Northwestern University
Kellogg Graduate School of Management

Finance 924-A   **Professor Petersen**
Real Options   **Spring 2001**

Preliminary

Valuation is at the foundation of almost all finance courses and the intellectual foundation of most valuation methods which we will examine is discounted cashflow. In Finance I you used DCF to value securities and in Finance II you used DCF to value projects. The valuation approach in Futures and Options appeared to be different, but was conceptually very similar. This course is meant to expand your knowledge of valuation – both the intuition of how it should be done as well as the practice of how it is done. Understanding when the two are the same and when they are not can be very valuable.

Prerequisites:
The prerequisite for this course is Finance II (441)/Turbo (440) and Futures and Options (465). Given the structure of the course, no auditors will be allowed.

Course Readings:
Course Packet for Finance 924 - Petersen

Warning:
This is a relatively new course. Thus you should expect that the content and organization of the course will be fluid and may change in real time. I reserve the right to add and alter the course materials during the term. I understand that this makes organization challenging. You need to keep on top of where we are and what requirements are coming. If you are ever unsure, ASK. I will keep you informed of the schedule via the course web page. You should check it each week to see what we will cover the next week and what assignments are due. The impetus for this course arose from the encouragement of a small group of students who were involved in its initial development. If you contribute your time, your experience, and – where appropriate – your cynicism, I think you will find the class rewarding.

November 5, 2001

Course Outline

Section I: Traditional Valuation Methods

Lecture 1: Valuation Fundamentals: Review of DCF. The value of a firm or a project is the discounted value of future cash flows. Thus valuations are only as good as your estimate of future cash flows. This is a challenge for existing firms, with financial histories, operating in stable industries. It is an even greater challenge for new firms, with little to no history, operating in industries that only recently began their existence (if that).
- Basic structure of DCF
- Change in the Way Markets Value Firms.
- Market Efficiency.
- Visual Basic & Math/Statistics Review
- Simulation as a Valuation Technique.
- Readings
  - "Cashflow.com" by Michael Mauboussin, Credit Suisse/First Boston
  - "Guilty as charged: Violations of the law of one price in financial markets" by Owen Lamont

Lecture 2: Firm Valuation with Multiples. Multiples are a simple and intuitive valuation approach that is often used in practice to value entire firms. Interestingly they are only rarely used to value projects. The multiples approach is appealing since it appears to require less information than traditional DCF methods and is often easier to explain. We will examine the role of multiples in valuation by discussing the West Teleservices case.
- Theoretical Justification
  - Definition of multiples.
  - Relation of multiples to each other.
  - Relation of multiples to DCF valuation.
- Practical Advantages
  - Simplicity and ease of communication.
  - Value versus price.
- Readings
  - Valuation by Multiples, Chapter 10 in Corporate Finance: A Valuation Approach, by Simon Benninga and Oded Sarig
  - West Teleservice Case and Questions

Section II: Valuations using Real Options

Lecture 3: Option to Invest. Real option valuation methods are often sold as a competitor or a substitute to discounted cashflow or net present value. I do not find this characterization very helpful. Instead think of the real options valuation as a way to more accurately estimate the required inputs to DCF. Thus implicit in any real options valuation is a forecast of the expected cash flows and an estimate of the correct discount rate. Remember this. There are a limited number of real options. Most real options can be viewed as one or more of the ones we will cover.

- Comparison to naive DCF.
  - Forecasting expected cashflows.
  - Sources of uncertainty.
  - Future decisions – specifying the decision rule.
- Option to Invest -- Investment in a Startup
  - Black Scholes.
  - Monte Carlo simulation
- Readings
  - Valuing a Startup, Chapter 10 in *Real Options*, by Martha Amram and Nalin Kulatilaka, 1999
  - The Real Power of Real Options by Keith J. Leslie and Max P. Michaels, *McKinsey Quarterly*, 1997.

Lecture 4: The Problem with Net Present Value: The Discount Rate. Conceptually, all valuation methods draw their logic from discounted cash flow. The appearance of option valuation is quite different. This raises the question of why we don't value options using DCF. This was the first method used for valuing options. The problem was calculating/estimating the correct discount rate is a major challenge for projects that have option like characteristics. This is why we will use your knowledge of financial option valuation to build intuition.

- Theoretical Problems.
  - Non-constant discount rates.
  - Black-Scholes and the replicating portfolio.
  - Leverage effects and different discount rates.
- Option β and the option discount rate
  - Lottery ticket on a risky asset.
  - Simulation approach and estimated βs.

Lecture 5: Option to Wait. Traditional NPV analysis argues that if the net present value of a project is positive, you should invest. This assumes, possibly unrealistically, that you must invest now or never. If you can also choose when to invest, then the simple NPV rule needs to be expanded.

- Option to wait – Land development.
    - Finite period example: numbers and intuition.
    - Infinite period example: numbers and intuition.
- Readings
    - The Options Approach to Capital Investment by Avinash Dixit and Robert Pindyck, *Harvard Business Review*, 1995.

Lecture 6: The Abandonment Option.
- Staged investment decisions.
- Binomial option pricing and early exercise.
- Readings.

Lecture 7: The Option to Open and Close.
- Peak load power plant.
- Estimating Volatility.
    - Statistical analysis.
    - Economic intuition.
- Readings.