures are timed in three phases:

1. *startup or ramp phase*: assemble the original portfolio
2. *reinvestment phase:* reinvest principal payments and coupon in excess of coupon paid out to security holders

3. *pay down phase:* pay back principal to the security holders

16.3 Valuing MBS and ABS

LOS 16.1.C.a: Explain how to compute the cash flow yield of a mortgage-backed or asset-backed security.

1. Make an assumption on prepayments.
2. Construct a corresponding cashflow stream.
3. Calculate the internal rate of return.

LOS 16.1.C.b: Compute the bond-equivalent yield of a cash flow yield.

$$\textit{bond equivalent yield} = 2 \cdot \left[(1 + y_{monthly})^6 - 1\right]$$

LOS 16.1.C.c: Discuss the limitations of the cash flow yield measure.

- If the projected cash flow does not materialize (faster or slower prepayments), the cash flow yield will be wrong.
- Projected cash flows are assumed to be reinvested at the cash flow yield. However, the reinvestment rate may change.
- The cash flow yield uses a single discount rate rather than spot rates.

LOS 16.1.C.d: Explain the limitations of the nominal spread and the zero-volatility spread for a mortgage-backed security.

Nominal spread = difference between the cash flow yield of the security and the yield on a treasury. Has all the problems of the cash flow yield. In addition, *it masks the fact that a part of the additional yield compensates the investor for accepting prepayment risk.*

Zero-volatility spread = a measure of the spread that, contrary to the nominal spread, uses the spot rate for discounting each projected cash flow. If the curve is flat or the security has a short maturity, the zero-volatility spread will be close to the nominal spread. Like the nominal spread, the zero volatility spread depends on a cash flow assumption and does not explicitly model prepayment risk.

LOS 16.1.C.e: Describe the Monte Carlo simulation model for valuing a mortgage-backed security.

1. Determine a term structure of volatilities.
2. Build an interest rate tree that ensures arbitrage-free prices for a base curve (treasury or swap rates). Adjust the tree to ensure arbitrage-free paths for Monte-Carlo simulations (vendors will do this for you, but they don't tell you how to do it in detail).
3. Generate a possible interest rate path for the base rate.
4. Translate the base rate at each node in a refinancing rate and feed it into a prepayment model. This will give you the cash flow at this node.
5. Calculate the spot base rate used for discounting each node, by aggregating the interest rate path up to the node:

$$z_\tau = \left[\prod_{\imath=1}^{n} (1 + s_{1,i}) \right]^{1/n} - 1$$

6. Calculate the present value of the interest rate path:

$$PV_p = \sum_{\tau=1}^{n} \frac{CF_\tau}{(1 + z_\tau + spread)^\tau},$$

where the spread is taken from observed spreads in other issues.

7. Repeat steps 3 to 6 N times. Note that N can be kept relatively low, if you are able to generate so-called representative paths (this is done with help of certain statistical techniques).
8. Value the security as the average present value of the N paths.

$$P^* = \frac{1}{N} \sum_{p=1}^{N} PV_p$$

LOS 16.1.C.f: Explain why the binomial model or any other model that uses the backward induction method cannot be used to value a mortgage-backed security.

Prepayments in a mortgage-backed security are *interest-path dependent.* This feature is not captured by backward induction (backward induction starts at the end of the path without bothering how the interest rate got there).

LOS 16.1.C.g: Explain the critical assumptions of the Monte Carlo simulation model.

- You must make an assumption about the volatility in the short rate in order to construct the interest rate tree.
- You need a prepayment model in order to get the cash flow stream.
- You must make an assumption about the fair OAS spread.

LOS 16.1.C.h: Explain why the Monte Carlo simulation model without adjustments to the interest rate paths does not provide an arbitrage-free value.

Binomial models are explicitely built to ensure arbitrage-free values. On the other hand, the way the Monte Carlo model is built includes nothing that ensures arbitrage-free values (it just generates interest rate paths based on some stochastic process). Therefore, the builder must make an arbitrary adjustment to the interest rate paths to get the model to be arbitrage free.

LOS 16.1.C.i: Explain how the option-adjusted spread is computed using the Monte Carlo simulation model and how this spread measure is interpreted.

Each path in the Monte Carlo simulation has a given cash flow stream and correpsonding base rates. The present value of each path is then calculated by the formula

$$PV_p = \sum_{\tau=1}^{n} \frac{CF_\tau}{(1 + z_\tau + spread)^\tau}.$$

The OAS is the level of the spread that sets the average present value of all N paths to the market rate, $\frac{1}{N}\sum_{p=1}^{N} PV_p = P_{market}$. In other words, the OAS reconciles the theoretical value with market price.

LOS 16.1.C.j: Apply option-adjusted spread analysis to value mortgage-backed securities and identify rich and cheap securities.

Calculate the OAS of different bonds or tranches and compare their OAS. For a given credit risk, securities with a high OAS are cheap and securities with a low OAS are rich. Sometimes, a tranche is rich because it offers a high nominal / zero-volatility yield (maybe because some dummies do not understand that the high nominal yield simply reflects high prepayment risk).

LOS 16.1.C.k: Explain how effective duration is computed using the Monte Carlo simulation model.

To get an effective duration, the current *base yields* (i.e. the treasury or the swap curve used in the Monte Carlo simulation) is shocked up and down. The duration is then calculated with the usual formula $D_{effective} = \frac{P_- - P_+}{2 \cdot P_0 \cdot \Delta y}$. Note that the calculation of P_- and P_+ assumes that *the term structure of volatilities and the spread do not change.*

LOS 16.1.C.l: Discuss some major assumptions that result in differences in effective durations reported by dealers and vendors.

Calculations differ because of:

- differences in the rate shocks
- differences in prepayment models
- differences in the assumed relationship between base rates and refinancing rates
- differences in the term structure of volatilities
- differences in OAS assumptions (which depends on the models and the inputs)

LOS 16.1.C.m: Explain other measures of duration used by practitioners in the mortgage-backed market (including cash flow duration, coupon curve duration, and empirical duration) and discuss the limitations of these duration measures.

Cash flow duration = a measure for the sensitivity of the cash flow yield with respect to a change in the base rate. The calculation of cash flow duration takes into account changes in prepayment rates, but does so in a naive way (it assumes a single prepayment rate over the life of the security). Despite its lack of sophistication, compared to Monte Carlo simulation, it is used widely and cited quite often.

Coupon curve duration = a duration measure based on market prices of similar bonds with different coupons. You obtain it by using the normal duration formula, setting P_0 to the current market price (e.g. for the 7% coupon bond), P_- to the price of a bond with 1-percentage point higher coupon (e.g. the 8% coupon bond) and P_+ to the price of a bond with 1-percentage point lower coupon (e.g. the 6% coupon bond). Although this measure seems to work quite will in practice, you only get the necessary data for generic mortgage-backed securities.

Empirical duration = a duration measure based on regression analysis of historical market prices on historical yields. The model is a-theoretical, easy to compute and relatively reliable. On the other hand, price histories for mortgage-backed securities may be hard to obtain. Moreover, the approach does not take into account different structures of the embedded options and time-varying volatilities.

LOS 16.1.C.n: Explain how to compute the cash flow duration for a mortgage-backed security and compare this measure with the (1) modified duration and (2) effective duration measures that result from using the Monte Carlo simulation model.

1. Calculate the cash flow stream based on your prepayment model.
2. Calculate the cash flow yield, y_0.
3. Shock the cash flow yield by Δy up and down to obtain $y_+ = y_0 + \Delta y$ and $y_- = y_0 - \Delta y$.
4. Using a prepayment model, calculate the new cash flow stream for the up and down scenario.
5. Calculate P_+ and P_- by applying discounting the cash flow streams with y_+ and y_-, respectively.
6. Plug all the data in the usual duration formula:

$$D = \frac{P_- - P_+}{2 \cdot P_0 \cdot \Delta y}$$

Cash flow duration is more accurate than modified duration because it allows for a change in the cash flow stream. In fact, the only thing that changes with respect to the calculation of modified duration is the change in cash flows. On the other hand, cash flow duration is less sophisticated than the effective duration measure obtained from a Monte Carlo simulation. Cash flow duration is based on a naive assumption about how prepayments may change. Therefore, effective duration is superior to cash flow duration.

LOS 16.1.C.o: Determine when an asset-backed security should be valued using the zero-volatility spread approach or the option-adjusted spread approach (using Monte Carlo simulation).

Zero-volatility spread approach: This approach *does not consider the prepayment option.* It can be used for ABS without prepayment options or ABS with prepayment options that are unlikely to be exercised (e.g. borrowers do not exhibit a tendency to refinance when the refinancing rate falls below the loan rate).

Option-adjusted spread approach: The approach is computationally intensive but has the advantage that it *considers the prepayment option.* It can be used for all ABS. In practice, it is used for ABS with embedded options that are expected to be exercised if it makes economic sense for the borrower to do so.

LOS 16.1.C.p: Determine whether the nominal spread, zero-volatility spread, or the option-adjusted spread should be used to evaluate a specific fixed income security.

- For *option-free bonds*, the z-spread approach should be used (the nominal spread can be used for bonds that have similar cash flows as the benchmark).
- For bonds with embedded options where the *cash flow is not interest path dependent* (e.g. callable or putable bond), the OAS spread based on a binomial model can be used.
- For bonds with embedded options where the *cash flow is interest path dependent* (e.g. mortgage-backed securities with a prepayment option), the OAS spread based on Monte Carlo simulation should be used.

16.4 A Framework for Assessing Trading Strategies

LOS 16.1.D.a: Explain leverage and the advantages and disadvantages of leverage.

Leveraging = *investment principle of borrowing funds in the hope of earning a return in excess of the costs of funds.* An investor using leverage borrows funds and invests them. His return is equal to the return on the investment minus the interest on borrowed funds.

Leverage basically magnifies any return in excess of funding costs. The advantage is that if investment returns are bigger than funding costs, the investor makes an additional profit. The disadvantage is that if investment returns are below funding costs, the investor makes a loss.

LOS 16.1.D.b: Compute and evaluate the effects of leverage on a trading strategy.

$$\begin{aligned} profit &= investment \times investment\ return \\ &\quad -borrowed\ funds \times borrowing\ rate \end{aligned}$$

LOS 16.1.D.c: Explain a repurchase agreement.

Repurchase (repo) agreement = *the sale of a security with a commitment by the seller to bay the same security back from the purchaser at a specified price (the repurchase price) at a designated future date (the repurchase date).* When a dealer uses a repo agreement to borrow funds, the dealer is said to do a *repo transaction.* If a non-dealer entity (e.g. a portfolio manager) uses a repo agreement to borrow funds, i.e. the dealer uses the repo agreement to borrow securities, the non-dealer entity is said to do a *reverse repo transaction.* The terms 'reversing out securities' and 'repo securities' are used to describe the action of lending securities and borrowing cash. On the other hand, the terms 'reversing in securities' and 'do repo' are used to describe the action of borrowing securities and lending cash.

From a financial point of view, a repurchase agreement is a *collateralized loan.* The interest rate applied to the loan is called the repo rate. Overnight repos (for one-day transactions) and term repos (for longer transactions) are used. Because of collateral, the repo rate is lower than the cost of bank financing. Dealers use repos to get cheap funds or to cover short positions.

LOS 16.1.D.d: Compute the dollar interest of a repurchase agreement.

$$dollar\ interest = amount\ borrowed \times repo\ rate \times \frac{repo\ term\ (actual)}{360}$$

LOS 16.1.D.e: Discuss the credit risks associated with a repurchase agreement.

Credit risk is close to zero because of the collateral in a repo. In general, the amount lent is lower than the value of the collateral. The excess collateral, called the repo margin or the 'haircut', is generally between 1-10%. In order to maintain a certain margin, the collateral is regularly marked to market. If the value of the collateral has declined such that the margin has fallen below a certain level (i.e. in case of a margin deficit), the borrower has to provide additional collateral or cash. Similarly, in case of an excess margin, the lender of funds returns collateral or cash.

Delivery risk is low if the collateral has been transferred to the lender (= delivered-out repo). However, the transfer of collateral is expensive. In order to find a balance between transaction costs and delivery risk, collateral is either kept in a separate account at the borrower (= hold-in custody repo), or delivered to a custodian account at the borrower's clearing bank (= tri-party repo).

LOS 16.1.D.f: Explain the factors that affect the repo (repurchase agreement) rate.

- quality of collateral (the higher the quality, the lower the repo rate)
- term of the repo
- delivery requirements (without delivery, the repo rate is higher)
- availability of collateral (hot or special collateral [= securities that are in high demand] pays a lower repo rate than general collateral)
- prevailing federal funds rate (determines the general level of repo transactions)
- seasonal factors (window dressing effects)

LOS 16.1.D.g: Compute the total return and expected total return (given a horizon price) for a bond over a given investment horizon.

1. Compute total coupon income (coupon payments plus reinvestment income based on an assumed reinvestment rate).
2. Compute the horizon price (= the sale price at the end of the investment horizon). The horizon price can be obtained from the horizon yield.
3. Compute the semiannual total return.

$$\tilde{r}_{sa} = \left(\frac{Coupon\ income + Horizon\ price}{Current\ full\ price} \right)^{1/h} - 1,$$

where h represents the number of semi-annual periods in the investment horizon.

4. Translate to annual rates either based on semi-annual compounding ($r_s a = 2\tilde{r}_{sa}$) or on an effective basis ($r = [1 + \tilde{r}_{sa}]^2 - 1)$).

LOS 16.1.D.h: Explain how option-adjusted spread (OAS) can be used to compute a horizon price.

The horizon price is obtained by entering the base rate and the OAS into a valuation model. Often, portfolio managers assume that the OAS will remain constant over the investment horizon (= constant-OAS total return). Alternatively, you may have a view on the OAS that you may want to enter in your valuation formula. E.g. if you assume that the OAS is going to widen, the discount rates will increase, resulting in a lower horizon return.

LOS 16.1.D.i: Describe scenario analysis.

A scenario is a set of assumptions concerning the variables that affect the calculation of the horizon return. Evaluating what will happen to a trading strategy under several scenarios is referred to as scenario analysis. Scenario analysis is sometimes required by regulators.

Scenario analysis should not be confounded with simulation (simulation is more powerful as it takes into account joint probability distributions of the variables).

LOS 16.1.D.j: Explain how interest rate risk is controlled in a trade.

Alternative trading strategies should be scaled by their *dollar duration* (by how many currency units does total return change for a given change in yields?). In other words, interest risk is controlled by equalizing the present value of a basis point.

If the manager fails to control interest risk, substituting one bond with another results in an implicit duration bet.

LOS 16.1.D.k: Calculate the par value of bonds that must be purchased in a trade to maintain the dollar duration of a portfolio.

To obtain a given dollar duration of a portfolio, you must by the following par value of the bond:

$$par\ value\ bond = \frac{dollar\ duration\ of\ portfolio}{\frac{price\ of\ bond}{100} \times duration\ of\ bond}$$

LOS 16.1.D.l: Explain why total return analysis and scenario analysis should be used to assess the potential performance of a trade before the trade is implemented.

- Total return analysis quantifies the potential performance of a trade.
- Scenario analysis gives you a feel for the what performance you may expect under different scenarios (so, it gives you a certain range of possible outcomes and indicates possible risks).
- Together, total return and scenario analysis sharpen your understanding for the kind of bets you are taking with a trading strategy (although a broker will try to sell you the trading strategy as an 'arbitrage' strategy).

LOS 16.1.D.m: Analyze trading strategies using scenario analysis and the analytical tools discussed.

- Start by decomposing the cash flows of the strategy.
- Define a likely scenario and calculate total returns.
- Then think of alternative scenarios.
- Carry out the total returns calculations for your alternative scenarios.
- Draw your conclusions.

16.5 Swap Contracts, Convertible Securities, and Other Embedded Derivatives

LOS 16.2.a: Identify common features of structured notes that distinguish them from regular fixed-income securities.

- Structured notes are designed for and tageted to a specific investor with very particular needs (e.g. get around regulation, save taxes).
- The issuer will normally hedge the unique exposure with swaps or exchange-traded derivatives. For the bond underwriter, this represents a nice additional business opportunity.

LOS 16.2.b: Differentiate between the structured note market and traditional debt market.

Traditional debt = 'boring' / plain vanilla bonds that pay a fixed or floating rate and a fixed principal.

Structured notes = debt issues that have their principal or coupon payment linked to some other underlying variable.

LOS 16.2.c: Describe the cash flow characteristics of dual-currency bonds, equity-index-linked notes, commodity-linked bull and bear bonds, and swap-linked notes.

Dual-currency bonds = bonds with a coupon denominated in a different currency than the principal. From an investor's point of view, they can be seen as a (1) single-currency fixed-coupon bond plus (2) a currency forward contract. Such bonds may be of interest to investors that are otherwise prohibited to use currency forward contracts.

Equity-index-linked notes = zero bond that pays a principal defined as a function of some equity index. Typically, the bonds are capital protected (i.e. principal payment is at least equal to the original issuance price). They can be structured either as a zero bond plus long call options on the underlying index or as a long index investment plus a long put. These notes are of interest to portfolio managers that want to add equity exposure in a portfolio of securities that look like bonds.

Commodity-linked bull and bear notes = securities whose principal is linked to the price of a commodity. The commodity price can enter positively (bull) or negatively (bear) in the formula of the principal. By issuing both bull and bear notes, the issuer will hold no exposure to the underlying commodity.

Swap-linked notes = securities with coupon and / or principal payments linked to swaps. There are many variants: floaters, reverse floaters, leveraged reverse floaters (i.e. the coupon is some cap rate - $n\times$ the floating rate). An issuer issuing reverse floaters, can hedge the exposure by entering in a swap, receiving fixed and paying floating.

Study Session 17

Derivative Investments: Futures and Swaps

17.1 Futures Prices

LOS 17.1.A.a: Explain and calculate open interest.

Open interest = *# of contracts for which delivery is currently obligated.* To obtain open interest you must (1) calculate the net position of all traders, and then (2) sum the net positions of all traders. The net position is used because *reversing trades reduce the number of contracts for which there will be delivery.* In practice, open interest increases until shortly before maturity and then drops as traders close their positions in order to avoid actual delivery.

LOS 17.1.A.b: Define and calculate the basis of a futures contract.

$$Basis = Current\ cash\ price - Futures\ price$$

In a *normal market*, the basis is higher for distant futures than for nearer future. In a *inverted market*, the reverse holds.

LOS 17.1.A.c: Differentiate between spot (cash) and futures prices and explain why the basis must converge to zero at expiration.

The spot price is the price you have to pay for something in a spot transaction. The futures prices is the price you pay for the same thing in a futures transaction.

The basis, i.e. the difference between futures and spot price will converge to zero at expiration because any difference would represent an arbitrage opportunity.

LOS 17.1.A.d: Identify the existence of an arbitrage opportunity, identify and arrange the appropriate strategy (a cash-and-carry arbitrage or a reverse cash-and-carry arbitrage), list the appropriate trades to take advantage of the arbitrage opportunity, and compute the corresponding arbitrage profits.

