

# Understanding Interest Rates

## Mishkin, Chapter 4:Part B (pp. 80-89)

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Last Revised: 21 February 2011

# Mishkin Chapter 4: Part B (pp. 80-89)

## Key In-Class Discussion Questions & Issues

- ★ Reading bond pages in financial news outlets
- ★ “Interest rate” versus “return rate”
- ★ “Nominal rate” vs. “real rate”
- ★ What is “interest rate risk”? Whose risk is it?

# Reading Bond Pages

- We will take a look at a typical bond page appearing in financial section of a newspaper
- These bond pages cover
  - U.S. Treasury (“government”) bonds and notes
  - U.S. Treasury bills
  - Corporate bonds

# Example of a Bond Page of a Newspaper

Wall Street Journal,  
Jan 12, 2006

## (a) Treasury bonds and notes

GOVT. BONDS & NOTES						
	Rate	Maturity Mo/Yr	Bid	Asked	Chg.	Ask Yld.
T-bond 1	1.875	Jan 06n	99:28	99:29	1	3.76
	5.625	Feb 06n	100:03	100:04	...	3.96
	9.375	Feb 06	100:14	100:15	...	3.98
	1.625	Feb 06n	99:21	99:22	...	4.07
	1.500	Mar 06n	99:12	99:13	...	4.24
	2.250	Apr 06n	99:11	99:12	...	4.32
	2.000	May 06n	99:06	99:07	1	4.34
	4.625	May 06n	100:01	100:02	...	4.36

## (b) Treasury bills

TREASURY BILLS												
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	Feb 16 06	34	4.05	4.04	-0.02	4.11	May 18 06	125	4.23	4.22	...	4.34
	Feb 23 06	41	4.06	4.05	-0.02	4.13	May 25 06	132	4.23	4.22	-0.01	4.35
	Mar 02 06	48	4.12	4.11	0.01	4.19	Jun 01 06	139	4.24	4.23	...	4.36
	Mar 09 06	55	4.13	4.12	0.01	4.20	Jun 08 06	146	4.25	4.24	...	4.37
	Mar 16 06	62	4.11	4.10	-0.01	4.19	Jun 15 06	153	4.25	4.24	-0.01	4.38
	Mar 23 06	69	4.17	4.16	0.01	4.25	Jun 22 06	160	4.24	4.23	-0.02	4.37
	Mar 30 06	76	4.19	4.18	0.02	4.28	Jun 29 06	167	4.26	4.25	...	4.40
	Apr 06 06	83	4.20	4.19	0.02	4.29	Jul 06 06	174	4.26	4.25	...	4.40
	Apr 13 06	90	4.21	4.20	0.01	4.30	Jul 13 06	181	4.28	4.27	-0.01	4.42

Source: Wall Street Journal, Thursday, January 13, 2006.

## (c) New York Stock Exchange bonds

### CORPORATE BONDS

Thursday, January 12, 2006

Forty most active fixed-coupon corporate bonds

Company (TICKER)	Coupon	Maturity	Last Price	Last Yield	*Est Spread	Ust†	Est \$ Vol (000's)
Tyco International Group (TYC)	6.000	Nov 15, 2013	103.104	5.505	110	10	143,116
HSBC Finance Corp (HSBC)	5.250	Jan 14, 2011	100.169	5.211	83	5	101,312
Wells Fargo (WFC)	4.875	Jan 12, 2011	99.851	4.909	54	5	94,719
Bank of America Corp (BAC)	4.875	Sep 15, 2012	99.217	5.014	57	5	93,623
Verizon New York Inc (VZ)	7.000	Dec 01, 2033	97.625	7.198	261	30	85,530

Volume represents total volume for each issue; price/yield data are for trades of \$1 million and greater. \*Estimated spreads, in basis points (100 basis points is one percentage point), over the 2, 3, 5, 10, or 30-year hot run Treasury note/bond. 2-year: 4.375 12/07; 3-year: 4.375 11/08; 5-year: 4.375 12/10; 10-year: 4.500 11/15; 30-year: 5.375 02/31. †Comparable U.S. Treasury issue.

