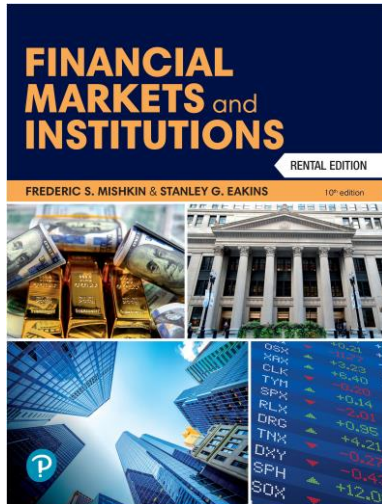# Financial Markets and Institutions

Tenth Edition

Chapter 5

How Do Risk and Term Structure Affect Interest Rates?

Chapter Preview (1 of 4)

In the last chapter, we examined interest rates, but made a **big** assumption—there is only one economy-wide interest rate. Of course, that isn't really the case.

In this chapter, we will examine the different rates that we observe for financial products.

Chapter Preview (2 of 4)

We will fist examine bonds that offer similar payment streams but differ in price. The price differences are due to the **risk structure of interest rates.** We will examine in detail what this risk structure looks like and ways to examine it.

Chapter Preview (3 of 4)

Next, we will look at the different rates required on bonds with different maturities. That is, we typically observe higher rates on longer-term bonds. This is known as the **term structure of interest rates**. To study this, we usually look at Treasury bonds to minimize the impact of other risk factors.

Chapter Preview (4 of 4)

- So, in sum, we will examine how the individual risk of a bond affects its required rate. We also explore how the general level of interest rates varies with the maturity of the debt instruments. Topics include:
  - Risk Structure of Interest Rates
  - Term Structure of Interest Rates

Risk Structure of Interest Rates

- To start this discussion, we first examine the yields for several categories of long-term bonds over the last 90 years.
- You should note several aspects regarding these rates, related to different bond categories and how this has changed through time.

Figure 5.1

Long-Term Bond Yields, 1919–2022
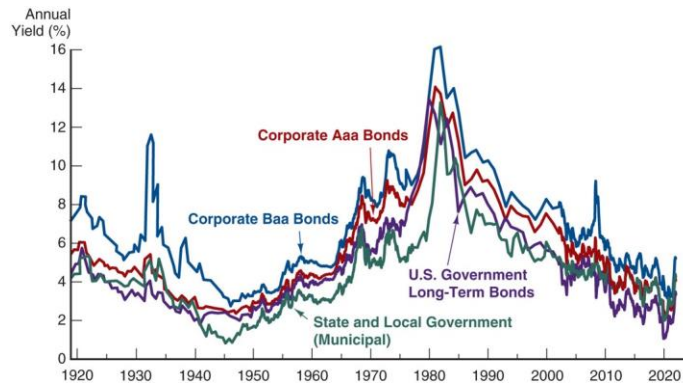
Sources: Board of Governors of the Federal Reserve System, Banking and Monetary Statistics, 1941–1970; Federal Reserve Bank of St. Louis FRED database, https://fred.stlouisfed.org/series/GS10 , https://fred.stlouisfed.org/series/AAA , https://fred.stlouisfed.org/series/BAA .

Risk Structure of Long Bonds in the United States

The figure shows two important features of the interest-rate behavior of bonds.

- Rates on different bond categories change from one year to the next.
- Spreads on different bond categories change from one year to the next.

Factors Affecting Risk Structure of Interest Rates

To further examine these features, we will look at three specific risk factors.

- Default Risk
- Liquidity
- Income Tax Considerations

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Default Risk Factor (1 of 4)

One attribute of a bond that influences its interest rate is its **risk of default,** which occurs when the issuer of the bond is unable or unwilling to make interest payments when promised.

