

# Credit Instruments

## Four Types of Credit Instruments

1. Simple loan
  2. Fixed-payment loan
  3. Coupon bond
  4. Discount (zero coupon) bond
- We want to understand what these are and how to compute the *interest rate* or *yield to maturity* for each of these.

# Present Value

## **PV in terms of a Simple Loan**

### Simple Loan

- Person A loans an amount of money called the *principal* to person B for a defined period of time known as the *maturity date*.
- On the maturity date person B pays person A back the principal along with additional payment for the interest.

Suppose additional payment on a one-year, \$100 loan is \$10.

Then implied rate of interest is

$$\frac{\$10}{\$100} = .10 = 10 \%$$

# Present Value

So, using the simple interest rate, a one-year \$100 loan at 10% yields

$$\$100*(1 + 0.1) = \$110$$

A two-year \$100 loan at 10% yields

$$\$100*(1 + 0.1)(1 + 0.1) = \$121 \text{ etc...}$$

After  $n$  years, \$100 loaned at interest rate  $i$  would turn into

$$\$100*(1 + i)^n$$

# Present Value

Year	1	2	3	n
FV	\$110	\$121	\$133	$\$100 \cdot (1 + 0.1)^n$

What is the value today of \$133 in three years?

$$PV = \frac{\$133}{(1 + 0.1)^3} = \$100$$

$$PV \text{ of } \$x \text{ in } n \text{ years} = \frac{\$x}{(1 + i)^n}$$

# Yield to Maturity: Loans

**Yield to maturity** = interest rate that equates today's value with present value of all future payments.

1. Simple Loan (\$100 principal, 1 year maturity, \$10 interest payment)

$$\$100 = \$110/(1 + i) \Rightarrow$$

$$i = \frac{\$110 - \$100}{\$100} = \frac{\$10}{\$100} = 0.10 = 10\%$$

2. Fixed Payment Loan ( $LV=\$1000$ ,  $FP=\$126$ . Years to maturity ( $n$ ) =25)

$$\$1000 = \frac{\$126}{(1+i)} + \frac{\$126}{(1+i)^2} + \frac{\$126}{(1+i)^3} + \dots + \frac{\$126}{(1+i)^{25}} \Rightarrow i = .12$$

$$LV = \frac{FP}{(1+i)} + \frac{FP}{(1+i)^2} + \frac{FP}{(1+i)^3} + \dots + \frac{FP}{(1+i)^n}$$

# Yield to Maturity: Bonds

3. Coupon Bond (Price =  $P$ , Face value ( $F$ ) = \$1000, Coupon payment ( $C$ ) = \$100, years to maturity ( $n$ ) = 10)

$$P = \frac{\$100}{(1+i)} + \frac{\$100}{(1+i)^2} + \frac{\$100}{(1+i)^3} + \dots + \frac{\$100}{(1+i)^{10}} + \frac{\$1000}{(1+i)^{10}}$$

$$P = \frac{C}{(1+i)} + \frac{C}{(1+i)^2} + \frac{C}{(1+i)^3} + \dots + \frac{C}{(1+i)^n} + \frac{F}{(1+i)^n}$$

Consol: Fixed coupon payments of  $\$C$  forever

$$P = \frac{C}{i} \quad i = \frac{C}{P}$$

4. Discount Bond or Zero-Coupon Bond ( $P = \$900$ ,  $F = \$1000$ ), one year

$$\$900 = \frac{\$1000}{(1+i)} \quad \Rightarrow$$

$$i = \frac{\$1000 - \$900}{\$900} = 0.111 = 11.1\%$$

$$i = \frac{F - P}{P}$$

# Relationship Between Price and Yield to Maturity

**Table 1 Yields to Maturity on a 10%-Coupon-Rate Bond Maturing in Ten Years (Face Value = \$1,000)**

Price of Bond (\$)	Yield to Maturity (%)
1,200	7.13
1,100	8.48
1,000	10.00
900	11.75
800	13.81

