

CHAPTER 14

Bond Prices and Yields

Bond Characteristics

- Bonds are debt: issuers are borrowers and holders are creditors.
 - The indenture is the contract between the issuer and the bondholder.
 - The indenture gives the coupon rate, maturity date, and par value.

Bond Characteristics

- Face or par value is typically \$1000; this is the principal repaid at maturity.
- The coupon rate determines the interest payment
 - Interest is usually paid semiannually
 - The coupon rate can be zero
 - Interest payments are called “coupon payments”

U.S. Treasury Bonds

- Note maturity is 1-10 years
- Bond maturity is 10-30 years
- Bonds and notes may be purchased directly from the Treasury
- Denomination can be as small as \$100, but \$1,000 is more common
- Bid price of 100:08 means $100 \frac{8}{32}$ or \$1002.50

Corporate Bonds

- Callable bonds can be repurchased before the maturity date.
- Convertible bonds can be exchanged for shares of the firm's common stock.
- Puttable bonds give the bondholder the option to retire or extend the bond.
- Floating rate bonds have an adjustable coupon rate

Preferred Stock

- Equity
- Fixed income
- Dividends are paid in perpetuity
- Nonpayment of dividends does not mean bankruptcy
- Preferred dividends are paid before common
- No tax break

Innovation in the Bond Market

- Inverse Floaters
 - Q. when to buy?
- Asset-Backed Bonds
- Catastrophe Bonds ([link1](#), [link2](#))
- Indexed Bonds
 - Treasury Inflation Protected Securities (TIPS)

Table 14.1 Principal and Interest Payments for a Treasury Inflation Protected Security

- TIPs:
 - notional grows with inflation
 - %-Coupon stays the same on growing notional

Time	Inflation in Year Just Ended	Par Value	Coupon Payment	+	Principal Repayment	=	Total Payment
0		\$1,000.00					
1	2%	1,020.00	\$40.80		\$ 0		\$ 40.80
2	3	1,050.60	42.02		0		42.02
3	1	1,061.11	42.44		1,061.11		1,103.55

Bond Pricing

$$P_B = \sum_{t=1}^T \frac{C_t}{(1+r)^t} + \frac{\text{ParValue}}{(1+r)^T}$$

P_B = Price of the bond

C_t = interest or coupon payments

T = number of periods to maturity

r = semi-annual discount rate or the semi-annual yield to maturity

Example 14.2: Bond Pricing

Price of a 30 year, 8% coupon bond
Interest rate = 10%.

$$\text{Price} = \sum_{t=1}^{60} \frac{\$40}{(1.05)^t} + \frac{\$1000}{(1.05)^{60}}$$

$$\text{Price} = \$810.71$$

Bond Prices and Yields

- Prices and yields (required rates of return) have an inverse relationship
- The bond price curve is convex w.r.t. interest rate (see Figure 14.3)
- The longer the maturity, the more sensitive the bond's price to changes in market interest rates

