Bond Prices and Yields

Bond Characteristics

- Fixed income security
  - An arragement between borrower and purchaser
  - The issuer makes specified payments to the bond holder on specified dates
- Face or par value
- Coupon rate
  - Zero coupon bond
- Indenture
  - The contract between the issuer nad the bondholder

Different Issuers of Bonds

- U.S. Treasury
  - Notes and Bonds
  - Ranging from 10 to 30 years
  - In denominations $1.000 or more
  - Minimum reduced in 2008 to $100
  - Semiannual payments

Figure 14.1 Listing of Treasury Issues

Treasury Bonds, Notes and Bills

January 17, 2006

Explanatory Notes

Representative Over-the-Counter quotation based on transactions of $1 million or more. Treasury bond, note and bill quotes are as of mid-afternoon. Colons in bid-and-asked quotes represent 32nds; 101:01 means 101 1/32. Net changes in 32nds. n-Treasury note. i-Inflation-Indexed Issue. Treasury bill quotes in hundredths, quoted on terms of a rate of discount. Days to maturity calculated from settlement date. All yields are to maturity and based on the asked quote. Latest 13-week and 26-week bills are boldfaced. For bonds callable prior to maturity, yields are computed to the earliest call date for issues quoted above par and to the maturity date for issues below par. *When issued.

Source: eSpeed/Cantor Fitzgerald

U.S. Treasury strips as of 3 p.m. Eastern time, also based on transactions of $1 million or more. Colons in bid and asked quotes represent 32nds: 99:01 means 99 1/32. Net changes in 32nds. Yields calculated on the asked quotation. ci-stripped coupon interest bp-Treasury bond, stripped principal. np-Treasury note, stripped principal. For bonds callable prior to maturity, yields are computed to the earliest call date for issues quoted above par and to the maturity date for issues below par.

Source: Bear, Stearns & Co. via Street Software Technology Inc.

Government Bonds & Notes

RATE	MATURITY MO/YR	BID	ASKED	CHG	ASK YLD
1.875	Jan 06n	99:29	99:30	1	3.76
5.625	Feb 06n	100:03	100:04	...	3.82
9.375	Feb 06	100:12	100:13	...	3.68
1.625	Feb 06n	99:22	99:23	1	4.16
1.500	Mar 06n	99:13	99:14	...	4.31
2.250	Apr 06n	99:12	99:13	...	4.33
6.500	Feb 10n	108:04	108:05	2	4.29
4.000	Mar 10n	98:29	98:30	3	4.28
0.875	Apr 10i	95:30	95:31	5	1.87
4.000	Apr 10n	98:28	98:29	3	4.28
3.875	May 10n	98:13	98:14	3	4.27
3.625	Jun 10n	97:11	97:12	2	4.28
3.875	Jul 10n	98:11	98:12	3	4.28
5.750	Aug 10n	106:03	106:04	2	4.26
4.125	Aug 10n	99:10	99:11	2	4.28
3.875	Sep 10n	98:09	98:10	3	4.28
4.250	Oct 10n	99:26	99:27	3	4.29
4.500	Nov 10n	100:28	100:29	3	4.29
4.375	Dec 10n	100:12	100:13	3	4.28
4.250	Jan 11n	99:28	99:29	2	4.27
3.500	Jan 11i	107:25	107:26	6	1.85
5.000	Feb 11n	103:09	103:10	3	4.27
13.875	May 11	103:02	103:03	...	9.81
5.000	Aug 11n	103:17	103:18	4	4.27
14.000	Nov 11	107:25	107:26	...	4.19
3.375	Jan 12i	108:16	108:17	8	1.86
4.875	Feb 12n	103:00	103:01	3	4.30
3.000	Jul 12i	106:26	106:27	8	1.87
4.375	Aug 12n	100:11	100:12	3	4.31
4.000	Nov 12n	98:06	98:07	4	4.30
10.375	Nov 12	110:13	110:14	...	4.34
3.875	Feb 13n	97:10	97:11	4	4.31
3.625	May 13n	95:25	95:26	5	4.29
1.875	Jul 13i	99:27	99:28	9	1.89
4.250	Aug 13n	99:16	99:17	5	4.32
12.000	Aug 13	118:20	118:21	–1	4.26
4.250	Nov 13n	99:14	99:15	4	4.33
2.000	Jan 14i	100:19	100:20	9	1.92
4.000	Feb 14n	97:22	97:23	4	4.34
4.750	May 14n	102:27	102:28	5	4.33
13.250	May 14	127:12	127:13	1	4.30
2.000	Jul 14i	100:20	100:21	10	1.91
7.625	Feb 25	138:18	138:19	10	4.57
6.875	Aug 25	129:16	129:17	9	4.57
6.000	Feb 26	118:19	118:20	9	4.57
6.750	Aug 26	128:25	128:26	9	4.57
6.500	Nov 26	125:22	125:23	10	4.57
6.625	Feb 27	127:18	127:19	9	4.57
6.375	Aug 27	124:19	124:20	11	4.57
6.125	Nov 27	121:11	121:12	10	4.57
3.625	Apr 28i	130:00	130:00	15	1.95
5.500	Aug 28	113:03	113:04	9	4.56
5.250	Nov 28	109:24	109:25	10	4.55
5.250	Feb 29	109:24	109:25	10	4.56
3.875	Apr 29i	135:22	135:23	10	1.95
6.125	Aug 29	122:16	122:17	10	4.55
6.250	May 30	124:28	124:29	10	4.55
5.375	Feb 31	112:28	112:29	9	4.51
3.375	Apr 32i	131:01	131:02	15	1.87

