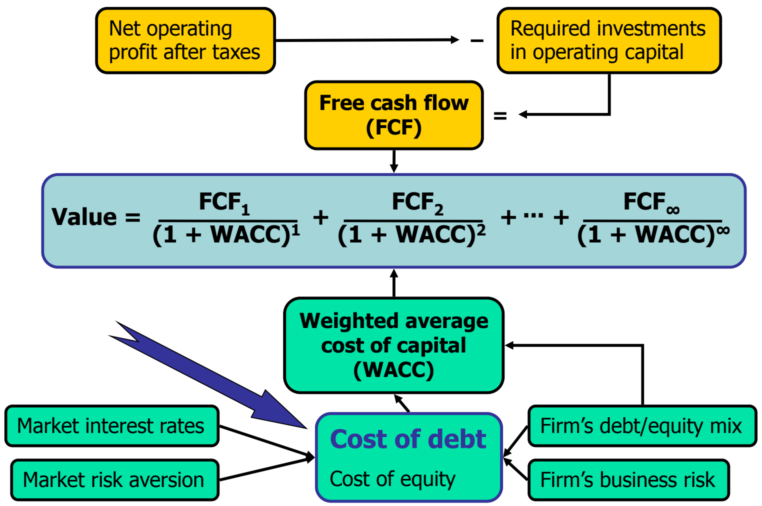
Chapter 5

Bonds, Bond Valuation, and
Interest Rates

Topics in Chapter

- Key features of bonds
- Bond valuation
- Measuring yield
- Assessing risk

Determinants of Intrinsic Value: The Cost of Debt



Key Features of a Bond

- Par value: Face amount; paid at maturity. Assume $1,000.
- Coupon interest rate: Stated interest rate. Multiply by par value to get dollars of interest. Generally fixed.

(More…)

Key Features of a Bond

- Maturity: Years until bond must be repaid. Declines.
- Issue date: Date when bond was issued.
- Default risk: Risk that issuer will not make interest or principal payments.

Call Provision

- Issuer can refund if rates decline. That helps the issuer but hurts the investor.
- Therefore, borrowers are willing to pay more, and lenders require more, on callable bonds.
- Most bonds have a deferred call and a declining call premium.

What's a sinking fund?

- Provision to pay off a loan over its life rather than all at maturity.
- Similar to amortization on a term loan.
- Reduces risk to investor, shortens average maturity.
- But not good for investors if rates decline after issuance.

Sinking funds are generally handled in 2 ways

- Call x% at par per year for sinking fund purposes.
  - Call if r_d is below the coupon rate and bond sells at a premium.
- Buy bonds on open market.
  - Use open market purchase if r_d is above coupon rate and bond sells at a discount.

Value of a 10-year, 10% coupon bond if r_d = 10%

0	1	2	...	10
10%				
V = ?	100	100		100 + 1,000

$$V_B = \frac{\$100}{(1 + r_d)^1} + \ldots + \frac{\$100}{(1 + r_d)^N} + \frac{\$1,000}{(1 + r_d)^N}$$

$$= \$90.91 + \ldots + \$38.55 + \$385.54$$
$$= \$1,000.$$

The bond consists of a 10-year, 10% annuity of \$100/year plus a \$1,000 lump sum at t = 10:

PV annuity	=	\$ 614.46
PV maturity value	=	385.54
Value of bond	=	\$1,000.00

	N	I/YR	PV	PMT	FV
INPUTS	10	10		100	1000
OUTPUT			-1,000		

What would happen if expected inflation rose by 3%, causing r = 13%?

	N	I/YR	PV	PMT	FV
INPUTS	10	13		100	1000
OUTPUT			-837.21		

When r_d rises, above the coupon rate, the bond's value falls below par, so it sells at a discount.

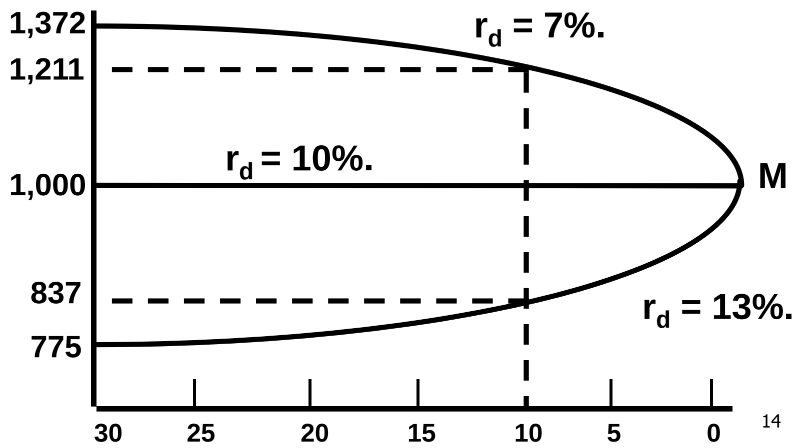
What would happen if inflation fell, and r_d declined to 7%?

