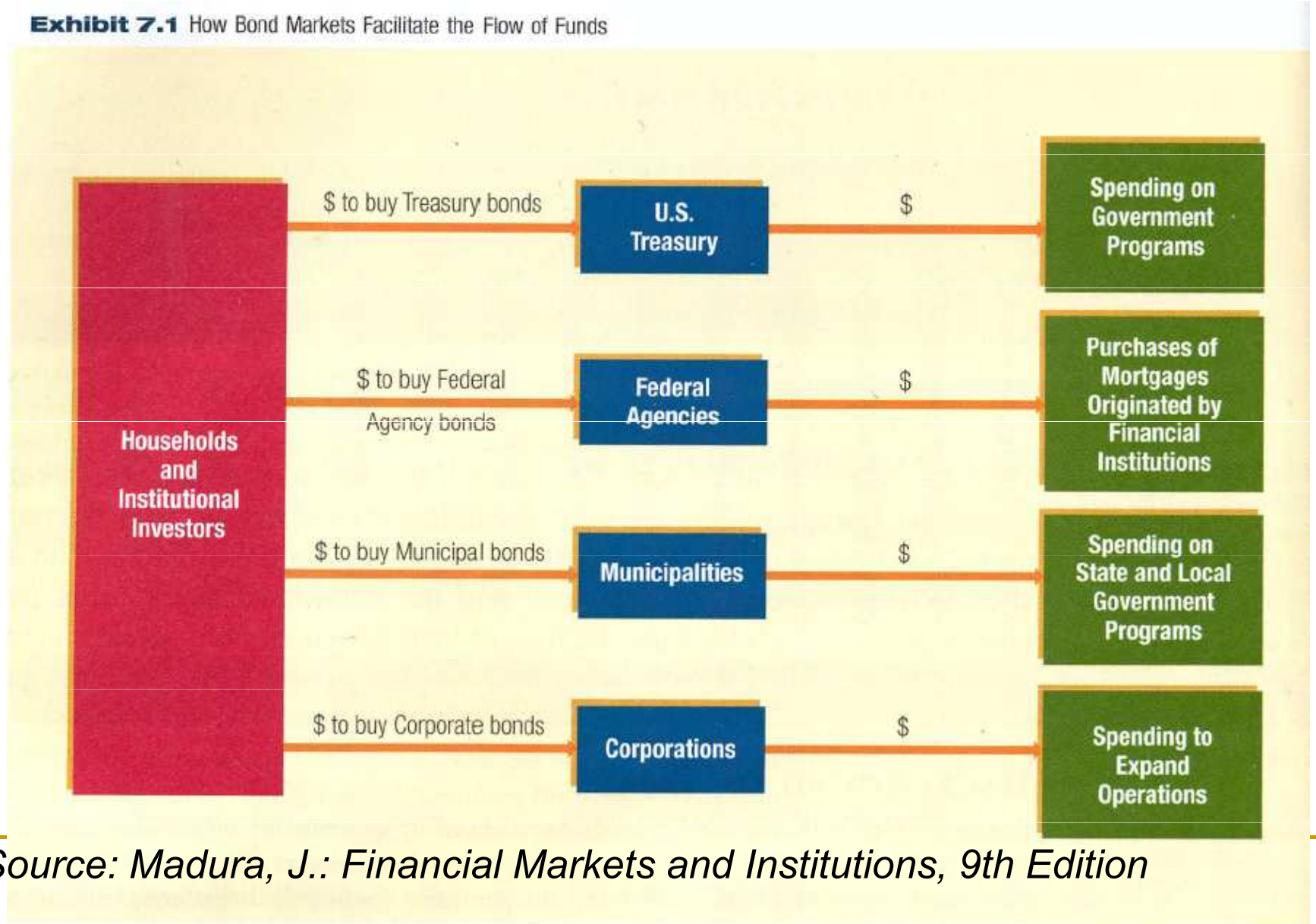
Bond Markets

Background on Bonds

- Bonds represent long-term debt securities
  - Contractual
  - Promise to pay future cash flows to investors
- The issuer of the bond is obligated to pay:
  - Interest (or coupon) payments periodically usually semiannually
  - Par or face value (principal) at maturity

How Bond Markets Facilitate the Flow of Funds

Exhibit 7.1 How Bond Markets Facilitate the Flow of Funds



- *Source: Madura, J.: Financial Markets and Institutions, 9th Edition*

FINANCIAL INSTITUTION	PARTICIPATION IN BOND MARKETS
Commercial banks and savings and loan associations (S&Ls)	• Purchase bonds for their asset portfolio. • Sometimes place municipal bonds for municipalities. • Sometimes issue bonds as a source of secondary capital.
Finance companies	• Commonly issue bonds as a source of long-term funds.
Mutual funds	• Use funds received from the sale of shares to purchase bonds. Some bond mutual funds specialize in particular types of bonds, while others invest in all types.
Brokerage firms	• Facilitate bond trading by matching up buyers and sellers of bonds in the secondary market.
Investment banking firms	• Place newly issued bonds for governments and corporations. They may place the bonds and assume the risk of market price uncertainty or place the bonds on a best-efforts basis in which they do not guarantee a price for the issuer.
Insurance companies	• Purchase bonds for their asset portfolio.
Pension funds	• Purchase bonds for their asset portfolio.