U.S. Treasury Strips

MATURITY		TYPE	BID	ASKED	CHG	ASK YLD
Feb	06	ci	99:23	99:23	...	3.53
Feb	06	bp	99:22	99:22	...	3.91
Feb	06	np	99:22	99:23	...	3.86
Apr	06	ci	99:00	99:01	...	4.09
May	06	ci	98:21	98:22	...	4.15
May	06	np	98:19	98:20	...	4.32
May	06	np	98:19	98:20	...	4.32
Jul	06	ci	98:03	98:03	1	3.94
Aug	06	ci	97:19	97:20	1	4.23
Aug	06	np	97:15	97:16	...	4.44
Oct	06	ci	96:28	96:29	...	4.30
Nov	06	ci	96:16	96:17	...	4.34
Nov	06	np	96:14	96:14	...	4.45
Nov	06	np	96:14	96:14	...	4.45
Feb	07	ci	95:19	95:20	...	4.21
Feb	07	np	95:13	95:14	...	4.39
May	07	ci	94:18	94:18	...	4.26
May	07	np	94:14	94:15	...	4.34
May	07	np	94:14	94:15	...	4.35
Aug	07	ci	93:18	93:18	...	4.26
Aug	07	np	93:15	93:16	...	4.32
Aug	07	np	93:14	93:15	...	4.33
Nov	07	ci	92:17	92:18	...	4.29
Nov	07	np	92:16	92:16	...	4.32
Feb	08	ci	91:19	91:20	1	4.26
Feb	08	np	91:19	91:19	1	4.27
Feb	08	np	91:16	91:17	1	4.31
May	08	ci	90:20	90:21	1	4.27
May	08	np	90:18	90:19	1	4.30
May	08	np	90:18	90:19	1	4.30
Aug	08	ci	89:23	89:23	1	4.25
Aug	08	np	89:21	89:21	1	4.28
Nov	08	ci	88:22	88:23	1	4.29
Feb	15	ci	67:02	67:03	4	4.45
Feb	15	bp	67:10	67:11	4	4.41
May	15	ci	66:17	66:18	4	4.41
Aug	15	ci	65:22	65:22	4	4.44
Aug	15	bp	65:29	65:30	4	4.40
Nov	15	ci	65:03	65:04	4	4.42
Nov	15	bp	65:05	65:06	4	4.41
Feb	16	ci	64:00	64:01	4	4.47
Feb	16	bp	64:11	64:11	4	4.42
May	16	ci	63:07	63:08	3	4.49
May	16	bp	63:17	63:18	4	4.44
Aug	16	ci	62:17	62:17	4	4.49
Nov	16	ci	61:23	61:23	4	4.51
Nov	16	bp	62:01	62:01	4	4.46

Accrued Interest and Quoted Bond Prices

- Quoted prices are not the prices that investor pay for the bond
- Quoted price does not include the interest that accrues between coupon payments dates

$$\text{Accrued interest} = \frac{\text{Annual coupon payment}}{2} \times \frac{\text{Days since last coupon payment}}{\text{Days separating coupon payments}}$$

EXAMPLE 14.1 Accrued Interest

Suppose that the coupon rate is 8%. Then the annual coupon is \$80 and the semiannual coupon payment is \$40. Because 30 days have passed since the last coupon payment, the accrued interest on the bond is $\$40 \times (30/182) = \$6.59$. If the quoted price of the bond is \$990, then the invoice price will be $\$990 + \$6.59 = \$996.59$.

- Corporations
  - Most of them traded in OTC markets by bond dealers
- Municipalities
- International Governments and Corporations
- Innovative Bonds
  - Floaters and Inverse Floaters
  - Asset-Backed
  - Catastrophe
- Indexed Bonds

- Innovative Bonds
  - Floaters and Inverse Floaters
    - Same as floating-rate bonds
    - Coupon rate on these bond falls when the general level of interest rates rises
  - Asset-Backed
    - Income from a specified group of assets is used to service the debt
    - Walt Disney Bonds
  - Catastrophe
    - Way how to transfer catastrophe risk in capital market