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Default Risk

U.S. Treasury bonds have usually been considered to have no default risk because the federal government can always increase taxes to pay off its obligations (or just print money). Bonds like these with no default risk are called **default-free bonds.**
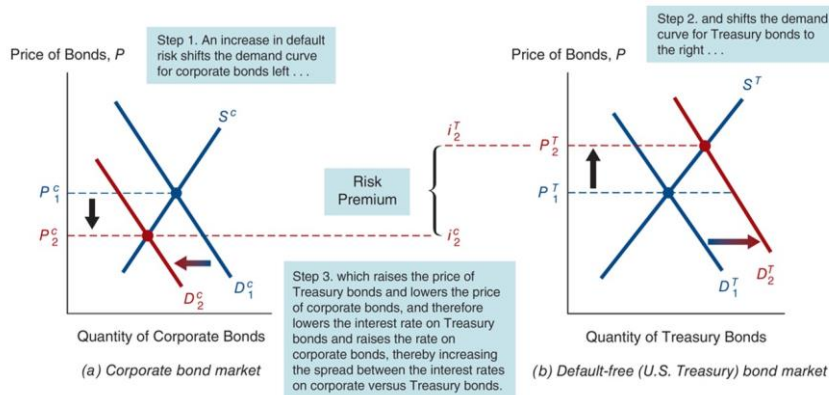
Default Risk Factor (2 of 4)

But are these bonds truly **default-free bonds?** During the budget negotiations in Congress in 1995–1996, and then again in 2011–2013, the Republicans threatened to let Treasury bonds default, and this had an impact on the bond market. If these bonds were truly "default-free," we should not have seen any reaction.

Default Risk Factor (3 of 4)

- The spread between the interest rates on bonds with default risk and default-free bonds, called the **risk premium,** indicates how much additional interest people must earn in order to be willing to hold that risky bond.
- A bond with default risk will always have a positive risk premium, and an increase in its default risk will raise the risk premium.

Figure 5.2

Response to an Increase in Default Risk on Corporate Bonds

Step 1. An increase in default risk shifts the demand curve for corporate bonds left . . .

Step 2. and shifts the demand curve for Treasury bonds to the right . . .

Step 3. which raises the price of Treasury bonds and lowers the price of corporate bonds, and therefore lowers the interest rate on Treasury bonds and raises the rate on corporate bonds, thereby increasing the spread between the interest rates on corporate versus Treasury bonds.

(a) Corporate bond market

(b) Default-free (U.S. Treasury) bond market

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Analysis of Figure 5.2: Increase in Default on Corporate Bonds

- Corporate Bond Market
  1. R^e on corporate bonds $\downarrow$, D^c $\downarrow$, D^c shifts left
  2. Risk of corporate bonds $\uparrow$, D^c $\downarrow$, D^c shifts left
  3. P^c $\downarrow$, i^c $\uparrow$

- Treasury Bond Market
  1. Relative R^e on Treasury bonds $\uparrow$, D^T $\uparrow$, D^T shifts right
  2. Relative risk of Treasury bonds $\downarrow$, D^T $\uparrow$, D^T shifts right
     P^T $\uparrow$, i^T $\downarrow$

- Outcome
  - Risk premium, $i^c - i^T$, rises

Default Risk Factor (4 of 4)

- Default risk is an important component of the size of the risk premium.
- Because of this, bond investors would like to know as much as possible about the default probability of a bond.
- One way to do this is to use the measures provided by credit-rating agencies: Moody's and S&P are examples.

Table 5.1

Bond Ratings by Moody's and Standard and Poor's

Moody's Rating	S&P Rating	Description	Examples of Corporations with Bonds Outstanding in 2016
Aaa	AAA	Highest quality (lowest default risk)	Microsoft, J&J
Aa	AA	High quality	Apple, General Electric
A	A	Upper-medium grade	MetLife, Intel, Harley-Davidson
Baa	BBB	Medium grade	McDonalds, BofA, HP, FedEx, Southwest Airlines
Ba	BB	Lower-medium grade	Best Buy, American Airlines, Delta Airlines, United Airlines
B	B	Speculative	Netflix, Rite Aid, J.C. Penney
Caa	CCC,CC	Poor (high default risk)	Sears, Elizabeth Arden
C	D	Highly speculative	Halcon Resources, Seventy-Seven Energy

Case: The Global Financial Crisis and the Baa-Treasury Spread

- Starting in 2007, the subprime mortgage market collapsed, leading to large losses for financial institutions.
- Because of the questions raised about the quality of Baa bonds, the demand for lower-credit bonds fell, and a "flight-to-quality" followed (demand for T-securities increased.
- Result: Baa-Treasury spread increased from 185 bps to 545 bps.

