

## Lecture 11: Bond Prices and Yields

ECON435: Financial Markets and the Macroeconomy

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## Bond Markets (recap)

Bond = IOU = fixed income security with maturity greater than 1 year

Bond indenture = contract between issuer and bondholders determining

- par value (face value)
- coupon rate
- maturity date

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## Categories of Bonds

Categories:

- Treasury notes and bonds
- Federal agency debt
- Municipal bonds
- Corporate bonds
- Mortgage securities
- ...

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## Treasury Bonds and Notes

Treasury bonds: more than 10 years

Treasury notes: maturity up to 10 years

TIPS: Treasury Inflation-Protected Securities: principal is adjusted by inflation

Time	Inflation in Year Just Ended	Par Value	Coupon Payment	+	Principal Repayment	=	Total Payment
0		\$1,000.00					
1	2%	1,020.00	\$40.80		\$ 0		\$ 40.80
2	3	1,050.60	42.02		0		42.02
3	1	1,061.11	42.44		1,061.11		1,103.55

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## Bond Listings in the Media

FT Listing:

- redemption date
- coupon
- bid price (at which you can sell), bid yield
- change in yield over:
  - 1 day, 1 week, 1 month, 1 year, ...
- for corporate bonds:
  - rating of issuer
  - spread over government bonds (= difference in yields)

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## Accrued Interest

If a bond is bought in between two coupon payments, the buyer must also pay for *accrued interest* since last coupon payment:

$$\text{Accrued} = \text{Coupon} \times \frac{\text{Days accrued}}{\text{Total days}}$$

Example: \$50 yearly coupon  
after 146 days:  $\$50 \times 146/365 =$   
in interest has accrued

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## Bond Provisions

- ❑ Call provision: can be repaid early (often: deferred call provision)
- ❑ Convertible provision: (conversion ratio, market conversion value, conversion premium)
- ❑ Put provision (puttable bonds)
- ❑ Floating rate bonds
- ❑ Asset-backed bonds
- ❑ Catastrophe bonds

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## Bond Pricing

Price = PV(coupons) + PV(par value):

$$P_B = \sum_{t=1}^T \frac{C}{(1+r)^t} + \frac{ParValue}{(1+r)^T}$$

Calculation simplified using annuity factor:

$$\sum_{t=1}^T \frac{1}{(1+r)^t} = \frac{1}{r} \left[ 1 - \frac{1}{(1+r)^T} \right]$$

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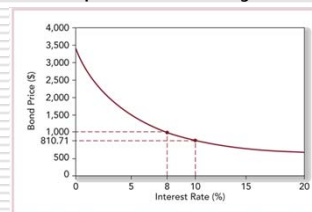
## Examples

- ❑ What is the price of a 3-year bond with \$10,000 face value that pays a yearly coupon of \$400 if the discount rate is 4%?
- ❑ What happens to the bond price if the discount rate falls to 3%?

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## Bond Prices and Yields

Bond prices and yields have an inverse relationship = convexity



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## Bond Prices and Yields

Bond prices at given market interest rates:

Time to Maturity	4%	6%	8%	10%	12%
1 year	1,038.83	1,029.13	1,000.00	981.41	963.33
10 years	1,327.03	1,148.77	1,000.00	875.35	770.60
20 years	1,547.11	1,231.15	1,000.00	828.41	699.07
30 years	1,695.22	1,276.76	1,000.00	810.71	676.77

One of the main risks of holding bonds  
= interest rate risk!!

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## Yield to Maturity

Yield to Maturity (YTM)

= interest rate that makes the PV of the bond equal to its market price

= current discount rate in the market

$$P_B = \sum_{t=1}^T \frac{C}{(1+r)^t} + \frac{ParValue}{(1+r)^T}$$

→ solve for  $r$  taking  $P_B$  as given

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## Example: Yield to Maturity

- 10 year bond
- 7% coupon paid semi-annually
- Current price: \$950

$$950 = \sum_{t=1}^{20} \frac{35}{(1+r)^t} + \frac{1000}{(1+r)^T}$$

→ Yield to maturity  $r$  (semi-annual) is 3.86%

Yield to call: similar concept for callable bonds

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## Alternative Yield Measures

- Bond Equivalent Yield: annual yield without compounding (like APR):  
 $7.72\% = 3.86\% \times 2$
- Effective Annual Yield: with compounding:  
 $(1.0386)^2 - 1 = 7.88\%$
- Current Yield =  
Annual Interest / Market Price  
 $\$70 / \$950 = 7.37\%$

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## Holding Period Return

Holding Period Return (HPR): consists of

- change in price of the bond (due to change in interest rates)
- coupon payments

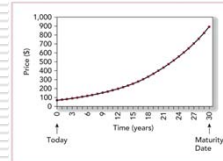
$$HPR = [\text{Coupon} + (P_{t+1} - P_t)] / P_t$$

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## Zero Coupon Bonds

Zero coupon bonds:

- do not pay coupons
- sell at discount and repay par value  
→ investors gain from increase in value



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## Default Risk

If companies (countries) cannot repay their debt → bondholders lose money

Rating companies: verify creditworthiness

- Moody's
- Standard & Poor's
- Fitch

Rating categories:

- Investment grade
- Speculative (junk bonds)

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## Rating Categories

	Very High Quality		High Quality		Speculative		Very Poor	
Standard & Poor's	AAA	AA	A	BBB	BB	B	CCC	D
Moody's	Aaa	Aa	A	Baa	Ba	B	Caa	C

At times both Moody's and Standard & Poor's have used adjustments to these ratings: S&P uses plus and minus signs: A+ is the strongest A rating and A- the weakest. Moody's uses a 1, 2, or 3 designation, with 1 indicating the strongest.

Investment grade: rating of BBB-/Baa3 or higher

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## Criteria used by Rating Agencies

- Coverage ratio
- Leverage
- Liquidity
- Profitability
- Cash flow to debt

Measures to protect investors:

- Subordination of future debt
- Dividend restrictions
- Collateral

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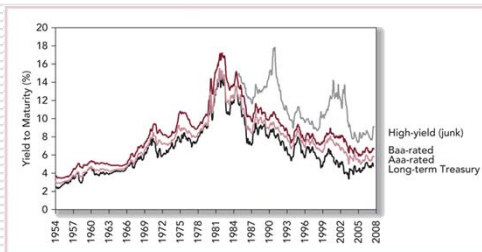
## Default Risk and Yield

Investors need to be compensated for higher default risk by higher yields

- Default premium
- At issuance: premium depends on rating and other firm characteristics
- Premium fluctuates along with risk (e.g. over the business cycle)

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## Bond Yields, 1954 – 2008



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## Collateralized Debt Obligations

CDOs were used to slice up a pool of loans into tranches of different riskiness:

Senior tranche (AAA)
Mezzanine (investment grade)
Equity (toxic waste)

→ at the heart of the current financial crisis

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