Bond Valuation

BOND - Security that obligates the issuer to make specified payments to the bondholder.

COUPON - The interest payments paid to the bondholder.

FACE VALUE - Payment at the maturity of the bond. Also called par value or maturity value.

COUPON RATE - Annual interest payment as a percentage of face value.

Governments and corporations borrow money by selling bonds to investors. The money they collect when the bond is issued, or sold to the public, is the amount of the loan. In return, they agree to make specified payments to the bondholders, who are the lenders.
When you own a bond, you generally receive a fixed interest payment each year until the bond matures. This payment is known as the coupon because most bonds used to have coupons that the investors clipped off and mailed to the bond issuer to claim the interest payment. At maturity, the debt is repaid: the borrower pays the bondholder the bond's face value (equivalently, its par value).
How do bonds work? Consider a U.S. Treasury bond as an example. Several years ago, the U.S. Treasury raised money by selling 6 percent coupon, 2002 maturity, Treasury bonds. Each bond has a face value of $1,000. Because the coupon rate is 6 percent, the government makes coupon payments of 6 percent of $1,000, or $60 each year. When the bond matures in July 2002, the government must pay the face value of the bond, $1,000, in addition to the final coupon payment.
Suppose that in 1999 you decided to buy the "6s of 2002," that is, the 6 percent coupon bonds maturing in 2002. The initial cash flow is negative and equal to the price you have to pay for the bond. Thereafter, the cash flows equal the annual coupon payment, until the maturity date in 2002, when you receive the face value of the bond, $1,000, in addition to the final coupon payment.

PV = PV (coupons) + PV (face value) = (coupon * annuity factor) + (face value * discount factor)

Annuity factor $= \frac{1}{i}\left[1 - \frac{1}{(1+i)^{t}}\right]$

Discount factor = $= \left[\frac{1}{(1+i)^{t}}\right]$

***N.B.*: When the market interest rate exceeds the coupon rate, bonds sell for less than face value. When the market interest rate is below the coupon rate, bonds sell for more than face value.**

CURRENT YIELD - Annual coupon payments divided by bond price.

A bond that is priced above its face value is said to sell at a premium. Investors who buy a bond at a premium face a capital loss over the life of the bond, so the return on these bonds is always less than the bond's current yield. A bond priced below face value sells at a discount.

Investors in discount bonds face a capital gain over the life of the bond; the return on these bonds is greater than the current yield.

***N.B.*: Because it focuses only on current income and ignores prospective price increases or decreases, the current yield mismeasures the bond's total rate of return. It overstates the return of premium bonds and understates that of discount bonds.**

YIELD TO MATURITY - Interest rate for which the present value of the bond's payments equals the price.

We need a measure of return that takes account of both current yield and the change in a bond's value over its life. The standard measure is called yield to maturity. The yield to maturity is the answer to the following question: At what interest rate would the bond be correctly priced?

***N.B.*: The yield to maturity is defined as the discount rate that makes the present value of the bond's payments equal to its price.**
When the interest rate rises, the present value of the payments to be received by the bondholder falls, and bond prices fall. Conversely, declines in the interest rate increase the present value of those payments and result in higher prices.

RATE OF RETURN - Total income per period per dollar invested.

When you invest in a bond, you receive a regular coupon payment. As bond prices change, you may also make a capital gain or loss. For example, suppose you buy the 6 percent Treasury bond today for a price of $1,010.77 and sell it next year at a price of $1,020. The return on your investment is the $60 coupon payment plus the price change of ($1,020 – $1,010.77) = $9.33. The rate of return on your investment of $1,010.77 is:

Rate of return = (coupon income + price change)/investment = ($60 + $9.33)/ $1,010.77 = .0686, or 6.86%

Because bond prices fall when market interest rates rise and rise when market rates fall, the rate of return that you earn on a bond also will fluctuate with market interest rates. This is why we say bonds are subject to interest rate risk. Do not confuse the bond's rate of return over a particular investment period with its yield to maturity. The yield to maturity is defined as the discount rate that equates the bond's price to the present value of all its promised cash flows. It is a measure of the average rate of return you will earn over the bond's life if you hold it to maturity. In contrast, the rate of return can be calculated for any particular holding period and is based on the actual income and the capital gain or loss on the bond over that period. The difference between yield to maturity and rate of return for a particular period is emphasized in the following example.

