Money, Banking, and the Financial System

SECOND EDITION

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ALWAYS LEARNING

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Money, Banking, and the Financial System

Second Edition

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The Fundamental Value of Stock

Now consider the case of an investor who intends to invest in a stock for two years. We apply the logic we used in the case of the one-year investment to the case of a two-year investment: The price of the stock should be equal to the sum of the present values of the dividend payments the investor expects to receive during the two years plus the present value of the expected price of the stock at the end of two years:

$$P_t = \frac{D^e_{t+1}}{(1 + r_E)} + \frac{D^e_{t+2}}{(1 + r_E)^2} + \frac{P^e_{t+2}}{(1 + r_E)^2}.$$

We could continue to consider investments over more years, which would lead to similar equations, with the final expected price term being pushed further and further into the future. Ultimately, as we found when discussing bonds, the price of a share of stock should reflect the present value of all the payments to be received from owning the stock over however many periods. In fact, economists consider the *fundamental value* of a share of stock to be equal to the present value of all the dividends investors expect to receive into the indefinite future:

$$P_t = \frac{D^e_{t+1}}{(1 + r_E)} + \frac{D^e_{t+2}}{(1 + r_E)^2} + \frac{D^e_{t+3}}{(1 + r_E)^3} + \ldots,$$

where the ellipsis (. . .) indicates that the dividend payments continue forever. Because we are looking at an infinite stream of dividend payments, there is no longer a final price term, P^e, in the equation.

What about firms that pay no dividends, such as Facebook and Berkshire Hathaway, the company run by Warren Buffett, perhaps the best-known and most successful investor of recent decades? We can use this same equation to calculate the fundamental value of the firm, under the assumption that investors expect it to eventually start paying dividends. In that case, some of the initial expected dividend terms would be zero, and we would insert positive numbers starting in the year in which we expected the firm to begin paying dividends. Investors probably would not buy the stock of a firm that was never expected to pay dividends because in that case, investors would never expect to receive their proportionate share of the firm's profits.

The Gordon Growth Model

The equation given above for the fundamental value of a share of stock isn't too helpful to an investor trying to evaluate the price of a stock because it requires forecasting an infinite number of dividends. Fortunately, in 1959, Myron J. Gordon, then an economist at the Massachusetts Institute of Technology, developed a handy method of estimating the fundamental value of a stock. Gordon considered the case in which investors expect a firm's dividends to grow at a constant rate, g, which could be, say, 5%. In that case, each dividend term in the equation above would be 5% greater than the dividend received in the previous year. Using this assumption that dividends are expected to grow at a constant rate, Gordon developed an equation showing the relationship between the current price of the stock, the current dividend paid, the expected

growth rate of dividends, and the required return on equities. This equation is called the **Gordon growth model**:

Gordon growth model A model that uses the current dividend paid, the expected growth rate of dividends, and the required return on equities to calculate the price of a stock.

$$P_t = D_t \times \frac{(1 + g)}{(r_E - g)}.$$

Suppose that Microsoft is currently paying an annual dividend of $0.60 per share. The dividend is expected to grow at a constant rate of 7% per year, and the return investors require to invest in Microsoft is 10%. Then, the current price of a share of Microsoft stock should be:

$$\$0.60 \times \frac{(1 + 0.07)}{(0.10 - 0.07)} = \$21.40.$$

There are several points to notice about the Gordon growth model:

1. The model assumes that the growth rate of dividends is constant. This assumption may be unrealistic because investors might believe that dividends will grow in an uneven pattern. For instance, Microsoft's profits—and the dividends it pays—may grow more rapidly during the years following the introduction of a new version of Windows than during the following years. Nevertheless, the assumption of constant dividend growth is a useful approximation in analyzing stock prices.
2. To use the model, the required rate of return on the stock must be greater than the dividend growth rate. This is a reasonable condition because if a firm's dividends grow at a rate faster than the required return on equities, the firm will eventually become larger than the entire economy, which, of course, cannot happen.
3. Investors' expectations of the future profitability of firms and, therefore, their future dividends, are crucial in determining the prices of stocks.