	N	I/YR	PV	PMT	FV
INPUTS	10	7		100	1000
OUTPUT			-1,210.71		

If coupon rate > r_d, price rises above par, and bond sells at a premium.

- Suppose the bond was issued 20 years ago and now has 10 years to maturity. What would happen to its value over time if the required rate of return remained at 10%, or at 13%, or at 7%?
- See next slide.

Bond Value ($) vs Years remaining to Maturity

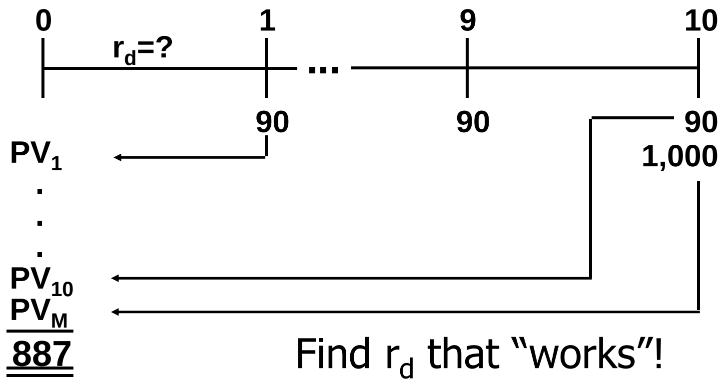


- At maturity, the value of any bond must equal its par value.
- The value of a premium bond would decrease to $1,000.
- The value of a discount bond would increase to $1,000.
- A par bond stays at $1,000 if r_d remains constant.

What's "yield to maturity"?

- YTM is the rate of return earned on a bond held to maturity. Also called "promised yield."
- It assumes the bond will not default.

YTM on a 10-year, 9% annual coupon, $1,000 par value bond selling for $887



Find r_d that "works"!

Find r_d

$$V_B = \frac{INT}{(1+r_d)^1} + \cdots + \frac{INT}{(1+r_d)^N} + \frac{M}{(1+r_d)^N}$$

$$887 = \frac{90}{(1+r_d)^1} + \cdots + \frac{90}{(1+r_d)^N} + \frac{1,000}{(1+r_d)^N}$$

	N	I/YR	PV	PMT	FV
INPUTS	10		-887	90	1000
OUTPUT		10.91			

- If coupon rate < r_d, bond sells at a discount.
- If coupon rate = r_d, bond sells at its par value.
- If coupon rate > r_d, bond sells at a premium.
- If r_d rises, price falls.
- Price = par at maturity.

Find YTM if price were $1,134.20.

	N	I/YR	PV	PMT	FV
INPUTS	10		-1134.2	90	1000
OUTPUT		7.08			

Sells at a premium. Because coupon = 9% > r_d = 7.08%, bond's value > par.

Definitions

Current yield = $\frac{\text{Annual coupon pmt}}{\text{Current price}}$

Capital gains yield = $\frac{\text{Change in price}}{\text{Beginning price}}$

Exp total return = YTM = Exp Curr yld + Exp cap gains yld

9% coupon, 10-year bond, P = \$887, and YTM = 10.91%

Current yield = $\frac{\$90}{\$887}$

= 0.1015 = 10.15%.

YTM = Current yield + Capital gains yield.

Cap gains yield = YTM - Current yield
= 10.91% - 10.15%
= 0.76%.

Could also find values in Years 1 and 2, get difference, and divide by value in Year 1. Same answer.

Semiannual Bonds

1. Multiply years by 2 to get periods = 2N.
2. Divide nominal rate by 2 to get periodic rate = $r_d/2$.
3. Divide annual INT by 2 to get PMT = INT/2.

INPUTS	2N	$r_d/2$	OK	INT/2	OK
	N	I/YR	PV	PMT	FV
OUTPUT					

Value of 10-year, 10% coupon, semiannual bond if rd = 13%.

	N	I/YR	PV	PMT	FV
INPUTS	2(10) 20	13/2 6.5		100/2 50	1000
OUTPUT			-834.72		

Callable Bonds and Yield to Call

- A 10-year, 10% semiannual coupon, $1,000 par value bond is selling for $1,135.90 with an 8% yield to maturity. It can be called after 5 years at $1,050.

Nominal Yield to Call (YTC)

	N	I/YR	PV	PMT	FV
INPUTS	10		-1135.9	50	1050
OUTPUT		3.765 x 2 = 7.53%			

If you bought bonds, would you be more likely to earn YTM or YTC?

- Coupon rate = 10% vs. YTC = r_d = 7.53%. Could raise money by selling new bonds which pay 7.53%.
- Could thus replace bonds which pay $100/year with bonds that pay only $75.30/year.
- Investors should expect a call, hence YTC = 7.5%, not YTM = 8%.

- In general, if a bond sells at a premium, then coupon > r_d, so a call is likely.
- So, expect to earn:
  - YTC on premium bonds.
  - YTM on par & discount bonds.

$r_d = r^* + IP + DRP + LP + MRP$.

