

**Fixed Income (FN351)****Learning Objectives****After reading this chapter, you will understand**

- why the yield on a Treasury security is the base interest rate
- the factors that affect the yield spread between two bonds
- what a yield curve is a spot rate and a spot rate curve
- how theoretical spot rates are derived using arbitrage arguments from the Treasury yield curve
- what the term structure of interest rates is
- why the price of a Treasury bond should be based on theoretical spot rates
- a forward rate and how a forward rate is derived

## Learning Objectives

### After reading this chapter, you will understand

- ❑ how long-term rates are related to the current short-term rate and short-term forward rates
- ❑ why forward rates should be viewed as hedgeable rates
- ❑ the main economic influences on the shape of the Treasury yield curve
- ❑ what the swap curve/LIBOR curve is and why it is used as an interest rate benchmark

3

## Base Interest Rates

- ❑ The securities issued by the U.S. Department of the Treasury are backed by the full faith and credit of the U.S. government.
- ❑ Interest rates on Treasury securities are the key interest rates in the U.S. economy as well as in international capital.
- ❑ The minimum interest rate that investors want is referred to as the *base interest rate* or *benchmark interest rate* that investors will demand for investing in a non-Treasury security.
  - This rate is the yield to maturity (hereafter referred to as simply *yield*) offered on a comparable maturity Treasury security that was most recently issued (“on the run”).
- ❑ Exhibit 5-1 (*see Overhead 5-5*) shows the yield.
  - These yields represent the benchmark interest rate.

4

**Exhibit 5-1****U.S. Treasury Security Yields on December 28, 2007**

Maturity	Yield
3-month	3.01
6-month	3.29
2-year	3.09
3-year	3.04
5-year	3.49
10-year	4.07
30-year	4.49

5

**Benchmark Spreads**

- The difference between the yields of any two bonds is called a *yield spread* as given below for bonds A and B:
 
$$\text{yield spread} = \text{yield on bond A} - \text{yield on bond B}$$
  - The normal way that yield spreads are quoted is in terms of basis points.
  - The yield spread reflects the difference in the risks associated with the two bonds.
  - When bond B is a benchmark bond and bond A is a non-benchmark bond, the yield spread is referred to as a *benchmark spread*; that is,
 
$$\text{benchmark spread} =$$

$$\text{yield on non-benchmark bond} - \text{yield on benchmark bond}$$
- The benchmark spread reflects the compensation that the market is offering for bearing the risks associated with the non-benchmark bond that do not exist for the benchmark bond.
  - Thus, the benchmark spread can be thought of as a risk premium.

6

## Benchmark Spreads (continued)

- Exhibit 5-2) provides information on benchmark spreads for actual trades for four issues.
- The four issues traded are shown in the second column of the exhibit.
  - The trade price and the resulting yield for each issue are shown in the fourth and fifth columns.
  - The appropriate Treasury benchmark for each traded bond is shown in the sixth column.
  - The yield for the Treasury benchmark issue on the trade date is shown in the seventh column.
  - The benchmark spread is then the difference between the yield on the traded issue and the yield on the Treasury benchmark issue and is shown in the last column.

7

## Exhibit 5-2

### U.S. Treasury Security Yields on December 28, 2007

Issuer	Issue	Rating	Trade Price	Yield (%)	Treasury Benchmark	Benchmark Yield (%)	Benchmark Spread (bps)
General Elect. Capital Corp.	GE 4.125 09/01/2009	Aaa/ AAA	100.182	4.008US/ T 3.125	11/30/ 2009	3.218	79.0
EI Du Pont De Nemours & Co.	DD 5 01/15/2013	A2/ A	100.681	4.843US/ T 3.375	11/30/ 2012	3.616	122.7
The Coca-Cola Company	KO 5.35 11/15/2017	Aa3/ A	102.533	5.020US/ T 4.25	11/15/ 2017	4.201	81.9
Wal-Mart Stores Inc.	WMT 6.5 08/15/2037	Aa2/ AA	109.010	5.855US/ T 4.75	02/15/ 2037	4.619	123.6

