

Brigham, Ehrhardt & Fox

Financial Management: Theory and Practice 1st EMEA edition



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1



Financial Management

Chapter 5 Bond Valuation



Professor Ines Nel
Financial Management / MBAC 813

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2

Chapter goals

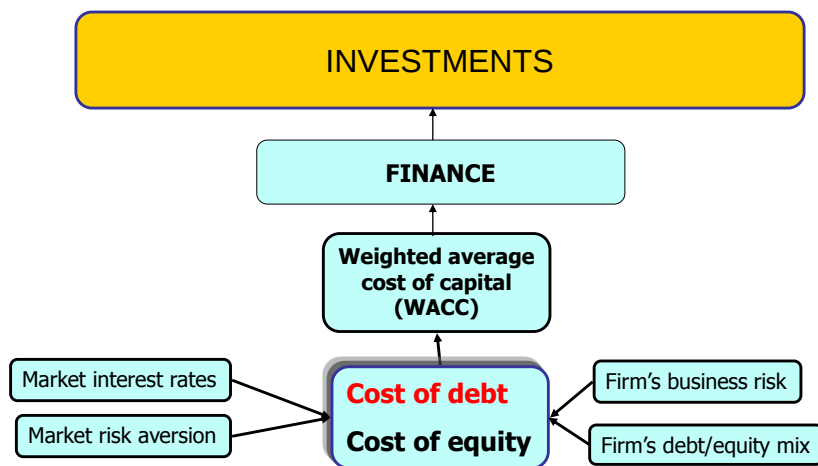
On completion you should be able to:

- ☒ Explain and value bonds.
- ☒ Explain the interaction between the variables used in the valuation process.

Topics in Chapter

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

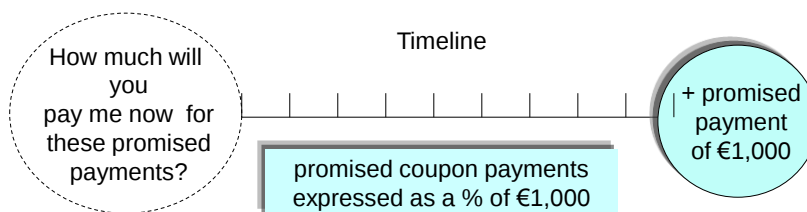
Finance



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5

Bond outline



A "5% 10 year bond" is a promise of an annual payment of €50 and €1,000 in 10 years' time.

A BOND is a financial instrument that is a standardized form of borrowing that is easily tradable (negotiable).

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The Basic Valuation Model

$$P_0 = \frac{CF_1}{(1+r)^1} + \frac{CF_2}{(1+r)^2} + \dots + \frac{CF_n}{(1+r)^n}$$

- P_0 = Price of asset at time 0 (today)
- CF_t = Cash flow expected at time t
- r = Discount rate (reflecting asset's risk)
- N = Number of discounting periods (usually years)

This model can express mathematically the price of any asset at $t = 0$ (time of valuation).

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7

BOND Valuation Fundamentals

Bonds are debt instruments used by **business and government** to raise large sums of money

Most bonds share certain basic characteristics

- First, a bond promises to pay investors a **fixed amount of interest**, called the bond's **coupon**.
- Second, bonds typically have a **limited** life and will repay the **face value / par value** on the maturity.
- Third, a bond's **coupon rate** equals the bond's annual coupon payment divided by its **par value**.
- Fourth, a bond's **coupon yield** equals the **coupon payment** divided by the bond's **current market price**.

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8

Cost components

The discount rate (r_i) is the **opportunity cost of capital**, i.e., the rate that could be earned on alternative investments of equal risk.

$$r_i = r^* + IP + LP + MRP + DRP$$

r^*	= Real rate of return
IP	= Inflation Premium
LP	= Liquidity Premium
MRP	= Maturity Risk premium
DRP	= Default risk premium

9

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Bond Value

Required return = Interest yield + Capital gain yield

$$\begin{aligned} \text{Price} &= \underbrace{\left[\frac{C}{(1+r)^1} + \frac{C}{(1+r)^2} + \dots + \frac{C}{(1+r)^n} \right]}_{\text{Present value of coupon payments}} + \underbrace{\left[\frac{M}{(1+r)^n} \right]}_{\text{Present value of par value}} \\ &= \sum_{t=1}^N \frac{INT}{(1+r_d)^t} + \frac{M}{(1+r_d)^N} \end{aligned}$$