Figure 14.3 The Inverse Relationship Between Bond Prices and Yields

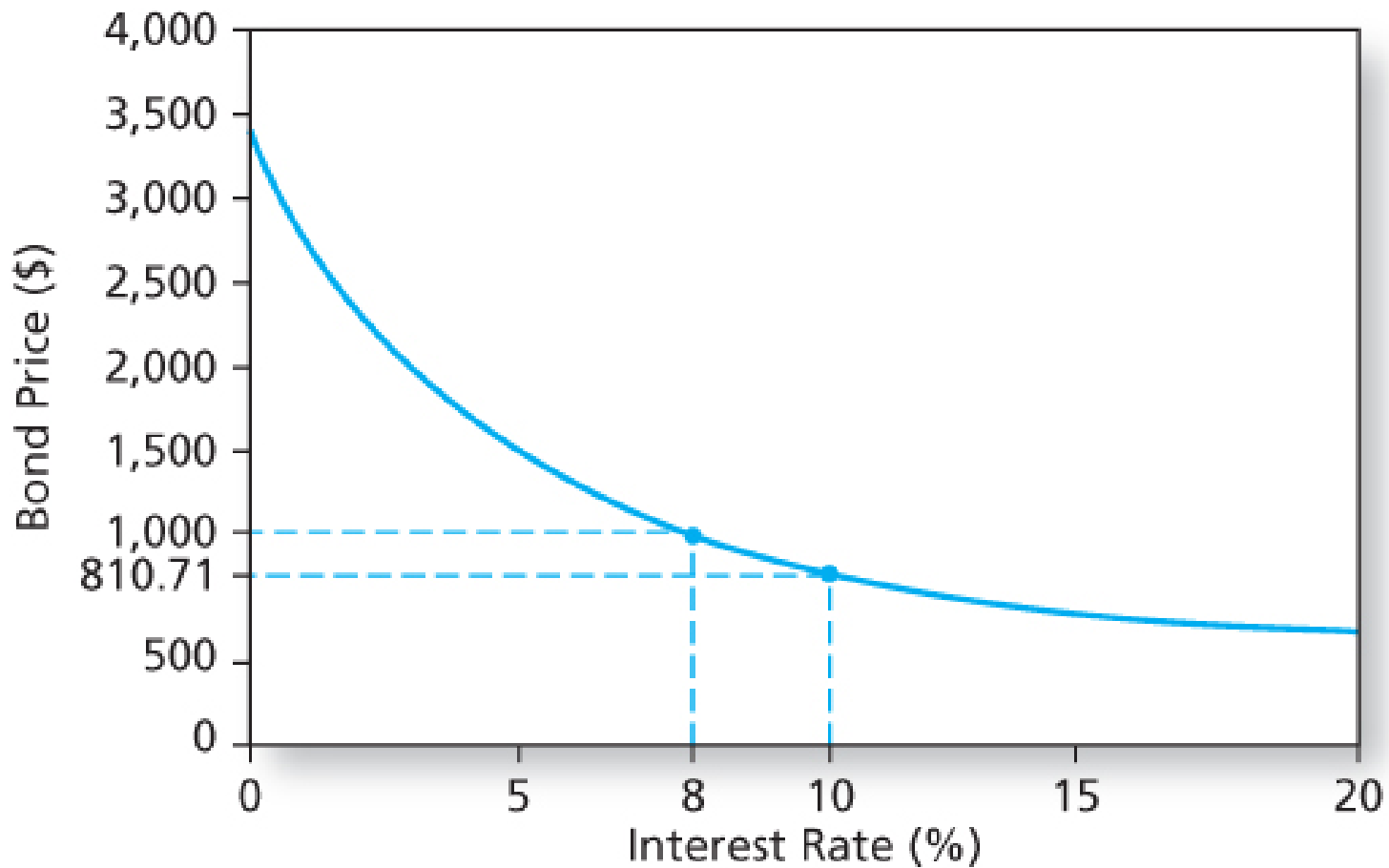


Table 14.2 Bond Prices at Different Interest Rates

Coupon = 8%
(semiannual)

Time to Maturity	Bond Price at Given Market Interest Rate				
	2%	4%	6%	8%	10%
1 year	1,059.11	1,038.83	1,029.13	1,000.00	981.41
10 years	1,541.37	1,327.03	1,148.77	1,000.00	875.35
20 years	1,985.04	1,547.11	1,231.15	1,000.00	828.41
30 years	2,348.65	1,695.22	1,276.76	1,000.00	810.71

Yield to Maturity

Yield To Maturity (YTM) = interest rate that makes the present value of the bond's payments equal to its price

Solve the bond formula for r :

$$P_B = \sum_{t=1}^T \frac{C_t}{(1+r)^t} + \frac{ParValue}{(1+r)^T}$$

Yield to Maturity Example

Suppose an 8% coupon, 30 year bond is selling for \$1276.76.

What is its average rate of return?

$$\$1276.76 = \sum_{t=1}^{60} \frac{\$40}{(1+r)^t} + \frac{1000}{(1+r)^{60}}$$

$r = \underline{\hspace{1cm}}\%$ per half year

Bond equivalent yield = $\underline{\hspace{1cm}}\%$

EAR = $((1+\underline{\hspace{1cm}})^2) - 1 = \underline{\hspace{1cm}}\%$

YTM vs. Current Yield

YTM

- The YTM is the bond's internal rate of return.
- YTM is the interest rate that makes the present value of a bond's payments equal to its price.
- YTM assumes that all bond coupons can be reinvested at the YTM rate.

