Fixed Income Securities, Debt Markets and the Macro Economy

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Session: Two.

Prerequisites: Basic mathematics and statistics.

Objectives and Content: The market for fixed income products is huge and ever growing. Throughout the 2007–2009 financial crisis, the 2008–2009 recession and the crisis in the Eurozone, debt markets have been in the spot light. Central banks have been trying to fight the crisis with aggressive expansionary monetary policy and by greatly expanding their balance sheets. Furthermore public debt has been mounting at a staggering rate in response to the Covid pandemic, and US government public debt is currently in excess of 120% of GDP and projected to accelerate in response to recent fiscal decisions.

In this environment, it is indispensable to have a thorough understanding of the functions and objectives of the major players in debt markets, of the various fixed income instruments and the risks associated with them, and of the models and methods used to value fixed income securities and their derivatives.

This course helps to develop the relevant knowledge and understanding of fixed income instruments and interest rate models for students aiming for a career in the fixed income field. The course will provide an overview of the major institutions, organisations and investors, and the recent developments in fixed income, covering both theoretical background and practical implementation.

We will discuss traditional debt instruments (namely government and corporate bonds) and fixed income derivatives (including mortgage-backed securities), develop the theories for valuing them and study the determinants of risk and return of fixed-income securities. To this end, we will cover the most important state-of-the-art interest rate models such as the Vasicek, Ho and Lee, or Black-Derman-Toy models; we also develop their theoretical underpinnings and provide examples for the practical implementation. We also discuss the role of fixed-income securities in risk management and introduce the concepts of duration and convexity.

Furthermore, we will take a closer look at the interdependencies and the roles of the different players in the debt markets. In particular, we will examine the role of and the instruments available to the central bank in setting interest rates. The major focus of the course will be on economic intuition and on understanding the products and interrelationships in the fixed income markets. We will relate the course topics to the credit crisis of 2007-2009 and discuss implications for the future of debt markets.
Throughout the course, there is an emphasis on the applications of the tools and the students will have plenty of opportunities to implement the models in the computer lab where 9 out of 12 classes will be held.

Readings: Much of the relevant material will be covered in the lecture notes although they are not intended as a substitute for a textbook. The main textbook is the following:

- Pietro Veronesi, *Fixed Income Securities: Valuation, Risk, and Risk Management*, Wiley and Sons, 2010.

Other recommended textbooks are:

- Suresh M. Sundaresan, *Fixed-Income Markets and Their Derivatives*, Academic Press, 2009, 3rd Edition.
- Frank Fabozzi, *Bond Markets, Analysis and Strategies*, Prentice Hall, 2013, 8th edition.

Additional selected readings will be assigned for individual topics.

Assessment: Two written examinations. In preparation for the examinations, the students are to submit a problem set that will be marked as a piece of formative assessment.

Classes: 9 of 12 classes will be held in the computer lab.

Course outline

Topic 1 **Introduction and overview of debt markets**

- Overview of debt contracts and classification of debt securities
- Players and their objectives
- Government debt markets
- The money market
- The repo market
- MBS and ABS markets
- Fixed income derivatives markets
- No-arbitrage and the law of one price
- Risks of debt securities

Supplementary readings:
- Veronesi, Chapter 1.
- Sundaresan, Chapter 1.

Topic 2 **Basics of fixed income securities**

- Discount factors, interest rates and compounding
- Term structure of interest rates
- Zero coupon and coupon bonds
- Bootstrapping and yield to maturity
- Floating rate bonds
- Quoting conventions

Supplementary readings:
- Veronesi, Chapter 2.
- Sundaresan, Chapter 2, 8, 9.

Topic 3 **Interest rate risk management**

- Variation in interest rates and bond price volatility
- Duration
- Portfolio immunization
- Convexity
- Non-parallel shifts of the yield curve

Supplementary readings:
- Veronesi, Chapters 3, 4.
- Sundaresan, Chapters 7, 8, 9.
- Fabozzi, Chapters 4, 5.

Topic 4 **Interest rate derivatives**

- Forward rates and forward discount factors
- Forward rate agreements and forwards
- Swaps
- Interest rate futures

- Interest rate options

Supplementary readings:
- Veronesi, Chapters 5, 6.
- Sundaresan, Chapters 14, 15, 16, 17.

Topic 5 **Binomial trees and derivatives pricing**

- One-step binomial trees
  - One-step interest rate trees
  - No-arbitrage on a binomial tree
  - Risk neutral pricing
- Multi-step binomial trees
  - A two-step binomial tree
  - Matching the term structure
  - Multi-step trees and risk neutral pricing
- Risk neutral trees and derivative pricing
  - The Ho-Lee model
  - The Black, Derman, and Toy model
  - Using risk neutral trees
- American options
  - Callable bonds
  - American swaptions

Supplementary readings:
- Veronesi, Chapters 9, 10, 11, 12.

Topic 6 **No-arbitrage and equilibrium interest rate models**

- Equilibrium interest models
- Vasicek model
- Cox, Ingersoll and Ross (CIR) model
- No-arbitrage models
- Multi-factor models

Supplementary readings:
- Veronesi, Chapters 14, 15, 19, 22.

Topic 7 **Government securities and their derivatives**

- US Treasury debt securities
- UK Treasury debt securities
- US Treasury futures
- Eurodollar futures
- Options on interest rate futures

Supplementary readings:
- Veronesi, Chapters 6, 7.
- Sundaresan, Chapters 6, 11, 13.

Topic 8 **Securitization and mortgage-backed securities**

- Securitization
- Mortgages and the prepayment option
- Mortgage-backed securities (MBS)
- Collateralized mortgage obligations (CMO)
- Hedging of MBS portfolios

Supplementary readings:
- Veronesi, Chapter 8.
- Sundaresan, Chapter 12.
- Fabozzi, Chapters 10, 11, 12, 15.

Topic 9 **Monetary policy, inflation, and interest rates**

- Roles of central banks
- Tools of monetary policy
- The Fed funds rate
- Inflation risk and economic activity

Supplementary readings:
- Veronesi, Chapter 7.
- Sundaresan, Chapters 3, 5.
- Federal Reserve Board, 2005, *Monetary Policy and the Economy.*

Topic 10 **The credit crisis**

- Securitization and the housing bubble
- The credit crisis of 2007–2009
- Amplification mechanisms
- Monetary policy reactions

Supplementary reading:
- Brunnermeier, Markus K., 2009, "Deciphering the 2007-08 Liquidity and Credit Crunch," *Journal of Economic Perspectives* 23, 77–100.
- Gorton, Gary, 2008, "The Panic of 2007," in *Maintaining Stability in a Changing Financial System*, Proceedings of the 2008 Jackson Hole Conference, Federal Reserve Bank of Kansas City.