Global and Southern African Perspectives

Principles of Managerial Finance

Third edition

CJ Zutter
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Pearson

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Basic valuation model

The value of an asset is the present value of all the future cash flows it is *expected to provide*. Therefore, calculating an asset's value means discounting the expected cash flows back to the present using a discount rate or required return commensurate with the asset's risk. Using the present value techniques explained in Chapter 5, we can express the value of any asset at time zero, V_0, as

$$V_0 = \frac{CF_1}{(1+r)^1} + \frac{CF_2}{(1+r)^2} + \ldots + \frac{CF_n}{(1+r)^n} \quad \textbf{(6.4)}$$

where

V_0 = value of the asset at time zero
CF_t = cash flow expected in year t
r = required return (discount rate)
n = time period (investment's life or investor's holding period)

We can use the basic idea behind Equation 6.4 to determine the value of many different kinds of assets.

PERSONAL FINANCE EXAMPLE 6.5

Precious Mncube values each asset by discounting its cash flows as indicated by Equation 6.4. Because Jakaranda's shares pay a perpetual stream of R3,000 dividends, Equation 6.4 reduces to Equation 5.7, which says that the present value of perpetuity equals the dividend payment divided by the required return. Precious decides that a 12% discount rate is appropriate for this investment, so her estimate of the value of Jakaranda's Enterprises shares is

$$\frac{\text{R3,000}}{0{,}12}$$
$$= \text{R25,000}$$

Next, Precious values the oil well investment, which she believes is the riskiest of the three investments. Discounting the oil well's cash flows using a 20% required return, Precious estimates the well's value to be

$$\text{R20,000}\,(1+0.20)^1 + \text{R40,000}\,(1+0.20)^2 + \text{R100,000}\,(1+0.20)^4$$
$$= \text{R281,626,67}$$

Finally, Precious estimates the value of the painting by discounting the expected R850,000 cash payment in 5 years at 15%:

$$\text{R850,000}\,(1+0.15)^5$$
$$= \text{R1,709,653,61}$$

Note that, regardless of the pattern of the asset's expected cash flows, Precious can use the basic valuation equation to determine the asset's value.

REVIEW QUESTIONS

6.12 Why is it important for financial managers to understand the valuation process?
6.13 What are the three key inputs to the valuation process?
6.14 Does the valuation process apply only to assets that provide an annual cash flow? Explain.
6.15 Define and specify the general equation for the value of any asset, V_0.

LO 5 LO 6

6.4 Bond valuation

Customizing the basic valuation equation to value specific securities such as bonds, preferred stock, and common stock is relatively straightforward. We describe bond valuation in this chapter, and we cover the valuation of common stock and preferred stock elsewhere in this text in Chapter 7.

Bond fundamentals

Bonds are long-term debt instruments used by business and government to raise large sums of money, typically from a diverse group of lenders. Most corporate bonds pay interest *semi-annually* (every six months) at a stated *coupon rate*; have an initial *maturity* of 10 to 30 years; and have a par value, principal, or face value, of R1,000 that the borrower must repay at maturity.

EXAMPLE 6.6

On January 1, 2020, Freedom Hills Company issued a 7.25% coupon rate, 10-year bond with a R1,000 par value that pays interest annually. Investors who buy this bond receive the contractual right to two types of cash flows: (1) R60 annual interest (7.25% coupon rate * R1,000 par value) distributed at the end of each year and (2) the R1,000 par value at the end of the tenth year.

We will use the Freedom Hills Company bond to see how the market prices change. We use the terms price and value (or pricing and valuation) interchangeably, reflecting a view that the participants in the bond market determine the price of a bond using the valuation principles outlined here.

Bond valuation

Valuing a bond is a simple application of Equation 6.4. The market price of a bond should equal the present value of the payments its issuer is contractually obligated to make. Those payments include a series of coupon (i.e., interest) payments and final payment to return the bond's par value to the investor when the bond matures. The basic model for the value, B_0, of a bond is given by

$$B_0 = C \times \left[\sum_{t=1}^{n} \frac{1}{(1 + r_d)^t}\right] + M \times \left[\frac{1}{(1 + r_d)^n}\right]$$

$$= C \times (PVIFA_{rd,n}) + M \times (PVIF_{rd,n}) \quad \textbf{(6.5)}$$

where

B_0 = value (or price) of the bond at time zero
C = annual coupon interest payment in rands
n = number of years to maturity
M = par value in rands
r = required return on the bond