Source: MarketAxess Corporate BondTicker

# Types of U.S. Government Bonds

## ◆ Treasury Bills

- ◆ **(Zero-coupon) discount bonds**
- ◆ Face value paid at maturity
- ◆ Maturities **up to one year**

## ◆ Treasury Notes

- ◆ **Coupon bonds**
- ◆ Coupon payments paid semiannually
- ◆ Face value paid at maturity
- ◆ Maturities **from 1 to 10 years**

## U.S. Government Bonds...Continued

### ◆ **Treasury Bonds**

#### ◆ **Coupon bonds**

- ◆ Coupon payments paid semiannually
- ◆ Face value paid at maturity
- ◆ Maturities **over 10 years**
- ◆ The 30-year bond is called the **long bond**.

### ◆ **Treasury Strips**

- ◆ **Collection of (zero-coupon) discount bonds**
- ◆ Created by separately “stripping” the coupons and face value from a Treasury bond or note.

## U.S. Government Bonds ... Continued

- Low default risk. Considered to be **risk-free**.
- Interest exempt from state and local taxes.
- Initial issues sold in Treasury auctions (primary market)
- Thereafter regularly traded (resold) in an OTC market (secondary market).

# Corporate Bonds

- **Corporate Coupon Bonds**
  - Secured by real property
  - Ownership of the property reverts to the bondholders upon default.
- IPOs handled by investment banks
- Thereafter regularly traded in secondary markets (generally OTC)
- A few corporations with exceptionally strong credit ratings list their bonds on stock market exchanges such as the NYSE



# Reading Bond Pages: Prelim Definitions

- **Current Yield** on a given coupon bond (C,F,N):

$$i_c = C/P, \quad P = \text{Bond market price}$$

- Given (C,F,N), how well does  $i_c$  approximate YTM?
  - The longer the maturity N (i.e., more like a consol), the more closely the current yield  $i_c$  approximates the YTM. (For consol bond,  $YTM=C/P = i_c$ )
  - The closer P is to face value F, the better the current yield  $i_c$  approximates YTM. (  $P=F$  implies  $C/F=C/P=YTM$  )
  - The current yield  $i_c$  and the YTM both move inversely to changes in P.

- **Discount Yield** on a Discount Bond (F,N):

$$i_{db} = [F - P_d]/F * 360/N$$

where

$P_d$  = Bond market price

N = Days To Maturity

- Discount yield  $i_{db}$  often quoted instead of YTM on discount bonds (long-time tradition)
- Discount yield  $i_{db}$  moves inversely to  $P_d$

# Basis Point

- Basis point – 1/100 of 1% (0.01 %)
- *Example:* Increase from 5.42% to 5.52% is an increase of 10 basis points (10/100)

# Example of a Bond Page of a Newspaper

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Source: Wall Street Journal, Thursday, January 13, 2006.

## (c) New York Stock Exchange bonds

### CORPORATE BONDS

Thursday, January 12, 2006

Forty most active fixed-coupon corporate bonds

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Volume represents total volume for each issue; price/yield data are for trades of \$1 million and greater. \*Estimated spreads, in basis points (100 basis points is one percentage point), over the 2, 3, 5, 10, or 30-year hot run Treasury note/bond. 2-year: 4.375 12/07; 3-year: 4.375 11/08; 5-year: 4.375 12/10; 10-year: 4.500 11/15; 30-year: 5.375 02/31. †Comparable U.S. Treasury issue.

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Quoted as % per \$100 of face value with fractions in 32s

YTM using asked price as CV

Coupon Rate = C/F

(b) Treasury bills

Discount Yields

TREASURY BILLS

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Source: Wall Street Journal, Thursday, January 13, 2006.