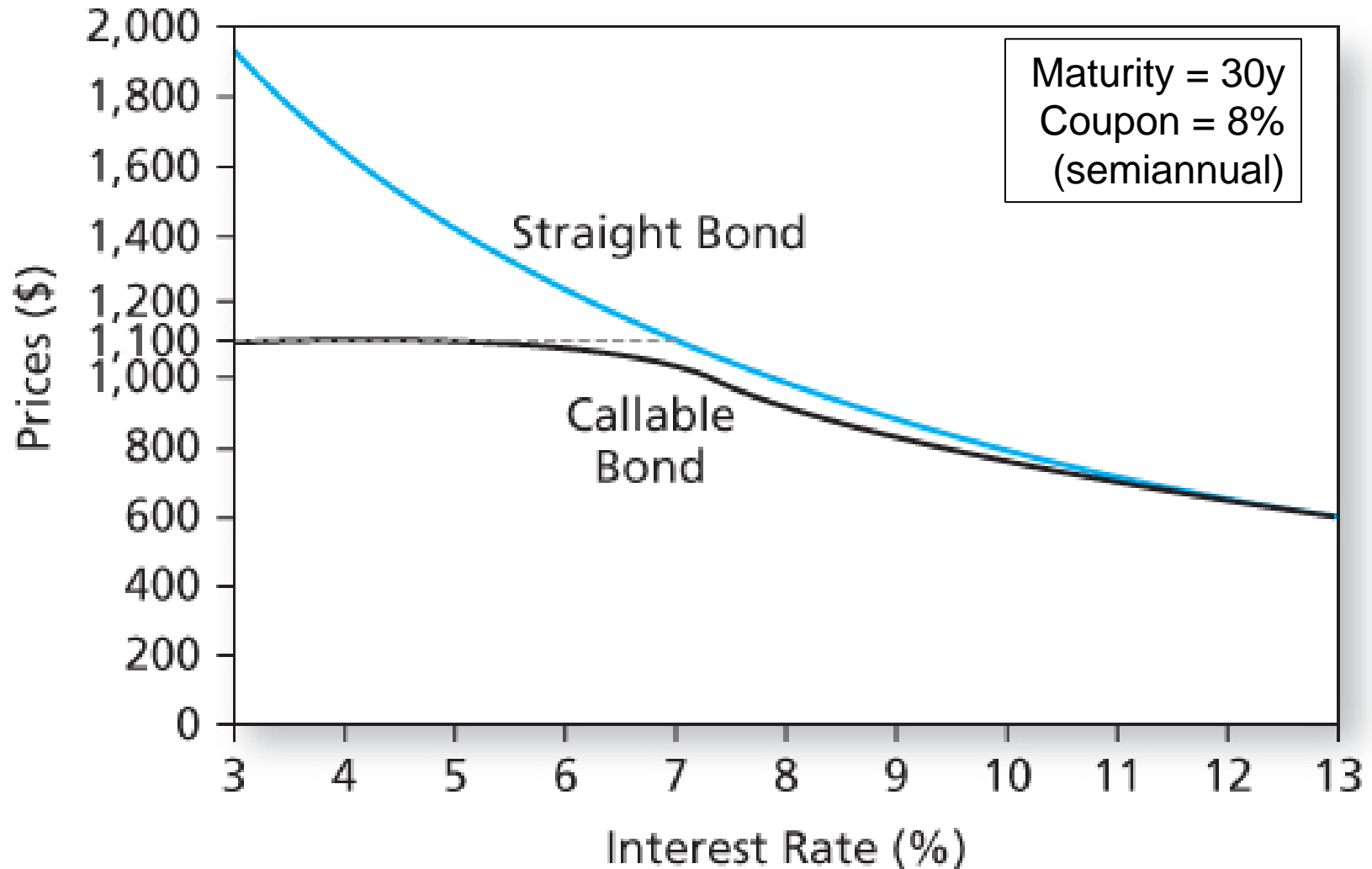
Current Yield

- The current yield is the bond's annual coupon payment divided by the bond price.
- For bonds selling at a premium, coupon rate $>$ current yield $>$ YTM.
- For discount bonds, relationships are reversed.

Yield to Call

- If interest rates fall, price of straight bond can rise considerably.
- The price of the callable bond is flat over a range of low interest rates because the risk of repurchase or call is high.
- When interest rates are high, the risk of call is negligible and the values of the straight and the callable bond converge.

Figure 14.4 Bond Prices: Callable and Straight Debt



Realized Yield versus YTM

- Reinvestment Assumptions
- Holding Period Return
 - Changes in rates affect returns
 - Reinvestment of coupon payments
 - Change in price of the bond