### Three Interesting Facts in Table 1

1. When bond is at par, yield equals coupon rate
2. Price and yield are negatively related
3. Yield greater than coupon rate when bond price is below par value

# Other Measures of Interest Rates

Current yield:  $i_c = \frac{C}{P}$

## Two Characteristics

1. Is better approximation to yield to maturity, nearer price is to par and longer is maturity of bond
2. Change in current yield *always* signals change in same direction as yield to maturity

## Yield on a Discount Basis

$$i_{db} = \frac{(F - P)}{F} \times \frac{360}{(\text{number of days to maturity})}$$

One year bill,  $P = \$900$ ,  $F = \$1000$

$$i_{db} = \frac{\$1000 - \$900}{\$1000} \times \frac{360}{365} = 0.099 = 9.9\%$$

## Two Characteristics

1. Understates yield to maturity; longer the maturity, greater is understatement
2. Change in discount yield *always* signals change in same direction as yield to maturity

# Bond Page of the Newspaper

## TREASURY BONDS, NOTES AND BILLS

January 22, 2003

Representative Over-the-Counter quotation based on transactions of \$1 million or more.

Treasury bond, note and bill quotes are as of mid-afternoon. Colons in bid-and-asked quotes represent 32nds; 101:01 means 101 1/32. Net changes in 32nds. n-Treasury note. Inflation-Indexed issue. Treasury bill quotes in hundredths, quoted on terms of a rate of discount. Days to maturity calculated from settlement date. All yields are to maturity and based on the asked quote. Latest 13-week and 26-week bills are bold-faced. For bonds callable prior to maturity, yields are computed to the earliest call date for issues quoted above par and to the maturity date for issues below par. \*When issued.

U.S. Treasury strips as of 3 p.m. Eastern time, also based on transactions of \$1 million or more. Colons in bid and asked quotes represent 32nds; 99:01 means 99 1/32. Net changes in 32nds. Yields calculated on the asked quotation. ci-stripped coupon interest. bp-Treasury bond, stripped principal. np-Treasury note, stripped principal. For bonds callable prior to maturity, yields are computed to the earliest call date for issues quoted above par and to the maturity date for issues below par.

Source: Bear, Stearns & Co. via Street Software Technology, Inc.

Source: eSpeed/Cantor Fitzgerald

### (a) Treasury bonds and notes

#### GOVT. BONDS & NOTES

	Rate	Maturity Mo/Yr	Bid	Asked	Chg.	Ask Yld.	
T-bond 1	4.750	Jan 03n	100:02	100:03	...	0.43	Current Yield = 4.75%
	5.500	Jan 03n	100:02	100:03	-1	0.46	
	5.750	Aug 03n	102:17	102:18	...	0.16	
T-bond 2	11.125	Aug 03	105:16	105:17	-1	1.22	Current Yield = 10.55%
T-bond 3	5.250	Feb 29	103:17	103:18	23	5.00	Current Yield = 5.07%
	3.875	Apr 29i	122:03	122:04	2	2.69	
	6.125	Aug 29	116:10	116:11	24	5.00	
T-bond 4	5.375	Feb 31	107:27	107:28	24	4.86	Current Yield = 4.98%