8

## Benchmark Spreads (continued)

- ❑ Some market participants measure the risk premium on a relative basis by taking the ratio of the yield spread to the yield level.
- ❑ This measure, called a *relative yield spread*, is as follows:
 
$$\text{relative yield spread} = \frac{\text{yield on bond A} - \text{yield on bond B}}{\text{yield on bond B}}$$
- ❑ The *yield ratio* is the quotient of two bond yields:
 
$$\text{yield ratio} = \frac{\text{yield on bond A}}{\text{yield on bond B}}$$
- ❑ The factors that affect the yield spread include:
  - the type of issuer, the issuer's perceived credit worthiness
  - the term or maturity of the instrument
  - provisions that grant either the issuer or the investor the option to do something
  - the taxability of the interest received by investors
  - the expected liquidity of the security

9

## Benchmark Spreads (continued)

- ❑ **Types of Issuers**
  - The bond market is classified by the type of issuer, including the U.S. government, U.S. government agencies, municipal governments, credit (domestic and foreign corporations), and foreign governments.
  - These classifications are referred to as *market sectors*.
  - Different sectors can be perceived to signify different risks and rewards.
  - Some market sectors are further subdivided into categories intended to reflect common economic characteristics.
  - For example, within the credit market sector, issuers are classified as follows: industrial, utility, finance, and non-corporate.
  - The spread between the interest rate offered in two sectors of the bond market with the same maturity is called an *intermarket sector spread*.
  - The spread between two issues within a market sector is called an *intramarket sector spread*.

10

## Benchmark Spreads (continued)

### □ Perceived Credit Worthiness of Issuer

- Default risk or credit risk refers to the risk that the issuer of a bond may be unable to make timely principal and/or interest payments.
- Most market participants rely primarily on commercial rating companies to assess the default risk of an issuer.
- The spread between Treasury securities and non-Treasury securities that are identical in all respects except for quality is referred to as a *credit spread*.
- Examples of credit spreads on December 28, 2007, are provided in Exhibit 5-3 (see *Overhead 5-12*).
- The Treasury yields for computing the credit spreads were those shown in Exhibit 5-2 (as was seen in *Overhead 5-8*).
- As can be seen, for a given maturity, the higher the credit rating is, the smaller the credit spread.

11

### Exhibit 5-3

#### Corporate Bond Yields and Risk Premium Measures Relative to Treasury Yields on December 28, 2007

Maturity	Rating	Corporate Yield (%)	Treasury Yield (%)	Yield Spread (bps)
5-year	AAA	4.60	3.49	111
5-year	AA	4.91	3.49	142
10-year	AAA	5.03	4.07	96
10-year	AA	5.32	4.07	125

Note: Yields were reported on *finance.yahoo.com*. The original source is *ValuBond*.

12

## Benchmark Spreads (continued)

### □ Inclusion of Options

- It is not uncommon for a bond issue to include a provision that gives either the bondholder and/or the issuer an option to take some action against the other party.
- The presence of an embedded option has an effect on the spread of an issue relative to a Treasury security and the spread relative to otherwise comparable issues that do not have an embedded option.
- An analytical measure called the *option-adjusted spread (OAS)* is the yield spread after adjusting for the value of the embedded options.
- Absent any embedded options, the lower rated bond would have a higher benchmark spread.

