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EC 247 Financial Instruments and Capital Markets

Class Exercise 4

These questions mainly correspond to chapter 12 of the Frederic S. Mishkin and Stanley G. Eakins, *Financial Markets and Institutions*, 7th Edition, Pearson Prentice Hall, 2012.

Chapter 12 examines securities that have an original maturity that is greater than one year. These types of securities are traded in capital markets and the best known securities are stocks and bonds. This chapter focuses on the characteristics of the bonds. Capital markets are used for long term financing and investments. We examine the purpose of capital markets and the participants in the capital market. Long term bonds traded in the capital market include long-term government notes and bonds, municipal bonds and corporate bonds. Treasury securities are free of default risk, but not risk-free. Bonds issued by local, county, and state governments are municipal bonds and are used to finance public interest projects. Municipal bonds are not free of default. Corporate bonds usually have a face value of $1,000 and can be redeemed at anytime. The chapter concludes by showing how to compute the value of bonds. An example focuses specifically on valuing semiannual bonds.

Questions 2 and 3:

The purpose of these questions is to show how we can compare returns from tax-exempt municipal bonds with those on fully taxable corporate bonds. Municipal bonds are securities issued by local and state (i.e. counties, cities) governments, either to finance public interest projects such as schools, utilities, and transportation systems or to fund temporary imbalances between receipts and expenditures. The source of repayment for these bonds is coming either from taxes or from revenues generated from a particular project. As a result, there are two types of municipal bonds: (a) General obligation bonds and (b) Revenue bonds. Municipal bonds are quite attractive to investors because interest payments (not capital gains) are exempt from federal taxation. This allows the municipality to borrow at a lower cost because investors will be satisfied with a lower interest rate (this issue was also discussed in chapter 5).

In order to compare returns between tax exempt municipal bonds and fully taxed corporate bonds we make use of the following equation:

Equivalent tax-free rate = taxable interest rate x (1- marginal tax rate) (1)

In question 2 we know that:

- The yield on a corporate bond (the taxable bond) which is selling at par is 10% and the marginal tax rate (MTR) is 20%.
- The par-value municipal bond (the tax-exempt bond) has a coupon rate of 8.50%. Since the bond is selling at par this will also be the yield on the municipal bond.

We directly apply the above formula in order to find the equivalent tax-exempt rate on the taxable corporate bond so as to compare it with the tax-free rate on the municipal bond. After comparing the two rates we can decide which security is more attractive.

In question 3 we know that:

- The municipal bond rate (tax-exempt) is 4.25%
- The corporate bond rate (taxable bond) is 6.25%

What we are looking for, is the marginal tax rate under the assumption that the investors are indifferent between the two bonds. This implies that after applying the marginal tax rate (which we do not yet know) on the taxable corporate bond, the equivalent tax free rate will be equal to the municipal bond rate. As a result, we proceed with equation (1) above and we solve for the marginal tax rate.

A discussion related to municipal and corporate bonds can be found on page 326 in the textbook.

Question 4

In this question we are looking for the price of a 20-year zero coupon (ZC) bond with par value of $1000 given that the yield to maturity is 10%. The price of an n-period ZC bond is given by the following formula:

$$P_n = \frac{FV}{(1+i_n)^n} \quad (2)$$

Where:
P_n = the price today of an n-period ZC bond
FV = The face or par value of the bond
i_n = the yield to maturity

The yield to maturity on this 20-year ZC bond is the constant annual rate of return that would be received if the bond is held until maturity.

Questions 5 and 6:

These questions focus on the notion of current yield. The current yield is an approximation of the yield to maturity on coupon bonds. The relevant formula is the following:

$$i_c = \frac{C}{P} \qquad (3)$$

Where:

i_c = current yield

P = price of a coupon bond

C = yearly coupon payment

Equation (3) also describes the yield to maturity for a perpetuity. A perpetuity is a promise to make a coupon payment indefinitely into the future. You can think of a perpetuity as a special sort of annuity. An annuity is a coupon paying bond with zero face value. It provides a sequence of payments which however terminates at a specified date. Consequently a perpetuity can be perceived as an annuity with no specified termination date.

When a coupon bond has a long term to maturity, it is very much like a perpetuity. That is why we can use the current yield as a close approximation of a yield to maturity of a long-term bond. A discussion related to the current yield calculation can be found on pages 334-335 in the textbook.

