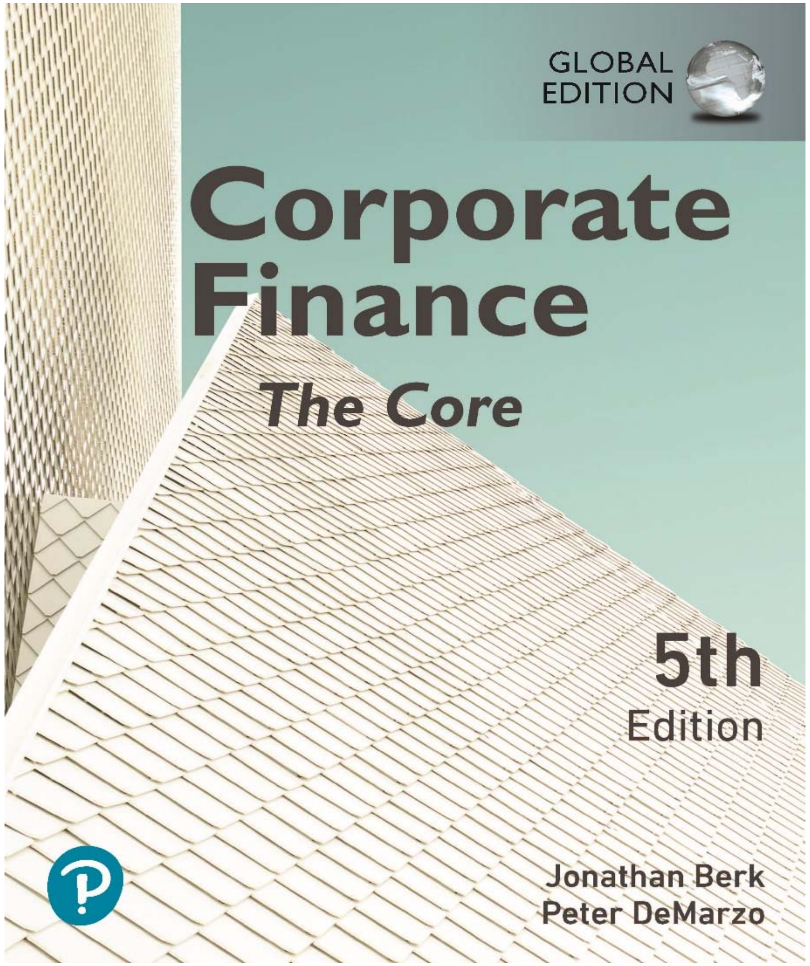
Corporate Finance: The Core

Fifth Edition, Global Edition



Chapter 5

Interest Rates

Pearson

Chapter Outline

5.1 Interest Rate Quotes and Adjustments

5.2 Application: Discount Rates and Loans

5.3 The Determinants of Interest Rates

5.4 Risk and Taxes

5.5 The Opportunity Cost of Capital

Learning Objectives (1 of 3)

- Define effective annual rate and annual percentage rate.
- Given an effective annual rate, compute the *n*-period discount rate.
- Convert an annual percentage rate into an effective annual rate, given the number of compounding periods.
- Describe the relation between nominal and real rates of interest.

Learning Objectives (2 of 3)

- Given two of the following, compute the third: nominal rate, real rate, and inflation rate.
- Describe the effect of higher interest rates on net present values in the economy.
- Explain how to choose the appropriate discount rate for a given stream of cash flows, according to the investment horizon.

Learning Objectives (3 of 3)

- Discuss the determinants of the shape of the yield curve.
- Explain why Treasury securities are considered risk-free, and describe the impact of default risk on interest rates.
- Given the other two, compute the third: after-tax interest rate, tax rate, and before-tax interest rate.

5.1 Interest Rate Quotes and Adjustments (1 of 2)

- The Effective Annual Rate
  - Indicates the total amount of interest that will be earned at the end of one year
  - Considers the effect of compounding
    - Also referred to as the effective annual yield (EAY) or annual percentage yield (APY)
  - Used as the discount rate r in our time value of money calculation

5.1 Interest Rate Quotes and Adjustments (2 of 2)

- Adjusting the Discount Rate to Different Time Periods
  - Earning a 5% return annually is **not** the same as earning 2.5% every six months.
- General Equation for Discount Rate Period Conversion

$$\text{Equivalent } n-\text{Period Discount Rate} = (1+r)^n - 1$$

  - Given a discount rate of r for one period
  - n can be larger than 1 (to compute a rate over more than one period) or smaller than 1 (to compute a rate over a fraction of a period)
- a 5% effective annual rate is equivalent to an interest rate of approximately x% earned every six months.
  - $x = (1.05)^{1/2} - 1 = 1.0247 - 1 = .0247 = 2.47$ (%)

  Note: $n = 0.5$ since we are solving for the six-month (or half year) rate.

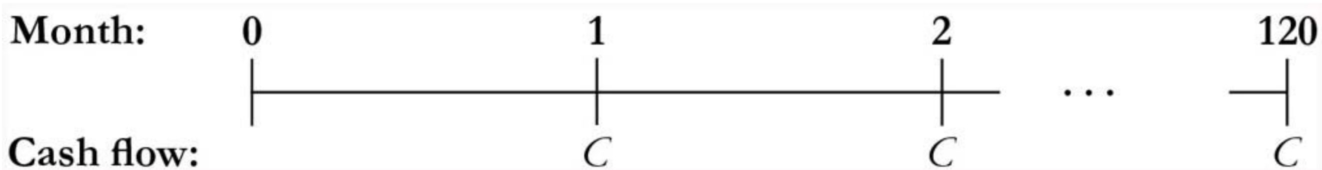
Textbook Example 5.1 (1 of 3)

Valuing Monthly Cash flows

- **Problem**
  - Suppose your bank account pays interest monthly with the interest rate quoted as an effective annual rate (EAR) of 6%. What amount of interest will you earn each month? If you have no money in the bank today, how much will you need to save at the end of each month to accumulate $100,000 in 10 years?

Textbook Example 5.1 (2 of 3)

- From Eq. 5.1, a 6% EAR is equivalent to earning $(1.06)^{\frac{1}{12}} - 1 = 0.4868\%$ per month. We can write the timeline for our savings plan using **monthly** periods as follows:



- That is, we can view the savings plan as a monthly annuity with $10 \times 12 = 120$ monthly payments. We can calculate the total amount saved as the future value of this annuity, using Eq. 4.10:

$$FV(\text{annuity}) = C \times \frac{1}{r}\left[(1+r)^n - 1\right]$$

- We can solve for the **monthly** payment C using the equivalent **monthly** interest rate r = 0.4868%, and n = 120 months:

Textbook Example 5.1 (3 of 3)

- We can also compute this result using the annuity spreadsheet:

	NPER	RATE	PV	PMT	FV	Excel Formula
Given	120	0.4868%	0	-	100,000	-
Solve for PMT	-	-	-	-615.47	-	= PMT(0.004868,120,0,100000)

- Thus, if we save \$615.47 per month and we earn interest monthly at an effective annual rate of 6%, we will have \$100,000 in 10 years.

Annual Percentage Rates (1 of 4)

- The **annual percentage rate (APR)**, indicates the amount of simple interest earned in one year.
  - **Simple interest** is the amount of interest earned **without** the effect of compounding.
  - The APR is typically less than the effective annual rate (EAR).

Annual Percentage Rates (2 of 4)

- **The APR itself cannot be used as a discount rate.**
  - The APR with k compounding periods is a way of quoting the actual interest earned each compounding period:

$$\text{Interest Rate per Compounding Period} = \frac{\text{APR}}{\left(\dfrac{\text{k periods}}{\text{year}}\right)}$$

Annual Percentage Rates (3 of 4)

- Converting an APR to an EAR

$$\boxed{1 + EAR = \left(1 + \frac{APR}{k}\right)^k}$$

  - The EAR increases with the frequency of compounding.
    - **Continuous compounding** is compounding every instant.

Annual Percentage Rates (4 of 4)

Table 5.1 Effective Annual Rates for a 6% APR with Different Compounding Periods

Compounding Interval	Effective Annual Rate
Annual	$\left[1+\frac{0.06}{1}\right]^{1}-1=6\%$
Semiannual	$\left[1+\frac{0.06}{2}\right]^{2}-1=6.09\%$
Monthly	$\left[1+\frac{0.06}{12}\right]^{12}-1=6.1678\%$
Daily	$\left[1+\frac{0.06}{365}\right]^{365}-1=6.1831\%$

– A 6% APR with continuous compounding results in an EAR of approximately 6.1837%.

Textbook Example 5.2 (1 of 4)

Converting the APR to a Discount Rate

- **Problem**
  - Your firm is purchasing a new telephone system, which will last for four years. You can purchase the system for an upfront cost of \$150,000, or you can lease the system from the manufacturer for \$4,000 paid at the end of each month.
  - Your firm can borrow at an interest rate of 5% APR with semiannual compounding. Should you purchase the system outright or pay \$4,000 per month?

Textbook Example 5.2 (2 of 4)

Solution

- The cost of leasing the system is a 48-month annuity of $4,000 per month:

Month:	0	1	2	. . .	48
Payment:		$4000	$4000		$4000

- We can compute the present value of the lease cash flows using the annuity formula, but first we need to compute the discount rate that corresponds to a period length of one month. To do so, we convert the borrowing cost of 5% APR with semiannual compounding to a monthly discount rate. Using Eq. 5.2,

the APR corresponds to a six-month discount rate of $\frac{5\%}{2} = 2.5\%$. To convert a six-month discount into a one-month discount rate, we compound the six-month rate by $\frac{1}{6}$ using Eq. 5.1:

$$(1.025)^{\frac{1}{6}} - 1 = 0.4124\% \text{ per month}$$

Textbook Example 5.2 (3 of 4)

$$1 + EAR = \left(1 + \frac{APR}{k}\right)^k$$

- (Alternatively, we could first use Eq. 5.3 to convert the APR to an *EAR*. $1+EAR = (1 + \frac{0.05}{2})^2 = 1.050625.$ Then we can convert the *EAR* to a monthly rate using Eq. 5.1: $(1.050625)^{\frac{1}{12}} - 1 = 0.4124\%$ month.)

Given this discount rate, we can use the annuity formula (Eq. 4.9) to compute the present value of the 48 monthly payments:

$$PV = 4000 \times \frac{1}{0.004124^{48}}\left(1 - \frac{1}{1.004124^{48}}\right) = \$173{,}867$$

- We can also use the annuity spreadsheet:

-	NPER	RATE	PV	PMT	FV	Excel Formula
Given	48	0.4124%	-	- 4,000	0	-
Solve for PV	-	-	**173,867**	-	-	= PV(0.004124,48,4000,0)

Textbook Example 5.2 (4 of 4)

- Thus, paying \$4,000 per month for 48 months is equivalent to paying a present value of \$173,867 today. This cost is $\$173,867 - \$150,000 = \$23,867$ higher than the cost of purchasing the system, so it is better to pay \$150,000 for the system rather than lease it.

  We can interpret this result as meaning that at a 5% APR with semiannual compounding, by promising to repay \$4,000 per month, your firm can borrow \$173,867 today. With this loan it could purchase the phone system and have an additional \$23,867 to use for other purposes.

5.2 Application: Discount Rates and Loans (1 of 2)

- Computing Loan Payments
  - Payments are made at a set interval, typically monthly.
  - All payments are equal and the loan is fully repaid with the final payment.
  - Each payment made includes the interest on the loan plus some part of the loan balance.

5.2 Application: Discount Rates and Loans (2 of 2)

- Computing Loan Payments
  - Consider a $30,000 car loan with 60 equal monthly payments, computed using a 6.75% APR with monthly compounding.
    - 6.75% APR with monthly compounding corresponds to a one-month discount rate of $\frac{6.75\%}{12} = 0.5625\%$.

$$C = \frac{P}{\frac{1}{r}\left(1 = \frac{1}{(1+r)^N}\right)} = \frac{30{,}000}{\frac{1}{0.005625}\left(1 - \frac{1}{(1+0.005625)^{60}}\right)} = \$590.50$$

Textbook Example 5.3 (1 of 3)

Computing the Outstanding Loan Balance

- **Problem**
  - Two years ago your firm took out a 30-year amortizing loan to purchase a small office building. The loan has a 4.80% APR with monthly payments of $2,623.33.

    1) How much do you owe on the loan today?

    2) How much interest did the firm pay on the loan in the past year?

Textbook Example 5.3 (2 of 3)

Solution

- After two years, the loan has 28 years, or 336 months, remaining:

- The remaining balance on the loan is the present value of these remaining payments, using the loan rate of $\frac{4.8\%}{12} = 0.4\%$ per month:

$$\text{Balance after 2 years} = \$2623.33 \times \frac{1}{0.004}\left(1 - \frac{1}{1.004^{336}}\right) = \$484{,}332$$

- During the past year, your firm made total payments of $\$2{,}623.33 \times 12 = \$31{,}480$ on the loan. To determine the amount that was interest, it is easiest to first determine the amount that was used to repay the principal. Your loan balance one year ago, with 29 years (348 months) remaining, was

Textbook Example 5.3 (3 of 3)

$$\text{Balance after one year} = \$2623.33 \times \left(1 - \frac{1}{1.004^{348}}\right) = \$492{,}354$$

Therefore, the balance declined by $\$492{,}354 - \$484{,}332 = \$8{,}022$ in the past year. Of the total payments made, $\$8{,}022$ was used to repay the principal and the remaining $\$31{,}480 - \$8{,}022 = \$23{,}458$ was used to pay interest.