Figure 14.5 Growth of Invested Funds

A. Reinvestment Rate = 10%

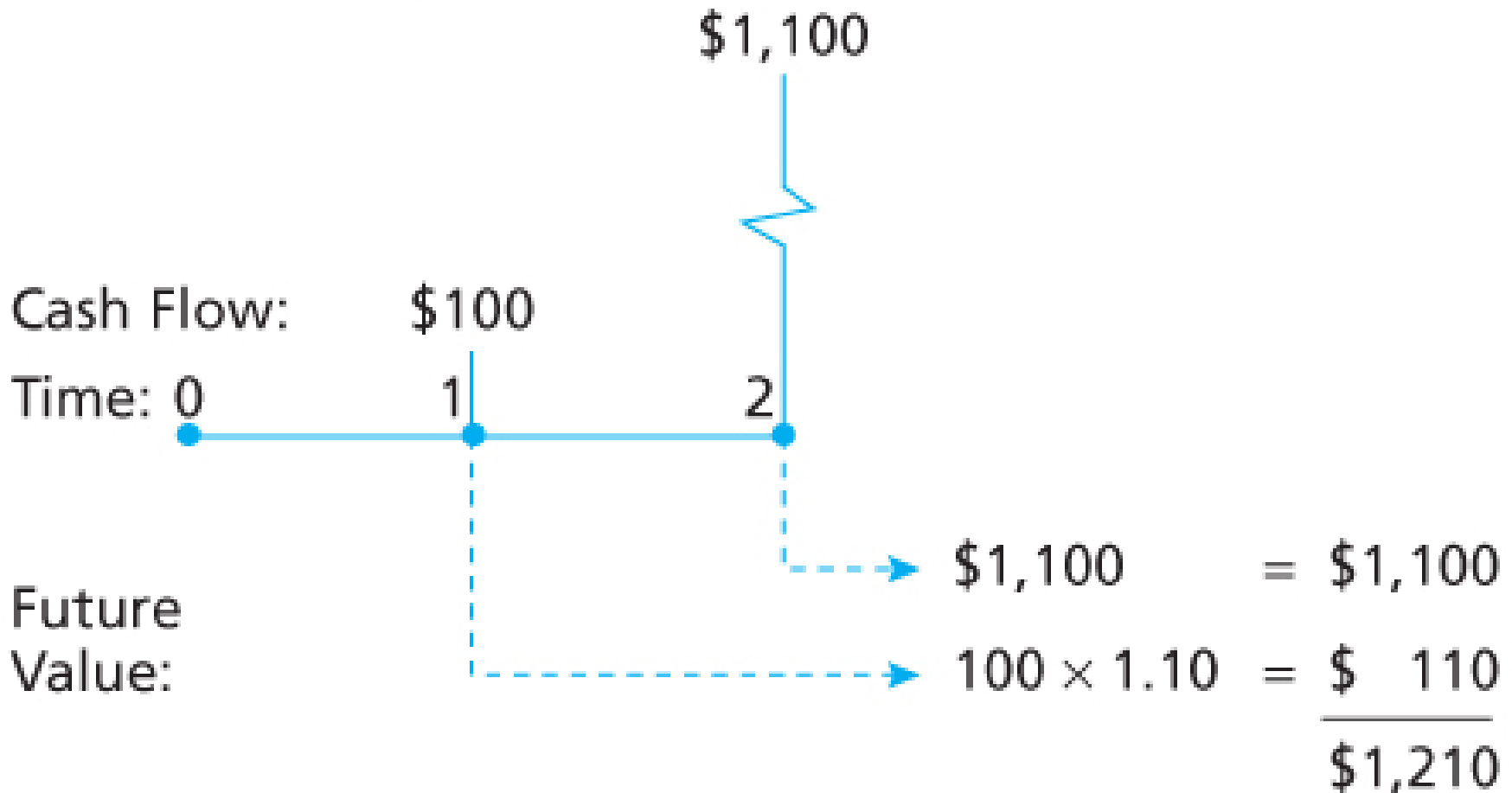


Figure 14.5 Growth of Invested Funds