Figure 14.2 Corporate Bond Listings

ISSUER NAME	SYMBOL	COUPON	MATURITY	RATING MOODY'S/S&P/ FITCH	HIGH	LOW	LAST	CHANGE	YIELD %
Gatx	GMT.IK	8.875%	Jun 2009	Baa1/BBB/BBB–	107.545	107.538	107.545	–0.100	5.433
Marshall & Ilsley	MI.YL	3.800%	Feb 2008	Aa3/A+/A+	98.514	98.470	98.514	0.064	5.263
Capital One	COF.HK	7.686%	Aug 2036	Baa2/BBB–/BBB–	113.895	113.390	113.733	0.257	6.621
Entergy Gulf States	ETR.KC	6.180%	Mar 2035	Baa3/BBB+/BBB	99.950	94.616	99.469	0.219	6.220
AOL Time Warner	AOL.HG	6.875%	May 2012	Baa2/BBB+/BBB	107.205	105.402	106.565	0.720	5.427
Household Intl	HI.HJG	8.875%	Feb 2008	Aa3/AA–/AA–	100.504	100.504	100.504	–0.109	5.348
SBC Comm	SBC.IF	5.875%	Feb 2012	A2/A/A	102.116	102.001	102.001	–0.156	5.415
American General Finance	AIG.GOU	5.750%	Sep 2016	A1/A+/A+	101.229	101.135	101.135	–0.530	5.595

FIGURE 14.2 Listing of corporate bonds

Source: *The Wall Street Journal Online*, January 12, 2007. Reprinted by permission of Dow Jones & Company, Inc. via Copyright Clearance Center, Inc. © 2007 Dow Jones & Company, Inc. All Rights Reserved Worldwide.

Table 14.1 Principal and Interest Payments for Treasury Inflation Protected Security

TABLE 14.1

Principal and interest payments for a Treasury Inflation Protected Security

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

- Repayments occur months or years in the future
  - Depend on the future value and present value
- Nominal risk free rate
  - Real risk free rate + compensation for expected inflation
- Not riskless
  - Additional premium
    - Default risk, liquidity, taxation, call risk, etc.

Bond Pricing

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

P_B = Price of the bond

C_t = interest or coupon payments

T = number of periods to maturity

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

Price: 10-yr, 8% Coupon, Face = $1,000

$$P = 40\sum_{t=1}^{20}\frac{1}{(1.03)^t} + \frac{1000}{(1.03)^{20}}$$

$$P = \$1{,}148.77$$

C_t = 40 (SA)

P = 1000

T = 20 periods

r = 3% (SA)

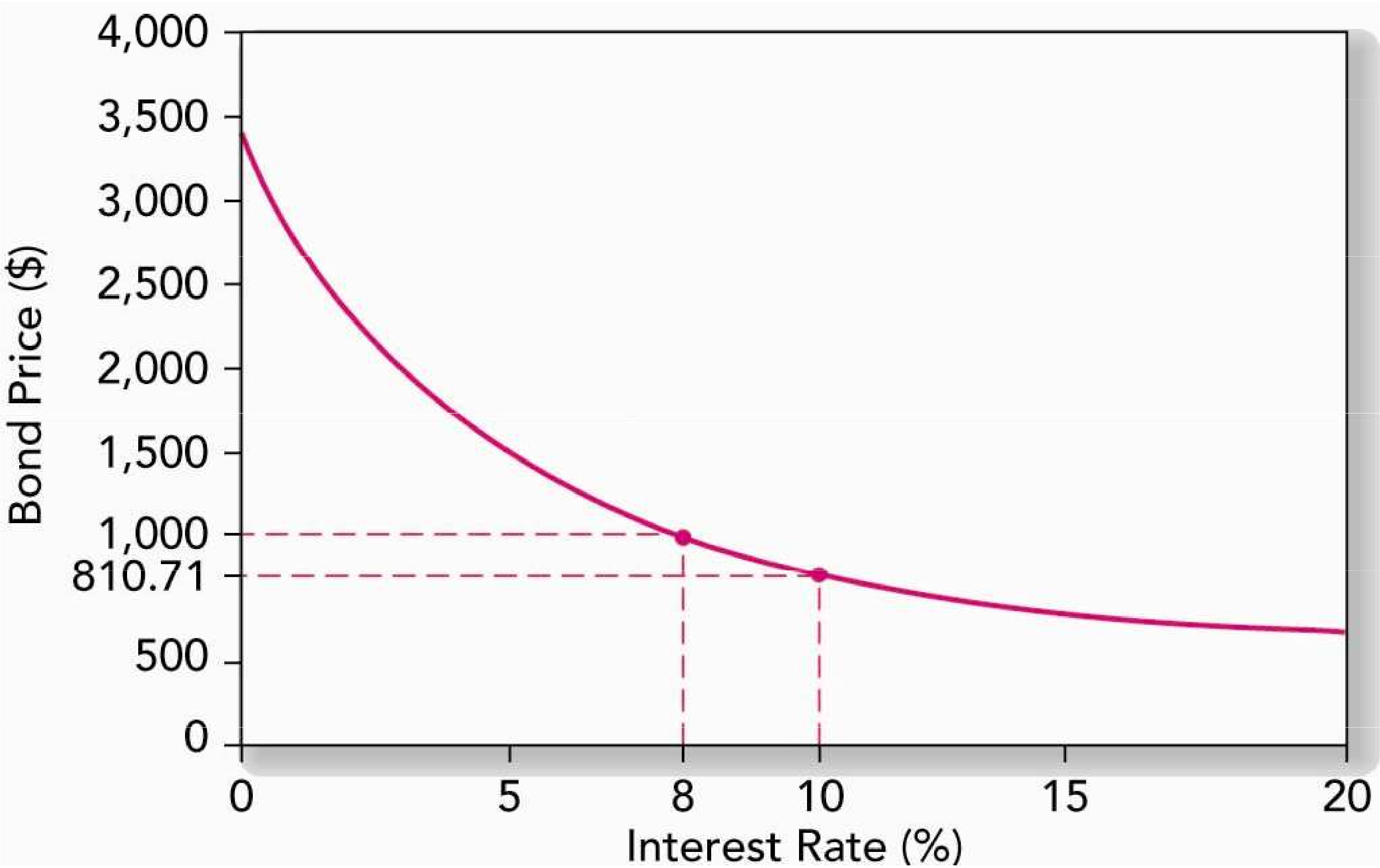
- At a higher interest rate
  - PV is lower
- Bond price will fall as market interest rates rise
- The negative shape
  - Inverse relationship between prices and yields
  - An increase in the interest rate results in a price decline that is smaller than the price gain resulting from decrease in the interest rate
    - convexivity