13

## Benchmark Spreads (continued)

### □ Taxability of Interest

- Because of the tax-exempt feature of municipal bonds, the yield on municipal bonds is less than Treasuries with the same maturity. This is seen in Exhibit 5-4 (see *Overhead 5-15*)
- The yield on a taxable bond issue after federal income taxes are paid is called the *after-tax yield*:
 
$$\text{after-tax yield} = \text{pretax yield} \times (1 - \text{marginal tax rate})$$
- Alternatively, we can determine the yield that must be offered on a taxable bond issue to give the same after-tax yield as a tax-exempt issue.
- This yield is called the *equivalent taxable yield* and is:
 
$$\text{equivalent taxable yield} = \text{tax-exempt yield} / (1 - \text{marginal tax rate})$$

14

## Exhibit 5-4

AAA municipal spread and AAA corporate

Maturity	Municipal Yield (%)	Corporate Yield (%)	Yield Ratio
5-year	3.35	4.91	0.68
10-year	3.87	5.03	0.77
20-year	4.59	5.32	0.86

Note: Yields were reported on finance. yahoo. com. The original source is ValuBond.

15

## Benchmark Spreads (continued)

- The municipal bond market is divided into two major sectors: *general obligations* and *revenue bonds*.
- State and local governments may tax interest income on bond issues that are exempt from federal income taxes.
- Some municipalities' exempt interest income from all municipal issues from taxation; others do not.
- Some states exempt interest income from bonds issued by municipalities within the state but tax the interest income from bonds issued by municipalities outside the state.
- Municipalities are not permitted to tax the interest income from securities issued by the U.S. Treasury.
- Thus part of the spread between Treasury securities and taxable non-Treasury securities of the same maturity reflects the value of the exemption from state and local taxes.

16

## Benchmark Spreads (continued)

### □ Expected Liquidity of an Issue

- Bonds trade with different degrees of liquidity.
- Bonds with greater expected liquidity will have lower yields that investors would require.
- Treasury securities are the most liquid securities in the world.
- The lower yield offered on Treasury securities relative to non-Treasury securities reflects the difference in liquidity.
- Even within the Treasury market, on-the-run issues have greater liquidity than off-the-run issues.

17

## Benchmark Spreads (continued)

### □ Financeability of an Issue

- A portfolio manager can use an issue as collateral for borrowing funds so as to create leverage.
- The typical market used by portfolio managers to borrow funds using a security as collateral for a loan is the repurchase agreement (repo) market.
- When a portfolio manager wants to borrow funds via a repo agreement, a dealer provides the funds.
- The interest rate charged by the dealer is called the repo rate.
- There is not one *repo rate* but a structure of rates depending on the maturity of the loan and the specific issue being financed.
- With respect to the latter, there are times when dealers are in need of particular issues to cover a short position.
- When a dealer needs a particular issue, that dealer will be willing to offer to lend funds at a lower repo rate than the general *repo rate* in the market.

18

## Benchmark Spreads (continued)

### ☐ Term To Maturity

- The *term to maturity* is the time remaining on a bond's life.
- The volatility of a bond's price is dependent on its term to maturity.
- All other factors constant, the longer the term to maturity of a bond, the greater the price volatility resulting from a change in market yields.
- Bonds are classified into three *maturity sectors*:
  - *Short-term* bonds have a term to maturity of between 1 to 5 years
  - *Intermediate* bonds have a term to maturity of between 5 and 12 years
  - *Long-term* bonds have a term to maturity greater than 12 years
- The spread between any two maturity sectors of the market is called a *maturity spread*.
- The relationship between the yields on otherwise comparable securities with different maturities is called the *term structure of interest rates*.