(c) New York Stock Exchange bonds

CORPORATE BONDS

Price in % per \$100 face value  
Current yield C/P

Thursday, January 12, 2006  
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Source: MarketAxess Corporate BondTicker

Traded vol measured in \$1000 face value

# Is an “interest rate” all that is needed to evaluate a financial asset?

- *EXAMPLE:*

- The forecasted average YTM on a 5-Year U.S. Treasury note maturing on 1/31/2016 is 2.20%  
(Bloomberg, 2/21/2011)
- From the Google website (9/20/2010): “We have never declared or paid a cash dividend nor do we expect to pay any dividends in the foreseeable future.”
- Does this mean that a 5-year U.S. Treasury note is **definitely** a better buy than a Google stock share?

# Risk and Return Considerations

- ◆ In addition to the interest rate -- an **intrinsic** rate of return based only on the contracted payment stream and purchase price -- smart investors also care about:
  - ◆ **Default risk**
  - ◆ **Return rate:** A measure taking into account purchase price AND sale price (“capital gains and losses”) as well as payment stream.
  - ◆ **Interest rate risk**

# Bond Ratings (Default Risk)

Moody's	S&P	Quality of Issue
Aaa	AAA	Highest quality. Very small risk of default.
Aa	AA	High quality. Small risk of default.
A	A	High-Medium quality. Strong attributes, but potentially vulnerable.
Baa	BBB	Medium quality. Currently adequate, but potentially unreliable.
Ba	BB	Some speculative element. Long-run prospects questionable.
B	B	Able to pay currently, but at risk of default in the future.
Caa	CCC	Poor quality. Clear danger of default .
Ca	CC	High specullative quality. May be in default.
C	C	Lowest rated. Poor prospects of repayment.
D	-	In default.

**Junk  
Bonds**  
↓



**Table 1 Bond Ratings by Moody's and Standard and Poor's**

Rating		Descriptions	Examples of Corporations with Bonds Outstanding in 2003
Moody's	Standard and Poor's		
Aaa	AAA	Highest quality (lowest default risk)	General Electric, Pfizer Inc., North Carolina State, Mobil Oil
Aa	AA	High quality	Wal-Mart, McDonald's, Credit Suisse First Boston
A	A	Upper medium grade	Hewlett-Packard, Anheuser-Busch, Ford, Household Finance
Baa	BBB	Medium grade	Motorola, Albertson's, Pennzoil, Weyerhaeuser Co., Tommy Hilfiger
Ba	BB	Lower medium grade	Royal Caribbean, Levi Strauss
B	B	Speculative	Rite Aid, Northwest Airlines Inc., Six Flags
Caa	CCC, CC	Poor (high default risk)	Revlon, United Airlines
Ca	C	Highly speculative	US Airways, Polaroid
C	D	Lowest grade	Enron, Oakwood Homes

# Interest Rates vs. Return Rates

- ◆ The **return rate**  $RET_{t,t+1}$  on an asset A held from time t to time t+1 is defined to be
  - the **SUM** of all payments (rents, coupon payments, dividends,..) earned by A from t to t+1
  - **PLUS** the capital gain (+) or loss (-) in the market value of A from t to t+1 (i.e., its value at time t+1 minus its value at time t)
  - **DIVIDED** by the market value of A at time t

**Example:** Return Rate on an N-Year Coupon Bond  
from Year  $t$  to Year  $t+1$  with  $1 \leq t+1 < N$

$$RET_{t,t+1} = \frac{C + P_{t+1} - P_t}{P_t} = i_c + g$$

where:  $i_c = \frac{C}{P_t} = \text{current yield}$

$$g = \frac{P_{t+1} - P_t}{P_t} = \text{capital gain (+) or loss (-)}$$

# Interest Rate Risk

- **KEY QUESTIONS:**

Suppose the YTM of a bond suddenly *increases*, (equivalently, the bond market price *decreases*).

- Who gains and who loses when this occurs?
- In particular, are people **who already own the bond** better or worse off? Why?
- Are people **who are planning to buy the bond** better or worse off? Why?