- *Source: Madura, J.: Financial Markets and Institutions, 9th Edition*

Bond Yields

- Yield from the Issuer's Perspective
  - Cost of financing
    - Yield to maturity
      - annualized yield that is paid by the issuer over the life of bond
      - Annualized discount rate that equates the future coupon and principal payments
      - Based on assumption that coupon can be reinvested at the same yield

Bond Yields

An investor can purchase a ten-year, $1000 par value bond with an 8 percent annualized coupon rate for $936. Determine the yield to maturity for this bond.

N	I	PV	PMT	FV
10	9	–936	80	1000

Bond Yield

- Yield from the Investor's Perspective
  - A: Investor holds it until maturity
    - Yield to maturity

Bond Yield

- B: Investor does not hold until maturity
  - Holding period return HPR
    - Less than one year – HPR = coupons + difference between selling and purchasing price
    - Over one year – HPR = annualized discount rate that equates payments received to the initial investments
- Yield consists of two components:

  (1) a set of coupon payments and

  (2) the difference between the par value that the issuer must pay to investors at maturity and the price it received when selling the bonds.
    - Selling price of the bond is uncertain if the bond is not hold to maturity
    - An investment on bond is subject to the risk that the holding period return will be less than expected

Kinds Bonds (Treasury)

- Coupon Bonds
  - Interest paid semiannually
  - To registered bondholders

- Stripped Treasury Bonds – STRIPS (Separate Trading of Registered Interest and Principal of Securities)
  - STRIPS are not issued by the Treasury but instead are created and sold by various financial institutions.
    - One security represents the principal payment (PO) at maturity
    - Other securities represents the interest payments (IO) at interest paying dates
- Inflation-Indexed Treasury Bonds – TIPS (Treasury Inflation-Protected Securities)
  - Intended for investors who seek inflation protection with their investments
  - Coupon rates less than other Treasuries
  - Principal value adjusted for the U.S. inflation rate (CPI) every 6 months
  - Coupon income increases with inflation

Corporate Bonds

- When corporations want to borrow for long-term periods they issue corporate bonds
  - Usually pay semiannual interest
  - Most have maturities between 10-30 years
  - Public offering vs. private placement
  - Limited exchange, larger OTC secondary market
  - Investors seek safety of principal and steady income

Corporate Bond Offerings

- Public Offering
  - Investment bank to underwrite the bonds
    - Syndicate of investment banks
    - Determine selling price
    - Prospectus of bond issuance
  - Registration of SEC
  - Used by institutional investors
- Private Placement
  - Not registered by SEC
  - For small amounts of funds ($30 million) easy to find an institutional investor
  - Disclosure of financial date
  - Security firms
  - No active secondary market
    - Institutional investor can trade bonds with each other

Corporate Bond Terminology

- Indenture
  - Legal document specifying rights and obligations of issuer and bondholder
- Trustee
  - Represents bondholders to assure compliance with indenture
- Sinking Fund Provision
  - Requirement that the firm retire a certain amount or number of bonds each year
  - Protects investors with principal reduction
- Protective Covenants
  - Places restrictions on the firm to protect bondholders
  - Examples: limits dividends and officer salaries, restricts additional debt

Corporate Bond Terminology

- Call provisions: Ability to pay bonds off early
  - Callable bond
  - Call premium
  - Advantage to issuers; disadvantage to investor
- Bond collateral
  - Usually consists of a mortgage on real property
  - Unsecured bonds are called debentures and are backed only by the general credit of the issuing firm