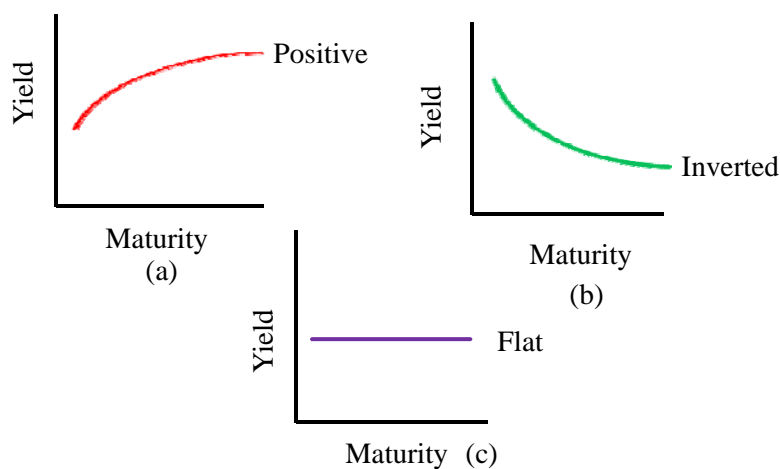
19

## Term Structure of Interest Rates

### ☐ Yield Curve

- The *yield curve* is the graphical depiction of the relation between the yield on bonds of the same credit quality but different maturities.
- Investors have typically constructed yield curves from observations of prices and yields in the Treasury market for two reasons:
  - i. First, Treasury securities are free of default risk, and differences in credit worthiness do not affect yields. Therefore, these instruments are directly comparable.
  - ii. Second, as the largest and most active bond market, the Treasury market offers the fewest problems of illiquidity or infrequent trading. The disadvantage is that the yields may be biased downward because they reflect favorable financing opportunities.
- Exhibit 5-5 (see *Overhead 5-21*) shows three typical shapes for the yield curve.

20

**Exhibit 5-5****Shape of Price-Yield Relationship for an Option-Free Bond**

21

**Term Structure of Interest Rates****□ Why the Yield Curve Should Not Be Used To Price a Bond**

- The bond pricing formula assumes that one interest rate should be used to discount all the bond's cash flows.
- Because of the different cash flow patterns, it is not appropriate to use the same interest rate to discount all cash flows.
- Each cash flow should be discounted at a unique rate appropriate for the time period in which the cash flow will be received.
- The correct way to think about bonds is that they are packages of zero-coupon instruments.
- Each zero-coupon instrument in the package has a maturity equal to its coupon payment date or, in the case of the principal, the maturity date.
- The value of the bond should equal the value of all the component zero-coupon instruments.

22

## Term Structure of Interest Rates

(continued)

### ❑ Why the Yield Curve Should Not Be Used To Price a Bond

- To determine the value of each zero-coupon instrument, it is necessary to know the yield on a zero-coupon Treasury with that same maturity.
- This yield is called the *spot rate*, and the graphical depiction of the relationship between the spot rate and maturity is called the *spot rate curve*.
- Because there are no zero-coupon Treasury debt issues with a maturity greater than one year, it is not possible to construct such a curve solely from observations of market activity on Treasury securities.
- Rather, it is necessary to derive this curve from theoretical considerations as applied to the yields of the actually traded Treasury debt securities.
- Such a curve is called a *theoretical spot rate curve* and is the graphical depiction of the *term structure of interest rate*.

23

## Term Structure of Interest Rates

(continued)

### ❑ Constructing the Theoretical Spot Rate Curve for Treasuries Bond

- A default-free theoretical spot rate curve can be constructed from the yield on Treasury securities.
- The Treasury issues that are candidates for inclusion are
  - i. on-the-run Treasury issues
  - ii. on-the-run Treasury issues and selected off-the-run Treasury issues
  - iii. all Treasury coupon securities, and bills
  - iv. Treasury coupon strips
- After the securities that are to be included in the construction of the theoretical spot rate curve are selected, the methodology for constructing the curve must be determined.
- If the on-the-run Treasury issues with or without selected off-the-run Treasury issues are used, a methodology called *bootstrapping* is used.

24

## Term Structure of Interest Rates

(continued)

### □ On-the-Run Treasury Issues

- The *on-the-run Treasury issues* are the most recently auctioned issue of a given maturity.
- These issues include 3-month, 6-month, and 1-year Treasury bills; 2-year, 5-year, and 10-year Treasury notes; and 30-year Treasury bond.
- Treasury bills are zero-coupon instruments; the notes and the bond are coupon securities.
- There is an observed yield for each of the on-the-run issues.
- For the coupon issues, these yields are not the yields used in the analysis when the issue is not trading at par.
- Instead, for each on-the-run coupon issue, the estimated yield necessary to make the issue trade at par is used.
- The resulting on-the-run yield curve is called the *par coupon curve*.

