Chapter 1
Theoretical Framework of Finance

Abstract The main purpose of this chapter is to explore important finance theories. First, we discuss discounted cash-flow valuation theory (classical financial theory). Second, we discuss the Modigliani and Miller (M and M) valuation theory. Third, we examine Markowitz portfolio theory. We then move on to the capital asset pricing model (CAPM), followed by the arbitrage pricing theory. Finally, we will look at the option pricing theory and futures valuation and hedging.

Keywords Discounted cash-flow valuation • M and M valuation theory • Markowitz portfolio theory • Capital asset pricing model • Arbitrage pricing theory • Option pricing model • Futures valuation and hedging

1.1 Introduction

Value determination of financial instruments is important in security analysis and portfolio management. Valuation theories are the basic tools for determining the intrinsic value of alternative financial instruments. This chapter provides a general review of the financial theory that most students of finance would have already received in basic corporate finance and investment classes. Synthesis and integration of the valuation theories are necessary for the student of investments in order to have a proper perspective of security analysis and portfolio management.

The basic policy areas involved in the management of a company are (1) investment policy, (2) financial policy, (3) dividend policy, and (4) production policy. Since the determination of the market value of a firm is affected by the way management sets and implements these policies, they are of critical importance to the security analyst. The security analyst must evaluate management decisions in each of these areas and convert information about company policy into price estimates of the firm's securities. This chapter examines these policies within a financial theory framework, dealing with valuation models.

There are six alternative but interrelated valuation models of financial theory that might be useful for the analysis of securities and the management of portfolios:

1. Discounted cash-flow valuation theory (classical financial theory)
2. M and M valuation theory
3. Capital asset pricing model (CAPM)
4. Arbitrage Pricing Theory (APT)
5. Option-pricing theory (OPT)
6. Futures Valuation and Hedging

The discounted cash-flow valuation and M and M theories are discussed in the typical required corporate-finance survey course for both bachelor's and master's programs in business. The main purpose of this chapter is to review these theories and discuss their interrelationships. The discounted cash-flow model is first reviewed by some of the basic valuation concepts in Sect. 1.2. In the second section, the four alternative evaluation methods developed by M and M in their 1961 article are discussed. Their three propositions and their revision with taxes are explored, including possible applications of their theories in security analysis. Miller's inclusion of personal taxes is discussed in Sect. 1.3. Section 1.4 discusses the Markowitz portfolio theory. Section 1.5 includes a brief overview of CAPM concepts. Section 1.6 introduces the Arbitrage Pricing Theory (APT). Sections 1.6 and 1.7 discuss the option-pricing theory and the futures valuation and hedging. Conclusion is presented in Sect. 1.8.

1.2 Discounted Cash-Flow Valuation Theory

Discounted cash-flow valuation theory is the basic tool for determining the theoretical price of a corporate security. The price of a corporate security is equal to the present value of future benefits of ownership. For example, for common stock, these benefits include dividends received while the stock is owned plus capital gains earned during the ownership period. If we assume a one-period investment and a world of certain cash flows, the price paid for a share of

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stock, P_0, will equal the sum of the present value of a certain dividend per share, d_1 (assumed to be paid as a single flow at year end), and the selling price per share P_1:

$$P_0 = \frac{d_1 + P_1}{1+k} \tag{1.1}$$

in which k is the rate of discount assuming certainty. P_1 can be similarly expressed in terms of d_2 and P_2:

$$P_1 = \frac{d_2 + P_2}{1+k} \tag{1.2}$$

If P_1 in Equation (1.1) is substituted into Equation (1.2), a two-period expression is derived:

$$P_0 = \frac{d_1}{(1+k)} + \frac{d_2}{(1+k)^2} + \frac{P_2}{(1+k)^2} \tag{1.3}$$

It can be seen, then, that an infinite time-horizon model can be expressed as the

$$P_0 = \sum_{t=1}^{\infty} \frac{d_t}{(1+k)^t} \tag{1.4}$$

Since the total market value of the firms' equity is equal to the market price per share multiplied by the number of shares outstanding, Equation (1.4) may be re-expressed in terms of total market value MV_0:

$$MV_0 = \sum_{t=1}^{\infty} \frac{D_t}{(1+k)^t} \tag{1.5}$$

in which D_t = total dollars of dividends paid during year t.

Using this basic valuation approach as a means of expressing the appropriate objective of the firm's management, the valuation of a firm's securities can be analyzed in a world of certainty.

1.2.1 Bond Valuation

Bond valuation is a relatively easy process, as the income stream the bondholder will receive is known with a high degree of certainty. Barring a firm's default, the income stream consists of the periodic coupon payments and the repayments of the principal at maturity. These cash flows must be discounted to the present using the required rate of return for the bond.

The basic principles of bond valuation are represented in the equation:

$$\mathrm{PV} = \sum_{t=1}^{n} \frac{\mathrm{CF}_t}{(1+k_b)^t} \tag{1.6}$$

where:

PV = present value of the bond;
n = the number of periods to maturity;
CF_t = the cash flow (interest and principal) received in period t;
k_b = the required rate of return of the bondholders (equal to risk-free rate i plus a risk premium).

1.2.1.1 Perpetuity

The first (and most extreme) case of bond valuation involves a perpetuity, a bond with no maturity date and perpetual interest payments. Such bonds do exist. In 1814, the English government floated a large bond issue to consolidate the various small issues it had used to pay for the Napoleonic Wars. Such bonds are called *consols*, and the owners are entitled to a fixed amount of interest income annually in perpetuity. In this case, Equation (1.6) collapses into the following:

$$\mathrm{PV} = \frac{\mathrm{CF}}{k_b} \tag{1.7}$$

Thus, the valuation depends directly on the periodic interest payment and the required rate of return for the bond. It can be seen that required rates of return, necessitated by a higher rate of inflation or an increase in the perceived risk of the bond, lower the present value, decreasing the bond's market value. For example, if the stated annual interest payment on the perpetuity bond is \$50 and the required rate of return in the market is 10%, the price of the security is stated:

$$\mathrm{PV} = \$50/0.10 = \$500$$

If its issuing price had been \$1,000, it can be seen that the required rate of return would have been only 5% ($k_b = \mathrm{CF}/\mathrm{PV} = \$50/\$1,000 = 0.05$, or 5%).

1.2.1.2 Term Bonds

Most bonds are term bonds, which mature at some definite point in time. Thus, Equation (1.6) should be respecified to take this fact into account:

$$\mathrm{PV} = \sum_{t=1}^{n} \frac{I_t}{(1+k_b)^t} + \frac{P_n}{(1+k_b)^n} \tag{1.8}$$

where:

I_t = the annual coupon interest payment;
P_n = the principal amount (face value) of the bond; and
n = the number of periods to maturity.

Again, it should be noted that the market price, PV, of a bond is affected by changes in the rate of inflation. If inflation increases, the discount rate must also increase to compensate the investor for the resultant decrease in the value of the debt repayment. The present value of each period's interest payment thus decreases, and the price of the bond falls. The bondholder is always exposed to interest-rate risk, the variance of bond prices resulting from fluctuations in the level of interest rates. Interest-rate risk, or price volatility of a bond caused by changes in interest-rate levels, is directly related to the term to maturity. There are two types of risk premiums associated with interest-rate risk as it applies to corporate bonds. The bond maturity premium refers to the net return from investing in long-term government bonds rather than the short-term bills. Since corporate bonds generally possess default risk, another of the components of corporate bond rates of return is default premium. The bond default premium is the net increase in return from investing in long-term corporate bonds rather than in long-term government bonds.