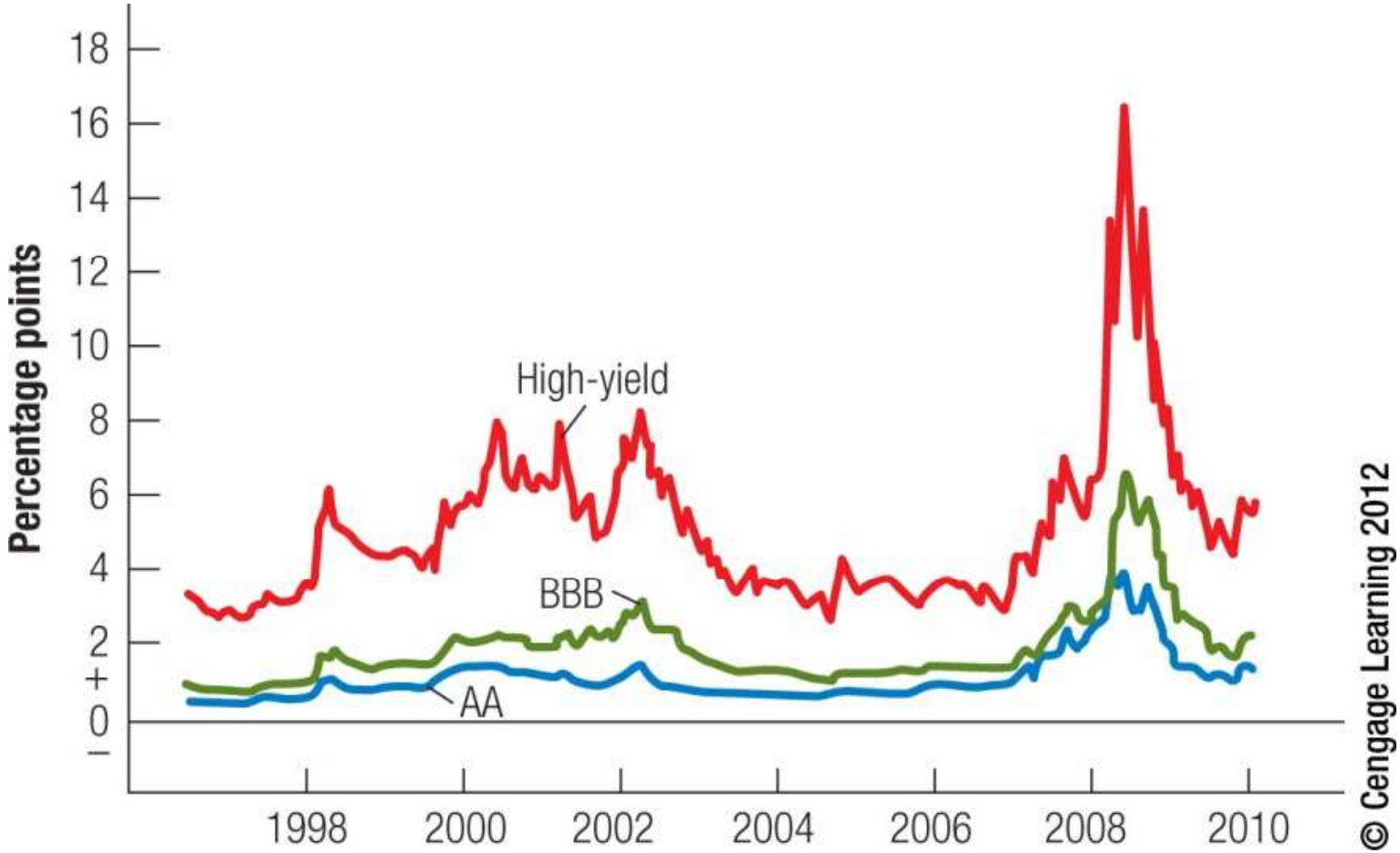
Corporate Bond Terminology

- Low-coupon and zero-coupon bonds
- Variable-rate bonds
- Convertible bonds
- Junk bonds

Junk Bonds

- Junk Bonds
  - Junk bonds are also called high-yield bonds or noninvestment rated bonds
  - Popularized in the direct finance boom of the 1980s
  - The risk premium is between three and seven percent above Treasury bonds
  - Secondary market supported by dealer market

Risk Premiums of Junk Bonds versus Other Corporate Bonds over Time



Bond Valuation and Risk

Bond Valuation and Risk

- The price of a bond is the present value of the cash flows that will be generated by the bond, namely periodic interest or coupon payments and the principal at maturity.