### (b) Treasury bills

#### TREASURY BILLS

Maturity	Days to Mat.	Bid	Asked	Chg.	Ask Yld.	Maturity	Days to Mat.	Bid	Asked	Chg.	Ask Yld.
Jan 30 03	7	1.15	1.14	-0.01	1.16	May 01 03	98	1.14	1.13	-0.02	1.15
Feb 06 03	14	1.14	1.13	-0.01	1.15	May 08 03	105	1.14	1.13	-0.03	1.15
<b>Feb 13 03</b>	<b>21</b>	<b>1.14</b>	<b>1.13</b>	<b>-0.01</b>	<b>1.15</b>	May 15 03	112	1.15	1.14	-0.02	1.16
Feb 20 03	28	1.14	1.13	...	1.15	May 22 03	119	1.15	1.14	-0.02	1.16
Feb 27 03	35	1.13	1.12	-0.01	1.14	May 29 03	126	1.15	1.14	-0.01	1.16
Mar 06 03	42	1.13	1.12	...	1.14	Jun 05 03	133	1.15	1.14	-0.02	1.16
Mar 13 03	49	1.13	1.12	-0.01	1.14	Jun 12 03	140	1.16	1.15	-0.01	1.17
Mar 20 03	56	1.12	1.11	-0.01	1.13	Jun 19 03	147	1.15	1.14	-0.02	1.16
Mar 27 03	63	1.13	1.12	-0.01	1.14	Jun 26 03	154	1.15	1.14	-0.01	1.16
Apr 03 03	70	1.13	1.12	-0.01	1.14	Jul 03 03	161	1.15	1.14	-0.02	1.16
Apr 10 03	77	1.12	1.11	-0.03	1.13	Jul 10 03	168	1.16	1.15	-0.02	1.17
Apr 17 03	84	1.14	1.13	-0.01	1.15	Jul 17 03	175	1.16	1.15	-0.03	1.17
Apr 24 03	91	1.15	1.14	...	1.16	Jul 24 03	182	1.17	1.16	...	1.18

### (c) New York Stock Exchange bonds

#### NEW YORK BONDS CORPORATION BONDS

Bonds	Cur Yld	Vol	Close	Net Chg.		
Bond 1	AT&T 5 <sup>5</sup> / <sub>8</sub> 04	5.5	238	101.63	...	Yield to Maturity = 3.68%
	AT&T 6 <sup>3</sup> / <sub>8</sub> 04	6.2	60	102.63	-0.13	
	AT&T 7 <sup>1</sup> / <sub>2</sub> 04	7.2	101	103.63	-0.13	
	AT&T 8 <sup>1</sup> / <sub>2</sub> 24	8.0	109	101	0.38	
	ATT 8.35s25	8.3	60	101	0.50	
	AT&T 6 <sup>1</sup> / <sub>2</sub> 29	7.5	190	87.25	0.13	
Bond 2	AT&T 8 <sup>5</sup> / <sub>8</sub> 31	8.4	138	102.75	0.88	Yield to Maturity = 8.40%

Source: Wall Street Journal, Thursday, January 23, 2003, p. C11.

# Distinction Between Interest Rates and Returns

## Rate of Return

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

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

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

# Key Facts about Relationship Between Interest Rates and Returns

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

(1) Years to Maturity When Bond Is Purchased	(2) Initial Current Yield (%)	(3) Initial Price (\$)	(4) Price Next Year* (\$)	(5) 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.

# Maturity and the Volatility of Bond Returns

## Key Findings from Table 2

1. Only bond whose return = yield is one with maturity = holding period
2. For bonds with maturity > holding period,  $i \uparrow P \downarrow$  implying capital loss
3. Longer is maturity, greater is % price change associated with interest rate change
4. Longer is maturity, more return changes with change in interest rate
5. Bond with high initial interest rate can still have negative return if  $i \uparrow$

## Conclusion from Table 2 Analysis

1. Prices and returns more volatile for long-term bonds because have higher interest-rate risk
2. No interest-rate risk for any bond whose maturity equals holding period

# Distinction Between Real and Nominal Interest Rates

## Real Interest Rate

**Interest rate that is adjusted for expected changes in the price level**

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

1. Real interest rate more accurately reflects true cost of borrowing
2. When real rate is low, greater incentives to borrow and less to lend

**if  $i = 5\%$  and  $\pi^e = 3\%$  then:**

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

**if  $i = 8\%$  and  $\pi^e = 10\%$  then**

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

# U.S. Real and Nominal Interest Rates

