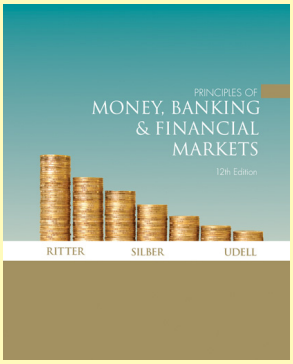
Chapter 4

Interest Rate Measurement and Behavior



Learning Objectives

- Describe present value and the mechanics of calculating interest rates
- Comprehend the different types of bonds and loans and how their structure influences their present value
- Understand interest rate determination and the supply and demand causes of interest rate fluctuations

Introduction

- **INTEREST RATES SERVE AS A YARDSTICK FOR COMPARING DIFFERENT TYPES OF SECURITIES AND MATURITIES**
  - **Cannot compare amount of total earning between different securities**
  - **Must consider the amount of funds in the initial investment to compute the rate of return (interest) on the different securities**

Calculating Interest Rates

- **Simple Interest**
  - Interest earned on the principle in one year's time.
  - **Time is worth money**
  - A dollar today is worth **more** than a dollar in the future
  - A dollar due in the future is worth **less** than a dollar today

Interest earned = principal × rate × time (in years)

Calculating Interest Rates (Cont.)

- **Compound Interest**
  - Interest that accumulates during a year is added to the principal at year's end, thereby earning more interest in the following year
  - Banks automatically add interest earned to the principle at specified time intervals
  - **Future Value [FV]**—amount today's principle will be worth in "n" years after adding compounded interest of rate "r".

$$FV = principle(PV) \times (1 + r)^n$$

Calculating Interest Rates (Cont.)

- **Compound Interest (Cont.)**
  - **Present Value [PV]**—amount a future sum of money in "n" years will be worth today after **discounting** back to the present at rate "r"

$$\text{Future value}/(1 + r)^n = \text{present value}$$

Calculating Interest Rates (Cont.)

- **Coupon Rate on Bonds**
  - Amount printed on the face of the bond
  - Annual (semiannual) interest payment (**coupon payment**)
  - Return based on **face value of the bond**, not amount paid for the bond
- **Current Yield**
  - Yield on annual interest received based on **purchase price of bond**
  - Ignores **capital gain**—difference between purchase price and amount when redeemed at maturity (face value)

Calculating Interest Rates (Cont.)

- **Yield to Maturity**
  - Most accurate and widely used measure of interest rates
  - Assume the bond is held to maturity
  - Includes capital gains between purchase and sales prices of the bond
  - Interest rate (**rate of discount**) which makes sum of present values of all expected future payments (annual interest plus face value) equal to purchase price

Calculating Interest Rates (Cont.)

- **Yield to Maturity (Cont.)**

$$P = \frac{C_1}{(1+r)} + \frac{C_2}{(1+r)^2} + \ldots\ldots + \frac{C_n + F_n}{(1+r)^n}$$

Where: P = Purchase price of bond
C = Annual coupon payment
F_n = Face value at maturity
r = rate of discount

Calculating Interest Rates (Cont.)

- **Zero-Coupon Bonds**
  - Bond holder received no coupon interest payments, **only the face value of the bond when it matures**
  - Rate of discount (return on the bond) equates discounted face value (***n***—number of years to maturity) with purchase price

$$P = \frac{\text{Face Value}}{(1 + r)^n}$$

Calculating Interest Rates (Cont.)

- **Inverse Relationship Between Yields and Bond Prices**
  - Higher interest rates mean lower bond prices and vice versa
  - If either the interest rate or price is known, the other can be computed
  - If either the rate of interest or purchase price changes, the other will automatically change in the opposite direction

Calculating Interest Rates (Cont.)

- **Why Long-Term Bonds are Riskier than Short-Term**
  - For long-term securities, a small change in interest rates involves a large change in price
  - For short-term securities, even a big change in yield involves only a small change in price
  - Longer a bond's maturity, the more its price will be affected by a change in the general level of interest rates

Calculating Interest Rates (Cont.)

- **Why Long-Term Bonds are Riskier than Short-Term (Cont.)**
  - Long-term bonds are riskier because threat of potential loss is greater **provided** the bonds must be sold prior to maturity
  - Greater likelihood with long-term bonds of needing to sell before maturity
  - Owners who can hold bonds until maturity will have **temporary paper losses** but eventually receive face value upon redemption at maturity

Calculating Interest Rates (Cont.)

- **Nominal Versus Real Interest Rates**
  - **Nominal Interest Rates**—Money amount of interest received
  - **Real Interest Rates**—**Purchasing power** of interest received
  - Real interest rate is the nominal interest adjusted for inflation

Real interest rate = Nominal rate – Inflation rate

Where:
- "**ex-anti**" is based on the **expected rate of inflation**
- "**ex-post**" is based on the **actual or realized rate of inflation**

Calculating Interest Rates (Cont.)

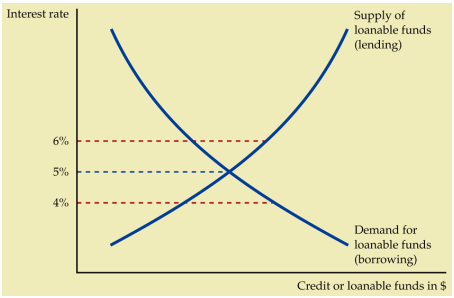
- **Return Versus Yield to Maturity**
  - **Rate of return** measures the cash flows received during a period relative to the amount invested at the beginning
  - For a bond held for one year, the return is computed as follows:

$$\text{Return} = \frac{\text{sales price} - \text{purchase price} + \text{coupon}}{\text{purchase price}}$$

What Determines the Level of Interest Rates

- **Supply/Demand Determine Interest Rate (Figure 4.1)**
  - Interest rate is **price** of credit or borrowing money
  - Market for **Credit** or **Loanable Funds** ([Interest rate vs. Quantity of funds)
    - **Supply of Funds**—**Upward sloping**, lenders are willing to extend **more credit** at higher interest rates
    - **Demand for Funds**—**Downward sloping**, borrowers are willing to **borrow less** at higher interest rates
    - **Equilibrium**—Intersection of supply and demand, no tendency to change
    - **Financial Markets**—Competitive so supply and demand pressures will result in interest rate changes

FIGURE 4.1 Supply and demand determine the interest rate.



