

Chapter-3

Risk and return

2.1. Introduction

In this chapter, we start from the basic premise that investors like returns and dislike risk. Therefore, people will invest in risky assets only if they expect to receive higher returns. We define precisely what the term *risk* means as it relates to investments. We examine procedures that managers use to measure risk, and we discuss the relationship between risk and return.

2.2. Meaning of risk

Risk is an important concept in financial analysis, especially in terms of how it affects the security prices and the rates of return. The investment risk is associated with the probability of low or negative future returns.

Thus, risk refers to the chances that some unfavorable event will occur. For instance, if you're engaged in sky-diving, you are taking a risky chance with your life — because sky-diving is risky. If you bet on the horses, you are risking your money. If you invest in speculative stocks (or, more realistically, *any* stocks), you are taking a risk in the hope of making an appreciable returns.

The riskiness of an asset can be considered in two ways: (1) on a *stand-alone basis*, where the asset's cash flows are analyzed, all by themselves; or, (2) in a *portfolio context*, where the cash flows from a number of assets are combined and then the consolidated cash-flows are analyzed.

In a portfolio context, an asset's risk can be divided into two components: (1) a *diversifiable risk component*, which can be diversified away and hence is of little concern to diversified investors; and, (2) a *market risk component*, which reflects that the risks in the general stock-market declines and which cannot be eliminated by diversification, hence does concern investors. Thus only the general market risk is *relevant*; diversifiable risk is irrelevant to most investors because it can be eliminated.

2.3. Types of risk

Some of the risks you take when you invest your money include the following:

a) Financial Risk

Financial risk is the risk that the business or government will not be able to return your money-much less pay a rate of return. Businesses, state agencies, and local governments have on some occasions declared bankruptcy. Government prints money, so there is no financial risk that it will not pay off its bonds. Insured savings accounts are insured by an agency of the federal government, so they carry very little financial risk.

b) Market Price Risk

This is the risk that the price of an investment will go down. This rarely happens to the money saved in a bank, savings and loan, or credit union. However, the prices of stocks, bonds, and mutual funds are determined by supply and demand, and they do go down (as well as up). The supply of an investment is the different quantities of investment that will be offered for sale at various prices during a specific time period. The demand for an investment refers to the different quantities of an investment that will be purchased at various prices during a specific time period. The equilibrium price is the price at which buyers want to buy the same amount of an investment that sellers want to sell.

The important point is that anything that changes the behavior of buyers and sellers can change the price of an investment. For example, technology stocks have been “hot” at various times. Prices increased because more people wanted technology stocks at various price levels (demand increased). When investors became less interested in technology stocks, the average price fell because fewer people wanted technology stocks at every price level (demand decreased).

c) Liquidity Risk

Liquidity is the ability to turn your money into cash or spendable funds, such as a checking account. Some investments are very liquid. For example, some savings accounts allow you to withdraw your money at any time without a penalty. Stocks listed on a stock exchange are very liquid; you can buy or sell

them at any time. Real estate and collectibles, on the other hand, are not very liquid because it takes time for a seller to find a buyer. Although the Internet is speeding up this process, there is no guarantee that a buyer and seller can get together on price and other terms for real estate and collectibles.

d) Inflation Risk

Money is invested today in order to spend it tomorrow. The goal is to receive the original investment back plus a return, so that you will be able to buy more in the future.

Inflation can decrease the value of your investment. When you save or invest, you are deferring your spending until a later time. If prices rise over that time, your money will not go as far.

Therefore, investors are more interested in the real rate of return than the nominal rate of return. The real rate of return is the nominal rate of return minus the inflation rate. For example, let's say you put your money in a certificate of deposit at an 8 percent rate of return. The annual rate of inflation is 3 percent. Therefore, your real rate of return is 5% ($8\% - 3\% = 5\%$). The longer the time period, the greater the inflation risk.

e) Fraud Risk

Some investments are misrepresented. In these cases, information about the investment is designed to deceive investors. Anyone can print a fancy brochure, make promises on the telephone, or guarantee great returns on the Internet. Criminals often make up facts. Therefore, it is important to investigate before you invest. Most investment fraud occurs in securities and savings schemes that do not involve banks, savings and loans, credit unions, and brokerage firms.

2.4. Measuring risk (standalone investment)

An asset's **stand-alone risk** is the risk an investor would face if he or she held only this one asset. Obviously, most assets are held in portfolios, but it is

necessary to understand stand-alone risk in order to understand risk in a portfolio context.

Risk is a difficult concept to grasp, and a great deal of controversy has surrounded attempts to define and measure it. However, a common definition, and one that is satisfactory for many purposes, is stated in terms of probability distributions.

To be most useful, any measure of risk should have a definite value—we need a measure of the tightness of the probability distribution. One such measure is the **standard deviation**, the symbol for which is σ pronounced “sigma.” **The smaller the standard deviation, the tighter the probability distribution, and, accordingly, the lower the riskiness of the stock.**

In order to calculate / estimate the standard deviation, we use the following steps:

Step 1: calculate the expected rate of return

$$\text{Expected rate of return} = \hat{r} = \sum_{i=1}^n P_i r_i$$

Where:

- ✓ r_i is the i^{th} possible outcome
- ✓ P_i is the probability of the i^{th} outcome
- ✓ n is the number of possible outcomes.

Step 2: Subtract the expected rate of return ($\hat{r}$) From each possible outcome (r_i) to obtain a set of deviations about $\hat{r}$

$$\text{Deviation} = r_i - \hat{r}$$

Step 3: square each deviation, then multiply the result by the probability of occurrence of its related outcome, and sum these products to obtain the variance of the probability distribution.

$$\text{var} = \sum_{i=1}^n (r_i - \hat{r})^2 P_i$$

Step 4: find the square root of the variance to obtain standard deviation

$$SD = \sqrt{\sum_{i=1}^n (r_i - \bar{r})^2 P_i}$$

Thus, the standard deviation is essentially a weighted average of the deviations from the expected value, and it provides an idea of how far above or below the expected value the actual value is likely to be.

Illustration-1

Here are given details about Wegagen bank and CBE.

DD for the bank's services	Probability (P)	Wegagen bank return (r)	CBE return (r)
Strong	0.3	100%	20%
Normal	0.4	15%	15%
Weak	0.3	(70)%	10%

Instruction: So based on the above information calculate the standard deviation of Wegagen bank and CBE and select the best investment in terms of risk and return.