Liquidity Factor (1 of 2)

- Another attribute of a bond that influences its interest rate is its liquidity; a liquid asset is one that can be quickly and cheaply converted into cash if the need arises. The more liquid an asset is, the more desirable it is (higher demand), holding everything else constant.

Corporate Bond Becomes Less Liquid

- Corporate Bond Market
    1. Liquidity of corporate bonds ↓, D^c ↓, D^c shifts left
    2. P^c ↓, i^c ↑
- Treasury Bond Market
    1. Relatively more liquid Treasury bonds, D^T ↑, D^T shifts right
    2. P^T ↑, i^T ↓
- Outcome
    - Risk premium, $i^c - i^T$, rises
- Risk premium reflects not only corporate bonds' default risk but also lower liquidity

Liquidity Factor (2 of 2)

- The differences between interest rates on corporate bonds and Treasury bonds (that is, the risk premiums) reflect not only the corporate bond's default risk but its liquidity too. This is why a risk premium is sometimes called a **risk and liquidity premium**.

Income Taxes Factor (1 of 3)

- An odd feature of Figure 5.1 is that municipal bonds tend to have a lower rate the Treasuries. Why?
- Munis certainly can default. Orange County (California) is a recent example from the early 1990s.
- Munis are not as liquid a Treasuries.

Income Taxes Factor (2 of 3)

- However, interest payments on municipal bonds are exempt from federal income taxes, a factor that has the same effect on the demand for municipal bonds as an increase in their expected return.
- Treasury bonds are exempt from state and local income taxes, while interest payments from corporate bonds are fully taxable.

Income Taxes Factor (3 of 3)

- For example, suppose you are in the 35% tax bracket. From a 10%-coupon Treasury bond, you only net $65 of the coupon payment because of taxes
- However, from an 8%-coupon municipal bond, you net the full $80. For the higher return, you are willing to hold a riskier municipal bond (to a point).

Figure 5.3

Interest Rates on Municipal and Treasury Bonds

(a) Market for municipal bonds

(b) Market for Treasury bonds
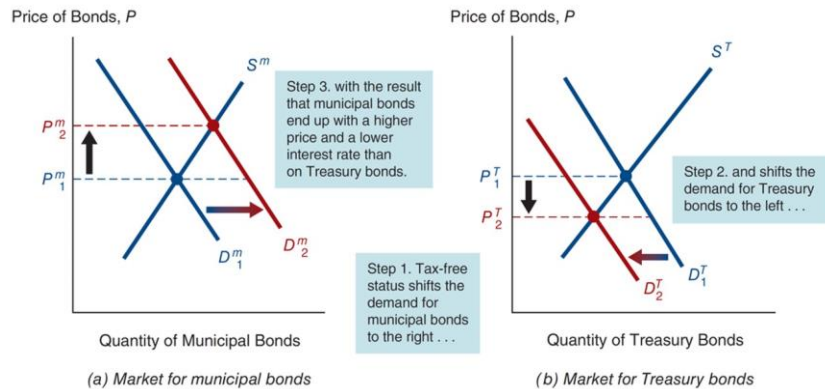
Analysis of Figure 5.3: Tax Advantages of Municipal Bonds

- Municipal Bond Market

  1. Tax exemption raises relative R^e on municipal bonds, $D^m \uparrow$, D^m shifts right

  2. $P^m \uparrow$

- Treasury Bond Market

  1. Relative R^e on Treasury bonds $\downarrow$, $D^T \downarrow$, D^T shifts left

  2. $P^T \downarrow$

- Outcome $i^m < i^T$

Case: Bush Tax Cut and Obama Repeal on Bond Interest Rates

- The 2001 tax cut called for a reduction in the top tax bracket, from 39% to 35% over a ten-year period.
- This reduces the advantage of municipal debt over T-securities since the interest on T-securities is now taxed at a lower rate.