5.3 The Determinants of Interest Rates (1 of 2)

- Inflation and Real Versus Nominal Rates
  - **Nominal Interest Rate:** The rates quoted by financial institutions and used for discounting or compounding cash flows
  - **Real Interest Rate:** The rate of growth of your purchasing power, after adjusting for inflation

5.3 The Determinants of Interest Rates (2 of 2)

$$\text{Growth in Purchasing Power} = 1 + r_r = \frac{1+r}{1+i} = \frac{\text{Growth of Money}}{\text{Growth of Prices}}$$

- The Real Interest Rate

$$r_r = \frac{r-i}{1+i} \approx r - i$$

Textbook Example 5.4

Calculating The Real Interest Rate

- **Problem**
  - In May of 2014, one-year U.S. government bond rates were about 0.1%, while the rate of inflation over the following year was around -0.05% (deflation). At the start of 2017, one-year interest rates were about 0.8%, and inflation over the following year was approximately 2.1%. What were the real interest rates in May 2014 and in 2017?

Textbook Example 5.4 (2 of 3)

- **Solution**
  - Using Eq. 5.5, the real interest rate in May 2014 was

$$\frac{(0.1\% + 0.05\%)}{(0.9995)} = 0.15\%.$$

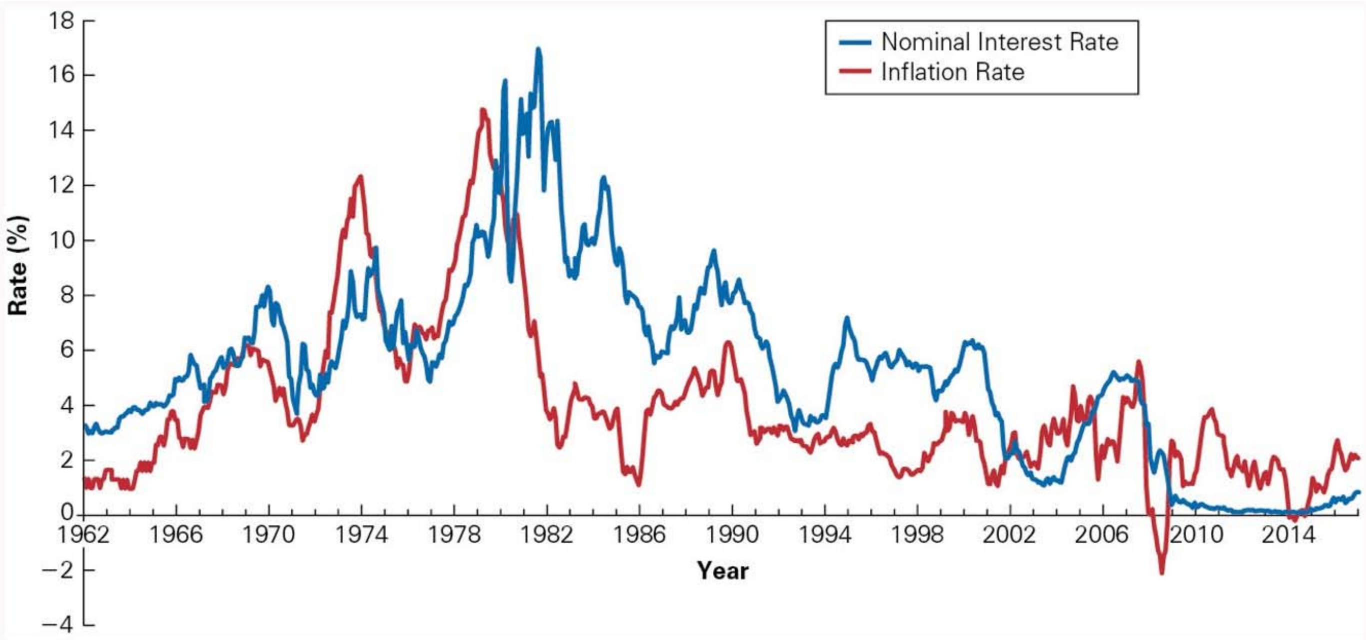
In 2017, the real interest rate was

$$\frac{(0.8\% - 2.1\%)}{(1.021)} = -1.27\%.$$

Textbook Example 5.4 (3 of 3)

- **Solution**
  - Note that the real interest rate was negative in 2017, indicating that interest rates were insufficient to keep up with inflation: Investors in U.S. government bonds were able to buy less at the end of the year than they could have purchased at the start of the year. On the other hand, because prices actually decreased (deflation) in the year following May 2014, the real interest rate briefly exceeded the nominal interest rate.

Figure 5.1 U.S. Interest Rates and Inflation Rates, 1962–2017



Interest rates are one-year Treasury rates, and inflation rates are the increase in the U.S. Bureau of Labor Statistics' consumer price index over the coming year, with both series computed on a monthly basis. The difference between them thus reflects the approximate real interest rate earned by holding Treasuries. Note that interest rates tend to be high when inflation is high.

Investment and Interest Rate Policy (1 of 2)

- An increase in interest rates will typically reduce the NPV of an investment.
  - Consider an investment that requires an initial investment of $10 million and generates a cash flow of $3 million per year for four years. If the interest rate is 5%, the investment has an NPV of

$$NPV = -10 + \frac{3}{1.05} + \frac{3}{1.05^2} + \frac{3}{1.05^3} + \frac{3}{1.05^4} = \$0.638 \text{ million}$$

Investment and Interest Rate Policy (2 of 2)

- If the interest rate rises to 9%, the NPV becomes negative and, the investment is no longer profitable:

$$NPV = -10 + \frac{3}{1.09} + \frac{3}{1.09^2} + \frac{3}{1.09^3} + \frac{3}{1.09^4} = -\$0.281 \text{ million}$$

Monetary Policy, Deflation, and the 2008 Financial Crisis

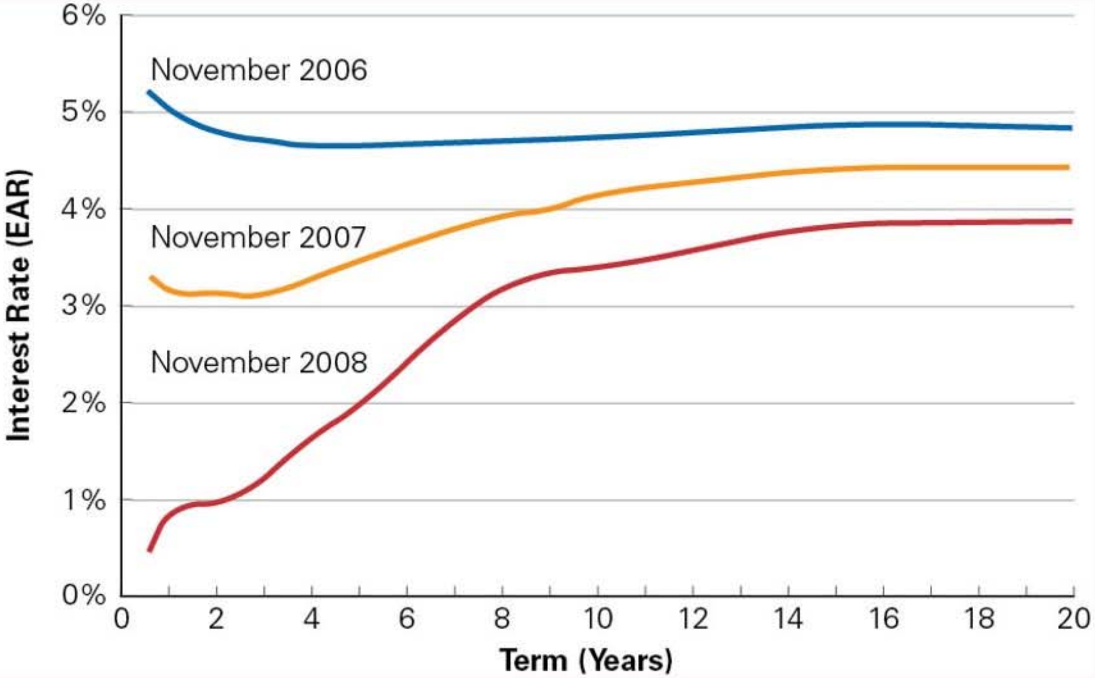
- When the 2008 financial crisis struck, the Federal Reserve responded by cutting its short-term interest rate target to 0%.
- While this use of monetary policy is generally quite effective, because consumer prices were falling in late 2008, the inflation rate was negative, and so even with a 0% nominal interest rate, the real interest rate remained positive.

The Yield Curve and Discount Rates (1 of 2)

- **Term Structure:** The relationship between the investment term and the interest rate
- **Yield Curve:** A graph of the term structure

Figure 5.2 Term Structure of Risk-Free U.S. Interest Rates, November 2006, 2007, and 2008

Term (years)	Date Nov-06	Nov-07	Nov-08
0.5	5.23%	3.32%	0.47%
1	4.99%	3.16%	0.91%
2	4.80%	3.16%	0.98%
3	4.72%	3.12%	1.26%
4	4.63%	3.34%	1.69%
5	4.64%	3.48%	2.01%
6	4.65%	3.63%	2.49%
7	4.66%	3.79%	2.90%
8	4.69%	3.96%	3.21%
9	4.70%	4.00%	3.38%
10	4.73%	4.18%	3.41%
15	4.89%	4.44%	3.86%
20	4.87%	4.45%	3.87%



The Yield Curve and Discount Rates (2 of 2)

- The term structure can be used to compute the present and future values of a risk-free cash flow over different investment horizons.

$$PV = \frac{C_n}{(1 + r_n)^n}$$

  – Present Value of a Cash Flow Stream Using a Term Structure of Discount Rates

$$PV = \frac{C_1}{1 + r_1} + \frac{C_2}{(1 + r_2)^2} + \cdots + \frac{C_N}{(1 + r_N)^N} = \sum_{n=1}^{N} \frac{C_N}{(1 + r_n)^n}$$

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Textbook Example 5.5 (1 of 2)

Using the Term 'Structure' to Compute Present Values

- **Problem**
  - Compute the present value in November 2008 of a risk-free five-year annuity of $1,000 per year, given the yield curve for November 2008 in Figure 5.2

Textbook Example 5.5 (2 of 2)

Solution

To compute the present value, we discount each flow by the corresponding interest rate:

$$PV = \frac{1000}{1.0091} + \frac{1000}{1.0098^2} + \frac{1000}{1.0126^3} + \frac{1000}{1.0169^4} + \frac{1000}{1.0201^5} = \$4775.25$$

Note that we cannot use the annuity formula here because the discount rates differ for each cash flow.

The Yield Curve and the Economy (1 of 2)

- Interest Determination
  - The Federal Reserve determines very short-term interest rates through its influence on the **federal funds rate**, which is the rate at which banks can borrow cash reserves on an overnight basis.
  - All other interest rates on the yield curve are set in the market and are adjusted until the supply of lending matches the demand for borrowing at each loan term.

Federal Reserve Chairman
Jerome Powel

Former Federal Reserve Chair
Janet Yellen

ECONOMY

Treasury Secretary Janet Yellen says she was wrong about the risks of inflation

June 1, 2022 · 12:18 PM ET

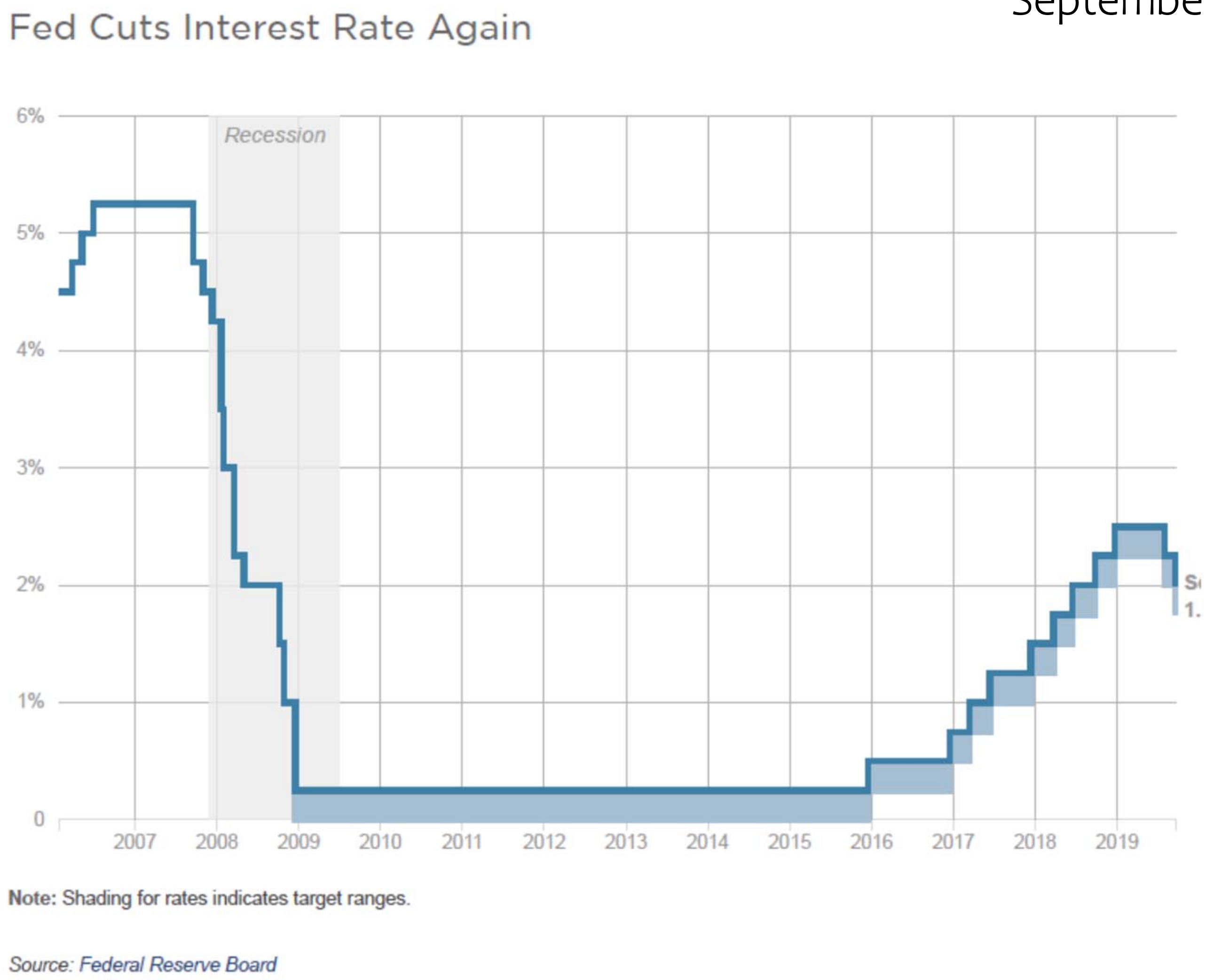

XIMENA BUSTILLO

Treasury Secretary Janet Yellen testifies before a Senate Banking, Housing and Urban Affairs Committee hearing last month.

