CHAPTER 11
Managing Bond Portfolios

11.1 INTEREST RATE RISK

Interest Rate Sensitivity

- Inverse relationship between price and yield
- An increase in a bond's yield to maturity results in a smaller price decline than the gain associated with a decrease in yield
- Long-term bonds tend to be more price sensitive than short-term bonds

Interest Rate Sensitivity (cont)

- Sensitivity of bond prices to changes in yields increases at a decreasing rate as maturity increases
- Interest rate risk is inversely related to bond's coupon rate
- Sensitivity of a bond's price to a change in its yield is inversely related to the yield to maturity at which the bond currently is selling

Figure 11.1 Change in Bond Price as a Function of YTM

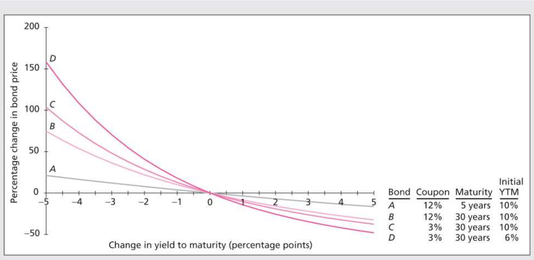
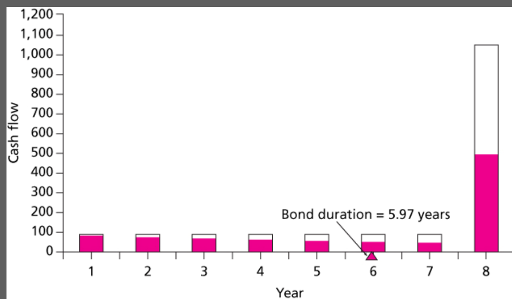


FIGURE 11.1
Change in bond price as a function of change in yield to maturity

Duration

- A measure of the effective maturity of a bond
- The weighted average of the times until each payment is received, with the weights proportional to the present value of the payment
- Duration is shorter than maturity for all bonds except zero coupon bonds
- Duration is equal to maturity for zero coupon bonds

Figure 11.2 Cash Flows of 8-yr Bond with 9% annual coupon and 10% YTM



Duration: Calculation

$$w_t = \left[CF_t / (1+y)^t\right] / Price$$

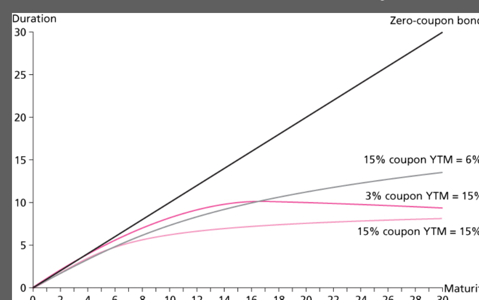
$$D = \sum_{t=1}^{T} t \times w_t$$

$CF_t = Cash \quad Flow \quad for \quad period \quad t$

Duration Calculation

8% Bond	Time years	Payment	PV of CF (10%)	Weight	C1 X C4
	1	80	72.727	.0765	.0765
	2	80	66.116	.0690	.1392
	3	1080	811.420	.8539	2.5617
Sum			950.263	1.0000	2.7774

Figure 11.3 Duration as a Function of Maturity



Duration/Price Relationship

- Price change is proportional to duration and not to maturity

$\Delta P/P = -D \times [\Delta y / (1+y)]$

D^* = *modified duration*

$D^* = D / (1+y)$

$\Delta P/P = - D^* \times \Delta y$

11.2 PASSIVE BOND MANAGEMENT

Immunization

- Passive management
  - Net worth immunization
  - Target date immunization

Figure 11.4 Growth of Invested Funds

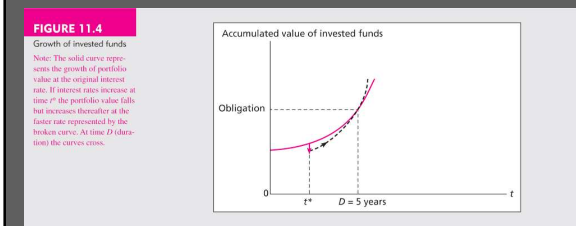
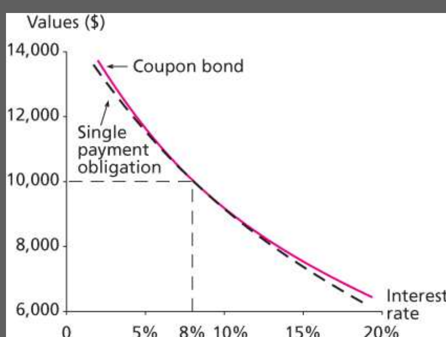


Figure 11.5 Immunization



Cash Flow Matching and Dedication

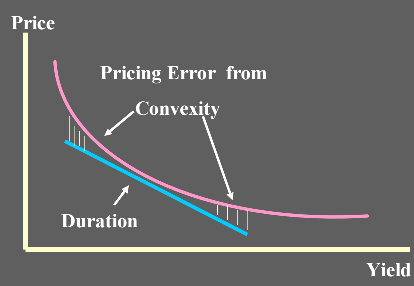
- Automatically immunizes a portfolio from interest rate movements
  - Cash flow from the bond and the obligation exactly offset each other
- Not widely pursued
- Sometimes not even possible

11.3 CONVEXITY

Limitations of Duration

- Duration is only an approximation
- Duration asserts that the percentage price change is directly proportional to the change in the bond's yield
- Underestimates the increase in bond prices when yield falls
- Overestimates the decline in price when the yield rises

Pricing Error from Convexity



Correction for Convexity

Modify the pricing equation:

$$\frac{\Delta P}{P} = -D \times \Delta y + \frac{1}{2} \times Convexity \times (\Delta y)^2$$

Convexity is Equal to:

$$\frac{1}{P \times (1+y)^2} \sum_{t=1}^{N} \left[\frac{CF_t}{(1+y)^t} \left(t^2 + t \right) \right]$$

Where: CF_t is the cash flow (interest and/or principal) at time t.

Figure 11.6 Bond Price Convexity

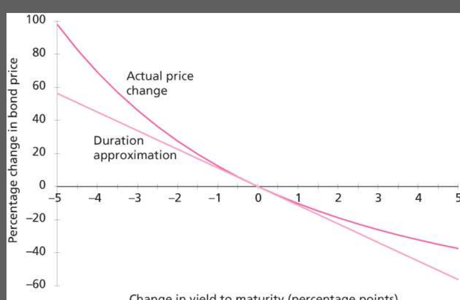
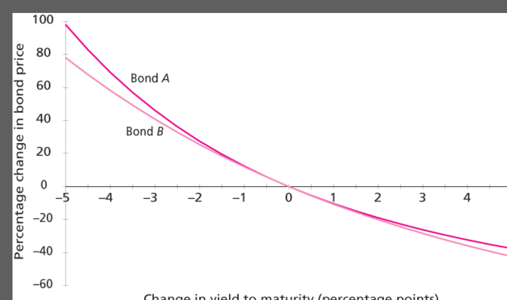


Figure 11.7 Convexity of Two Bonds



11.4 ACTIVE BOND MANAGEMENT

Swapping Strategies

- Substitution swap
- Intermarket swap
- Rate anticipation swap
- Pure yield pickup
- Tax swap

Horizon Analysis

- Analyst selects a particular investment period and predicts bond yields at the end of that period

Contingent Immunization

- Allow the managers to actively manage until the bond portfolio falls to a threshold level
- Once the threshold value is hit the manager must then immunize the portfolio
- Active with a floor loss level

Figure 11.8 Contingent Immunization