Case: Bush Tax Cut and Possible Repeal on Bond Interest Rates

- The Bush tax cuts were repealed under President Obama. Our analysis is reversed. The advantage of municipal debt increased relative to T-securities, since the interest on T-securities is taxed at a higher rate.

Term Structure of Interest Rates

Now that we understand risk, liquidity, and taxes, we turn to another important influence on interest rates—maturity.

Bonds with different maturities tend to have different required rates, all else equal.

Following the News

For example, Yahoo.com publishes a plot of the **yield curve** (rates at different maturities) for Treasury securities.

The picture on page 96 of your text is a typical example, from May 17, 2016.

What is the three-month rate? The two-year rate? What is the shape of the curve?

Following the News: A Stylized Figure of the Yield Curve
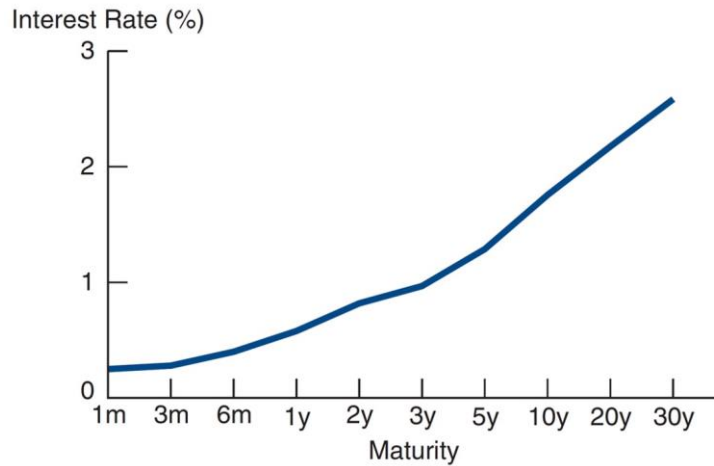
Term Structure Facts to Be Explained (1 of 2)

Besides explaining the shape of the yield curve, a good theory must explain why:

- Interest rates for different maturities move together. We see this on the next slide.

Figure 5.4

Movements Over Time of Interest Rates on U.S. Government Bonds with Different Maturities
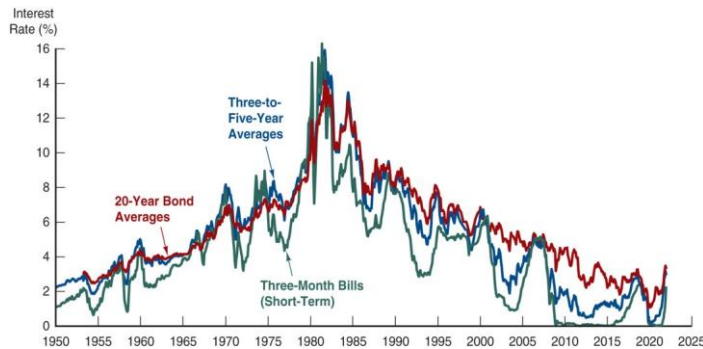
Term Structure Facts to Be Explained (2 of 2)

Besides explaining the shape of the yield curve, a good theory must explain why:

- Interest rates for different maturities move together.
- Yield curves tend to have steep upward slope when short rates are low and a downward slope when short rates are high.
- Yield curve is typically upward sloping.

Three Theories of Term Structure

1. Expectations Theory
   - Pure expectations theory explains 1 and 2, but not 3
2. Market Segmentation Theory
   - Market segmentation theory explains 3, but not 1 and 2
3. Liquidity Premium Theory
   - Solution: Combine features of both pure expectations theory and market segmentation theory to get liquidity premium theory and explain all facts

Expectations Theory (1 of 4)

- **Key Assumption:** Bonds of different maturities are perfect substitutes
- **Implication:** R^e on bonds of different maturities are equal

Expectations Theory (2 of 4)

To illustrate what this means, consider two alternative investment strategies for a two-year time horizon**.**

1. Buy $1 of one-year bond, and when it matures, buy another one-year bond with your money.
2. Buy $1 of two-year bond and hold it.

