Session 21: Fixed Income IV

Fall 2025

Outline

- Duration matching: immunization
- Active management

Interest Rate Risk Management

- Investors and financial institutions are subject to interest-rate risk
  - Homeowner: mortgage payments (ARM)
  - Bank: short-term deposits and long-term loans
  - Pension fund: owns bonds and must pay retirees
- A change in the interest rate results in
  1. Price risk
  2. Reinvestment risk
- Goal: construct a portfolio which is insensitive to interest rate changes

Summary

- The duration (D) of a bond is defined as minus the **elasticity** of its price (P) with respect to (1 plus) its YTM (y):

$$D = -\frac{dP}{dy}\frac{1+y}{P} = \sum_{1}^{T} w_t\, t \quad \text{where} \quad w_t = \left(\frac{CF_t}{(1+y)^t}\right) \Big/ P = \frac{PV(CF_t)}{P}$$

- For fixed cash flows, duration is equal to the average of the cash-flow times, weighted by their contribution to the present value of the bond
- The price response to a yield change is therefore

$$\frac{\Delta P}{P} \cong -\underbrace{\frac{D}{1+y}}_{\substack{\text{modified} \\ \text{duration}}} \Delta y$$

Duration Matching: Immunization

- Duration matching means to make the duration of assets and liabilities equal
- The sensitivity to interest rate changes is

$$\Delta P \cong \frac{D^{\text{assets}}}{1+y} P^{\text{assets}} \Delta y - \frac{D^{\text{liabilities}}}{1+y} P^{\text{liabilities}} \Delta y = 0$$

- Interest rate changes make the values of assets and liabilities change by the same amount: the portfolio is *immunized*

Silicon Valley Bank (SVB) Crisis

- SVB held a large portfolio of long-duration Treasuries and MBS
  - many with effective durations above 8–10 years, making the bank highly exposed to rising rates.
- After COVID, tech clients began burning cash and withdrawing deposits
  - funding dried up, layoffs increased, and SVB faced accelerating liquidity pressure.
- The Federal Reserve raised interest rates by more than 400 basis points in under a year
  - one of the fastest tightening cycles in modern U.S. history.
- SVB's long-duration bonds lost around 30% of their market value
  - unrealized losses wiped out the bank's equity cushion and triggered a confidence shock.

FNMA

- Imagine you own a large portfolio of mortgage-backed securities (ignore default risk). How do you hedge interest rate risk?
- What is the relation between the MBS prices and interest rates or, more generally, between callable bonds and interest rates?

GM's Pension Fund

- General Motor's pension fund had
  - Liabilities with duration of about 15 years
  - Assets (bonds) with duration of about 5 years
  - Problem: Duration mismatch!
- If interest rates fall
  - Price risk
    - The value of the bonds increases
    - The present value of the liabilities increases more
  - Reinvestment risk
    At the new interest rate, the assets can not be reinvested to make the future payments

The Problem

- Suppose
  - The GM pension fund must pay $100M in 15 years
  - The current market interest rate (yield) is 6% at all maturities
  - The fund is currently fully funded:
    PV(assets) = PV(liabilities)
- Problem: the pension fund wants to invest in 1-year and 30-year zero-coupon bonds to fully fund and immunize its liabilities

The Solution

- What should the weights be in the asset portfolio?
- What are the bond prices?
- How many bonds should GM buy?
- What happens if interest rates increase immediately to 7%? Is the fund immunized?

The Numbers

				6%			7%	
	D	Weight	FV	PV (mil.)	Price	# Bonds (mil.)	Price	PV (mil.)
L	15		100	41.73				36.24
A 1-year	1	0.517		21.58	94.34	0.229	93.46	21.38
A 30-year	30	0.483		20.14	17.41	1.157	13.14	15.20
A total	15			41.73				36.58

Problems with Immunization

- Requires rebalancing
  What is the asset duration after the increase in rates?

- It is an approximation that assumes
  - A flat term structure of interest rates
  - Changes in the level of interest rates, not in the slope of the term structure or other types of shape changes
  - Small interest rate changes – improve duration matching by also matching *convexity*

Active Management

- Interest rate forecasting
- Riding the yield curve
- Relative value (convergence) trades

Conclusion

- Interest rate risk management is critical for
  - Pension funds
  - Insurance companies
  - Fixed income money managers
  - Financial institutions
  - GSEs
  - The Fed
- But it is not always easy!

Assignments

- Reading
  - BKM: Chapter 15
  - Problems: 15.4-15.9, 15.11, 15.14, 15.21, 15.23, 15.27, CFA 15.1
- Assignments
  - Problem Set 5 due 14th November