

Chapter 7



The Risk and Term Structure of Interest Rates

Learning Objectives

1. Explain the links between credit risk, bond ratings, and bond yields.
2. Distinguish taxable and tax-free bonds.
3. Define the yield curve and interpret it using the expectations hypothesis and liquidity premium theory.
4. Discuss how yields anticipate future economic activity.

Introduction

- Changes in bond prices and the associated changes in interest rates, can have a pronounced effect on borrowing costs corporations face.
 - In 1998 we saw the simultaneous increase in some interest rates and decline in others - a rise in what are called **interest rate spreads**.
 - Changes in the perceived risk of Ford's and GM's bonds led to declines in prices.
 - This leads to increases in interest rates and higher corporate borrowing costs.

Ratings and the Risk Structure of Interest Rates

- Default is one of the most important risks a bondholder faces.
- Independent companies (rating agencies) have arisen to evaluate the creditworthiness of potential borrowers.
 - The government has acknowledged a few firms as “nationally recognized statistical rating organizations” (NRSROs).
- Dodd-Frank Wall Street Reform and Consumer Protection Act, partially to reduce reliance on ratings agencies

Bond Ratings

- The best known bond rating services are
 - Moody's
 - Standard & Poor's
- They monitor the status of individual bond issuers and assess the likelihood a lender will be repaid by the bond issuer.
- A high rating suggests that a bond issuer will have little problem meeting a bond's payment obligations.

Bond Ratings

- Firms or governments with an exceptionally strong financial position carry the highest ratings and are able to issue the highest-rated bonds, Triple A.
- The top four categories are considered **investment-grade bonds**.
 - These bonds have a very low risk of default.
 - Reserved for most government issuers and corporations that are among the most financially sound.

Bond Ratings

- The distinction between investment-grade and speculative, noninvestment-grade is important.
 - A number of regulated institutional investors are not allowed to invest in bonds rated below investment grade, which is Baa on Moody's scale or BBB on Standard and Poor's scale.

Table 7.1**A Guide to Bond Ratings**

	Moody's	Standard & Poor's	Description	Examples of Issuers with Bonds Outstanding in 2016
Investment Grade	Aaa	AAA	Bonds of the best quality with the smallest risk of default. Issuers are exceptionally stable and dependable.	Johnson & Johnson Microsoft Canada
	Aa	AA	Highest quality with slightly higher degree of long-term risk.	Google Procter & Gamble China
	A	A	High-medium quality, with many strong attributes but somewhat vulnerable to changing economic conditions.	JPMorgan Chase Wells Fargo Israel
	Baa	BBB	Medium quality, currently adequate but perhaps unreliable over the long term.	Hewlett Packard Time Warner Brazil Italy
Noninvestment, Speculative Grade	Ba	BB	Some speculative element, with moderate security but not well safeguarded.	Goodyear Tire Nokia Portugal
	B	B	Able to pay now but at risk of default in the future.	Hertz Office Depot Kenya
Highly Speculative	Caa	CCC	Poor quality, clear danger of default.	Greece Venezuela
	Ca	CC	Highly speculative quality, often in default.	
	C	C	Lowest-rated, poor prospects of repayment though may still be paying.	
	D	D	In default.	

Bond Ratings

- Speculative grade bonds are bonds issued by companies and countries that may have difficulty meeting their bond payments but are not at risk of immediate default.
- Highly speculative bonds consist of debts that are in serious risk of default.
- All bonds with grades below investment grade are often referred to as **junk bonds** or *high-yield bonds*.

Bond Ratings

- Types of junk bonds:
 - **Fallen angels** are bonds that were once investment-grade, but their issuers fell on hard times.
 - Bonds issued by issuers about which there is little known.
- Material changes in a firm's or government's financial conditions precipitate changes in its debt ratings.
 - **Ratings downgrade** - lower an issuer's bond rating.
 - **Ratings upgrade** - upgrade an issuer's bond rating.



LESSONS FROM THE CRISIS SUBPRIME MORTGAGES

- A residential mortgage is called *subprime* when it does not meet the key standards of creditworthiness that apply to conventional *prime* mortgages.
 - Creditworthiness standards are meant to increase the likelihood that the borrower will be able to repay the loan: cover the size of mortgage, price of the home, and the ratio between the two: *the loan-to-value ratio* (LTV ratio).
- Conventional prime mortgages (qualifying or confirming mortgages) are those that satisfy the rules for inclusion in a collection or pool of mortgages to be guaranteed by a U.S. Government agency.



LESSONS FROM THE CRISIS SUBPRIME MORTGAGES

- Subprime loans may fail to meet some or all of these standards for a qualifying mortgage.
- Like other loans, subprime loans can be at a fixed or variable rate (ARMs).
 - ARMs typically provide a low interest rate, or teaser rate, for a couple of years and then the interest resets to a higher rate.
 - This gives borrowers the ability to refinance after the introductory rate is up.