Expectations Theory (3 of 4)

The important point of this theory is that if the expectations theory is correct, your **expected** wealth is the same (at the start) for both strategies. Of course, your actual wealth may differ, if rates change **unexpectedly** after a year.
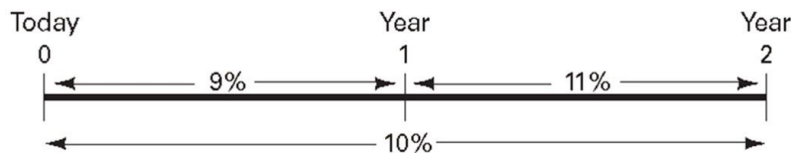
Expectations Theory (4 of 4)

- To help see this, here's a picture that describes the same information:

Today
0

Year
1

Year
2

$$i_t \quad\quad i_{t+1}^e$$

$$i_{2t} = \frac{i_t + i_{t+1}^e}{2}$$
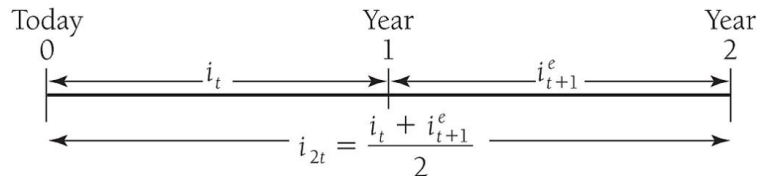
Example 5.2: Expectations Theory

- This is an example, with actual #'s:

Today
0

Year
1

Year
2

9%   11%

10%

More Generally for *n*-Period Bond ... (1 of 2)

$$i_{nt} = \frac{i_t + i^e_{t+1} + i^e_{t+2} + \cdots + i^e_{t+(n-1)}}{n}$$

• Don't let this seem complicated. Equation 2 simply states that the interest rate on a long-term bond equals the average of short rates expected to occur over life of the long-term bond.

More Generally for *n*-Period Bond ... (2 of 2)

• Numerical example
  – One-year interest rate over the next five years are expected to be 5%, 6%, 7%, 8%, and 9%
• Interest rate on two-year bond today:

$$(5\% + 6\%) / 2 = 5.5\%$$

• Interest rate for five-year bond today:

$$(5\% + 6\% + 7\% + 8\% + 9\%) / 5 = 7\%$$

• Interest rate for one- to five-year bonds today: 5%, 5.5%, 6%, 6.5% and 7%

Expectations Theory and Term Structure Facts (1 of 4)

- Explains why yield curve has different slopes
  1. When short rates are expected to rise in future, average of future short rates $= i_{nt}$ is above today's short rate; therefore yield curve is upward sloping.
  2. When short rates expected to stay same in future, average of future short rates same as today's, and yield curve is flat.
  3. Only when short rates expected to fall will yield curve be downward sloping.

Expectations Theory and Term Structure Facts (2 of 4)

- Pure expectations theory explains fact 1—that short and long rates move together
  1. Short rate rises are persistent
  2. If $i_t \uparrow$ today, i^e_{t+1}, i^e_{t+2} etc. $\uparrow \Rightarrow$ average of future rates $\uparrow \Rightarrow i_{nt} \uparrow$
  3. Therefore: $i_t \uparrow \Rightarrow i_{nt} \uparrow$ (i.e., short and long rates move together)

Expectations Theory and Term Structure Facts (3 of 4)

- Explains fact 2—that yield curves tend to have steep slope when short rates are low and downward slope when short rates are high

  1. When short rates are low, they are expected to rise to normal level, and long rate = average of future short rates will be well above today's short rate; yield curve will have steep upward slope.