A cash-and-carry arbitrage exists, if the futures price is above the spot price plus cost of carry:

$$F_{0,\tau} > S_0 \cdot (1 + C)^{\tau},$$

where $F_{0,\tau}$ is the current futures price with expiry at τ, S_0 is the current spot price, and C represents the periodic cost of carry (including financing cost). You can take advantage of a cash-and-carry arbitrage by: (1) buy the underlying at S_0 with borrowed funds at a repo rate of C and (2) sell the underlying with futures contract. At expiry, your proceeds from the futures transaction, $F_{0,\tau}$ will be bigger than the repayment of the loan, $S_0(1+C)^\tau$. Your arbitrage profit will be $F_{0,\tau} - S_0 \cdot (1+C)^\tau$ minus transaction costs.

A reverse cash-and-carry arbitrage exists, if the futures price is below the spot price plus cost of carry:

$$F_{0,\tau} < S_0 \cdot (1+C)^\tau.$$

You can take advantage of a cash-and-carry arbitrage by: (1) sell the underlying short at S_0 and lend out the proceeds at a repo rate of C and (2) buy the underlying with futures contract. At expiry, the collected proceeds from your loan, $S_0(1+C)^\tau$ will be higher than the price you have to pay for the delivery of the underlying, $F_{0,\tau}$. Your arbitrage profit will be $S_0 \cdot (1+C)^\tau - F_{0,\tau}$ minus transaction costs.

LOS 17.1.A.e: Show that under the no-arbitrage framework, the implied repo (repurchase agreement) rate is the same as the cost of carry.

The relationship holds because of the way the implied repo is defined. Setting the futures horizon to 1 ($\tau = 1$), the implied repo is defined as

$$C = \frac{F_{0,\tau}}{S_0} - 1.$$

Rearranging, we obtain $F_{0,\tau} = S_0(1+C)$. Any deviation from this equality will imply an arbitrage opportunity.

LOS 17.1.A.f: Compute the implied repo rate, given the cash price and futures price.

$$C = \left[\frac{F_{0,\tau}}{S_0} - 1\right]^{1/\tau}$$

For the most simple case of $\tau = 1$, we have

$$C = \frac{F_{0,\tau}}{S_0} - 1$$

LOS 17.1.A.g: Illustrate how market imperfections (transaction costs, unequal borrowing and lending rates, and restrictions on short selling) create upper and lower no-arbitrage futures pricing bounds

- In a cash-and-carry trade, transaction costs increase the the negative cash flows. Therefore, a cash-and-carry arbitrage with transaction costs only exists if $F_{0,\tau} > S_0 \cdot (1 + C)(1 + T)$ where T represents transaction costs and we have set the futures period to $\tau = 1$. Conversely, transaction costs reduce the the positive cash flows in a reverse cash-and-carry trade. Therefore, a reverse cash-and-carry arbitrage with transaction costs only exists if $F_{0,\tau} < S_0 \cdot (1 + C)(1 - T)$.

- Unequal borrowing and lending rates mean that the cost of carry depends on the trade. Specifically, for a cash-and-carry arbitrage, funds are borrowed so that the borrowing rate, C_B, must be applied. The lending rate, C_L applies to reverse cash-and-carry trades.

- Restrictions on short selling affect reverse cash-and-carry trades. Specifically, if short selling is restricted, you only receive a fraction, f of the proceeds. Consequently, only this fraction f can be lent out and earns interest C. Therefore, for a reverse cash and carry arbitrage to exist, $F_{0,\tau} < S_0 \cdot (1 + f \cdot C_L)(1 - T)$

- Now, as arbitrageurs remove all arbitrage opportunities, the range of possible values for $F_{0,1}$ is given by

$$S_0 \cdot (1 + fC_L) \cdot (1 - T) \leq F_{0,1} \leq S_0 \cdot (1 + C_B) \cdot (1 + T)$$

LOS 17.1.A.h: Explain how market imperfections affect traders.

- Transaction costs, differential borrowing and lending rates and restrictions on short selling, all effect the width of no-arbitrage bounds on futures prices.

- While all trades face transaction costs, the size of the costs differ, because of

  1. different commissions (commissions are inexistent for floor members but prohibitive for individuals)
  2. bid-ask spreads (size dependent)
  3. exchange fees (where you trade)
  4. search costs (economies of scale)

LOS 17.1.A.i: Define market backwardation and relate backwardation to an assets convenience yield.

Convenience yield = return on holding an asset (e.g. coupon payments). Sometimes the convenience yield is positive, i.e. it is 'convenient to hold the asset', because the market needs the asset now. Example: soybeans are in high demand 1 month before the next harvest, so the spot price may be higher than the futures price with expiry after the next harvest; so the market pays a premium for the convenience of owning the soybeans now rather than at a future date. In the presence of convenience yield, the cost of carry may become negative and the futures price can fall below the spot price.

Backwardation = a situation where the futures trades below the stock price. Backwardation is generally caused by a convenience yield.

LOS 17.1.A.j: Explain the role of backwardation and convenience yield in futures arbitrage strategies.

Arbitrage strategies are difficult to apply to assets in backwardation because *assets with a convenience yield are difficult to carry.* Suppose you observe that the futures price of soybeans is below current spot price. At first sight, this looks like a reverse cash-and-carry arbitrage. However, when you start to try selling short the soybeans, you will find that nobody will lend you the beans (in fact, they all find it very inconvenient to lend them to a speculator and would only do so if you paid them some kind of convenient yield...).

LOS 17.1.A.k: Contrast normal backwardation and a market that is in backwardation.

Don't mix up these terms:

Normal backwardation = the view that futures prices tend to rise over the contract life due to the hedgers' general desire to be net short. The idea goes back to Keynes and Hicks. They looked at futures markets in a demand / supply framework: Hedgers are driven by the desire to hedge their overall long positions. For this, *hedgers buy protection from speculators.* Speculators will only sell protection (i.e. go long), when the futures price is lower than their expectation. As the contract reaches expiry, this insurance premium declines and the futures price can move up to expectations.

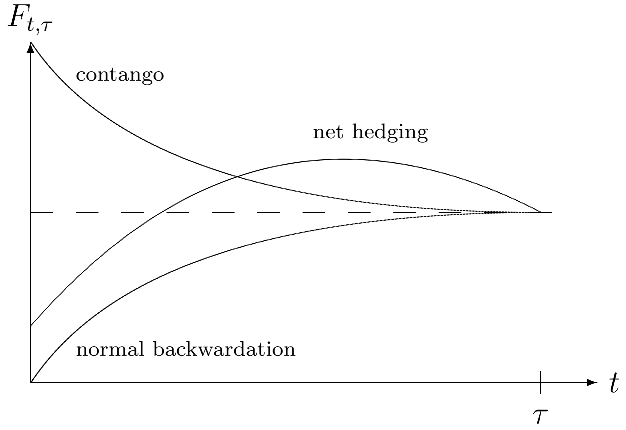
Market in backwardation = a market where cash prices exceed futures prices or nearby futures prices exceed distant futures prices.

LOS 17.1.A.l: Define a contango.

Contango = the inverse situation of normal backwardation. In a contango, hedgers are net long. In order for speculators to go net short, the futures price must lie above the expected future cash price. This premium disappears towards the exercise date and drives down the futures price over time.

LOS 17.1.A.m: Illustrate and explain what determines the differing futures price patterns under normal backwardation, contango, and the net hedging hypothesis.

- Under *normal backwardation*, hedgers are net short. For speculators to go long, the futures price must lie above the expected future spot price. This premium disappears over time.
- Under *contango*, hedgers are net long. For speculators to go short, the futures price must lie below the expected future spot price. This discount disappears over time.
- Under the *net hedging hypothesis*, hedgers change their net position over time. The premium or discount to attract speculators changes accordingly. The hypothesis can be justified by the presence of different groups of hedgers (e.g. grain farmers and cereal producers have different hedging needs on the same commodity; farmers will short sell their future harvest and cereal producers may at a later stage buy their inputs in the futures market).



17.2 Interest Rate Futures: Introduction

LOS 17.1.B.a: Compute, given the discount yield, the price quote of a U.S. Treasury bill (T-Bill) futures contract.

The price of a T-Bill futures is quoted on a IMM index basis:

$$\begin{matrix}\textit{IMM index}\\ \textit{quote}\end{matrix} = 100 \times \left(1 - \begin{matrix}\textit{discount}\\ \textit{yield}\end{matrix}\right),$$

e.g. the price of a 6% contract is quoted as $100 \times (1 - .06) = 94$.

LOS 17.1.B.b: Compute, given LIBOR (London Interbank Offered Rate), the price of a Eurodollar futures contract

Like the T-Bill futures, Eurodollar futures are quoted on a IMM index basis:

$$\begin{matrix}\textit{IMM index}\\ \textit{quote}\end{matrix} = 100 \times (1 - LIBOR).$$

E.g. the price of a Eurodollar contract at LIOBOR 6% is equal to $100 \times (1 - .06) = 94$.

LOS 17.1.B.c: Compute the invoice amount given either the T-bill (Eurodollar) price or the futures quote

The invoice amount is given by:

$$\begin{matrix}\textit{invoice}\\ \textit{amount}\end{matrix} = \$10,000,000 \times \left(1 - \begin{matrix}\textit{discount}\\ \textit{yield}\end{matrix} \cdot \frac{\textit{days to maturity}}{360}\right).$$

Use the T-bill yield and LIBOR for T-bill futures and Eurodollar deposits, respectively. Note that the T-bill futures contract is always based on a 90-day bill; so, a basis point change in the discount yield will always lead to a change in the price by $25.

LOS 17.1.B.d: Determine whether an arbitrage profit exists, using the cost-of-carry model for both the T-bill and T-bond contracts.

Arbitrage on T-bill contracts: Arbitrage opportunities exist if $F_{0,n\ days} \neq S_0(1+C_{n\ days} \cdot n360)$, where $F_{0,n\ days}$ is the current futures price for a T-bill contract with n days to expiry, S_0 is the current cash price on a T-bill with *90+n days to maturity* (i.e. it will have 90-days to maturity at the contract date) and $C_{n\ days}$ is the financing cost on a actual/ 360 basis. If $F_{0,n\ days}$ is too big, you make an arbitrage profit by engaging in a cash-and-carry trade; if it is too low, use a reverse cash-and-carry trade. Note: in the formula above, time to maturity is expressed as n days rather than in fractional years (τ) and cost of carry is not compounded; this is done to align the formula with typical quotation conventions.

Arbitrage on T-Bond futures: The arbitrage argument is is identical with one difference: because the bond earns a coupon, the actual cost of carry is smaller (an approximation: $C = financing\ rate - coupon\ rate$). The cost-of-carry model for T-Bond futures is given by:

$$F_{0,\tau} + \begin{array}{c}\textit{Accrued}\\ \textit{interest at } \tau\end{array} + \begin{array}{c}\textit{Future value}\\ \textit{of coupons}\end{array} = \left[S_0 + \begin{array}{c}\textit{Accrued}\\ \textit{interest now}\end{array}\right] \cdot (1+C)^{\tau}$$

LOS 17.1.B.e: Identify the existence of an arbitrage opportunity, identify and arrange the appropriate strategy (a cash-and-carry arbitrage or a reverse cash-and-carry arbitrage), and compute the corresponding arbitrage profits.

A cash-and-carry arbitrage exists, if the futures price is above the spot price plus cost of carry:

$$F_{0,n\ days} > S_0\left(1 + C_{n\ days} \cdot \frac{n}{360}\right)$$

where $F_{0,n\ days}$ is the current futures price for a T-bill contract with n days to expiry, S_0 is the current cash price on a T-bill that with *90+n days to maturity* (i.e. not a current 90-day T-bill!) and $C_{n\ days}$ is the n-day financing cost on a actual/ 360 basis. You will make an arbitrage profit of $F_{0,n\ days} - S_0\left(1 + C_{n\ days} \cdot \frac{n}{360}\right)$ by selling a T-bill futures contract, investing in the corresponding T-bill and borrowing the necessary cash.

A reverse cash-and-carry arbitrage exists, if the futures price is below the spot price plus cost of carry:

$$F_{0,n\ days} < S_0\left(1 + C_{n\ days} \cdot \frac{n}{360}\right)$$

You will make an arbitrage profit of $S_0\left(1 + C_{n\ days} \cdot \frac{n}{360}\right) - F_{0,n\ days}$ by buying a T-bill futures contract, selling the corresponding T-bill short and lending out the proceeds the necessary cash.

LOS 17.1.B.f: Show that, under the no-arbitrage framework, the implied repo (repurchase agreement) rate is the same as the cost-of-carry.

The annualized implied repo rate, on a actual/ 360 basis is defined as

$$C_{implied,n\ days} = \left(\frac{F_{0,n\ days}}{S_0} - 1\right) \times \frac{360}{n}$$

No-arbitrage requires that

$$F_{0,n\ days} = S_0 \left(1 + C_{financing,n\ days} \cdot \frac{n}{360}\right)$$

Solving this second equation for $C_{financing}$ confirms that

$$C_{implied} = C_{financing}$$

Note that if $C_{implied} > C_{financing}$, a cash-and-carry trade will yield a positive arbitrage profit.

LOS 17.1.B.g: Calculate the implied repo rate, given the spot Treasury bill price and the Treasury bill futures price for the period from today until the expiration of the futures, and annualize that implied repo rate.

The non-annualized implied repo rate is obtained by:

$$C_{n\ days} = \left(\frac{F_{0,n\ days}}{S_0} - 1\right)$$

You can annualize this rate either by using the actual / 360 convention ($C_{n\ days} \cdot \frac{360}{n}$) or effective yield ($(1 + C_{n\ days})^{360/n} - 1$).

17.3 Stock Index Futures: Introduction

LOS 17.1.C.a: Describe index arbitrage and program trading.

Index arbitrage = the use of cash-and-carry strategies on stock index futures. Cash-and-carry trades are done by entering a futures position on the index and an offsetting position in the stocks included in the index.

Program trading = the use of computers to exploit index arbitrage opportunities. The computer is necessary because index arbitrage requires the simultaneous buying and selling of a future and a large number of stocks (the DJIA contains 30 stocks, the S&P 500 contains 500...). Moreover, you first need to detect opportunities before you can trade.

LOS 17.1.C.b: Describe the effects of dividends on the cost-of-carry model.

- Dividends complicate the cost-of-carry model for index futures because the *index is generally a price index.* You can interpret dividends as negative cost of carry that increase the attractiveness of holding the stocks rather than the index future. Alternatively, you can interpret dividends as cash paid out to stockholders that reduce the value of the index.

- Dividends are uncertain. They are difficult to forecast for indices that contain companies with unstable dividend policy.

- If dividends are known, the arbitrage-free futures price can be calculated by:

$$F_{0,\tau} = S_0 \cdot (1 + C)^{\tau} - \sum_{i=1}^{\#\ of\ stocks} D_i \cdot (1 + r_i),$$

  where r_i is the rate of interest earned on dividend i.

LOS 17.1.C.c: Define and calculate the fair value of a stock index futures contract.

Fair value of an index futures = *the futures price that fits the cost-of-carry model.*

$$\begin{aligned} F^*_{0,\tau} &= S_0 \cdot (1 + C)^{\tau} - \sum_{i=1}^{\#\ of\ stocks} D_i \cdot (1 + r_i) \\ &= \begin{matrix} \textit{Future value} \\ \textit{of stocks} \end{matrix} + \begin{matrix} \textit{Future value} \\ \textit{of dividends} \end{matrix} \end{aligned}$$

LOS 17.1.C.d: Explain the difficulties in implementing an index arbitrage strategy.

- a lot of data to be analyzed
- program trading necessary to simultaneously trade all stocks in the index
- uncertain dividends (in practice not that uncertain)
- uncertain reinvestment returns on dividends

17.4 Foreign Exchange Futures

LOS 17.1.D.a: Demonstrate that the interest rate parity (covered interest arbitrage) relationship and the cost-of-carry model are equivalent

The interest rate parity condition states that the forward exchange rate is determined by the spot rate and the interest rate differential,

$$F_{0,\tau} = S_0 \cdot \left(\frac{1 + s_{foreign}}{1 + s_{domestic}} \right)^{\tau} ,$$

where exchange rates are quoted indirectly. Note that the part in parentheses ($\frac{1+s_{foreign}}{1+s_{domestic}} \approx s_{foreign} - s_{domestic}$) represents the cost of carry.

LOS 17.1.D.b: Compute, using the cost-of-carry model, the theoretical futures price and determine whether an arbitrage profit exists.

Using direct quotes (foreign currency units per domestic currency unit), the theoretical futures price is given by the IRP formula:

$$F^*_{0,\tau} = S_0 \cdot \left(\frac{1 + s_{foreign}}{1 + s_{domestic}} \right)^{\tau} .$$

An arbitrage profit exists if $F_{0,\tau} \neq F^*_{0,\tau}$.

LOS 17.1.D.c: Identify and construct the appropriate strategy (a cash-and-carry arbitrage or a reverse cash-and-carry arbitrage) to exploit an arbitrage opportunity.

1. Calculate the fair value of the future

$$F^*_{0,\tau} = S_0 \cdot \left(\frac{1 + s_{foreign}}{1 + s_{domestic}} \right)^{\tau} .$$

2. Compare the fair value to the market price. If $F_{0,\tau} > F^*_{0,\tau}$, you can make an arbitrage profit by selling the foreign currency in the spot market and buying it in the futures market (= cash-and-carry). If $F_{0,\tau} < F^*_{0,\tau}$, you can make an arbitrage profit by selling the foreign currency in the future market and buying it in the spot market (= reverse cash-and-carry).

LOS 17.1.D.d: Compute the profits from an arbitrage strategy.

$$profit = \begin{cases} F_{0,\tau} - S_0 \cdot \left(\frac{1+s_{foreign}}{1+s_{domestic}}\right)^{\tau} & \text{for carry trade} \\ S_0 \cdot \left(\frac{1+s_{foreign}}{1+s_{domestic}}\right)^{\tau} - F_{0,\tau} & \text{for reverse carry} \end{cases}$$

17.5 Using Futures Markets

LOS 17.2.A.a: Describe how futures can be used to construct a hedge.

You can hedge a certain existing position buy entering the opposite position in the futures market.

LOS 17.2.A.b: Differentiate between a short and a long hedge.

Long hedge = buying the underlying with a futures contract because of an existing short position (e.g. a company hedging against the risk of rising prices in one of its inputs of production).

Short hedge = selling the underlying with a futures contract because of an existing long position (e.g. a producer locking in the sale price of his product by selling the product in the futures market).

LOS 17.2.A.c: Determine, given a risk exposure, whether a short or long hedge is appropriate.

- If the risk exposure is long (e.g. you own the underlying, or you know that you will own the underlying in the future), enter a short hedge.
- If the risk exposure is short (e.g. you owe the underlying, or you will need it in the future), enter a long hedge.