Bond Prices and Yields

Prices and Yields (required rates of return) have an inverse relationship

- When yields get very high the value of the bond will be very low.
- When yields approach zero, the value of the bond approaches the sum of the cash flows.

Figure 14.3 The Inverse Relationship Between Bond Prices and Yields



- The inverse relation between price and yield is a central feature of fixed-income securities
- Interest rate fluctuations represent the main source of risk
- General rule in evaluating bonds price risk
  - Keeping all other factors same
  - The longer the maturity of the bond, the greater the sensitivity of price to fluctuations in the interest rate
- This is why short-term T securities are considered to be the safest
  - Free not only of default risk but also largely price risk

Table 14.2 Bond Prices at Different Interest Rates (8% Coupon Bond, Coupons Paid Semiannually

TABLE 14.2

Bond prices at different interest rates (8% coupon bond, coupons paid semiannually)

Time to Maturity	Bond Price at Given Market Interest Rate				
	4%	6%	8%	10%	12%
1 year	1,038.83	1,029.13	1,000.00	981.41	963.33
10 years	1,327.03	1,148.77	1,000.00	875.35	770.60
20 years	1,547.11	1,231.15	1,000.00	828.41	699.07
30 years	1,695.22	1,276.76	1,000.00	810.71	676.77

Yield to Maturity

- A investor considering the purchase of a bond is not quoted
  - Use bond price, maturity day, coupon payment to infer return offered by the bond over its life
- Yield to maturity
  - Interest rate that makes the PV of a bond's payments equal to its price

Yield to Maturity

- Interest rate that makes the present value of the bond's payments equal to its price.

Solve the bond formula for r

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

Yield to Maturity Example

$$950 = \sum_{t=1}^{20} \frac{35}{(1+r)^t} + \frac{1000}{(1+r)^T}$$

10 yr Maturity **Coupon Rate = 7%**

Price = $950

Solve for r = semiannual rate

$\boxed{\textbf{r = 3.8635\%}}$

	A	B	C	D	E
1		**Semiannual coupons**		**Annual coupons**	
2					
3	Settlement date	1/1/2000		1/1/2000	
4	Maturity date	1/1/2030		1/1/2030	
5	Annual coupon rate	0.08		0.08	
6	Bond price (flat)	127.676		127.676	
7	Redemption value (% of face value)	100		100	
8	Coupon payments per year	2		1	
9					
10	**Yield to maturity (decimal)**	**0.0600**		**0.0599**	
11					
12	The formula entered here is: =YIELD(B3,B4,B5,B6,B7,B8)				