B. Reinvestment Rate = 8%

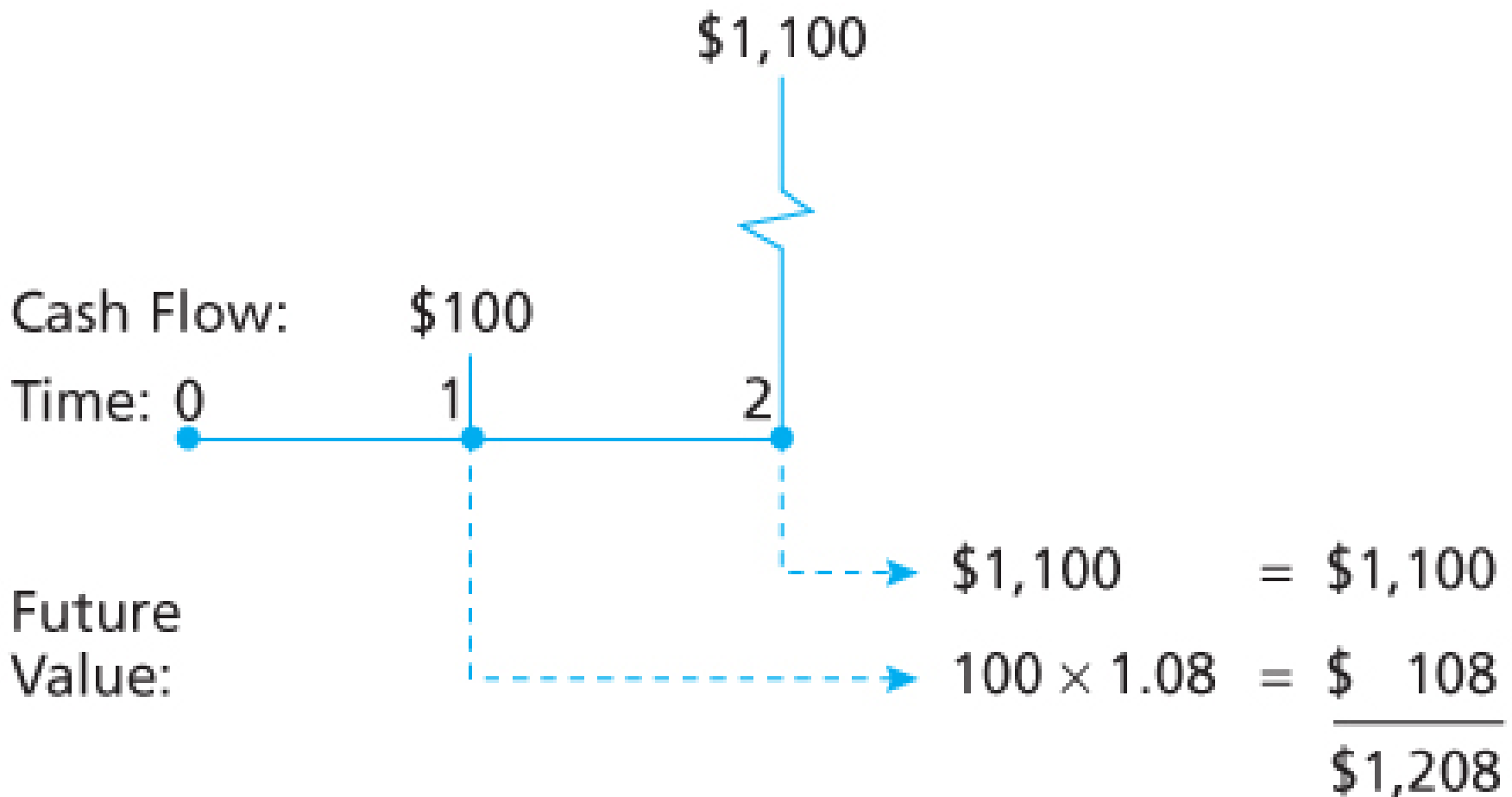
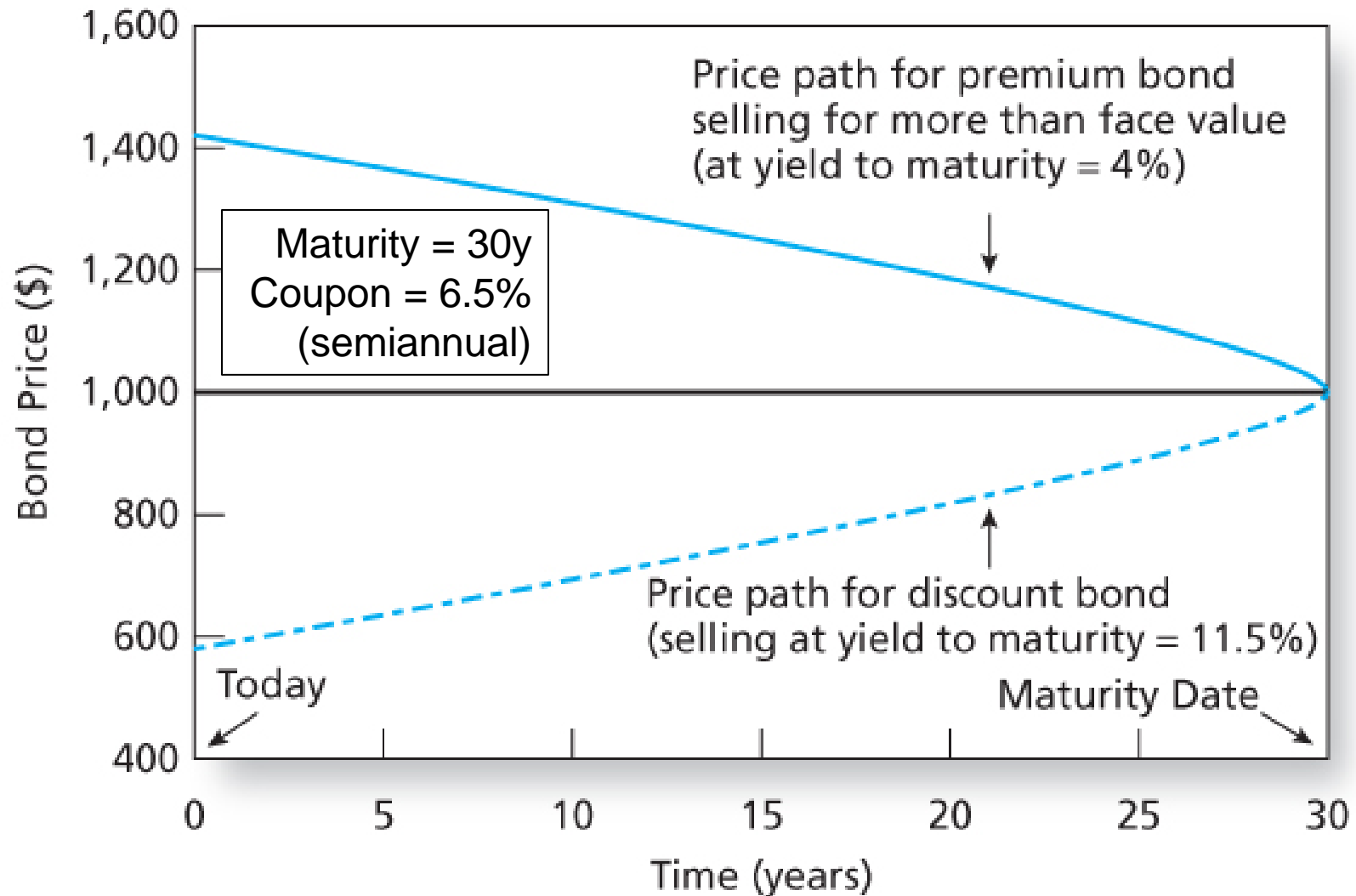