Solved Problem 6.2

Using the Gordon Growth Model to Evaluate GE Stock

The Gordon growth model is a useful tool for calculating the price of a stock. Apply the model to the following two problems:

a. If General Electric (GE) is currently paying an annual dividend of $0.40 per share, its dividend is expected to grow at a rate of 7% per year, and the return investors require to buy GE's stock is 10%, calculate the price per share for GE's stock.

b. In September 2012, the price of IBM's stock was $207 per share. At the time, IBM was paying an annual dividend of $3.40 per share. If the return investors required to buy IBM's stock was 0.10, what growth rate in IBM's dividend must investors have been expecting?

Solving the Problem

Step 1 **Review the chapter material.** This problem is about using the Gordon growth model to calculate stock prices, so you may want to review the section "The Gordon Growth Model," which begins on page 198.

Step 2 **Calculate GE's stock price by applying the Gordon growth model equation to the numbers given in part (a).** The Gordon growth model equation is:

$$P_t = D_t \times \frac{(1 + g)}{(r_E - g)}.$$

Substituting the numbers given in the problem allows us to calculate the price of GE's stock:

$$\$0.40 \times \frac{(1 + 0.07)}{(0.10 - 0.07)} = \$14.27.$$

Step 3 **Calculate the expected growth rate of IBM's dividend by applying the Gordon growth model equation to the numbers given in part (b).** In this problem, we know the price of the stock but not the expected rate of dividend growth. To calculate the expected rate of dividend growth, we need to plug the numbers given into the Gordon growth equation and then solve for g:

$$\begin{aligned} \$207 &= \$3.40 \times \frac{(1 + g)}{(0.10 - g)} \\ \$207 \times (0.10 - g) &= \$3.40 \times (1 + g) \\ \$20.70 - \$207g &= \$3.40 + \$3.40g \\ g &= \frac{\$17.30}{\$210.40} = 0.082, \text{ or } 8.2\%. \end{aligned}$$

Our calculation shows that investors must have been expecting IBM's dividend to grow at an annual rate of 8.2%.

See related problem 2.11 at the end of the chapter.

6.3

Learning Objective

Explain the connection between the assumption of rational expectations and the efficient markets hypothesis.

Rational Expectations and Efficient Markets

The Gordon growth model shows that investors' expectations of the future profitability of firms play a crucial role in determining stock prices. In fact, expectations play an important role throughout the economy because many transactions require participants to forecast the future. For instance, if you are considering taking out a mortgage loan in which you agree to pay a fixed interest rate of 5% for 30 years, you will need to forecast such things as:

- Your future income: Will you be able to afford the mortgage payments?
- The future inflation rate: What will be the real interest rate on the loan?
- The future of the neighborhood the house is in: Will the city extend a bus line to make it easier to travel downtown?

Adaptive Expectations Versus Rational Expectations

Economists have spent considerable time studying how people form expectations. Early studies of expectations focused on the use of information from the past. For example, some economists assumed that investors' expectations of the price of a firm's

stock depended only on past prices of the stock. This approach is called **adaptive expectations**. Some stock analysts employ a version of adaptive expectations known as *technical analysis*. These analysts believe that certain patterns in the history of a stock's price are likely to be repeated, and, therefore, can be used to forecast future prices.

Adaptive expectations
The assumption that people make forecasts of future values of a variable using only past values of the variable.

Today, most economists are critical of the adaptive expectations approach because it assumes that people ignore information that would be useful in making forecasts. For example, in the late 1970s, the rate of inflation increased each year from 1976 through 1980. Anyone forecasting inflation by looking only at its past values would have expected inflation to be *lower* than it turned out to be. The rate of inflation declined each year from 1980 through 1983. During this period, anyone forecasting inflation by looking only at its past values would have expected inflation to be *higher* than it actually was. Anyone taking into account additional information, such as Federal Reserve policy, movements in oil prices, or other factors that affect inflation rather than relying only on past values of inflation would have made a more accurate forecast.