Solution

Standard deviation for Wegagen bank

$P \times r_i$ (step-1)	$r_i - \bar{r}$ (Step 2)	$(r_i - \bar{r})^2$ (step 3)	$(r_i - \bar{r})^2 P_i$
$0.3 \times 100\% = 30\%$	$100 - 15 = 85$	7,225	2167.5
$0.4 \times 15\% = 6\%$	$15 - 15 = 0$	0	0
$0.3 \times (70)\% = (21)\%$	$-70 - 15 = -85$	7,225	2167.5
$\sum \bar{r} = 15\%$	Sum (variance)		4,335
	Square root of variance (standard deviation)		65.84%

Calculate the standard deviation for CBE by yourself (answer SD= 3.87)

2.5. Using Historical Data to Measure Risk

In the example just given, we described the procedure for finding the standard deviation when the data are in the form of a probability distribution. If only sample returns data over some past period are available, the standard deviation of returns should be estimated using this formula:

$$\text{estimated } \sigma = s = \sqrt{\frac{\sum_{t=1}^n (\bar{r}_t - \bar{r}_{avg})^2}{N-1}}$$

Where

- $\bar{r}_t$ -denotes the past realized rate of return in Period t
- $\bar{r}_{avg}$ is the average annual return earned during the last N years
- N- year

Illustration

The following is information about the ABC - company

Year	$\bar{r}_t$
2003	15%
2004	-5
2005	20

Required: calculate estimated standard deviation

$$\bar{r}_{avg} = \frac{(15\% - 5\% + 20\%)}{3} = 10\%$$

$$\begin{aligned} \text{estimated } \sigma = s &= \sqrt{\frac{(15\% - 10\%)^2 + (-5\% - 10\%)^2 + (20\% - 10\%)^2}{3 - 1}} \\ &= \sqrt{\frac{350\%}{2}} = 13.23\% \end{aligned}$$

2.6. Measuring Stand-Alone Risk: The Coefficient of Variation

If a choice has to be made between two investments ***that have the same expected returns, but different standard deviations***, most people would choose the one with the lower the standard deviation and, therefore, the lower risk. Similarly, given a choice between two investments with the same risk (standard deviation) but different expected returns, investors would generally prefer the investment with the highest expected return. To most people, this is common sense—return is “good,” risk is “bad,” and, consequently, investors want as much return and as little risk as possible. **But how do we choose between two investments if one has the higher expected return, but the other the lower standard deviation?** To help answer this question, we use another measure of risk, the **coefficient of variation (CV)**, which is the standard deviation divided by the expected return:

$$\text{coefficient of variation (CV)} = \frac{\sigma}{\bar{r}}$$

The coefficient of variation shows the risk per unit of return, and it provides a more meaningful risk measure when the expected returns on two alternatives are not the same.

In a case where the coefficient of variation is necessary, consider Projects X and Y. These projects have different expected rates of return and different standard deviations. Project X has a 60 percent expected rate of return and a 15 percent standard deviation, while Project Y has an 8 percent expected return but only a 3 percent standard deviation. Is Project X riskier, on a relative basis, because it has the larger standard deviation? If we calculate the coefficients of variation for these two projects, we find that ***Project X has a coefficient of variation of $15/60 = 0.25$*** , and ***Project Y has a coefficient of variation of $3/8 = 0.375$*** . Thus, we see that ***Project Y actually has more risk per unit of return than Project X, in spite of the fact that X's standard deviation is larger.*** Therefore, even though Project Y has the lower standard deviation, according to the coefficient of variation it is riskier than Project X.

Illustration

Based on the above information calculate coefficient of variation for Wegagen and CBE

Solution

Since Wegagen bank and CBE have the same expected return, the coefficient of variation is not necessary in this case. Here the bank with the larger standard deviation, Wegagen bank, must have the larger coefficient of variation. In fact, the coefficient of variation for Wegagen bank is $65.84/15 = 4.39$ and that for CBE is $3.87/15 = 0.26$. Thus, Wegagen bank is almost 17 times riskier than CBE on the basis of this criterion.

NOTE: the coefficient of variation captures the effects of both risk and return; it is a better measure for evaluating risk in situations where investments have substantially different expected returns.

2.7. Risk in a portfolio context

Thus far we have considered the riskiness of assets when they are held in isolation. Now we analyze the riskiness of assets held as a part of a portfolio. As we shall see, an asset held in a portfolio is less risky than the same asset held in isolation. Since investors dislike risk, and since the risk can be reduced by holding portfolios that is, by diversifying most financial assets are indeed held in portfolios.

This being the case, from an investor's standpoint the fact that a particular stock goes up or down is not very important; *what is important is the return on his or her portfolio, and the portfolio's risk. Logically, then, the risk and return of an individual security should be analyzed in terms of how that security affects the risk and return of the portfolio in which it is held.*

2.7.1. Portfolio returns

The **expected return on a portfolio** $\hat{r}_p$ is simply the weighted average of the expected returns on the individual assets in the portfolio, with the weights being the fraction of the total portfolio invested in each asset:

$$\hat{r}_p = \sum_{i=1}^n w_i \hat{r}_i$$

Where:

- $\hat{r}_i$ - **Expected return on individual stocks**
- w_i - **The fraction of the portfolio's dollar value invested in Stock i**
- **N - no of stocks in the portfolio**

Note: (1) that W_i is the fraction of the portfolio's dollar value invested in Stock i (*that is, the value of the investment in Stock i divided by the total value of the portfolio*) and (2) that the w_i 's must sum to 1.0.

Illustration

Assume that in August 2001, a security analyst estimated that the following returns could be expected on the stocks of four large companies:

	EXPECTED RETURN, $\hat{r}_i$
Microsoft	12.0%

General Electric	11.5
Samsung	10.0
Coca-Cola	9.5

If we formed a Birr 100,000 portfolio, investing Birr 25,000 in each stock what will be the expected portfolio return?

Solution

$$\begin{aligned}\hat{r}_p &= \mathbf{w}_1\hat{r}_1 + \mathbf{w}_2\hat{r}_2 + \mathbf{w}_3\hat{r}_3 + \mathbf{w}_4\hat{r}_4 \\ &= 0.25(12\%) + 0.25(11.5\%) + 0.25(10\%) + 0.25(9.5\%) \\ &= \mathbf{10.75\%}\end{aligned}$$

Of course, after the fact and a year later, the actual **realized rates of return**, $\bar{r}_i$, on the individual stocks—the $\bar{r}_i$, or “r-bar,” values—will almost certainly be different from their expected values, so $\bar{r}_i$ will be different from $\hat{r}_p = 10.75\%$.