Rate of Return versus Yield to Maturity

Our 6 percent coupon bond with maturity 2002 currently has 3 years left until maturity and sells today for $1,010.77. Its yield to maturity is 5.6 percent. Suppose that by the end of the

year, interest rates have fallen and the bond's yield to maturity is now only 4 percent. What will be the bond's rate of return?At the end of the year, the bond will have only 2 years to maturity. If investors then demand an interest rate of 4 percent, the value of the bond will be

$$\text{PV at } 4\% = \frac{\$60}{1.04} + \frac{\$1{,}060}{1.04^2} = \$1{,}037.72$$

You invested $1,010.77. At the end of the year you receive a coupon payment of $60 and have a bond worth $1,037.72. Your rate of return is therefore:

$$\text{Rate of return} = \frac{\$60 + \$1{,}037.72 - \$1{,}010.77}{\$1{,}010.77} = .0860, \text{ or } 8.60\%$$

The yield to maturity at the start of the year was 5.6 percent. However, because interest rates fell during the year, the bond price rose and this increased the rate of return.

***N.B.*: When interest rates do not change, the bond price changes with time so that the total return on the bond is equal to the yield to maturity. If the bond's yield to maturity increases, the rate of return during the period will be less than that yield. If the yield decreases, the rate of return will be greater than the yield**.

INTEREST RATE RISK - The risk in bond prices due to fluctuations in interest rates.

We have seen that bond prices fluctuate as interest rates change. In other words, bonds exhibit interest rate risk. Bond investors cross their fingers that market interest rates will fall, so that the price of their bond will rise. If they are unlucky and the market interest rate rises, the value of their investment falls.

But all bonds are not equally affected by changing interest rates. Compare the two curves in Figure 1. The red line shows how the value of the 3-year, 6 percent coupon bond varies with the level of the interest rate. The blue line shows how the price of a 30-year, 6 percent bond varies with the level of interest rates. You can see that the 30- year bond is more sensitive to interest rate fluctuations than the 3-year bond. This should not surprise you. If you buy a 3-year bond when the interest rate is 5.6 percent and rates then rise, you will be stuck with a bad deal—you have just loaned your money at a lower interest rate than if you had waited. However, think how much worse it would be if the loan had been for 30 years rather than 3 years. The longer the loan, the more income you have lost by accepting what turns out to be a low coupon rate. This shows up in a bigger decline in the price of the longer-term bond. Of course, there is a flip side to this effect, which you can also see from Figure 1. When interest rates fall, the longer-term bond responds with a greater increase in price.

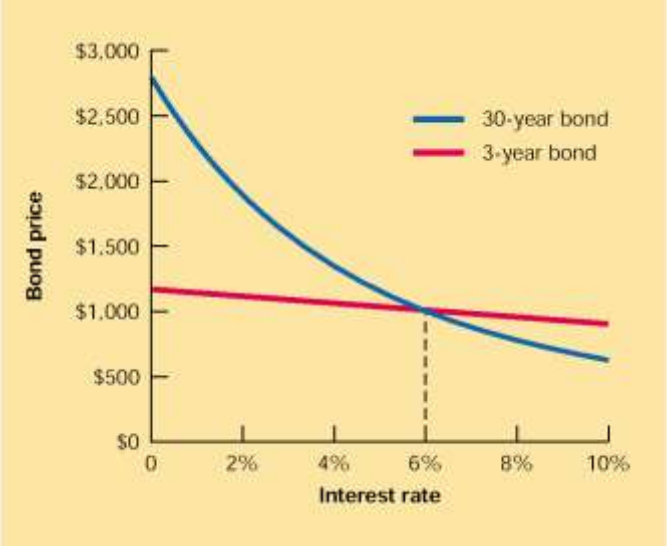

Figure 1.

NOMINAL AND REAL RATES OF INTEREST

Earlier we drew a distinction between nominal and real rates of interest. The cash flows on the 6 percent Treasury bonds are fixed in nominal terms. Investors are sure to receive an interest payment of $60 each year, but they do not know what that money will buy them. The real interest rate on the Treasury bonds depends on the rate of inflation. For example, if the nominal rate of interest is 5.6 percent and the inflation rate is 3 percent, then the real interest rate is calculated as follows:

(1 + real interest rate) = (1 + nominal interest rate)/ (1 + inflation rate) = 1.056 / 1.03 = 1.0252
Real interest rate = .0252, or 2.52%
Since the inflation rate is uncertain, so is the real rate of interest on the Treasury bonds.