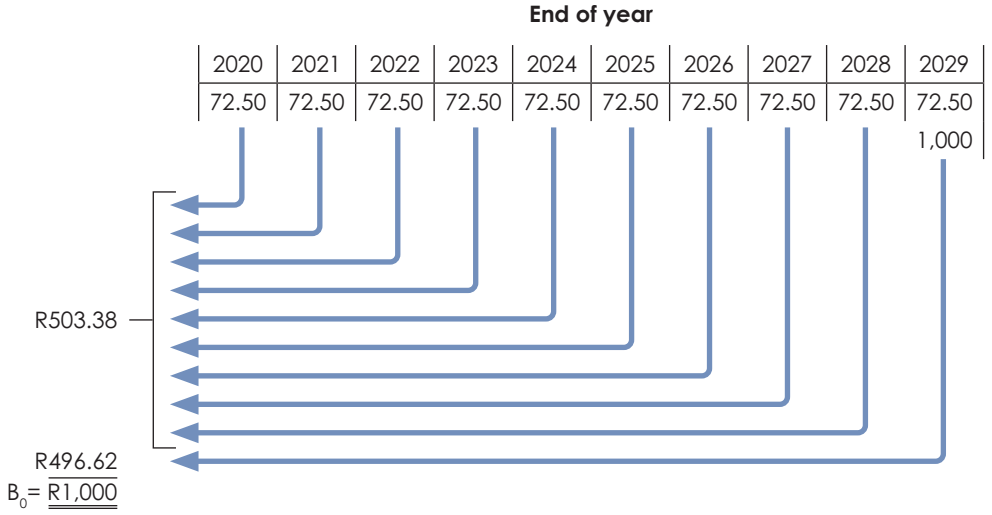
Notice that the stream of cash flows provided by a bond is composed of an annuity paying C rands for n years plus a lump sum payment of M rands when the bond matures. Determining the value of a bond today means calculating the present value of the annuity of coupon payments and adding to that the present value of the bond's par value paid at maturity. Therefore, an alternative mathematical approach to calculating a bond's price makes use of the formulas for the present value of an annuity and the present value of a lump sum, discussed previously in this text.

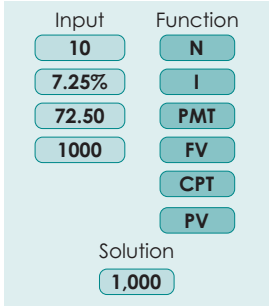
The first term in Equation 6.5 is the formula for the present value of an annuity, and the second term is the present value of a lump sum. We can calculate a bond's value by using Equations 6.5 or by using a financial calculator or spreadsheet.

PERSONAL FINANCE EXAMPLE 6.7

Zinhle Ngcobo wishes to determine the current value of the Freedom Hills Company bond. *If the bond pays interest annually* and the required return on the bond is 7.25% (equal to its coupon rate), then we can calculate the bond's value using Equation 6.5.

The timeline below depicts the computations involved in finding the bond value.





Calculator use: Using the Freedom Hills Company's inputs shown at the left, you should find the bond value to be exactly R1,000. If you compare the calculator keystrokes to the ones we displayed when we used a calculator to find the present value of an ordinary annuity earlier in this text, you will see that there is an additional term here, namely, the R1,000 future value (FV). We must add that to our sequence of keystrokes because the bond pays out an annuity plus a lump sum at the end. When we add the FV keystroke, we are capturing the value of that final lump sum payment when the bond matures. Note that the *calculated bond value is equal to its par value, which will always be the case when the required return is equal to the coupon rate.*

Spreadsheet use: We can also calculate the value of the Freedom Hills Company bond, as shown in the following Excel spreadsheet.

	A	B
1	BOND VALUE ANNUAL INTEREST, REQUIRED RETURN = COUPON INTEREST RATE	
2	Annual interest payment	R72.50
3	Coupon interest rate	7.25%
4	Number of years to maturity	10
5	Par value	R1,000.00
6	Bond value	R1,000.00
7	Entry in Cell B6 is (PV(B4,B5,–B3))+((B5*(1+ B3)^–B4)) Note that the first part of the expression (PV(B4,B5,–B3) calculates present value of interest payments using present value of annuity function and the second expression (B5*(1+ B3)^–B4) calculates present value of the maturity value of the bond using present value of a single sum formula.	

Semi-annual interest rates and bond values

As a practical matter, most bonds make semi-annual rather than annual interest payments. Continuing with the example of the Freedom Hills Company bond, we note that if it paid interest semi-annually rather than annually, then investors would receive an annuity of 20 coupon payments (two payments per year for ten years) of R36.25 each (half of the annual R72.50 coupon paid every six months).