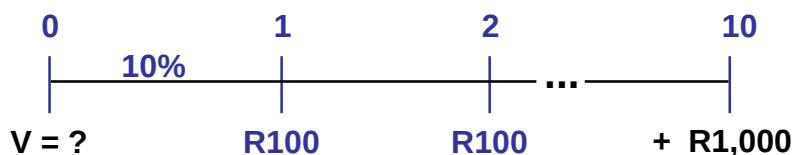
Where:

r = market rate of return
 t = number of periods at interest flow
 N = number of periods at maturity

10

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



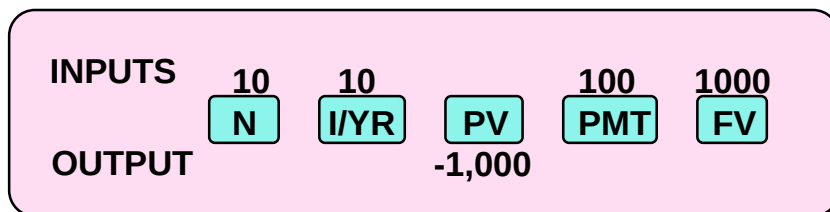
$$\begin{aligned}
 V_B &= \frac{R100}{(1+r_d)^1} + \dots + \frac{R100}{(1+r_d)^{10}} + \frac{R1000}{(1+r_d)^{10}} \\
 &= R90.91 + \dots + R38.55 + R385.54 \\
 &= \text{\textcolor{red}{\$1,000.}}
 \end{aligned}$$

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11

The bond consists of a 10-year, 10% annuity of R100 / year plus a \$1,000 lump sum at $t = 10$:

PV annuity(annual interest) =	R 614.46
PV loan amount at maturity =	R 385.54
Value of bond =	<u>R1,000.00</u>



What if inflation expected to rise 3%, then $r = 13\%$ - (R837.21)

What if inflation expected to fall 3%, then $r_d = 7\%$? - (R1210.71)

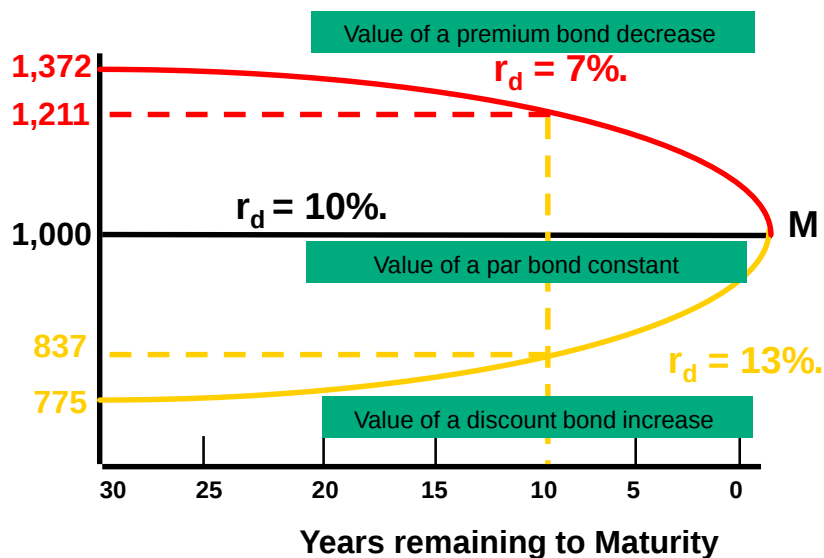
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12

Bond maturity

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%?

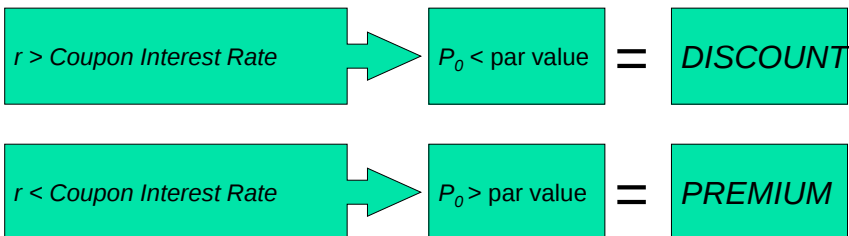
Bond Value Amount



Bonds: *Premiums & Discounts*

What happens to bond values if the required return (market rate) is not equal to the coupon rate?

