**Bonds – Chapt. 8 in RWJJ**

**Definitions:**

**Bond** - An IOU. A loan. - A security that obligates the issuer to make specified payments to the bondholder.

**Maturity** - Date when the loan is paid off.

**Face Value** – Large single-sum payment at maturity – separate from an interest payment

**Coupon Rate** - Annual interest payment as a percent of the face value

Note that most bonds make their interest payments semiannually.

**Example**: 10 year $10,000 U.S. Treasury Note with 7% coupon rate. New Issue

Maturity – Ten years from today

Face Value - $10,000

Coupon Rate - 7% of $10,000 = $700 per year = $350 every six months

 350 350 350 350 350 350 350 350 350 350 350 350 350 350 350 350 350 350 350 10,350

0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20

**Who issues Bonds?**

US Government - bills(< 1yr.), notes(1-10 yrs) and bonds(> 10 yrs)

Other governments

Corporations

States

Cities

School Districts

Hospitals

**What is a bond worth?**

Price of Bond = Value of Bond

The value of the bond is the present value of its future cash flows, discounted at the appropriate (appropriate based on risk) current interest rate (the bond’s yield)

**Example**: The above bond is a 10 year annuity (20 semiannual coupon payments) plus the $10,000 face value. Assume the current interest rate (bond’s yield) is 7%. What is its price?

If we have semiannual payments, we need to use the semiannual interest rate and the number of semiannual payments, so r = 7%/2 = 3.5% and t = 20



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= 10,000

If you hold the bond for 2 years and the interest rate (yield) is still 7%, what is the bond’s value? Note there are now 16 semiannual periods remaining.

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= 10,000

Each year the PV of the interest payments decreases (due to fewer payments) but the PV of the principal increases (because you are closer to the time you get it). As long as the bond’s coupon rate is equal to the bond’s yield (the current interest rate), the bond’s price will remain equal to its face value.

Now suppose we hold the bond for 2 years and comparable investments elsewhere are now paying 5% (2.5% semiannually). Note the bond itself has not changed.



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= $11,305.50 Note that the price went up

Why did the price of the bond go up?

Look at the same thing, but comparable investments are now 9% (4.5% semiannually).



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= $8,876.60 Note that the price went down

Why did the price of the bond go down?

# Bond values and interest rates move in opposite directions

Bond prices are usually expressed as a percentage of their face value.

**Examples**: 100 - Selling at par

 102 - Selling at a premium (102% of the face value)

 98 - Selling at a discount (98% of the face value)

**Premium** – Price is above the face value

**Discount** – Price is below the face value

All else equal, bonds with a higher coupon rate will sell at a premium and those with a lower coupon rate will sell at a discount.

**Yield to Maturity** - Also the IRR or BEY (Bond Equivalent Yield) of the bond.

 The interest rate for which the PV of the bond’s future cash flows equals its price.

What interest rate solves this?



Note the same r appears four times in the equation.

The solution is 2.5%. With semiannual payments, this is the semiannual yield. By convention, we double this to get the yield to maturity of 5%. By definition, the YTM of a bond is its semi-annual yield times two. The effective annual rate (EAR) would be greater than the YTM. The YTM is the same idea as an APR.

You can solve this with a financial calculator, Excel, or by trial and error.

Solve for r using Excel’s Rate Funtion:

PV = -11,305.50

PMT = 350

FV = 10,000

t = 16

The solution is 2.5% which we double to get a YTM of 5.00%.

On Excel, if you know the exact dates (settlement and maturity dates), you can use the Yield Function.

**Yield to maturity** is the rate of return you get if you hold the bond to maturity (and if you are able to reinvest all coupon payments at that rate).

Similar bonds (risk and maturity) should have similar YTMs. In a competitive marketplace, prices adjust to give similar bonds the same YTM. - If one bond has a higher yield, people buy it which bids up the price, and its yield falls.

**More Yield to Maturity:**

$10,000 10-year bond with 2 years remaining till maturity

Coupon Rate = 7%

Price = $10,370.00

What is the yield to maturity?

$10,370.00 = 350 + 350 + 350 + 350 + 10,000

 (1+r) (1+r)2 (1+r)3 (1+r)4 (1+r)4

Note that if the price is > $10,000, the interest rates must have gone down from 7%.

In this case, r = 2.52%, and the yield is 5.03%

**Interest Rate Risk** - The risk of fluctuations in a bond’s value due to interest rate changes.

Note: If interest rates go up, the value of every bond goes down, but some bonds lose more value than other bonds. The biggest factor affecting the interest rate risk of a bond is its time to maturity. Which bond has more interest rate risk: a 2-year bond, or a 20-year bond?

Can the price of a bond change even if interest rates don’t?

**Example**: You bought this 7% 10-year bond 2 years after it was issued for $11,305.50. Its yield to maturity was 5%. What is it worth in 3 years if it still yields 5%?

\_\_\_\_\_\_\_\_\_\_\_\_\_11,305.50\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_?\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_maturity

0 4 10 20





Price = 10,875.20

Why did the price drop?

The prices of all bonds will converge to their face amount as they approach maturity. Of course if the price *was* the face amount (par value), it remains constant.

Actually, every bond has two prices:

**Ask** - Price a bond dealer is willing to sell a bond for

**Bid** - Price a bond dealer is willing to buy a bond for

Ask > Bid

**Ask – Bid**: The difference is the **spread** - The profit to the dealer.

When we don’t specify whether we are referring to the bid or the ask, we can assume that “the price” of a bond is the midpoint between the bid and ask prices.

**Government Bonds** - Prices are often quoted in 32nds.

 Example: 105:28 or 105-28 = 105 28/32 % of face value

 = 105.875% of face value

 For $1 million bond = $1,058,750

**Term Structure of Interest Rates** - The relationship between time to maturity and yield to maturity. Do long-term bonds yield more, less, or the same as short-term bonds? - That’s the question the term structure addresses.

**Yield Curve** - A graph of the term structure with YTM on vertical axis and time to maturity on the horizontal axis.

Yield Curves can be:

 Upward Sloping

 Downward Sloping

 Flat

An upward sloping is the most typically seen of the three.

**Default Risk (or credit risk)** - The risk that whoever we loaned money to will not pay it back on time or in full.

**Bond Ratings** - Provided by Moody’s and Standard & Poor’s (S&P). The ratings are not identical, but they are close. Companies and municipalities pay to be rated.

Ceteris Paribus, the highest grade bond offers the lowest return.

There is a risk/return tradeoff.