SPREADSHEET 14.1

Finding yield to maturity in Excel

eXcel

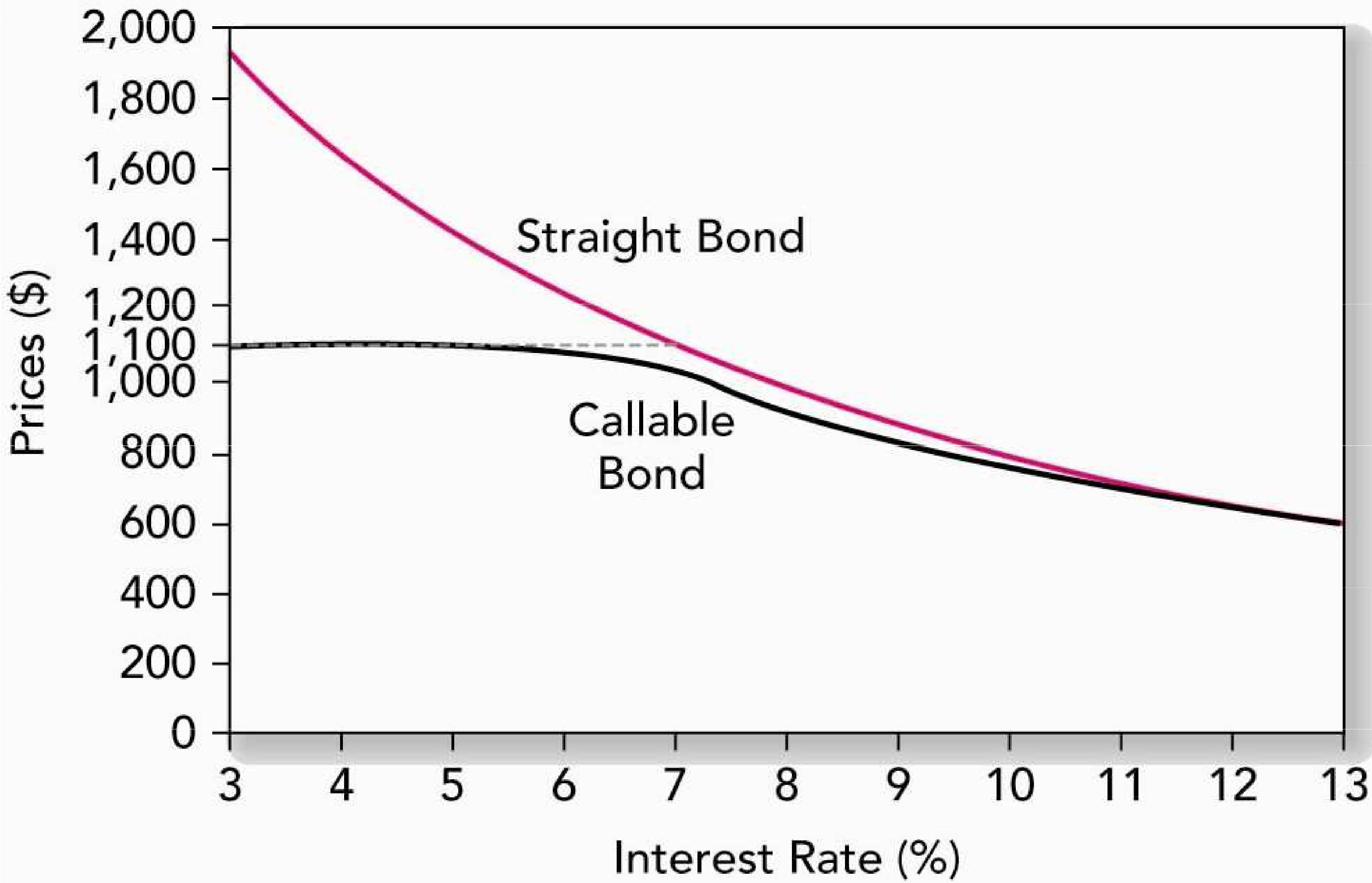
Please visit us at

www.mhhe.com/bkm

Yield to Call

- Yield to maturity
  - Hold till maturity
- Yield to Call

Figure 14.4 Bond Prices: Callable and Straight Debt



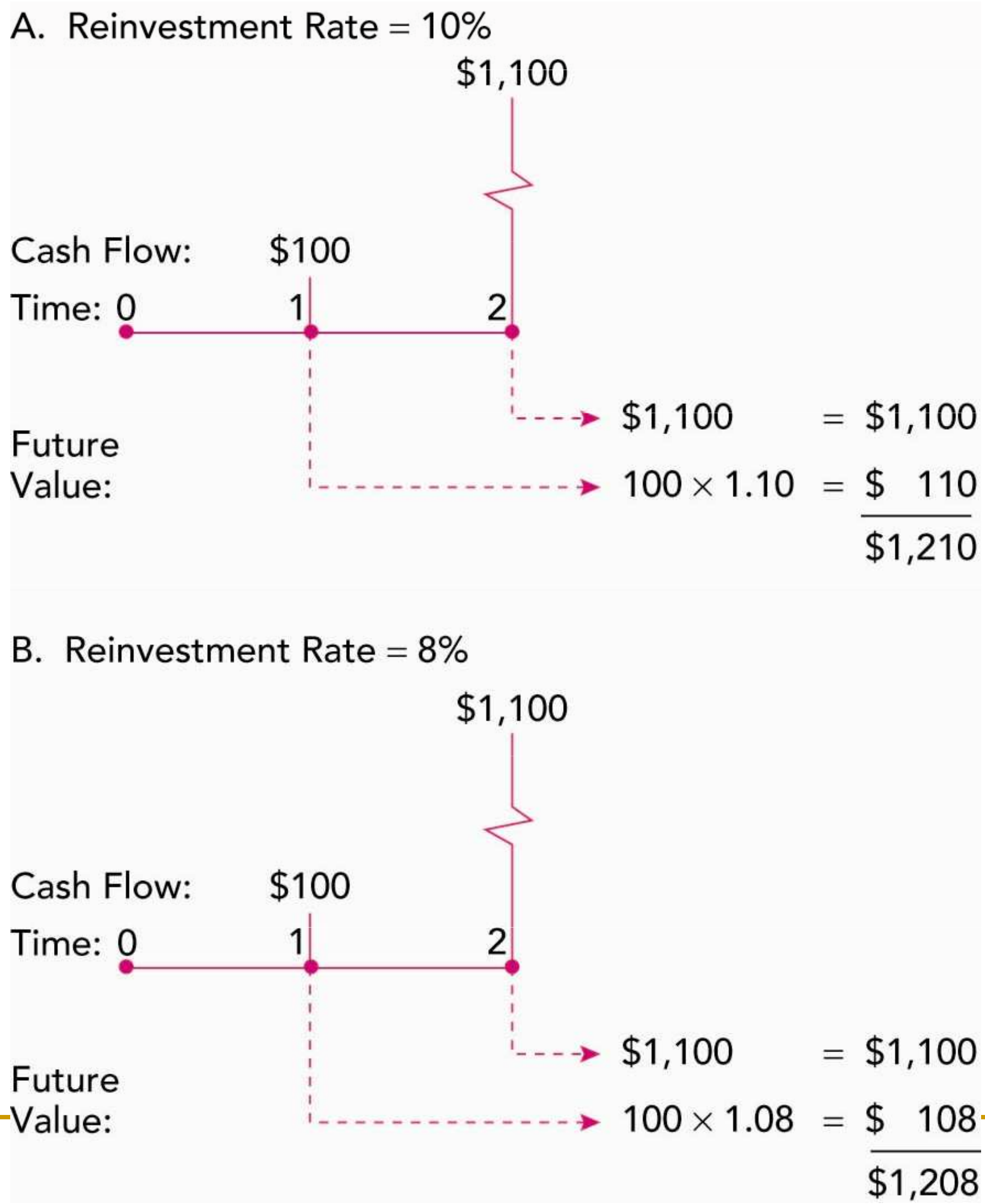
Example 14.4 Yield to Call

	Yield to Call	Yield to Maturity
Coupon payment	$40	$40
Number of semiannual periods	20 periods	60 periods
Final payment	$1,100	$1,000
Price	$1,150	$1,150

Realized Yield versus YTM

- Reinvestment Assumptions
  - All coupons from return realized over life if all coupons are reinvested at an interest rate equal to the bond's yield to maturity
- When reinvestment rate equal to the 10%
  - Realized compound return equals yield to maturity
  - If not - reinvestment rate risk
    - Changes in interest rate

Figure 14.5 Growth of Invested Funds



Bond Prices Over Time

- Bond prices are set according to the PV
  - If coupon rate > market interest rate
    - Income is greater than that available elsewhere in the market
    - Price of these bonds above their par values