The bond's value will differ from its par value



Yield to maturity (YTM)

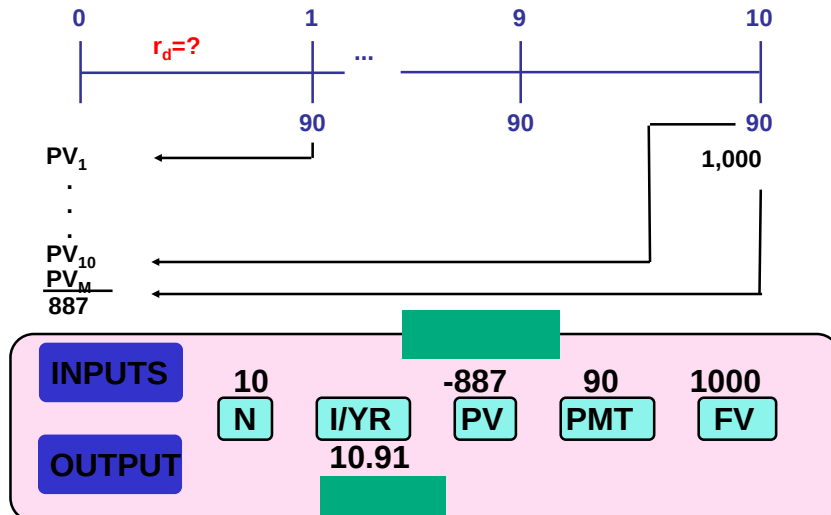
YTM is the rate of return earned on a bond held to maturity.
Also called “**promised yield.**”

Rate of return investors earn if they buy the bond at **issue price** (P_0) and hold it until maturity.

The YTM on a bond selling at **par value** (face value) will always equal the coupon interest rate.

YTM is the **discount rate** that equates the PV of a bond's cash flows (interest plus capital gains) with its price.

YTM on a 10-year, 9% annual coupon, R1000 par value bond selling at R887



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17

Definitions

Current Yield = Annual coupon Pmt / Current price

$$= R90 / R887 = 10.15 \%$$

YTM = Expected current + Capital Gains yield

Calculated as 10.91% (See slide 17)

(NB: YTM = Expected total return)

Capital Gains Yield = (End – Begin price) / begin price

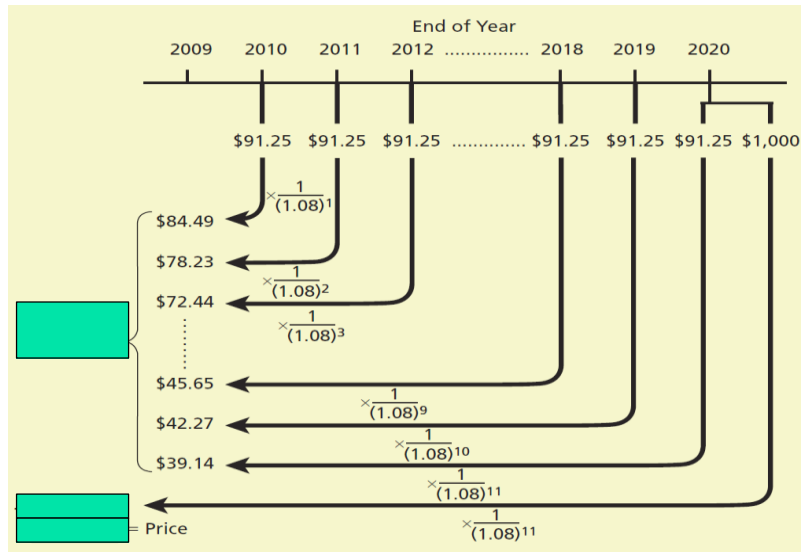
The normal equation cannot be used -therefor

$$= 10.91\% - 10.15\% = 0.76\%$$

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18

Valuation of a 9.25% coupon \$1,000 par bond, maturing at end of 2020, required return is 8%



19

Bond Issuers

Bond issuers

- Corporate bonds
- Municipal bonds
- Treasury bills, notes and bonds
- Agency bonds
 - Home loans
 - Mortgage