Additional features of a bond can affect its valuation. Convertible bonds, those with a provision for conversion into shares of common stock, are generally more valuable than a firm's straight bonds for several reasons. First, the investor receives the potential of positive gains from conversion, should the market price of a firm's common stock rise above the conversion price. If the stock price is greater than the conversion price, the convertible bond generally sells at or above its conversion value. Second, the bondholder also receives the protection of fixed income payment, regardless of the current price of the stock – assuring the investor that the price of the bond will be at least equal to that of a straight bond, should stock prices fail to increase sufficiently. Third, for any given firm the coupon rate of return from its bonds is generally greater than the dividend rate of return (dividend yield) from its common stock – thus causing a measure of superiority for a convertible bond over its conversion into common stock until stock dividends rise above the bond's coupon rate. Even then, the convertible bond may be preferred by investors because of the higher degree of certainty of interest payments versus dividends that would decline if earnings fall.

A sinking fund provision may also increase the value of a bond, at least at its time of issue. A sinking-fund agreement specifies a schedule by which the sinking-fund will retire the bond issue gradually over its life. By providing cash to the sinking-fund for use in redeeming the bonds, this provision ensures the investor some potential demand for the bond, thus increasing slightly the liquidity of the investment.

Finally, the possibility that the bond may be called will generally lower the value relative to a noncallable bond. A call provision stipulates that the bond may be retired by the issuer at a certain price, usually above par or face value. Therefore, in periods of large downward interest movements, a company may be able to retire a high coupon bond and issue new bonds with a lower interest payment requirement. A call feature increases the risk to investors in that their expected high interest payments may be called away from them, if overall interest rate levels decline.

1.2.2 Common-Stock Valuation

Common-stock valuation is complicated by an uncertainty of cash flows to the investor, necessarily greater than that for bond valuation.[1]

Not only might the dividends voted to shareholders each period change in response to management's assessment concerning the current level of earnings stability, future earnings prospects, or other factors, but the price of the stock may also either rise or fall – resulting in either capital gains or losses, if the shares are sold. Thus, the valuation process requires the forecasting of both capital gains and the stream of expected dividends. Both must also be discounted at the required rate of return of the common stockholders.

$$P_0 = \frac{d_1}{1+k} + \frac{d_2}{(1+k)^2} + \cdots + \frac{P_n}{(1+k)^n} \tag{1.9}$$

where:

$P_0 =$ the present value, or price, of the common stock per share;
$d =$ the dividend payment per share;
$k =$ the required rate of return of the common stockholders; and
$P_n =$ the price of the stock in period n when sold.

However, P_n can also be expressed as the sum of all discounted dividends to be received from period n forward into the future. Thus, the value at the present time can be expressed as an infinite series of discounted dividend payments:

$$P_0 = \sum_{t=1}^{\infty} \frac{d_t}{(1+k)^t} \tag{1.4}$$

in which d_t is the dividend payment in period t. Several possibilities exist regarding the growth of dividend payments over time. First, dividends may be assumed to be a constant amount, and the formula for the stock's valuation is simple Equation (1.7), where CF is the constant dividend and k is the required rate of return of the common stockholder.

Second, dividends may be expected to grow at some constant rate, g. In such a case, a dividend at time t is simply the compound value of the present dividend (i.e.,

[1] This is true because foregoing interest puts the firm into default, while missing dividend payments does not.

$P_t = (1+g)^t d_0$). Under this assumption, if $g < k$, the valuation equation can be simplified to the following:

$$P_0 = \frac{d_1}{(k-g)} \tag{1.10}$$

This equation represents the Gordon growth model. Note that a critical condition for this model is that the constant growth of dividends must be less than the constant required rate of return. The zero growth situation is a special case of this model, in which:

$$P_0 = \frac{d_1}{k} \tag{1.11}$$

Finally, dividends can exhibit a period of supernormal growth (i.e., g is greater than k) before declining to the normal growth situation assumed in the Gordon model (g is less than k). Supernormal growth often occurs during the "takeoff" phase in a firm's life cycle. That is, a firm may experience a life cycle analogous to that of a product: first, a low-profit introductory phase, then a takeoff phase of high growth and high profits, leveling off at a plateau during its mature stage, perhaps followed by a period of declining earnings. Computer and electronics manufacturers experienced a period of supernormal growth during the 1960s, as did semiconductor firms during the 1970s. Bioengineering firms appear to be the super growth firms of the 1980s.

The valuation of a supernormal growth stock requires some estimate of the length of the supernormal growth period. The current price of the stock will then consist of two components: (1) the present value of the stock during the supernormal growth period, and (2) the present value of the stock price at the end of the supernormal growth period:

$$P_0 = \sum_{t=1}^{n} \frac{d_0(1+g_s)^t}{(1+k)^t} + \frac{\frac{d_{n+1}}{k-g_n}}{(1+k)^n} \tag{1.12}$$

where:

g_s = supernormal growth rate;
n = the number of periods before the growth drops from supernormal to normal;
k = the required rate of return of the stockholders; and
g_n = the normal growth rate of dividends (assumed to be constant thereafter).

As we can see from our development of the discounted cash-flow financial theory, the primary determinant of value for securities is the cash flow received by the investors. Anything that affects the cash flow, such as the dividend policy, investment policy, financing policy, and production policy of the firm, needs to be evaluated in order to determine a market price.

Some shortcomings of this approach include the overemphasis on the evaluation of the individual firm to the exclusion of portfolio concepts and the interrelationship with the overall market indexes. Most of the classical models are also static in nature, overlooking the concept of dynamic growth. Nevertheless, a fundamental approach to security valuation – the stream of dividends approach – has evolved from this theory.

1.3 M and M Valuation Theory

Modigliani and Miller (M and M 1961) have proposed four alternative valuation methods to determine the theoretical value of common stocks. This section discusses these valuation approaches in some detail. M and M's four more or less distinct approaches to the valuation of common stock are as follows:

1. The discounted cash-flow approach;
2. the current earnings plus future investment opportunities approach;
3. the stream of dividends approach; and
4. the stream of earnings approach

Working from a valuation expression referred to by M and M as the "fundamental principle of valuation":

$$P_0 = \frac{1}{1+k}(d_1 + P_1) \tag{1.13}$$

M and M further developed a valuation formula to serve as a point of reference and comparison among the four valuation approaches:

$$V_0 = \sum_{t=0}^{\infty} \frac{1}{(1+k)^{t+1}}(X_t - I_t) \tag{1.14}$$

where:

V_0 = the current market value of the firm;
X_t = net operating earnings in period t; and
I_t = new investment during period t.

In this context, the discounted cash-flow approach can be expressed:

$$V_0 = \sum_{t=0}^{\infty} \frac{1}{(1+k)^{t+1}}(R_t - O_t) \tag{1.15}$$

in which R_t is the stream of cash receipts by the firm and O_t is the stream of cash outlays by the firm. This fundamental principle is based on the assumption of "perfect markets," "rational behavior," and "perfect certainty" as defined by M and M. Since X_t differs from R_t and I_t differs from O_t only by the cost of goods sold and depreciation expense, if $(R_t - O_t)$ equals $(X_t - I_t)$, then (1.15) is equivalent to (1.14) and the discounted cash-flow approach is an extension of

Equation (1.13), the fundamental valuation principle. Hence, the security analyst must be well versed in generally accepted accounting principles in order to evaluate the worth of accounting earnings of $(X_t - I_t)$.

The investment-opportunities approach seems in some ways the most natural approach from the standpoint of an investor. This approach takes into account the ability of the firm's management to issue securities at "normal" market rates of return and invest in the opportunities, providing a rate higher than the normal rate of return. From this framework, M and M developed the following expression, which they show can also be derived from Equation (1.14):

$$V_0 = \frac{X_0}{k} + \sum_{t=0}^{\infty} \frac{I_t(k_t^* - k)}{(1+k)^{t+1}} \tag{1.16}$$

in which X_0 is the perpetual net operation earning and k_t^* is the "higher than normal" rate of return on new investment I_t.

