Interest Rates

• Rates and basis points
  – 100 basis points are equal to one percentage point
• Short-term riskless rate
  – Provides foundation for other rates
  – Approximated by rate on Treasury bills
  – Other rates differ because of
    • Maturity differentials
    • Security risk premiums

Determinants of Interest Rates

• Real rate of interest
  – Rate that must be offered to persuade individuals to save rather than consume
  – Rate at which real capital physically reproduces itself
• Nominal interest rate
  – Function of the real rate of interest and expected inflation premium

Interest Rates

• Maturity differentials
  – Term structure of interest rates
    • Accounts for the relationship between time and yield for bonds the same in every other respect
• Risk premium
  – Yield spread or yield differential
  – Associated with issuer’s particular situation

Determinants of Interest Rates

• Market interest rates on riskless debt = real rate + expected inflation
  – Fisher Hypothesis
• Real rate estimates obtained by subtracting the expected inflation rate from the observed nominal rate
• Real interest rate is an ex ante concept
Measuring Bond Yields

- **Yield to maturity**
  - Most commonly used
  - Promised compound rate of return received from a bond purchased at the current market price and held to maturity
  - Equates the present value of the expected future cash flows to the initial investment
  - Similar to internal rate of return

\[
P = \sum_{t=1}^{n} \frac{C_t/2}{(1 + YTM/2)^t} + \frac{MV}{(1 + YTM/2)^n}
\]

- For a zero coupon bond
  \[
  YTM = 2 \times \left( \frac{MV}{P} \right)^{1/n} - 1
  \]

Yield to Maturity

- Investors earn the YTM if the bond is held to maturity and all coupons are reinvested at YTM

Yield to Call

- Yield based on the deferred call period
- Substitute number of periods until first call date for and call price for face value

\[
P = \sum_{t=1}^{n} \frac{C_t/2}{(1 + YTC/2)^t} + \frac{CP}{(1 + YTC/2)^n}
\]

Realized Compound Yield

- Rate of return actually earned on a bond given the reinvestment of the coupons at varying rates

\[
RCY = \left( \frac{\text{Total future dollars}}{\text{Purchase price of bond}} \right)^{1/n} - 1.0
\]

- Horizon return analysis
  - Bond returns based on assumptions about reinvestment rates

Bond Valuation Principle

- **Intrinsic value**
  - An estimated value
  - Present value of the expected cash flows
  - Required to compute intrinsic value
  - Expected cash flows
  - Timing of expected cash flows
  - Discount rate, or required rate of return by investors

Bond Valuation

- Value of a coupon bond:

\[
V = \sum_{t=1}^{n} \frac{C_t/2}{(1 + r/2)^t} + \frac{MV}{(1 + r/2)^n}
\]

- Biggest problem is determining the discount rate or required yield
- Required yield is the current market rate earned on comparable bonds with same maturity and credit risk
Bond Price Changes

- Over time, bond prices that differ from face value must change
- Bond prices move inversely to market yields
- The change in bond prices due to a yield change is directly related to time to maturity and indirectly related to coupon rate

Measuring Bond Price Volatility: Duration

- Important considerations
  - Different effects of yield changes on the prices and rates of return for different bonds
  - Maturity inadequate measure of volatility
  - May not have identical economic lifetime
  - A measure is needed that accounts for both size and timing of cash flows

Calculating Duration

- Need to time-weight present value of cash flows from bond
  \[ D = \frac{\sum_{t=1}^{n} \frac{PV(CF_t)}{Market \ Price} \times t}{Market \ Price} \]
- Duration depends on three factors
  - Maturity of the bond
  - Coupon payments
  - Yield to maturity

Duration Relationships

- Duration increases with time to maturity but at a decreasing rate
  - For coupon paying bonds, duration is always less than maturity
  - For zero coupon-bonds, duration equals time to maturity
- Duration increases with lower coupons
- Duration increases with lower yield to maturity
Why is Duration Important?

- Allows comparison of effective lives of bonds that differ in maturity, coupon
- Used in bond management strategies particularly immunization
- Measures bond price sensitivity to interest rate movements, which is very important in any bond analysis

Estimating Price Changes Using Duration

- Modified duration = $D^* = D / (1 + r)$
- $D^*$ can be used to calculate the bond’s percentage price change for a given change in interest rates

\[
\% \Delta \text{in bondprice} = \frac{-D}{(1 + r)} \times \Delta r
\]

Convexity

- Refers to the degree to which duration changes as the yield to maturity changes
  - Price-yield relationship is convex
- Duration equation assumes a linear relationship between price and yield
- Convexity largest for low coupon, long-maturity bonds, and low yield to maturity

Duration Conclusions

- To obtain maximum price volatility, investors should choose bonds with the longest duration
- Duration is additive
  - Portfolio duration is just a weighted average
- Duration measures volatility which isn’t the only aspect of risk in bonds

Bonds: Analysis and Strategy

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Chapter 9
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Why Buy Bonds?

