Chapter 6: Bonds

Bond terminology

A bond is defined as a security sold by governments and corporations to raise money from investors today in exchange for a promised future payment. The bond certificate states the terms of a bond as well as the amounts and dates of all payments to be made. The maturity date of a bond is the final repayment date, until this date payments will continue. The term of a bond is the time remaining until the final repayment date of a bond is known. The notional amount of bond used to compute its interest payment is called the face value, or principal value, or par value. This value is usually repaid on the maturity date. Coupons are promised interest payments, in addition to the face value. Coupons are paid periodically until the maturity date. The coupon rate determines the amount of each coupon payment of a bond.

Coupon payment:

$$CPN = \frac{Coupon\ rate\ x\ Face\ value}{Number\ of\ coupon\ payment\ per\ year}$$

Zero-coupon bonds

Bonds without coupon payments are known as *zero-coupon bonds,* the investor only receives the face value at the maturity date. *Treasury bills* are an example of zero-coupon bonds. These bonds are issued by the U.S. government with a maturity of up to one year.

A zero-coupon bond has got two cash flows: the payment of the current market price when purchasing and the receiving of the face value at the maturity date. The market price of a zero-coupon bond is always lower than the face value; these bonds always trade at a *discount*. Zero-coupon bonds are also known as *pure discount bonds.*

The IIR of an investment in a bond is the yield to maturity (YTM). The YTM, or yield, is the discount rate that sets the present value of the promised bond payment equal to the current market prices of the bond. In other words, it's the return you will earn if you buy the bond at its current market price, hold the bond to maturity and receive the promised face value payment.

Yield to maturity of an n-year zero-coupon bond:

$$1 + YTMn = (\frac{face\ value}{price})^{\frac{1}{n}}$$

Often people will refer to the yield to maturity of the zero-coupon risk-free bond as the risk-free interest rate. Some financial professionals also use the term *spot interest rate.*

The risk-free interest rates for investments until date n correspond to the yields of risk-free zero-coupon bonds that mature on date n. The *zero-coupon yield curve* is the plot of the yield of risk-free zero-coupon bonds as a function of the bond's maturity date.

Coupon bonds

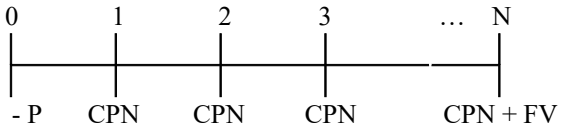
Bonds that pay regular coupon interest payments up to maturity, when the face value is also paid are called coupon bonds. There're two types of U.S. Treasury coupon securities:

- Treasury notes are currently traded in financial markets, with original maturities from one to ten years.
- Treasury bonds are currently traded in financial markets, with original maturities of more than ten years.

The zero-coupon bonds have only two cash flows, but coupon bonds have got many cash flows. This makes it more complicated to calculate the yield to maturity. The return on a coupon bond comes from two sources:

1. Differences between the purchase price and the face value
2. The periodic coupon payments.

The following timeline represents the cash flows of a coupon bond:



Yield to maturity of a coupon bond:

$$P = CPN\ x \frac{1}{y}\left(1 - \frac{1}{(1+y)^N}\right) + \frac{FV}{(1+y)^N}$$

The yield to maturity of the bond is the single discount rate, y, that equates the PV of the bond's remaining cash flows to its current price.

The first part $CPN\ x \frac{1}{y}\left(1 - \frac{1}{(1+y)^N}\right)$ is the present value of all the periodic coupon payments.

Where $\frac{1}{y}\left(1 - \frac{1}{(1+y)^N}\right)$ is the annuity factor using the YTM (y).

The last part $\frac{FV}{(1+y)^N}$ is the present value of the face value repayment using the YTM (y).

When we calculate the yield to maturity with this formula, the yield we compute is a rate per coupon interval. Yields are typically quoted as APRs so we multiply by the number of coupons per year, thereby converting the answer into an APR quote with the same compounding interval as the coupon rate.

The change of bond prices

Zero-coupon bonds always trade for a discount, but coupon bonds may trade at a discount or at a premium. A *premium* is a price at which coupon bonds trade that is greater than their face value.

When the bond price is equal to the face value the bond trades at *par*. This occurs when the coupon rate is equal to the yield to maturity. When the coupon rate is higher than the yield to maturity the bond trades *above par*, or *at a premium*. In this case, the bond price is greater than the face value of the bond. When the bond price is less than the face value the bond trades *below par,* or *at a discount.* When a bond trades at a discount, the coupon rate is lower than the yield to maturity.

As interest rates and bond yields rise, bond prices will fall and vice versa, so that interest rates and bond prices always move in opposite direction.

The market price of a bond can change over time for two reasons.

1. The bonds get closer to the maturity date, as time passes.
2. The YTM and the price will are affected by changes in market interest rates.

As a coupon payment nears, the price will slowly rise. After the payment is made, the price will drop immediately.

The effect of time on bond prices is predictable. On the other hand, the changes in interest rates are unpredictable. Because bonds have got different characteristics, bonds will respond differently to changes in interest rates. Long-term bonds are more sensitive to changes than short-term bonds. Long-term bonds are evaluated more riskier. The sensitivity also depends on the coupon rate of a bond. Bonds with low coupon rates are more sensitive to changes in the interest rates.

Bond traders make a difference between the dirty price and the clean price of a bond. *The dirty price or invoice price* is the actual cash price of a bond. Bond traders quote bonds in terms of a *clean price*, this is the bond's cash price less an adjustment for accrued interest, the amount of the next coupon payment that has already accrued.

Clean price = dirty price – accrued interest.

Accrued interest = coupon amount x (days since last coupon payment / days in current coupon period).

Corporate bonds

Bonds issued by corporations are called *corporate bonds*. The bonds we discussed before, U.S. Treasury bonds, have no risk of default. Treasure bonds are risk-free because there is practically no change the government will fail to pay the interest and default. For that reason, the interest rates will be low. However, corporate bonds have risks or defaults. There is a *credit risk:* the risk of default by the issue of any bond that is not default free; it is an indication that the bond's cash flows are not known with certainty. As compensation, investors in corporate bonds demand a higher interest rate.

General truths:

1. An investor pays more for a default-free bond than for a bond with credit risk.
2. The yield of bonds with credit risk will be higher than the yield of default-free bonds, because the yield is calculated using the promised cash flows instead of the excepted cash flows.

Now we can conclude that the yield to maturity of a bond with credit risk will always be higher than the expected return of investing in the bond, because the promised cash flows will always be higher than the expected cash flows.

The creditworthiness of bonds for investors is summarized in bond ratings. *Investment-grade bonds* are bonds in the top four categories of creditworthiness with a low risk of default. The bonds in one of the bottom five categories of creditworthiness are *speculative bonds,* bonds with a high risk of default.

The *default spread* or *credit spread* is the difference between the risk-free interest rate on U.S. Treasury notes and the interest rates on all other loans. The magnitude of the credit spread will depend on investors' assessment of the likelihood that a particular firm will default.