Impact of the Discount Rate on Bond Valuation

- Critical for accurate valuation
- The appropriate discount rate
  - Yield that could be earned on alternative investments with similar risk and maturity
  - Higher return on riskier securities -> higher discount rates
  - A high-risk securities have a lower value than a low risk securities even though both have the same expected cash flow

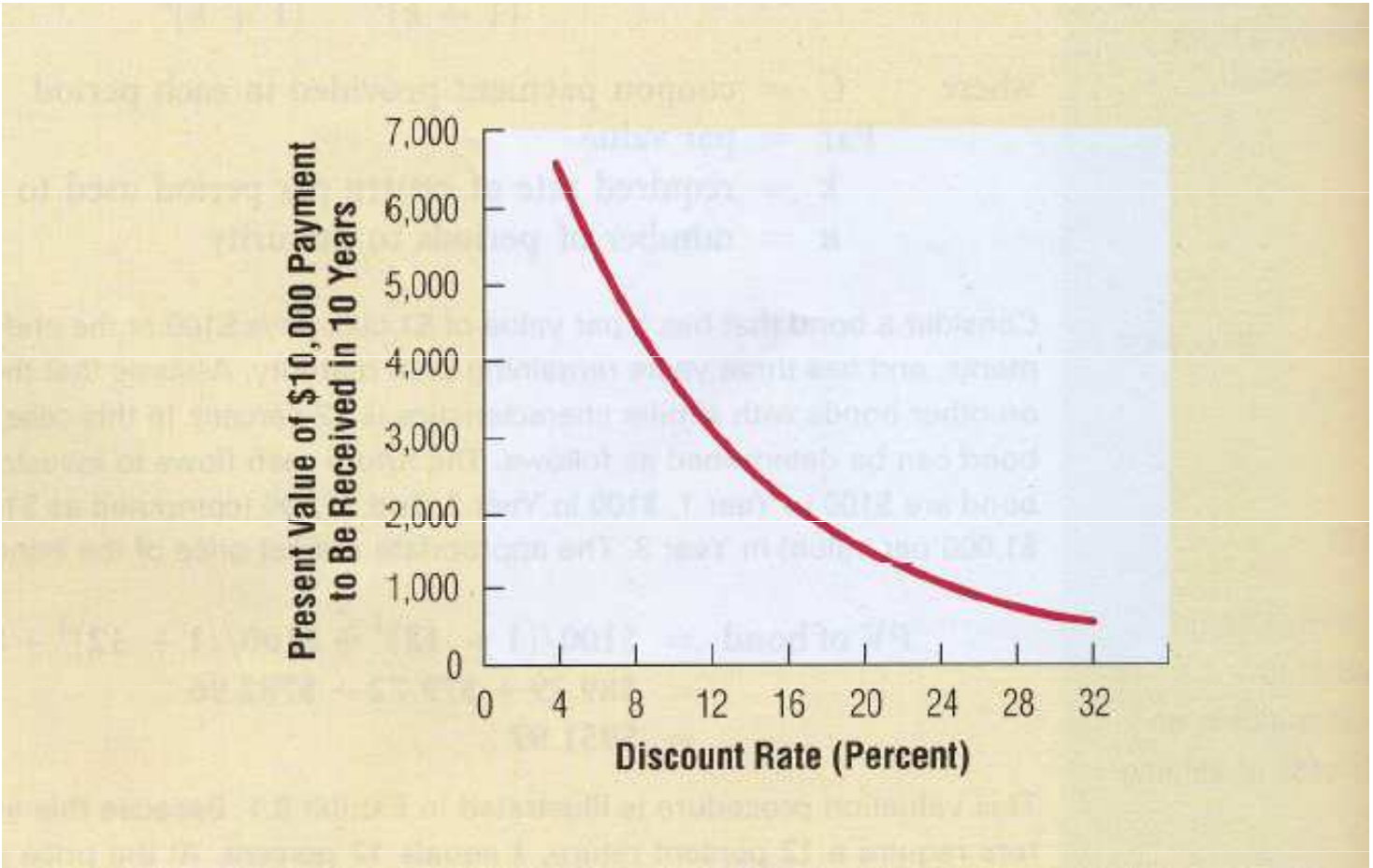
Bond Risks and Prices

- Higher risk
- Higher discount rates
- Lower bond prices

- Lower risk
- Lower discount rates
- Higher bond prices

Note Inverse Relationship Between Risk, required returns and Bond Prices

Relation between Discount Rate and Present Value of Payment - $10,000 Payment to Be Received in 10 Years (EXCEL sheet yield)



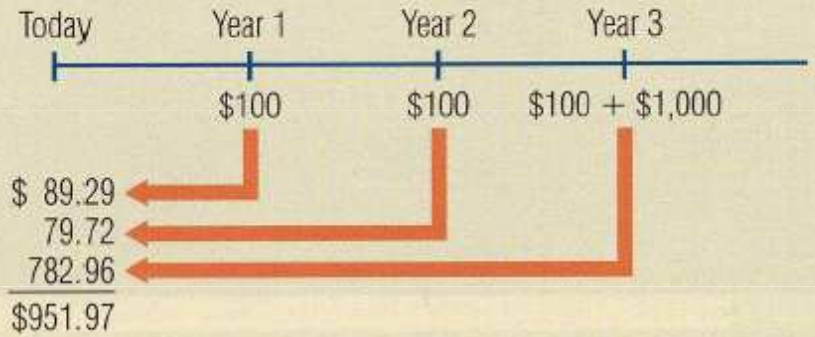
- *Source: Madura, J.: Financial Markets and Institutions, 9th Edition*