- Attractive to investors seeking steady income and aggressive investors seeking capital gains
- Promised yield to maturity is known at the time of purchase
- Can eliminate risk that a rise in rates decreases bond price by holding to maturity

The Case Against Buying Bonds

- Don't hold bonds unless investing strictly for income
  - Capital appreciation negative 1926-96
- Alternative: a combination of cash investments and stocks
- Investors should consider whether they could build better portfolios that do not include bonds

Rates of Return on Bonds and Bills

<table>
<thead>
<tr>
<th>Series</th>
<th>Geometric Mean (%)</th>
<th>Arithmetic Mean (%)</th>
<th>Standard Deviation (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Long-term corporate bonds</td>
<td>5.6</td>
<td>5.9</td>
<td>8.4</td>
</tr>
<tr>
<td>Long-term government bonds</td>
<td>5.0</td>
<td>5.4</td>
<td>8.7</td>
</tr>
<tr>
<td>Intermediate government bonds</td>
<td>5.3</td>
<td>5.4</td>
<td>5.6</td>
</tr>
<tr>
<td>U.S. Treasury bills</td>
<td>3.7</td>
<td>3.7</td>
<td>3.3</td>
</tr>
<tr>
<td>Inflation</td>
<td>3.1</td>
<td>3.2</td>
<td>4.6</td>
</tr>
</tbody>
</table>

Buying Foreign Bonds

- Why?
  - Foreign bonds may offer higher returns at a point in time than alternative domestic bonds
  - Diversification
- Can be costly and time-consuming
  - Illiquid markets
  - Transaction costs and exchange rate risk

Understanding the Bond Market

- Benefits from a weak economy
  - Interest rates decline and bond prices increase
- Important relationship is between bond yields and inflation rates
  - Investors react to expectations of future inflation rather than current actual inflation

The Term Structure of Interest Rates

- Term structure of interest rates
  - Relationship between time to maturity and yields
- Yield curves
  - Graphical depiction of the relationship between yields and time for bonds that are identical except for maturity
  - Default risk held constant
Term Structure of Interest Rates

- Upward-sloping yield curve
  - typical, interest rates rise with maturity
- Downward-sloping yield curves
  - Unusual, predictor of recession?
- Term structure theories
  - Explanations of the shape of the yield curve and why it changes shape over time

Pure Expectations Theory

- Long-term rates are an average of current short-term rates and those expected to prevail over the long-term period
  - Average is geometric rather than arithmetic
- If expectations otherwise, the shape of the yield curve will change

Liquidity Preference Theory

- Rates reflect current and expected short rates, plus liquidity risk premiums
- Liquidity premium to induce long term lending
  - Implies long-term bonds should offer higher yields
- Interest rate expectations are uncertain

Preferred Habitat Theory

- Investors have preferred maturities
  - Borrowers and lenders can be induced to shift maturities with appropriate risk premium compensation
  - Shape of yield curve reflects relative supplies of securities in each sector
- Most market observers are not firm believers in any one theory

Risk Structure of Rates

- Yield spreads
  - Relationship between yields and the particular features on various bonds
- Yield spreads are a result of
  - Differences in: quality, coupon rates, callability, marketability, tax treatments, issuing country

Passive Bond Strategies

- Investors do not actively seek out trading possibilities in an attempt to outperform the market
  - Bond prices fairly determined
  - Risk is the portfolio variable to control
- Investors do assess default and call risk
  - Diversify bond holdings to match preferences
### Passive Bond Strategies

- **Buy and hold**
  - Choose most promising bonds that meet the investor's requirements
  - No attempt to trade in search of higher returns
- **Indexing**
  - Attempt to match performance of a well-known bond index
  - Indexed bond mutual funds

### Immunization

- **Used to protect a bond portfolio against interest rate risk**
  - Price risk and reinvestment risk cancel
- **Price risk results from relationship between bond prices and rates**
- **Reinvestment risk results from uncertainty about the reinvestment rate for future coupon income**

### Immunization

- **Risk components move in opposite directions**
  - Favorable results on one side can be used to offset unfavorable results on the other
- **Portfolio immunized if the duration of the portfolio is equal to investment horizon**
  - Like owning zero-coupon bond

### Active Bond Strategies

- **Requires a forecast of changes in interest rates**
  - Lengthen (shorten) maturity of bond portfolio when interest rates are expected to decline (rise)
- **Horizon analysis**
  - Projection of bond performance over investment horizon given reinvestment rates and future yield assumptions

### Active Bond Strategies

- **Identify mispricing among bonds then swap**
  - Substitution swap, yield pickup swap, rate anticipation swap, sector swap
- **Interest rate swaps**
  - Exchange a series of cash flows
  - Convert from fixed- to floating-rate
  - Primarily used to hedge interest rate risk

### Building a Fixed-Income Portfolio

- **If conservative investor**
  - View bonds as fixed-income securities that will pay them a steady stream of income with little risk
  - Buy and hold Treasury securities
- **Conservative investor should consider:**
  - Maturity, reinvestment risk, rate expectations, differences in coupons, indirect investing
### Building a Fixed Income Portfolio

- **If aggressive investor**
  - View bonds as source of capital gains arising from changes in interest rates
  - Treasury bonds can be bought on margin to further magnify gains (or losses)
  - Seek the highest total return

- **International bonds**
  - Direct or indirect investment