Immunization

Reading: Tuckman and Serrat, Chapter 4

Asset-Liability Management

- Suppose you have liabilities or obligations consisting of a stream of fixed cash flows you must pay in the future.
  - Pension liabilities
  - Insurance liabilities
  - Bond defeasance

- How can you structure an asset portfolio to fund these liabilities?

Dedication

- The only completely riskless approach is to construct an asset portfolio with cash flows that exactly match the liability cash flows.
- This funding method is called *dedication*.
- This approach may be infeasible or excessively costly.
- In some situations, risk managers may want more flexibility.

Immunization

- Consider a more flexible but more risky approach, called *immunization*:
  - The liabilities have a certain market value.
  - That market value changes as time passes and as interest rates change.
- Construct an asset portfolio with
  - the same market value and
  - the same duration as the liabilities
  - so that the asset value tracks the liability value over time.
- Can include derivatives as well as fixed cash flows.

Typical Duration Mismatches

	Assets	Liabilities
Commercial banks (+)	Long-term loans	Short-term deposits
Insurance companies (-)	Short-term bonds	Long-term commitments
Pension funds (-)	Medium-term bonds	Long-term commitments
Corporations (+)	Long-term projects	Short-term debt

From Veronesi, Fixed Income Securities, p. 97.

Duration/Market Value Matching

- Change in value ~-dollar duration x change in rates

- Matching the dollar duration of assets and liabilities means matching their changes in value if all rates change by the same amount—hedges against parallel yield curve shifts.

- Matching market value means liabilities are fully funded.

- Hedging against parallel shifts is really just a first step.

Structuring an Asset Portfolio

- Suppose your liabilities have market value of $100M and duration of 6.

- You want to structure an asset portfolio with the same market value and duration.

- Construct an asset portfolio with just two securities:
    - A bond with price $110 and duration 8
    - A CMO with price $70 and duration 4

- **Class Problem**: What are the number of units of the bond and CMO, N1 and N2, in the immunizing asset portfolio?

Simply Dollar Duration Matching

- Suppose your liabilities have dollar duration of 100M and your assets have dollar duration 500M

- You want to leave your existing assets in place and close the gap by selling interest rate swap contracts.

- Suppose each swap contract has present value zero and dollar duration of 10M.

- **Class Problem**: How many contracts must you sell to give your net position zero dollar duration?

Structuring an Asset Portfolio

- Suppose your liabilities have market value of $100M and duration of 6.

- You want to structure an asset portfolio with the same market value and duration/dollar duration.

- Construct an asset portfolio with just two securities:
  - A bond with price $110 and duration 8
  - A CMO with price $70 and duration 4

- **Class Problem Solution**: What are the number of units of the bond and CMO, N_1 and N_2, in the immunizing asset portfolio?

$$N_1 \times 110 + N_2 \times 70 = 100M$$

$$N_1 \times 880 + N_2 \times 280 = 600M$$

$$\Rightarrow N_1 = 454,545, N_2 = 714,286$$

Or, $w_1 = w_2 = 50\%$, so $N_1 = 50M/110$ and $N_2 = 50M/70$.

Simply Dollar Duration Matching

- Suppose your liabilities have dollar duration of 100M and your assets have dollar duration 500M.

- You want to leave your existing assets in place and close the gap by selling interest rate swap contracts.

- Suppose each contract has dollar duration of 10M.

- **Class Problem Solution**: How many contracts must you trade to give your net position zero dollar duration?

$$500M + N \times 10M - 100M = 0$$

$$\Rightarrow N = -400M/10M = -40. \text{ Sell 40 contracts.}$$