Here:

r_d	=	Required rate of return on a debt security.
r^*	=	Real risk-free rate.
IP	=	Inflation premium.
DRP	=	Default risk premium.
LP	=	Liquidity premium.
MRP	=	Maturity risk premium.

What is the nominal risk-free rate?

- $r_{RF} = (1+r^*)(1+IP)-1$

  $= r^* + IP + (r^* x IP)$

  $\approx r^* + IP$. (Because r^*xIP is small)
- r_{RF} = Rate on Treasury securities.

Estimating IP

- Treasury Inflation-Protected Securities (TIPS) are indexed to inflation.
- The IP for a particular length maturity can be approximated as the difference between the yield on a non-indexed Treasury security of that maturity minus the yield on a TIPS of that maturity.

Bond Spreads, the DRP, and the LP

- A "bond spread" is often calculated as the difference between a corporate bond's yield and a Treasury security's yield of the same maturity. Therefore:
  - Spread = DRP + LP.
- Bond's of large, strong companies often have very small LPs. Bond's of small companies often have LPs as high as 2%.

Bond Ratings		% defaulting within:	
S&P and Fitch	Moody's	1 yr.	5 yrs.
Investment grade bonds:			
AAA	Aaa	0.0	0.0
AA	Aa	0.0	0.1
A	A	0.1	0.6
BBB	Baa	0.3	2.9
Junk bonds:			
BB	Ba	1.4	8.2
B	B	1.8	9.2
CCC	Caa	22.3	36.9

Source: Fitch Ratings

Bond Ratings and Bond Spreads (YahooFinance, March 2009)

Long-term Bonds	Yield (%)	Spread (%)
10-Year T-bond	2.68	
AAA	5.50	2.82
AA	5.62	2.94
A	5.79	3.11
BBB	7.53	4.85
BB	11.62	8.94
B	13.70	11.02
CCC	26.30	23.62

What factors affect default risk and bond ratings?

- Financial ratios
  - Debt ratio
  - Coverage ratios, such as interest coverage ratio or EBITDA coverage ratio
  - Profitability ratios
  - Current ratios

(More…)

Bond Ratings Median Ratios

(S&P)

	Interest coverage	Return on capital	Debt to capital
AAA	23.8	27.6%	12.4%
AA	19.5	27.0%	28.3%
A	8.0	17.5%	37.5%
BBB	4.7	13.4%	42.5%
BB	2.5	11.3%	53.7%
B	1.2	8.7%	75.9%
CCC	0.4	3.2%	113.5%

Other Factors that Affect Bond Ratings

- Provisions in the bond contract
  - Secured versus unsecured debt
  - Senior versus subordinated debt
  - Guarantee provisions
  - Sinking fund provisions
  - Debt maturity

(More…)

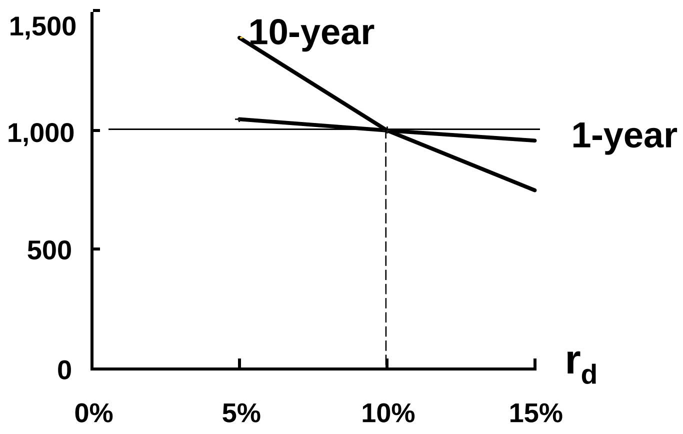
- Other factors
  - Earnings stability
  - Regulatory environment
  - Potential product liability
  - Accounting policies

Interest rate (or price) risk for 1-year and 10-year 10% bonds

Interest rate risk: Rising r_d causes bond's price to fall.

r_d	1-year	Change	10-year	Change
5%	$1,048	4.8%	$1,386	38.6%
10%	1,000	4.4%	1,000	25.1%
15%	956		749	

Value



What is reinvestment rate risk?

- The risk that CFs will have to be reinvested in the future at lower rates, reducing income.
- Illustration: Suppose you just won $500,000 playing the lottery. You'll invest the money and live off the interest. You buy a 1-year bond with a YTM of 10%.

- Year 1 income = $50,000. At year-end get back $500,000 to reinvest.
- If rates fall to 3%, income will drop from $50,000 to $15,000. Had you bought 30-year bonds, income would have remained constant.

The Maturity Risk Premium

- Long-term bonds: High interest rate risk, low reinvestment rate risk.
- Short-term bonds: Low interest rate risk, high reinvestment rate risk.
- Nothing is riskless!
- Yields on longer term bonds usually are greater than on shorter term bonds, so the MRP is more affected by interest rate risk than by reinvestment rate risk.

Term Structure Yield Curve

- Term structure of interest rates: the relationship between interest rates (or yields) and maturities.
- A graph of the term structure is called the yield curve.