For example, Coca-Cola’s price might double and thus provide a return of +100 percent, whereas Microsoft might have a terrible year, fall sharply, and have a return of -75 percent.

2.7.2. Portfolio Risk

Although the expected return on a portfolio is simply the weighted average of the expected returns of the individual assets in the portfolio, the riskiness of the portfolio, δ_p , is *not* the weighted average of the individual assets’ standard deviations. The portfolio’s risk is generally *smaller* than the average of the assets δ .

We have shown that we can calculate the expected rate of return and evaluate the uncertainty, or risk, of an investment by identifying the range of possible returns from that investment and assigning each possible return a weight based on the probability that it will occur. Although the graphs help us visualize the dispersion of possible

returns, most investors want to quantify this dispersion using statistical techniques. These statistical measures allow you to compare the return and risk measures for alternative investments directly. Two possible measures of risk (uncertainty) have received support in theoretical work on portfolio theory: the *variance* and the *standard deviation* of the estimated distribution of expected returns.

In this section, we demonstrate how variance and standard deviation measure the dispersion of possible rates of return around the expected rate of return.

i. Variance

The larger the **variances for an expected rate** of return, the greater the dispersion of expected returns and the greater the uncertainty, or risk, of the investment. The formula for the variance is as follows:

$$\begin{aligned}\text{Variance } (\delta^2) &= \sum_{i=1}^n (\text{probability}) \times (\text{Possible return} - \text{expected return})^2 \\ &= \sum_{i=1}^n p_{i[r_i - \bar{r}]}^2\end{aligned}$$

ii. Standard deviation

The **standard deviation** is the square root of the variance:

$$\text{Standard deviation} = \sqrt{\sum_{i=1}^n p_{i[r_i - \bar{r}]}^2}$$

iii. A Relative Measure of Risk

In some cases, an unadjusted variance or standard deviation can be misleading. If conditions for two or more investment alternatives are not similar—that is, if there are major differences in the expected rates of return—it is necessary to use a measure of *relative variability* to indicate risk per unit of expected return. A widely used relative measure of risk is the **coefficient of variation (CV)**, calculated as follows:

$$\text{Coefficient of variation (CV)} = \frac{\text{standard deviation of returns } (\delta i)}{\text{Expected rate of return } \bar{r}}$$

Illustration-1

Let's assume that there is a portfolio, which has 50 percent in Stock A and 25 percent in each of Stocks B and C. The relevant calculations can be summarized as follows:

State of Economy	Probability of State of Economy	Rate of Return If State Occurs		
		Stock- A	Stock-B	Stock-C
Boom	0.4	10%	15%	20%
Bust	0.6	8	4	0

Required: based on the above data calculate:

- Portfolio return at the time of boom and bust
- Portfolio variance
- Standard deviation

Solution

- Portfolio return at the time of boom

$$\begin{aligned}
 \hat{r}_p &= w_a \hat{r}_b + w_b \hat{r}_b + w_c \hat{r}_c \\
 &= (50\% * 10\%) + (25\% * 15\%) + (25\% * 20\%) \\
 &= 5 + 3.75 + 5 \\
 &= \underline{\underline{13.75\%}}
 \end{aligned}$$

- Portfolio variance at the time of boom

$$\begin{aligned}
 \text{Variance}(\delta^2) &= \sum_{i=1}^n p_{i[r_i - \hat{r}]}^2 \\
 &= 0.4(10\% - 13.75\%)^2 + 0.4(15\% - 13.75\%)^2 + 0.4(20\% - 13.75\%)^2 \\
 &= 297.52 + 33.06 + 826.45 \\
 &= \underline{\underline{1,157.03}}
 \end{aligned}$$

- Standard deviation at the time of boom

$$\text{Standard deviation } (\delta) = \sqrt{\delta^2}$$

$$=\sqrt{1,157.03}$$

$$= \underline{\underline{34.0}}$$

CHAPTER-4: FIXED INCOME SECURITIES

1.1. Meaning of bond

A **bond** is a long-term contract under which a borrower (the issuer) agrees to make payments of interest and principal, on specific dates, to the holders (creditors) of the bond.

Investors have many choices when investing in bonds, but bonds are classified into four main types: Treasury, corporate, municipal, and foreign. Each differs with respect to risk and consequently to its expected return.

1. **Treasury bonds**, generally called Treasuries and sometimes ***referred to as government bonds***, are issued by the federal government. It is reasonable to assume that the federal government will make good on its promised payments, so Treasuries have no default risk. However, these

bond prices decline when interest rates rise, so they are not completely risk free.

2. **Corporate bonds**, as the name implies, are issued by corporations. Unlike Treasuries, corporate bonds are exposed to default risk—if the issuing company gets into trouble, it may be unable to make the promised interest and principal payments. Different corporate bonds have different levels of default risk, depending on the issuing company's characteristics and on the terms of the specific bond. Default risk is often referred to as “credit risk,” and, the larger the default risk, the higher the interest rate investors demand.
3. **Municipal bonds**, or “munis,” are issued by state and local governments. Like corporate, munis are exposed to some default risk. However, munis offer one major advantage over all other bonds: the interest earned on most munis is exempt from federal taxes, and also from state taxes if the holder is a resident of the issuing state. Consequently, the interest rates on munis are considerably lower than on corporate of equivalent risk.
4. **Foreign bonds** are issued by foreign governments or foreign corporations. Foreign corporate bonds are, of course, exposed to default risk, and so are the bonds of some foreign governments. An additional risk exists if the bonds are denominated in a currency other than that of the investor's home currency. For example, if you purchase a corporate bond denominated in Japanese yen, even if the company does not default, you still could lose money if the Japanese yen falls relative to the dollar.

1.2. BOND CHARACTERISTICS

Although all bonds have some common characteristics, they do not always have the same contractual features. For example, most corporate bonds have provisions for early repayment (call features), but these provisions can be quite different for different bonds. Differences in contractual provisions, and in the underlying strength of the companies backing the bonds, lead to major differences in bonds' risks, prices, and expected returns. To understand bonds, it is important that you understand the following terms.