Tom Williams/AP

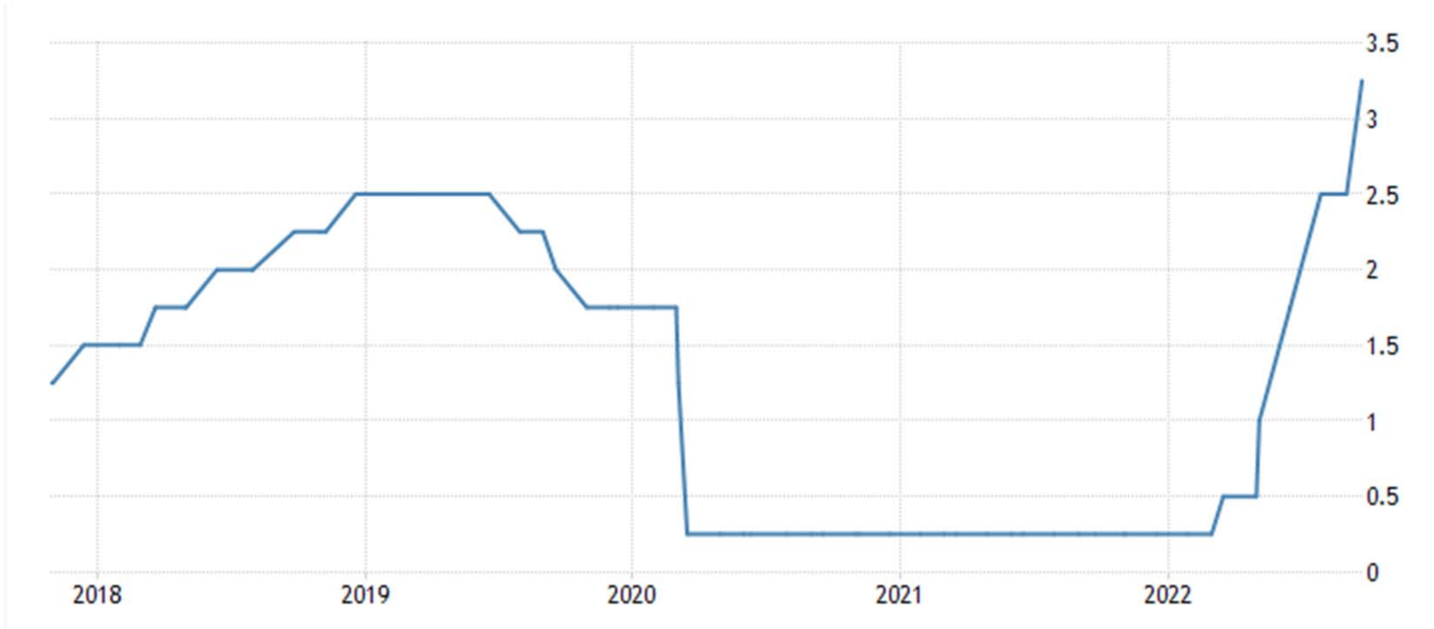
Fed Cuts Interest Rates To Prop Up The Slowing Economy

September 18, 2019



Fed Raises Interest Rates To Curb The Inflation

The Federal Reserve raised the target range for the fed funds rate by 75bps to 2.5%-3.25% during its Sep. 2022 meeting.



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FINANCE | HEARD ON THE STREET

Despite What Powell Says, the Fed Is Likely Done

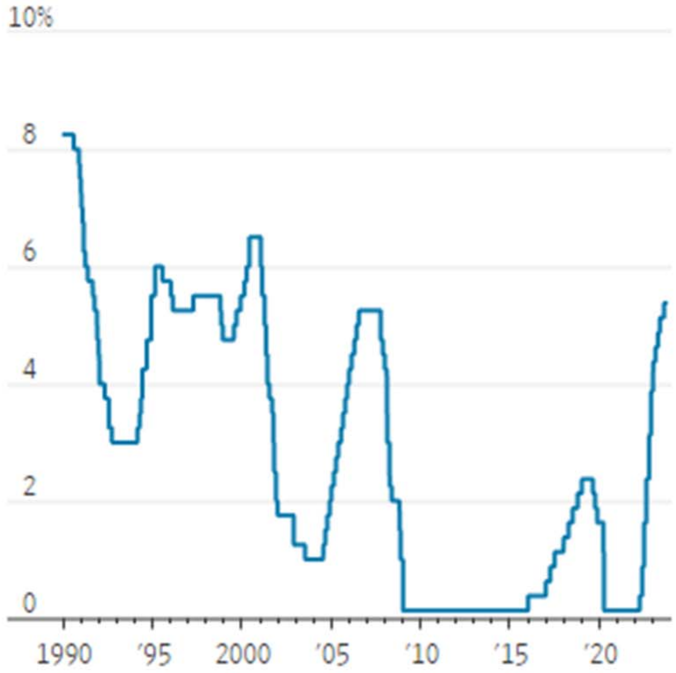
Federal Reserve chief left the central bank's options open, in part to prevent investors from asking the next question: When will the Fed cut?

By Justin Lahart Follow

Aug. 26, 2023 12:01 am ET

Fed Chairman Jerome Powell indicated that if another rate increase comes, it probably won't occur next month. PHOTO: AARON SCHWARTZ/ZUMA PRESS

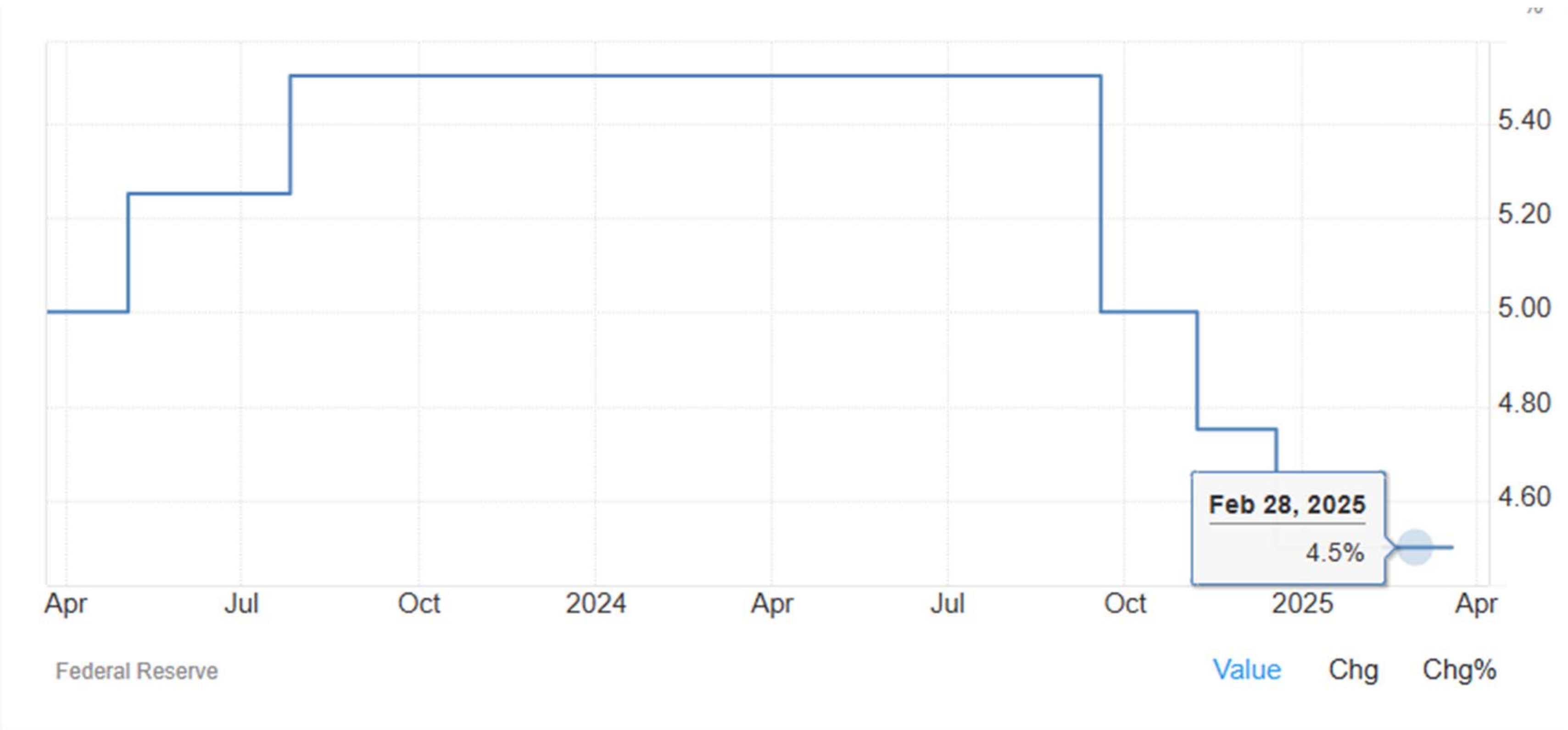
The Federal Reserve's target rate



Note: Values from Dec. 16, 2008 onwards reflect midpoint of target range

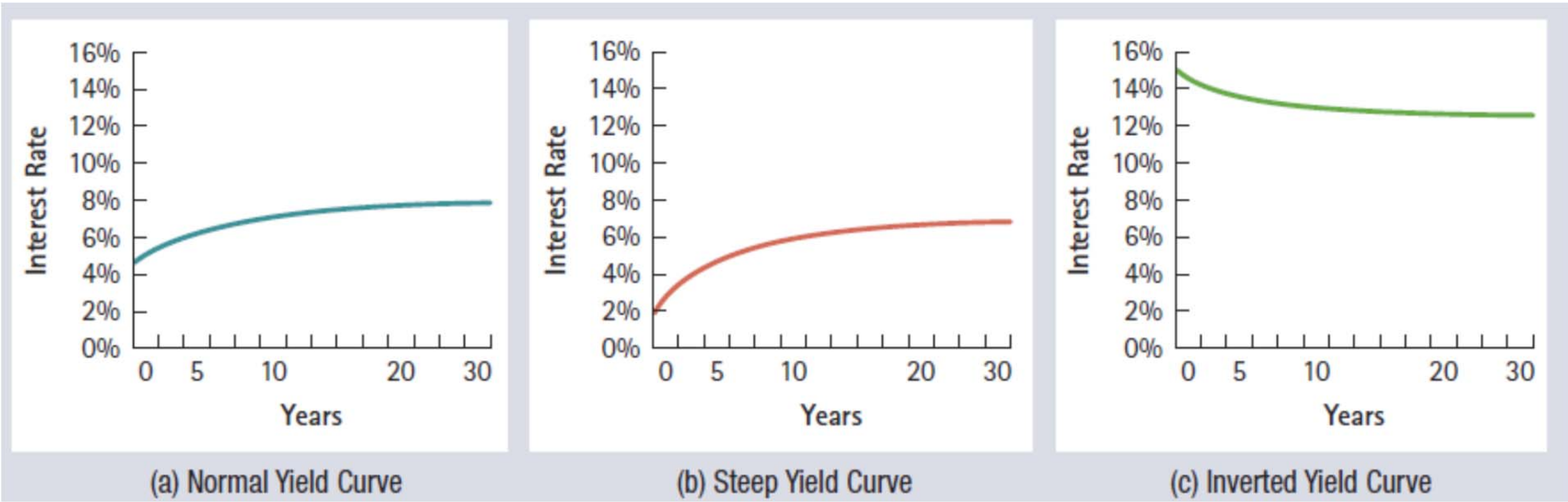
Source: Federal Reserve

United States Fed Funds Interest Rate



The Yield Curve and the Economy (2 of 2)

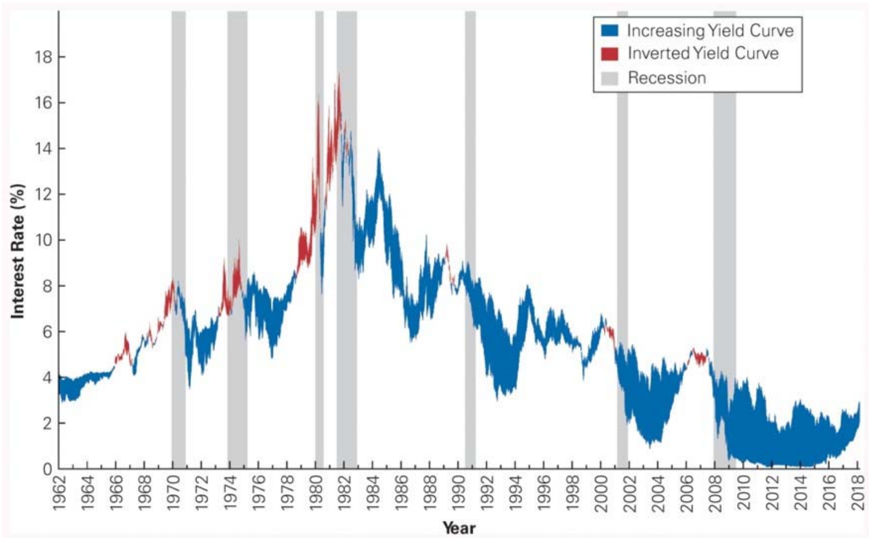
- Interest Rate Expectations
  - The shape of the yield curve is influenced by interest rate expectations.