LESSONS FROM THE CRISIS SUBPRIME MORTGAGES

- Although at their peak subprime mortgages accounted for less than 15 percent of overall residential mortgages, they helped trigger the financial disruptions of 2007-2009.
- The key reason is that some large, highly leveraged financial institutions held a sizable volume of MBS backed by subprime mortgages.



IN THE BLOG

In Search of Better Credit Assessments

- Credit rating agencies (CRAs) sky-high ratings of mortgage-backed securities played a central role in the financial crisis of 2007-2009
- Securities and Exchange Commission issued two guidelines to reform the operations of CRAs
 1. Required CRAs to establish controls to limit the conflict of interest arising from the “issuer pays” arrangement
 - Incentive problems
 2. CRAs to publish information about the pools they are rating (transparency)

Commercial Paper

- **Commercial paper** is a short-term version of a bond.
 - The borrower offers no collateral so the debt is *unsecured*.
 - Commercial paper is
 - Issued on a discount basis, as a zero-coupon bond specifying a single future payment with no associated coupon payments.
 - Has maturity of less than 270 days.
 - Roughly one-third is held by money-market mutual funds.

Commercial Paper

- Most commercial paper is issued with a maturity of 5 to 45 days and is used exclusively for short-term financing.
- The rating agencies rate the creditworthiness of commercial paper issuers in the same way they do bond issuers.
- Almost all carry Moody's P-1 or P-2 rating
 - P stands for **prime grade commercial paper**.
 - Speculative-grade commercial paper does exist, but not because it was issued as such.

Commercial Paper

Table 7.2

Commercial Paper Ratings

	Moody's	Standard & Poor's	Description	Examples of Issuers with Commercial Paper Outstanding in 2016
Investment or Prime Grade	P-1	A-1+, A-1	Strong likelihood of timely repayment.	Coca-Cola General Electric Procter & Gamble
	P-2	A-2	Satisfactory degree of safety for timely repayment.	General Mills Time Warner
	P-3	A-3	Adequate degree of safety for timely repayment.	Alcoa*
Speculative, below Prime Grade		B, C	Capacity for repayment is small relative to higher-rated issuers.	
Defaulted		D		

The Impact of Ratings on Yields

- Bond ratings are designed to reflect default risk.
- The lower the rating
 - The higher the risk of default.
 - The lower its price and the higher its yield.
- To understand quantitative ratings, it is easier to compare them to a benchmark.

The Impact of Ratings on Yields

- U.S. Treasury issues are viewed as having little default risk, so they are used as **benchmark bonds**.
- Yields on other bonds are measured in terms of the **spread over Treasuries**.
- Bond yield is the sum of two parts:
= U.S. Treasury yield + Default risk premium

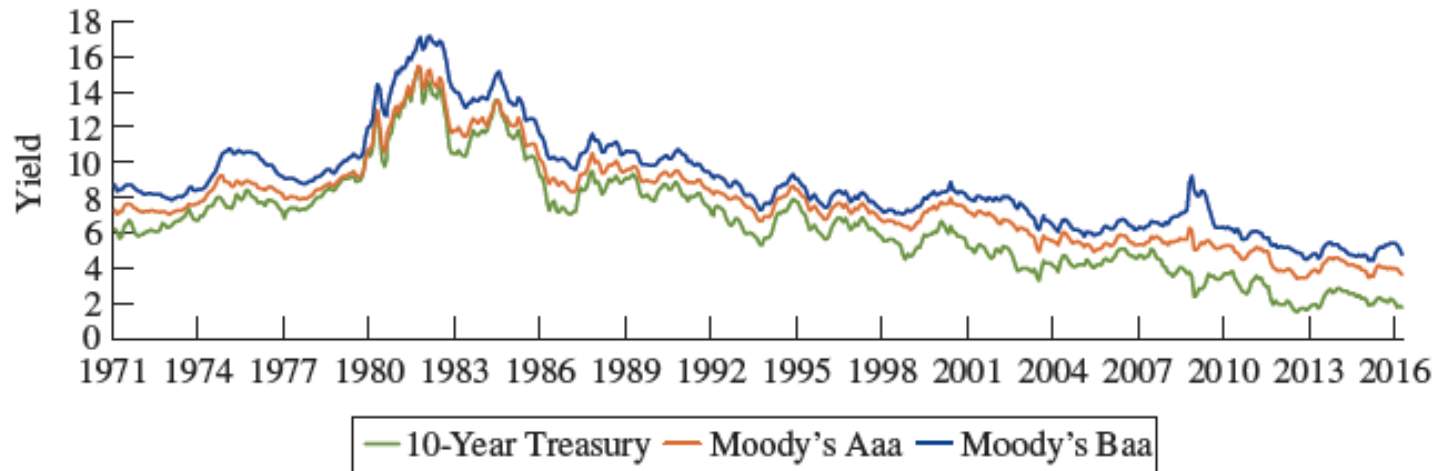
The Impact of Ratings on Yields

- If bond ratings properly reflect risk, then the lower the rating of the issuer, the higher the default-risk premium.
- When Treasury yields move, all other yields move with them.
- We can see this from Figure 7.2 showing a plot of the **risk structure of interest rates**.