LOS 17.2.A.d: Explain a cross-hedge and describe a situation that would necessitate a cross-hedge.

Cross-hedge = a hedge in which the characteristics of the spot and futures positions do not match perfectly. A cross-hedge will not as effective in reducing risk as a direct hedge (you hold some basis risk). Differences can arise because:

- The contract size of the futures contract does not allow a perfect hedge.
- There is no futures contract for this precise commodity (e.g. industrial versus pure silver, T-bill versus commercial paper, bills with different coupons).
- The settlement dates do not match perfectly (futures contracts have specific settlement dates).

LOS 17.2.A.e: Calculate the appropriate number of futures contracts needed to create a risk-minimizing hedge, given the beta coefficient estimated from regressing changes in the cash price (dependent variable) on changes in the futures price (independent variable).

Given the regression equation

$$\Delta S_t = \alpha + \beta \cdot \Delta F_t + \varepsilon,$$

the number of contracts needed to create a risk-minimizing hedge is given by:

$$\begin{matrix} \textit{\# of} \\ \textit{contracts} \end{matrix} = \beta \times \frac{\textit{cash position}}{\textit{contract size}}$$

E.g. to hedge 10 tonnes long cannabis, using a cannabis future with contract size 100 kg, and a β of .5, you will need $.5 \times \frac{10{,}000}{100} = 50$ contracts.

17.6 Interest Rate Futures: Introduction

LOS 17.2.B.a: Demonstrate the mechanics of long and short interest rate hedges.

Long interest rate hedge: Buy buying an interest rate futures, a trader actually locks in the current *forward* rate. E.g. a portfolio manager will receive cash 3 months from now and expects rates to fall with respect to current forward rates. He will buy a futures contract. As rates fall, the funds will have to be invested at a lower rate. However, the gain on the futures contract offsets the loss.

Short interest rate hedge: Buy selling an interest rate futures, a trader can hedge a current long position against capital losses due to a rise in interest rates. E.g. a portfolio manager has a portfolio of bonds and fears that rates will rise. He will sell a futures contract. As rates rise, the portfolio will decline in value. However, this loss is offset be the gains in value on the futures contract.

LOS 17.2.B.b: Identify whether a long hedge or a short hedge is appropriate, using interest rate futures, for a given scenario.

- Use a long hedge if you want to hedge an existing short position (e.g. to lock in current rates for future investments, to hedge against changes in the value of your debt, or for traders to hedge their short positions).
- Use a short hedge if you want to hedge an existing long position (e.g. to reduce interest rate exposure of a fixed-income portfolio).

LOS 17.2.B.c: Calculate the total cash flows of a hedged position and compare them with the cash flows of an unhedged position.

1. Calculate the cash flows of the unhedged position.
   Example: You are long \$1 mio in a 180-day T-bill that you would like to sell in 3 months. The implied 3-month rate 3 months forward stands at 5%. If this rate were realized, you would receive $\$1mio \times (1 - .05 \cdot \frac{90}{360}) = \$987,500$. However, you expect the 3-month interest rate to rise to 10%. So, cash flow at in three months is $\$1mio \times (1 - .1 \cdot \frac{90}{360}) = \$975,000$, representing a loss of \$12,500.
2. Calculate the cash flows of the hedged position at inception. Normally, a hedge does not add require any cash flows at inception.
   Example: Sell \$1 mio face value of treasury bills on the futures market.
3. Calculate the cash flows of the hedged position at the maturity date. For this, note that the *value of a \$1 mio T-bill will always change by \$25 for each basis point in yield.*
   Example: If the 3-month interest rate goes up to 10% from the current forward rate of 5%, you will make a gain on your futures position (because you're short) of $500 \times \$25 = \$12,500$. Added to the proceeds from the sale of the T-bill, \$975,000, total cash flows are \$987,000, which is the same cash flow of the unhedged position is the short rates moves to the level implied by the forward rate.

LOS 17.2.B.d: Illustrate the role of the basis in interest rate hedging.

The $basis = spot\ yield - futures\ yield$ is not what you're interested in, because the *market value of a futures contract is driven by the forward yield rather than the spot yield.* In other words, by going long the futures contract, you lock in the *forward rate* and not the current spot rate.

Illustration: Suppose the forward rate is 10% and the spot rate is 5%. An borrower cannot lock in the current spot rate with a futures contract. If he goes short the futures, and the spot rate rises to 10%, the futures contract will be worth 0 at expiry. So, does not give protection against a rise in rates.

LOS 17.2.B.e: Compute the impact of cross-hedging on the total cash flows of a hedging strategy.

Calculate the cash flows for a perfect hedge and compare it to the cash flows of a cross hedge. For interest rate futures, you may find the difference by looking at the effect of a change in the spread between the underlying of the futures contract and your existing position on the invoice amount:

$$\begin{matrix} \mathit{\Delta\ cash\ flow} \\ \mathit{cross\ hedge} \end{matrix} = notional \cdot \Delta spread \cdot \frac{days\ to\ maturity}{360}$$

17.7 Stock Index Futures: Introduction

LOS 17.2.C.a: Calculate the hedge ratio, using the portfolio value and the portfolio beta.

$$\begin{matrix} \#\ of \\ contracts \end{matrix} = -\beta \cdot \frac{portolio\ value}{F_{0,t}}$$

Note that the hedge ratio is already given by β.

LOS 17.2.C.b: Identify whether a long hedge or a short hedge is appropriate, and determine the appropriate number of futures contracts to implement the required long or short hedge

A *long hedge* is appropriate for hedging an existing short position (e.g. to profit from market movements without cash outlays, for dealers who have sold a portfolio). A *short hedge* is appropriate for hedging an existing long position (e.g. to reduce the market sensitivity of an equity portfolio).

The number of contracts required is given by:

$$\begin{matrix} \#\ of \\ contracts \end{matrix} = -\beta \cdot \frac{value\ of\ existing\ position}{F_{0,t}}$$

LOS 17.2.C.c: Determine the appropriate futures trade required to properly implement a hedge.

Long equity hedge: Appropriate for an existing short position.

1. Initiation: buy the required number of contracts $(-\beta \cdot \frac{value\ of\ existing\ position}{F_{0,t}})$.
2. Maturity: close your futures position by selling the contract. The realized gain will approximately offset the loss on your short position.

Short equity hedge: Appropriate for an existing long position.

1. Initiation: sell the required number of contracts $(-\beta \cdot \frac{value\ of\ existing\ position}{F_{0,t}})$.
2. Maturity: close your futures position by buying the contract. The realized gain will approximately offset the loss on your long position.

LOS 17.2.C.d: Calculate the total cash flows of a hedged position and compare these cash flows with the cash flows of an unhedged position.

1. Calculate the cash flows of the unhedged position.
   Example: You are long \$1 mio in an equity portfolio. Over the next 6 months you expect dividends with a future value of \$50 k and a fall in equity prices by 20%. After 6 months, you are going to sell your portfolio. Total cash flows are $\$1mio \cdot (1-20\%) + \$50k = \$850k$.

2. Calculate the cash flows of the hedged position at inception. Normally, a hedge does not add require any cash flows at inception.
   Example: Assuming a β of 1, an index level of 1,000, and a contract value of \$10 per index point, sell $1 \cdot \frac{\$1mio}{\$10 \cdot 1{,}000} = 100\ contracts$.

3. Calculate the cash flows of the hedged position at the maturity date.
   Example: Ignoring dividends and financing costs, if the index falls by 20%, you will make a loss on your equity futures contract of $100 \cdot (800 - 100) \cdot \$10 = 200k$. Add this realized gain to proceeds from the sale of your portfolio to obtain a total flow of \$1,050k. Hence, the futures contract offsets the loss in your existing position.

17.8 Foreign Exchange Futures

LOS 17.2.D.a: Explain transaction exposure and translation exposure

Transaction exposure = foreign exchange risk related to actual transactions. Transaction exposure affects actual profits.

Translation exposure = foreign exchange risk arising from the need to restate foreign currency earnings in terms of the domestic currency. Translation exposure affects the balance sheet of a company.

LOS 17.2.D.b: Identify whether a long hedge or a short hedge is appropriate and determine the appropriate number of foreign exchange futures contracts to implement the required long or short hedge.

A *long hedge* is appropriate to hedge an existing short position (e.g. you need foreign currency to pay a bill in the future). A *short hedge* is appropriate to hedge an existing long position (e.g. a producer needs to hedge foreign currency receipts against local costs, a company wants to hedge against translation risk on the earnings of its foreign subsidiary). The number of foreign exchange futures contracts depends on the contract size.

LOS 17.2.D.c: Calculate the total cash flows of a hedged position and compare these cash flows with the cash flows of an unhedged position.

1. Calculate the cash flows of the unhedged position.
2. Calculate the cash flows of the hedged position at the inception date (normally 0).
3. Calculate the cash flows of the hedged postion at maturity.

17.9 The Swaps Market: Introduction

LOS 17.3.A.a: Discuss the characteristics of and motivations for swap contracts and differentiate swap contracts from futures contracts, especially with respect to payment date versus expiration date.

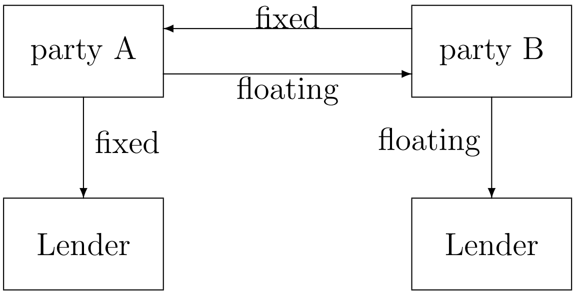
Characteristics. Compared to futures contracts, swaps have the following characteristics:

- Futures are highly standardized, swaps are highly customized.
- The time horizon on a swap is much longer than that on a futures contract.
- Swap transactions are done in the privacy of an over-the-counter transaction. Futures contracts are traded in an open and transparent market.
- Swaps are virtually unregulated while futures markets are highly regulated.
- Swaps are exposed to counter-party risk, while the exchange guarantees execution of futures contracts.

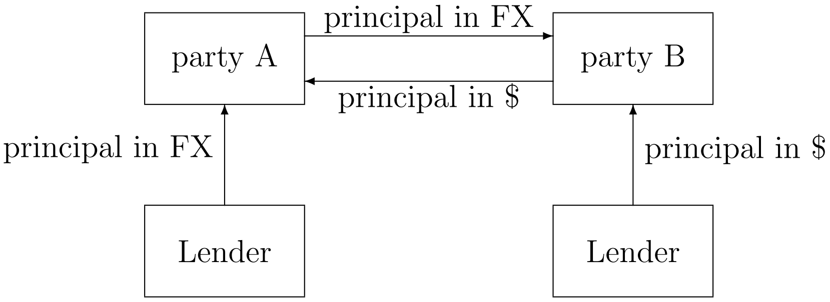
Motivations. In the past, the motivation for swaps were perceived arbitrage possibilities in funding costs. Today, *swaps are used as an efficient (low transaction costs) way to structure cash flows.* Swaps reduce hedging costs, transaction costs, give privacy and provide ways to circumvent regulation.

LOS 17.3.A.b: Diagram (with a box and arrow diagram) and explain the cash flows between the parties to a plain vanilla swap contract, including situations in which an intermediary participates.

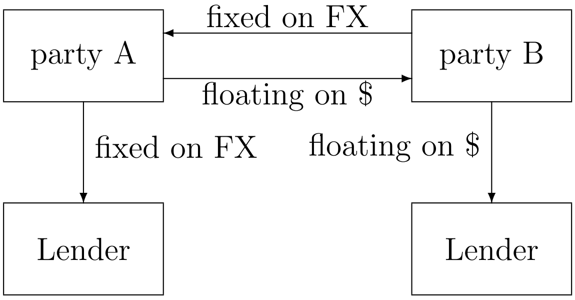
Plain vanilla interest rate swap: If parties A and B enter into an interest rate swap agreement, one party agrees to pay a fixed rate and receives a floating rate. The floating rate is generally defined at LIBOR, while the fixed rate is set to a level that sets the initial value of the swap to zero. The cash flows are shown in the diagram below. Note that no principal is exchanged in a plain vanilla interest rate swap and all payments are made on a net basis.



Plain vanilla foreign currency swap: Foreign currency swaps includes an exchange of principal at initiation:



During the swap agreement, party A *pays floating on $* and party B *pays fixed on foreign currency*:



At termination, the principal payments are reversed (and lenders paid off).

Swap facilitators: the presence of a swap facilitator does not change the picture. If the swap facilitator acts as a *swap broker*, he simply brings the two parties together and does not appear at all in the picture. If he acts as a *swap dealer*, he simply takes on the role of the counterparty.

LOS 17.3.A.c: Calculate a swap's cash flows.

1. Calculate the cash flow of the floating leg. For *swaps determined in advance and paid in arrears* (the normal case), the floating leg payment at t is

   $$CF_{floating,t} = notional \times \tau \times LIBOR_{t-\tau}.$$

   For *in-advance swaps*, payments at t are

   $$CF_{floating,t} = \frac{1}{(1 + LIBOR_t \cdot \tau)} \times notional \times \tau \times LIBOR_t.$$

   Normally, τ will be 0.25 (i.e. 3 months or 1/4 year). Note that the way the tenor τ is used to account...

2. Calculate the cash flow of the fixed leg. For *swaps determined in advance and paid in arrears* (the normal case), the fixed leg payment at t is

   $$CF_{fixed,t} = notional \times \tau \times Fixed\,rate.$$

For *in-advance swaps*, the payment is discounted to present value, using the current swap rate:

$$CF_{fixed,t} = \frac{1}{(1 + LIBOR \cdot \tau} \times notional \times \tau \times Fixed\, rate.$$

3. For interest rate swaps, net out the payment

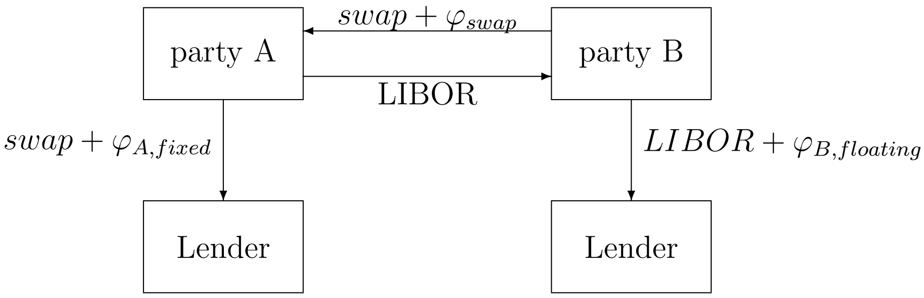
$$CF_{net,t} = CF_{fixed,t} - CF_{floating,t}.$$

LOS 17.3.A.d: Distinguish between swap situations in which all cash flows are netted and swap situations that involve an exchange of principal.

Foreign currency swaps involve an exchange of principal, all the rest is netted out.

LOS 17.3.A.e: Illustrate the appropriate cash flow diagram for a swap and calculate the net borrowing/lending costs for the two swap counterparties.

If both parties borrow in the same currency, the appropriate diagram is that of a plain vanilla interest rate swap:



To obtain effective borrowing or lending costs, simply add all the cash flows that a party receives and subtract the cash flows the party has to pay. If the swap is based on swap rate for fixed and LIBOR for floating ($\varphi_{swap} = 0$), borrowing or lending costs are simply translated from LIBOR to swap rate (or inverse) plus the same spread.

LOS 17.3.A.f: Determine whether entering a swap arrangement reduces a partys borrowing costs.

Borrowing fixed and swaping it into floating reduces borrowing cost compared to borrowing floating if $\varphi_{A,fixed} < \varphi A, float + \varphi_{swap}$, i.e. if the spread paid over the fair swap curve is lower than the spread over LIBOR when borrowing floating plus a counterparty risk premium (φ_{swap}). The reverse holds for $\varphi_{A,fixed} < \varphi A, float + \varphi_{swap}$.

LOS 17.3.A.g: Differentiate among a plain vanilla interest rate swap, an amortizing swap, an accreting swap, a seasonal swap, a roller coaster swap, an off-market swap, a forward swap, a basis swap, a yield curve swap, a constant-maturity swap, and a diff swap.

Plain vanilla interest rate swap = a swap in which one party pays a floating rate and the other pays a fixed rate on a notional in the same currency.

Amortizing swap = a swap in which the notional decreases over time (e.g. to hedge mortgage-backed securities).

Accrediting swap = a swap in which the notional increases over time (e.g. to hedge construction costs).

Seasonal swap = a swap in which the notional varies according to a fixed plan (e.g. to hedge for fluctuations in cash flow needs of retailers).

Roller coaster = a swap in which the notional first increases and then amortizes to zero.

Off-market swap = a swap in which the fixed leg at initiation is set to a level different from the swap curve. An off-market swap has value at initiation and one of the counterparties will have to be compensated for entering into the swap.

Forward swap = a swap in which cash payments start somewhere in the future.

Basis swap = a floating-floating swap in which the payments are calculated on two different indices (e.g. LIBOR and T-bill rate).

Yield curve swap = a floating-floating swap in which the payments are based on interest rates of different maturities (e.g. 3-month LIBOR vs 30-year treasury).

Constant-maturity swap = a special case of yield curve swap in which payments are based on a constant-maturity treasury index.

LOS 17.3.A.h: Illustrate and explain how a plain vanilla interest rate swap and a plain vanilla currency swap can be combined to form a combined interest rate and currency swap (CIRCUS).

CIRCUS (combined interest rate and currency swap) = the combination of a plain vanilla interest rate swap and a plain vanilla currency swap. You can combine the following two transactions:

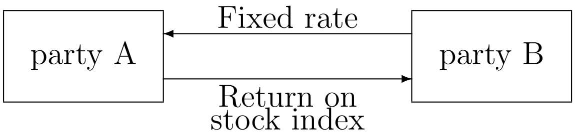
1. Plain vanilla currency swap: Pay fixed on a notional in foreign currency and recieve floating on a notional in \$.
2. Plain vanilla interest rate swap: Pay floating in \$ and receive fixed in \$.

Result: You pay fixed in foreign currency and receive fixed in \$. Hence, the *CIRCUS is a fixed-fixed currency swap.*

LOS 17.3.A.i: Discuss the characteristics of and motivations for an equity swap.

- In an equity swap, one party receives a fixed rate payment and pays a payment based on the return of a certain equity index.
- Possible motivations: hedge an equity portfolio (receive fixed), get exposure to the equity market (pay fixed).

LOS 17.3.A.j: Diagram (with a box and arrow diagram) and calculate the net periodic swap cash flows for an equity swap, given the equity return, notional principal, fixed percentage return, and the tenor of the swap.



The net payment in an equity swap can be calculated as:

$$CF_{net} = notional \times \left(\begin{matrix} \textit{Return on} \\ \textit{stock index} \end{matrix} - \begin{matrix} \textit{Fixed} \\ \textit{rate} \end{matrix} \right)$$

LOS 17.3.A.k: Discuss the characteristics of a swaption.