The Yield Curve and the Economy (2 of 2)

- Interest Rate Expectations
  - The shape of the yield curve is influenced by interest rate expectations.
    - An inverted yield curve indicates that interest rates are expected to decline in the future.
      - Because interest rates tend to fall in response to an economic slowdown, an inverted yield curve is often interpreted as a negative forecast for economic growth.
        - Each of the last six recessions in the United States was preceded by a period in which the yield curve was inverted.
        - The yield curve tends to be sharply increasing as the economy comes out of a recession, and interest rates are expected to rise.

Figure 5.3 Short-Term Versus Long-Term U.S. Interest Rates and Recessions



One-year and ten-year U.S. Treasury rates are plotted, with the spread between them shaded in blue if the shape of the yield curve is increasing (the one-year rate is below the ten-year rate) and in red if the yield curve is inverted (the one year rate exceeds the ten-year rate). Gray bars show the dates of U.S. recessions as determined by the National Bureau of Economic Research. Note that inverted yield curves tend to precede recessions by 12–18 months. In recessions, interest rates tend to fall, with short-term rates dropping further. As a result, the yield curve tends to be steep coming out of a recession.

Textbook Example 5.6 (1 of 4)

Comparing Short- and Long-Term Interest Rates

- **Problem**
  - Suppose the current one-year interest rate is 1%. If it is known with certainty that the one-year interest rate will be 2% next year and 4% the following year, what will the interest rates $r_1, r_2,$ and r_3 of the yield curve be today? Is the yield curve flat, increasing, or inverted?

Textbook Example 5.6 (2 of 4)

Solution

We are told already that the one-year rate $r_1 = 1\%$.

To find the two-year rate, note that if we invest \$1 for one-year at the current one-year rate and then reinvest next year at the new one-year rate, after two-years we will earn:

$$\$1 \times (1.01) \times (1.02) = \$1.0302$$

We should earn the same payoff if we invest for two-years at the current two-year rate r_2:

$$\$1 \times (1 + r_2)^2 = \$1.0302$$

Textbook Example 5.6 (3 of 4)

Otherwise, there would be an arbitrage opportunity: if investing at the two-year rate led to a higher payoff, investors could invest for two-years and borrow each year at the one-year rate. Investing at the two-year rate could led to a lower payoff. Investors could invest each year at the one-year rate and borrow at the two-year rate.

Solving for r_2, we find that

$$r_2 = (1.032)^{\frac{1}{2}} - 1 = 1.499\%$$

Textbook Example 5.6 (4 of 4)

Similarly, investing for three years at the one-year rates should have the same payoff as investing at the current three-year rate:

$$(1.01)\times(1.02)\times(1.04)=1.0714=\left(1+r^{3}\right)^{3}$$

We can solve for $r_3=(1.0714)^{\frac{1}{3}}-1=2.326\%.$

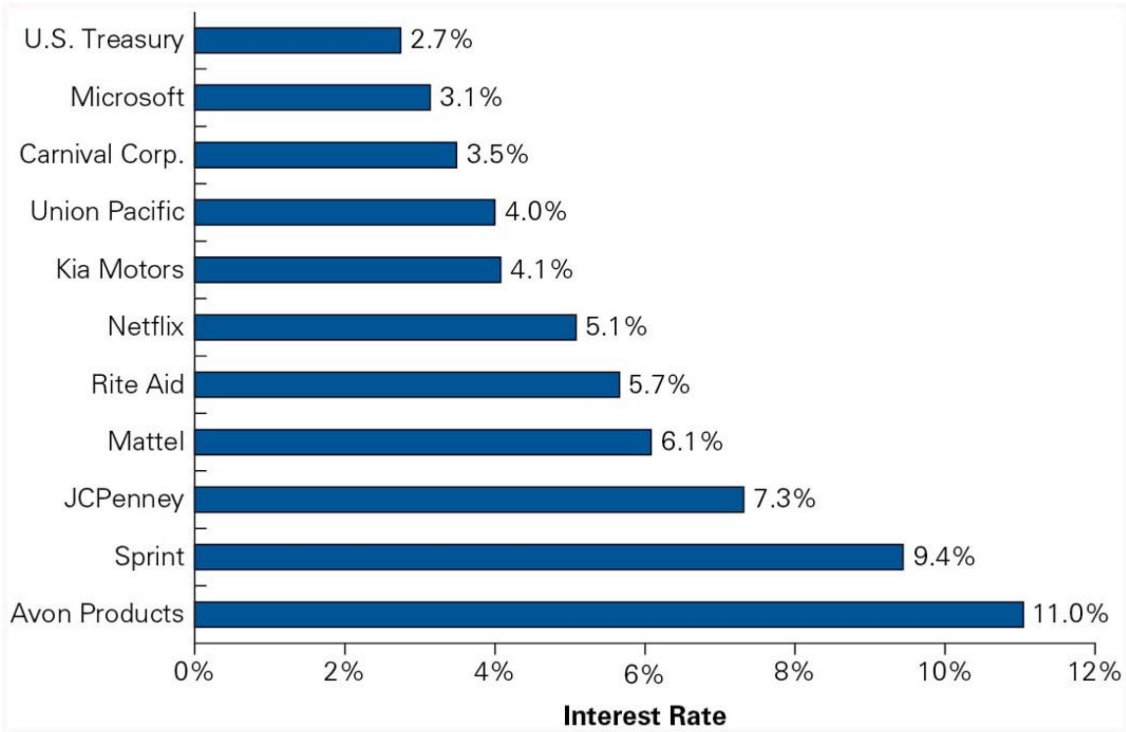
Therefore, the current yield curve has $r_1=1\%, r_2=1.499\%,$

and $r_3=2.326\%$ The yield curve is increasing as a result of the anticipated higher interest rates in the future.

5.4 Risk and Taxes

- Risk and Interest Rates
  - U.S. Treasury securities are considered “risk-free.” All other borrowers have some risk of default, so investors require a higher rate of return.

Figure 5.4 Interest Rates on Five-Year Loans for Various Borrowers, July 2018



Source: FINRA.org.

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Textbook Example 5.7 (1 of 2)

Discounting Risky Cash Flows

- **Problem**
  - Suppose the U.S. government owes your firm $1,000 to be paid in five years. Based on the interest rates in Figure 5.4, what is the present value of this cash flow? Suppose instead JC Penney owes your firm $1,000. Estimate the present value in this case.

Textbook Example 5.7 (2 of 2)

Solution

Assuming we can regard the government's obligation as risk free (there is no chance you won't be paid), then we discount the cash flow using the risk-free Treasury interest rate of 2.7%:

$$PV = \$1000 \div (1.027)^5 = \$875.28$$

The obligation from JC Penney is not risk-free. JCPenney may face financial difficulties and fail to pay the $1,000. Because the risk of this obligation is likely to be comparable to the five-year bond quoted in Figure 5.4, the 7.3% interest rate of the loan is a more appropriate discount rate to use to compute the present value in this case:

$$PV = \$1000 \div (1.073)^5 = \$703.07$$

Note the substantially lower present value of JC Penney's debt compared to the government debt due to JC Penney's higher risk of default.

After-Tax Interest Rates

Taxes reduce the amount of interest an investor can keep, and we refer to this reduced amount as the **after-tax interest rate**.

$$r - (\tau \times r) = r(1 - \tau)$$

Textbook Example 5.8 (1 of 3)

Comparing After-tax Interest Rates

- **Problem**
  - Suppose 1) you have a credit card with a 14% APR with monthly compounding, 2) a bank savings account paying 5% EAR, and 3) a home equity loan with a 7% APR with monthly compounding.
  - Your income tax rate is 40%. The interest on the savings account is taxable, and the interest on the home equity loan is tax deductible.
  - What is the effective after-tax interest rate of each instrument, expressed as an EAR?
  - Suppose you are purchasing a new car and are offered a car loan with a 4.8% APR and monthly compounding (which is not tax deductible). Should you take the car loan?

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Textbook Example 5.8 (2 of 3)

Solution

Because taxes are typically paid annually, we first convert each interest rate to an EAR to determine the actual amount of interest earned or paid during the year. The savings account has a 5% EAR. Using Eq. 5.3, the EAR of the credit card is

$$\left(1+\frac{0.14}{12}\right)^{12}-1=14.93\%,$$

and the EAR of the home equity loan is $\left(1+\frac{0.07}{12}\right)^{12}-1=7.23\%.$

Next, we compute the after-tax rate for each. Because the credit card interest is not tax deductible, its after after-tax interest rate is the same as its pre-tax interest rate, 14.93%. The after-tax interest rate on the home equity loan ,which is tax deductible, is $7.23\% \times (1-0.40)=4.34\%.$

The after-tax interest rate that we will earn on the savings account is

$5\% \times (1-0.40)=3\%.$

Textbook Example 5.8 (3 of 3)

Now consider the car loan. Its EAR is

$$\left(1+\frac{0.048}{12}\right)^{12}-1=4.91\%.$$

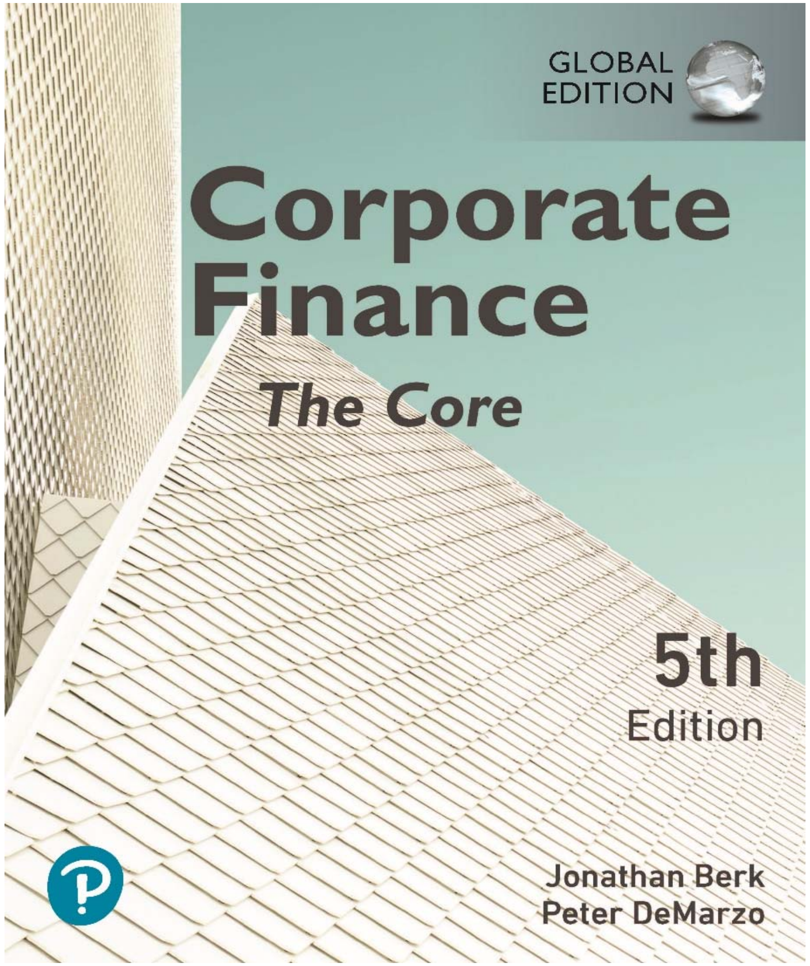
It is not tax deductible, so this rate is also its after-tax interest rate. Therefore, the car loan is not our cheapest source of funds. It would be best to use savings, which has an opportunity cost of foregone after-tax interest of 3%. If we don't have sufficient savings, we should use the home equity loan, which has an after-tax cost of 4.34%. And we should certainly not borrow using the credit card!

5.5 The Opportunity Cost of Capital

- **Investor's Opportunity Cost of Capital:** The best available expected return offered in the market on an investment of comparable risk and term to the cash flow being discounted
  - Also referred to as **Cost of Capital**

Corporate Finance: The Core

Fifth Edition, Global Edition



Chapter 6

Valuing Bonds

Chapter Outline

Learning Objectives (1 of 4)

- Identify the cash flows for both coupon bonds and zero-coupon bonds, and calculate the value for each type of bond.
- Calculate the yield to maturity for both coupon and zero-coupon bonds, and interpret its meaning for each.

Learning Objectives (2 of 4)

- Given coupon rate and yield to maturity, determine whether a coupon bond will sell at a premium or a discount; describe the time path the bond's price will follow as it approaches maturity, assuming prevailing interest rates remain the same over the life of the bond.

Learning Objectives (3 of 4)

- Illustrate the change in bond price that will occur as a result of changes in interest rates; differentiate between the effect of such a change on long-term versus short-term bonds.
- Discuss the effect of coupon rate to the sensitivity of a bond price to changes in interest rates.
- Define duration, and discuss its use by finance practitioners.

Learning Objectives (4 of 4)

- Calculate the price of a coupon bond using the Law of One Price and a series of zero-coupon bonds.
- Discuss the relation between a corporate bond's expected return and the yield to maturity; define default risk and explain how these rates incorporate default risk.
- Assess the creditworthiness of a corporate bond using its bond rating; define default risk.

Anyone who've ever purchased a bond?

1. Issuer
2. Face value
3. Maturity date
   - Bond price
     - $900 => r= YTM=?
     - $800 => r=?

- Pure discount bond
- Coupon bond => coupon payment + face value
  - **Face value**: $10,000, **maturity date**: 2 years,
    coupon rate: 10%, payment quarterly,
  - **Current price**= $ 9,000 => r=?