25

## Term Structure of Interest Rates (continued)

### □ On-the-Run Treasury Issues

- The goal is to construct a theoretical spot rate curve with 60 semiannual spot rates: 6 month rate to 30-year rate.
- Excluding the three-month bill, there are only six maturity points available when only on-the-run issues are used.
- The 54 missing maturity points are extrapolated from the surrounding maturity points on the par yield curve.
- The simplest interpolation method, and the one most commonly used, is linear extrapolation.
- Specifically, given the yield on the par coupon curve at two maturity points, the following is calculated:

$$\frac{\text{yield at higher maturity} - \text{yield at lower maturity}}{\text{number of semiannual periods between the two maturity points} + 1}$$

- The yield for all intermediate semiannual maturity points is found by adding to the yield at the lower maturity the amount computed here.

26

## Term Structure of Interest Rates

### ❑ On-the-Run Treasury Issues

- There are two problems with using just the on-the-run issues.
  - i. First, there is a large gap between some of the maturities points, which may result in misleading yields for those maturity points when estimated using the linear interpolation method.
    - Specifically, the concern is with the large gap between the five-year and 10-year maturity points and the 10-year and 30-year maturity points.
  - i. The second problem is that the yields for the on-the-run issues themselves may be misleading because most offer the favorable financing opportunity in the repo market mentioned earlier.
    - This means that the true yield is greater than the quoted (observed) yield.

27

## Term Structure of Interest Rates

### ❑ On-the-Run Treasury Issues

- As shown in Exhibit 5-6 (*see Overhead 5-29*), we can convert the par yield curve into the theoretical spot rate curve using bootstrapping.
- To explain the process of estimating the theoretical spot rate curve from observed yields on Treasury securities, we consider
  - i. a six-month Treasury bill where its annualized yield is the six-month spot rate and
  - ii. a one-year Treasury where its annualized yield is the one year spot rate.
- Given these two spot rates, we can compute the spot rate for a theoretical 1.5-year zero-coupon Treasury.
- Given the theoretical 1.5-year spot rate, we can obtain the theoretical 2-year spot rate and so forth until we derive theoretical spot rates for the remaining 15 half-yearly rates.
- The spot rates using this process represent the term structure of interest rates and can be viewed in Exhibit 5-7 (*see Overhead 5-30*).

28

**Exhibit 5-6 Maturity and Yield to Maturity for 20 Hypothetical Treasury Securities**

Period	Years	Yield to Maturity/Coupon Rate (%)
1	0.5	5.25
2	1.0	5.50
3	1.5	5.75
4	2.0	6.00
5	2.5	6.25
6	3.0	6.50
7	3.5	6.75
8	4.0	6.80
9	4.5	7.00
10	5.0	7.10
11	5.5	7.15
12	6.0	7.20
13	6.5	7.30
14	7.0	7.35
15	7.5	7.40
16	8.0	7.50
17	8.5	7.60
18	9.0	7.60
19	9.5	7.70
20	10.0	7.80

29

**Exhibit 5-7 Theoretical Spot Rates**

Period	Years	Yield to Maturity/Coupon Rate (%)
1	0.5	5.25
2	1.0	5.50
3	1.5	5.76
4	2.0	6.02
5	2.5	6.28
6	3.0	6.55
7	3.5	6.82
8	4.0	6.87
9	4.5	7.09
10	5.0	7.20
11	5.5	7.26
12	6.0	7.31
13	6.5	7.43
14	7.0	7.48
15	7.5	7.54
16	8.0	7.67
17	8.5	7.80
18	9.0	7.79
19	9.5	7.93
20	10.0	8.07

30

## Term Structure of Interest Rates

### ❑ On-the-Run Treasury Issue and Selected Off-the-Run Treasury Issues

- One of the problems with using just the on-the-run issues is the large gaps between maturities, particularly after five years.
- To mitigate this problem, some dealers and vendors use selected off-the-run Treasury issues.