From the expression it can be seen that if a firm cannot generate a rate of return of its new investments higher than the normal rate, k, the price/earnings ratio applied to the firm's earnings will be equal to $1/k$, thus implying simple expansion rather than growth over time. An important variable for security analysis is a firm's P/E ratio (or earnings multiple), defined as:

$$\text{P/E ratio} = \frac{\text{Market price}}{\text{Earnings per share}}$$

Conceptually the P/E ratio is determined by three factors: (1) the investor's required rate of return (K); (2) the retention ratio of the firm's earning, b, where b is equal to 1 minus the dividend payout ratio; and (3) the firm's expected return on investment (r). Using the constant-growth model Equation (1.10):

$$P_0 = \frac{d_1}{k-g}$$

$$P_0 = \frac{E_1(1-b)}{k-(br)}$$

$$\frac{P_0}{E_1} = \frac{1-b}{k-(br)} \tag{1.17}$$

in which b is the retention rate and E_1 is the next period's expected profit.

The P_0/E ratio is theoretically equal to the payout ratio of a firm divided by the difference between the investor's required return and the firm's growth rates. In the above equation a direct relationship has been identified between price/earnings ratio and discount cash-flow valuation model.

The stream-of-dividends approach has been by far the most popular in the literature of valuation; it was developed in the pre-M and M period. Assuming an infinite time horizon, this approach defines the current market price of a share of common stock as equal to the discounted present value of all future dividends:

$$P_0 = \sum_{t=0}^{\infty} \frac{1}{(1+k)^{t+1}}(d_t) \tag{1.18}$$

Restating in terms of total market value:

$$V_0 = \sum_{t=0}^{\infty} \frac{1}{(1+k)^{t+1}}(D_t) \tag{1.19}$$

With no outside financing, it can be seen that $D_t = X_t - I_t$ and:

$$V_0 = \sum_{t=0}^{\infty} \frac{1}{(1+k)^{t+1}}(X_t - I_t)$$

which is Equation (1.14). With outside financing through the issuance of shares of new common stock, it can be shown that:

$$V_0 = \sum_{t=0}^{\infty} \frac{1}{(1+k)^{t+1}}(D_t + V_{t+1} - m_{t+1}{}^* P_{t+1}) \tag{1.20}$$

in which m_{t+1} is the number of new shares issued at price P_{t+1}. For the infinite horizon, the value of the firm is equal to the investments it makes and the new capital it raises, or:

$$V_{t+1} - (m_{t+1})(P_{t+1}) = I_t - (X_t - D_t)$$

Thus, Equation (1.20) can also be written in the form of Equation (1.14):

$$V_0 = \sum_{t=0}^{\infty} \frac{1}{(1+k)^{t+1}}(X_t - I_t) \tag{1.14}$$

Given the M and M ideal assumptions, the above result implies the irrelevance of dividends because the market value of the dividends provided to new stockholders must always be precisely the same as the increase in current dividends. This is in direct disagreement with the findings of the discounted cash-flow model, where dividends are a major determinant of value. In this case, dividends have no impact on value, and the firm's investment policy is the most important determinant of value. Security analysis should concern itself with the future investment opportunities of the firm and forget about dividends.

M and M also developed the stream-earnings approach, which takes account of the fact that additional capital must be acquired at some cost in order to maintain the stream of future earnings at its current level. The capital to be raised is I_t and its cost is K percent per period thereafter; thus, the current value of the firm under this approach can be stated:

$$V_0 = \sum_{t=0}^{\infty} \frac{1}{(1+k)^{t+1}}(X_t - I_t)$$

which, again, is Equation (1.14).

Under none of these four theoretical approaches does the term D_t remain in the final valuation expression and because X_t, I_t, and k are assumed to be independent of D_t, M and M conclude that the current value of a firm is independent of its current and future dividend decisions. The amount gained by stockholders is offset exactly by the decline in the market value of their stock. In the short run, this effect if observed when a stock goes ex-dividend – that is, if the market price of the stock falls by the amount of the dividend on the last day the old shareholders are entitled to receive a dividend payment. The stock's value depends only on the expected future earnings stream of the firm. Security analysts spend much time and effort forecasting a firm's expected earnings.

While the above analysis ignores the case in which external financing is obtained through the issuance of debt, in such a situation M and M's *position* then rests upon their indifference proposition with respect to leverage (M and M 1958), discussed elsewhere in this chapter. Since that analysis shows that under a set of assumptions consistent with their "fundamental principal of valuation" the real cost of debt in a world of no taxation is equal to the real cost of equity financing, M and M conclude that the means of external financing used to offset the payment of dividends does not affect their hypothesis that dividends are irrelevant.

Prior to Miller and Modigliani's (1961) article, the classical view held that dividend policy was a major determinant of the value of the corporation and that firms should seek their "optimal payout ratios" to maximize their value. M and M's conclusions about the irrelevance of dividend policy given investment policy, collided head-on with the existing classical view. The view that the value of the firm is independent of dividend policy also extends into a world with corporate taxes but without personal taxes.

1.3.1 Review and Extension of M and M Proposition I

The existence of optimal capital structure has become one of the important issues for academicians and practitioners in finance. While classical finance theorists argue that there is an optimal capital structure for a firm, the new classical financial theory developed y M and M (1958, 1963) has cast doubt upon the existence of such an optimal structure. The specific assumptions that they made, consistent with the dividend irrelevance analysis previously outlined, include the following:

1. Capital markets are perfect (frictionless).
2. Both individuals and firms can borrow and lend at the risk-free rate.
3. Firms use risk-free debt and risky equity.
4. There are only corporate taxes (that is, there are no wealth taxes or personal income taxes).
5. All cash flow streams are perpetuities (that is, no growth).

Developing the additional concepts of risk class and homemade leverage, M and M derived their well-known Proposition I, both with and without corporate taxes.[2]

If all firms are in the same risk class, then their expected risky future net operating cash flow ($\dot{X}$) varies only by a scale factor. Under this circumstance, the correlation between two firms' net operating income (NOI) within a risk class should be equal to 1.0. This implies that the rates of return will be equal for all firms in the same risk class, that is:

$$R_{it} = \frac{\dot{X}_{it} - \dot{X}_{i\,t-1}}{X_{i\,t-1}} \qquad (1.21)$$

and because $\dot{X}_{it} = C\dot{X}_{jt}$ where C is the scale factor:

$$R_{jt} = \frac{C\dot{X}_{jt} - C\dot{X}_{jt}}{C\dot{X}_{j\,t-1}} = R_{it} \qquad (1.22)$$

in which R_{it} and R_{jt} are rates of return for the ith and jth firms, respectively. Therefore, if two streams of cash flow differ by only a scale factor, they will have the same distributions of returns and the same risk, and they will require the same expected return.

The concept of homemade leverage is used to refer to the leverage created by individual investors who sell their own debt, while corporate leverage is used to refer to the debt floated by the corporation. Using the assumption that the cost of homemade leverage is equal to the cost of corporate leverage, M and M (1958) derived their Proposition I both with and without taxes. However, the Proposition I with taxes was not correct, and they subsequently corrected this result in their 1963 paper. Mathematically, M and M's Proposition I can be defined:

$$V_j = (S_j + B_j) = X_j/\rho_k \qquad (1.23)$$

[2] In 1985 Franco Modigliani won the Nobel Prize for his work on the life cycle of savings and his contribution to what has become known as the M and M theory, discussed in this section.

and Proposition I with taxes can be defined as

$$V_j^L = \frac{(1-\tau_j)X_j}{\rho_k^\tau} + \frac{\tau I_j}{r} = V_j^U + \tau B_j \tag{1.24}$$

In Equation (1.23), B_j, S_j, and V_j are, respectively, the market value of debt, common shares, and the firm. X_j is the expected profit before deduction of interest, ρ_k the required rate of return or the cost of capital in risk class k. In Equation (1.24), ρ_k^τ is the required rate of return used to capitalize the expected returns net of tax for the unlevered firm with long-run average earnings before tax and interest of (X_j) in risk class k. τ_j is the corporate tax rate for the jth firm, I_j is the total interest expense for the jth firm, and r is the market interest rate used to capitalize the certain cash inflows generated by risk-free debt. B_j is total risk-free debt floated by the jth firm, and V^L and V^U are the market values of the leveraged and unleveraged firms, respectively.