- a) **PAR VALUE:** Also called the maturity value or face value; the amount that an issuer agrees to pay at the maturity date.
- b) **COUPON INTEREST RATE:** With bonds, notes, or other fixed income securities, the stated percentage rate of interest, usually paid twice a year (semiannually). **Coupon payments** - A bond's dollar interest payments. **When this coupon payment, as it is called, is divided by the par value, the result is the coupon interest rate.**

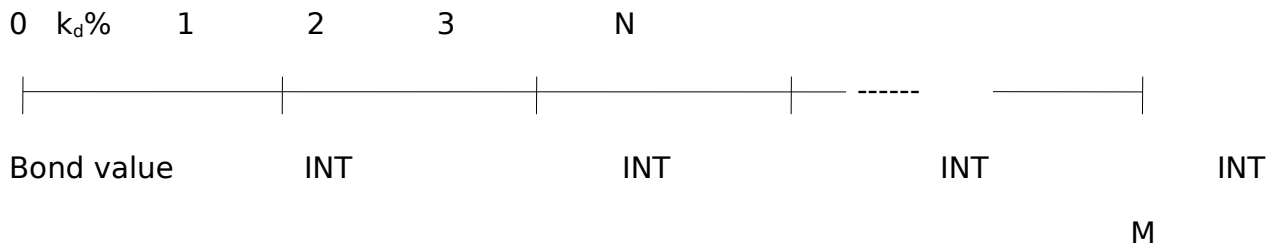
For example, Allied's bonds have a \$1,000 par value, and they pay \$100 in interest each year. The bond's coupon interest is \$100, so its coupon interest rate is $\$100/\$1,000 = 10$ percent.

- c) **Maturity date** - Date on which the principal amount of a bond or other debt instrument becomes due and payable.
- d) **Call provision** - An embedded option granting a bond issuer the right to buy back all or part of an issue prior to maturity.
- e) **Bond indenture** - is the legal agreement between the firms issuing the bonds and the bond trustee who represents the bondholders. The indenture provides the specific terms of the loan agreement, including a description of the bonds, the rights of the bondholders, the rights of the issuing firm, and the responsibilities of the trustee.
- f) **Sinking fund** - A fund to which money is added on a regular basis that is used to ensure investor confidence that promised payments will be made and that is used to redeem debt securities or preferred stock issues.
- g) **Sinking fund provision** - A condition included in some corporate bond indentures that requires the issuer to retire a specified portion of debt each year.
- h) **Convertible bond** - General debt obligation of a corporation that can be exchanged for a set number of common shares of the issuing corporation at a pre-stated conversion price.
- i) **Warrant** - A security entitling the holder to buy a proportionate amount of stock at some specified future date at a specified price, usually one higher than current market price. Warrants are traded as

securities whose price reflects the value of the underlying stock. Corporations often bundle warrants with another class of security to enhance the marketability of the other class. Warrants are like call options, but with much longer time spans-sometimes years. And, warrants are offered by corporations, while exchange-traded call options are not issued by firms.

1.3. BOND VALUATION

The value of any financial asset -- a stock, a bond, etc., or even a physical asset -- is simply the present value of the cash flows (discounted at the asset's required rate of return) which the asset is expected to generate over its lifetime.



Where

k_d = the bond's market rate of interest or required rate of return; also called the yield to maturity (YTM); This is the discount rate that is used to calculate the present value of the bond's cash flows (Can change many times over the bond's life).

N = the number of years before the bond matures.

M = the par, or maturity, value of the bond(usually \$1,000).

CIR = the coupon interest rate (does not change over the bond's life).

INT = the dollar amount of interest the bond pays per year

($INT = CIR \times M$).

Bond valuation model with annual coupons:

$$V_B = \sum_{t=1}^N \frac{INT}{(1+k_d)^t} + \frac{M}{(1+k_d)^N} = INT(PVIFA_{k_d,n}) + M(PVIF_{k_d,n})$$

The first term on the right-hand side of the equation above is the present value of an annuity; the second term is the present value of a single amount, the final payment of the bond's par value.

Price = Coupon $\times$ Annuity factor (k_d, T) + Par value $\times$ PV factor (k_d, N)

$$\text{Price (V}_B\text{)} = \text{Coupon} \times \frac{1}{Kd} \left[1 - \frac{1}{(1+Kd)^N} \right] + \text{Par value} \times \frac{1}{(1+Kd)^N}$$

Bond valuation model with semi-annual coupons:

$$V_B = \sum_{t=1}^{2N} \frac{\text{INT}/2}{(1 + k_d/2)^t} + \frac{M}{(1+k_d/2)^{2N}} = \text{INT}/2(\text{PVIFA } k_{d/2,2n}) + M(\text{PVIF } k_{d/2,2n})$$

Or

$$\text{Price (V}_B\text{)} = \text{Coupon} \times \frac{1}{Kd/2} \left[1 - \frac{1}{(1+Kd/2)^{2N}} \right] + \text{Par value} \times \frac{1}{(1+Kd/2)^{2N}}$$

Zero Coupon bond valuation model:

$$V_{\text{Zero}} = M/(1 + k_d)^n = M(\text{PVIF}_{k_d,n})$$

Or

$$\frac{1}{(1+Kd)^N}$$

Illustration

ATT issues \$1,000,000 worth of 10-year, \$1,000 bonds with an 8% annual coupon rate. The yield (r) on similar bonds is also 10%.

Required: calculate the value of the bond

Solution

$$\text{Price (V}_B\text{)} = \text{Coupon} \times \frac{1}{Kd} \left[1 - \frac{1}{(1+Kd)^N} \right] + \text{Par value} \times \frac{1}{(1+Kd)^N}$$

$$\begin{aligned}
&= 80 \times \frac{1}{0.1} \left[1 - \frac{1}{(1+0.1)^{10}} \right] + 1,000 \times \frac{1}{(1+0.1)^{10}} \\
&= 491.56 + 385.54 \\
&= \underline{\underline{877.1}}
\end{aligned}$$

Bond Valuation: Important Relationships

- A decrease in interest rates (required rates of return) will cause the value of a bond to increase; an interest rate increase will cause a decrease in value. The change in value caused by changing interest rates is called **interest rate risk**. A bondholder owning a long-term bond is exposed to greater interest rate risk than when owning a short-term bond.
- The market value of the bond will always approach its par value as its maturity date approaches, provided the firm does not go bankrupt.
- If the bondholder's required rate of return (current interest rate) equals the coupon interest rate, the bond will sell at "**par**," or maturity value.
- If the current interest rate exceeds the bond's coupon rate, the bond will sell below par value or at a "**discount**."
- If the current interest rate is less than the bond's coupon rate, the bond will sell above par value or at a "**premium**."