Swaption = an option on a swap contract. The option can be European or American style. There are two types:

- A *receiver swaption* gives the holder the right to receive fixed. It can be viewed as a call option on a fixed-rate bond. The receiver swaption will be exercised if market rates fall below the fixed rate in the underlying swap contract, i.e. the option comes into the money if rates fall. You may want to buy a receiver option to hedge the call feature of one of your callable bonds.
- A *payer swaption* give the holder the right to pay fixed. It can be viewed as a put option on a fixed-rate bond. The payer swaption will be exercised if market rates increase above the fixed rate in the underlying swap contract, i.e. the option comes into the money if rates rise. A borrower may want to buy a receiver option to hedge against the risk that one of his puttable bonds is actually put.

LOS 17.3.A.l: Explain how extendible and cancelable swap agreements may be analyzed as a combined position consisting of a plain vanilla interest rate swap and a swaption.

Extendible swap = a swap that gives one of the parties (the pay-fixed or pay-floating) the right to extend the tenor of the swap agreement. If the party exercises this right (i.e. this option), it actually enters into an extension swap. This means that an extendible swap can be analyzed as a combination of a swap and a swaption. Variants:

- An *extendible pay-fixed swap* can be viewed as a combination of a plain vanilla interest rate swap plus a payer swaption. The extension option will be exercised if rates rise (it's nice to pay fixed).
- An *extendible pay-floating swap* can be viewed as a combination of a plain vanilla interest rate swap plus a receiver swaption. The extension option will be exercised if rates fall (it's nice to receive fixed).

Cancelable swap = a swap that gives one of the parties (the pay-fixed or pay-floating) the right to cancel an existing swap at a specific time during the original tenor of the swap agreement. If the party exercises this right (i.e. this option), it actually enters a new swap whose payments exactly offset the payments of the existing swap for the rest of the tenor. This means that a cancelable swap can also be analyzed as a combination of a swap and a swaption. Variants:

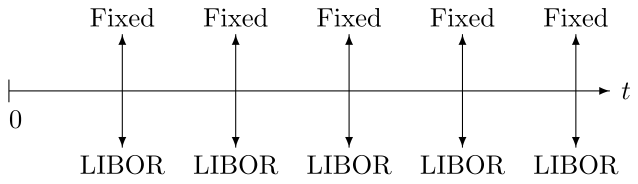
- An *cancelable pay-fixed swap* can be viewed as a combination of a plain vanilla interest rate swap plus a receiver swaption. The swap will be canceled if rates fall (it's better to quit this swap).
- An *cancelable pay-floating swap* can be viewed as a combination of a plain vanilla interest rate swap plus a payer swaption. The extension option will be exercised if rates rise (it's better to stop paying floating for such a low fixed rate).

17.10 The Swaps Market: Refinements

LOS 17.3.B.a: Demonstrate how swap agreements can be viewed as a combination of capital market instruments.

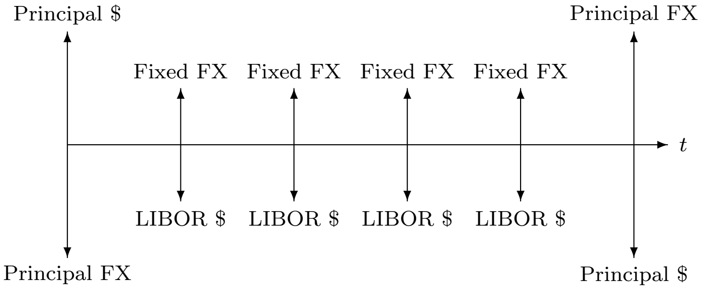
A swap agreement is simply a set of cash flow streams. In general, you can *replicate the cash flow stream* by combining floating-rate notes (FRN) with fixed-rate bonds:

- A *plain vanilla interest rate swap*,



  can be replicated by a long position in a fixed-rate bond (the cash flows above the line) and a short position in a FRN (the cash flows below the line).

- A *plain vanilla currency swap*,



  can be replicated by selling a dollar floater (get cash now, pay back in the end) and buying a bond in FX (pay cash now, get it back in the end.

- Analogous arguments hold for other swaps.

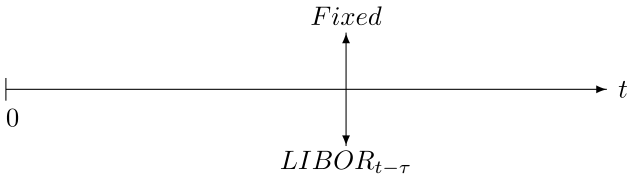
LOS 17.3.B.b: Demonstrate how swap agreements can be viewed as a portfolio of forward rate agreements.

Forward rate agreement = a forward contract that exchanges a fixed rate payment against a future LIBOR rate. Normally, FRAs are *determined in advance and settled in arrears.* Under this scenario, the cash flow at t is defined by

$$\begin{aligned} CF_{net,t} &= CF_{fixed,t} - CF_{floating,t} \\ &= notional \times \tau \times \left(\begin{array}{c} Fixed \\ rate \end{array} - LIBOR_{t-\tau} \right) \end{aligned}$$

An FRA with the cash flows at t defined by the τ-period LIBOR rate defined at $t - \tau$ and a fixed rate of $x\%$, will be quoted as $(t - \tau) \times t$ $x\%$, e.g. a FRA quoted at 9×12 5% will pay in 12 months the difference between 5% and the 3-month LIBOR in starting in 9 months.

Graphically, a FRA is represents the cash flow of one of the future cash flow dates of a swap contract:



To obtain the cash flow stream of a swap contract, you will need to combine FRAs with different expiry dates and an identical notional. This is called a *strip.* To build the strip, you will have to use on-market and off-market FRA. An *on-market* FRA is a FRA with zero intrinsic value (i.e. the fixed rate is equal to the forward rate). An *off-market FRA* is an FRA with nonzero intrinsic value (i.e. the fixed rate is different from the forward rate). *The sum of the values of your FRA strip will be equal to the present value of the corresponding swap contract.*

LOS 17.3.B.c: Demonstrate how an interest rate swap agreement can be viewed as a strip of Eurodollar futures contracts.

Eurodollar futures can be seen as a standardized FRA. Therefore, the argument for viewing a swap agreement as a strip of Eurodollar futures contracts is similar to that of viewing a swap agreement as a strip of FRA. However, Eurodollar futures will not match the features of the swap contract as closely as the FRAs:

- Eurodollar futures require margin.
- Eurodollar futures are traded for a limited number of maturities.
- Eurodollar futures are available only out to 10 years.

LOS 17.3.B.d: Show how a forward rate agreement is the same as a pair of interest rate options.

The payoff function of a call on LIBOR is given by:

$$CF_{call,t} = notional \times \tau \times \max\left(0, \left[LIBOR_{t-\tau} - \begin{matrix} Fixed \\ rate \end{matrix}\right]\right)$$

Similarly, the payoff function of a put on LIBOR is given by:

$$CF_{put,t} = notional \times \tau \times \max\left(0, \left[\begin{matrix} Fixed \\ rate \end{matrix} - LIBOR_{t-\tau}\right]\right)$$

Combining a long call and a short put with the same strike price (fixed rate) yields

$$CF_{net,t} = notional \times \tau \times \left(LIBOR_{t-\tau} - \begin{matrix} Fixed \\ rate \end{matrix}\right),$$

which is exactly the payout of an FRA.

Note that put and call options, like FRA, are determined in advance and settled in arrears, i.e. LIBOR is fixed at $t - \tau$ and the cash flow occurs at t.

LOS 17.3.B.e: Demonstrate how an interest rate swap can be viewed as a zero-cost interest rate collar.

The basic idea of using caplets and floorlets for replicating swaps is given by:

1. Caplets and Floorlets can be interpreted as an FRA plus a long call and short put, respectively, on LIBOR.
2. Calls and puts can be combined into an FRA.
3. FRAs can be combined to a swap contract.

Caplets basically provide a cap to the floating rate funding costs over a certain period in the future. Short floorlets provide a floor on the same funding costs. Combining a cap and a floor gives a collar. If the strike price of the two options is identical, this collar is indefinitely tight. A *zero-cost collar* is a collar in which the price paid for the call is exactly offset by the premium received on the put.

LOS 17.3.B.f: Demonstrate how a swap agreement can be viewed as a portfolio of caps and floors.

A *cap* is sequence of caplets; a *floor* is a sequence of floorlets. By buying a call and selling a floor, a trader actually builds a collar for the future floating rate. Therefore, combining caplets and floorlets is equivalent to a comination of FRAs or a plain vanilla interest rate swap.

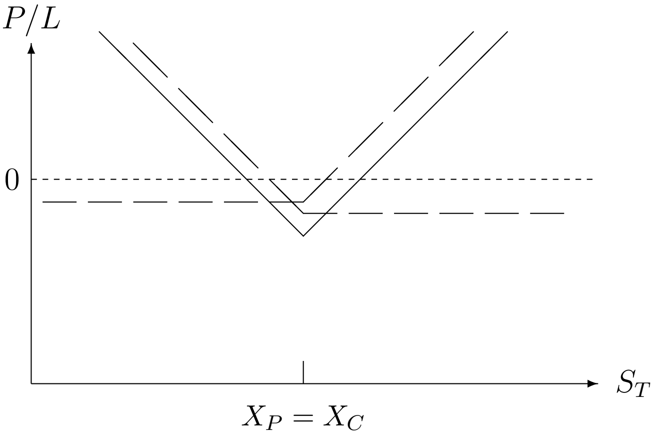
Study Session 18

Derivative Investments: Options

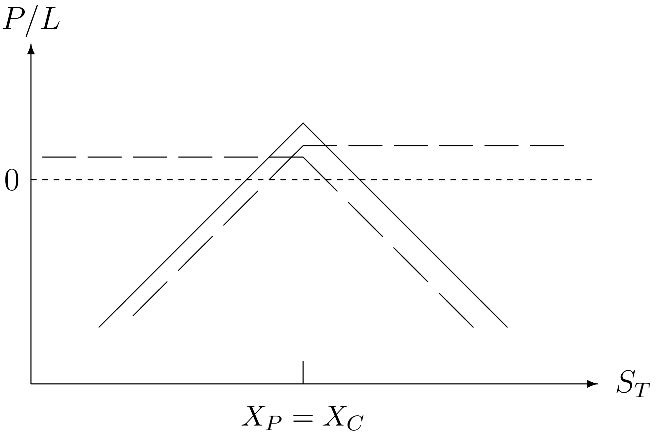
18.1 Option Payoffs and Option Strategies

LOS 18.1.A.a: Draw the profit/loss diagrams, complete with intercepts, at expiration of an option-trading strategy.

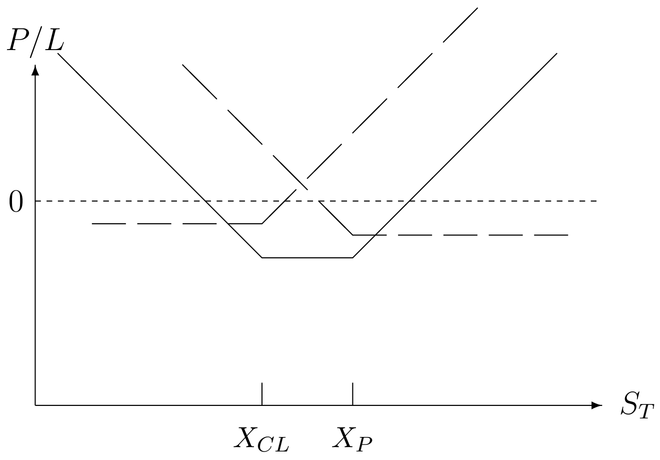
Long straddle = long put and long call with same strike price.



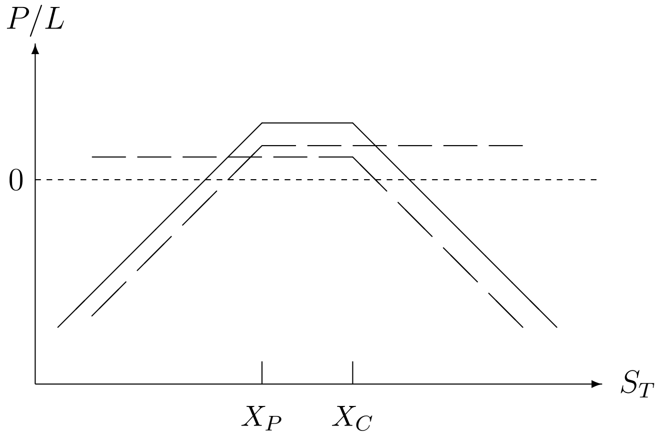
Short straddle = short put and short call with same strike price.



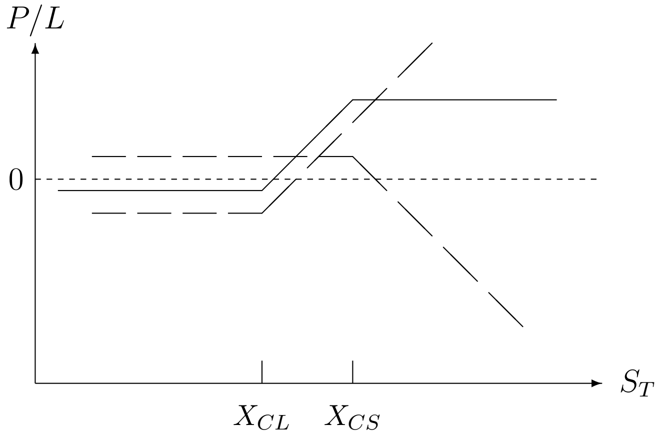
Long strangle = long put and long call with different strike price $X_C > X_P$.



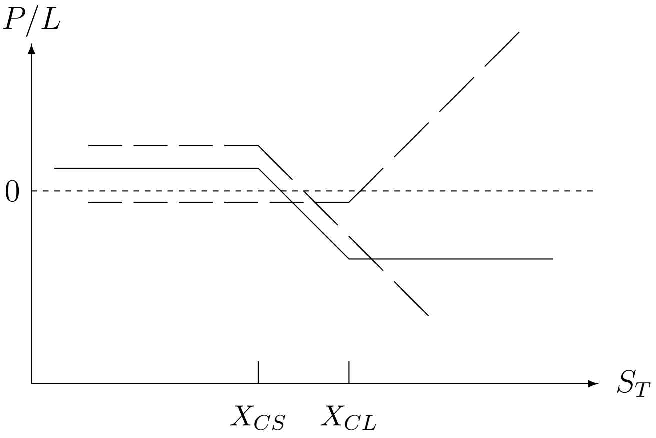
Short strangle = short put and short call with different strike price $X_C > X_P$.



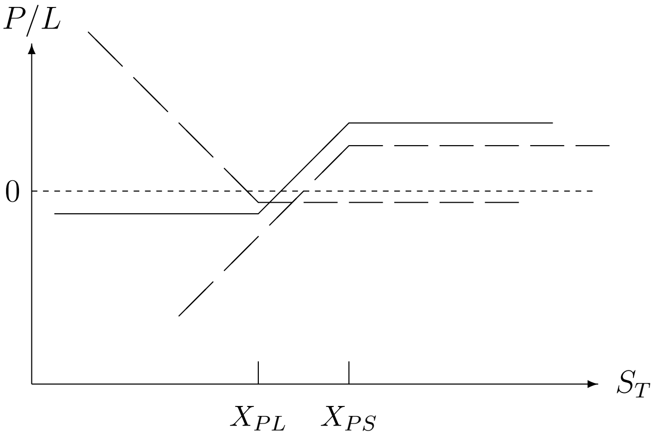
Bull spread of calls = a long and a short call with the strike price of the long call below the strike price of the short call, $X_{CL} < X_{CS}$.



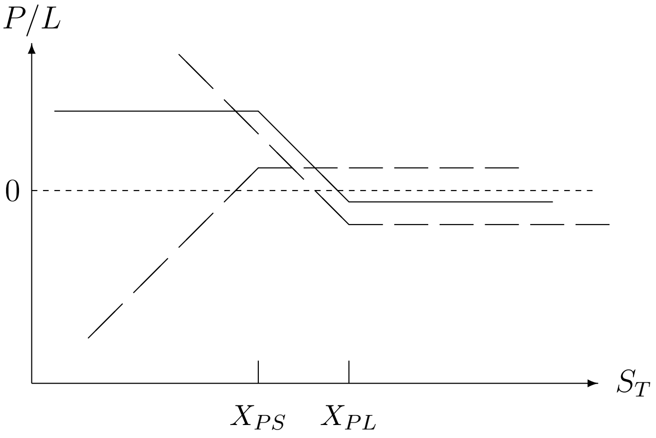
Bear spread of calls = a long and a short call with the strike price of the long call above the strike price of the short call, $X_{CS} < X_{CL}$.



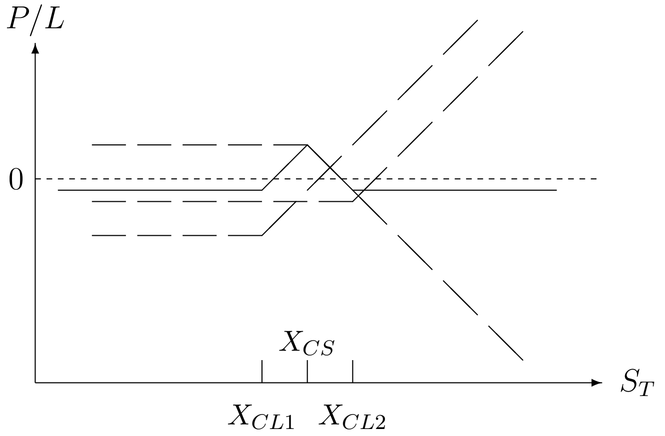
Bull spread of puts = a long and a short put with the strike price of the long put below the strike price of the short put, $X_{PL} < X_{PS}$.



Bear spread of puts = a long and a short put with the strike price of the long put above the strike price of the short put, $X_{PL} > X_{PS}$.



Long butterfly spread = two long calls with a position of 1 each and a short call with a position of 2, such that $X_{CL1} < X_{CS} < X_{CL2}$. Similarly, you can set up a butterfly with 2 different long puts and a short put, such that $X_{PL1} < X_{PS} < X_{PL2}$.



Short butterfly spread = two short calls with a position of 1 each and a long call with a position of 2, such that $X_{CS1} < X_{CL} < X_{CS2}$. Similarly, you can set up a short butterfly with 2 different short puts and a long put, such that $X_{PS1} < X_{PL} < X_{PS2}$ (you got the picture...).

LOS 18.1.A.b: Calculate the cost of the following option-trading strategies: straddle, strangle, bull and bear spreads, and butterfly spread.