By comparing these two equations, we find that the advantages of a firm with leverage will increase that firm's value by $\tau_j B_j$ – that is, the corporate tax rate times the total debt floated by that firm. One of the important implications of this proposition is that there is no optimal capital structure for the firm unless there are bankruptcy costs associated with its debt flotation. If there are bankruptcy costs, then a firm will issue debt until its tax benefit is equal to the bankruptcy cost, thus providing, in such a case, an optimal capital structure for the firm. In addition to the bankruptcy costs, information signaling (see Leland and Pyle 1977, and Ross 1977a) and differential expectations between shareholders and bondholders can be used to justify the possible existence of an optimal structure of a firm. The existence of optimal capital structure is an important issue for security analysts to investigate because it affects the value of the firm and the value of the firm's securities. Is a firm with a high level of debt more valuable than a similar firm with very little debt? M and M say it doesn't matter or that the highly leveraged firm is more valuable.

The important assumptions used to prove the M and M Proposition I with taxes are that (1) there are no transaction costs, (2) homemade leverage is equal to corporate leverage, (3) corporate debt is riskless, and (4) there is no bankruptcy cost. Overall, M and M's Proposition I implies that there is no optimal capital structure. If there is a tax structure that systematically provides a lower after-tax real cost of debt relative to the after-tax real cost of equity, the corporation will maximize the proportion of debt in its capital structure and will issue as much debt as possible to maximize the tax shield associated with the deductibility of interest.

Stiglitz (1969) extends M and M's proposition using a general equilibrium state preference framework. He is able to show that M and M's results do not depend on risk classes, competitive capital markets, or agreement by investors. The only two fundamental assumptions are that there is no bankruptcy and individuals can borrow at the same rate as firms. Stiglitz (1974) develops the argument that there may be a determinate debt-equity ratio for the economy as a whole, but not for the individual firm.

1.3.2 *Miller's Proposition on Debt and Taxes*

Miller (1977) argues that although there is no optimal capital structure for an individual firm, in the aggregate case there may be an optimal structure. In balancing bankruptcy cost against tax shelter, an optimal capital structure is derived, just as the classical view has always maintained.

The Tax Reform Act of 1986 taxes dividends and long-term capital gains at the same top rate of 28%. This is a major change from the old 50% rate on dividends and 20% rate on long-term capital gains. The new tax bill has also shifted the major tax burden to corporations and away from individuals. Even though the maximum corporate tax rate will decrease to 34% from the current top rate of 46%, corporations will be paying more taxes because of the loss of the Investment Tax Credits and the Accelerated Cost Recovery System depreciation allowances.

These changes in the tax code will shift the emphasis of corporate management from retaining earnings in order to generate price appreciation and capital gains to the payout of corporate funds in the form of dividends.

In his presidential address at the Annual Meeting of the American Finance Association, Merton Miller (1977) incorporates personal taxes into the Modigliani and Miller (1958, 1963) argument for the relationship between the firm's leverage and cost of capital.

M and M's Proposition I shows that the value of the leveraged firm equals the value of the unleveraged firm plus the tax shield associated with interest payments, as shown by Equation (1.24):

$$V^L = V^U + t_c B \tag{1.25}$$

where:

V^L = the value of the leveraged firm;
V^U = the value of the unleveraged firm;
t_c = the corporate tax rate; and
B = the value of the firm's debt.

Miller generalizes the M and M relationship shown in Equation (1.25) to include personal taxes on dividends and capital gains as well as taxes on interest income, to yield:

$$V^L = V^U + \left[1 - \frac{(1-t_c)(1-t_{ps})}{(1-t_{pB})}\right] B \tag{1.26}$$

in which t_{ps} is the personal tax rate on income from stock and t_{pB} is the personal tax rate on income from bonds.

1.4 Markowitz Portfolio Theory

Professors Markowitz, Miller, and Sharpe earned their Nobel Prize in applied economics in 1989. Section 1.3 briefly discussed the M and M theory. In the next section, we will discuss CAPM. In this section we will discuss Prof. Markowitz portfolio theory. In the paper entitled "Markowitz, Miller, and Sharpe: The First Nobel Laureates in Finance," Lee (1991) has discussed this historical event in details.

Markowitz suggests two constrained maximization approaches to obtain the optimal portfolio weight. The first approach is to minimize the risk or variance of the portfolio, subject to the portfolio's attaining some target expected rate of return, and also subject to the portfolio weight summing to one. The problem can be stated mathematically:

$$\text{Min } \sigma_p^2 = \sum_{i=1}^{n}\sum_{j=1}^{n} W_i W_j \sigma_{ij} \tag{1.27}$$

Subject to

$$1. \quad \sum_{i=1}^{n} W_i E(R_i) = E^* \tag{1.28}$$

where E^* is the target expected return and

$$2. \quad \sum_{i=1}^{n} W_i = 1.0 \tag{1.29}$$

The first constraint simply says that the expected return on the portfolio should equal the target return determined by the portfolio manager. The second constraint says that the weights of the securities invested in the portfolio must sum to one. The Lagrangian objective function can be written:

$$\text{Min } L = \sum_{i=1}^{n}\sum_{j=1}^{n} W_i W_j + \lambda_1 \sum_{i=1}^{n}\left[W_i E(R_i) - E^*\right] + \lambda_2\left(\sum_{i=1}^{n} W_i - 1\right) \tag{1.30}$$

Taking the partial derivatives of this equation with respect to each of the variables, W_1, W_2, W_3, λ_1, λ_2 and setting the resulting five equations equal to zero yields the minimization of risk subject to the Lagrangian constraints. This system of five equations and five unknowns can be solved by the use of matrix algebra. Equations (1.30) minimizes the portfolio variance given the portfolio's targeted expected rate of return.

In the second approach, the maximization problem in Equation (1.30) can be rewritten as

$$\text{Max } L = \sum_{i=1}^{n} W_i \overline{R}_i + \lambda_1 \left\{\left[\sum_{j=1}^{n}\sum_{i=1}^{n} \text{Cov}(R_i, R_j)\right]^{1/2} - \sigma_p\right\} + \lambda_2\left(\sum_{i=1}^{n} W_i - 1\right) \tag{1.31}$$

where $\overline{R}_i$ is the average rate of rates of return of the portfolio given targeted standard deviation of the portfolio σ_P. Essentially Equation (1.31) maximizes the expected rates of return of the portfolio given the targeted standard deviation of the portfolio.

In this book, a large portion is dedicated to the portfolio theory and its application. Chapter 10 discusses portfolio optimization models and mean-variance spanning tests. Chapter 12 discusses the estimation risk and power utility portfolio selection. Chapter 13 discusses theory and methods in the international portfolio management. Chapter 17 provides discussion on portfolio theory, CAPM, and the performance measures. Chapter 18 discusses the intertemporal equilibrium models, portfolio theory, and the capital asset pricing model.

1.5 Capital Asset Pricing Model

At about the same time as M and M were developing their work, developments in portfolio theory were leading to a model describing the formation of capital asset prices in world of uncertainty: the capital asset pricing model (CAPM).

The CAPM is a generalized version of M and M theory in which M and M theory is provided with a link to the market:

$$E(R_j) = R_f + \beta_j[E(R_m) - R_f] \tag{1.32}$$

where:

R_j = the rate of return for security j;
β_j = a volatility measure relating the rate of return on security j with that of the market over time;
R_m = the rate of return for the overall market (typically measured by the rate of return reflected by a market index, such as the S&P 500); and
R_f = the risk-free rate available in the market (usually the rate of return on U.S. Treasury bills is used as a proxy).