1.4. BOND YIELD

The value of a bond, its fair price, is the present value of its promised future payments for coupon and principal. This present value is determined by the bonds required return. Recall again that the required return is the minimum rate of return you must expect to be willing to make the investment (buy the bond).

When a bond is issued, its terms are set by the issuing firm to achieve a particular fair price for the bond. Most often, firms set the terms so that, when the bond is issued, the fair price will be very close to the bond's par value. However, after the bonds have been issued, their fair price will reflect current market conditions. In other words, bond values change over time. This is because the contract terms, especially the schedule of payments, are usually fixed. But the required return always reflects

current market conditions. As a result, whenever the interest rate (required return) changes, the bond price (the present value of its future payments) changes.

1.4.1. Yield to maturity

The percentage rate of return paid on a bond, note, or other fixed income security if the investor buys and holds it to its maturity date. The calculation for YTM is based on the **coupon rate**, **length of time to maturity**, and **market price**. It assumes that coupon interest paid over the life of the bond will be reinvested at the same rate.

$$\text{Estimated YTM} = \frac{\text{INT} + [(M - V_B)/n]}{(M + V_B)/2}$$

Example

Suppose you were offered a 14-year, 10 percent annual coupon, \$1,000 par value bond at a price of \$1,494.93. What rate of interest would you earn on your investment if you bought the bond and held it to maturity?

Soln

Given :

$$\text{Int} = 1000 \times 10\% = 100$$

$$M = 1000$$

$$t = 1$$

$$N = 14$$

$$V_b = 1,494.93$$

$$\text{Estimated YTM} = \frac{\text{INT} + [(M - V_B)/n]}{(M + 2V_B)/3}$$

$$\text{Estimated YTM} = \frac{100 + [(1000 - 1494.93)/14]}{(1000 + 2(1,494.93))/3}$$

$$\text{Estimated YTM} = \frac{64.65}{1,329.95} = \underline{5\%}$$

1.4.2. Current yield

It is The annual interest payment on a bond divided by the bond's current price. Unlike the yield to maturity, the current yield does not represent the return that investors should expect to receive from holding the bond. The current yield provides information regarding the amount of cash income that a bond will generate in a given year, but since it does not take account of capital gains or losses that will be realized if the bond is held until maturity (or call), it does not provide an accurate measure of the bond's total expected return.

$$\text{Current yield} = \frac{\text{Stated (coupon) interest per year}}{\text{Current market price}}$$

Illustration

15% \$ 200 debenture is currently selling for Rs. 220, the annual current yield would be

soln

$$\text{Current yield} = \frac{\text{Stated (coupon) interest per year}}{\text{Current market price}}$$

$$= \frac{(200 \times 15\%)}{220} = \underline{13.64\%}$$

You must notice that the 15% debenture is currently selling for \$220 because interest rates have subsequently declined and debenture/bond prices move inversely with interest rates. The current yield has declined to 13.64%. The coupon rate of 15% reflects this.

1.4.3. Yield to call

The percentage rate of return on a bond or note if the investor buys and holds the security until the call date. This yield is valid only if the security is called prior to maturity. Generally bonds are callable over several years and normally are called at a slight premium. The calculation of yield to call is based on **coupon rate, length of time to call, call price** and **market price**.

$$\text{Estimated YTC} = \frac{\text{INT} + [(\text{Call Price} - V_B)/\text{Years to Call}]}{(\text{Call Price} + 2V_B)/3}$$

Illustration

Suppose the 8% annual coupon, 30-year maturity bond sells for \$1,150 and is callable in 10 years at a call price of \$1,100. What will be the estimated yield to call on the bond?

Solution

$$\text{Int} = 1,000 \times 8\% = 80$$

$$V_B = 1,150$$

$$\text{Call price} = \$1,100$$

$$\text{years to call} = 10$$

$$\text{Estimated YTC} = \frac{\text{INT} + [(\text{Call Price} - V_B)/\text{Years to Call}]}{(\text{Call Price} + 2V_B)/3}$$

$$= \frac{80 + [(\$1,100 - 1,150)/10]}{(1,100 + (2 \times 1,150))/3}$$

$$= \frac{65}{1,133.3}$$

$$= \underline{5.74\%}$$

1.4.4. Yield to maturity on a zero coupon bond

A zero-coupon bond (also called a **pure-discount bond**) is a bond that makes no payments until its maturity. Its par value, which is paid at maturity, is the combined repayment of principal and all the interest over the bond's life. The Equation used to value a zero-coupon bond, or to determine its YTM will be:

Example

$$\text{YTM}_{\text{Zero}} = (M/V_{\text{Zero}})^{1/n} - 1.0$$

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XYZ Company has a zero-coupon bond that will pay \$ 1,000 at maturity in exactly 20 years. The bond is selling for \$178.43. What is its YTM?

Soln

$$\begin{aligned} \text{YTM}_{\text{Zero}} &= (M/V_{\text{Zero}})^{1/n} - 1.0 \\ &= (1000/178)^{1/20} - 1 \\ &= \underline{\mathbf{0.09 \text{ or } 9\%}} \end{aligned}$$

1.5. RISKS IN BOND

The YTM is the bond's *promised* return, which is its expected return—if the payments are certain. But what if the bond issuer may not make all the payments exactly as promised?

If the firm fails to make a payment, or even if it is just late making a payment, the investor's Realized return will be less than the promised return. But the firm is not going to pay more than the contract requires, so the realized return will never be more than the promised return.

Therefore, when there is any chance the payments will not be made exactly as promised—any payment risk—the expected return is less than the YTM.

Nevertheless, the YTM is a good estimate of the expected return on high-grade bonds because the payment risk is low. The YTM is not always a good estimate of the expected return on so-called "junk" bonds, named for precisely their higher level of payment risk.

1.5.1. Interest Rate Risk

Bonds rarely sell for exactly face (par) value, even if that was their original selling price. Whenever a bond's required return changes, the bond's fair price also changes. A bond selling below its par value is called a **discount bond**. A bond selling above its par value is called a **premium bond**.

With contractually fixed cash flows (interest and principal payments), a drop in the required return raises the present value, and vice versa. Because of this, owning a bond is risky. This risk, that market prices will fluctuate, exists even if the firm is healthy and makes all of the required payments. This risk is called **interest-rate**

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risk. Because of interest-rate risk, even bonds that are guaranteed against default have some risk.

A bond can be riskless (or as close as possible to being riskless) *only* in the sense that the future cash flows will occur as promised. If you sell the bond before its maturity, it is likely to be for a price that differs from your purchase price. In fact, a decline in market value can easily exceed the income received from the interest payments while you own the bond!