Figure 14.6 Prices over Time of 30-Year Maturity, 6.5% Coupon Bonds



YTM vs. HPR

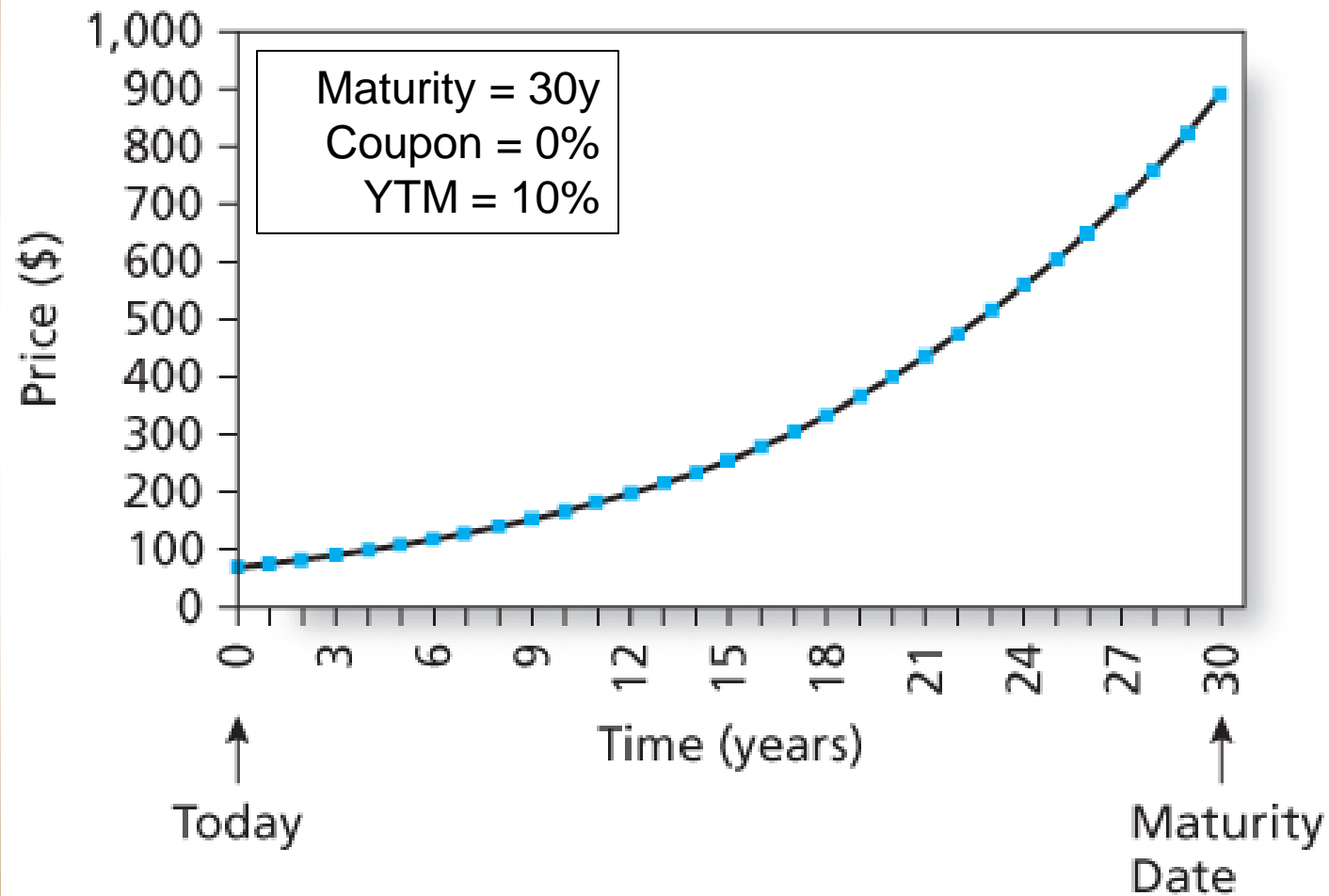
YTM

- YTM is the average return if the bond is held to maturity
- YTM depends on coupon rate, maturity, and par value
- All of these are readily observable in the market

HPR

- HPR is the rate of return over a particular investment period
- HPR depends on the bond's price at the end of the holding period, an unknown future value
- HPR can only be forecasted

Figure 14.7 The Price of a 30-Year Zero-Coupon Bond over Time



Default Risk and Bond Pricing

- Rating companies:
 - Moody's Investor Service, Standard & Poor's, Fitch, DBRS (Canada)
- Rating Categories
 - Highest rating is AAA or Aaa
 - Investment grade bonds are rated BBB or Baa and above
 - Speculative grade/junk bonds have ratings below BBB or Baa

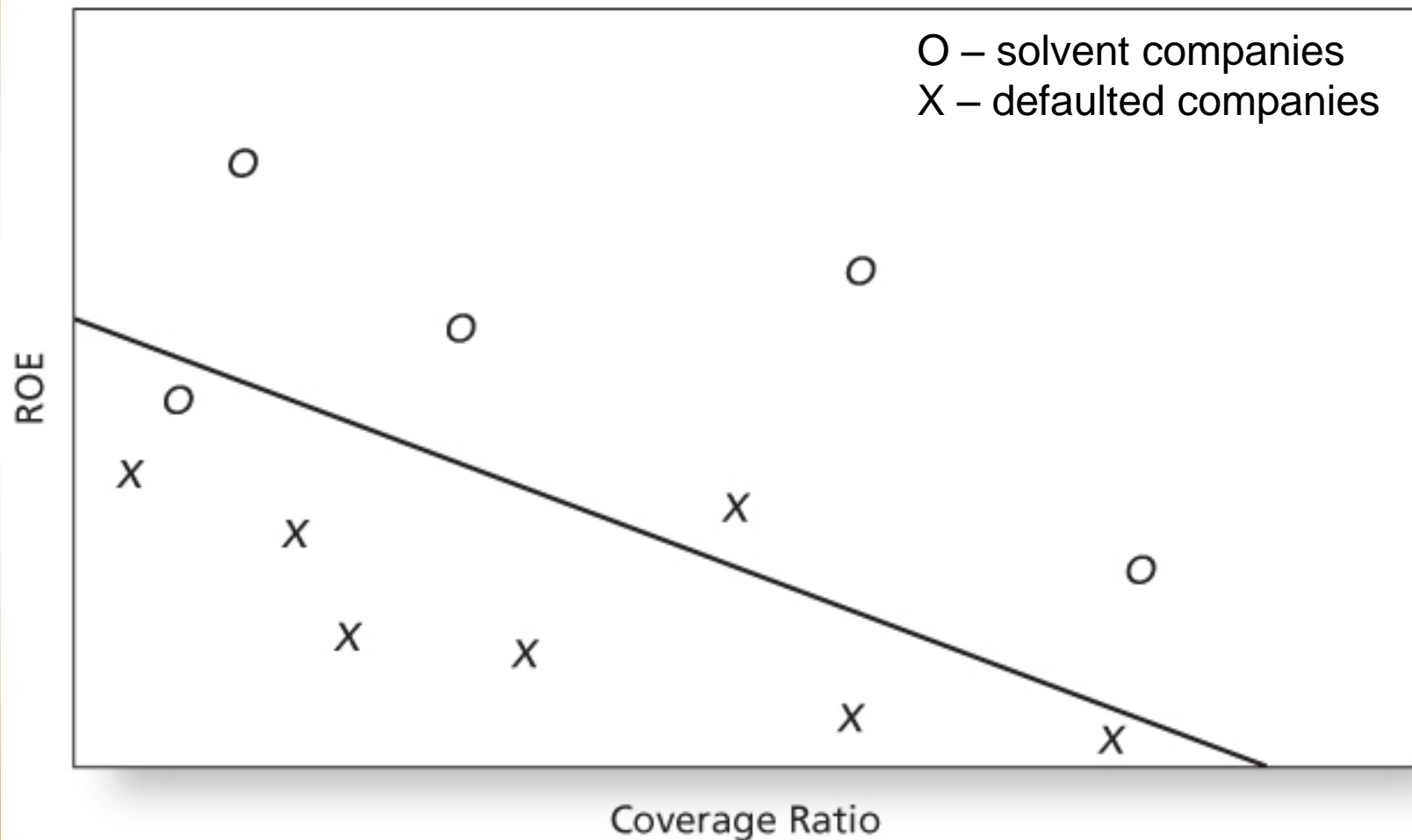
Factors Used by Rating Companies

- Coverage ratios ($\text{EBIT}/\text{IntExp}$)
- Leverage ratios (D/E)
- Liquidity ratios (CA/CL)
- Profitability ratios (ROA , ROE)
- Cash flow to debt ($\text{CF}/\text{Outst. Debt}$)