20

Risk-Free vs. Risky Bonds

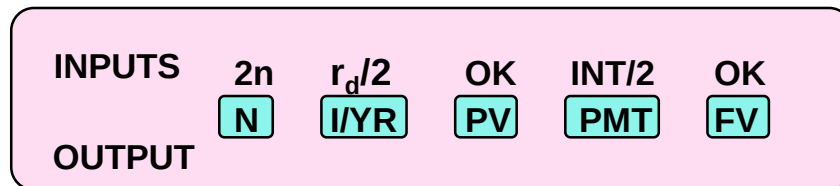
- **Treasury bonds provide a known contractual stream of cash flows**
 - if you can observe the **market price** of a bond, you can infer what the market's required return must be.
- A risk-free bond has no chance of default by its issuer.
 - Zero-coupon Treasuries
 - Coupon-paying Treasuries

Risk-Free vs. Risky Bonds

- Discount rate on **corporate bond** should be higher than on **Treasury bond** with the **same maturity** because corporate bonds carry **default risk**.
 - Risk that the corporation may not make all scheduled payments
- **Yield spread** between Treasury and corporate bonds
 - The **difference** in yield to maturity **between two bonds or classes of bonds** with similar maturities

Semi-annual 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 = $INT/2$.



Key Features of a Bond

A 5% 10 year bond is a promise of an annual payment of €50 and €1,000 in 10 years' time.

- Par value: Face amount; paid at maturity. Assume €1,000 (£100 in the UK).
- Coupon interest rate: A way of expressing annual payments.
- Multiply by par value to get euros.
- Generally fixed.

Key Features of a Bond

- Maturity: Years until bond must be repaid.
- Issue date: Date when bond was issued.
- Security or collateral: claim on assets in the event of non payment

Call Provision

- Issuer can refund bond. That helps the issuer but hurts the investor.
- Therefore, borrowers are willing to pay more, and lenders require more, on callable bonds.

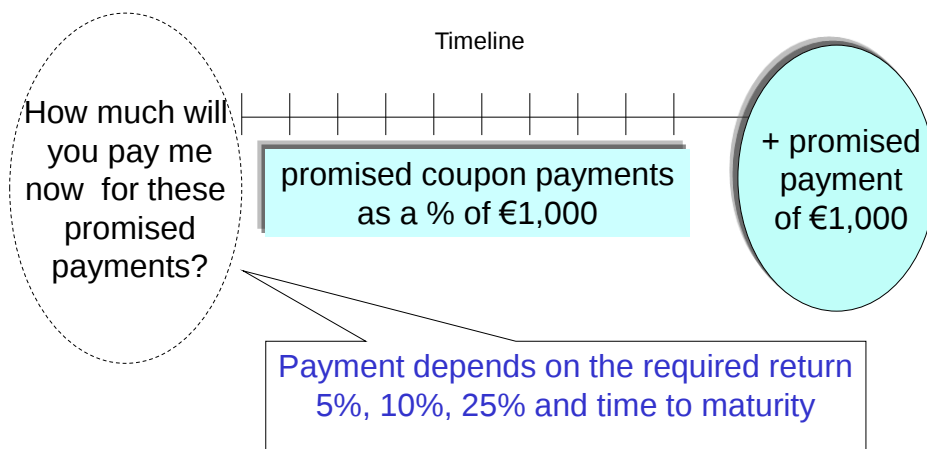
What's a sinking fund?

- Provision to pay off a loan over its life rather than all at maturity.
- Reduces risk to investor, shortens average maturity.

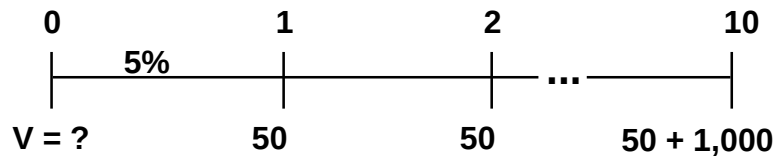
Sinking funds are generally handled in 2 ways

- Call $x\%$ at par per year for sinking fund purposes.
- Buy bonds on open market.