# Interest Rate Risk...Continued

- When YTM *increases* (i.e., bond price *decreases*)
  - those who *already own* the bond are *worse off* .
  - Why? If they should decide to sell the bond, their capital gain would be lower (or their capital loss larger) due to the lower bond sale price.
- **Interest rate risk:**
  - The uncertainty regarding possible adverse changes in return rate *faced by bond-holders* due to possible increases in the YTM (equivalently, decreases in the bond price) during the holding period.

# Interest Rate Risk: Example (Mishkin, p. 81)

Note on Table 2: When Price = Face = \$1000,  
then Current Yield  $I_c = YTM = 10\%$

**Table 2 One-Year Returns on Different-Maturity 10%-Coupon-Rate Bonds When Interest Rates Rise from 10% to 20% at beginning of year 2**

(1) Years to Maturity When Bond Is Purchased	(2) Initial Current Yield (%)	(3) Initial Price (\$)	(4) Price at beg. of yr. 2* (\$)	(5) <sup>+</sup> Rate of Capital Gain (%)	(6) Rate of Return (2 + 5) (%)
30	10	1,000	503	-49.7	-39.7
20	10	1,000	516	-48.4	-38.4
10	10	1,000	597	-40.3	-30.3
5	10	1,000	741	-25.9	-15.9
2	10	1,000	917	-8.3	+1.7
1	10	1,000	1,000	0.0	+10.0

\*Calculated using Equation 3.  
Mish 4, p. 75

<sup>+</sup>  $[(4) - (3)] / (3) =$  Cap gain calculated from  
beginning of year 1 to beginning of year 2

# Key Findings from Table 2

- 1) The only bond whose return rate equals its initial YTM is the 1-year bond whose maturity equals its holding period (not affected by rise in YTM at beg of year 2).
- 2) For bonds with maturity  $>$  holding period,  $\text{YTM} \uparrow$  ( $P \downarrow$ ) implies a capital loss ( $\text{RET} \downarrow$ ) from Year 1 to Year 2.
- 3) The longer the maturity, the **larger** the drop in price when the YTM increases from 10% to 20%, hence the larger the capital loss (drop in RET) from Year 1 to 2.
- 4) A person who buys a bond with a high initial YTM (low P) can still earn a **negative** return rate for the year if  $\text{YTM} \uparrow$  **\*\*AFTER\*\*** he/she purchases the bond.

# Distinction Between Real and Nominal Interest Rates

## ◆ (Ex Ante) Real Interest Rate:

Interest rate that is adjusted for expected changes in the price level as measured by the expected inflation rate:

$$i_r = i - \pi^e$$

1. The *real interest rate*  $i_r$  more accurately reflects the true cost of borrowing in terms of lost purchasing power.
2. When the real interest rate  $i_r$  is low, there is greater incentive to borrow (lower payments made) and less incentive to lend (lower payments received).