What Determines the Level of Interest Rates (Cont.)

- **Why Does the Interest Rate Fluctuate**
  - U.S. Treasury bond yields change day to day (**Figure 4.2**)
  - **Movement along a single curve**—Changes in the interest rate results in a movement along a single demand or supply curve (**Figure 4.3**)
  - **Shifts of a Curve**—Change in determinants of supply or demand (other than interest rate) causes the respective curve to shift (**Figure 4.4**)
  - **Changes in Equilibrium**—Shift of either the supply or demand curve will reflect a change in the equilibrium interest rate

FIGURE 4.2 U.S. Treasury bond yields fluctuate from day to day (2007).

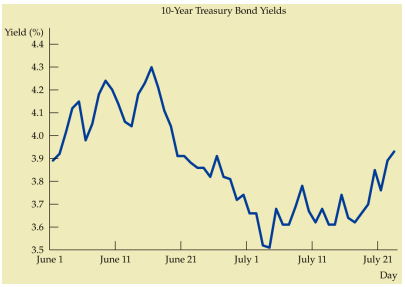


FIGURE 4.3 Movement along a demand curve versus a shift in demand.

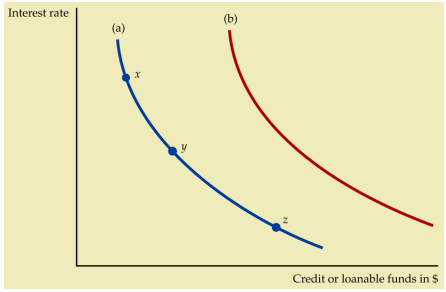
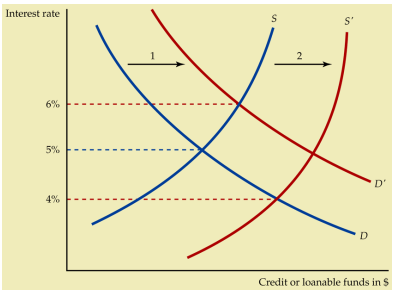


FIGURE 4.4 Shifts in demand (1) or supply (2) curves can change the equilibrium interest rate.



What Determines the Level of Interest Rates (Cont.)

- **Behind Supply and Demand**
  - **Borrowing (demand)**
    - Business firms—finance inventory or buy capital equipment
    - Households—buy cars, consumer goods, or homes
    - State and local government—provide infrastructure or public services
    - Federal government—finance Federal Budget Deficit
- **INCREASES IN BORROWING—SHIFT DEMAND TO RIGHT AND RAISE INTEREST**

What Determines the Level of Interest Rates (Cont.)

- **Behind Supply and Demand (Cont.)**
  - **Lending or Credit (supply)**
    - Financial institutions or individuals lend to market
    - Government authorities may restrict lending by banks
    - Ability of individuals to lend depends on their savings—less savings results in lower amount of lending
- **DECREASES IN LENDING—SHIFT SUPPLY TO LEFT AND RAISE INTEREST**

What Determines the Level of Interest Rates (Cont.)

- **The Importance of Inflationary Expectations**
  - Effect of a change in **expectations of increasing inflation**
    - **Demand**—Borrowers increase demand since they will be repaying in depreciated dollars and desire to purchase before the prices increase
    - **Supply**—Lenders decrease supply since they will be repaid with money of diminished purchasing power
- **SHIFTS OF THE DEMAND AND SUPPLY CURVE WILL CAUSE THE INTEREST RATE TO INCREASE**

What Determines the Level of Interest Rates (Cont.)

- **The Importance of Inflationary Expectations (Cont.)**
  - **Self-fulfilling Prophesies**—If individuals and institutions expect inflation and interest rates to increase, they will alter behavior that causes the higher rates that were anticipated

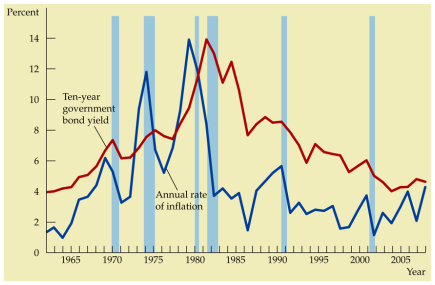
What Determines the Level of Interest Rates (Cont.)

- **Cyclical and Long-term Trends in Interest Rates (Figure 4.5)**
  - Level of interest rates tends to rise during cyclical expansion and fall during recessions. During economic expansion:
    - Firms and households increase borrowing—demand curve right
    - FED usually tightens credit during expansion—supply curve left

What Determines the Level of Interest Rates (Cont.)

- **Cyclical and Long-term Trends in Interest Rates (Figure 4.5) (Cont.)**
  - Level of interest rates on upward long-term trend between 1950 and 1981
    - Large federal budget deficit forced US Treasury to increase borrowing—pushing up interest rates
    - Expectations of increasing inflation
  - Since early 1980s rates have trended downward
    - Federal deficits continued to increase in 1980's
    - Expectations of **lower** inflation has been major reason for fall of interest rates.

FIGURE 4.5 Trends in interest and inflation rates since 1960.



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