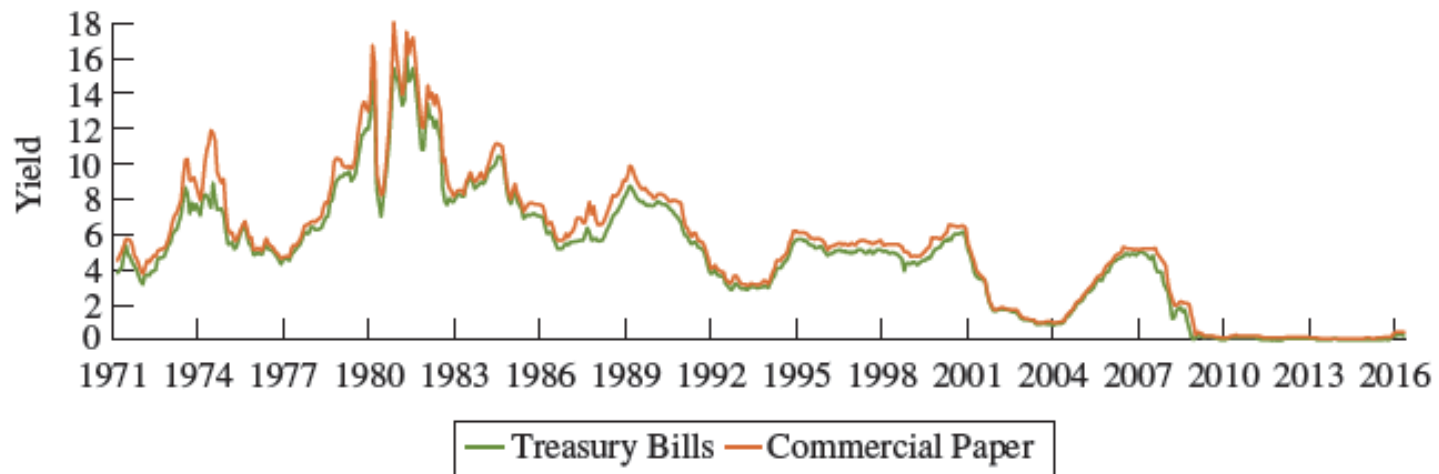
Figure 7.2

The Risk Structure of Interest Rates

A. Comparing Long-Term Interest Rates



B. Comparing Short-Term Interest Rates



The Impact of Ratings on Yields

- Changes in the U.S. Treasury yields account for most of the movement in the Aaa and Baa bond yields.
- From 1979-2016, the 10-year U.S. Treasury bond yield has averaged almost a full percentage point below the average yield on Aaa bonds and two percentage points below the average yield on Baa bonds.

The Impact of Ratings on Yields

- A two-percentage point increase in the yield, from 5 to 7 percent, lowers the value of the promise of \$100 in 10 years by \$10.56, or 17 percent.
- Clearly ratings are crucial to corporations' ability to raise financing.
 - A lower rate increases the costs of funds.
- Investors clearly must be compensated for assuming risk.



YOUR FINANCIAL WORLD

Your Credit Rating

- Companies aren't the only ones with credit ratings: you have one too.
- There are companies keeping track of your financial information.
- All this information is combined into a credit score, which you should care about.
- The better your credit score, the lower the interest rate you will pay on debt.



LESSONS FROM THE CRISIS ASSET-BACKED COMMERCIAL PAPER

- Asset-backed commercial paper (ABCP) is a short-term liability with a maturity of up to 270 days.
 - ABCP is collateralized by assets that financial institutions place in a special portfolio.
- These played a special role in the housing boom that preceded the financial crisis of 2007-2009.



LESSONS FROM THE CRISIS

ASSET-BACKED COMMERCIAL PAPER

- To lower costs and limit asset holding, some large banks created firms (a form of shadow bank) that issued ABCP and used the money to buy mortgages and other loans.
- When the ABCP matures, issues have to borrow (or sell underlying assets) to be able to return the principal to the ABCO holders.
 - The risk was that the issuers would be unable to borrow - they faced *rollover* risk.
 - If they were also unable to sell the long-term assets easily, the shadow banks would face failure.



LESSONS FROM THE CRISIS

ASSET-BACKED COMMERCIAL PAPER

- The uncertainty in the value of mortgages lead ABCP purchasers to realize the risk and ABCP purchases halted.
- Firms that has issued ABCP faced an immediate threat to their survival.
 - Inability to sell assets or obtain other funding caused many to fail.
 - Some banks rescued their shadow banks, facing heightened liquidity needs and pressures to sell assets during the worst time - the middle of a crisis.