DEFAULT (OR CREDIT) RISK - The risk that a bond issuer may default on its bonds.

DEFAULT PREMIUM - The additional yield on a bond investors require for bearing credit risk.

INVESTMENT GRADE - Bonds rated Baa or above by Moody's or BBB or above by Standard & Poor's.

JUNK BOND - Bond with a rating below Baa or BBB

There is an important distinction between bonds issued by corporations and those issued by the U.S. Treasury. National governments don't go bankrupt—they just print more money.7 So investors do not worry that the U.S. Treasury will default on its bonds. However, there is some chance that corporations may get into financial difficulties and may default on their bonds. Thus the payments promised to corporate bondholders represent a best-case scenario: the firm will never pay more than the promised cash flows, but in hard times it may pay less.

The risk that a bond issuer may default on its obligations is called default risk (or credit risk). It should be no surprise to find that to compensate for this default risk companies need to promise a higher rate of interest than the U.S. Treasury when borrowing money. The difference between the promised yield on a corporate bond and the yield on a U.S. Treasury bond with the same coupon and maturity is called the default premium. The greater the chance that the company will get into trouble, the higher the default premium demanded by investors.

The safety of most corporate bonds can be judged from bond ratings provided by Moody's, Standard & Poor's, or other bond-rating firms. Table 3.1 lists the possible bond ratings in declining order of quality. For example, the bonds that receive the highest Moody's rating are known as Aaa (or "triple A") bonds. Then come Aa ("double A"), A, Baa bonds, and so on. Bonds rated Baa and above are called investment grade, while those with a rating of Ba or below are referred to as speculative grade, high-yield, or junk bonds.

It is rare for highly rated bonds to default. For example, since 1971 fewer than one in a thousand triple-A bonds have defaulted within 10 years of issue. On the other hand, almost half of the bonds that were rated CCC by Standard & Poor's at issue have defaulted within 10 years. Of course, bonds rarely fall suddenly from grace. As time passes and the company becomes progressively more shaky, the agencies revise the bond's rating downward to reflect the increasing probability of default.

Problems

A1. Calculate the present value of a 6-year bond with a 9 percent coupon. The interest rate is 12 percent.

A2. A 4-year maturity bond with a 14 percent coupon rate can be bought for $1,200. What is the yield to maturity? You will need a bit of trial and error (or a financial calculator) to answer this question.

A.3. Suppose that the bond's yield to maturity had risen to 7 percent during the year. Show that its rate of return would have been less than the yield to maturity.

A.4. Suppose you buy the bond next year for $1,007.37, and hold it for yet another year, so that at the end of that time it has only 1 year to maturity. Show that if the bond's yield to maturity is still 5.6 percent, your rate of return also will be 5.6 percent and the bond price will be $1,003.79.

A.5. Suppose that the interest rate rises overnight from 5.6 percent to 10 percent. Calculate the present values of the 6 percent, 3-year bond and of the 6 percent, 30-year bond both before and after this change in interest rates. Confirm that your answers correspond with Figure 1.

A.6. You buy an 8 percent coupon, 10-year maturity bond for $980. A year later, the bond price is $1,050.
a. What is the new yield to maturity on the bond?
b. What is your rate of return over the year?

A.7. A 2-year maturity bond with face value $1,000 makes annual coupon payments of $80 and is selling at face value. What will be the rate of return on the bond if its yield to maturity at the end of the year is:

a. 6 percent
b. 8 percent
c. 10 percent

A.8. A bond that pays coupons annually is issued with a coupon rate of 4 percent, maturity of 30 years, and a yield to maturity of 8 percent. What rate of return will be earned by an investor who purchases the bond and holds it for 1 year if the bond's yield to maturity at the end of the year is 9 percent?

A.9. You buy an 8 percent coupon, 10-year maturity bond when its yield to maturit is 9 percent. A year later, the yield to maturity is 10 percent. What is your rate of return over the year?

A.10. Consider three bonds with 8 percent coupon rates, all selling at face value. The short-term bond has a maturity of 4 years, the intermediate-term bond has maturity 8 years, and the long-term bond has maturity 30 years.
a. What will happen to the price of each bond if their yields increase to 9 percent?
b. What will happen to the price of each bond if their yields decrease to 7 percent?
c. What do you conclude about the relationship between time to maturity and the sensitivity of bond prices to interest rates?

Sursa bibliografica:
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