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DEBT INSTRUMENTS & MARKETS
SUMMER 2008

Instructor: Professor Ralph S.J. Koijen, K-MEC 9-98, 212-998-0924, email: rkoijen@stern.nyu.edu

Time and Location: M, W 6PM - 9PM, KMC3-110

Office Hours: M, W 9PM - 10PM or by appointment.

Course Description: This course describes the important fixed income securities and markets, and in turn develops tools for valuing these securities and managing their interest rate and credit risk. Historically, *fixed-income* refers to securities which promise fixed cash flows over their lives. Now, we generally view any fixed-income instrument as one in which its value depends on the level of interest rates and/or the health of the underlying assets. Thus, along with an analysis of fixed-rate bonds, we will also look at other securities, such as floaters, inverse floaters, bond options, caps/floors, callable bonds, interest rate swaps, credit default swaps and mortgage-backed securities.

The study of fixed income securities is highly quantitative in nature. Students should be comfortable with mathematics such as linear algebra and deterministic calculus, as well as basic probability theory such as probability distributions, mean, variance, covariance, and the like. A basic background in finance is required, such as the core course, *Foundations in Finance*. Although some previous coursework in options is helpful, it is not necessary to have taken an options course as the analysis of fixed-income derivatives will be self-contained. Students will need to use a calculator that can raise a number to an arbitrary power, and are expected to be very familiar with a spreadsheet package like Excel (including, for example, its solver function).

Required reading:

- Lecture notes and problem sets

Recommended reading:

- Bruce Tuckman, *Fixed Income Securities*, Wiley, 2nd edition, 2002
- Frank J. Fabozzi, *The Handbook of Fixed Income Securities*, McGraw-Hill, 7th edition, 2005
- Sundaresan, *Fixed Income Markets and Their Derivatives*, South-Western, 2nd edition, 2002

The following list of books, although by no means comprehensive, would be useful to know if you are interested in the quantitative aspects of fixed income markets:

- Duffie and Singleton, *Credit Risk*, Princeton University Press, 2003

- Lando, Credit Risk Modelling, Princeton University Press, 2004
- Rebonato, Interest-rate Option Models, Wiley, 2nd edition, 2000
- Shreve, Stochastic Calculus for Finance, The Binomial Asset Pricing Model, Springer-Verlag, 2004
- Shreve, Stochastic Calculus for Finance, Continuous Time Models, Springer-Verlag, 2004

Grading: There will be weekly problems sets, a midterm exam, and a final. Problem sets will contribute to your participation grade. Your overall grade will be based on:

Problem sets	10%
Midterm	40%
Final	50%

Exams: All exams will be open book(any book or books)-open notes. Bring a decent calculator that can raise numbers to arbitrary powers. Laptop computers are not allowed.

Tentative Schedule of the Lectures

Topic I: Introduction & Valuation of Fixed Cash Flows

A brief course overview and review of basic valuation. This part of the course covers the valuation of fixed cash flows, including an analysis of the discount function, no arbitrage valuation, bond portfolio replication, and important concepts such as yield-to-maturity and forward rates.

Topic II: The Interest Rate Sensitivity of Instruments with Fixed Cash Flows

This part of the course covers the interest rate sensitivity of fixed cash flows, including the important concepts of duration and convexity, and how these concepts apply to a portfolio of securities. These tools are then used to show how to hedge the interest rate risk of securities with fixed cash flows.

Topic III: Introduction to Variable Cash Flows

These lectures provide an introduction to markets with variable cash flows. As a starting point, we discuss the valuation and interest rate sensitivity of floating rate notes and inverse floaters. We also cover one of the more important securities in the fixed income market, the interest rate swap.

Topic IV: Valuation and Interest Rate Sensitivity of Interest-Rate Dependent Cash Flows

This part of the course covers the techniques for valuing cash flows which depend on interest rates. The lectures will include a description of the major characteristics of interest rates,

the development of a popular, Wall Street one-factor model of interest rates, and a valuation and hedging methodology for this model.

Topic V: Fixed-Income Options

These lectures will focus on the valuation of fixed-income options, and embedded options in fixed-income securities. As options are a building block for many securities, these lectures are crucial for the understanding of later concepts. I will start with an overview of options, and then show how to value options and measure their interest rate sensitivity using the valuation framework within a one-factor setting.

Topic VI: Fixed-Income Options - Applications

This part of the course covers important applications of interest rate options, in particular, common embedded options in the fixed-income market such as (i) callable bonds, (ii) caps, floors or collars, and (iii) swaptions.

Topic VII: The Credit Market

This topic covers the important area of credit markets. In order to value fixed income securities that face credit risk, it is necessary for us to build a second factor, namely that of the underlying assets of the firm. After building this model, we will show you how to value bonds of different priority and the underlying equity of the firm. The final application will be to discuss the motivation, pricing and risk of credit default swaps.

Topic VIII: The Mortgage-Backed Securities Market

This lecture provides a brief description of the mortgage market, including mortgages, mortgage-backed securities and collateralized mortgage obligations. Issues associated with the distribution rules for cash flows and a method for valuing and measuring the interest rate sensitivity of mortgage backs will also be discussed.

Topic IX: Course Review

An overview of the important concepts of the course.

Final Exam