### ❑ All Treasury Coupon Securities and Bills

- Using only on-the-run issues, even when extended to include a few off-the-run issues, fails to recognize the information embodied in Treasury prices that are not included in the analysis.
- Thus, it is argued that it is more appropriate to use all Treasury coupon securities and bills to construct the theoretical spot rate curve.

31

## Term Structure of Interest Rates

### ❑ Treasury Coupon Strips

- Treasury coupon strips are zero-coupon Treasury securities.
- It would seem logical that the observed yield on strips could be used to construct an actual spot rate curve.
- There are three problems with using the observed rates on strips.
- First, the liquidity of the strips market is not as great as that of the Treasury coupon market.
- Second, the tax treatment of strips is different from that of Treasury coupon securities.
- Finally, there are maturity sectors in which non-U.S. investors find it advantageous to trade off yield for tax advantages associated with a strip.

32

## Term Structure of Interest Rates

- ❑ **Using the Theoretical Spot Rate Curve**
  - Exhibit 5-8 (*see Overhead 5-34*) shows how to value a Treasury bond properly using the theoretical spot rates.
  - The bond in the illustration is a hypothetical 10-year Treasury security with a coupon rate of 10%.
  - Arbitrage forces a Treasury to be priced based on spot rates and not the yield curve.
  - The ability of dealers to purchase securities and create value by stripping forces Treasury securities to be priced based on the theoretical spot rates.

33

### Exhibit 5-8 Theoretical Spot Rates

Period	Year	Cash Flow	Spot Rate (%)	PV of \$1 at Spot Rate	PV of Cash Flow
1	0.5	5	5.25	0.974421	4.872107
2	1.0	5	5.50	0.947188	4.735942
3	1.5	5	5.76	0.918351	4.591756
4	2.0	5	6.02	0.888156	4.440782
5	2.5	5	6.28	0.856724	4.283619
6	3.0	5	6.55	0.824206	4.121030
7	3.5	5	6.82	0.790757	3.953783
8	4.0	5	6.87	0.763256	3.816280
9	4.5	5	7.09	0.730718	3.653589
10	5.0	5	7.20	0.701952	3.509758
11	5.5	5	7.26	0.675697	3.378483
12	6.0	5	7.31	0.650028	3.250138
13	6.5	5	7.43	0.622448	3.112238
14	7.0	5	7.48	0.597889	2.989446
15	7.5	5	7.54	0.573919	2.869594
16	8.0	5	7.67	0.547625	2.738125
17	8.5	5	7.80	0.521766	2.608831
18	9.0	5	7.79	0.502665	2.513325
19	9.5	5	7.93	0.477729	2.388643
20	10.0	105	8.07	0.453268	47.593170
Theoretical Value = 115.4206					

34

## Term Structure of Interest Rates

### □ Forward Rates

- From the yield curve we can extrapolate the theoretical spot rates. In addition, we can extrapolate the market's consensus of future interest rates.
- To see the importance of knowing the market's consensus for future interest rates, consider the following two investment alternatives for an investor who has a one-year investment horizon.