In the CAPM framework, the valuation of a company's securities is dependent not only on its cash flows but also on those of other securities available for investment. It is assumed that much of the total risk, as measured by standard deviation of return, can be diversified away by combining the stock of a firm being analyzed with those of other companies. Unless the cash flows from these securities are perfectly positively correlated, smoothing or diversification will take place. Thus, the security return can be divided into two components: a systematic component that is perfectly correlated with the overall market return and an unsystematic component that is independent of the market return:

$$\text{Security return} = \text{Systematic return} + \text{Unsystematic return} \quad (1.33)$$

Since the security return is perfectly correlated with the market return, it can be expressed as a constant, beta, multiplied by the market return (R_m). The beta is a volatility index measuring the sensitivity of the security return to changes in the market return. The unsystematic return is residual of the relationship of R_j with R_m.

As has been previously noted, the standard deviation of the probability distribution of a security's rate of return is considered to be an appropriate measure of the total risk of that security. This total risk can be broken down into systematic and unsystematic components, just as noted above for security return:

$$\text{Total security risk} = \text{Systematic risk} + \text{Unsystematic risk} \quad (1.34)$$

Diversification is achieved only when securities that are not perfectly correlated with one other are combined. The unsystematic risk components tend to cancel each other as they are all residuals from the relationship of security returns with the overall market return. In the process, the portfolio risk measure declines without any corresponding lowering of portfolio return (see Fig. 1.1). It is assumed in this illustration that the selection of additional securities as the portfolio size is increased is performed in some random manner, although any selection process other than intentionally choosing perfectly correlated securities will suffice. Unsystematic risk is shown to be gradually eliminated until the remaining portfolio risk is completely market related. While for an actual portfolio the systematic risk will not remain constant as securities are added, the intent is to show that the unsystematic-risk portion can be diversified away, leaving the market related systematic portion as the only relevant measure of risk. Empirical studies have shown that a portfolio of about 20 securities not highly correlated with one another will provide a high degree of diversification. Although capital-market theory assumes that all investors will hold the market portfolio, it is neither necessary nor realistic to assume that all investors will be satisfied with the market level of risk. There are basically two ways that investors can adjust their risk level within the CAPM theoretical framework. First, funds for investment can

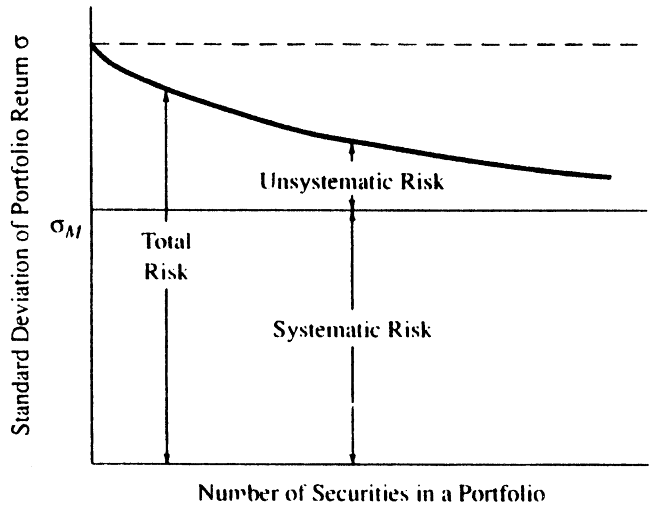

Fig. 1.1 Diversification process

be divided between the market portfolio and risk-free securities. The capital-market line (CML) is derived assuming such a tradeoff function.

This is illustrated in Fig. 1.2, in which point M is the market portfolio and points on the CML below and above M imply lending and borrowing at the risk-free rate. The second way of adjusting the portfolio risk level is by investing in a fully diversified portfolio of securities (that is, the correlation coefficient of the portfolio with the market, r_{pm} is equal to 1.0) that has a weighted average beta equal to the systematic-risk level desired:

$$\beta_p = \sum_{j=1}^{n} W_j B_j \quad (1.35)$$

in which W_j is the proportion of total funds invested in security j. In the CAPM, systematic risk as measured by beta is the only risk that need be undertaken; therefore, it follows that no risk premium should be expected for the bearing of unsystematic risk. With that in mind, the relationship between expected return and risk can be better defined through the illustration of the security-market line (SML) in Fig. 1.3 in which R_m and β_m are the expected return and risk level of the market portfolio. In equilibrium, all securities and combinations of securities are expected to lie along this line. In contrast, only fully diversified portfolios would be expected to fall along the CML, because only with full diversification is total risk equal to systematic risk alone.

In addition to the static CAPM developed by Sharpe (1964) and others Merton has discussed intertemporal CAPM. In Chap. 6 we will discuss the static CAPM and beta forecasting and in Chap. 18 we will focus on intertemporal CAPM.

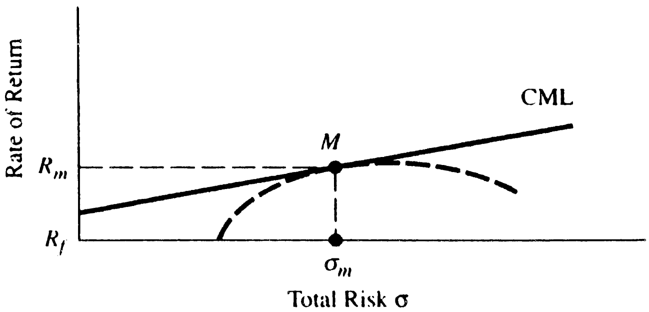

Fig. 1.2 Capital market line

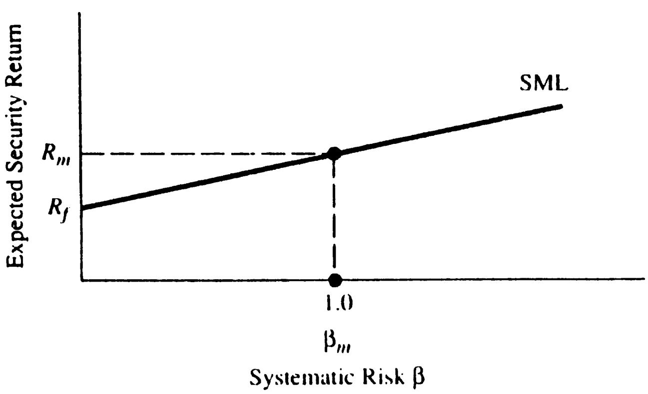

Fig. 1.3 Security market line

1.6 Arbitrage Pricing Theory

1.6.1 Ross's Arbitrage Model Specification

This section focuses on two related forms of the arbitrage pricing model (APM). The first is the model as originally proposed by Ross (1976).

The initial and probably the most prominent assumption made by APM concerns the return-generating process for assets. Specifically, individuals are assumed to believe (homogeneously) that the random returns on the set of assets being considered are governed by a k-factor generating model of the form:

$$\tilde{r}_i = E_i + b_{i1}\tilde{\delta}_1 + \ldots + b_{ik}\tilde{\delta}_k + \tilde{\epsilon}_i \; (i = 1, \ldots, n) \tag{1.36}$$

where:

$\tilde{r}_i$ = random return on the ith asset;
E_i = expected return on the ith asset;
$\tilde{\delta}_j$ = jth factor common to the returns of all assets under consideration with a mean of zero, common factors that in essence capture the systematic component of risk in the model;
b_{ij} = a coefficient called a *factor loading* that quantifies the sensitivity of asset i's returns to the movements in the common factor $\tilde{\delta}_j$ (and is analogous to the beta in the CAPM); and
$\tilde{\epsilon}_i$ = an error term, or unsystematic risk component, idiosyncratic to the ith asset, with mean zero and variance equal to $\tilde{\sigma}^2_\epsilon$.