Bond Valuation



Value of a 10-year, 5% coupon bond if investors want a return of 15%



$$V_B = \frac{€50}{(1 + r_d)^1} + \dots + \frac{€50}{(1 + r_d)^N} + \frac{€1,000}{(1 + r_d)^N}$$

$$= €43.48 + €37.81\dots + €259.54$$

$$= €498.12$$

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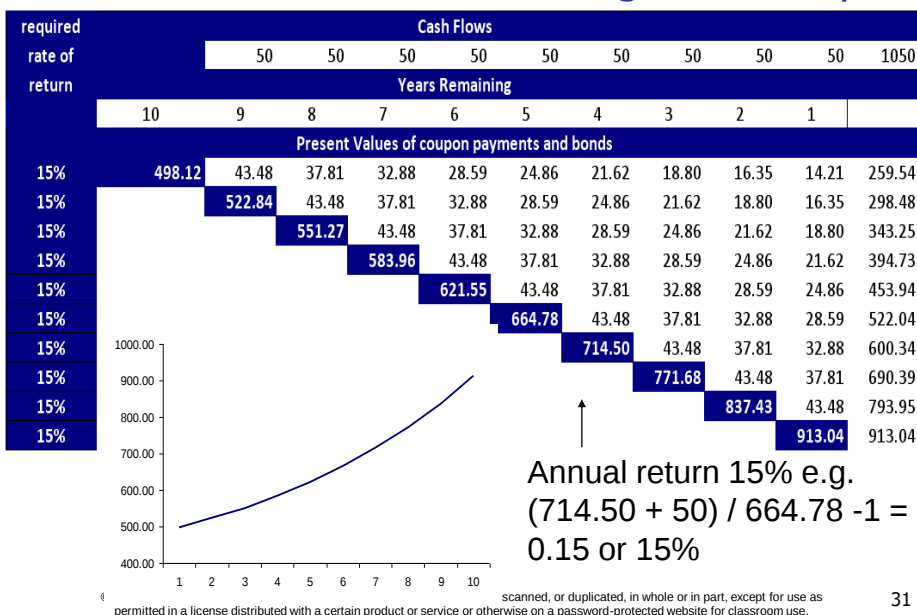
Bond Value and returns

10 year 5% bond

		Cash Flows									
		50	50	50	50	50	50	50	50	50	1050
		Years									
required rate of return	present value of bond	1	2	3	4	5	6	7	8	9	10
Present Values of coupon payments and par value											
15%	498.12	43.48	37.81	32.88	28.59	24.86	21.62	18.80	16.35	14.21	259.54
10%	692.77	45.45	41.32	37.57	34.15	31.05	28.22	25.66	23.33	21.20	404.82
5%	1000.00	47.62	45.35	43.19	41.14	39.18	37.31	35.53	33.84	32.23	644.61
2%	1269.48	49.02	48.06	47.12	46.19	45.29	44.40	43.53	42.67	41.84	861.37

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Bond Value € vs. Years remaining to Maturity



31

Yield to maturity (YTM)? Trial and Error!

		Cash Flows									
		90	90	90	90	90	90	90	90	90	1090
		Years									
required rate of return	present value of bond	1	2	3	4	5	6	7	8	9	10
Present Values of coupon payments and par value											
11%	882.22	81.08	73.05	65.81	59.29	53.41	48.12	43.35	39.05	35.18	383.88
10%	938.55	81.82	74.38	67.62	61.47	55.88	50.80	46.18	41.99	38.17	420.24
9%	1000.00	82.57	75.75	69.50	63.76	58.49	53.66	49.23	45.17	41.44	460.43
8%	1067.10	83.33	77.16	71.44	66.15	61.25	56.72	52.51	48.62	45.02	504.88

YTM is that discount rate that equates the cash flows to the current value of the bond €887 i.e. nearly 11% in this case

32

Bond Spreads

- 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:

- Bond’s of large, strong companies often have very small spreads.

Bond Ratings		% defaulting within:	
<u>S&P and Fitch</u>	<u>Moody's</u>	<u>1 yr.</u>	<u>5 yrs.</u>
<i><u>Investment grade bonds:</u></i>			
AAA	Aaa	0.00	0.00
AA	Aa	0.03	0.17
A	A	0.09	0.74
BBB	Baa	0.23	2.54
<i><u>Junk bonds:</u></i>			
BB	Ba	1.17	6.91
B	B	2.14	9.28
CCC	Caa	24.47	35.23
Source: Fitch Ratings			

Bond Ratings and Bond Spreads (March 2012)

Long-term Bonds	Yield (%)	Spread (%)
10-Year T-bond	2.18	
AAA	4.11	1.93
AA	3.38	1.20
A	3.37	1.19
BBB	6.24	4.06
BB	6.28	4.10
B	7.02	4.84
CCC	9.98	7.80

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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...)