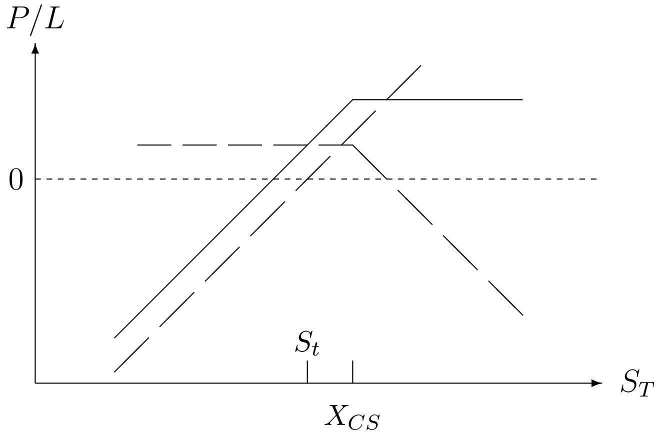
- long straddle: $C_t(S_t, X, T) + P_t(S_t, X, T)$
- short straddle: $-C_t(S_t, X, T) - P_t(S_t, X, T)$
- long strangle: $C_t(S_t, X_C, T) + P_t(S_t, X_P, T)$ where $X_C > X_P$
- short strangle $-C_t(S_t, X_C, T) - P_t(S_t, X_P, T)$ where $X_C > X_P$
- bull spread: $C_t(S_t, X_{CL}, T) - C_t(S_t, X_{CS}, T)$ where $X_{CL} < X_{CS}$ or $P_t(S_t, X_{PL}, T) - P_t(S_t, X_{PS}, T)$ where $X_{PL} < X_{PS}$
- bear spread: $-C_t(S_t, X_{CS}, T) + C_t(S_t, X_{CL}, T)$ where $X_{CS} < X_{CL}$ or $-P_t(S_t, X_{PS}, T) + P_t(S_t, X_{PL}, T)$ where $X_{PS} < X_{PL}$
- long butterfly: $C_t(S_t, X_{CL1}, T) - 2 \cdot C_t(S_t, X_{CS}, T) + C_t(S_t, X_{CL2}, T)$ where $X_{CL1} < X_{CS} < X_{CL2}$
- short butterfly: $-C_t(S_t, X_{CS1}, T) + 2 \cdot C_t(S_t, X_{CL}, T) - C_t(S_t, X_{CS2}, T)$ where $X_{CL1} < X_{CS} < X_{CL2}$

LOS 18.1.A.c: Determine, using a profit/loss diagram, the profit or loss of an option-trading strategy for any asset value.

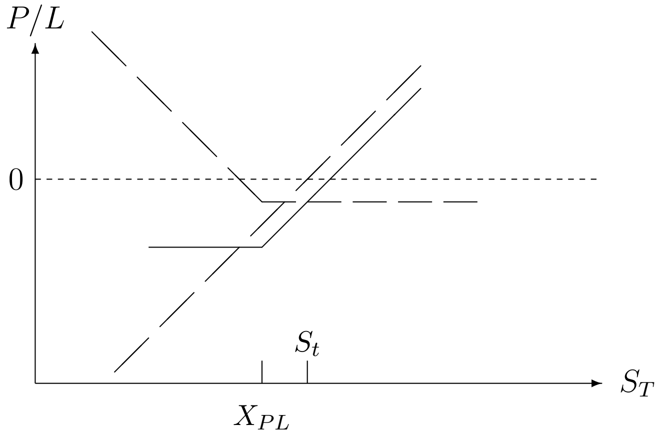
1. Draw the diagram (see LOS 18.1.A.a).
2. Determine the cost of setting up the trade (see LOS 18.1.A.b).
3. Calculate the payoff by summing the payoff for all option positions.
4. Your profit is the payoff minus cost.

LOS 18.1.A.d: Draw the profit/loss diagrams for a covered call (stock plus a short call) and for portfolio hedging (stock plus a long put), at option expiration.

Covered call = long a stock plus short a call:

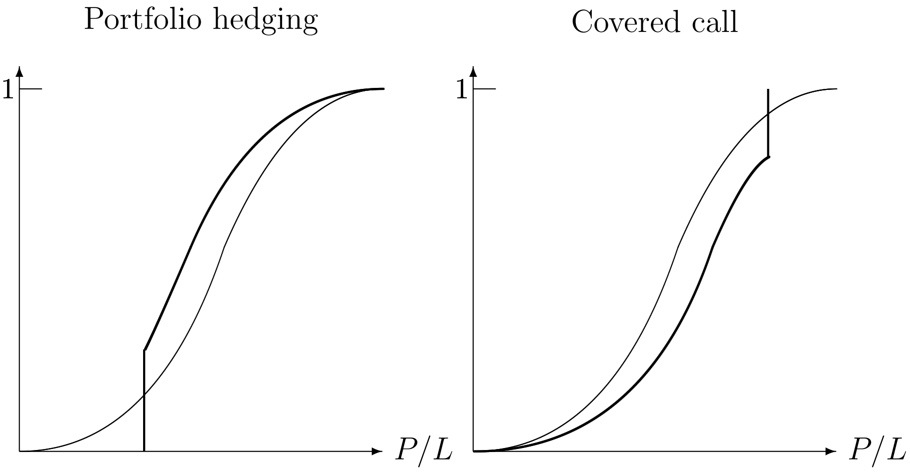


Portfolio hedging = long a stock plus long a put:



LOS 18.1.A.e: Compare the impact of covered calls with the impact of portfolio hedging on the distribution of portfolio value.

The following graph shows the *cumulative probability distribution* of the two strategies (thick lines) compared to the long stock position without an option (thin lines):



LOS 18.1.A.f: Illustrate and explain the differences in expiration profits/losses of a hedged and unhedged portfolio, using the expiration profit/loss diagram of a portfolio hedging strategy and the portfolio (index) profit/loss profile.

The profit/ loss diagram of a portfolio hedging strategy is given in LOS 18.1.d. At expiration, the payoff of a hedged portfolio is equal to $P_T + S_T = S_T + \max(0, X - S_T)$. Given the profit of the unhedged portfolio, $S_T - S_t$ and the cost of the put option, P_t, the hedge only improves portfolio performance if $S_T < X - P_t$ i.e. if the stock price falls more below the strike price than the cost of the put option.

LOS 18.1.A.g: Demonstrate how to create a stock synthetically, using a European put option, a European call option, and a risk-free discount bond.

The following transactions produce a synthetic stock:

- go long a call with expiry T and strike price X
- go short a put with the same expiry data and strike price
- invest an amount $X \cdot e^{-r\cdot(T-t)}$ at the risk free rate

To see this, you must realize that at T the payoff of this portfolio is equal to $\max(0, S_T - X) - \max(0, X - S_T) + X = S_T - X + X = S_T$.

LOS 18.1.A.h: State and explain put call parity.

The put call parity is based on the observation that the following two portfolios must have the same cost:

1. a stock, S_t
2. a synthetic stock portfolio consisting of:
   - a long call with expiry T and strike price X
   - a short put with the same expiry data and strike price
   - a cash amount $X \cdot e^{-r\cdot(T-t)}$ invested at the risk free rate

The put-call parity holds because the two portfolios have the same payoff at expiry. If the price of the portfolios differed, it would be possible to sell the rich portfolio and buy the cheap one; at expiry, you could reverse the trade and cash in the risk-free profit.

The put-call parity can be stated as follows:

$$S_t = C_t - P_t + X \cdot e^{-r\cdot(T-t)},$$

or, rearranging:

$$P_t = C_t - S_t + X \cdot e^{-r\cdot(T-t)}.$$

LOS 18.1.A.i: Calculate, using put call parity, the value of a European call (put), given the corresponding European put (call) value.

$$\begin{aligned} P_t &= C_t - S_t + X \cdot e^{-r\cdot(T-t)} \\ C_t &= P_t + S_t - X \cdot e^{-r\cdot(T-t)} \end{aligned}$$

Note that if $S_t = X$, $C_t > P_t$ because X enters as its discounted value in the put-parity condition.

LOS 18.1.A.j: Show and explain why put call parity must always hold for European-style options.

The put-call parity always holds because otherwise it would be possible to make a risk-free profit. To see this, you can plug any data you like into the put-call parity...

LOS 18.1.A.k: Show how to create synthetic securities using the put call parity relationship.

Because of the put-call parity condition, you can synthetically create any of the four instruments involved with the other three.

18.2 European Option Pricing

LOS 18.1.B.a: Describe how to replicate a European equity call option synthetically, using stocks and bonds.

Take a stock with current price S_t. Assume that next period, the stock price will either move up to $U \cdot S_t$ or down to $D \cdot S_t$. Further assume that one \$ invested today will grow to R\$ at the end of the period.

Now, the task is to find a *combination of n stocks and and the borrowing of b\$* such that the portfolio matches the price of a call option, when the stock goes up, C_U, and when the stock goes down, C_D:

$$\begin{aligned} C_U &= n \cdot (U \cdot S_t) - b \cdot R \\ C_D &= n \cdot (U \cdot S_t) - b \cdot R \end{aligned}$$

n and b are found by solving the two equations with the two variables:

$$\begin{aligned} n &= \frac{C_u - C_D}{(U-D) \cdot S_t} \\ b &= \frac{C_u \cdot D - C_D \cdot U}{(U-D) \cdot R} \end{aligned}$$

Substituting n and b into the portfolio equation $C_t = n \cdot S_t - b \cdot R$ and simplifying yield:

$$\begin{aligned} C_t &= \frac{1}{R}\left[\left(\frac{R-D}{U-D}\right) \cdot C_U + \left(\frac{U-R}{U-D}\right) \cdot C_U\right] \\ &= \frac{1}{R}\left[\pi_U C_U + \pi_D C_D\right] \end{aligned}$$

So, today's call price can be seen as the present value of the expected future call price, with the up and down state weighted at the synthetic probabilities π_U and π_D, respectively.

LOS 18.1.B.b: Discuss alternative methods for estimating volatility inputs for the Black Scholes model.

- You can use *historical volatilities:*

  $$\hat{\sigma}_t = \sqrt{\sum_{i=0}^{n} \frac{s_{t-i} - \bar{s}}{n-1}}$$

  where $s_t = \ln S_t$ and $\bar{s} = \frac{i=0}{n} \sum s_{t-i}$. The problem with historical volatilities is that they are backward-looking rather than reflecting the volatility at this moment.
- You can use *weighted historical volatilites* or the volatilies obtained from a sophisticated *conditional heteroscedasticity model.*
- You can use *implied volatilities.* This requires an option pricing model, and if you use if as input for Black-Scholes, the presence of other traded options on the same underlying.

LOS 18.1.B.c: Calculate, given the Black Scholes model or the binomial model (single- and two-period only), the value of a European call (put) option, using the appropriate inputs.

Using the Black-Scholes model: You simply need to plug the data into the Black-Scholes formula.

$$\begin{aligned} C_t^* &= S_t \cdot N(d_1) - X \cdot e^{-r(T-t)} \cdot N(d_2) \\ P_t^* &= X \cdot e^{-r(T-t)} \cdot N(-d_2) - S_t \cdot N(d_1) \\ \textit{where} \quad d_1 &= \frac{\ln\left(\frac{S_t}{X}\right) + \left(r + \frac{1}{2}\sigma^2\right) \cdot (T-t)}{\sigma \cdot \sqrt{T-t}} \\ d_2 &= d_1 - \sigma\sqrt{T-t} \end{aligned}$$

Remember that you can obtain the put price from put-call parity.

Using the binomial model:

1. Draw the binomial tree. For this, use either the D and U provided or calculate them as:

   $$U = e^{\sigma\sqrt{(\tau)}}, \qquad D = \frac{1}{U}$$

2. At each node, calculate the risk-neutral probabilities for the up and down state:
   $$\pi_U = \frac{R-D}{U-D}, \qquad \pi_D = \frac{U-R}{U-D}$$
   If the interest rate is given in continuous compounding terms:
   $$\pi_U = \frac{e^{r\tau}-D}{U-D}, \qquad \pi_D = \frac{U-e^{r\tau}}{U-D}$$
   where τ is the period tenor.
3. Find the value of the option by backward induction
   $$C_t = \frac{1}{R} \cdot [\pi_U C_U + \pi_D C_D] = e^{-r\tau} \cdot [\pi_U C_U + \pi_D C_D]$$

LOS 18.1.B.d: Draw the single- and two-period binomial tree for both the underlying asset and the corresponding option.

Draw a tree, calculate S_t at each node, find the terminal value of the option and use backward induction to determine C_t.

LOS 18.1.B.e: Describe the conditions under which the binomial tree becomes the Black Scholes model.

The binomial model uses discrete time, the Black-Scholes model uses continuous times. The binomial model converges to the Black-Scholes model as the number of periods becomes very large / the length of each period becomes very small.

LOS 18.1.B.f: Differentiate between volatility and implied volatility.

Volatility = the variability of a series.

Implied volatility = the volatility when put into an option pricing model equalizes the theoretical price with the market price.

LOS 18.1.B.g: Annualize a stocks standard deviation of returns, given either a daily, weekly, or monthly standard deviation.

$$\begin{aligned}\hat{\sigma}_{annual} &= \hat{\sigma}_{daily} \cdot \sqrt{250} \\ &= \hat{\sigma}_{weekly} \cdot \sqrt{54} \\ &= \hat{\sigma}_{monthly} \cdot \sqrt{12}\end{aligned}$$

LOS 18.1.B.h: Explain how the Black Scholes model is adjusted when dividends are paid at a continuous rate.

Dividends are regarded as *capital leaking to the shareholders.* For a trader long a call on a stock, dividend payments reduce S_T and therefore the payoff of the option. Therefore, *dividends push down the value of a call option.*

To take dividends into account, we must *reduce the stock value by dividend payments.* One model that does this, is the Merton model. Merton introduces a fixed dividend rate, δ, that reduces the value of the stock. Note that δ effectively acts as negative interest (imagine you pay your financing cost with dividends), or as *negative cost of carry.* Consequently, the Black-Scholes model becomes

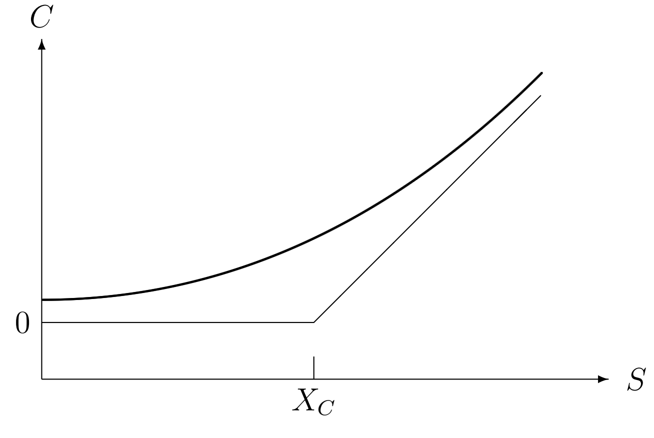
$$C_t = e^{-\delta(T-t)} \cdot S_t \cdot N(d_1) - X \cdot e^{-r(T-t)} \cdot N(d_2)$$

with dividends also entering into the formula of d_1.

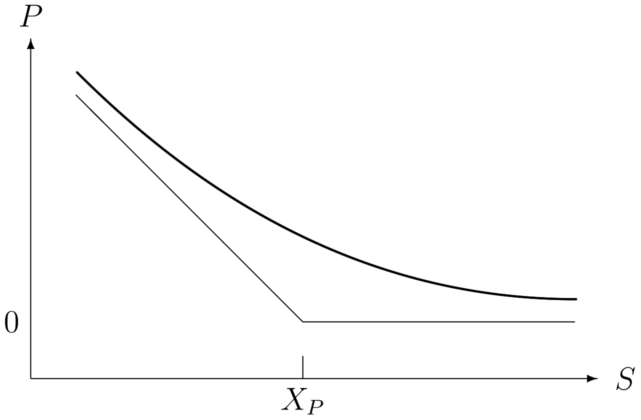
18.3 Option Sensitivities and Option Hedging

LOS 18.1.C.a: Draw the payoff diagram of a European put option or European call option before and at expiration.

European call option: the graph shows a European call before (thick line) and at expiry (thin line):

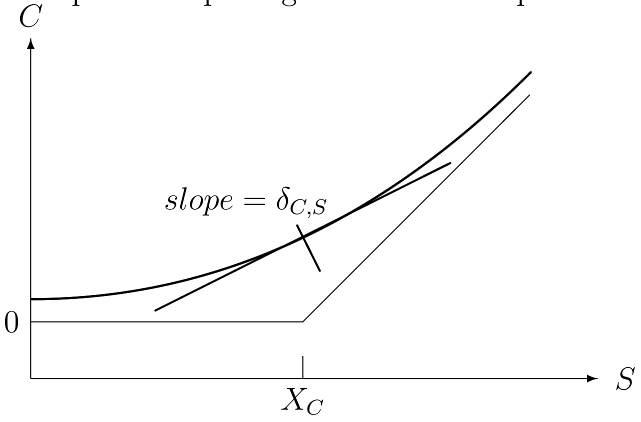


European put option: the graph shows a European put before (thick line) and at expiry (thin line):



LOS 18.1.C.b: Diagram the geometric interpretation of delta, using the payoff diagram of the European put or call before expiration.

Delta (δ) is the slope of the pricing formula of an option:



LOS 18.1.C.c: Calculate the change in option price, given delta and the change in asset price.

$$\Delta C \approx \delta \cdot \Delta S$$

LOS 18.1.C.d: Calculate delta, given the change in option price and the change in asset price.

$$\delta = \frac{\partial C}{\partial S} \approx \frac{\Delta C}{\Delta S}$$

LOS 18.1.C.e: Analyze the properties of a delta-neutral portfolio and relate those properties to hedging.

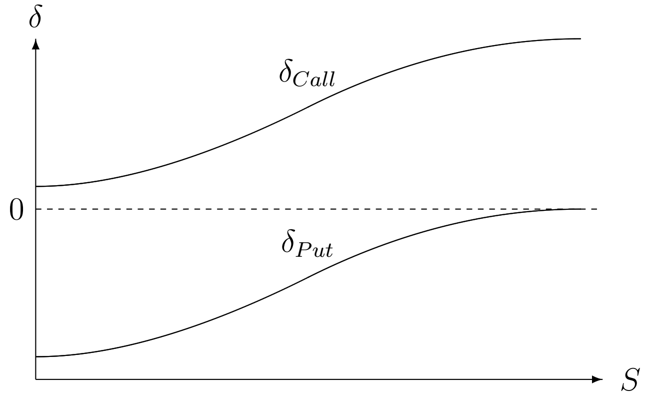
A delta-neutral portfolio is a portfolio consisting of δ long stocks and a short call such that the value of the portfolio does not change with a change in the price of the stock. Approximating the change in the option price with $\Delta C \approx \delta \cdot \Delta S$, the portfolio changes its value due to a change in the stock price by

$$\Delta Portfolio = -\Delta C + n \cdot \Delta S = -\delta \cdot \Delta S + \delta \cdot \Delta S = 0.$$

The delta-neutral portfolio can used to hedge a long stock position: simply sell $\frac{1}{\delta}$ calls for each stock, and the portfolio value will not change for a small change in S. However, because δ changes with S, the portfolio must continuously rebalanced.