Bond Valuation Process

$$PV \text{ of bond} = \frac{C}{(1+k)^1} + \frac{C}{(1+k)^2} + \cdots + \frac{C + \text{Par}}{(1+k)^n}$$

where
- C = coupon payment provided in each period
- Par = par value
- k = required rate of return per period used to discount the bond
- n = number of periods to maturity

Exhibit 8.1 Valuation of a Three-Year Bond



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Valuation of Bonds with Semiannual Payments (EXCEL sheet Price)

$$\text{PV of bond with semiannual payments} = \frac{C/2}{[1+(k/2)]^{1}} + \frac{C/2}{[1+(k/2)]^{2}} + \cdots + \frac{C/2 + \text{Par}}{[1+(k/2)]^{2n}}$$

Relations between Coupon Rate, Required Return and Bond Price, y = 0,1, FV 1000, n=1

- 1. Discount bonds: Bonds Selling below Par (1.000)
  - Coupon rate is below required rate, the price of the bond is below par (P < 1,000)
- 2. Par Bonds: Bonds Selling at Par (1.000)
  - Coupon rate equals the required rate, the price of the bond is equal to par value (P = 1,000)
- Premium Bonds: Bonds Selling above Par (1.000)
  - Coupon rate is above the required rate, the price of the bond is above the par (P > 1,000)

Explaining Bond Price Movements

- The price of a bond should reflect the present value of future cash flows discounted at a required rate of return
- The required return on a bond is primarily determined by
  - Prevailing risk-free rate
  - Risk premium