Holding-Period Return: Single Period

$$HPR = [\, I + (\, P_0 - P_1\,)] \,/\, P_0$$

where

I = interest payment

P_1 = price in one period

P_0 = purchase price

Holding-Period Example

CR = 8% YTM = 8% N=10 years

Semiannual Compounding P_0 = $1000

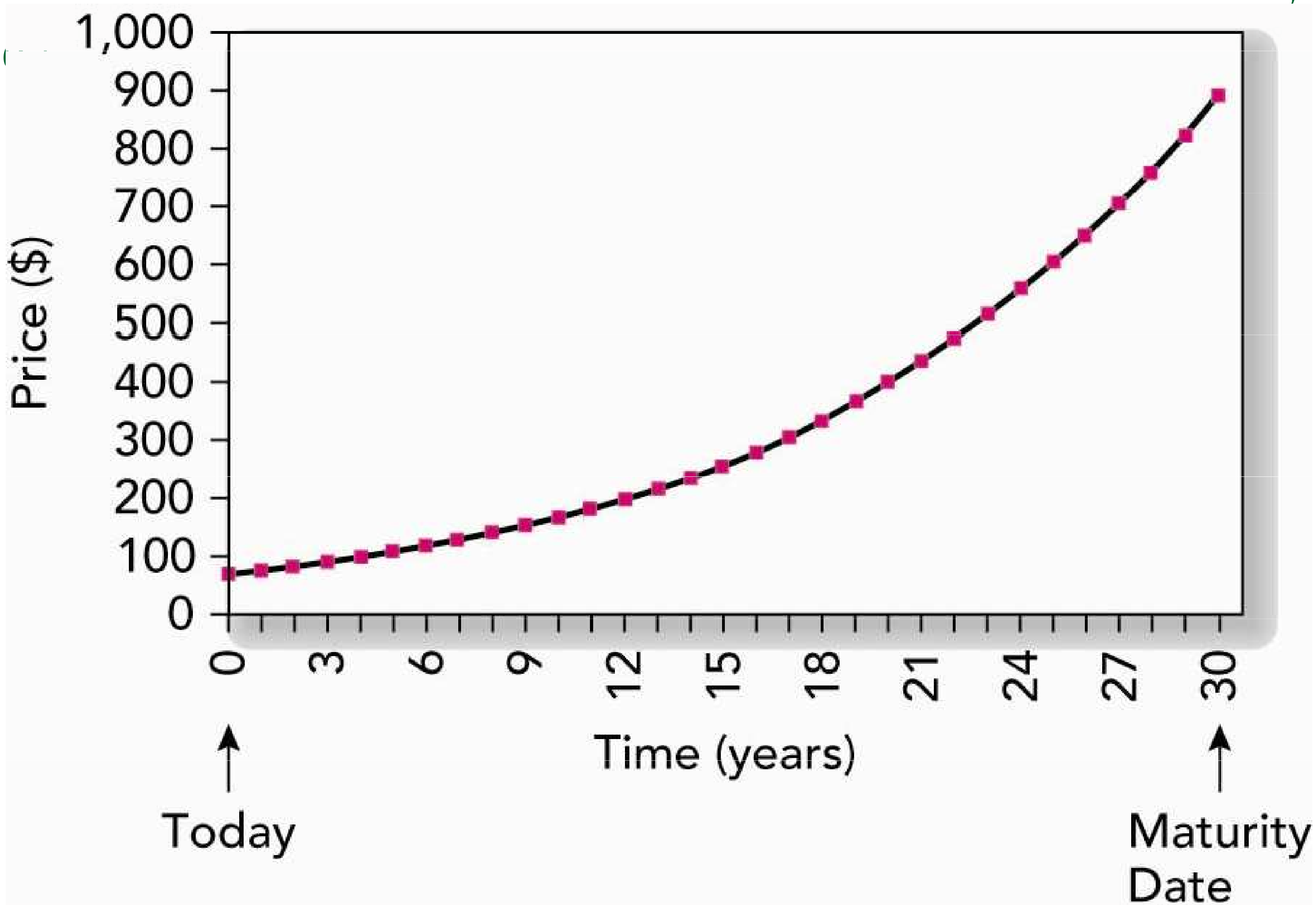
In six months the rate falls to 7%

P_1 = $1068.55

HPR = [40 + (1068.55 - 1000)] / 1000

HPR = 10.85% (semiannual)

Figure 14.7 The Price of a 30-Year Zero-Coupon Bond over Time at a Yield to Maturity of 10



Default Risk and Ratings

- Rating companies
  - Moody's Investor Service
  - Standard & Poor's
  - Fitch
- Rating Categories
  - Investment grade
  - Speculative grade

Figure 14.8 Definitions of Each Bond Rating Class

Bond Ratings

	Very High Quality		High Quality		Speculative		Very Poor	
Standard & Poor's	AAA	AA	A	BBB	BB	B	CCC	D
Moody's	Aaa	Aa	A	Baa	Ba	B	Caa	C

At times both Moody's and Standard & Poor's have used adjustments to these ratings:
S&P uses plus and minus signs: A + is the strongest A rating and A – the weakest.
Moody's uses a 1, 2, or 3 designation, with 1 indicating the strongest.

Moody's	S&P	
Aaa	AAA	Debt rated Aaa and AAA has the highest rating. Capacity to pay interest and principal is extremely strong.
Aa	AA	Debt rated Aa and AA has a very strong capacity to pay interest and repay principal. Together with the highest rating, this group comprises the high-grade bond class.
A	A	Debt rated A has a strong capacity to pay interest and repay principal, although it is somewhat more susceptible to the adverse effects of changes in circumstances and economic conditions than debt in higher-rated categories.
Baa	BBB	Debt rated Baa and BBB is regarded as having an adequate capacity to pay interest and repay principal. Whereas it normally exhibits adequate protection parameters, adverse economic conditions or changing circumstances are more likely to lead to a weakened capacity to pay interest and repay principal for debt in this category than in higher-rated categories. These bonds are medium-grade obligations.
Ba B Caa Ca	BB B CCC CC	Debt rated in these categories is regarded, on balance, as predominantly speculative with respect to capacity to pay interest and repay principal in accordance with the terms of the obligation. BB and Ba indicate the lowest degree of speculation, and CC and Ca the highest degree of speculation. Although such debt will likely have some quality and protective characteristics, these are outweighed by large uncertainties or major risk exposures to adverse conditions. Some issues may be in default.
C	C	This rating is reserved for income bonds on which no interest is being paid.
D	D	Debt rated D is in default, and payment of interest and/or repayment of principal is in arrears.