In 1961, John Muth of Carnegie Mellon University proposed a new approach he labeled *rational expectations*. With **rational expectations**, people make forecasts using all available information. Muth argued that someone who did not use all available information would not be acting rationally. That is, the person would not be doing his or her best to achieve the goal of an accurate forecast. For example, in forecasting the price of a firm's stock, investors should use not just past prices of the stock but also any other information that is helpful in forecasting the future profitability of the firm, including the quality of the firm's management, new products the firm might be developing, and so on. If a sufficient number of investors and traders in the stock market have rational expectations, the market price of a stock should equal the best guess of the present value of expected future dividends, which, as we saw earlier, is the stock's *fundamental value*. Therefore, if market participants have rational expectations, they can assume that the stock prices they observe represent the fundamental values of those stocks.

Rational expectations
The assumption that people make forecasts of future values of a variable using all available information; formally, the assumption that expectations equal optimal forecasts, using all available information.

To economists, if people have rational expectations, their expectations equal the optimal forecast (the best guess) of prices, using all information available to them. Although we are applying rational expectations to stocks, this concept applies to any financial security. If investors in the stock market have rational expectations, then the expectation of the future value of a stock should equal the optimal (best guess) price forecast. Of course, saying that investors have rational expectations is not the same as saying that they can foretell the future. In other words, the optimal forecast is optimal, but it may be wrong.

To state this concept more exactly, suppose that at the end of trading today on the stock market, P^e_{t+1} is the optimal forecast of the price of Apple's stock at the end of trading tomorrow. If P_{t+1} is the *actual* price of Apple's stock at the end of trading tomorrow, then it is very unlikely that we will see $P^e_{t+1} = P_{t+1}$. Why? Because tomorrow, investors and traders are likely to obtain additional information about Apple—perhaps sales of the iPad during the previous month are below what was forecast—that will change their view of the fundamental value of Apple's stock. So, there is likely to be a *forecast error*, which is the difference between the forecast price of Apple's stock and the actual price of Apple's stock. But no one can accurately forecast the size of that error because the error is caused by *new* information that is not available when the forecast is made. If the

information was available when the forecast is made, rational expectations tells us that it would have been incorporated into the forecast. To state the point more formally:

$$P_{t+1} - P^{e}_{t+1} = \text{Unforecastable error}_{t+1}.$$

So, when a forecast is made, we can be fairly sure that the forecast will turn out to be lower or higher than the actual value of the variable being forecast, but we have no way of telling how large the error will be or even whether it will be positive (that is, our forecast was too low) or negative (that is, our forecast was too high).

The Efficient Markets Hypothesis

As originally developed by John Muth, the concept of rational expectations applies whenever people are making forecasts. The application of rational expectations to financial markets is known as the **efficient markets hypothesis**. With respect to the stock market, the efficient markets hypothesis states that when investors and traders use all available information in forming expectations of future dividend payments, the equilibrium price of a stock equals the market's optimal forecast—the best forecast given available information—of the stock's fundamental value. How can we be sure that markets will operate as the efficient markets hypothesis predicts and that equilibrium prices will equal fundamental values?

Efficient markets hypothesis The application of rational expectations to financial markets; the hypothesis that the equilibrium price of a security is equal to its fundamental value.