Table 14.3 Financial Ratios and Default Risk by Rating Class, Long-Term Debt

	3-year (2002 to 2004) medians						
	AAA	AA	A	BBB	BB	B	CCC
EBIT interest coverage multiple	23.8	19.5	8.0	4.7	2.5	1.2	0.4
EBITDA interest coverage multiple	25.5	24.6	10.2	6.5	3.5	1.9	0.9
Funds from operations/total debt (%)	203.3	79.9	48.0	35.9	22.4	11.5	5.0
Free operating cash flow/total debt (%)	127.6	44.5	25.0	17.3	8.3	2.8	(2.1)
Total debt/EBITDA multiple	0.4	0.9	1.6	2.2	3.5	5.3	7.9
Return on capital (%)	27.6	27.0	17.5	13.4	11.3	8.7	3.2
Total debt/total debt + equity (%)	12.4	28.3	37.5	42.5	53.7	75.9	113.5

Figure 14.9 Discriminant Analysis



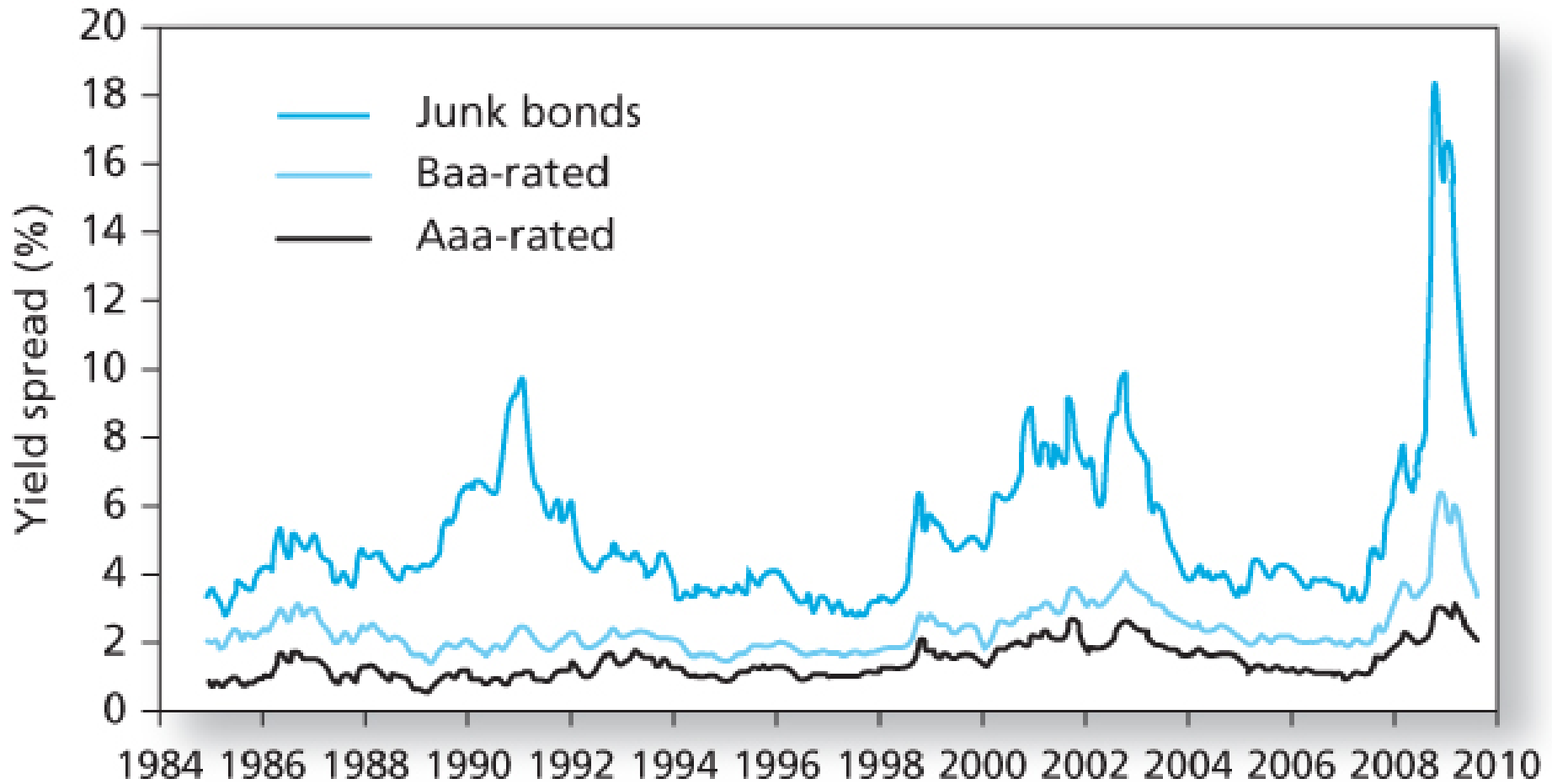
Protection Against Default

- Sinking funds – a way to call bonds early
- Subordination of future debt– restrict additional borrowing (i/creditor agreement)
- Dividend restrictions– force firm to retain assets rather than paying them out to shareholders
- Collateral – a particular asset bondholders receive if the firm defaults.
Distinguishes secured vs unsecured debt.