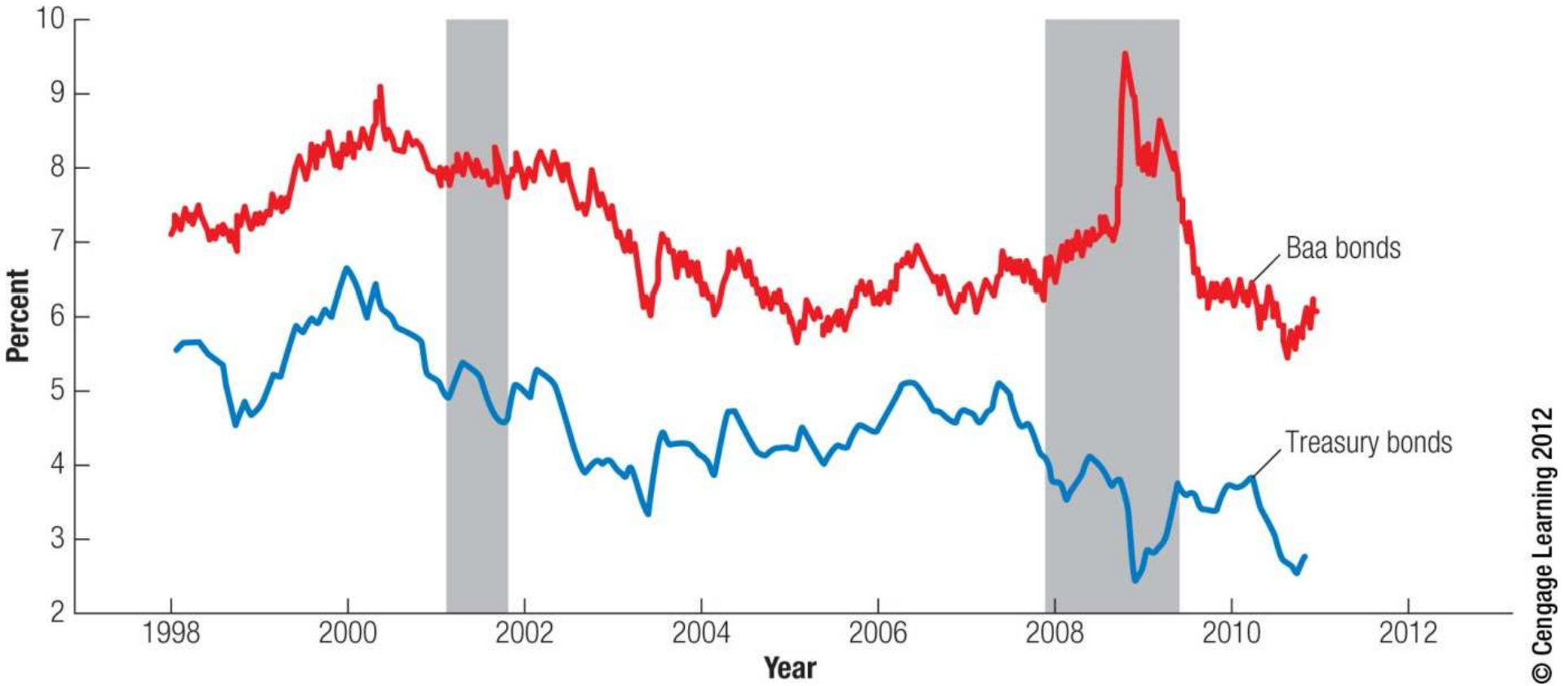
Factors that affect the risk-free rate

- Changes in returns on real investment
  - Financial investment an alternative to real investment
  - Opportunity cost of financial investment is the returns available from real investment
  - Federal Government deficits/surplus position
- Inflationary expectations
  - Consumer price index
  - Federal Reserve monetary policy position
  - Oil prices and other commodity prices
  - Exchange rate movements

Factors that affect the credit or default risk premium

- Strong economic growth
  - High level of cash flows
  - Investors bid up bond prices; lower default premium
- Weak economic growth
  - Lower profits and cash flows
  - Impact on specific industries varied
  - Investors flee from risky bonds to Treasury bonds
  - Bond prices fall; default premiums increase

Bond Risk Premium over Time



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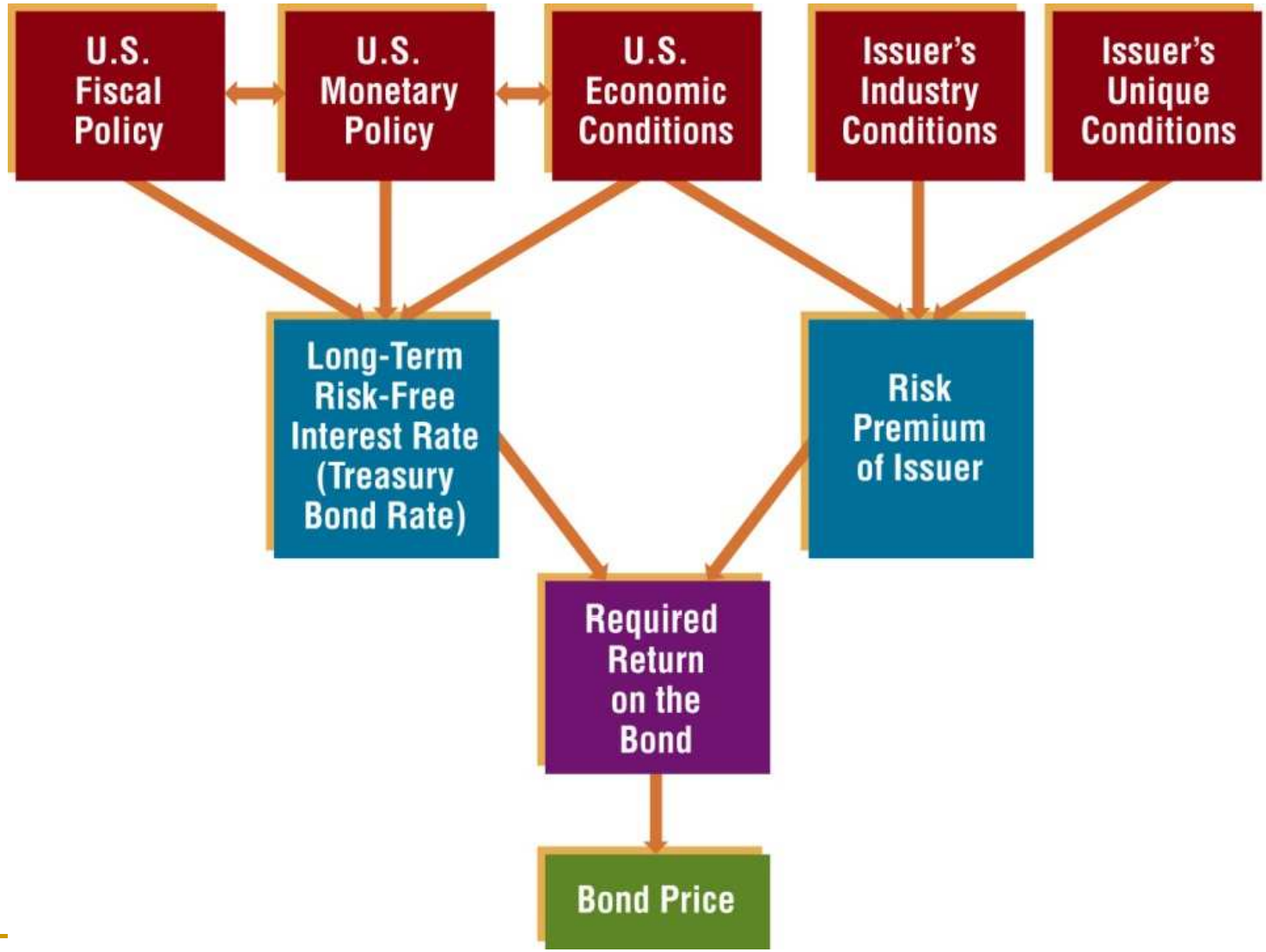
Framework for Explaining Changes in Bond Prices over Time