Moreover, it is assumed that the $\tilde{\epsilon}_i$ reflects the random influence of information that is unrelated to other assets. Thus, the following condition is assumed to hold:

$$E\left\{\tilde{\epsilon}_i | \tilde{\epsilon}_j\right\} = 0 \tag{1.37}$$

as well as $\overline{\epsilon}_i$ and $\overline{\epsilon}_j$ independence for all $i \neq j$. Also, for any two securities i and j:

$$E\left\{\tilde{\epsilon}_i, \tilde{\epsilon}_j\right\} = 0 \tag{1.38}$$

for all i and j, where $i \neq j$. If this last condition did not hold – that is, if there was too strong a dependence between $\tilde{\epsilon}_i$ and $\tilde{\epsilon}_j$ – it would be equivalent to simply saying that the k-hypothesized common factors existed. Finally, it is assumed that for the set of n assets under consideration that n is much greater than the number of factors k.

Before developing Ross's riskless arbitrage argument, it is essential to examine Equation (1.36) more closely and draw some implications from its structure. First, consider the effect of omitting the unsystematic risk terms $\tilde{e}_i$. Equation (1.36) would then imply that each asset i has returns $\tilde{r}$ that are an exact linear combination of the returns on a riskless asset (with constant return) and the returns on k other factors or assets (or column vectors) $\tilde{\delta}_i, \ldots, \tilde{\delta}_k$. Moreover, the riskless return and each of the k factors can be expressed as a linear combination of $k + 1$ other return – for example, r, through r_{k+1} – in this type of setting. Taking this logic one step further, since any other asset return is a linear combination of the factors, it must also be a linear combination of the returns of the first $k + 1$ assets. Hence, portfolios composed from the first $k + 1$ assets must be perfect substitutes for all other assets in the market. Consequently, there must be restrictions on the individual returns generated by the model, as perfect substitutes must be priced equivalently. This sequence of mathematical logic is the core of APT. That is, only a few systematic components of risk exist in the economy, and consequently many portfolios will be close substitutes, thereby demanding the same value.

To initiate Ross's arbitrage argument about APT, it is best to start with the assumption of Equation (1.36). Next, presume an investor who is contemplating an alteration of the currently held portfolio, the difference between any new portfolio and the old portfolio will be quantified by changes in the investment proportions $x_i (i = 1, \ldots, n)$. The x_i represents the dollar amount purchased or sold of asset i as a fraction of total invested wealth. The investor's portfolio investment is constrained to hold to the following condition:

$$\sum_{i=1}^{n} x_i = 0 \tag{1.39}$$

In words, Equation (1.39) says that additional purchases of assets must be financed by sales of others. Portfolios that require no net investment such as $x \equiv (x_j, \ldots, x_n)$ are called *arbitrage portfolios*.

Now, consider an arbitrage portfolio chosen in the following manner. First, the portfolio must be chosen to be well diversified by keeping each element, x, of order $1/n$ in size. Second, the x of the portfolio must be selected in such a way as to eliminate all systematic risk (for each h):

$$xb_h \sum_{i=1} x_i b_{ih} = 0\,(h = 1, \ldots, k) \tag{1.40}$$

The returns on any such arbitrage portfolios can be described:

$$\begin{aligned} x\tilde{r} &= (xE) + (xb)\tilde{\delta}_1 + \ldots + (xb_k)\tilde{\delta}_k + (x\tilde{\in}) \\ &\approx xE + (xb_1)\tilde{\delta}_1 + \ldots + (xb_k)\tilde{\delta}_k = xE \end{aligned}$$

where $x\tilde{r} = \sum_{i=1}^{n} x_i \tilde{r}_i$ and $xE = \sum_{i=1}^{n} x_i E_i$. Note that the term $(x\tilde{\in})$ is (approximately) eliminated by the effect of holding a well-diversified portfolio of n assets where n is large. Using the law of large numbers, if σ^2 denotes the average variance of the $\tilde{e}_i$ terms, and assuming for simplicity that each x, approximately equals $1/n$ and that the $\in_i$ are mutually independent:

$$\text{Var}(x\tilde{\in}) = \text{Var}\left(\frac{1}{n}\sum_i \in_i\right) = \frac{\text{Var}(\tilde{\in}_i)}{n^2} = \frac{\sigma^2}{n^2} \tag{1.41}$$

Thus if n is large the variance of $x\tilde{\in}$ will be negligible.

Reconsidering the steps up to this point, note that a portfolio has been created that has no systematic or unsystematic risk and using no wealth. Under conditions of equilibrium, it can be stated unequivocally that *all portfolios of these n assets that satisfy the conditions of using no wealth and having no risk must also earn no return on average*. In other words, there are no free lunches in an efficient market, at least not for any extended period of time. Therefore the expected return on the arbitrage portfolio can be expressed:

$$x\tilde{r} = xE = \sum_{i=1}^{n} x_i E_i = 0 \tag{1.42}$$

Another way to state the preceding statements and results is through linear algebra. In general, any vector x with elements on the order of $1/n$ that is orthogonal to the constant vector and to each of the coefficient vectors $b_h (h = 1, \ldots, k)$ must also be orthogonal to the vector of expected returns. A further algebraic consequence of this statement is that the expected return vector E must be a linear combination of the constant vector and the b vectors. Using algebraic terminology, there exist $k + 1$ weights $(\lambda_0, \lambda_1, \ldots, \lambda_k)$ such that:

$$E_i = \lambda_0 + \lambda_1 b_{il} + \ldots + \lambda_k b_{ik}, \quad \text{for all } i \tag{1.43}$$

In addition, if there exists a riskless asset with return E_0, which can be said to be the common return on all zero-beta assets – that is, $b_{ih} = 0$ (for all h) – then:

$$E_0 = \lambda_0$$

Utilizing this definition and rearranging:

$$E_i - E_0 = \lambda_1 b_{il} + \ldots + \lambda_k b_{ik} \tag{1.44}$$

The pricing relationship depicted in Equation (1.44) is the central conclusion of the APT. Before exploring the consequences of this pricing model through a simple numerical example, it is best to first give some interpretation to the λ_h, the factor risk premium. If portfolios are formed with a systematic risk of 1 relative to factor h and no risk on other factors, then each λ_h can be interpreted as:

$$\lambda_h = E^h - E_0 \tag{1.45}$$

In words, each λ_h can be thought of as the excess return or market risk premium on portfolios with only systematic factor h risk. Hence, Equation (1.44) can be rewritten:

$$E_i - E_0 = (E^1 - E_0)b_{i1} + \ldots + (E^k - E_0)b_{ik} \tag{1.46}$$

The implications that arise from the arguments concerning APT that have been constructed thus far can be summarized in the following statement: *APT yields a statement of relative pricing on subsets of the universe of assets*. Moreover, note that the arbitrage pricing model of Equations (1.44) or (1.46) can be tested by examining only subsets of the set of all return. Consequently, the market portfolio plays no special role in APT, since any well-diversified portfolio could serve the same purpose. Hence, it can be empirically tested on any set of data, and the results should be generalizable to the entire market.

Even though the APT is very general and based on few assumptions, it provides little guidance concerning the identification of the priced factors. Hence empirical research must achieve two goals.

1. Identify the number of factors.
2. Identify the various economics underlying each factor.

Chapter 64 will discuss the relationship between the liquidity risk and the arbitrage pricing theory.

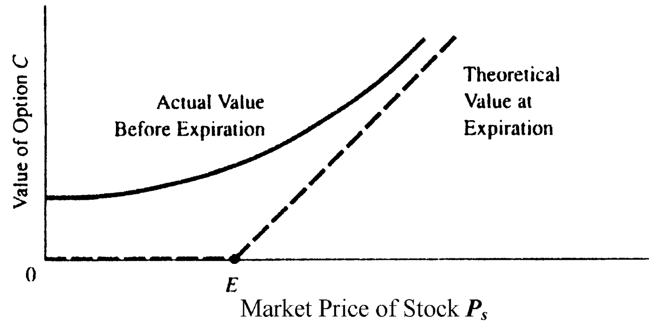

Fig. 1.4 Theoretical and actual values of a call option

1.7 Option Valuation

Option contracts give their holders the right to buy and sell a specific asset at some specified price on or before a specified date. Since these contracts can be valued in relation to common stock, the basic concepts involved have a number of applications to financial theory and to the valuation of other financial instruments.