How much interest-rate risk is there? It depends primarily on the bond's remaining maturity. When all else is equal, interest-rate risk is greater with a longer remaining maturity.

1.5.2. **Inflation Risk**

Bond payments are stated in nominal dollars. That is, they ignore inflation—and the decrease in purchasing power it causes. Current inflationary expectations are built into the required return. If inflation turns out to be less than expected, the future cash flows will have more purchasing power than expected, which would be a gain for the bondholders. On the other hand, if inflation turns out to be more than expected, the future cash flows will have less purchasing power, a loss. Fixed-income securities can have considerable inflation risk.

1.5.3. **Currency Risk**

Many people invest in foreign securities. Payments from foreign securities are usually made in a foreign currency. If the value of that currency changes, relative to the value of a dollar, the dollar-denominated value of your investment will change. For example, suppose you buy a Japanese bond that makes payments in yen. If the yen appreciates (depreciates) relative to the dollar, the bond's payments will be worth more (less) when you convert them into dollars.

1.5.4. **Marketability Risk**

The volume of trading in corporate bonds is lower than the volume in common stocks. Bonds are less liquid and have larger trading costs. This reduces the bond's return. If a bond's liquidity changes significantly, the bond's required return will change to reflect the change in trading costs. The possibility of significant changes in liquidity creates marketability risk, which affects bond values.

1.6. **RATING OF BONDS**

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Bond ratings are critical to a company's ability to issue debt at an acceptable interest rate. Unrated debt is extremely difficult, if not impossible to sell. Corporations desiring to sell bonds must submit their proposals to an independent rating company for the debt to be assigned a rating. This rating, coupled with market rates of interest and the special features of the debt, will determine how much the company will have to pay in interest.

Bond ratings provide the fundamental analysis of thousands of issues. The rating agencies analyze the issuing organization and the specific issue to determine the probability of default and inform the market of their analyses through their ratings.

The primary question in the bond credit analysis is whether the firm can service its debt in a timely manner over the life of a given issue. Consequently, the rating agencies consider expectations over the life of the issue, along with the historical and current financial position of the company.

Any time new information relevant to the company's ability to repay the debt (i.e. Changes in the company's financial health) are discovered and determined to be of sufficient impact, that company's debt rating might be changed. Obviously, good information should result in a better rating or upgrade and bad information should result in a downgrade.

Bonds of companies that suffered downgrades would decline in value to equate the yield to the new level of risk. Conversely, bonds that were upgraded should increase in price.

Bond ratings are important for firms raising capital via a debt offering. Companies that are financially sound enough to get a higher rating will be able to sell debt with lower interest payments than their riskier counterparts. Bond rating agencies also actively monitor outstanding debt they have rated for changes in status. Companies placed on watch lists are companies who are facing potential changes in the rating of their debt.

- ❖ **Junk bond** - A bond with a speculative credit rating of BB (S&P) or Ba (Moody's) or lower. Junk or high-yield bonds offer investors higher yields than bonds of financially sound companies.

Investment grade bonds have low default risk and higher rating.

Junk bonds are bonds that are rated as speculative grade

Moody's

S&P

Investment Grade Bonds: Low Risk/High

Ratings

Aaa	AAA	Gilt edge, prime, maximum safety
Aa1	AA+	
Aa2	AA	Very high grade, high quality
Aa3	AA-	
A1	A+	
A2	A	Upper medium grade
A3	A-	
Baa1	BBB+	
Baa2	BBB	Lower medium grade
Baa3	BBB-	

Speculative Grade Bonds: High Risk/Low

Ratings

Ba1	BB+	
Ba2	BB	Low grade, speculative
Ba3	BB-	
B1	B+	
B2	B	Highly speculative
B3	B-	

Very Speculative Grade Bonds: High

Risk of Default

	CCC+	
Caa	CCC	Substantial risk, in poor standing

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CCC-

Ca
speculative

CC

May be in default, extremely

C

C

paid

CI

Income Bonds; no interest is being

D

1.7. ANALYSIS OF CONVERTIBLE BONDS

Convertible bonds are debentures (i.e., unsecured debt instruments) that may be converted at the holder's option into the stock of the issuing company. Since the firm has granted the holder the right to convert the bonds, these bonds are usually subordinate to the firm's other debt. They also tend to offer a lower interest rate (i.e., coupon rate) than is available on nonconvertible debt. Thus, the conversion feature means that the firm can issue lower-quality debt at a lower interest cost. Investors are willing to accept this reduced quality and interest income because the market value of the bond will appreciate if the price of the stock rises. These investors are thus trading quality and interest for possible capital gains.

Since convertible bonds are long-term debt instruments, they have features that are common to all bonds. They are usually **issued in \$1,000 denominations, pay interest semiannually, and have a fixed maturity date**. If the bonds are converted into stock, the maturity date is irrelevant because the bonds are retired when they are converted. Convertible bonds frequently have a sinking fund requirement, which, like the maturity date, is meaningless once the bonds are converted.

Convertible bonds are *always callable*. The firm uses the call to force the holders to convert the bonds. Once the bond is called, the owner must convert, or any appreciation in price that has resulted from an increase in the stock's value will be lost. Such forced conversion is extremely important to the issuing firm, because it no longer has to pay the interest and retire the debt.

1.7.1. The Value of Convertible Bonds

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The value of a convertible bond can be described in terms of three components: The first considers the value of the bond solely **as stock**. The second covers the bond's value only as a **debt instrument**, and the last section combines these values to show the **hybrid nature of convertible bonds**.

1. The convertible bond as stock—the conversion value

Conversion value is what the bonds would be worth if they were immediately converted into common stock at current prices. **Conversion value** depends on (1) ***the face value or principal amount of the bond (FV)***, (2) ***the conversion (or exercise) price of the bond***, and (3) ***the market price of the common stock***. The face value divided by the *conversion price* of the bond gives the number of shares into which the bond may be converted.

The conversion value of the bond as stock may be expressed in equation form. The number of shares into which the bond may be converted is called the *conversion ratio*, or

$$\text{Conversion Ratio} = \frac{\text{Par Value of Bond}}{\text{Conversion Price}}$$

If the conversion price is \$40 per share and the par value of the bond is \$1000, then the conversion ratio is 25 shares, which is computed as follows.

$$\frac{\$1,000}{\$40} = 25$$

This means is that 1 bond equals 25 shares.