An Example of the Efficient Markets Hypothesis Consider an example. Suppose that it is 10:14 Monday morning, and the price of Microsoft stock is $32.10 per share, the company is currently paying an annual dividend of $0.90 per share, and its dividend is expected to grow at a rate of 7% per year. At 10:15, Microsoft releases new sales information that indicates that sales of its latest version of Windows have been much higher than expected, and the firm expects higher sales to continue into the future. This news causes you and other investors to revise upward your forecast of the growth rate of Microsoft's annual dividend from 7% to 8%. At this higher growth rate and assuming an r_E of 10%, the present value of Microsoft's future dividends rises from $32.10 to $48.60. So, this new information causes you and other investors to buy shares of Microsoft. This increased demand will cause the price of Microsoft's shares to keep rising until they reach $48.60, which is the new fundamental value of the stock. Investors who have rational expectations can profit by buying or selling a stock when its market price is higher or lower than the optimal forecast of the stock's fundamental value. In this way, self-interested actions of informed traders cause available information to be incorporated into market prices.

Does the efficient markets hypothesis require that all investors and traders have rational expectations? Actually, it does not. The process of buying and reselling securities to profit from price changes over a brief period of time is called **financial arbitrage** (see Chapter 3). The profits made from financial arbitrage are called *arbitrage profits*. In competing to buy securities where earning arbitrage profits is possible, traders will force prices to the level where investors can no longer earn arbitrage profits. As long as there are some traders with rational expectations, the arbitrage profits provided by new information will give these traders the incentive to push stock prices to their fundamental values. For instance, in the example just discussed, once the new information on Microsoft becomes available, traders can earn arbitrage profits equal to $16.50 per share,

Financial arbitrage The process of buying and selling securities to profit from price changes over a brief period of time.

or the difference between the old fundamental value and the new fundamental value. Competition among even a few well-informed traders will be enough to quickly drive the price up to its new fundamental value.

Although the efficient markets hypothesis indicates that the price of a share of stock is based on all available information, our Microsoft example shows that the prices of stocks will change day-to-day, hour-to-hour, and minute-to-minute. Stock prices constantly change as news that affects fundamental values becomes available. Note that anything that affects the willingness of investors to hold a stock or another financial asset affects the stock's fundamental value. Therefore, we would expect that if new information leads investors to change their opinions about the risk, liquidity, information costs, or tax treatment of the returns from owning a stock, the price of the stock will change because the r_E will change.

What About "Inside Information"? The efficient markets hypothesis assumes that publicly available information is incorporated into the prices of stocks. But what about information that is not publicly available? Suppose, for example, that the managers of a pharmaceutical firm receive word that an important new cancer drug has unexpectedly received government approval, but this information has not yet been publicly released. Or suppose that economists at the U.S. Bureau of Labor Statistics have finished calculating the previous month's inflation rate, which shows that inflation was much higher than investors had expected, but this information has also not yet been publicly released. Relevant information about a security that is not publicly available is called **inside information**. A strong version of the efficient markets hypothesis holds that even inside information is incorporated into stock prices. Many studies have shown, however, that it is possible to earn above-average returns by trading on the basis of inside information. For instance, the managers of the pharmaceutical firm could buy their company's stock and profit from the increase in the stock's price once the information on the drug's approval is released.

Inside information
Relevant information about a security that is not publicly available.

There is an important catch, though: Trading on inside information—known as *insider trading*—is illegal. Under U.S. securities laws, as enforced by the Securities and Exchange Commission (SEC), employees of a firm may not buy and sell the firm's stocks and bonds on the basis of information that is not publicly available. They also may not provide the information to others who would use it to buy and sell the firm's stocks and bonds. In 2012, a former Intel executive was among more than 20 people convicted of providing inside information about their firms to the manager of the Galleon hedge fund. The manager of the hedge fund was sentenced to 11 years in prison for having illegally earned $75 million trading stocks on the basis of inside information. Federal prosecutors called it the biggest insider trading case in history.

Are Stock Prices Predictable?

A key implication of the efficient markets hypothesis is that stock prices are not predictable. To see why, suppose that it is 4:00 P.M., stock trading has closed for the day, Apple stock has closed at a price of $675, and you are trying to forecast the price of Apple's stock at the close of trading tomorrow. What is your optimal forecast? The efficient markets hypothesis indicates that it is $675. In other words, the best forecast of the price