<u>In question 5</u> we directly apply equation (3) so as to calculate the current yield of a 10-year \$1000 par value bond with 5% annual coupon rate and a yield to maturity of 6%. In order to find the current yield we have to know the annual coupon payment and the price of the bond. The annual coupon payment is \$50 (5% of \$1000 par value). The price of the bond is calculated as following:

$$P = \frac{\$50}{(1.06)^1} + \frac{\$50}{(1.06)^2} + \frac{\$50}{(1.06)^3} + \frac{\$50}{(1.06)^4} + \frac{\$50}{(1.06)^5} + \frac{\$50}{(1.06)^6} + \frac{\$50}{(1.06)^7} + \frac{\$50}{(1.06)^8} + \frac{\$50}{(1.06)^9} + \frac{\$1050}{(1.06)^{10}}$$

Which implies that $P = \$926.40$

Thus the current yield will be: $i_c = \frac{C}{P} = \frac{\$50}{\$926.40} = 5.4\%$

In question 6 we are given the current yield and the yield to maturity for a $1000 par bond and we are asked to find the price of the bond. We make use again of equation (3) i.e. that $i_c = \frac{C}{P}$. However we do not know neither the coupon payment nor the price of the bond. However, we do know that $i_c = \frac{C}{P} = 0.06713$. We solve this equation for C and get:

$$C = 0.06713 * P \tag{4}$$

In addition, we know that the price of the bond is given as:

$$P = \frac{C + \$1000}{(1 + 0.1)} \tag{5}$$

Note that this is a $1000 par bond with an annual coupon and with 1-year to maturity. Thus, at maturity we will receive our coupon plus the par value.

What we have to do is to substitute equation (4) in equation (5) so as to eliminate C and solve for the price level.

SOLUTIONS

Question 1

Contrast investors' use of capital markets with their use of money markets.

The money market is the market for debt securities issued with original maturities of less than one year and a high degree of liquidity. They are usually sold in large denominations and have low default risk. The money market provides an ideal place to warehouse funds until they are needed, or until a more prosperous investment opportunity arises. Similarly, the money market provides a low-cost source of funds to firms, the Government, and intermediaries that need a short-term infusion of funds. There are several players in the money market which include the U.S. Treasury Department, the Federal Reserve, commercial banks, businesses, investment firms, and individuals. All participants work on both sides of the market except for the U.S. Treasury Department, which is always a demander and never a supplier of the money market. The participants use a variety of money market instruments to diversify their needs.

On the other hand, firms and individuals use the capital markets for long-term investment purposes. The primary reason for borrowing long term is to reduce the risk that interest rates will rise before paying off the debt. This reduction in risk will however come with a cost. Long-term interest rates are higher than short term ones.

Question 2

The yield on a corporate bond is 10% and it is currently selling at par. The marginal tax rate is 20%. A par value municipal bond with a coupon rate of 8.50% is available. Which security is a better buy?

Equivalent tax-free rate = taxable interest rate x (1- marginal tax rate)

In this case, $0.10 \times (1 - 0.20) = 8\%$. The corporate bond offers a lower after-tax yield given the marginal tax rate, so the municipal bond is more attractive.

Question 3

If the municipal bond rate is 4.25% and the corporate bond rate is 6.25%, what is the marginal tax rate assuming investors are indifferent between the two bonds?

Equivalent tax-free rate = taxable interest rate x (1- marginal tax rate)

In this case:

$$0.0425 = 0.0625 * (1 - MTR)$$

$$(1 - MTR) = \frac{0.0425}{0.0625}$$

$$(1 - MTR) = 0.68$$

$$-MTR = 0.68 - 1$$

$$MTR = 1 - 0.68$$

$$MTR = 0.32 = 32\%$$

Question 4

A zero coupon bond has a par value of $1,000 and matures in 20 years. Investors require a 10% annual return on these bonds. For what price should the bond sell? (note, zero coupon bonds do not pay any interest)

We directly apply equation (2) above i.e. $P_n = \frac{FV}{(1+i_n)^n}$

$$P_n = \frac{FV}{(1+i_n)^n} = \frac{\$1000}{(1+0.1)^{20}} = \$148.64$$

Question 5

A 10-year, 1,000 par value bond with a 5% annual coupon is trading to yield 6%. What is the current yield?

The current yield will be: $i_c = \frac{C}{P} = \frac{\$50}{\$926.40} = 5.4\%$

Question 6

A $1,000 par bond with an annual coupon has only 1 year until maturity. Its current yield is 6.713% and its yield to maturity is 10%. What is the price of the bond?

We know that $i_c = \frac{C}{P} = 0.06713$. We solve this equation for C and get that:

$$C = 0.06713 * P$$

Then, we substitute into the following equation in order to solve for the price level.

$$P = \frac{C + \$1000}{(1+0.1)}$$

This implies that:

$$P = \frac{(0.06713 * P) + \$1000}{(1+0.1)}$$

$$1.10 * P = 0.06713 * P + \$1000$$

$$1.10 * P - 0.06713 * P = \$1000$$

$$P(1.10 - 0.06713) = \$1000$$

$$P = \frac{\$1000}{1.10 - 0.06713} = \$968.17$$

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