  Excel (=RATE(8, 250,-9000,10000) ⇒ 4%

Three types of US Treasury securities

1. **T-Bills**

2. **T-Notes**

3. **T-Bonds**


일천만
10,000,000
대한민국정부
1987 년 제 1 차
외국환평형기금채권
발행일: 1987 년 3 월 26 일
상환일: 1988 년 3 월 24 일
일 천 만 원
견양
1. 이 채권은 외국환 관리법의 규정에 의하여 발행한 것이다.
2. 이 채권은 상환일부터 한국은행 본·지점에서 액면금액으로 일시 상환한다.
3. 이 채권의 등록은 한국은행에서만 취급한다.
4. 이 채권의 소멸시효는 상환일로 부터 5년으로 한다.
가000000000가
37
재 무 부 장 관

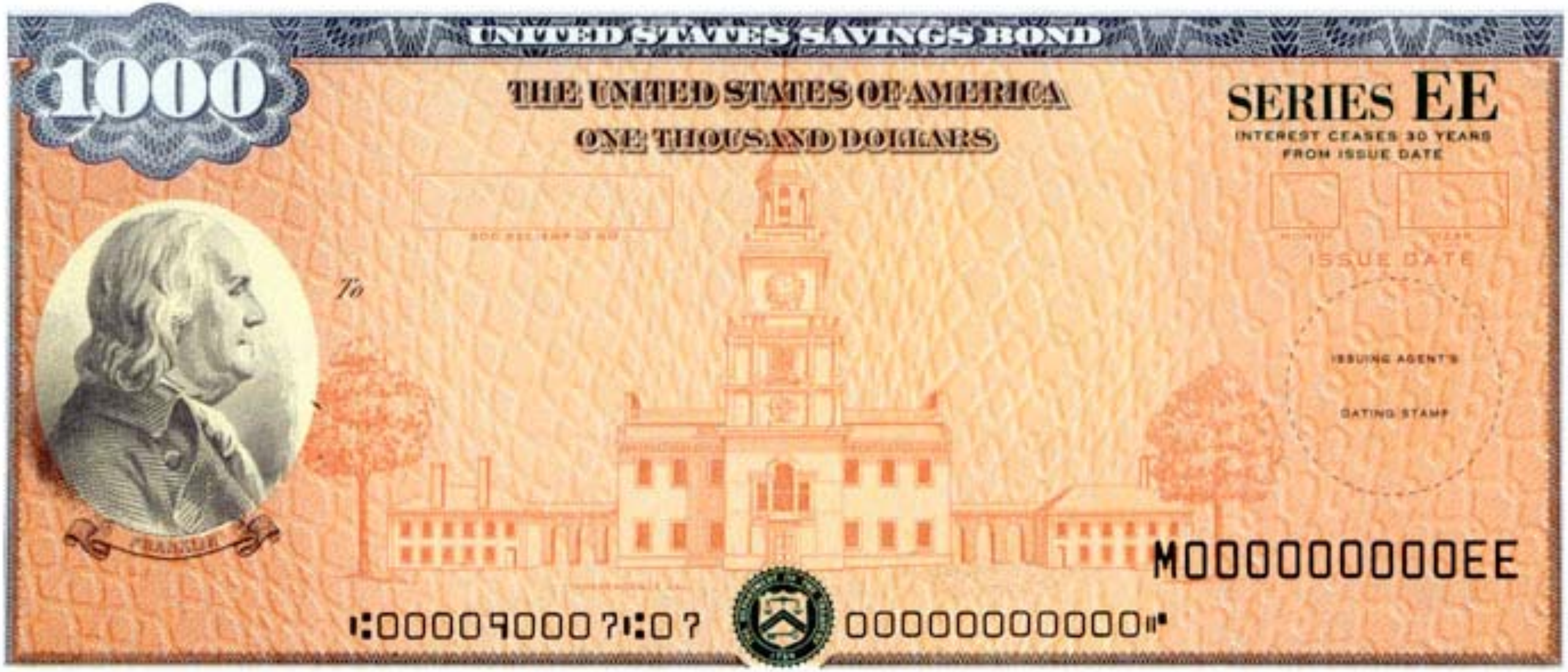
채권 견양: 금강개발산업㈜ 제11회 전환사채권(만기일: 2002년 12월 31일)

액면가: 100만원

발행일: 1995년 4월 26일
상환일: 2002년 12월 31일

8th coupon
2002.12.31

1st coupon
1995.12.31


UNITED STATES SAVINGS BOND
1000
THE UNITED STATES OF AMERICA
ONE THOUSAND DOLLARS
SERIES EE
INTEREST CEASES 30 YEARS FROM ISSUE DATE
ISSUE DATE
To
ISSUING AGENT'S
DATING STAMP
M000000000EE

6.1 Bond Cash Flows, Prices, and Yields (1 of 2)

- Bond Terminology
  - Bond Certificate
    - States the terms of the bond
  - Maturity Date
    - Final repayment date
  - Term
    - The time remaining until the repayment date
  - Coupon
    - Promised interest payments

6.1 Bond Cash Flows, Prices, and Yields (2 of 2)

- Bond Terminology
  - Face Value
    - Notional amount used to compute the interest payments
  - Coupon Rate
    - Determines the amount of each coupon payment, expressed as an APR
  - Coupon Payment

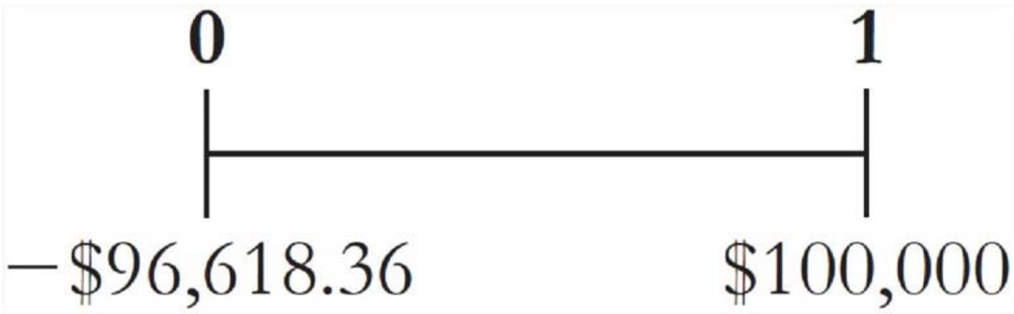
$$CPN = \frac{\text{Coupon Rate} \times \text{Face Value}}{\text{Number of Coupon Payments per Year}}$$

Zero-Coupon Bonds (1 of 7)

- Zero-Coupon Bond
  - Does not make coupon payments
  - Always sells at a **discount** (a price lower than face value), so they are also called **pure discount bonds**
  - **Treasury Bills** are U.S. government zero-coupon bonds with a maturity of up to one year.

Zero-Coupon Bonds (2 of 7)

- Suppose that a one-year, risk-free, zero-coupon bond with a $100,000 face value has an initial price of $96,618.36. The cash flows would be



  – Although the bond pays no “interest,” your compensation is the difference between the initial price and the face value.

Zero-Coupon Bonds (3 of 7)

- Yield to Maturity
  - The discount rate that sets the present value of the promised bond payments equal to the current market price of the bond
    - Price of a Zero-Coupon bond

$$P = \frac{FV}{(1 + YTM_n)^n}$$

Pearson

Zero-Coupon Bonds (4 of 7)

- Yield to Maturity
  - For the one-year zero coupon bond:

$$96{,}618.36 = \frac{100{,}000}{(1 + YTM_1)}$$

$$1 + YTM_1 = \frac{100{,}000}{96{,}618.36} = 1.035$$

    - Thus, the YTM is 3.5%

Zero-Coupon Bonds (5 of 7)

- Yield to Maturity
  - Yield to Maturity of an *n*-Year Zero-Coupon Bond

$$YTM_n = \left(\frac{FV}{P}\right)^{1/n} - 1$$

Textbook Example 6.1 (1 of 2)

Yields for Different Maturities

Problem

Suppose the following zero-coupon bonds are trading at the prices shown below per $100 face value. Determine the corresponding spot interest rates that determine the zero coupon yield curve

Maturity	**1 Year**	**2 Years**	**3 Years**	**4 Years**
Price	$96.62	$92.45	$87.63	$83.06

Textbook Example 6.1 (2 of 2)

Solution

Using Eq. 6.3, we have

$$r_1 = YTM_1 = \frac{100}{96.62} - 1 = 3.50\%$$

$$r_2 = YTM_2 = \left(\frac{100}{92.45}\right)^{\frac{1}{2}} - 1 = 4.00\%$$

$$r_3 = YTM_3 = \left(\frac{100}{87.63}\right)^{\frac{1}{3}} - 1 = 4.50\%$$

$$r_4 = YTM_4 = \left(\frac{100}{83.06}\right)^{\frac{1}{4}} - 1 = 4.75\%$$

Zero-Coupon Bonds (6 of 7)

- Risk-Free Interest Rates
  - A default-free zero-coupon bond that matures on date *n* provides a risk-free return over the same period
  - Thus, the Law of One Price guarantees that the risk-free interest rate equals the yield to maturity on such a bond
  - Risk-Free Interest Rate with Maturity *n*

$$r_n = YTM_n$$

Zero-Coupon Bonds (7 of 7)

- Risk-Free Interest Rates
  - Spot Interest Rate
    - Another term for a default-free, zero-coupon yield
  - Zero-Coupon Yield Curve
    - A plot of the yield of risk-free zero-coupon bonds as a function of the bond's maturity date

Pearson

Coupon Bonds (1 of 2)

- Coupon Bonds
  - Pay face value at maturity
  - Pay regular coupon interest payments
- Treasury Notes
  - U.S. Treasury coupon security with original maturities of 1–10 years
- Treasury Bonds
  - U.S. Treasury coupon security with original maturities over 10 years

Textbook Example 6.2 (1 of 2)

The Cash Flows of a Coupon Bond

Problem

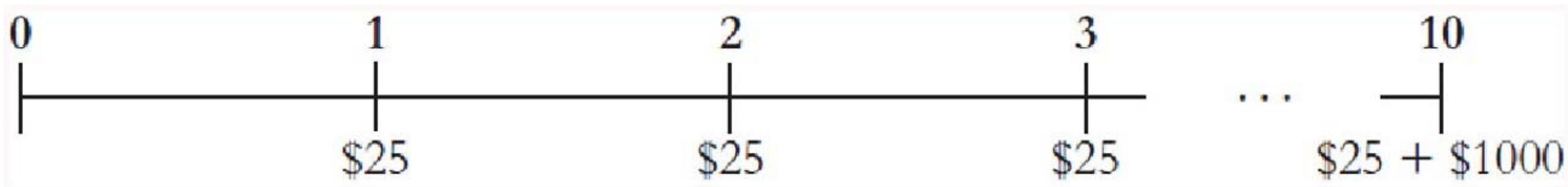
The U.S. Treasury has just issued a five-year, $1000 bond with a 5% coupon rate and semiannual coupons. What cash flows will you receive if you hold this bond until maturity?

Textbook Example 6.2 (2 of 2)

Solution

The face value of this bond is \$1000. Because this bond pays coupons semiannually, from Eq. 6.1, you will receive a coupon payment every six months of $CPN = \$1000 \times \frac{5\%}{2} = \$25.$

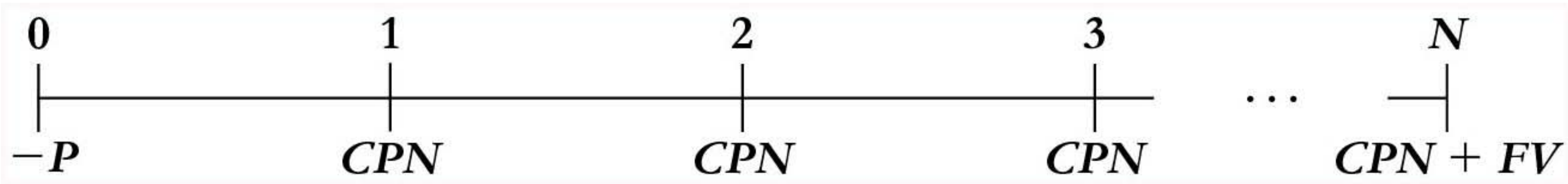
Here is the timeline, based on a six-month period:



Note that the last payment occurs five years (10 six-month periods) from now and is composed of both a coupon payment of \$25 and the face value payment of \$1000.

Coupon Bonds (2 of 2)

- Yield to Maturity
  - The YTM is the **single** discount rate that equates the present value of the bond's remaining cash flows to its current price



  - Yield to Maturity of a Coupon Bond

$$P = CPN \times \frac{1}{y}\left(1 - \frac{1}{(1+y)^N}\right) + \frac{FV}{(1+y)^N}$$

Textbook Example 6.3 (1 of 3)

Computing the Yield to Maturity of a Coupon Bond

Problem

Consider the five-year, $1000 bond with a 5% coupon rate and semiannual coupons described in Example 6.2. If this bond is currently trading for a price of $957.35, what is the bond's yield to maturity?

Textbook Example 6.3 (2 of 3)

Solution

Because the bond has 10 remaining coupon payments, we compute its yield y by solving:

$$957.35 = 25 \times \frac{1}{y}\left(1 - \frac{1}{(1+y)^{10}}\right) + \frac{1000}{(1+y)^{10}}$$

We can solve it by trial-and-error or by using the annuity spreadsheet:

Textbook Example 6.3 (3 of 3)

	NPER	RATE	PV	PMT	FV	Excel Formula
Given	10		−957.35	25	1,000	
Solve for Rate		3.00%				=RATE(10,25, -957.35,1000)

- Therefore, $y = 3\%$. Because the bond pays coupons semiannually, this yield is for a six-month period. We convert it to an APR by multiplying by the number of coupon payments per year. Thus the bond has a yield to maturity equal to a 6% APR with semiannual compounding.