# Real vs. Nominal Interest Rates: Examples

**CASE 1:** If  $i = 5\%$  and  $\pi^e = 3\%$ , then:

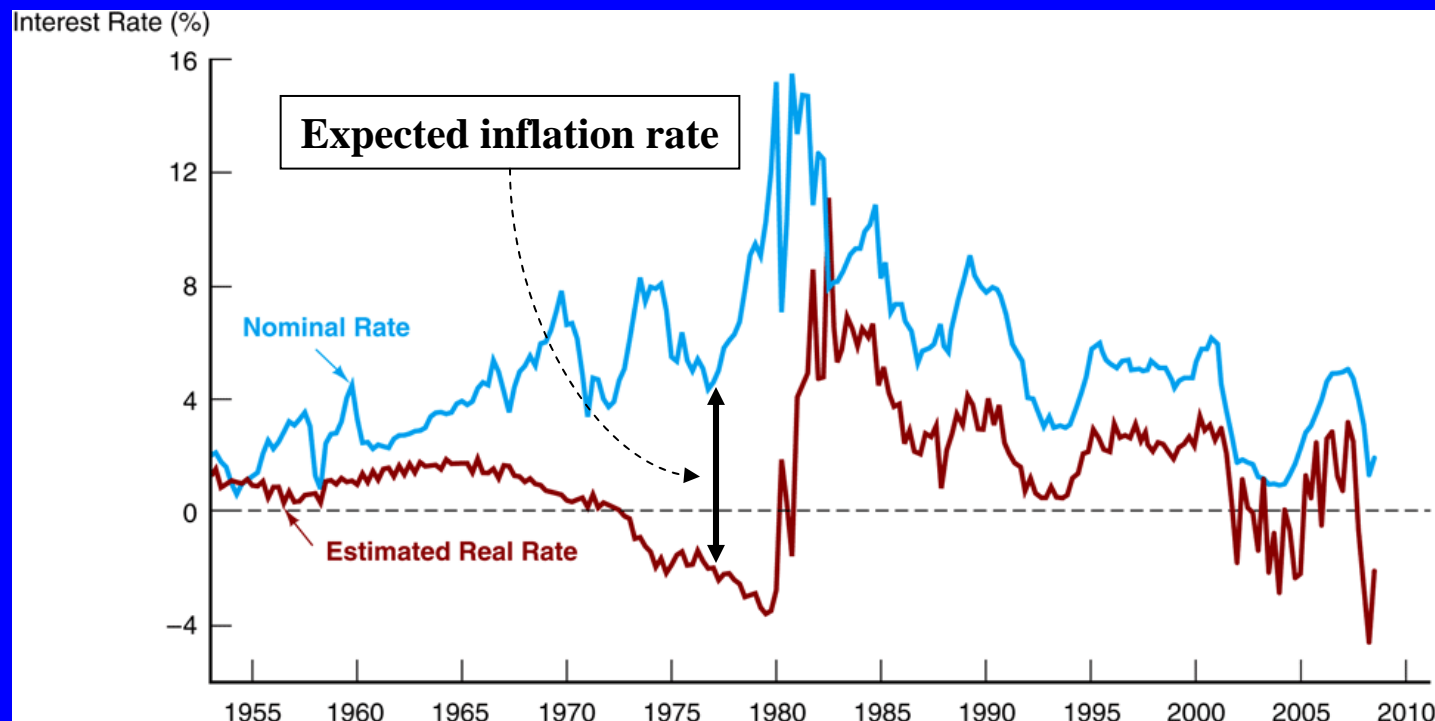
$$i_r = [5\% - 3\%] = 2\%$$

**CASE 2:** If  $i = 8\%$  and  $\pi^e = 10\%$ , then

$$i_r = [8\% - 10\%] = -2\%$$

**Would-be borrowers are happier under CASE 2 than under CASE 1!**

## FIGURE 1 (Mishkin, p. 86): U.S. Nominal and Estimated Real Interest Rates (3-Month Treasury Bill), 1953–2008



Sources: Nominal rates from [www.federalreserve.gov/releases/H15](http://www.federalreserve.gov/releases/H15). The real rate is constructed using the procedure outlined in Frederic S. Mishkin, "The Real Interest Rate: An Empirical Investigation," *Carnegie-Rochester Conference Series on Public Policy* 15 (1981): 151–200. This procedure involves estimating expected inflation as a function of past interest rates, inflation, and time trends and then subtracting the expected inflation measure from the nominal interest rate.

## Real vs. Nominal Interest Rates in the Real World

- Nominal interest rates are the interest rates typically observed in financial markets.
- Real interest rates are not normally observed.
- However, since 1997 the U.S. Treasury has issued *Treasury Inflation Protected Securities (TIPS)*, a coupon bond with payments indexed to the inflation rate. (See Mishkin, Chapter 4, p. 87)
- The difference between the YTM  $i$  for a regular N-year Treasury bond and the YTM  $i_r$  for an N-year TIPS yields a measure of the expected inflation rate:

$$i - i_r = \Pi^e$$