Differences in Tax Status and Municipal Bonds

- Taxes are also an important factor affecting the yield on a bond.
- Bondholders must pay income tax on the interest income they receive from owning privately issued bonds - **taxable bonds**.
- The coupon payments on bonds issued by state and local governments, **municipal** or **tax-exempt bonds**, are specifically exempt from taxation.

Differences in Tax Status and Municipal Bonds

- The general rule in the U.S. is that the interest from bonds issued by one government is not taxed by another government, although the issuing government may tax it.
- In an effort to make their bonds more attractive to investors, state and local governments usually choose not to tax the interest on their own bonds.
- Investors base their decisions on the *after-tax yield*.

Differences in Tax Status and Municipal Bonds

- The yield on a tax-exempt bond equals the taxable bond yield times one minus the tax rate:

Tax-Exempt Bond Yield

$$= (\text{Taxable Bond Yield}) \times (1 - \text{Tax Rate}).$$

- Overall, the higher the tax rate, the wider the gap between the yields on taxable and tax-exempt bonds.

Term Structure of Interest Rates

- Why do bonds with the same default rate and tax status but different maturity dates have different yields?
 - Long-term bonds are like a composite of a series of short-term bonds.
 - Their yield depends on what people expect to happen in the future.

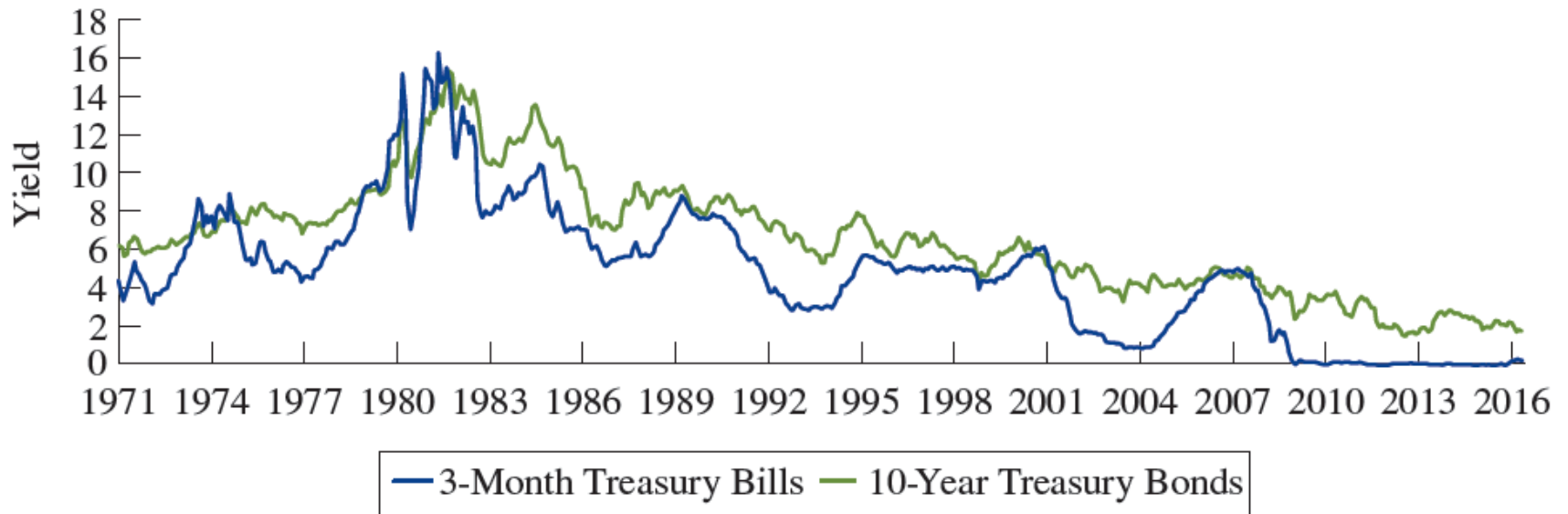
Term Structure of Interest Rates

- The relationship among bonds with the same risk characteristics but different maturities is called the **term structure of interest rates**.
- Comparing 3-month and 10-year Treasury yields we can see:
 1. Interest rates of different maturities tend to move together.
 2. Yields on short-term bonds are more volatile than yields on long-term bonds.
 3. Long-term yields tend to be higher than short-term yields.

Term Structure of Interest Rates

Figure 7.3

The Term Structure of Treasury Interest Rates



The Expectations Hypothesis

- The expectations hypothesis of the term structure focuses on the risk-free interest rate.
- The risk-free interest rate can be computed, assuming there is not uncertainty about the future.

The Expectations Hypothesis

- If there is no uncertainty, then an investor will be indifferent between holding a two-year bond or a series of two one-year bonds.
 - Certainty means that the bonds of different maturities are perfect substitutes for each other.
- The expectations hypothesis implied that the current two-year interest rate should equal the average of current one-year rate and the one-year interest rate one year in the future.