Textbook Example 6.4 (1 of 2)

Computing a Bond Price from Its Yield to Maturity

Problem

Consider again the five-year, $1000 bond with a 5% coupon rate and semiannual coupons presented in Example 6.3. Suppose you are told that its yield to maturity has increased to 6.30% (expressed as an APR with semiannual compounding). What price is the bond trading for now?

Textbook Example 6.4 (2 of 2)

Solution

Given the yield, we can compute the price using Eq.65. First, note that a 6.30% APR is equivalent to a semiannual rate of 3.15%. Therefore, the bond price is

$$P = 25 \times \frac{1}{0.0315}\left(1 - \frac{1}{1.0315^{10}}\right) + \frac{1000}{1.0315^{10}} = \$944.98$$

We can also use the annuity spreadsheet:

	NPER	RATE	PV	PMT	FV	Excel Formula
Given	10	3.15%		25	1,000	
Solve for PV			-944.98			=PV (0.0315,10, 25,1000)

6.2 Dynamic Behavior of Bond Prices

- Discount
  - A bond is selling at a **discount** if the price is less than the face value
- Par
  - A bond is selling at **par** if the price is equal to the face value
- Premium
  - A bond is selling at a **premium** if the price is greater than the face value

Discounts and Premiums (1 of 3)

- If a coupon bond trades at a discount, an investor will earn a return both from receiving the coupons and from receiving a face value that exceeds the price paid for the bond.
  - If a bond trades at a discount, its yield to maturity will exceed its coupon rate.

Discounts and Premiums (2 of 3)

- If a coupon bond trades at a premium, it will earn a return from receiving the coupons, but this return will be diminished by receiving a face value less than the price paid for the bond.
- Most coupon bonds have a coupon rate so that the bonds will **initially** trade at, or very close to, par.

Discounts and Premiums (3 of 3)

Table 6.1 Bond Prices Immediately After a Coupon Payment

When the bond price is	We say the bond trades	This occurs when
greater than the face value	"above par" or "at a premium"	Coupon Rate > Yield to Maturity
equal to the face value	"at par"	Coupon Rate = Yield to Maturity
less than the face value	"below par" or "at a discount"	Coupon Rate < Yield to Maturity

Textbook Example 6.5 (1 of 2)

Determining the Discount or Premium of a Coupon Bond

Problem

Consider three 30-year bonds with annual coupon payments. One bond has a 10% coupon rate, one has a 5% coupon rate, and one has a 3% coupon rate. If the yield to maturity of each bond is 5%, what is the price of each bond per $100 face value? Which bond trades at a premium, which trades at a discount, and which trades at par?

Textbook Example 6.5 (2 of 2)

Solution

We can compute the price of each bond using Eq.6.5. Therefore, the bond prices are

$$P(10\%\text{ coupon}) = 10 \times \frac{1}{0.05}\left(1 - \frac{1}{1.05^{30}}\right) + \frac{100}{1.05^{30}} = \$176.86$$ (trades at a premium)

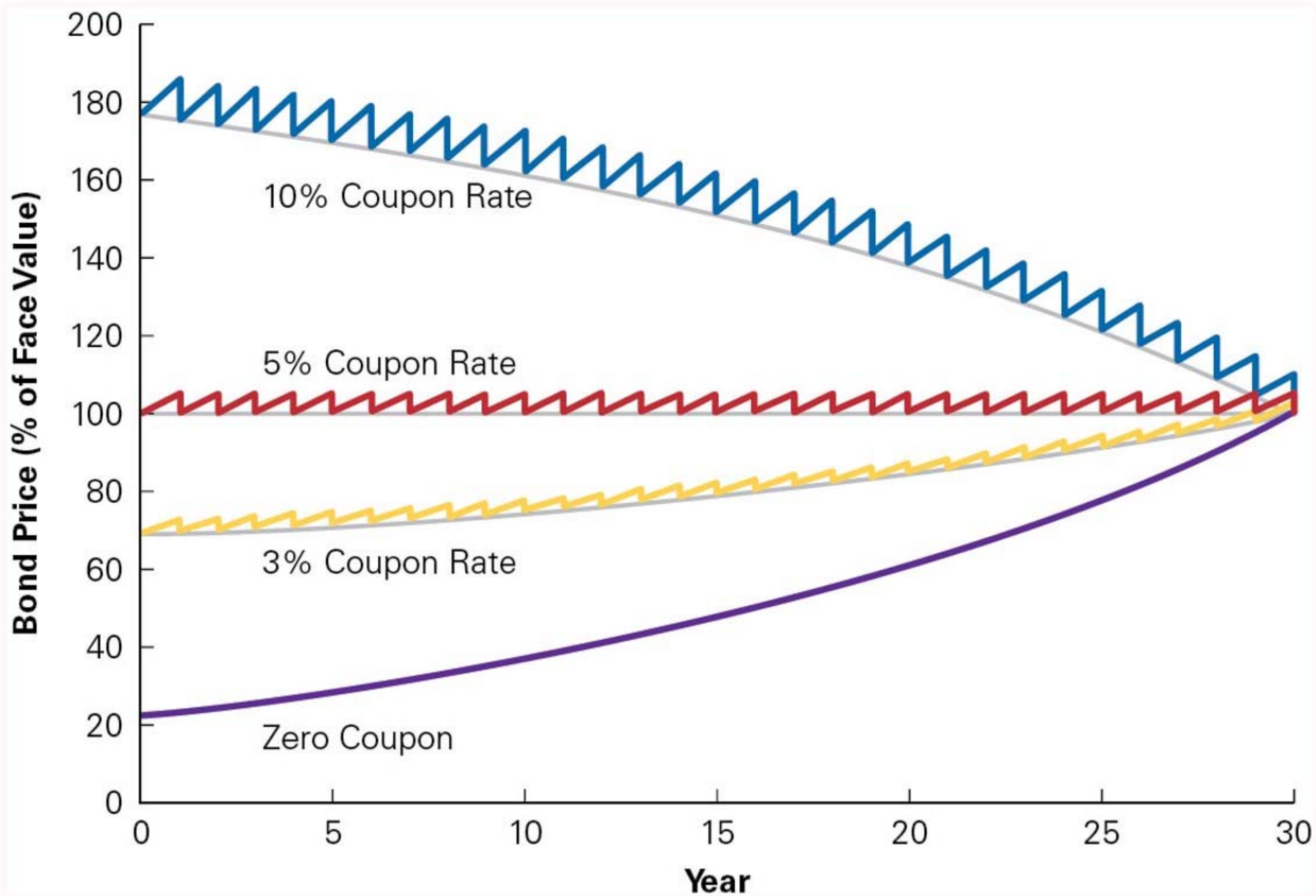
$$P(5\%\text{ coupon}) = 5 \times \frac{1}{0.05}\left(1 - \frac{1}{1.05^{30}}\right) + \frac{100}{1.05^{30}} = \$100.00$$ (trades at par)

$$P(3\%\ coupon) = 3 \times \frac{1}{0.05}\left(1 - \frac{1}{1.05^{30}}\right) + \frac{100}{1.05^{30}} = \$69.26$$ (trades at a discount)

Time and Bond Prices

- Holding all other things constant, a bond's yield to maturity will not change over time.
- Holding all other things constant, the price of discount or premium bond will move toward par value over time.
- If a bond's yield to maturity has not changed, then the IRR of an investment in the bond equals its yield to maturity even if you sell the bond early.

Figure 6.1 The Effect of Time on Bond Prices



Textbook Example 6.6

The Effect of Time on the Price of a Coupon Bond

Problem

Consider a 30-year bond with a 10% coupon rate (annual payments) and a $100 face value. What is the initial price of this bond if it has a 5% yield to maturity? If the yield to maturity is unchanged, what will the price be immediately before and after the first coupon is paid?

Textbook Example 6.6 (2 of 4)

Solution

We computed the price of this bond with 30 years to maturity in Example 6.5:

$$P = 10 \times \frac{1}{0.05}\left(1 - \frac{1}{1.05^{30}}\right) + \frac{100}{1.05^{30}} = \$176.86$$

Now consider the cash flows of this bond in one year, immediately before the first coupon is paid. The bond now has 29 years until it matures, and the timeline is as follows:

Textbook Example 6.6 (3 of 4)

Again, we compute the price by discounting the cash flows by the yield to maturity. Note that there is a cash flow of $10 at date zero, the coupon that is about to be paid. In this case, we can treat the first coupon separately and value the remaining cash flows as in Eq. 6.5:

$$P(\text{just before first coupon}) = 10 + 10 \times \frac{1}{0.05}\left(1 - \frac{1}{1.05^{29}}\right) + \frac{100}{1.05^{29}} = \$185.71$$

Note that the bond price is higher than it was initially. It will make the same total number of coupon payments, but an investor does not need to wait as long to receive the first one. We could also compute the price by noting that because the yield to maturity remains at 5% for the bond, investors in the bond should earn a return of 5% over the year:? $176.86 \times 1.05 = \$185.71$.

Textbook Example 6.6 (4 of 4)

What happens to the price of the bond just after the first coupon is paid? The timeline is the same as that given earlier, except the new owner of the bond will not receive the coupon at date zero. Thus, just after the coupon is paid, the price of the bond (given the same yield to maturity) will be

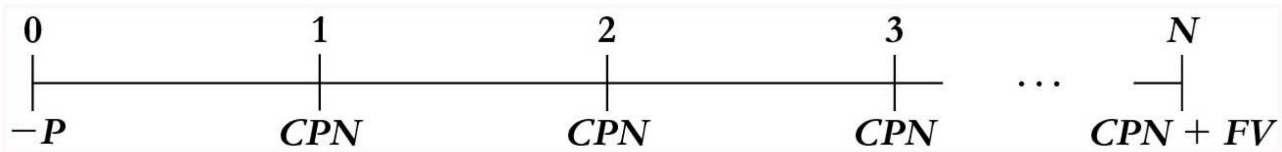
$$P(\text{just after first coupon}) = 10 \times \frac{1}{0.05}\left(1 - \frac{1}{1.05^{29}}\right) + \frac{100}{1.05^{29}} = \$175.71$$

The price of the bond will drop by the amount of the coupon ($10) immediately after the coupon is paid, reflecting the fact that the owner will no longer receive the coupon. In this case, the price is lower than the initial price of the bond. Because there are fewer coupon payments remaining, the premium investors will pay for the bond declines. Still, an investor who buys the bond initially, receives the first coupon, and then sells it earns a 5% return if the bond's yield does not change:

$$\frac{(10 + 175.71)}{176.86} = 1.05.$$

Interest Rate Changes and Bond Prices

- There is an **inverse** relationship between interest rates and bond prices.
  - As interest rates and bond yields rise, bond prices fall.
  - As interest rates and bond yields fall, bond prices rise.



  - Yield to Maturity of a Coupon Bond

$$P = CPN \times \frac{1}{y}\left(1 - \frac{1}{(1+y)^N}\right) + \frac{FV}{(1+y)^N}$$

Interest Rate Changes and Bond Prices
(2 of 2)

- The sensitivity of a bond's price to changes in interest rates is measured by the bond's **duration**.
  - Bonds with high durations are highly sensitive to interest rate changes.
  - Bonds with low durations are less sensitive to interest rate changes.

Textbook Example 6.7 (1 of 3)

The Interest Rate Sensitivity of Bonds

Problem

Consider a 15-year zero-coupon bond and a 30-year coupon bond with 10% annual coupons. By what percentage will the price of each bond change if its yield to maturity increases from 5% to 6%?

Textbook Example 6.7 (2 of 3)

Solution

First, we compute the price of each bond for each yield to maturity:

Yield to Maturity	15-Year, Zero-Coupon Bond	30-Year, 10% Annual Coupon Bond
5%	$\frac{100}{1.05^{15}} = \$48.10$	$10 \times \frac{1}{0.05}\left(1 - \frac{1}{1.05^{30}}\right) + \frac{100}{1.05^{30}} = \$176.86$
6%	$\frac{100}{1.06^{15}} = \$41.73$	$10 \times \frac{1}{0.06}\left(1 - \frac{1}{1.06^{30}}\right) + \frac{100}{1.06^{30}} = \$155.06$

Pearson

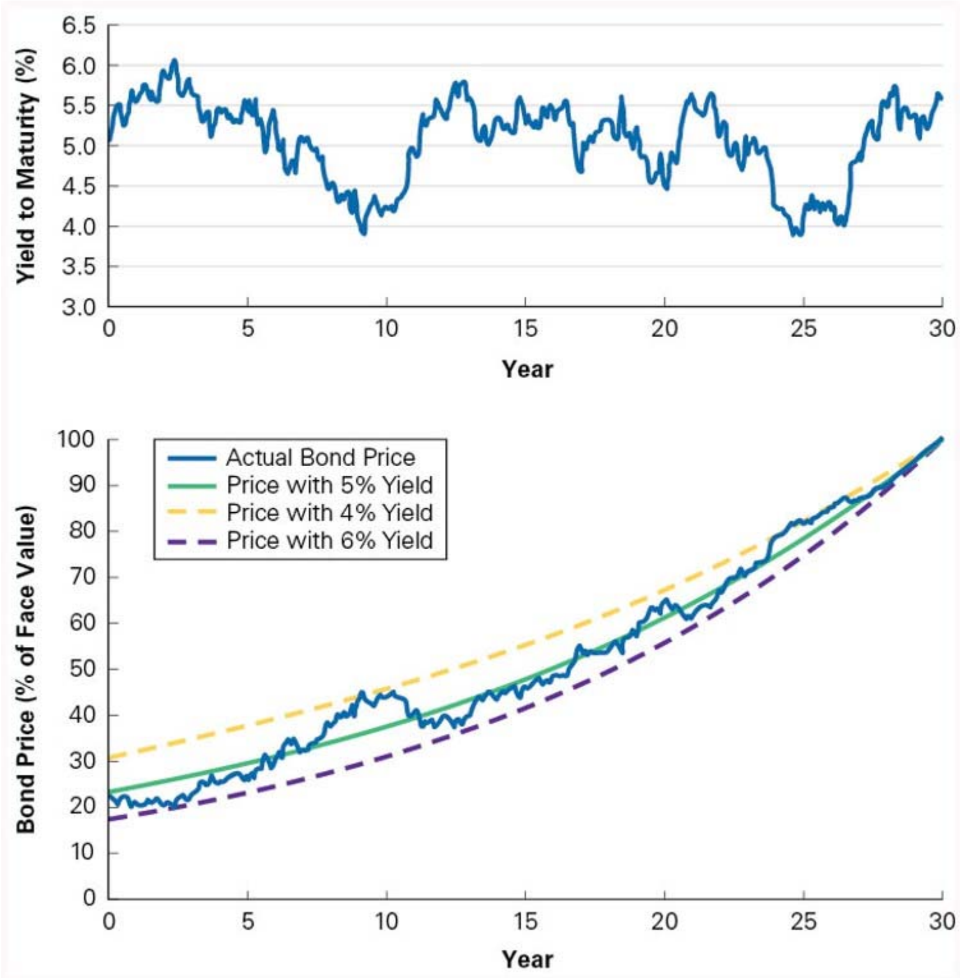
Textbook Example 6.7 (3 of 3)

The price of the 15-year zero-coupon bond changes by

$\frac{(41.73 - 48.10)}{48.10} = -13.2\%$ if its yield to maturity increases from 5% to 6%. For the 30-year bond with 10% annual coupons, the price change is $\frac{(155.06 - 176.86)}{176.86} = -12.3\%$.

