

Chapter 7. Bonds and Their Valuation

What is a bond? A well structured IOU with a Face Value (FV), maturity date, and (typically, equal) coupon payments.

Coupon (Interest) rate is rather specified instead of coupon payments. However, we can determine coupon payments: Each coupon payment = $FV \times \text{coupon rate per period}$
Ex: \$1,000, coupon rate = 8%, semi-annual coupon paying bond, 10 year bond => Time line?
Each coupon payment = \$40, the last payment $\$40 + \$1,000 = \$1,040$, $N = 2 \times 10 = 20$

Who issues? Federal government (treasury bonds = securities), municipal bonds (munis) issued by state and local governments, corporate bonds, foreign governments and corporations.
Aside) Coupon income on munis is tax exempt from both federal and the issuing state/local taxes.
Default risk is a major concern for corporate bonds.

Bond characteristics: Par value = Face value = Principal, Coupon (fixed, variable, or zero-coupon = deep discount), Maturity date,
(Indenture) Provisions = fine prints: examples of provisions are Call (callable bonds) - issuer has the option to retire the bond prior to its maturity at a specified value. It is not good for investors and the price (return on this bond) should be lower (higher). Sinking fund = fund set aside to pay off the bonds, giving bond investors a piece of mind => higher bond price/lower returns, Puttable - investor has an option to terminate the bond prior to its maturity (or extend the maturity) => good for investors, higher bond price/lower returns, Convertibility (CB): investors can convert a bond into equity. Investors like this. Other issues: income bond = only interest payments, if possible, indexed bonds = coupon payments are based on an inflation index, - - -

Bond Valuation:

What is value? = worth, ultimately subjective, but we try to teach you to learn an "educated" way to come up with a "reasonable" value.

Why important? Our basic economic (investment) decision whether to buy (investing = buying the asset) is based on the comparison between the value & the (market) price, which is given to an individual.

How? Many different approaches. In basic finance, the best approach is the PV model. Given a prospective stream of future cash flows, we determine the (present) value **at a (given) investor's required rate of return (discount rate, opportunity cost (returns or interest rates from the best alternative))**

Example:

$PV = C \times PVIFA(r\%, n) + F \times PVIF(r\%, n)$
or C PMT, F FV, r i/y, n N, CPT => PV

Ex: 15 year annual coupon paying bond with 10% coupon rate, $FV = \$1000$. What is the PV at $r = 10\%$? Note that $C = 1000 \times 0.1 = \$100$, 15 N, 1000 FV, 10% i/Y CPT PV = \$1,000

What if $r = 7\%$? PV = \$1,273.24

What if $r = 15\%$? PV = \$707.63

⇒ Note that there is an **inverse (negative)** relationship between the discount rate (r) and the PV. Does it make sense? Given a bond (or all the payments from the bond), how much you may think about the bond varies inversely as what other investment opportunities

available. If there is a great opportunity out there with r =opportunity cost high, the value you may have for the given bond could be less. Alternatively, - - - . .

* Value vs. Price

Once you determine a PV, you compare the PV with the price of the bond (which is given) to make an investment decision. If $PV > P_0$, then the bond is undervalued (or underpriced) and you want to buy (invest in) the bond. Otherwise, the bond is overvalued (or overpriced). While everyone is trying to identify “good” bonds to invest, if the market is “efficient”, then Price should be close to the “average” Value of most investors, and Price should be close to the Value and move close to Value pretty quickly, even if there is a disparity between the value and the price. In real life, it is hard and almost impossible to find a bond which has the value a way more than the market price.

* Bond Valuation (p.200 – p.203, p.209 – p.210): Negative relationship between interest (=discount) rates and bond values as we already talked about earlier.

A typical bond makes interest (coupon) payments semi-annually. For a semi-annual coupon bond, $C = INT = \text{Face Value} * APR \text{ coupon rate} / 2$, $N = 2 * \# \text{years}$, required rate of return (=discount rate), $r_d = APR \text{ rate} / 2$

WARNING: some books inadvertently use “price” instead of “value”! An individual cannot determine the (market) price as it is already given. All you can do is to determine your own assessment of the value, not the price. However, the price is very close to the value in reality, even though they are conceptually totally different.