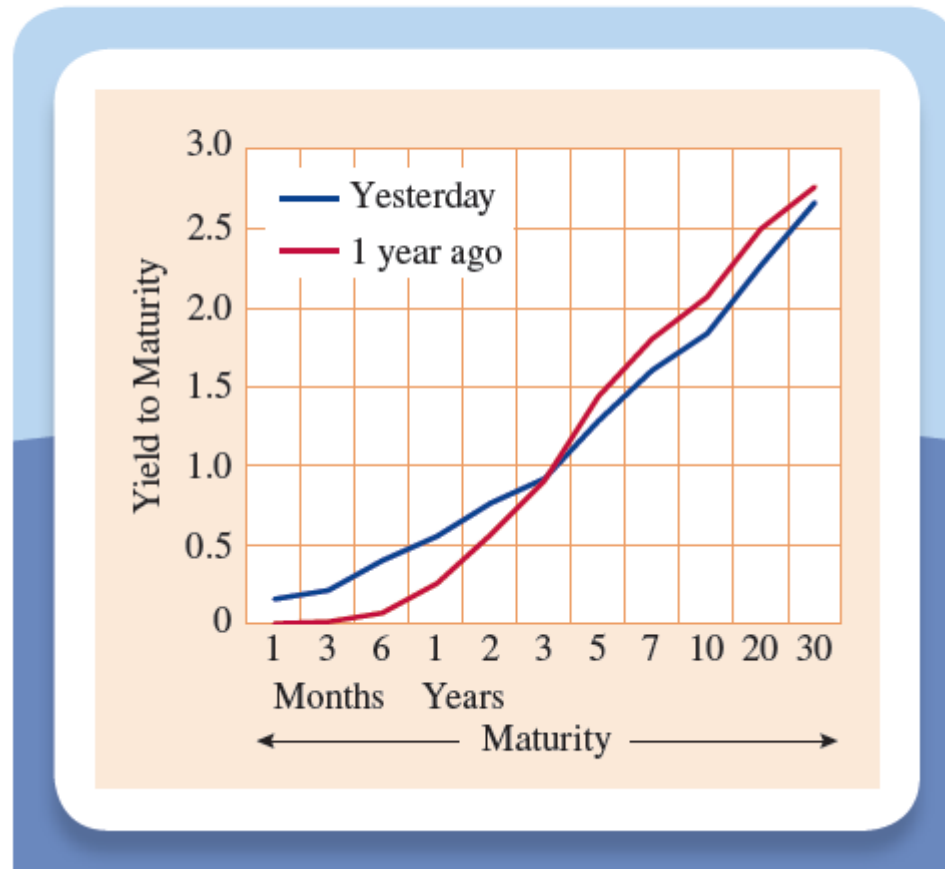
The Expectations Hypothesis

- When interest rates are expected to rise, long-term interest rate will be higher than short-term interest rates.
 - The **yield curve** which plots the yield to maturity on the vertical axis and the time to maturity on the horizontal axis, will slope up.
- This also means:
 - If interest rates are expected to fall, the yield curve will slope down.
 - If expected to stay the same, the yield curve will be flat.

The Expectations Hypothesis

Figure 7.4

The U.S. Treasury Yield Curve



The Expectations Hypothesis

Figure 7.5

The Expectations Hypothesis and Expectations of Future Short-term Interest Rates



The Expectations Hypothesis

- If bonds of different maturities are perfect substitutes for each other, then we can construct investment strategies that must have the same yields.
 1. Invest in a two-year bond and hold it to maturity
 2. Invest in two one-year bonds, one today and one when the first matures.

The Expectations Hypothesis

- The expectations hypothesis tells us investors will be indifferent between the two options.
- This means they must have the same return:

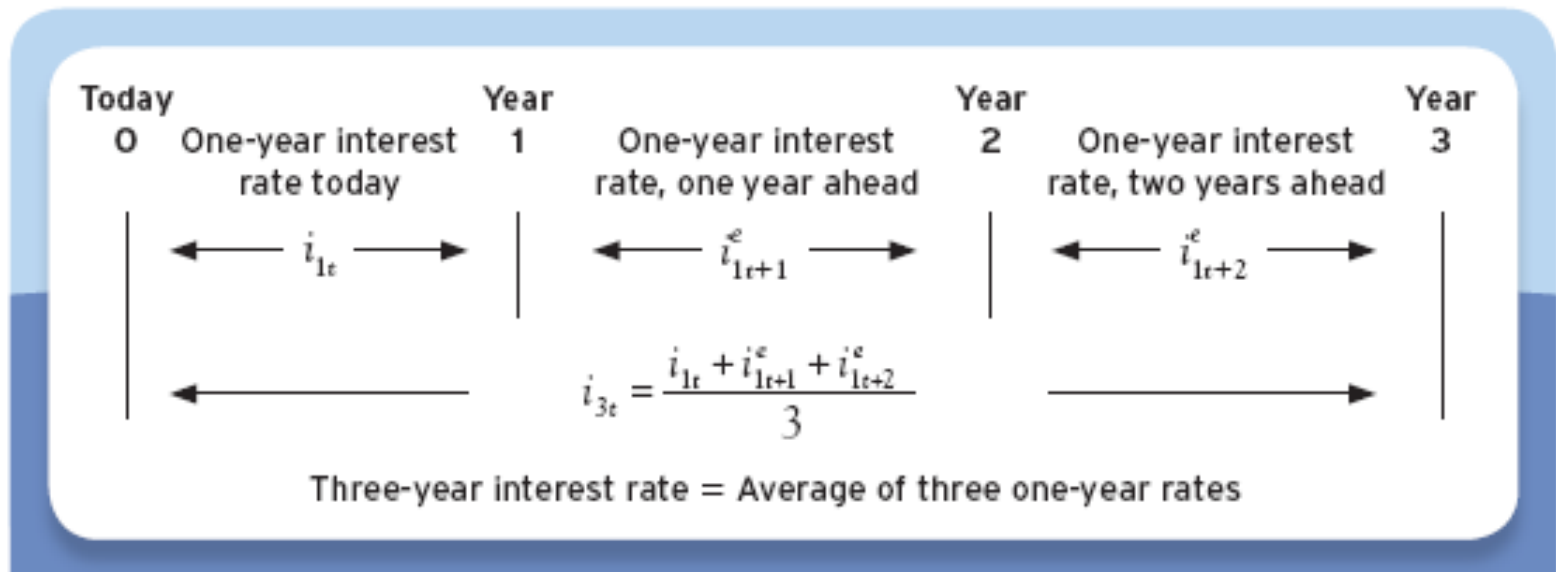
$$(1 + i_{2t})(1 + i_{2t}) = (1 + i_{1t})(1 + i^e_{1t+1})$$

- We can now write the two-year interest rate as the average of the current and future expected one-year interest rates:

$$i_{2t} = \frac{i_{1t} + i^e_{1t+1}}{2}$$

The Expectations Hypothesis

The Expectations Hypothesis of the Term Structure:



The Expectations Hypothesis

- We can generalize this: a bond with n years to maturity is the average of n expected future one-year interest rates:

$$i_{nt} = \frac{i_{1t} + i_{1t+1}^e + i_{1t+2}^e + \dots + i_{1t+n-1}^e}{n}$$

The Expectations Hypothesis

Does this hypothesis explain the three observations we started with?

1. Interest rates of different maturities will move together.
 - We can see this holds from the previous equation.
2. Yields on short-term bonds will be more volatile than yields on long-term bonds.
 - Long-term rates are averages of short-term rates, so changing one short-term rate has little effect on the long term rate.

The Liquidity Premium Theory

- Risk is the key to understanding the upward slope of the yield curve.
- Bondholders face both inflation and interest-rate risk.
 - The longer the term of the bond, the greater both types of risk.
- Computing real return from nominal return requires a forecast of *expected* future inflation.
 - *A bond's inflation risk increases with its time to maturity.*

The Liquidity Premium Theory

- Interest-rate risk arises from the mismatch between the investor's investment horizon and a bond's time to maturity.
 - If a bondholder plans to sell a bond prior to maturity, changes in the interest rate generate capital gains or losses.
 - The longer the term of the bond, the greater the price changes for a given change in interest rates and the larger the potential for capital losses.
- Investors require compensation for the increase in risk they take for buying longer term bonds.

The Liquidity Premium Theory

- We can think about bond yields as having two parts:
 - One that is risk free: explained by the expectations hypothesis.
 - One that is a risk premium: explained by inflation and interest-rate risk.
- Together this forms the **liquidity premium theory of the term structure** of interest rates.

$$i_{nt} = rp_n + \frac{i_{1t} + i_{1t+1}^e + i_{1t+2}^e + \dots + i_{1t+n-1}^e}{n}$$



APPLYING THE CONCEPT

THE FLIGHT TO QUALITY

- During financial crises, people sell risky investments & buy safe ones.
- An increase in the demand for government bonds coupled with a decrease in the demand for virtually everything else is called a **flight to quality**.
 - This leads to an increase in the risk spread.

Information in the Risk Structure of Interest Rates

- The immediate impact of a pending recession is to raise the risk premium on privately issued bonds.
 - Note that an economic slowdown or recession does not affect the risk of holding government bonds.
 - The impact of a recession on companies with high bond ratings is also usually quite small.
- The lower the initial grade of the bond, the more the default-risk premium rises as general economic conditions deteriorate.