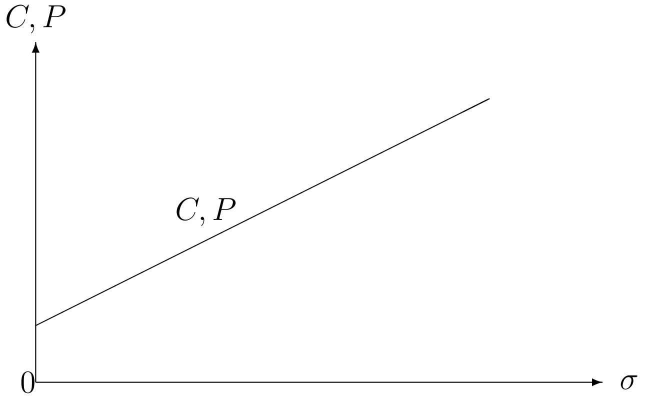
LOS 18.1.C.f: Diagram and explain the delta of a European put or call as a function of asset price.

δ is always positive for call options and negative for put options. In absolute terms, δ is close to 1 for in-the money options and close to 0 for options far out of the money:



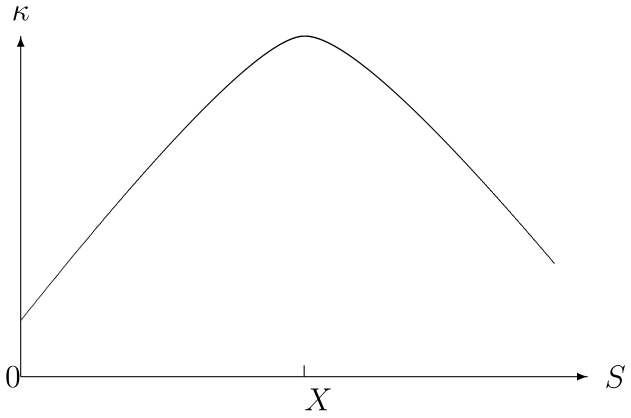
LOS 18.1.C.g: Diagram and explain option price as a function of increasing volatility.

The price of a put and call option increases with volatility at a rate vega / kappa (κ). Volatility increases the time value of an option. The intercept (zero volatility) is determined by the intrinsic value (i.e. calls and puts have different lines).



LOS 18.1.C.h: Diagram and explain an options sensitivity to volatility as a function of asset price.

Kappa, κ, alias vega measures the sensitivity of an option with respect to a change in volatility. κ is highest for options at the money.



LOS 18.1.C.i: Modify the delta-neutral portfolio and show how the portfolio is related to a synthetic call that is created using bonds and the underlying asset.

Keep the number of options to:

$$\begin{matrix} \# \ of \\ optionsatt \end{matrix} = -\frac{number\ of\ stocks}{\delta_t}$$

LOS 18.1.C.j: Illustrate how the delta-neutral portfolio is related to portfolio insurance.

Delta hedging (i.e. keep a portfolio delta-neutral) is a *dynamic strategy that immunizes a portfolio against all changes in S.* In contrast, portfolio insurance is a *static strategy that provides protection to the downside but keeps the upside open.*

LOS 18.1.C.: Relate gamma to changes in an options delta and stock price.

Gamma (γ) measures how δ changes as S changes. Mathematically, it is the second derivative of the option price with respect to the price of the underlying:

$$\gamma = \frac{\partial^2 C}{\partial S^2} = \frac{\partial^2 P}{\partial S^2} = \frac{\partial \delta}{\partial S}$$

γ is the slope of in the diagram of LOS 18.1.C.f. It is always identical for calls and puts. γ tends to be highest for options at the money. It increases as expiration approaches for options at the money but drops for options deep-out and deep-in the money.

18.4 Options on Stock Indexes, Foreign Currency, and Futures

LOS 18.1.D.a: Calculate the value of a European call (put) option, given the formulas for either the Black Scholes model or the binomial model (single- and two-period only) when no continuous dividend is paid by the underlying security.

See LOS 18.1.B.c.

LOS 18.1.D.b: Calculate the value of a European call (put) option, given the formulas for the Merton model when a continuous dividend is paid by the underlying security.

You simply need to plug the data into the Merton formula.

$$\begin{aligned} C_t^* &= e^{-\delta(T-t)} S_t \cdot N(d_1) - X \cdot e^{-r(T-t)} \cdot N(d_2) \\ P_t^* &= X \cdot e^{-r(T-t)} \cdot N(-d_2) - S_t \cdot N(d_1) \\ \textit{where} \quad d_1 &= \frac{\ln\left(\frac{S_t}{X}\right) + \left(r - \delta + \frac{1}{2}\sigma^2\right) \cdot (T-t)}{\sigma \cdot \sqrt{T-t}} \\ d_2 &= d_1 - \sigma\sqrt{T-t} \end{aligned}$$

Remember that you can obtain the put price from put-call parity.

LOS 18.1.D.c: Calculate the value of a European call (put) option, using the appropriate inputs and given the formulas for the Black Scholes model, the Merton model, or the binomial model (single- and two-period only).

See LOS 18.1.B.f, 18.1.D.b, and 18.1.D.d.

LOS 18.1.D.d: Draw the single- and two-period binomial tree for both the underlying asset and the corresponding option for an asset that pays a continuous dividend.

The tree is identical to that of S_t without dividend payments. On the other hand, the risk-neutral probabilities are now calculated as:

$$\pi_U = \frac{e^{(r-\delta)\tau} - D}{U - D}, \qquad \pi_D = \frac{U - e^{(r-\delta)\tau}}{U - D}$$

LOS 18.1.D.e: Illustrate the conditions necessary for the Merton model to be the same as the Black Scholes model.

The models are identical if the continuous dividend rate $\delta = 0$.

LOS 18.1.D.f: Describe the conditions under which the binomial model becomes the Merton model.

A binomiam model becomes the Merton model if

- Dividend payments are included in the calculation of $R = e^{(r-\delta)\tau}$
- The time periods, τ, become indefinitesimaly small.

LOS 18.1.D.g: Show how the Merton model can be adapted to evaluate stock index, foreign currency, and futures options.

Stock index: The Merton model performs better for stock indices than for stocks because the actual dividend payments more closely resemble that of a continuous dividend rate δ.

Foreign currency: δ can be interpreted as negative cost of carry. By replicating a foreign currency future, you will earn interest on the foreign currency balcance. This interest is negative cost of carry. Therefore, for foreign currency futures, δ is set to the foreign interest rate and r to the domestic interest rate.

Futures options: In the cost-of-carry model, the futures price is equal to the future value of the spot price. The growth rate from spot to futures is r and can be interpreted as negative cost of carry δ. So, total cost of carry in the Merton model, $r - \delta$, reduces to zero and the model simplifies considerably.

18.5 Interest Rate Derivative Instruments

LOS 18.2.a: Describe the basic features of an interest rate futures contract.

Futures contract = an agreement that requires a party to the agreement either to buy or sell something at a designated future date at a predetermined price. Futures are standardized and traded on an exchange. Because of the intermediation of the exchange or clearinghouse and the margin, futures are not subject to counterparty risk. The features of a futures contract are:

- futures price = the price at which the future transaction is settled
- settlement date = delivery date = the date at which the future transaction is settled
- margin = a required deposit to guarantee that the party can honour its obligation in the futures contract; at the outset, the parties deposit an intial margin on a margin account; if the amount on the margin account falls below a specified level, they have to pay in a variation margin that reestablishes the initial margin
- mark-to-market = adjustment of the amount in the margin account to changes in the market price of the underlying

Interest rate futures contract = a futures contract based on an interest rate instrument.

LOS 18.2.b: Explain the differences between a futures and forward contract.

- Futures trade on an exchange; forwards are traded over-the-counter.
- Futures are highly standardized (size, settlement date); forwards are highly customized. Standardization of futures allows for an active secondary market.
- Because of margin and intermediation by the clearinghouse, futures are not subject to counterparty risk. Forwards do not generally contain a margin and there is no clearinghouse.

LOS 18.2.c: Describe the delivery options embedded in the Treasury bond futures contract.

Quality option = right of the short to chose the bond to deliver. Treasury bond futures are calculated on the basis of a hypothetical bond of $100,000 par value, 6% coupon, and 20 years tenor at expiry date. For actual delivery, the short may chose one bond in a basket of bonds. He will receive from the long:

$$\begin{matrix}\mathit{Invoice}\\\mathit{price}\end{matrix} = \begin{matrix}\mathit{Contract}\\\mathit{size}\end{matrix} \times \left(\begin{matrix}\mathit{Futures}\\\mathit{STD\ price}\end{matrix} \times \begin{matrix}\mathit{Conversion}\\\mathit{factor}\end{matrix} + \begin{matrix}\mathit{Accrued}\\\mathit{interest}\end{matrix} \right)$$

Normally, the short will deliver the *cheapest to deliver* (CTD) bond. The CTD is the bond with the lowest implied repo rate (the financing rate that would set the profit on a cash-and-carry trade to 0). The implied repo is given by:

$$\left(\frac{\begin{matrix}\mathit{Futures}\\\mathit{price}\end{matrix} \times \begin{matrix}\mathit{Conversion}\\\mathit{factor}\end{matrix} + \begin{matrix}\mathit{Accrued}\\\mathit{at\ expiry}\end{matrix} + \begin{matrix}\mathit{FV\ of\ interim}\\\mathit{coupons}\end{matrix}}{\begin{matrix}\mathit{Cost\ of}\\\mathit{investment}\end{matrix}} - 1 \right) \times \frac{360}{\begin{matrix}\mathit{days\ to}\\\mathit{expiry}\end{matrix}}$$

Timing option = right of the short to chose the delivery date within the defined delivery month.

Wildcard option = right of the short to chose to deliver after the closing price of the futures contract is determined.

LOS 18.2.d: Describe counterparty risk.

Counterparty risk = the risk that one of the parties in a forward contract will not honor its obligations. Counterparty risk is an issue in forward contracts but eliminated for futures by margin requirements and intermediation by the clearinghouse.

LOS 18.2.e: Describe the basic features of an interest rate option contract.

Interest rate option = a contract that gives the buyer (the long), the right but not the obligation to buy (call option) or sell (put option) an interest rate instrument at a specific strike price. Options have a asymmetric risk / reward relationship. They downside of the payoff of the long is limited to the price of the option; as this price is paid at the initiation of the trade, the long does not need to pay margin. On the other hand, the downside of the short is unlimited; therefore, the short must provide margin for exchange traded options.

LOS 18.2.f: Describe futures options, their trading mechanics, and the reasons for their popularity.

Futures option = a contract that gives the buyer (the long) the right but not the obligation to buy (call option) or sell (put option) a futures contract at a specified strike price. Futures options are *settled in cash*, i.e. the futures is immediately marked to the market and the writer (the short) pays any net balance to the long. Futures options are quoted in $\frac{1}{64}\%$ of the notional, i.e. a future quoted at 24 of a notional \$1mio will cost $\$1mio \cdot \frac{24}{64}\% = \$3750$.

Futures options are more popular than options on physicals because:

- no accrued interest calculations
- reduced likelihood of short squeeze (the are 'cleaner')
- pricing of futures contract is more readily available than prices of specific bonds

LOS 18.2.g: Explain why over-the-counter interest rate options are used by institutional investors.

Exchange traded options are standardized, provide a relatively liquid secondary market and are virtually free of counterparty risk because of the intermediation by the exchange and the margin requirements of the short.

Institutional investors like buying over-the counter (OTC), or dealer options for:

- *Customization:* OTC options can be tailored to the specific needs of the clients (particular underlying, timing, size, payoff structure).
- *Use for hedging:* The lack of liquidity is not so problematic for an institution that used the option for asset / liability management and intends to keep the option until expiry.

LOS 18.2.h: Explain an interest rate swap and the relationship between interest rate swaps and forward contracts.

See LOS 17.3.B.b.

LOS 18.2.i: Explain an interest rate cap and floor and the relationship between caps and floors and options.

Interest rate cap (ceiling) = an agreement in which the short agrees to compensate the long over a specific horizon (= the length of the agreement) if the reference rate exceeds a predetermined level (= the strike rate). The agreement specifies a frequency of settlement (e.g. quarterly) and a notional on which cash flows are calculated. It can be viewed as a package of options, with a separate option for each settlement date (a caplet). For the long of an interest rate cap, the cap actually limits the maximum financing cost if he is subject to floating-rate financing.

Interest rate floor = an agreement in which the short agrees to compensate the long over the length of the agreement if the reference rate falls below the strike rate. It can be viewed as a package of options, with a separate option for each settlement date (a floorlet).

LOS 18.2.j: Compute the payoff for a cap and a floor.

$$\begin{aligned} CF_{cap,t} &= notional \times \tau \times \max\left(0, LIBOR_{t-\tau,\tau} - X\right) \\ CF_{floor,t} &= notional \times \tau \times \max\left(0, X - LIBOR_{t-\tau,\tau}\right) \end{aligned}$$

where τ is the length of each settlement period, X is the strike rate, and $LIBOR_{t-\tau,t}$ is the τ-period LIBOR rate at the beginning of the settlement period (caps and floors are determined in advance and settled in arrears).

LOS 18.2.k: Contrast options on interest rates and options on fixed income securities.

Call options on interest rates provide a positive cash flow to the long if *interest rates rise*. Call options on fixed income securities provide a positive cash flow to the long if the value of the instrument rises, i.e. if *interest rates fall*. Caps and caplets are options on interest rates. (Analogously for puts.)

LOS 18.2.l: Interpret cap and floor positions in isolation and when combined with an existing position.

A cap or floor position in isolation is equivalent to a package of interest rate calls and puts, respectively (or, alternatively, fixed income puts and calls). A cap combined with a short FRN (i.e. a borrower floating) effectively provides a cap on borrowing costs. A floor combined with a long FRN (i.e. a mortgage bank) effectively provides a floor on investment income.

18.6 What Does an Option Pricing Model Tell Us about Option Prices

LOS 18.3.a: Explain why using the dynamic riskless arbitrage strategy (the force behind the Black Scholes option pricing model) is difficult in real markets.

- There are risks: continuous time rebalancing at infinite fractions is not feasible.
- There are costs: transaction costs.
- There is uncertainty: volatility cannot be known exactly.

LOS 18.3.b: Identify the factors that are not part of the Black Scholes option pricing model but that may still affect option prices.

- taxes
- transaction costs
- margins
- interactions with related financial instruments
- restrictions on short sales
- differences between market participants

These factors may drive the price of an option away from its value or create *arbitrage bounds* around the model value. Arbitrage bounds can be very wide (e.g. Figlewski reports option values of $1.74-2.35 without arbitrage opportunities).

LOS 18.3.c: Discuss the reasons the Black Scholes model may be wrong.

The Black-Scholes model is wrong if its assumptions are violated:

- *Volatility is not constant* over a longer time horizon.
- Security movements do not follow a geometric brownian motion but have *fat tails.*
- There is some *non-randomness* in stock prices.

- Black-Scholes build on continuous rebalancing, so it is definitely inappropriate for *non-traded assets* (e.g. you should not value the put option in a corporate bond with Black-Scholes as the company is not traded independently of the bond).

LOS 18.3.d: Discuss the reasons the Black Scholes model may provide the correct value of an option even though that value is different from the market price of the option.

The Black-Scholes model can still give the right answer, and the market is is wrong. The market may be away from the fair value of an option because of the *absence of arbitrage possibilities*. Examples:

- Out-of-the-money options are attractive for buyers as substitute for lottery tickets, but hedging against large price movements is hard for sellers. Therefore, such options trade away from the fair value at a premium.
- American options are hard to value. People don't like that and so these options trade away from any theoretical value.
- Bundling securities can change the total price adds value for investors (that's why they pay a premium on CMOs). Therefore, we should not expect embedded options to trade at the fair value of the option alone.
- Hedging becomes hard in times of crises, so don't expect market prices to be fair...

Study Session 19

Alternative Investments

19.1 Valuing Real Estate

LOS 19.1.a: Compare the valuation of real estate with the valuation of financial assets.

Simiarities

- The value of financial assets and real assets is the present value of the cash flow generated by the asset.

Differences

- Real assets are illiquid.
- Real assets often have finite life (at least homes, not so land) while financial assets tend to have infinite lifes with their value increasing over time. This difference is reflected in the terminal value.

LOS 19.1.b: Discuss the measurement problems inherent in real estate valuation.

Most measurement problems in real estate valuation refer to the risk premium. The discussion can refer to CAPM and APT:

Measurement of systematic risk: Obtaining a β for real assets is pretty hard. A price history for a given real asset is seldom available. Instead, some kind of real estate index must be used. This is not without problems (the index may behave differently than the property at hand; the index may be smoothed due to infrequent appreciations). Moreover, to obtain a β the real estate index has to be regressed against a market portfolio. Unfortunately, the choice of the market portfolio is far from straightforward. Using a commonly available stock index will underestimate the correlation with the 'market' and, therefore, bias the β downward.

Adjustments for other risk factors: Real investments are subject to additional risk factors that are not captured by CAPM and are hard to integrate into an APT framework:

- lack of liquidity: depends on the investment horizon and economic conditions (liquidity tends to increase in a boom but disappears in a bust); in practice, you may subtract a liquidity discount
- legal risk: real assets are particularly exposed to changes in legislation (tax law, zoning requirements)
- information costs: information cost is high for real assets

Measurement of non-systematic risk: APT and CAPM assume that non-systematic risk can be diversified away. This may not be true for real assets. However, you may argue that non-systematic risk should not be an issue because investors can invest in REITS, the lack of diversification is sometimes the result of an explicit view, and diversification is achievable for institutional investors.

LOS 19.1.c: Discuss how real estate indexes are used to address measurement issues, and compare real estate indexes with other financial indexes.

Real estate indices are used as a proxy for the behavior of property prices. By regressing these indices, β can be calculated and used for determining an appropriate discount rate. The following real estate indexes are used:

Real Estate Investment Trusts: REITS are frequently traded and can be used to gauge the evolution of market prices of properties. However, the properties owned by REITS may not be representative for the real estate market. In practice, REITS behave more like small cap equity rather than property.

Frank Russell Company Index: This index is based on commingled properties owned by real estate equity funds (CREFs). Appraised values of the properties is used for the pricing. This leads to smoothing and serial correlation.

Case and Shiller Index: Contrary to the Frank Russell data, this index is based on actual transaction prices.

LOS 19.1.d: Discuss the impact of the choice of the market portfolio on the evaluation of real estate investments.

CAPM is derived for the representative investor who optimizes the allocation of *all his net assets* in the risk-return space. Consequently, in theory, systematic risk should be measured with respect to all assets in the economy.

In practice, stock indices (e.g. S&P500) are often used as proxy for the market index. Stocks react differently than real assets to swings in economic activity. The reaction of stocks to inflation tends to be negative, while property prices increase with inflation. Consequently, the return of a market portfolio that includes real estate will be different from a market portfolio consisting only of stocks. For this reason, when using stock indices as proxy for the market index, the correlation between real estate and the market will be underestimated. A low β results in a low risk premium and a cost of capital that is too low.