While there are a variety of option contracts – for example, call options, put options, combinations of calls and puts, convertible securities, and warrants – this chapter's discussion is limited to call options. A call option gives the holder the right to buy a share of stock at a specified price, known as the exercise price, and the basic American option can be exercised at any time through the expiration date. The value of the option at expiration is the difference between the market price of the underlying stock and its exercise price (with a minimum value of zero, of course).

While several factors affect the value of an option, the most important factor is the price volatility of the stock – the greater the volatility, the greater the value of the option, other things remaining the same. We will also note that the longer the time left before expiration and the higher the level of interest rates in the market, the greater the option value, all other things held the same.

The theoretical value of a call option at expiration is the difference between the market price of the underlying common stock, p_s and the exercise price of the option, E, or zero, whichever is greater:

$$C = \text{Max}(P_s - E,\ 0) \tag{1.47}$$

When the price of the stock is greater than the exercise price, the option has a positive theoretical value that will increase dollar for dollar with the price of the stock. When the market price of the stock is equal to or less than the exercise price, the option has a theoretical value of zero, as shown in Fig. 1.4. Nevertheless, as long as some time remains before expiration, the actual market price of the option (referred to as the option premium at the time of issue) is likely to be greater than its theoretical value. This increment above the theoretical value is called the *time value* or *speculative value* of the option, and its size will depend primarily on the perceived likelihood of a profitable move on the price of the stock before expiration of the option.

The full range of possible values for the market price of the option is from the theoretical value on the low side to the market price of the stock itself on the high side. For the option price to be equal to the stock price, an infinite time to expiration would be implied. For the option price to be equal to the theoretical value only, imminent expiration would be implied. For virtually all options for which the value would be determined, however, the option price would fall somewhere between these two extremes. Because an option costs less than its underlying stock, the percentage change in option price is greater than the percentage change in stock price, given some increase in the market price of the stock. Thus, a leveraged rate of return can be earned by investment in the option rather than the stock. As stock price continues to increase, the difference between the percentage change in option price and the percentage change in stock price will tend to converge.

Thus far it has been shown that the value of an option will be a function of the underlying stock price, the exercise price of the option, and the time to maturity. Yet there is still another factor that is probably the single most important variable affecting the speculative value of the option. That is the price volatility of the underlying stock. The greater the probability of significant change in the price of the stock, the more likely it is that the option can be exercised at a profit before expiration. There is another factor affecting the speculative premium for options. This is the level of interest rates in the market – specifically for option analysis, the *call money* rate charged by brokers for the use of margin in common-stock accounts. As this concept is discussed later, it is sufficient here to point out that the leverage achieved through option investment is similar to that achieved through direct margin purchase of the underlying common stock, but without the explicit interest cost involved in the latter. Thus, the higher the call money rate, the greater the savings from the use of options and the greater the speculative value of the option.

To summarize, there are five variables necessary to determine the value of an American call option (ignoring dividends on the common stock):

1. and 2. *Stock price–Exercise price*: The relationship between these two prices determines whether the option has a positive theoretical value.
3. *Time to maturity*: The longer the time to maturity, the greater the speculative value of the option because the chances for a profitable movement in the price of the stock are increased.
4. *Volatility of stock price*: There is a positive relationship between the volatility of the underlying stock price and the speculative value of the option because with greater volatility, there is greater potential for gain on the upside and greater benefit from the downside protection involved with the option.
5. *Interest rate*: The higher the call money rate for direct margin purchase of common stock, the greater the relative value of being able to achieve equal amounts of leverage through the alternative of option purchase.

The factors that affect the value of an option can be written in a functional form:

$$\boldsymbol{C = f(S, X, \sigma^2, T, r_f)} \tag{1.48}$$

where:

C = value of the option;
S = stock price;
X = exercise price;
σ^2 = variance of the stock;
T = time to expiration; and
r_f = risk-free rate.

The value of the option increases as a function of the value of the stock for a given exercise price and maturity date. The lower the exercise price, the greater the value of the option. The longer the time to maturity, the higher the value of the option. The holder of an option will prefer more variance in the price of the stock to less. The greater the variance (price volatility) the greater the probability that the stock price will exceed the exercise price and thus benefit the holder.

Considering two related financial securities – common stock and the option on the common stock – it is possible to illustrate how a risk-free hedged position can be developed. In this way, unprofitable price movements in one of the securities will be offset by profitable price movements in the other. The hedge ratio determines the portion of stock held long in relation to the options in the short position (or vice versa). With a complete hedge, the value of the hedged position can be the same regardless of the stock-price outcome. In efficient financial markets, the rate of return earned on perfectly hedged positions will be the risk-free rate. Consequently, it is then possible to determine the appropriate option price at the beginning of the period. If the actual market price is above or below this value, arbitrage would then drive the option price toward its correct level. This process and the development of the Black-Scholes (1973) continuous type of option-pricing model will be discussed in Chaps. 23, 24, and 27. Cox et al. (1979) discrete type of binomial option-pricing model will be analyzed in Chaps. 25, 26, and 28.

1.8 Futures Valuation and Hedging

A basic assumption of finance theory is that investors are risk averse. If we equate risk with uncertainty, can we question the validity of this assumption? What evidence is there?

As living, functional proof of the appropriateness of the risk aversion assumption, there exist entire markets whose sole underlying purpose is to allow investors to display their uncertainties about the future. These particular markets, which primary focus on the future, are called just that, futures markets. These markets allow for the transfer of risk from hedgers (risk-averse individuals) to speculators (risk-seeking individuals). A key element necessary for the existence of futures markets is the balance between the number of hedgers and speculators who are willing to transfer and accept risk.

A future contract is a standardized legal agreement between a buyer and a seller, who promise now to exchange a specified amount of money for goods or services at a future time. Of course, there is nothing really unusual about a contract made in advance of delivery. For instance, whenever something is ordered rather than purchased on the spot, a futures (or forward) contract is involved. Although the price is determined at the time of the order, the actual exchange of cash for the merchandise takes place later. For some items the lag is a few days, while for others (such as a car) it may be months. Moreover, a futures contract imparts a legal obligation to both parties of the contract to fulfill the specifications. To guarantee fulfillment of this obligation, a "good-faith" deposit, also called margin, may be required from the buyer (and the seller, if he or she does not already own the product).

To ensure consistency in the contracts and to help develop liquidity, futures exchanges have been established. These exchanges provide a central location and a standardized set of rules to enhance the credibility of these markets and thus generate an orderly, liquid arena for the price determination of individual commodities at distinct points in the future.

A substantial increase in the number of types of futures contracts offered by the exchanges has been occurring over the last decade. At the same time, the growth in futures trading volume has been phenomenal. Two explanations can be offered for this increase in futures activity. These increases can be intuitively correlated with the growing levels of uncertainty in many facts of the economic environment – for example, inflation and interest rates. A second view is based on the argument that even though the world has not become any more uncertain, the increased integration of financial and real markets has increased the risk exposure of any given individual. The tremendous growth in the home-mortgage and consumer-debt financial markets has allowed the purchase of more expensive real assets. This increase in the rise of individual financial leverage has increased individual exposure to interest-rate fluctuations, thereby increasing the requirements for risk-sharing across markets or between individuals with varied portfolios. Futures markets have the potential to help people manage or transfer the uncertainties that plague the world today.