Of course, they will also receive R1,000 when the bond matures. Calculating the value for a bond paying semi-annual interest requires three changes to the approach we've used so far:

1. Convert the annual coupon payment, C, to a semi-annual payment by dividing C by 2.
2. Recognize that if the bond has *n* years to maturity, it will make 2*n* coupon payments (i.e., in n years there are 2*n* semi-annual periods).
3. Discount each payment by using the semi-annual required return calculated by dividing the required annual return, *r*, by 2.
4. As we noted in Chapter 5, the effective annual rate of interest, *EAR*, for stated interest rate *r*, when interest is paid semi-annually ($m = 2$) can be found by using Equation 5.25:

$$EAR = \left(1 + \frac{i}{m}\right)^m - 1 \qquad \textbf{(6.6)}$$

Therefore, EAR equals to

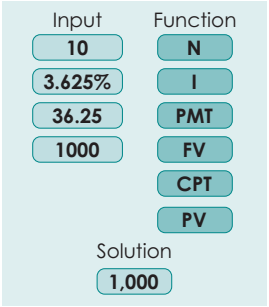
$$= \left(1 + \left(\frac{7.25\%}{2}\right)^2\right) - 1 = (1.03625)^2 - 1 = 1.07381 - 1 = 0.07381 = 7.38\%$$

Because most bonds pay semi-annual interest at semi-annual rates equal to 50% of the stated annual rate, their effective annual rates are generally higher than their stated annual rates. For example, a bond with a 12% required stated annual return that pays semi-annual interest would have an effective annual rate of

$$= \left(1 + \left(\frac{12\%}{2}\right)^2\right) - 1 = (1.06)^2 - 1 = 1.1236 - 1 = 0.1236 = 12.36\%$$

Spreadsheet use: The value of the Freedom Hills Company bond paying semi-annual interest at a required annual return of 7.25% also can be calculated as shown in the following Excel spreadsheet.

	A	B
1	BOND VALUE ANNUAL INTEREST, REQUIRED RETURN = COUPON INTEREST RATE	
2	Annual interest payment	R36.25
3	Coupon interest rate	3.63%
4	Number of years to maturity	20
5	Par value	R1,000.00
6	Bond value	R1,000.00
7	Entry in Cell B6 is (PV(B4,B5,–B3))+((B5*(1+ B3)^–B4)) Note that the first part of the expression (PV(B4,B5,–B3) calculates present value of interest payments using present value of annuity function and the second expression (B5*(1+ B3)^–B4) calculates present value of the maturity value of the bond using present value of a single sum formula.	



As before, because the required rate on this bond equals the coupon rate, the bond sells at par value. We will soon see that when the required return does not equal the coupon rate, the bond may sell above or below par value.

Calculator use: When using a calculator to find the price of a bond that pays interest semi-annually, we must double the number of periods and divide both the required annual return and the annual coupon payment by 2. For the Freedom Hills Company bond, we would use 20 periods (2 * 10 years), a semi-annual required return of 3.625% ($\frac{7.25\%}{2}$), and an interest payment of R36.25 ($\frac{R72.50}{2}$). Using these inputs, you should find the bond value with semi-annual interest to be R1,000, as shown at the left.

Changes in bond values

The price of a bond in the marketplace does not remain fixed at its par value. In Table 6.2, you saw that the prices of bonds often differ from their par values. Some bonds are valued below par (current price below 100), and others are valued above par (current price above 100). A variety of forces in the economy, as well as the passage of time, affect bond values. The most important thing to know about bond prices is that they move in the opposite direction of required returns. When the required return rises, the bond price falls, and when the required return falls, the bond price rises.

Required returns and bond values

Whenever the required return on a bond differs from the bond's coupon rate, the bond's price will differ from its par value. The required return is likely to differ from the coupon rate because either (1) economic conditions have changed since the bond was issued, causing a shift in the cost of funds; or (2) the bond issuer's risk has changed. Increases in the cost of funds or risk will raise the required return; decreases in the cost of funds or risk will lower the required return. When the required return is greater than the coupon rate, the bond's value **discount** will be less than its par value. In this case, the bond sells at a discount. Looking back at Table 6.2, you can see that Company A and Company E bonds sell at a discount, and these bonds have a yield to maturity that exceeds the coupon rate. When the required return falls below the coupon rate, the bond's value will be greater than par. In this situation, the bond sells at a **premium**, which is the case for Company B and Company D in Table 6.2 on page 231.

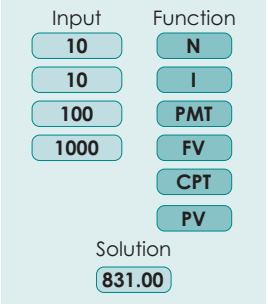
discount the amount by which a bond sells below its par value

premium the amount by which a bond sells above its par value

PERSONAL FINANCE EXAMPLE 6.8

Let's reconsider the Freedom Hills Company bond paying a 7.25% coupon rate and maturing in 10 years (assume annual interest payments for simplicity). Initially, we assumed that the required return on this bond was 7.25%, and in that case, the bond's value was R1,000, equal to par value.