The conversion value of the bond is the product of the conversion ratio and the price of the stock. It shows the value of the stock/bond if the bond is converted today

$$\text{Conversion Value} = (\text{Market Price of stock}) \times (\text{Conversion Ratio})$$

Or

$$\text{Conversion value} = \frac{\text{Par Value of Bond}}{\text{Conversion Price}} \times \text{market price of stock}$$

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Let's assume in the above example the current market price of stocks is \$35 per share. The conversion value of the stock will be?

$$\text{Conversion Value} = (\text{Market Price of stock}) \times (\text{Conversion Ratio})$$

$$\text{Conversion Value} = \$35 \times 25 = \underline{\$875}$$

❖ **Conversion Price** – Price of buying a share of stock if you purchase the bond at par and immediately convert it.

$$\text{Conversion Price} = \text{Face Value} / \text{Conversion Ratio}$$

2. The convertible bond as debt—the investment value

The **investment value** of a convertible bond is related to **(1) the annual interest that the bond pays (PMT), (2) the current interest rate that is paid on comparable nonconvertible debt, and (3) the requirement that the principal (FV) be retired at maturity (after n number of years) if the bond is not converted**. In terms of present value calculations, the value of a convertible bond as nonconvertible debt is given in:

$$V_B = \sum_{t=1}^N \frac{INT}{(1+k_d)^t} + \frac{M}{(1+k_d)^N} = INT(PVIFA_{k_d,n}) + M(PVIF_{k_d,n})$$

Or

$$\text{Price } (V_B) = \text{Coupon} \times \frac{1}{Kd} \left[1 - \frac{1}{(1+Kd)^N} \right] + \text{Par value} \times \frac{1}{(1+Kd)^N}$$

Illustration

Suppose that debenture issued by ABC-corporation had been rated A, and A-rated bonds were priced to yield 4 percent per year. Further suppose the annual coupons were \$33.75, the principal amount was \$1,000 and maturity 16 years. The straight bond value of ABC-corporation convertible bonds can be how much?

Solution

The straight bond value of ABC-corporation convertible bonds can be determined by discounting the \$33.75 coupon payment and principal amount at 4 percent:

$$\begin{aligned}
 \text{Price (V}_B) &= \text{Coupon} \times \frac{1}{Kd} \left[1 - \frac{1}{(1+Kd)^N} \right] + \text{Par value} \times \frac{1}{(1+Kd)^N} \\
 &= 33.75 \times \frac{1}{0.04} \left[1 - \frac{1}{(1+0.04)^{16}} \right] + 1,000 \times \frac{1}{(1+0.04)^{16}} \\
 &= 393.26 + 533.91 \\
 &= \underline{\underline{927.17}}
 \end{aligned}$$

3. The bond's value as a hybrid security

The market price (P_m) of the convertible bond combines both the conversion value of the bond and its investment value as nonconvertible debt. If the price of the stock were to decline significantly below the exercise price of the bond, the market price of the convertible bond would be influenced primarily by the bond's value as nonconvertible debt. In effect, the bond would be priced as if it were a pure debt instrument. As the price of the stock rises, the conversion value of the bond rises and plays an increasingly important role in the determination of the market price of the convertible bond. At sufficiently high stock prices, the market price of the bond is identical with its conversion value.

**Value of convertible bond = the greater of (Straight bond value,
Conversion value) + Option value**

For example

Suppose the Moulton Company has outstanding 1,000 shares of common stock and 100 bonds. Each bond has a face value of \$1,000 at maturity. They are discount bonds and pay no coupons. At maturity each bond can be converted into 10 shares of newly issued common stock.

What circumstances will make it advantageous for the holders of Moulton convertible bonds to convert to common stock at maturity?

If the holders of the convertible bonds convert, they will receive $100 \times 10 = 1,000$ shares of common stock. Because there were already 1,000 shares, the total number of shares outstanding becomes 2,000 upon conversion. Thus, converting

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bondholders own 50 percent of the value of the firm, V . If they do not convert, they will receive \$100,000 or V , whichever is less. The choice for the holders of the Moulton bonds is obvious. They should convert if 50 percent of V is greater than \$100,000. This will be true whenever V is greater than \$200,000.

Stock and equity valuation

4.1. Stock characteristic

A stock represents an ownership interest in a corporation, but to the typical investor, a share of stock is simply a piece of paper characterized by two features:

1. It entitles its owner to dividends, but only if the company has earnings out of which dividends can be paid and management chooses to pay dividends rather than retaining and reinvesting all the earnings. Whereas a bond contains a *promise* to pay interest, stock provides no such promise—if you own a stock, you may *expect* a dividend, but your expectations may not in fact be met.
2. Stock can be sold, hopefully at a price greater than the purchase price. If the stock is actually sold at a price above its purchase price, the investor will receive a **capital gain**. Generally, when people buy common stock they expect to receive capital gains; otherwise, they would not buy the stock. However, after the fact, they can end up with capital losses rather than capital gains.

Applying the valuation procedure to common stocks is more difficult than applying it to bonds for various reasons.

- First, in contrast to coupon payments on bonds, the size and timing of the dividend cash flows are less certain.
- Second, common stocks are true perpetuities in that they have no final maturity date.
- Finally, unlike the rate of return, or yield, on bonds, the rate of return on common stock is not directly observable.

4.2. Dividend discount model

One of the most widely used equity valuation model is the dividend discount model (DDM). According to the dividend discount model, the value of a share of stock is equal to the present value of all the future dividends it is expected to provide over an infinite time horizon.

$$V_s = \sum_{t=1}^{\infty} \frac{D_1}{(1+k_s)^1} + \frac{D_2}{(1+k_s)^2} + \frac{D_3}{(1+k_s)^3} + \dots + \frac{D_{\infty}}{(1+k_s)^{\infty}}$$

The dividend discount model is based on the following assumptions:

- The future value of dividend is known by the investor
- Dividends are expected to be distributed at the end of each year until infinity
- Dividends are the only way investors get money back from the company

4.2.1. Single period valuation model

The investor expects to hold the equity share for one year. The price of the equity share will be:

$$P_o = \frac{D_1}{(1+K_s)} + \frac{P_1}{(1+K_s)}$$

Where:

- P_o = current price of the equity share
- D_1 = dividend expected a year hence
- P_1 = Price of the share expected a year hence
- K_s = rate of return required on the equity share

Illustration

Suppose you are thinking of purchasing the stock of **Samsung** and you expect it to pay a \$2 dividend in one year and you believe that you can sell the stock for \$14 at that time. If you require a return of 20% on investments of this risk, what is the maximum you would be willing to pay?

$$P_o = \frac{2}{(1+0.2)} + \frac{14}{(1+0.2)}$$

$$P_o = \underline{\underline{13.34}}$$

4.2.2. *The zero-growth model*

The most basic of all DDM is the zero growth models. This model assumes that dividend will be constant over time, so that growth

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is zero, and that the investor's required rate of return is constant.

$$P_o = \frac{D}{(1+K_s)} + \frac{D}{(1+K_s)} + \frac{D}{(1+K_s)} + \frac{D}{(1+K_s)} + \dots$$

The above equation, on simplification becomes;

$$P_o = \frac{D}{K_s}$$

For example, if a stock paid a (constant) dividend of \$3 a share and you wanted to earn 10% on your investment, the value of the stock would be \$30 a share (\$3/0.10=\$30).