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Bond Ratings and 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%

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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...)

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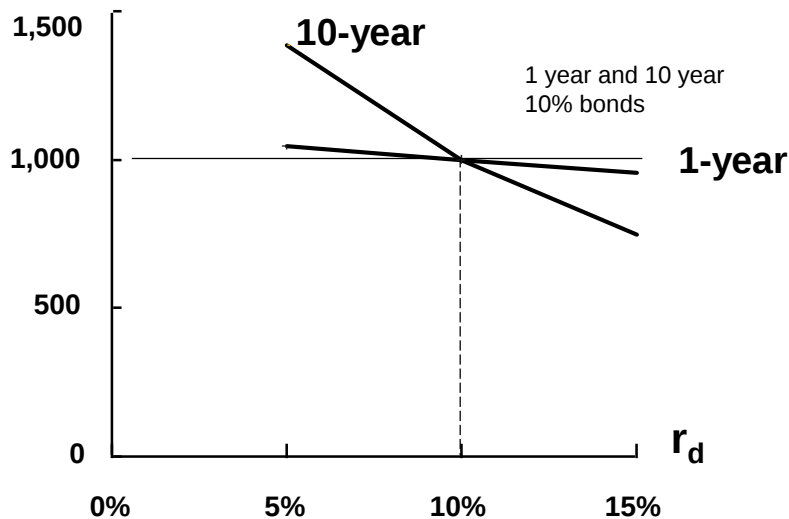
Other Factors that Affect Bond Ratings

- 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: r_d changes causes bond prices to fall at different rates				
	1-Year		10-Year	
r_d	Price	Change	Price	Change
5.0%	€1,048		€1,386	
		↘ 4.8%		↘ 38.6%
10.0%	€1,000		€1,000	
		↘ 4.5%		↘ 33.5%
15.0%	€957		€749	

Value



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41

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%.

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What is reinvestment rate risk?

- 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.

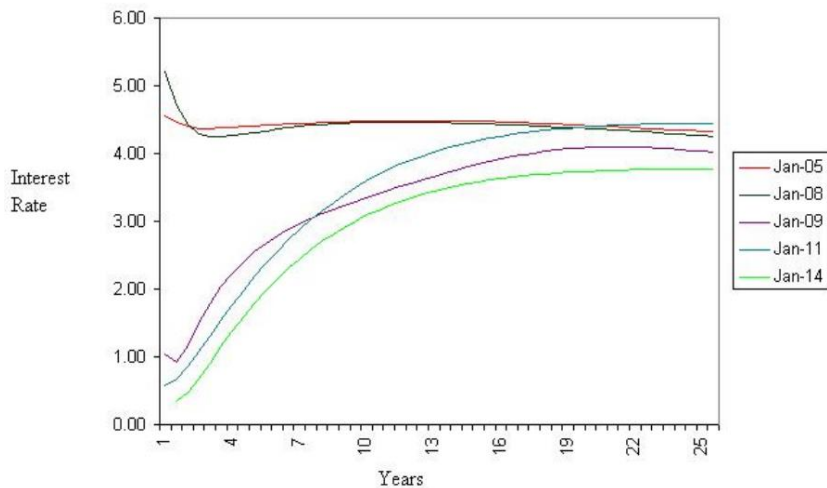
The Maturity Risk Premium

- 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 (see yield curve).

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.

Yield curve U.K. Govt bonds



source: Bank of England website

Bond impact: Statement of Financial Position

Borrower Balance Sheet			
Assets	R2000	Equity	R1000
		Long term loans	R1000
Total Assets	R2000	Total Funds	R2000

Investor Balance Sheet			
Assets	R1000	Equity	R1837 R2000
Investments	R1837 R1000		
Total Assets	R1837 R2000	Total Funds	R1837 R2000

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Have we reached our goals ?

Can we ?

- ☒ Explain and value bonds.
- ☒ Explain the interaction between the variables used in the valuation process.

Small Cases

You consider purchasing a 10-year, 12% semi-annual paying coupon bond. In your decision you work on the assumption that market rates for the period will average current inflation rate plus either 1) 4% or 2) 8%. What should you offer for the bond under either scenario.

ANSWERS: 1) R1124.62 2) R894.06