  2. When short rates are high, they will be expected to fall in future, and long rate will be below current short rate; yield curve will have downward slope.

Expectations Theory and Term Structure Facts (4 of 4)

- Doesn't explain fact 3—that yield curve usually has upward slope
  - Short rates are as likely to fall in future as rise, so average of expected future short rates will not usually be higher than current short rate: therefore, yield curve will not usually slope upward.

Market Segmentation Theory (1 of 2)

- **Key Assumption:** Bonds of different maturities are not substitutes at all
- **Implication:** Markets are completely segmented; interest rate at each maturity are determined separately

Market Segmentation Theory (2 of 2)

- Explains fact 3—that yield curve is usually upward sloping
  - People typically prefer short holding periods and thus have higher demand for short-term bonds, which have higher prices and lower interest rates than long bonds
- Does not explain fact 1or fact 2 because its assumes long-term and short-term rates are determined independently.

Liquidity Premium Theory (1 of 3)

- **Key Assumption:** Bonds of different maturities are substitutes, but are not perfect substitutes
- **Implication:** Modifies pure expectations theory with features of market segmentation theory

Liquidity Premium Theory (2 of 3)

- Investors prefer short-term rather than long-term bonds. This implies that investors must be paid positive liquidity premium, i_{nt}, to hold long term bonds.

Liquidity Premium Theory (3 of 3)

- Results in following modification of expectations theory, where I_{nt} is a liquidity premium added to the equation.
- We can see this graphically on the next slide.

Figure 5.5

The Relationship Between the Liquidity Premium and Expectations Theories
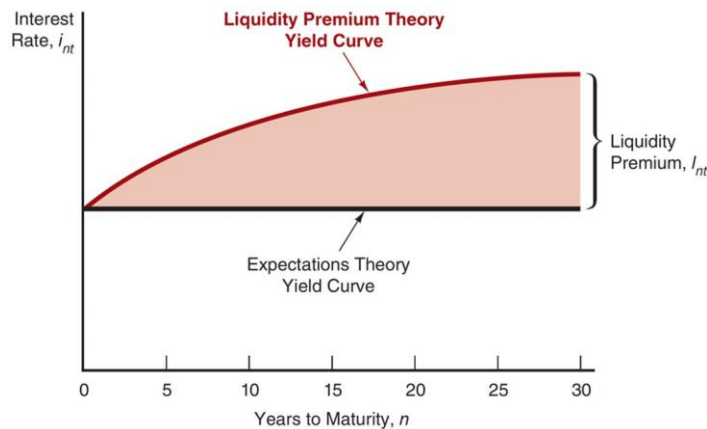
Numerical Example (1 of 2)

1. One-year interest rate over the next five years: 5%, 6%, 7%, 8%, and 9%
2. Investors' preferences for holding short-term bonds so liquidity premium for one- to five-year bonds: 0%, 0.25%, 0.5%, 0.75%, and 1.0%

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Numerical Example (2 of 2)

- Interest rate on the two-year bond:

$$0.25\% + (5\% + 6\%)/2 = 5.75\%$$

- Interest rate on the five-year bond:

$$1.0\% + (5\% + 6\% + 7\% + 8\% + 9\%)/5 = 8\%$$

- Interest rates on one to five-year bonds: 5%, 5.75%, 6.5%, 7.25%, and 8%

- Comparing with those for the pure expectations theory, liquidity premium theory produces yield curves more steeply upward sloped.