Even though the 30-year bond has a longer maturity, because of its high coupon rate, its sensitivity to a change in yield is actually less than that of the 15-year zero coupon bond.

Figure 6.2 Yield to Maturity and Bond Price Fluctuations over Time

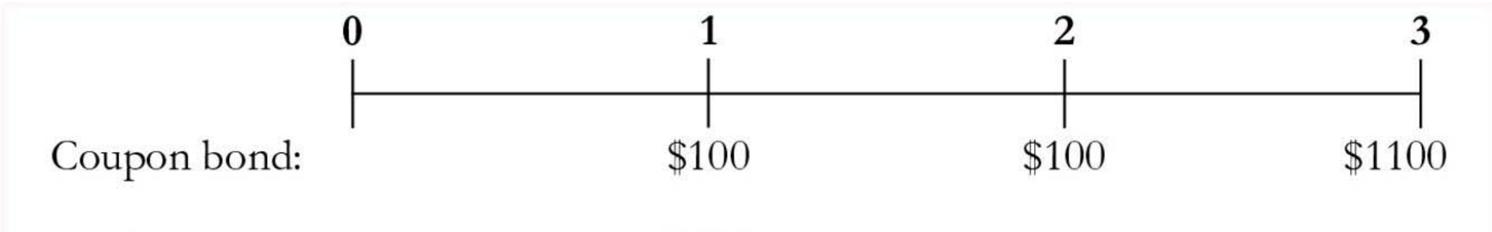


6.3 The Yield Curve and Bond Arbitrage

- Using the Law of One Price and the yields of default-free zero-coupon bonds, one can determine the price and yield of any other default-free bond.
- The yield curve provides sufficient information to evaluate all such bonds.

Replicating a Coupon Bond (1 of 3)

- Replicating a three-year $1000 bond that pays 10% annual coupon using three zero-coupon bonds:



Replicating a Coupon Bond (1 of 3)

- Replicating a three-year $1000 bond that pays 10% annual coupon using three zero-coupon bonds:

	0	1	2	3
Coupon bond:		$100	$100	$1100
1-year zero:		$100		
2-year zero:			$100	
3-year zero:				$1100
Zero-coupon bond portfolio:		$100	$100	$1100

Replicating a Coupon Bond (2 of 3)

Table 6.2 Yields and Prices (per $100 Face Value) for Zero-Coupon Bonds

Maturity	**1 year**	**2years**	**3 years**	**4 years**
YTM	3.50%	4.00%	4.50%	4.75%
Price	$96.62	$92.45	$87.63	$83.06%

Replicating a Coupon Bond (3 of 3)

Zero-Coupon Bond	Face Value Required		Cost
1 year	100		96.62
2 years	100		92.45
3 years	1100		11 × 87.63 = 963.93
		Total Cost:	$1153.00

- By the Law of One Price, the three-year coupon bond must trade for a price of $1153.

Valuing a Coupon Bond Using Zero-Coupon Yields

- The price of a coupon bond must equal the present value of its coupon payments and face value.
  - Price of a Coupon Bond

$$V = PV\left(\text{Bond Cash Flows}\right)$$

$$= \frac{CPN}{1+YTM_1} + \frac{CPN}{(1+YTM_2)^2} + \dots + \frac{CPN+FV}{(1+YTM_n)^n}$$

$$P = \frac{100}{1.035} + \frac{100}{1.04^2} + \frac{100+1000}{1.045^3} = \$1153$$

Coupon Bond Yields

- Given the yields for zero-coupon bonds, we can price a coupon bond

$$P = 1153 = \frac{100}{(1+y)} + \frac{100}{(1+y)^2} + \frac{100+1000}{(1+y)^3}$$

$$P = \frac{100}{1.0444} + \frac{100}{1.0444^2} + \frac{100+1000}{1.0444^3} = \$1153$$

	NPER	RATE	PV	PMT	FV	Excel Formula
Given	3		−1,153	100	1,000	
Solve for Rate		**4.44%**				= RATE(3, 100, −1153, 1000)

Textbook Example 6.8 (1 of 3)

Yields on Bonds with the Same Maturity

Problem

Given the following zero-coupon yields, compare the yield to maturity for a three-year, zero-coupon bond; a three-year coupon bond with 4% annual coupons; and a three-year coupon bond with 10% annual coupons. All of these bonds are default free.

Maturity	1 year	2 years	3 years	4 years
Zero- coupon YTM	3.50%	4.00%	4.50%	4.75%

Textbook Example 6.8 (2 of 3)

Solution

From the information provided, the yield to maturity of the three-year, zero-coupon bond is 4.50%. Also, because the yields match those in Table 6.2, we already calculated the yield to maturity for the 10% coupon bond as 4.44%. To compute the yield for the 4% coupon bond, we first need to calculate its price. Using Eq. 6.6, we have

$$P = \frac{40}{1.035} + \frac{40}{1.04^2} + \frac{40 + 1000}{1.045^3} = \$986.98$$

The price of the bond with a 4% coupon is \$986.98. From Eq. 6.5, its yield to maturity solves the following equation:

$$\$986.98 = \frac{40}{(1+y)} + \frac{40}{(1+y)^2} + \frac{40 + 1000}{(1+y)^3}$$

Textbook Example 6.8 (3 of 3)

We can calculate the yield to maturity using the annuity spreadsheet:

	NPER	RATE	PV	PMT	FV	Excel Formula
Given	3		−986.98	100	1,000	
Solve for Rate		**4.47%**				= RATE(3, 40, −986.98, 1000)

To summarize, for the three-year bonds considered

Coupon rate	**0%**	**4%**	**10%**
YTM	4.50%	4.47%	4.44%

Treasury Yield Curves

- Treasury Coupon-Paying Yield Curve
  - Often referred to as “the yield curve”
- On-the-Run Bonds
  - Most recently issued bonds
  - The yield curve is often a plot of the yields on these bonds.

6.4 Corporate Bonds

- Corporate Bonds
  - Issued by corporations
- Credit Risk
  - Risk of default

Corporate Bond Yields (1 of 9)

- Investors pay less for bonds with credit risk than they would for an otherwise identical default-free bond.
- The yield of bonds with credit risk will be higher than that of otherwise identical default-free bonds.

Corporate Bond Yields (2 of 9)

- No Default
  - Consider a one-year, zero-coupon Treasury Bill with a YTM of 4%.
    - What is the price?

$$P = \frac{1000}{1 + YTM_1} = \frac{1000}{1.04} = \$961.54$$

1	4			1000
N	I/YR	PV	PMT	FV
		-961.54		

Corporate Bond Yields (3 of 9)

- Certain Default
  - Suppose now bond issuer will pay 90% of the obligation.
    - What is the price?

$$P = \frac{900}{1 + YTM_1} = \frac{900}{1.04} = \$865.38$$

N	I/YR	PV	PMT	FV
1	4			900
		-865.38		

Corporate Bond Yields (4 of 9)

- Certain Default
  - When computing the yield to maturity for a bond with certain default, the *promised* rather than the *actual* cash flows are used.

$$YTM = \frac{FV}{P} - 1 = \frac{1000}{865.38} - 1 = 15.56\%$$

$$\frac{900}{865.38} = 1.04$$

Pearson

Corporate Bond Yields (5 of 9)

- Certain Default
  - The yield to maturity of a certain default bond is not equal to the expected return of investing in the bond.
  - The yield to maturity will always be higher than the expected return of investing in the bond.

Corporate Bond Yields (6 of 9)

- Risk of Default
  - Consider a one-year, $1000, zero-coupon bond issued.
  - Assume that the bond payoffs are uncertain.
    - There is a 50% chance that the bond will repay its face value in full and a 50% chance that the bond will default and you will receive $900.
      - Thus, you would expect to receive $950.
    - Because of the uncertainty, the discount rate is 5.1%.

Corporate Bond Yields (7 of 9)

- Risk of Default
  - The price of the bond will be

$$P = \frac{950}{1.051} = \$903.90$$

  - The yield to maturity will be

$$YTM = \frac{FV}{P} - 1 = \frac{1000}{903.90} - 1 = 10.63\%$$

Corporate Bond Yields (8 of 9)

- Risk of Default
  - A bond's expected return will be less than the yield to maturity if there is a risk of default.
  - A higher yield to maturity does not necessarily imply that a bond's expected return is higher.

Corporate Bond Yields (9 of 9)

Table 6.3 Price, Expected Return, and Yield to Maturity of a One-Year, Zero-Coupon Avant Bond with Different Likelihoods of Default

Avant Bond (1-year, zero-coupon)	Bond Price	Yield to Maturity	Expected Return
Default Free	$961.54	4.00%	4%
50% Chance of Default	$903.90	10.63%	5.1%
Certain Default	$865.38	15.56%	4%

Bond Ratings

- Investment Grade Bonds
- Speculative Bonds
  - Also known as Junk Bonds or High-Yield Bonds
- Rating organizations
  - Standard and Poor's Corporation (S&P)
  - Moody’s Investors Service Inc.
  - Fitch Ratings, Ltd

Table 6.4 Bond Ratings (1 of 2)

Rating*	Description (Moody's)
Investment Grade Debt	
Aaa/AAA	Judged to be of the best quality. They carry the smallest degree of investment risk and are generally referred to as "gilt edged." Interest payments are protected by a large or an exceptionally stable margin and principal is secure. While the various protective elements are likely to change, such changes as can be visualized are most unlikely to impair the fundamentally strong position of such issues.
Aa/AA	Judged to be of high quality by all standards. Together with the Aaa group, they constitute what are generally known as high-grade bonds. They are rated lower than the best bonds because margins of protection may not be as large as in Aaa securities or fluctuation of protective elements may be of greater amplitude or there may be other elements present that make the long-term risk appear somewhat larger than the Aaa securities.
A/A	Possess many favorable investment attributes and are considered as upper-medium-grade obligations. Factors giving security to principal and interest are considered adequate, but elements may be present that suggest a susceptibility to impairment some time in the future.
Baa/BBB	Are considered as medium-grade obligations (i.e., they are neither highly protected nor poorly secured). Interest payments and principal security appear adequate for the present but certain protective elements may be lacking or may be characteristically unreliable over any great length of time. Such bonds lack outstanding investment characteristics and, in fact, have speculative characteristics as well.

Table 6.4 Bond Ratings (2 of 2)

[Table 6.4 continued]

Speculative Bonds	
Ba/BB	Judged to have speculative elements; their future cannot be considered as well assured. Often the protection of interest and principal payments may be very moderate, and thereby not well safeguarded during both good and bad times over the future. Uncertainty of position characterizes bonds in this class.
B/B	Generally lack characteristics of the desirable investment. Assurance of interest and principal payments of maintenance of other terms of the contract over any long period of time may be small.
Caa/CCC	Are of poor standing. Such issues may be in default or there may be present elements of danger with respect to principal or interest.
Ca/CC	Are speculative in a high degree. Such issues are often in default or have other marked shortcomings.
C/C, D	Lowest-rated class of bonds, and issues so rated can be regarded as having extremely poor prospects of ever attaining any real investment standing.