Junk Bonds

- High-yield bonds
- Before 1977 – fallen angels
- After 1977 – original-issue junk
- Drexel Burnham Lambert – Michael Milken

Factors Used by Rating Companies

- Coverage ratios
  - Earnings to fixed costs
  - Low or falling – cash flow difficulties
- Leverage ratios
  - Debt-to-equity ratio
- Liquidity ratios
  - Current:
  - Quick (without inventories)
- Profitability ratios
- Cash flow to debt

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

	Three-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
Historical default rate (%)	0.5	1.3	2.3	6.6	19.5	35.8	54.4

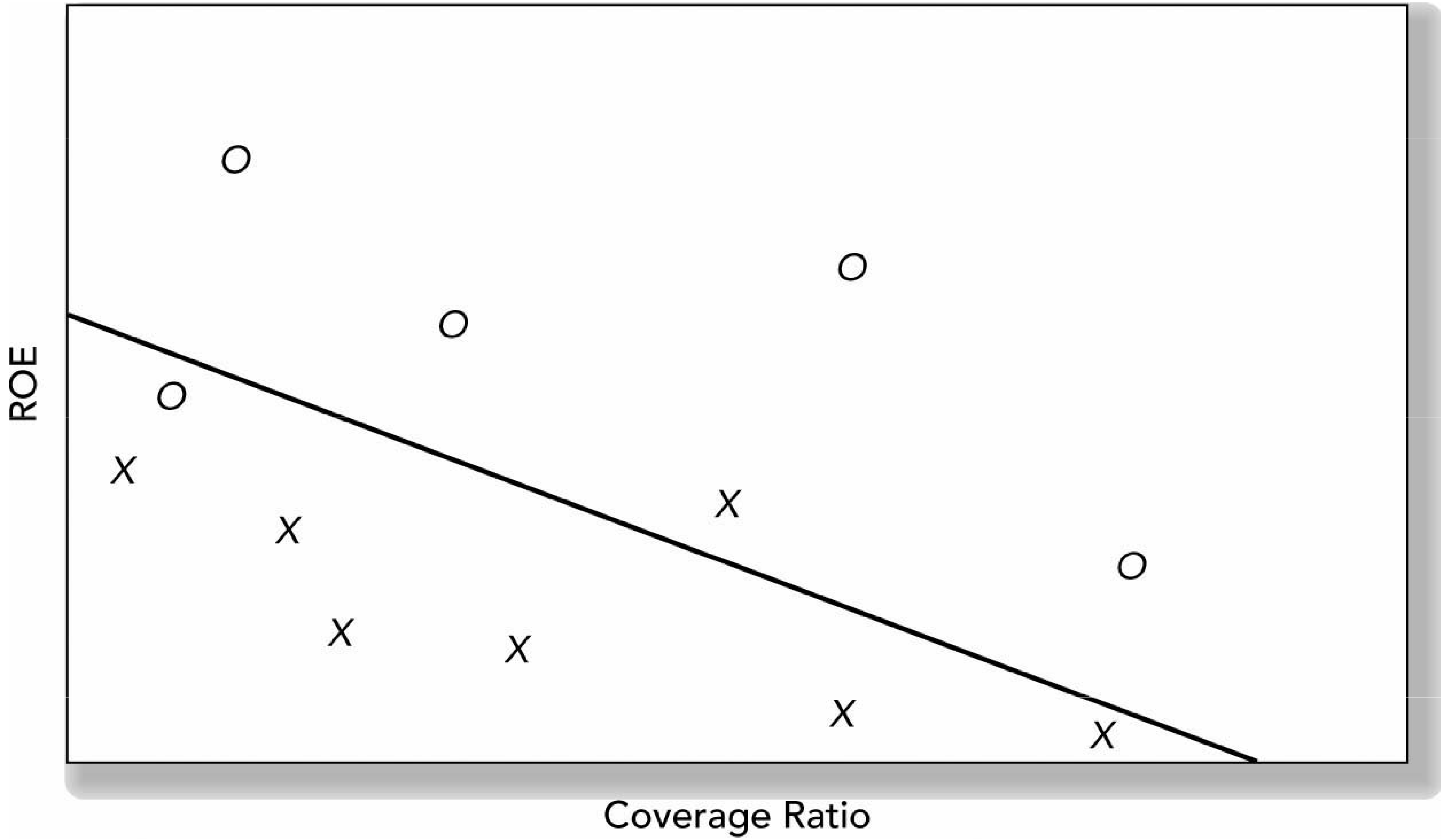
TABLE 14.3

Financial ratios and default risk by rating class, long-term debt

Note: EBITDA is earnings before interest, taxes, depreciation, and amortization

Source: *Corporate Rating Criteria*, Standard & Poor's, 2006. Historical default rates from "Static Pools Cumulative Average Default Rates (%)," Standard & Poor's. Reproduced by permission of Standard & Poor's, a division of The McGraw-Hill Companies, Inc.

Figure 14.9 Discriminant Analysis



Protection Against Default

- Sinking funds
  - To help ensure the commitment to spread payment problems over several years
- Subordination of future debt
  - Factor that determine bond safety is total outstanding debt of the issuer
- Dividend restrictions
- Collateral

Default Risk and Yield

- Yield to maturity and expected yield
  - Maximum possible yield vs. yield with possibility of default
- Default premiums
  - To compensate for the possibility of default
  - Yields compared to ratings
  - Yield spreads over business cycles

Figure 14.11 Yields on Long-Term Bonds, 1954 – 2006