Aside) Bond sells at a discount (premium, par) => the PV or price is less (higher, equal to) than the Face Value. Examples on p.203 and p.208 are about different discount rates ($r_d = 10\%$, 15% , 5%) for the same bond (coupon rate= 10%). Note that PVs are different for different coupon rates (coupon rate= 13% , 10% , 7%) with the same discount rate= 10% .

⇒ Note that when the coupon rate is high (higher than the discount rate or yield), then the bond sells at a par and the bond PV curve will be placed above the face value. For this bond, you will have a negative capital gains (or capital loss) as the $PV > \text{Face Value}$ (Face value can be thought of the payment you will get when you return (resell) the bond back to the issuer). Whether the bond is at a par ($PV = FV$), or at a premium ($PV > FV$), or at a discount ($PV < FV$), the expected total return (YTM) should be the same as you get a competitive return as the market return. However, the composition of the total return between income return (current yield for a bond) and the capital gains return may change. See below in our discussion about YTM.

* YTM (yield to maturity): (Given the price), a special discount rate which makes $PV = \text{price}$.

Example (p.203 – P.205) – Return on bond investment if the bond is held until maturity. For this, all you need to do is enter all the information including the price of the bond (entered into PV), then try to compute the discount rate, i/Y

Ex. 9.5% semi-annual coupon 20 year maturity bond with 15 years remaining. $FV = 1000$ and the current price is $\$1,137.76$. What is the YTM? => 47.5 PMT , 30 N , 1000 FV & -1137.76 PV , then $CPT \ i/Y = 3.96 * 2 = 7.92\%$

Aside: What is the current yield (coupon income rate) of the bond = annual coupon payment/current bond price = $\$95 / \$1137.76 = 8.35\%$. What is then the expected capital gains rate from the current price of $\$1137.76$ to $\$1000$ Face Value? Total return measured by YTM = 7.92% minus the current yield of $8.35\% = -0.43\%$.

YTC (yield to call)? If the bond is callable, you can determine the yield based only on the coupon payments you expect to get until the bond gets called and the call value. Ex: the bond can be called within 5 years from now and the call value (the lump-sum the issuer will pay when called) is \$1,040. Everything is the same except 10 N (5 years *2 periods a year), 1040 FV => CPT $i/Y=6.88\%$

NOTE: Yield = return for investors, but it is a cost of financing from an issuer's perspective. Since YTC is less than YTM, the issuer is expected to call to save at 6.88% instead of keep paying more at 7.92%.

Remark: %change in the value due to changes in interest rates varies for different bonds. The bond with longer time to maturity and/or lower coupon rates have greater % changes => long term bonds and smaller coupon paying bonds are more sensitive to changes in interest rates. (p. 210 – p.214) – We need to talk about this in class. However, with this fact, you can work on the Aplia HW at the moment. When investors are seeking a steady income, they are more concerned about reinvestment rate risk in case interest rates fall. They really hate when the bonds get called so that they have to reinvest and there are no good investment opportunities.

* Bond Investment Risks

- Interest Rate Risk – The value of a bond changes as the discount rate (or YTM) changes. The bond with a longer maturity and a smaller coupon rate is more sensitive to changes in discount rate. (Aplia Question #5-1)

- Reinvestment (Rate) Risk – If the maturity of a bond is shorter than your investment horizon, you need to buy another bond and will be subject to changes in the future interest rate. You have a greater reinvestment risk with a shorter maturity and a larger coupon rate (=> you need to invest your coupon payments and these investments are subject to future interest rate changes) (Aplia #5-2,3)

- Default Risk

1) different types of corporate bonds

2) bond ratings

* Bond Markets and Quotations p.220

Aplia tips:

#4. If I, F, and C are given, you can get PV or price. If PV or Price and F, C are given, you can get the I or yield.

#3. Determining YTM, YTC ~ a piece of cake. If $YTC < YTM$, then the issuer wants to call to save its cost of borrowing money. To have a bond price of PV at par, the coupon rate should be the same as the discount rate of yield.

#1 and #2. YTM is the total return on a bond = current yield + capital gains rate. If a bond has a coupon rate < discount rate (or yield), then the bond's price or PV < Face Value=\$1000. In this case, the bond sells at a discount and the price or the PV value of the bond increases over time, eventually to its last period value of \$1,000. Along the way, you will enjoy an appreciation of the value of the bond (that is, capital gains). The current yield=annual coupon payment/PV or price is not