Sensitivity of Bond Prices to Interest Rate Movements

- Depends on the bond's characteristics
- Indicates the potential damage to bond holdings in response to an increase in interest rates
  - BOND PRICE ELASTICITY
  - DURATION

Bond Price Elasticity

- Bond Price Elasticity = Bond price sensitivity for any % change in market interest rates
- Bond Price Elasticity =

  (% Change In Price)/(% Change In Interest Rates)
- Increased elasticity means greater price risk

$$P_b^e = \frac{\text{percentage change in } P_b}{\text{percentage change in } k}$$

Sensitivity of Bond Prices to Interest Rate Movements

a. **Influence of Coupon Rate on Bond Price Sensitivity**
   i. A zero-coupon bond is most sensitive to changes in the required rate of return.
   ii. The price of a bond that pays all of its yield in the form of coupon payments is less sensitive to changes in the required rate of return.

b. **Influence of Maturity on Bond Price Sensitivity** - As interest rates decrease, long-term bond prices increase by a greater degree than short-term bond prices.

Sensitivity of Bonds with Different Coupon Rates to Interest Rate Changes (EXCEL sheet elasticity)

EFFECTS OF A DECLINE IN THE REQUIRED RATE OF RETURN					
(1) BONDS WITH A COUPON RATE OF:	(2) INITIAL PRICE OF BONDS WHEN k = 10%	(3) PRICE OF BONDS WHEN k = 8%	(4) = [(3) – (2)]/(2) PERCENTAGE CHANGE IN BOND PRICE	(5) PERCENTAGE CHANGE IN k	(6) BOND PRICE ELASTICITY (P_b^e)
0%	$ 386	$ 463	+19.9%	–20.0%	–.995
5	693	799	+15.3	–20.0	–.765
10	1,000	1,134	+13.4	–20.0	–.670
15	1,307	1,470	+12.5	–20.0	–.625

EFFECTS OF A DECLINE IN THE REQUIRED RATE OF RETURN					
(1) BONDS WITH A COUPON RATE OF:	(2) INITIAL PRICE OF BONDS WHEN k = 10%	(3) PRICE OF BONDS WHEN k = 12%	(4) = [(3) – (2)]/(2) PERCENTAGE CHANGE IN BOND PRICE	(5) PERCENTAGE CHANGE IN k	(6) BOND PRICE ELASTICITY (P_b^e)
0%	$ 386	$ 322	–16.6%	+20.0%	–.830
5	693	605	–12.7	+20.0	–.635
10	1,000	887	–11.3	+20.0	–.565
15	1,307	1,170	–10.5	+20.0	–.525

- *Source: Madura, J.: Financial Markets and Institutions, 9th Edition*

Duration

- Measure of bond price sensitivity
- Measures the life of bond on a PV basis
- Duration = Sum of discounted, time-weighted cash flows divided by price
- The longer a bond's duration, the greater its sensitivity to interest rate changes
- The duration of a zero-coupon bond = bond's term to maturity
- The duration of any coupon bond is always less than the bond's term to maturity

Duration

$$DUR = \frac{\sum_{t=1}^{n} \frac{C_t(t)}{(1+k)^t}}{\sum_{t=1}^{n} \frac{C_t}{(1+k)^t}}$$

where

C_t = coupon or principal payment generated by the bond

t = time at which the payments are provided

k = bond's yield to maturity (reflects investors' required rate of return

Modified duration (EXCEL sheet duration)