Default Risk and Yield

- The risk structure of interest rates refers to the pattern of default premiums.
- There is a difference between the yield based on expected cash flows and yield based on promised cash flows.
- The difference between the expected YTM and the promised YTM is the *default risk premium*.

Figure 14.11 Yield Spreads



Credit Default Swaps

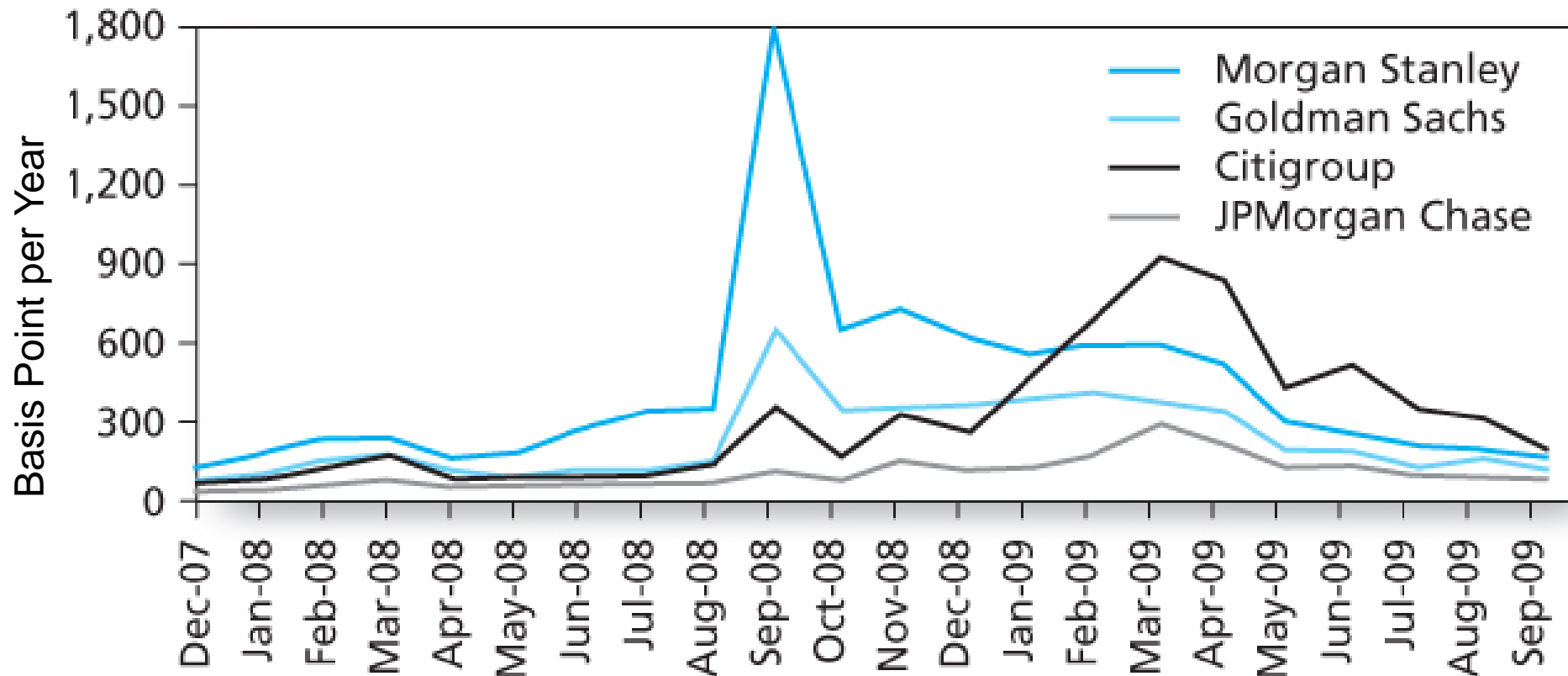
- A credit default swap (CDS) acts like an insurance policy on the default risk of a corporate bond or loan.
- CDS buyer pays annual premiums.
- CDS issuer agrees to buy the bond in a default or pay the difference between par and market values to the CDS buyer.

Credit Default Swaps

- Institutional bondholders, e.g. banks, used CDS to enhance creditworthiness of their loan portfolios, to manufacture AAA debt¹
- CDS can also be used to speculate that bond prices will fall
- This means there can be more CDS outstanding than there are bonds to insure! (note on the evolution of this)

¹ caveat on counterparty risk

Figure 14.12 Prices of Credit Default Swaps



Credit Risk and Collateralized Debt Obligations (CDOs)

- Major mechanism to reallocate credit risk in the fixed-income markets
 - Structured Investment Vehicle (SIV) often used to create the CDO
 - Loans are pooled together and split into tranches with different levels of default risk.
 - Mortgage-backed CDOs were an investment disaster in 2007

Figure 14.13 Collateralized Debt Obligations

		Senior-Subordinated Tranche Structure	Typical Terms
		Senior tranche	70–90% of notional principal, coupon similar to Aa-Aaa rated bonds
		Mezzanine 1	5–15% of principal, investment-grade rating
Bank	Structured Investment Vehicle, SIV		
		Mezzanine 2	5–15% of principal, higher-quality junk rating
		Equity/first loss/residual tranche	<2%, unrated, coupon rate with 20% credit spread