LOS 19.1.e: Recommend some practical solutions for estimating risk parameters.

- Regress an index of real estate investments against returns of a consolidated market portfolio (i.e. a market portfolio that includes all assets in an economy). Remaining problems: real estate data are still smoothed due to the appraising process, and only low frequency data are available.
- Use the risk characteristics of REITs and master limited partnerships. Remaining problems: securitized investments like REITs may behave differently than direct investments (try to find a REIT that invests in the same class of property).
- Use the underlying sources of cash flow to derive the risk factors (e.g. use retail store data to gauge the performance of a shopping mall).

LOS 19.1.f: Evaluate the impact of diversification, liquidity, legal changes, and information cost on the real estate investment decision.

Diversification: The market β may underestimate risk because it assumes perfect diversification. Real assets are often too big to be diversified. Opposite arguments:

  - Investors chose concentration because they think they have specialized knowledge.
  - It is often possible to only buy a small share in a property or to invest in a diversified pool of properties.
  - Institutional investors are big enough to diversify their real estate holding. They are the marginal investors that define the discount rate.

Liquidity: Real estate markets are less liquid because there is a smaller number of participants, transaction costs are high, and information is scarce. For an investor, the premium for lack of liquidity depends on the time horizion of the investments and the economic environment (liquidity increases in booms). In practice, value to property assuming a liquid market, then subtract a lack-of-liquidity discount.

Legal changes: Real assets are exposed to the tax code and to local laws (zoning requirements, property taxes, rent controls). This risk is hard to price in.

Inforamtion cost: Real estate transactions require specialised and local knowhow. The market, therefore, contains more noise that gives rise to investment opportunities.

LOS 19.1.g: Discuss the survey approach to modeling as a technique for estimating discount rates.

Instead of deriving a discount rate via the CAPM or APT, simply ask investors what cost of capital they require.

Advantages:

- no abstract and dubious model required
- you can ask for specific types of property
- the approach is feasible because the number of large investors is small

Disadvantages:

- there are different types of investors that give a range of discount rates; it is not clear what answer drives the market
- participants in the survey have different levels of risk
- investors in real estate become more and more heterogeneous; answers by participants that invest for structuring pass-throughs are not very useful
- survey data do not allow an internal check for reasonableness (in CAPM, the cost of capital will always be higher than the risk-free rate)
- estimates based on a model can be used proactively (use the forecast of your risk factors)

LOS 19.1.h: Differentiate between the cost of equity and the cost of capital as those two costs apply to real estate investments.

Cost of equity (k_e) = discount rate used to value cashflows to equity (i.e. after debt payments).

Cost of capital (k_w) = discount rate used to value predebt cashflows.

The cost of capital is weighted avergage of the cost of equity and the cost of debt: $k_w = w_e k_e + w_d k_d$, where the w_e denotes the weight of equity relative to total capital, $w_e = \frac{Equity}{Equity+Debt}$, and the cost of debt is equal to the after-tax interest rate, $k_d = (1 - tax\ rate) \cdot Interest\ rate$.

LOS 19.1.i: Discuss the estimation of cash inflows and cash outflows.

Cash inflows: basically rent and lease payments. Factors to consider:

- Rents: Past trends give a first idea. In a stable real estate market, future trends should be close to the expected inflation rate. Rents will grow faster in a tight market with low vacancy rates.

- Vacancy rate: vacancies depend on the demand and supply for this type of property and on general economic conditions.
- for leases, the terms of the lease

Cash outflows: expenses take the form of property taxes, insurance, repairs, maintenance, and marketing costs. Factors to consider:

- Reimbursability: tenants may have to pay for some expenses
- Expenses stop: office leases often put a cap on the expenses to be paid by the owner; the tenant pays the rest.

LOS 19.1.j: Compare the basic approaches to estimation of the terminal value.

Growth at expected inflation rate: Simply assume that the value of the property increases at the same rate as general prices. Problem: the approach implicitly assumes that the current price is fair.

$$P_n = P_0 \cdot (1 + Inflation\ rate)^t$$

Constant growth of cash flows: Assume that the cash flows after the terminal year continue to grow at a constant rate forever.

$$P_n = \frac{CF_{n+1}}{\overline{k}_w - \overline{g}}$$

Capitalization rate: Analytically similar to the constant growth rate of cash flows.

$$P_n = \frac{CF_{n+1}}{\overline{k}_c},$$

where k_c denotes the capitalization rate. The link to the infinite growth mode is straightforward. Comparing the two estimates of P_n yields:

$$\frac{CF_{n+1}}{\overline{k}_w - \overline{g}} = \frac{CF_n \cdot (1 + \overline{g})}{\overline{k}_w - \overline{g}} = \frac{CF_{n+1}}{\overline{k}_c} \Leftrightarrow \overline{k}_c = \frac{\overline{k}_w - \overline{g}}{1 + \overline{g}}$$

LOS 19.1.k: Estimate the value of a real estate property, using a discounted cash flow model.

1. Estimate the discount rate. Obtain β by regressing real estate returns against a consolidated market portfolio. Calculate the cost of equity, $k_e = r_f + \beta\varphi_{real\ estate}$ and the cost of debt, $k_d = Interest\ rate \cdot (1 - tax\ rate)$. Determine the financing mix w_d and w_e. Finally, calculate the weighted cost of capital, $k_w = w_e k_e + w_d k_d$.

2. Estimate the cash inflows for the extraordinary-growth period:

$$CF_{in,i} = \begin{matrix}\textit{Rentable}\\ \textit{space}\end{matrix} \times \left(1 - \begin{matrix}\textit{Vacancy}\\ \textit{rate}\end{matrix}\right) \times \begin{matrix}\textit{Rent per}\\ m^2\end{matrix}$$

3. Estimate the cash outflows for the extraordinary-growth period:

$$CF_{out,i} = \begin{matrix}\textit{Fixed operating}\\ \textit{expenses}\end{matrix} + \begin{matrix}\textit{Variable operating}\\ \textit{expenses}\end{matrix} + \begin{matrix}\textit{Real estate}\\ \textit{taxes}\end{matrix}$$

4. Estimate free cash flow

$$CF_i = (1 - \textit{tax rate}) \cdot (CF_{in,i} - CF_{out,i}) - \begin{matrix}\textit{Capital}\\ \textit{expenditures}\end{matrix}$$

5. Estimate a terminal value

$$P_n = \frac{CF_{n+1}}{\overline{k}_w - \overline{g}}$$

6. Estimate the present value, using a two-stage model:

$$P_0^* = \sum_{i=1}^{t} \frac{CF_i}{(1+\overline{k}_w)^i} + \frac{P_n}{(1+k_w)^n}$$

Alternatively, you could adjust CF_i for interest payments and use k_e instead of k_w for discounting in order to obtain the value of equity. The difference between the value of equity and the value of property should be equal to the value of debt.

LOS 19.1.l: Discuss the advantages and disadvantages of using a comparable valuation approach in real estate valuation.

Advantages

- It can be used for valuing assets that do not generate cash flows.
- It may capture changes in underlying conditions that are not yet reflected in cash flows (rent control laws may prevent adjustment of rents).
- It is much simpler than discounting cash flows.
- In theory, comparables should work quite well for real estate assets because there are often several houses in an area with the same growth and risk characteristics.

Disadvantages

  - It requires the definition of a comparable. Most adjustments for location and age are basically subjective (standardization for size and income, on the other hand, is straightforward).

LOS 19.1.m: Estimate the value of a property using comparable sales information.

- You can use average price per square foot of the comparables and multiply this number with the square footage of the property.
- You can use average price per dollar of gross rent of the comparables and multiply this number with the gross rent of the property.

19.2 Clients for Alternative Assets: Institutional Investors

LOS 19.2.a: Discuss investor considerations with respect to alternative investments as an asset class.

Variability among manager performance: The difference between the best performing manager and the worst performing manager is much greater for alternative investments. The choice of the manager becomes crucial.

Market timing: Typically, venture capital funds have a limited time frame. Venture capital funds that start in the same year are subsumed in the same 'vintage year'. Performance varies between vintage years. Institutional investors should avoid concentration in a given year but rather spread their investments among different vintage years.

Timing of returns: Returns in venture capital funds typically follow a J-curve (no returns at the beginning, high returns in the end). This is additional argument for pacing the investment over time.

Commited versus invested capital: If you invest in a venture capital fund, you do not pay in immediately the whole amount. Instead, investors commit a certain amount. The fund manager then calls the commitments over a certain period (e.g. 4 years). In the same period, the first disbursement are made (sometimes because an investment went down the river, sometimes because a firm was taken over etc.). Consequently, invested capital rarely reaches the amount of capital commited.

Terms and conditions: Institutional investors must make sure that the terms and conditions align their interest with that of the manager. Crucial aspects:

- Investors like to see the general partner (i.e. the manager) to hold a large share of the fund.
- Management fees tend to be higher than for other funds (typically 1-2.5%). The justification of the fee is more important than the absolute amount. Watch out for hidden fees.
- The manager typically participates by 20% of performance (= *carried interest*). Performance can be measured against capital invested or capital invested plus a preferred interest in the order of 9%.

LOS 19.2.b: Illustrate the J-Curve and explain how the concept might be used by institutional investors in their asset allocation decisions.

The J-curve describes the typical evolution of retunrs over the life of a venture capital fund:

1. At the beginning, the manager invests capital in promising enterprises.
2. Over the first 2-3 years, some investments turn out as a flop. They go bust, and most of the funds invested in them must be written off. Other investment perform as hoped, but as long as they are kept in the portfolio, the are *carried at cost* and do not show a positive return. Consequently, the returns of the fund are negative in the first couple of years.
3. After this initial phase, some investments are written up in value, leading to break-even around year 5.
4. After year 5, the manager starts to sell the successful investments (IPOs or take-overs or whatever). This leads to liquidity and high returns in the later phase of the fund.

LOS 19.2.c: Evaluate how capital invested, management fees, and carried interest affect both investors and management.

Capital invested: If the manager has a considerable amount of his own resources invested in the fund, he will avoid excessive risk and his interest in the performance of the fund are identical to that of the investor.

Management fee: The higher the fee, the more the manager gets and the more the investor has to pay. If the fee is too low, however, the manager may not be very motivated or take excessive risk to make the deal pay. Investors have an interest that the fee covers reasonable expenses.

Carried interest: Performance participation is a double-edged sword. It motivates managers to do their best, but it can also give an incentive to take more risk. Carried interest should be calculated net of fee and on a total fund basis (rather than for individual investments).

19.3 Selecting and Structuring Investments: The Venture Capitalists Perspective

LOS 19.3.a: Describe how venture capital deals are generated.

Deal flow refers to the investment opportunities generated by the venture capitalist. The capacity to generate deal flow distinguishes a good venture capitalist from a mediocre one. Sources of deal flow:

Referrals: Most deals come from hints of clients, managers in the existing portfolio, friends, limited partners etc. Investment bankers and attorneys provide particularly good ideas, because they have pre-screened the market.

Direct prospecting: Some deals can be found by screening company and technology directories, attending trade shows, traveling the country.

Company management: Make yourself known by advertising, distributing brochures and effectively making investments.

Once you have a pool of ideas, screen them (= check whether they fit in your portfolio) and carry out a due diligence analysis of the potential deals.

LOS 19.3.b: Analyze the due diligence process and evaluate its effect on the effectiveness of an investment strategy.

Once a potential investment target is identified, a due diligence analysis, taking 4-12 weeks, is carried out. The topics covered by the due diligence process: Management team, the prospects of the product, the market (competitive structure and how the product fits), the financial plan, and the timing of the investment. Elements of the process:

Management interviews: Meet with management to understand their goals, capabilities, responsibilities, and whether it is possible to establish a working relationship with them. Also check the personal references and carry out background checks.

Customer and vendor references: If there are already, check whether they are satisfied with the products of the company and why the are clients. Also check the vendors.

Financial analysis: Peel apart the revenue and expenditure model and question all underlying assumptions. Value the venture.

Legal analysis: Explore all legal issues like patents, royalties, warranties, and contingencies.

Third-party analysis: Hire a consultant that does some additional analysis.

LOS 19.3.c: Explain the issues that affect the valuation of a venture capital investment.

- Return expectations are generally evaluated on the basis of an internal rate of return, compared to the return objectives of the portfolio.
- Risk is not easy to quantify (e.g. what is the risk of poor management?), but pretty crucial.
- The stage of the company (is it early-stage or mezzanine?) will affect valuation.
- Valuation of comaparables
- Liquidity
- Amount of influence the venture capitalist can exercise
- Possibility of future dilution

LOS 19.3.d: Differentiate the concerns of the entrepreneur from the concerns of the venture capitalist when structuring an investment.

Entrepreneur concerns:

- keep a job and a role in the company
- participate in the upside
- get the capital to fund planned growth without affecting future funding policy
- know-how and value of advice by the venture capitalist

Venture capitalist concerns:

- get good balance of risk and return
- participate in the upside (opportunity to increase stake if the venture works fine) with downside protection; this is often achieved with convertible preferred stock or subordinated debt with warrants
- establish a good working relationship with management

Study Session 20

Portfolio Management

20.1 Efficient Capital Markets

LOS 20.1.A.a: Describe the set of assumptions that imply an efficient capital market

The three assumptions behind an *informationally efficient* market are:

1. a large number of competing profit-maximizing participants analyze and value securities
2. new information regarding securities comes to the market in a random fashion
3. competing investors attempt to adjust security prices rapidly to reflecct the effect of new information

Under these assumptions, security prices adjust rapidly to the arrival of new information and, therefore, the current prices of securities reflect all information about the security.

LOS 20.1.A.b: Discuss the three forms of the efficient market hypothesis

Weak form EMH: The price of a security reflects all security-market information. Hence, you cannot predict the next price movement based on the historical sequence of prices, trading volume data and other data generated by this security's market, like odd-lot transactions, block trades, and transactions by exchange specialist or other unique groups. The weak form EMH precludes the success of technical analysis.

Semi-strong form EMH: Security prices reflect all publicly available informaiton. Hence, you cannot predict the next price movement, even if you take into account nonmarket information such as P/E ratios, dividend-yield ratios, price-book ratios, stock splits, macroeconomic or political data.

Strong form EMH: Security prices reflect all public and private information. Hence, you cannot predict the next price move based on private information. In fact, nobody has any relevant private information at all. Implicitly, the strong form EMH assumes perfect markets, in which all information is cost-free and available to everyone at the same time.

LOS 20.1.A.c: Explain the implications of efficient capital markets for technical analysis, fundamental analysis, and portfolio management

Technical analysis: Under weakly efficient markets, technical analysis cannot produce excess returns. Empirical evidence shows that technical trading rules depending only on historic price data will not produce abnormal returns after transaction costs.

Fundamental analysis: Fundamental analysis can produce excess returns only if you produce a better estimate of the intrinsic value than the market. Under semi-strong efficient markets, this is unlikely as long as you depend on past data. To outperform, you must do a superior job in understanding the drivers of prices and in predicting movements in those variables. Basically, you must be able to predict earnings surprises.

Portfolio management: Active management can only produce superior results if it relies on superior analysis. This means that in principle, you should invest passively if you don't have a superior analyst. In this case, concentrate on

1. determine and quantify adequate risk levels
2. construct appropriate efficient portfolio
3. diversify completely to eliminate non-systematic risk
4. rebalance to keep the adequate risk level
5. minimize all kinds of costs (turnover, liquidity costs, taxes)

20.2 Portfolio Management

LOS 20.1.B.a: Describe the concept of risk aversion.

Risk aversion means that given a choice between two assets with equal rates of return, an investor will normally select the asset with the lower level of risk. Examples to explain risk aversion: bond spreads above default levels, insurance. Technically, you can model risk aversions by a utility function with decreasing marginal utility (the concavity will then lead to declining expected utility as the variance increases).

LOS 20.1.B.b: Identify several measures of risk and explain the circumstances in which their use might be appropriate in both stand-alone and portfolio contexts.

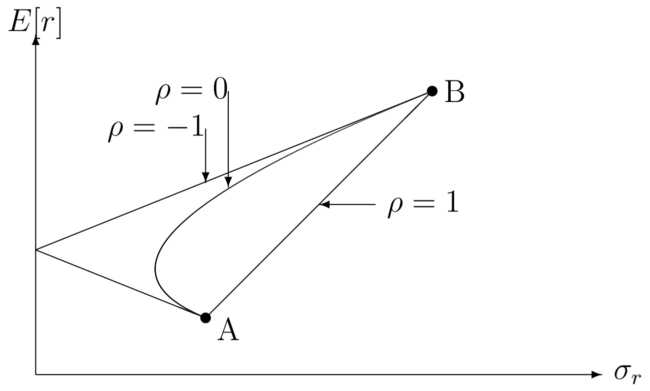
- *Variance and standard deviation*: shows dispersion around the expected return.
- *Range of returns*: shows best and worst case.
- *Shortfall probability*: shows the risk of not achieving a given minimum return.
- *Semivariance:* dispersion below the mean return.
- *Value at risk:* maximum risk at a given confidence level in monetary terms.

LOS 20.1.B.c: Compute the standard deviation of rates of return for a risky asset.

$$\sigma_r = \sqrt{\sum} \pi_i (r_i - E(r_i))^2$$

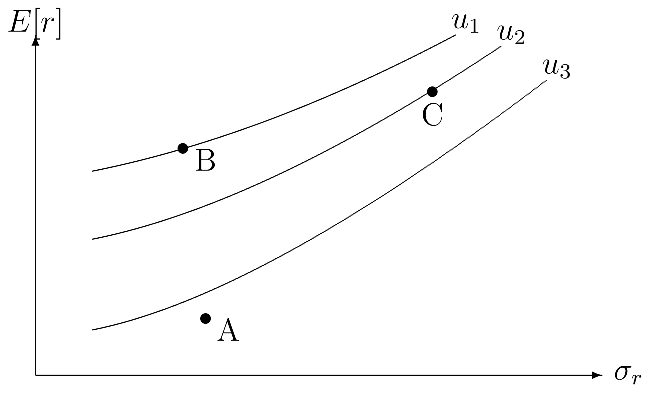
LOS 20.1.B.d: Describe and illustrate the change in the risk-return tradeoff of a two-asset portfolio as the correlation between the two assets changes in specified ways.

$$\begin{aligned} E[r] &= w_A E[r_A] + (1 - w_A) E[r_B] \\ \sigma_r &= \sqrt{w_A^2 \sigma_A^2 + (1 - w_A)^2 \sigma_B^2 + 2 w_A w_B \sigma_{AB}} \\ &= \sqrt{w_A^2 \sigma_A^2 + (1 - w_A)^2 \sigma_B^2 + 2 w_A w_B \rho_{AB} \sigma_A \sigma_B} \end{aligned}$$



LOS 20.1.B.e: Explain and illustrate, in the absence of a risk-free asset, how a given investor would choose an optimal risky portfolio from a given set of alternative portfolios.