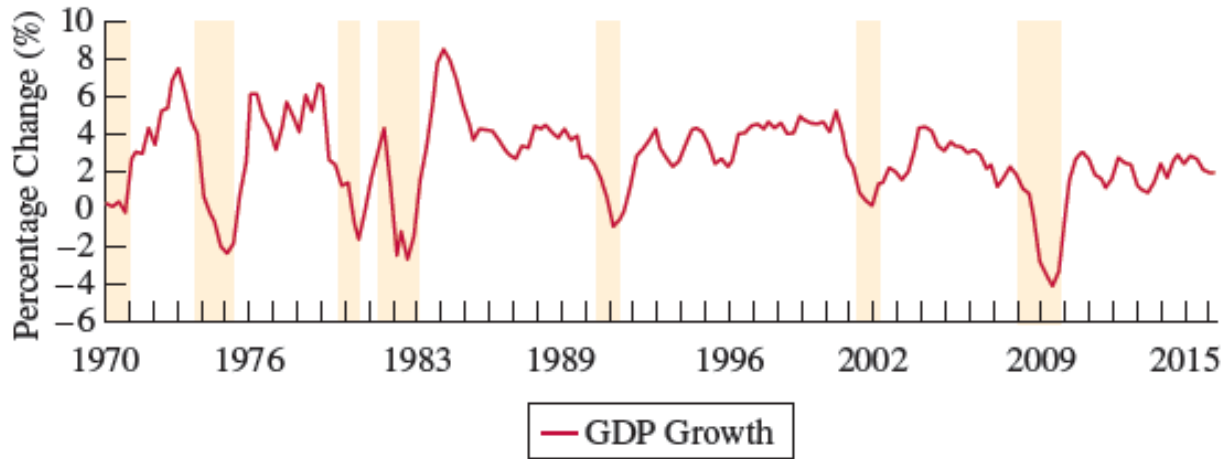
Information in the Risk Structure of Interest Rates

- Panel A of Figure 7.6 shows the annual GDP growth over four decades superimposed on shading that shows the dates of recessions.
 - During shaded periods growth is usually negative.
- Panel B of figure 7.6 shows GDP growth against the spread between yields on Baa-rated bonds and U.S. Treasury bonds.
 - When risk spread rises, output falls.

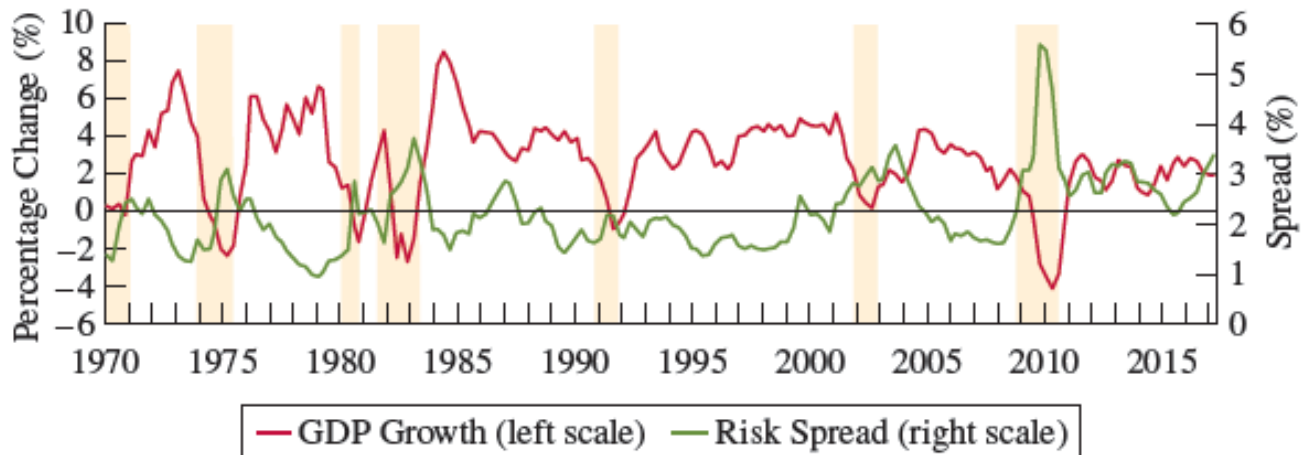
Figure 7.6

The Risk Spread and GDP Growth

A. GDP Growth with Recessions Shaded



B. GDP Growth with Risk Spread



Information in the Term Structure of Interest Rates

- Information on the term structure, particularly the slope of the yield curve helps to forecast general economic conditions.
 - The yield curve *usually* slopes upward.
 - On rare occasions, short-term interest rates exceed long-term yields leading to an *inverted* yield curve.
- This is a valuable forecasting tool because it predicts a general economic slowdown.
 - Indicates policy is tight because policymakers are attempting to slow economic growth and inflation.