*Alternative 1: Buy a one-year instrument.*

*Alternative 2: Buy a six-month instrument and when it matures in six months, buy another six-month instrument.*

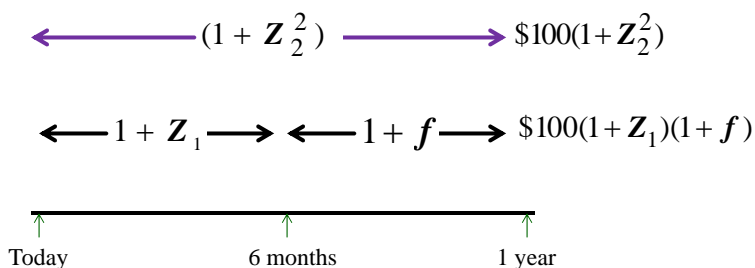
- With *alternative 1*, the investor will realize the one-year spot rate and that rate is known with certainty but with *alternative 2*, the investor will realize the 6-month spot rate, but the 6-month rate 6 months from now is unknown.
- Therefore, for *alternative 2*, the rate that will be earned over one year is not known with certainty. This is illustrated in Exhibit 5-9 (*see Overhead 5-36*)

35

## EXHIBIT 5-9

### Two Alternative One-Year Investments

Total Dollars at End of One  
Year per \$100 Investment



36

## Term Structure of Interest Rates

### ❑ Relationship Between Six-Month Forward Rates and Spot Rates

- In general, the relationship between a  $t$ -period spot rate ( $z_t$ ), the current six-month spot rate ( $z_1$ ), and the six month forward rates is

$$z_t = [(1 + z_1) (1 + f_1) (1 + f_2) \cdots (1 + f_{t-1})]^{1/t} - 1$$

where  $f_t$  is the six-month forward rate beginning  $t$  six-month periods from now.

### ❑ Other Forward Rates

- It is not necessary to limit ourselves to six-month forward rates.
- The spot rates can be used to calculate the forward rate for any time in the future for any investment horizon.

37

## Term Structure of Interest Rates

### ❑ Forward Rate as a Hedgeable Rate

- A natural question about forward rates is how well they do at predicting future interest rates.
- The forward rate may never be realized but is important in what it tells investors about his expectation relative to what the market consensus expects.
- Some market participants prefer not to talk about forward rates as being market consensus rates but refer to forward rates as being *hedgeable rates*.
- For example, by buying the one-year security, the investor can *hedge* the six-month rate six months from now.

38

## Term Structure of Interest Rates

### □ Determinants of the Shape of the Term Structure

- If we plot the term structure – the yield to maturity, or the spot rate, at successive maturities against maturity – what is it likely to look like?
- Exhibit 5-5 (as was *seen in Overhead 5-21*) showed three generic shapes that have appeared for the U.S. Treasury yield curve with some frequency over time.
- Exhibit 5-10 (*see Overhead 5-40*) shows five selective daily Treasury yield curves in tabular form.
- Two major theories have evolved to account for these observed shapes of the yield curve: *expectations theories* and *market segmentation theory*.

39

### Exhibit 5-10 U.S. Treasury Yield Curve for Five Selective Dates

Day	3 mos	6 mos	1 yr	2 yrs	3 yrs	Shape
4/23/2001	3.75	3.78	3.75	3.77	4.15	Normal
4/10/1992	3.74	3.88	4.12	5.16	5.72	Steep
8/14/1981	N/A	N/A	16.71	16.91	15.88	Inverted
1/3/1990	7.89	7.94	7.85	7.94	7.96	Flat
1/4/2001	5.37	5.20	4.82	4.77	4.78	Humped
Day	3 mos	6 mos	1 yr	2 yrs	3 yrs	Shape
4/23/2001	4.38	4.78	5.06	5.84	5.73	Normal
4/10/1992	6.62	7.03	7.37	N/A	7.89	Steep
8/14/1981	15.34	15.04	NA	14.74	13.95	Inverted
1/3/1990	7.92	8.04	7.99	N/A	8.04	Flat
1/4/2001	4.82	5.07	5.03	5.56	5.44	Humped