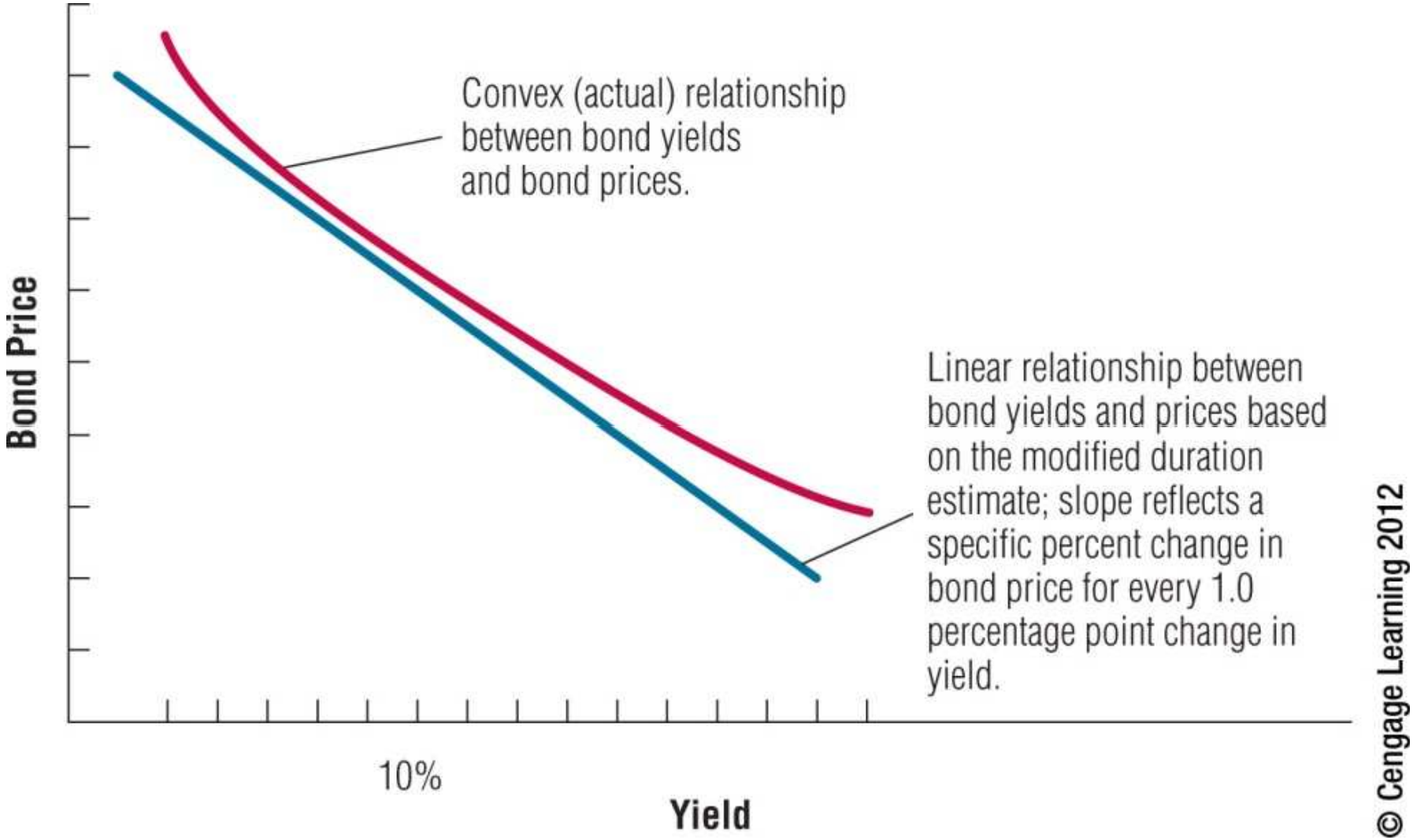
- Modified Duration (DUR*): Can be used to estimate the percentage change in the bond's price in response to a 1 percentage point change in bond yields

$$DUR^* = \frac{DUR}{1+k}$$

Sensitivity of Bond Prices to Interest Rate Movements

- Bond Convexity - The actual response of the bond's price to a change in bond yields is convex and is represented by the red curve in Exhibit 8.8
- Convexity is more pronounced for bonds with long maturities
- Convexity is more pronounced for bonds with low (or no) coupons.

Relationship between Bond Yields and Prices



Bond Convexity (EXCEL sheet convexity)

- Determinants of bond convexity

$$\text{Convexity} = \frac{\frac{d^2P}{di^2}}{f \cdot P}$$

$$\frac{d^2P}{d^2i} = \frac{1}{\left(1+\frac{y}{f}\right)^2}\left[\sum_{t=1}^{n}\frac{(t^2+t)CF_t}{\left(1+\frac{y}{f}\right)^t}\right]$$

Volatility

- Taylor Expansion:

$$\frac{\Delta P}{P} = -\frac{\text{Duration}}{\left(1+\frac{y}{2}\right)}\Delta y + \frac{1}{2}\frac{\text{Convexity}}{\left(1+\frac{y}{2}\right)^2}\Delta y^2$$

Modified Duration effect

Convexity effect