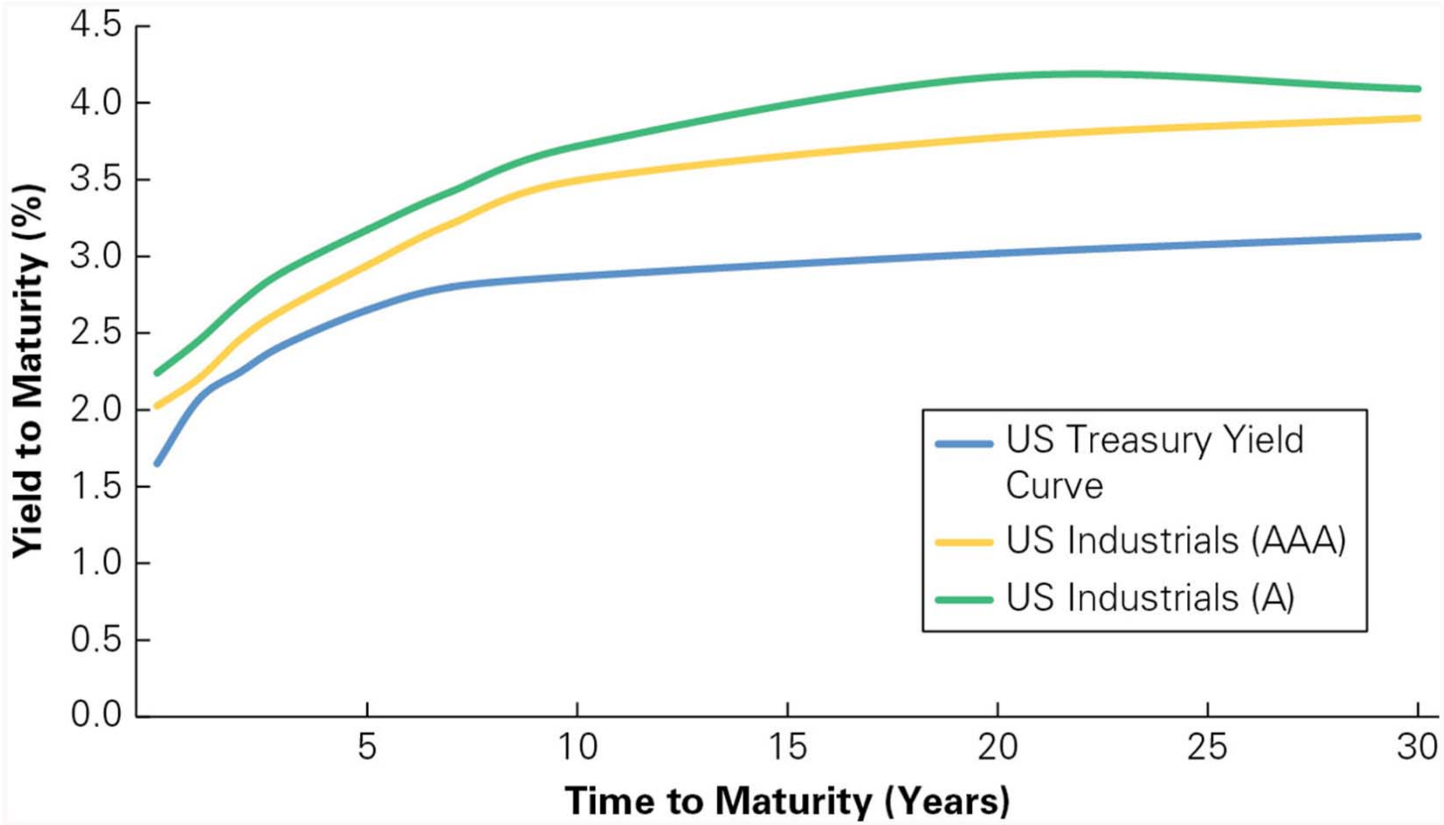
*Ratings: Moody's/Standard & Poor's

Source: www.moodys.com

Corporate Yield Curves

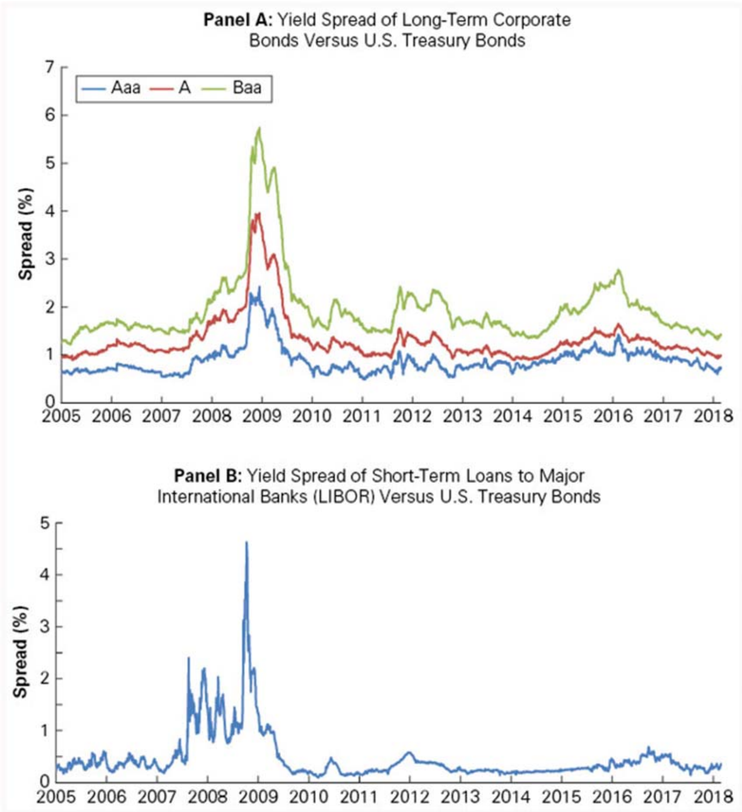
- Default Spread
  - Also known as Credit Spread
  - The difference between the yield on corporate bonds and Treasury yields

Figure 6.3 Corporate Yield Curves for Various Ratings, February 2018



Source: Bloomberg

Figure 6.4 Yield Spreads and the Financial Crisis



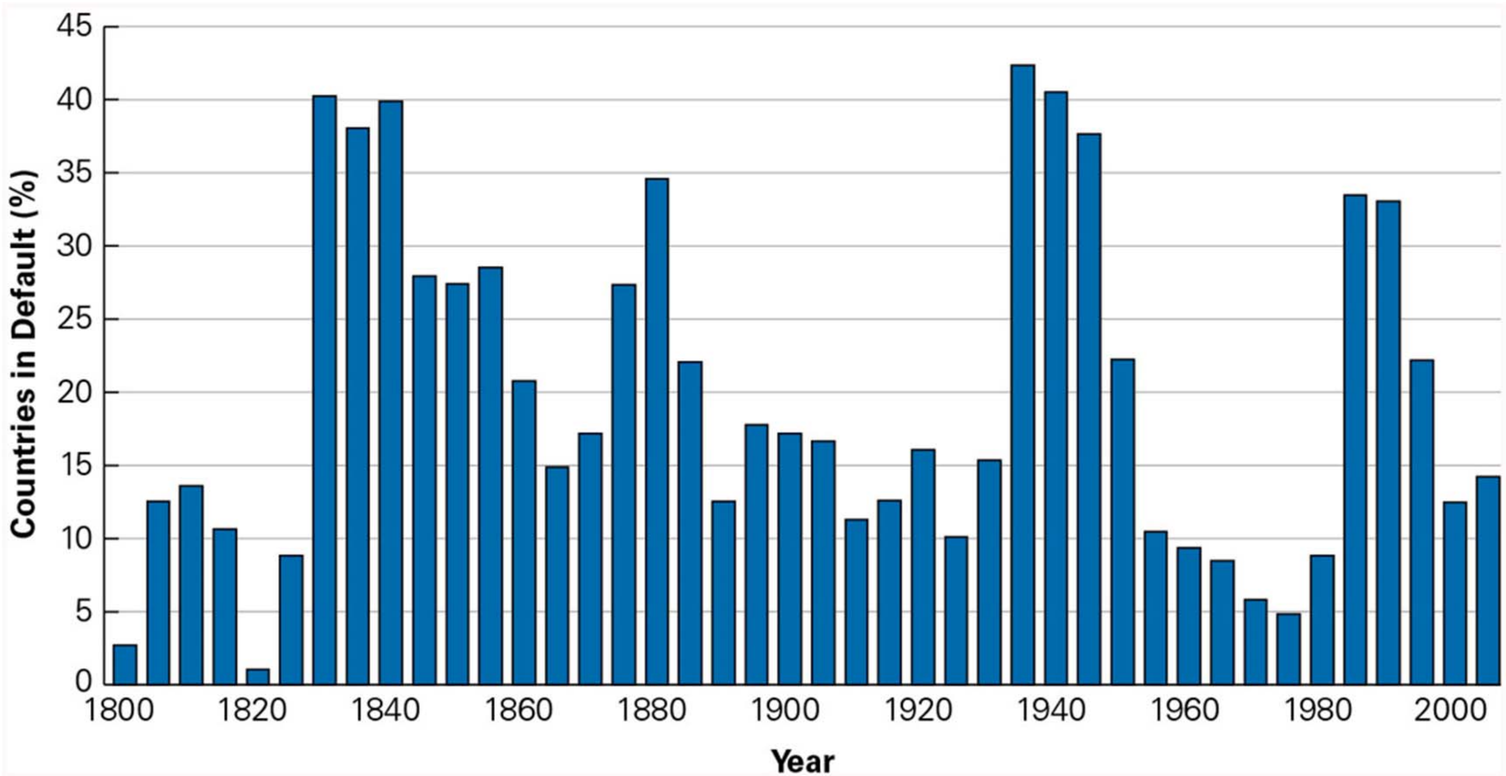
Source: Bloomberg.com

6.5 Sovereign Bonds

- Bonds issued by national governments
  - U.S. Treasury securities are generally considered to be default free.
  - All sovereign bonds are not default-free,
    - e.g., Greece defaulted on its outstanding debt in 2012.
  - Importance of inflation expectations.
    - Potential to "inflate away" the debt.
  - European sovereign debt, the EMU, and the ECB

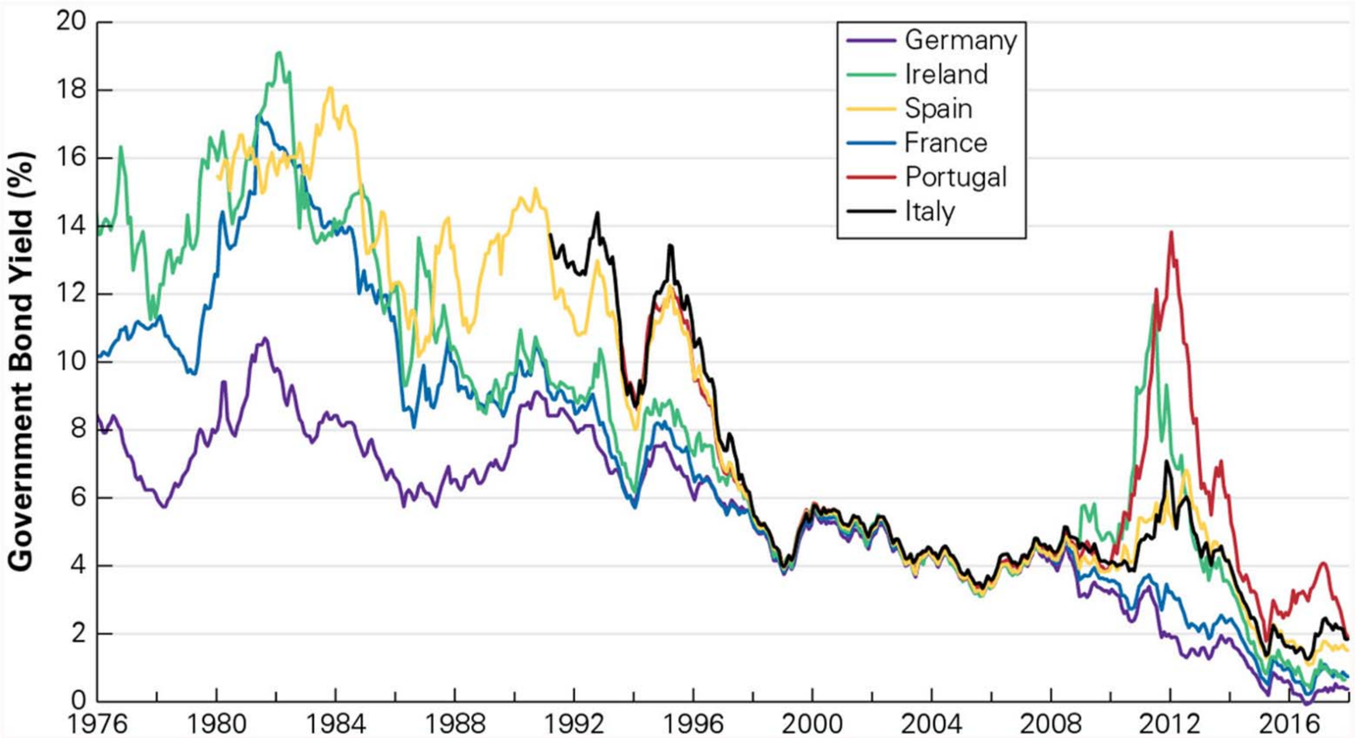
http://www.tradingeconomics.com/country-list/rating

Figure 6.5 Percent of Debtor Countries in Default or Restructuring Debt, 1800–2006



Source: Data from **This Time Is Different,** Carmen Reinhart and Kenneth Rogoff, Princeton University Press, 2009.

Figure 6.6 European Government Bond Yields, 1976–2018



Source: Federal Reserve Economic Data, research.stlouisfed.org/fred2.

Why did Silicon Valley Bank collapse?

- Silicon Valley Bank's business had boomed during the pandemic as tech companies flourished.

- In 2021, when interest rates were at record lows, the cash-rich SVB invested billions of dollars into long-term U.S. Treasury bonds.
  - Long-term bonds pay out in full only when they're held to maturity; otherwise, they risk losing value if interest rates rise.

Why did Silicon Valley Bank collapse?

- The tech sector as a whole took a downward turn in 2023, and companies increasingly began to withdraw their deposits from the bank.
  - In order to make good on those withdrawals, SVB had to sell part of its bond holdings at a steep loss of $1.8 billion, the bank said last week.
  - That announcement spooked the bank's clients, who got worried about SVB's viability, and then proceeded to withdraw even more money from the bank — a textbook definition of a bank run.
  - On Thursday alone, clients raced to collectively withdraw an attempted $42 billion in deposits, and SVB's share value dropped by more than 60%. By midday Friday (on March 10, 2023), SVB had been taken over by the FDIC (Federal Deposit Insurance Corporation).
  - This marked the second-largest bank failure in U.S. history

Lowly T-Bills Are Suddenly Sexy. Yes, Treasury Bills!

By Alexis Leondis, Bloomberg, Sep. 27, 2022

The interest rate on the one-year Treasury bill is an eye-popping 4.1%, up from .07% last year.

Finally worth saving. *Photographer: Chung Sung-Jun/Getty Images*

https://www.youtube.com/watch?v=BbIG8RAoLI0