The investor chooses the portfolio that gives him the highest level of utility. Graphically, use indifference curves. If two portfolios lie on the same indifference curve (i.e. they give the same level of utility), the investor can choose by tossing a coin.



LOS 20.1.B.f: Describe and calculate the expected return and variance of a two-asset portfolio.

$$\begin{aligned} E[r] &= w_A E[r_A] + (1 - w_A) E[r_B] \\ \sigma_r &= \sqrt{w_A^2 \sigma_A^2 + (1 - w_A)^2 \sigma_B^2 + 2 w_A w_B \sigma_{AB}} \\ &= \sqrt{w_A^2 \sigma_A^2 + (1 - w_A)^2 \sigma_B^2 + 2 w_A w_B \rho_{AB} \sigma_A \sigma_B} \end{aligned}$$

The expected return is the weighted mean expected return (the weights equal to the weight of each asset in the portfolio). The variance will crucially depend on the covariance between the assets. If the covariance is smaller than one (or even negative), the portfolio will profit from diversification effects.

LOS 20.1.B.g: Describe and calculate the covariance and correlation coefficient between two assets' returns.

The covariance is defined as the second moment of the joint distribution and estimated via the sum of the products of deviations from the mean:

$$\begin{aligned} \sigma_{AB} &= E\left\{(r_A - E[r_A])(r_B - E[r_B])\right\} \\ Cov_{AB} &\doteq \frac{1}{n-1} \sum_{i=1}^{n} \left(r_{A,i} - \overline{r}_A\right)\left(r_{B,i} - \overline{r}_B\right) \end{aligned}$$

where $\overline{r}_A = \frac{1}{n}\sum_{j=1}^{n} r_{A_j}$. The correlation coefficient is calculated on the basis of the covariance and standard deviations:

$$\begin{aligned} \rho_{AB} &= \frac{\sigma_{AB}}{\sigma_A \sigma_B} \\ r_{AB} &= \frac{Cov_{AB}}{s_A s_B} \end{aligned}$$

$$= \frac{\sum_{i=1}^{n}\left(r_{A,i}-\overline{r}_A\right)\left(r_{B,i}-\overline{r}_B\right)}{\sqrt{\sum_{i=1}^{n}\left(r_{A,i}-\overline{r}_A\right)^2}\sqrt{\sum_{i=1}^{n}\left(r_{B,i}-\overline{r}_B\right)}}$$

Note that the adjustment for the bias in the estimate of sample variance ($n-1$ in the denominator) is not necessary in the calculation of r because n appears in Cov_{AB} as well as in the estimate of σ_A and σ_B; it cancels out in the last expression.

LOS 20.1.B.h: List the statistical inputs necessary to apply Markowitz portfolio theory in a large portfolio context.

1. a vector of expected returns

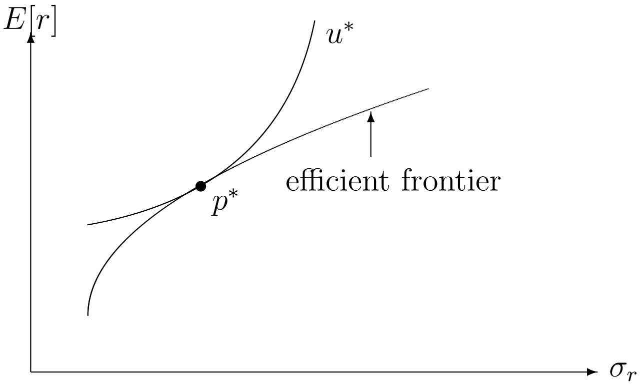
2. a covariance matrix of returns (i.e. the variance of each instrument plus the covariance or correlation coefficient for each pair)

LOS 20.1.B.i: Explain and illustrate the concept of the efficient frontier.

The efficient frontier shows, for a given level of risk, the highest expected return that can be achieved by combining the members of a set of securities in a portfolio. Turning the argument around, it gives the lowest level of risk, for a given target expected return, that can be achieved by combining the members of the set of securities. The link between expected returns and risk is given by the formulas

$$\begin{aligned} E[r_p] &= \sum_i w_i E[r_i] \\ \sigma_p &= \sqrt{\sum_i \sigma_i^2 + \sum_{i,j\neq i} \sigma_{i,j}} \\ \sum_{i=1}^{n} &= 1 \end{aligned}$$

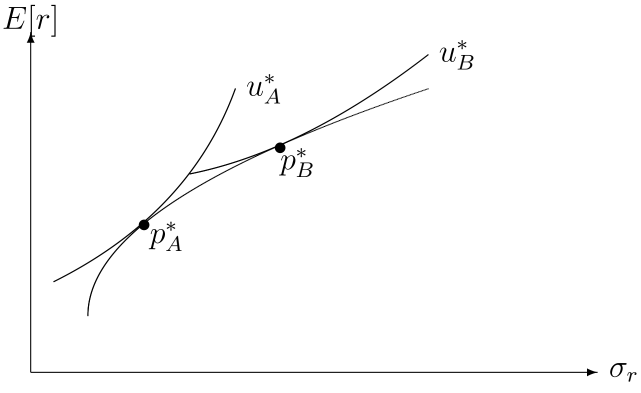
Graphically, the three functions combine in a concave line in the $E[r]$-σ_r-space:



The efficient frontier shows the set of efficient portfolios. Any portfolio lying below the frontier is not efficient (you can achieve lower risk for the same level of expected returns by further diversification).

LOS 20.1.B.j: Describe and illustrate, using utility analysis, how a risk averse investor selects his optimal portfolio.

For an investor, the optimal portfolio is the portfolio on the efficient frontier that gives him the highest level of utility. Graphically, the optimal portfolio is given by the point at which the utility function is tangent to the efficient frontier - p^*). The more risk aversion, the steeper the utility function, the less risky the optimal portfolio.



20.3 Asset Pricing Models

LOS 20.1.C.a: Distinguish between the original capital market theory assumptions and the revised assumptions that underlie the capital asset pricing model (CAPM).
The original assumptions of capital market theory are:

1. investors are efficient mean-variance optimizers
2. lending and borrowing possible at the risk-free rate
3. homogeneous expectations (all investors have the same probability distribution of returns)
4. identical one-step investment horizon
5. investments are indefinitely divisible
6. no transaction costs and taxes
7. no inflation or inflation fully reflected in prices
8. capital markets are in equilibrium

The CAPM has two additional assumptions:

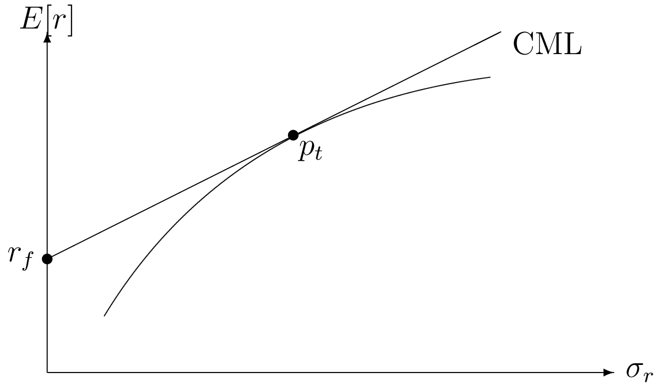
1. quadratic utility function
2. normally distributed returns

LOS 20.1.C.b: Explain how the presence of a risk-free asset changes the characteristics of the Markowitz efficient frontier.

A risk-free asset has a variance of zero ($\sigma_f = 0$). Consequently, its covariance with a risky asset is also zero ($\sigma_{if} = 0$). Recalling the formula for the risk of a two-asset portfolio, we see that a combination of the risk-free asset with a risky asset (or a risky portfolio) is given by

$$\begin{aligned}
\sigma_p &= \sqrt{(1-w_f)^2\sigma_i^2 + w_f^2\sigma_f^2 + 2\sigma_{if}} \\
&= \sqrt{(1-w_f)^2\sigma_i^2 + 0 + 0} \\
&= (1-w_f)\sigma_i.
\end{aligned}$$

This means that the risk of the total portfolio is linear in w_i. Because the expected return is also linear in w_i ($E[r] = (1-w_f)r_i + w_f r_f$), the combination of a risk-free asset with any risky asset will yield a straight line in the σ-$E[r]$-space. The risky portfolio that yields, in combination with the risk-free portfolio, the highest level of expected return for a given level of risk, is known as tangency portfolio. The line connecting the tangency portfolio with the risk free rate is called the *capital market line (CML)*, and it is tangent to the efficient frontier of risky assets. The CML represents the efficient frontier in the presence of the risk-free asset.



Note that under the assumptions listed in LOS 20.1.C.a, all points on the CML are achievable. The points to the left of the tangency portfolio can be achieved by investing a part of the portfolio in the tangency portfolio and the rest in the risk-free asset. Points to the right can be achieved by borrowing at r_f and investing all the cash in the tangency portfolio (leverage).

LOS 20.1.C.c: Describe the market portfolio and the role it plays in the formation of the capital market line (CML).

The market portfolio is the tangency portfolio of LOS 20.1.C.b because all participants in the market try to hold combinations of the tangency portfolio and the risk-free asset.

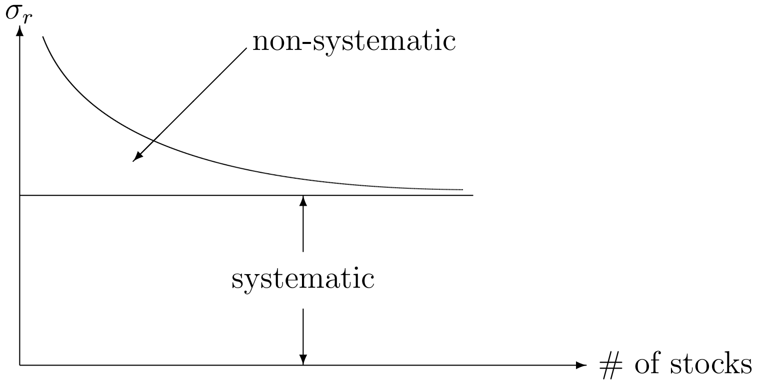
LOS 20.1.C.d: Define and distinguish between systematic and unsystematic risk.

Systematic risk refers to the risk that comes from a common factor. In the CAPM, the common factor is the market return and systematic risk refers to the risk of the market portfolio. It is the part of the risk that can not be diversified away.

Unsystematic risk is the risk specific to the security. Because it is not driven by a common factor, unsystematic risk has a low (or zero) covariance between securities and can, therefore, be greatly reduced by diversification.

LOS 20.1.C.e: Explain and illustrate the standard deviation of return as a function of the number of stocks in the portfolio.

Diversification can reduce unsystematic risk, i.e. risk that is not caused by a common factor.[1] Graphically, we have:



In practice, the correlation between US-stocks is about .5. One study has shown that a portfolio of 12-18 stocks can already reap about 90% of potential benefits of diversification. Another study has included the effect of transactions costs and comes to the conclusion that we would need at least 30 stocks for a borrowing investor and 40 stocks for a lending investor.

LOS 20.1.C.f: Discuss the security market line (SML) and how it differs from the CML.

The security market line is derived via the optimization problem of the market investor. It can be shown that in the optimal market portfolio, each security will have the same ratio of marginal contribution to expected return over marginal contribution to risk. Furthermore, this ratio is the same as the slope of the CML. Solving this latter equality for $E[r_i]$ yields:

$$\begin{aligned} E[r_i] &= r_f + \frac{\sigma_{i,m}}{\sigma_m^2}(E[r_m] - r_f) \\ &= r_f + \beta_i(E[r_m] - r_f) \end{aligned}$$

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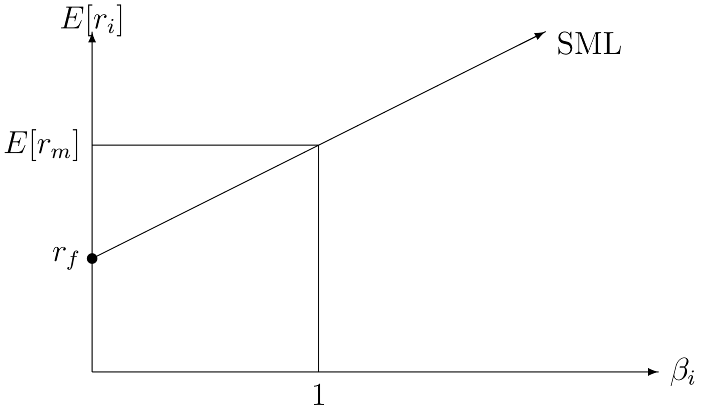
[1] This can be shown mathematically. Suppose you have n securities that are each driven by a common factor λ and a specific shock, $r_i = \alpha_i \lambda + \epsilon_i$. For simplicity, further assume that α is identical for all assets, that the variance of specific shocks (σ_ϵ^2) is identical for all assets, and that we build an equally weighted portfolio of the n assets. We then have $\sigma_i^2 = \alpha^2\sigma_\lambda^2 + \sigma_{\epsilon_i}^2$. By definition, the specific shocks are orthogonal, and we also have $\sigma_{i,j} = \alpha^2\sigma_\lambda^2$. Plugging all this into the formula for portfolio variance, we get: $\sigma_p^2 = \sum_i \frac{1}{n^2}\alpha^2\sigma_\lambda^2 + \sum_i \frac{1}{n^2}\sigma_\epsilon + \sum_{i,j\neq i} \frac{1}{n}\frac{1}{n}\alpha^2\sigma_\lambda^2 = \alpha^2\sigma_\lambda^2 + \frac{1}{n}\sigma_\epsilon^2$. The latest expression shows that portfolio variance is the sum of a fixed systmatic part ($\alpha^2\sigma_\lambda^2$) and a non-systematic part that declines with n ($\frac{1}{n}\sigma_\epsilon^2$).

This equation is known as the capital asset pricing model. Graphically, it can be represented as follows:



For the interpretation of the CAPM, keep the following in mind:

- β has replaced σ as the measure of risk. This is because investors can always diversify away non-systematic risk. Accordingly, you should not expect to be rewarded for non-systematic risk.
- β is derived in the same way as the β of a regression of the stock against the market.
- The market portfolio has a β of 1.

LOS 20.1.C.g: Calculate, based on the SML, the expected return for an asset.

Plug the figures in $E[r_i] = r_f + \beta_i(E[r_m] - r_f)$.

LOS 20.1.C.h: Define and calculate the beta of a risky asset.

$$\beta_i = \frac{\sigma_{i,m}}{\sigma_m^2} = \frac{\sigma_i \sigma_m \rho_{i,m}}{\sigma_m^2} = \frac{\sigma_i}{\sigma_m}\rho_{i,m}$$

LOS 20.1.C.i: Determine, based on the SML, whether a security is undervalued, overvalued, or properly valued.

A security is overvalued if $E[r_i] < r_f + \beta_i(E[r_m] - r_f)$ and undervalued if $E[r_i] > r_f + \beta_i(E[r_m] - r_f)$.

LOS 20.1.C.j: Outline the appropriate trading strategy based on valuation using the SML.

Determine whether a security is overvalued or undervalued. Buy undervalued securities and sell overvalued securities. Note: empirical evidence suggests that you will not make any money with this strategy.

LOS 20.1.C.k: List and describe the major assumptions of the arbitrage pricing theory (APT).

1. Capital markets are perfectly competitive.
2. Investors prefer more wealth to less wealth with certainty.
3. The stochastic process generating asset returns can be represented as a k-factor model. $r_i = \beta_{i,0} + \beta_{i,1}\lambda_1 + \ldots + \beta_{i,k}\lambda_k + \epsilon_i$.

LOS 20.1.C.l: List and describe the assumptions required by the CAPM that are not required by the APT.

1. quadratic utility function
2. normally distributed asset returns
3. a market (equilibrium) portfolio that contains all risky assets and is mean-variance efficient

20.4 Extensions and Testing of Asset Pricing Theories

LOS 20.1.D.a: Evaluate the effect on the security market line (SML) of relaxing each of the following assumptions: taxes, transaction costs, heterogeneous expectations, and multiple planning periods.

Taxes: For an investor, taxes change the return on an asset. Specifically, capital gains taxes remove gains from appreciation and income taxes remove gains from income (including interest paid or received in the risk-free asset). As taxes differ between individuals and institutions, the optimization problem varies between investors and there is no longer a consistent market portfolio. Empirical evidence suggests that tax effects to the CML are present, but the interpretation of results is not unanimous.

Transaction costs: If you have transaction cost, deviations from the SML are only corrected if they exceed a certain band at which trading gains outweight trading costs.

Heterogeneous expectations: If investors have diverging expectations on risk and return, they also have diverging CMLs and SMLs. Still, these could be aggregated to a band of which the width represents the degree of disagreement.

Multiple planning periods: Diverging planning periods have the same effect as diverging expectations. Multi-period extensions of CAPM do exist.

LOS 20.1.D.b: Discuss the stability of individual asset and portfolio betas over time.

- Studies show that the βs of a single stock is not stable; however, stability is much higher for a portfolio of stocks.
- βs show a higher volatility over a short period but a lower volatility over longer periods.
- One study has shown that portfolio βs are biased if individual βs are unstable.
- You need at least 36 months of data to get a reasonable estimate.

LOS 20.1.D.c: Discuss beta estimation problems and why published beta estimates may differ.

Normally, βs are estimated from the characteristic line, i.e. a regression of market returns on stock returns. If you don't estimate β yourself, you can use published data (e.g. *Value line* or *Merrill Lynch*). However, estimates of β vary a lot! Differences are due to some crucial choices:

- different time intervals (weekly or monthly) explains most of the difference between Merrill and Value Line
- different history (length or starting points)
- different index proxies
- different estimation methods

LOS 20.1.D.d: Discuss why Roll's critique of the CAPM and Shanken's challenge to the APT cause many observers to consider the models to be untestable.

Roll criticized the test of the CAPM because it depends on a market portfolio of risky assets that is not observable. Therefore, he developed APT which relies on less restrictive assumptions.

Shankan , in turn, criticized APT because the choice of factors can be more or less arbitrary. He wrote that if returns were not explained by the model, proponents would not take it as evidence against APT but only against the specific choice of factors while any success in explaining variance was credited to APT. Moreover, as many factors can be non-observable, the whole thing becomes pretty esoteric.

LOS 20.1.D.e: Describe the concept of benchmark error.

CAPM relies on the market portfolio, i.e. a portfolio that contains all assets in the economy. However, in practice you can't operationalize this portfolio. Some researchers think that's not a big deal. Ross, however, referred to the problem as *benchmark error* and pretended that it was quite serious. Two cases of problem were identified:

1. Wrong β (errors in estimating systematic risk) will lead to erroneous conclusions about the performance of a portfolio against the SML. In stock selection, a wrong β can lead to erroneous trades.

2. Wrong SML will lead to erronous appreciation of portfolio managers.

In practice, the choice of the reference index can make quite a big difference. However, this basically shows that the CAPM has a measurement proble; it does not invalidate it as a normative model.