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Liquidity Premium Theory: Term Structure Facts

- Explains all three facts
    - Explains fact 3—that usual upward sloped yield curve by liquidity premium for long-term bonds
    - Explains fact 1 and fact 2 using same explanations as pure expectations theory because it has average of future short rates as determinant of long rate

Figure 5.6

- Yield Curves and the Market's Expectations of Future Short-Term Interest Rates According to the Liquidity Premium Theory
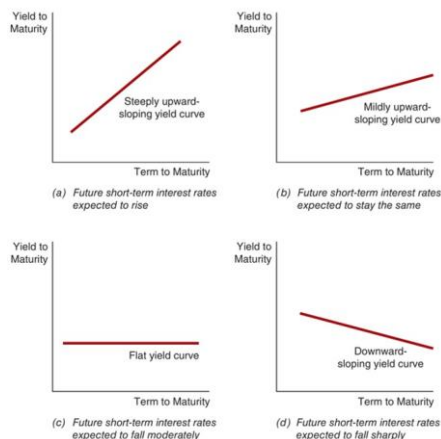
Evidence on the Term Structure

- Initial research (early 1980s) found little useful information in the yield curve for predicting future interest rates.
- Recently, more discriminating tests show that the yield curve has a lot of information about very short-term and long-term rates, but says little about medium-term rates.

Case: Interpreting Yield Curves (1 of 3)

- The picture on the next slide illustrates several yield curves that we have observed for U.S. Treasury securities in recent years.
- What do they tell us about the public's expectations of future rates?

Figure 5.7

Yield Curves for U.S. Government Bonds
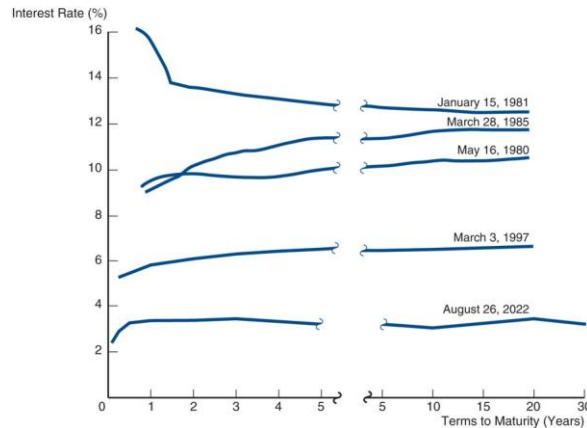
Case: Interpreting Yield Curves (2 of 3)

- The steep downward curve in 1981 suggested that short-term rates were expected to decline in the near future. This played-out, with rates dropping by 300 bps in three months.
- The upward curve in 1985 and 2016 suggested a rate increase in the near future.

Case: Interpreting Yield Curves (3 of 3)

- The moderately upward slopes in 1980 and 1997 suggest that short term rates were not expected to rise or fall in the near term.
- The steep upward slope in 2016 suggests short term rates in the future will rise.

Mini-Case: The Term Structure as a Forecasting Tool

- The yield curve does have information about future interest rates, and so it should also help forecast inflation and real output production.
  - Rising (falling) rates are associated with economic booms (recessions) [Chapter 4].
  - Rates are composed of both real rates and inflation expectations [Chapter 3].

The Practicing Manager: Forecasting Interest Rates with the Term Structure

- Pure Expectations Theory: Invest in one-period bonds or in a two-period bond $\Rightarrow$
- Solve for forward rate
- Numerical example: **the one-year rate** = 5%, the two-year rate = 5.5%
- So, the expected forward rate is $(1.055)^2 / (1.05) - 1 = 6\%$

Forecasting Interest Rates with the Term Structure (1 of 2)

- This can be generalize to the following formula:

$$i_{t+n}^{e} = \frac{(1 + i_{n+1t})^{n+1}}{(1 + i_{nt})^{n}} - 1$$

Forecasting Interest Rates with the Term Structure (2 of 2)

- Liquidity Premium Theory: $i_{nt} - l_{nt} =$ same as pure expectations theory; replace i_{nt} by $i_{nt} - l_{nt}$ to get adjusted forward-rate forecast

$$i^e_{t+n} = \frac{(1 + i_{n+1t} - l_{n+1t})^{n+1}}{(1 + i_{nt} - l_{nt})^n} - 1$$

Chapter Summary

- Risk Structure of Interest Rates: We examine the key components of risk in debt: default, liquidity, and taxes.
- Term Structure of Interest Rates: We examined the various shapes the yield curve can take, theories to explain this, and predictions of future interest rates based on the theories.

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