As you can see, the only cash flow variable that's used in this model is the fixed annual dividend. Given that the annual dividend on this stock never changes, does that mean the price of the stock never changes? Absolutely not! For as the capitalization rate that is, the required rate of return changes, so will the price of the stock. Thus, if the capitalization rate goes up to, say, 15%, the price of the stock will fall to \$20 (\$3/0.15).

4.2.3. The constant-growth model

The zero-growth model is a good beginning, but it does not take into account a growing stream of dividends, which is more likely to be the case in the real world. The standard and more widely recognized version of the dividend valuation model assumes that dividends will grow over time at a specified rate. In this version, the value of a share of stock is still considered to be a function of its future dividends, but such dividends are expected to grow forever (to infinity) at a constant rate of growth, *g*. accordingly the value of a share of stock can be

$$\text{value of a share of stock} = \frac{\text{Next year's dividends}}{(\text{required rate of return} - \text{constant rate of growth})}$$

Or

$$V_s = \frac{D_1}{K_s - g}$$

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Suppose **XYZ-Company** plans to pay \$2.30 per share in dividends in the coming year. If its equity cost of capital is 7% and dividends are expected to grow by 2% per year in the future, estimate the value of **XYZ-Company's** stock.

$$V_s = \frac{D_1}{K_s - g} = \frac{2.30}{0.07 - 0.02} = \underline{\underline{46}}$$

You would be willing to pay 20 times this year's dividend of \$2.30 to own **XYZ-Company** stock because you are buying a claim to this year's dividend and to an infinite growing series of future dividends.

Once you've determined the dividend growth rate, g , you can find next year's dividend, D_1 , as:

$$D_1 = D_0 \times (1 + g)$$

Where;

- D_0 equals the actual (current) level of dividends.

Let's say that in the latest year ABC-Company paid \$2.50 a share in dividends. If you expect these dividends to grow at the rate of 6% a year, you can find next year's dividends as follows:

$$\begin{aligned} D_1 &= D_0 \times (1 + g) \\ &= \$2.50 \times (1 + .06) \\ &= \$2.50 \times (1.06) = \underline{\underline{\$2.65}} \end{aligned}$$

The only other information you need is the capitalization rate, or required rate of return, k . (Note that k must be greater than g for the constant-growth model to be mathematically operative.)

4.2.4. The variable-growth model

Although the constant-growth dividend valuation model is an improvement over the zero-growth model, it still has some shortcomings. The most obvious of these is the fact that it does not allow for changes in expected growth rates. To overcome this problem, we can use a form of the DVM that allows for *variable*

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rates of growth over time. Essentially, the *variable-growth dividend valuation model* derives, in two stages, a value based on future dividends and the future price of the stock (which price is a function of all future dividends to infinity). The variable-growth version of the model finds the value of a share of stock as follows:

Common Stock Valuation under Supernormal Growth (two-stage growth)

$$p_o = \frac{D_o(1+g_s)}{(R-g_s)} \left[1 - \left[\frac{1+g_s}{1+R} \right]^{N_s} \right] + \frac{D_o(1+g_s)^{N_s}(1+g_n)}{R-g_n} [(1+R)^{-N_s}]$$

- **P₀ = current price of the equity share**
 - **D₀ = The dollar amount of the last actual dividend on the stock**
 - **R = Required rate of return on the stock**
 - **g_n = Expected constant growth rate of the dividends on the stock**
 - **g_s = Expected supernormal growth rate of the dividends on the stock**
 - **N_s = Number of years of initial (supernormal) growth**
-

Illustration

Through the Glass Corp. is growing quickly. Dividends are expected to grow at a 20 percent rate for the next three years, with the growth rate falling off to a constant 6 percent thereafter. If the required return is 13 percent and the company just paid a \$3.05 dividend, what is the current share price?

Solution

With supernormal dividends, we find the price of the stock when the dividends level off at a constant growth rate, and then find the present value of the future stock price, plus the present value of all dividends during the supernormal growth period. The stock begins constant growth after the third dividend is paid,

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so we can find the price of the stock in Year 3, when the constant dividend growth begins as:

$$P_3 = D_3 (1 + g) / (R - g)$$

$$P_3 = D_0 (1 + g_1)^3 (1 + g_2) / (R - g)$$

$$P_3 = \$3.05(1.20)^3(1.06) / (.13 - .06)$$

$$P_3 = \$79.81$$

The price of the stock today is the present value of the first three dividends, plus the present value of the Year 3 stock price. The price of the stock today will be:

$$\begin{aligned} & \frac{\$3.05(1.2)}{1.13} + \frac{\$3.05(1.2)^2}{1.13^2} + \frac{\$3.05(1.2)^3}{1.13^3} + \frac{79.81}{1.13^3} \\ & = \$65.64 \end{aligned}$$

Alternatively, using the equation above:

$$P_0 = \frac{D_0(1+g_s)}{(R-g_s)} \left[1 - \left(\frac{1+g_s}{1+R} \right)^{N_s} \right] + \frac{D_0(1+g_s)^{N_s}(1+g_n)}{R-g_n} [(1+R)^{-N_s}]$$

$$P_0 = \frac{\$3.05(1.20)}{(.13-.20)} \left[1 - \left(\frac{1.20}{1.13} \right)^3 \right] + \frac{\$3.05(1.20)^3(1.06)}{.13-.06} [(1.13)^{-3}]$$

$$P_0 = -52.2857 (-.19759068) + \$79.8089 (.69305)$$

$$P_0 = \$10.33117 + \$55.31158$$

$$= \underline{\underline{\$65.64}}$$