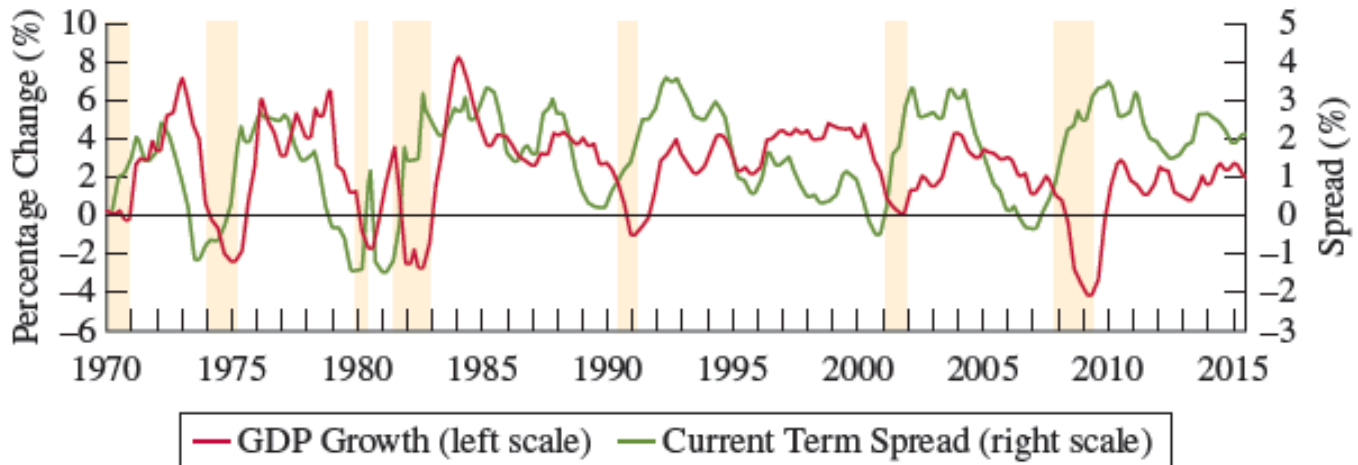
Information in the Term Structure of Interest Rates

- Figure 7.7 shows GDP growth and the slope of the yield curve, measured as the difference between the 10-year and 30 month yields: **term spread**.
- Panel A shows GDP growth together with the growth and term spread at the same time.
- Panel B shows GDP growth in the current year against the slope of the yield curve one year earlier.
 - The two lines clearly move together.

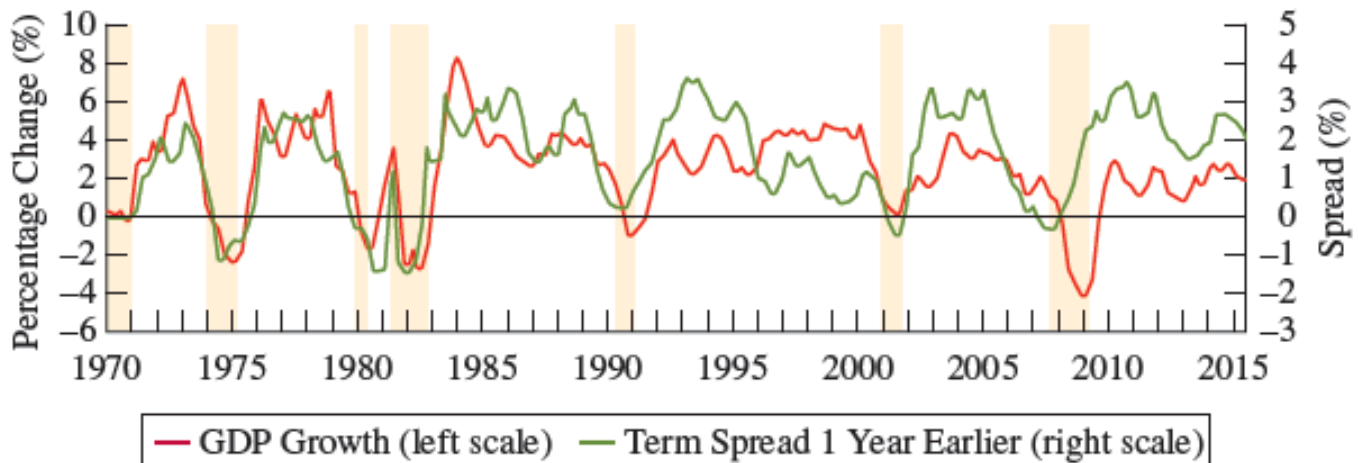
Figure 7.7

The Term Spread and GDP Growth

A. Current Term Spread and GDP Growth



B. GDP Growth with Term Spread 1 Year Earlier



Information in the Term Structure of Interest Rates

- When the term spread falls, GDP growth tends to fall one year later.
- However, the yield curve did not predict the depth or duration of the recession of 2007-2009.
 - One and two year rates did not anticipate the persistent plunge of overnight rates.
 - The widening risk spread signaled a severe economic downturn providing a more useful predictor in this case.



APPLYING THE CONCEPT

EMERGING-MARKET BONDS

- Emerging market economies have gained wider access to international financing
 - After the 2007-2009 financial crisis foreign investors became willing to purchase bonds issued by EME corporations and governments
- Rapid expansion of EME bonds and rise of EME debt as a fraction of the global total
- EMEs attracted investors because they neither caused the financial crisis or suffered from it as much as advanced economies
- EMEs could face rising default risk, if and when global interest rates rise and the U.S. dollar appreciates.