40

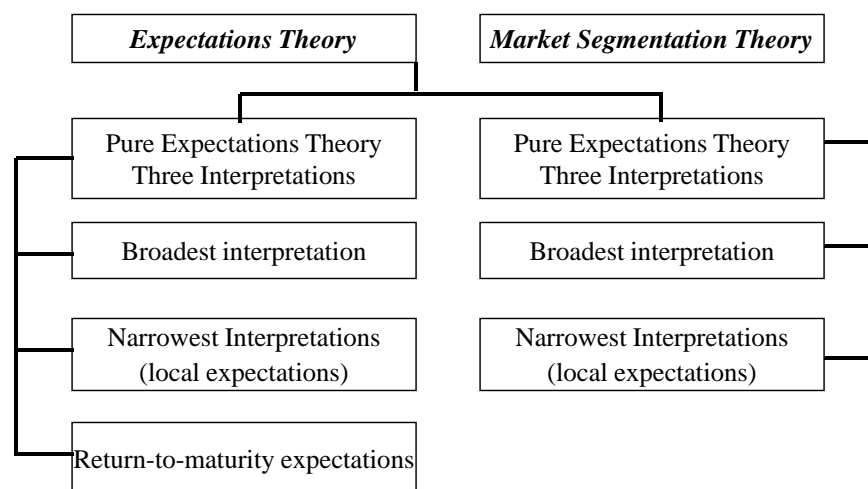
## Term Structure of Interest Rates

### □ Determinants of the Shape of the Term Structure

- There are several forms of the *expectations theory*: *pure expectations theory*, *liquidity theory*, and *preferred habitat theory*.
- Expectations theories share a hypothesis about the behavior of short-term forward rates and also assume that the forward rates in current long-term bonds are closely related to the market's expectations about future short-term rates.
- These three theories differ, however, as to whether other factors also affect forward rates, and how.
- The *pure expectations theory* postulates that no systematic factors other than expected future short-term rates affect forward rates; the *liquidity theory* and the *preferred habitat theory* assert that there are other factors.
- Accordingly, the last two forms of the expectations theory are sometimes referred to as *biased expectations theories*.
- Exhibit 5-11 (*see Overhead 5-42*) depicts the relationships among these three theories.

41

## Exhibit 5-11 Term Structure Theories



42

## Term Structure of Interest Rates

### ❑ Pure Expectations Theory

- According to the *pure expectations theory*, the forward rates exclusively represent the expected future rates.
- Thus, the entire term structure at a given time reflects the market's current expectations of the family of future short-term rates.

### ❑ Liquidity Theory

- The *liquidity theory of the term structure* says that the implied forward rates will *not* be an unbiased estimate of the market's expectations of future interest rates because they embody a liquidity premium.
- While an upward-sloping yield curve *may reflect* expectations about future interest rates, it is a liquidity premium increasing with maturity that can explain why the yield curve slopes upward.

43

## Term Structure of Interest Rates

### ❑ Preferred Habitat Theory

- The *preferred habitat theory* also adopts the view that the term structure reflects the expectation of the future path of interest rates as well as a risk premium.
- the *preferred habitat theory* rejects the assertion that the risk premium must rise uniformly with maturity.

### ❑ Market Segmentation Theory

- The *market segmentation theory* also recognizes that investors have preferred habitats dictated by the nature of their liabilities.
- However, the *market segmentation theory* differs from the *preferred habitat theory* in that it assumes that neither investors nor borrowers are willing to shift from one maturity sector to another to take advantage of opportunities arising from differences between expectations and forward rates.

44

## Term Structure of Interest Rates

### □ The Main Influences of the Shape of the Yield Curve

- Empirical evidence suggests that the three main influences on the shape of the Treasury yield curve are:
  - i. the market's expectations of future rate changes
  - ii. bond risk premiums
  - iii. convexity bias.
- The convexity bias influence is the least well known of the three influences.
- The longer the maturity, the more convexity the security has.
- That is, longer-term Treasury securities have a more attractive feature due to convexity than shorter-term Treasury securities.
- As a result, investors are willing to pay more for longer-term Treasury securities and therefore accept lower returns.
- This influence on the shape of the Treasury yield curve is what is referred to as the convexity bias.

45