Let's see what happens to the bond's value if the required return is higher or lower than the coupon rate. Table 6.5 shows that at a 10% required return, the bond sells at a discount with a value of R 831.00, but if the required return is 5%, the bond sells at a premium with a value of R 1,173.74.



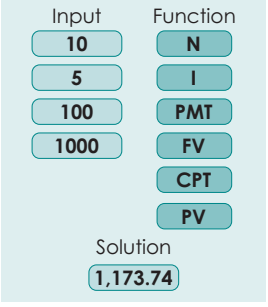


Table 6.5 Bond values for various required returns for Freedom Hills Company bond paying a 7.25% coupon rate and maturing in 10 years with a face value of R1,000

Required return	Bond value	Status
10%	R831.00	Discount
7.25	1,000.00	Par value
5	1,173.74	Premium

Calculator use: Using the inputs shown at the left for the two different required returns, you will find the value of the bond to be below or above par. At an 10% required return, the bond would sell for R831, which is a *discount* of R169 below par value. At a 5% required return, the bond would sell for R1,173.74, which is a *premium* of R173.74 above par value. Figure 6.4 illustrates the inverse relationship between the required return and the price of the Freedom Hills Company bond.

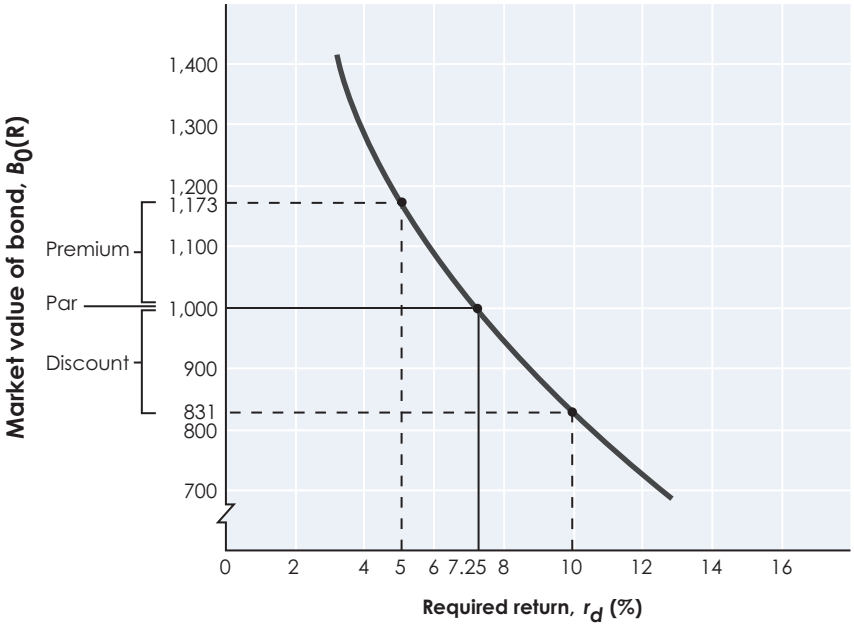


Figure 6.4 **Bond values and required returns.** Bond values and required returns (Freedom Hills Company's 7.25% coupon interest rate, 10-year maturity, R1,000 par, January 1, 2020, issue paying annual interest).

Spreadsheet use: The values for the Freedom Hills Company bond at required returns of 10% and 5% also can be calculated as shown in the following Excel spreadsheet. Once this spreadsheet has been configured, you can calculate the bond price for any required return by simply changing the input values.

	A	B	C
1	BOND VALUE ANNUAL INTEREST, REQUIRED RETURN NOT EQUALS TO COUPON INTEREST RATE		
2	Annual interest payment	R72.50	R72.50
3	Coupon interest rate	7.25%	7.25%
4	Required return	10%	5.0%
5	Number of years to maturity	10	10
6	Par value	R1,000.00	R1,000.00
7	Bond value	R831.02	R1,173.74
8	Entry in Cell B7 for a discount is (PV(B4,B5,–B3))+(B6*(1+B4)^–B5)) Note that the bond trades at a discount (i.e., below par) because the bond's coupon rate is below investors' required rate of return. Entry in Cell B7 for a premium is (PV(C4,C5,–C3))+(C6*(1+C4)^–C5)) Note that the bond trades at a premium (i.e., above par) because the bond's coupon rate is above investors' required rate of return.		

Whenever the required return is different from the coupon rate, the number of years to maturity affects a bond's price. An additional factor is whether required returns are constant or change over the life of the bond.

Constant required returns: When the required return is different from the coupon rate and is constant until maturity, the value of the bond will approach its par value as the passage of time brings the bond's maturity date closer. (Of course, when the required return equals the coupon rate, the bond's value will remain at par until it matures.)