This section examines the basic types of futures contracts offered and the functioning of futures markets. In addition the uses of financial and index futures are illustrated, and the theoretical pricing concepts related to these financial instruments are discussed. The important terms associated with futures contracts and futures markets are defined and an analysis of futures market follows. A theory of valuation is introduced, and the section closes with a discussion of various hedging strategies and concepts.

1.8.1 Futures Markets: Overview

In the most general sense, the term commodity futures is taken to embrace all existing futures contracts. Nevertheless, for purposes of clarity and classification its meaning here is restricted to a limited segment of the total futures markets. Accordingly, futures contracts can be classified into three main types.

1. Commodity futures
2. Financial futures
3. Index futures

Within this classification commodity futures include all agriculturally related futures contracts with underlying assets, such as corn, wheat, rye, barley, rice, oats, sugar, coffee, soybeans, frozen orange juice, pork bellies, live cattle, hogs, and lumber. Also within the commodity-futures framework are futures contracts written on precious metals, such as gold, silver, copper, platinum, and palladium, and contracts written on petroleum products, including gasoline, crude oil, and heating oil. Many of the futures contracts on metals and petroleum products have been introduced as recently as the early 1980s.

Producers, refineries, and distributors, to name only a few potential users, employ futures contracts to assure a particular price or supply – or both – for the underlying commodity at a future date.

Futures-market participants are divided into two broad classes: hedgers and speculators. Hedging refers to a futures-market transaction made as a temporary substitute for a cash-market transaction to be made at a later date. The purpose of hedging is to take advantage of current prices by using futures transactions. For example, banks and corporations can be hedgers when they use futures to fix future borrowing and lending rates.

Futures market speculation involves taking a short or long futures position solely to profit from price changes. If you think that interest rates will rise because of an increase in inflation, you can sell T-bill futures and make a profit if interest rates do rise and the value of T-bills falls.

Financial futures are a trading medium initiated with the introduction of contracts on foreign currencies at the International Monetary Market (IMM) in 1972. In addition to futures on foreign currencies, financial futures include contracts based on Treasury bonds (T-bonds), Treasury bills (T-bills), Treasury notes (T-notes), bank certificates of deposit, Eurodollars, and GNMA mortgage securities. These latter types of financial futures contracts are also referred to as *interest-rate futures* as their underlying asset is an interest-bearing security. While foreign-currency futures arose with the abolition of the Bretton Woods fixed exchange-rate system during the early 1970s, interest-rate futures surged in popularity and number following the change in U.S. monetary policy in October 1979. The effect of the Federal Open Market Committee's decision to deemphasize the traditional practice of "pegging" interest rates was to greatly increase the volatility of market interest rates. Thus, interest-rate changes have become a highly prominent risk to corporations, investors, and financial institutions.

Index futures represent the newest and boldest innovation in the futures market to date. An index-futures contract is in for which the underlying asset is actually a portfolio of assets – for example, the Major Market Index (MMI) includes 20 stocks traded on the NYSE and the S&P index includes 500 stocks. Contracts on more diverse types of indexes include a high-quality bond index, an interest-rate index composed of interest-bearing market securities, and the consumer price index.

The S&P 500 index, requiring delivery of the 500 stocks constituting the S&P 500 stock index, would certainly have dampened enthusiasm for this and similar index contracts. Because of this, an index-futures contract is settled on the basis of its cash value when the contract matures. The cash value of the contract is equal to the closing index value on its last trading day multiplied by a dollar amount of $500. Many portfolio managers are taking advantage of index futures to alter their portfolios risk-return distributions.

1.8.2 The Valuation of Futures Contracts

The discussions of each of the three classifications of futures contracts have pointed out pricing idiosyncrasies and have examined specific pricing models for particular types of contracts. Nevertheless, the underlying tenets of any particular pricing model have their roots in a more general theoretical framework of valuation. Consequently, the focus is now on the traditional concepts of futures contracts valuation.

1.8.2.1 The Arbitrage Argument

An instant before the futures contract matures, its price must be equal to the spot (cash) price of the underlying commodity, or:

$$F_{t,T} = S_t \tag{1.49}$$

where:

$F_{t,T}$ = the price of the futures contract at time t, which matures at time T, where $T > t$ and $T - t$ is a very small interval of time; and

S_t = the spot price of the underlying commodity at time t.

If Equation (1.49) did not hold arbitrage condition would prevail. More specifically, when $t = T$ at the maturity of the contract, all trading on the contract ceases and the futures price equals the spot price. If an instant before maturity $F_{t,T} < S_t$, one could realize a sure profit (an arbitrage profit) by simultaneously buying the futures contract (which is undervalued) and selling the spot commodity (which is overvalued). The arbitrage profit would equal:

$$S_t - F_{t,T} \tag{1.50}$$

However, if $F_{t,T} > S_t$ is the market condition an instant before maturity, smart traders would recognize this arbitrage condition and sell futures contracts and buy the spot commodity until $t = T$ and $F_{t,T} = S_t$. In fact, the effect of selling the futures and buying the spot would bid their prices down and up, respectively. Thus, the arbitrage process would alleviate any such pricing disequilibrium between the futures contract and its underlying spot commodity.

1.8.2.2 Interest Costs

The previous simplified argument demonstrated that the futures and spot prices must be equal an instant before the contract's maturity. This development assumes no costs in holding the spot commodity or carrying it (storing it) across time. If such a market condition held, Equation (1.49) could be extended to apply to any point of time where $t < T$. However, by having to buy or sell the spot commodity to carry out the arbitrage process, the trader would incur certain costs. For instance, if the spot commodity were purchased because it is undervalued relative to the futures, the trader or *arbitrageur* would incur an opportunity or interest cost. Any funds he or she tied up in the purchase of the commodity could alternatively be earning some risk-free interest rate R_f through investment in an interest-bearing risk-free security. Therefore, the futures price should account for the interest cost of holding the spot commodity over time, and consequently Equation (1.49) can be modified to:

$$F_{t,T} = S_t(1 + R_{f,T-t}) \tag{1.51}$$

where $R_{f,T-t}$ is the risk-free opportunity cost or interest income that is lost by tying up funds in the spot commodity over the interval $T - t$.

1.8.2.3 Carrying Costs

Since theories on the pricing of futures contracts were developed long before the introduction of financial or index futures, the costs of storing and insuring the spot commodity were considered relevant factors in the price of a futures contract. That is, someone who purchased the spot commodity to hold from time t to a later period T incurs the costs of actually housing the commodity and insuring it in case of fire or theft. In the case of livestock such as cattle or hogs, the majority of this cost would be in feeding. The holder of a futures contract avoids these costs borne by the spot holder, making the value of the contract relative to the spot commodity increase by the amount of these carrying costs. Therefore, Equation (1.51) can be extended:

$$F_{t,T} = S_t(1 + R_{f,T-t}) + C_{T-t} \tag{1.52}$$

where C_{T-t} is the carrying costs associated with the spot commodity for the interval $T - t$.

1.8.2.4 Supply and Demand Effects

As for other financial instruments or commodities, the price of a futures contract is affected by expectations of future supply and demand conditions. The effects of supply and demand for the current spot commodity (as well as for the future spot commodity) have not yet been considered in this analysis.

If the probability exists that future supplies of the spot commodity might significantly differ from current supplies, then this will affect the futures price. The discussion up to this point has assumed that the aggregate supply of the commodity was fixed over time and that demand remained constant; however, for agricultural, financial, and index futures this is a very unrealistic assumption. For instance, if it is expected that the future available supply of wheat for time T will decline because of poor weather, and demand is unchanged, one would then expect the future spot price of wheat to be higher than the current spot price. Furthermore, a futures contract on wheat that matures at time T can also be considered to represent the expected spot price at time T and consequently should reflect the expected change in supply conditions. In a more extreme fashion, if there is no current supply of wheat, then the futures price would reflect only future supply conditions and the expected future spot price at time T. This can be expressed as:

$$F_{t,T} = E_t(\widetilde{S}_T) \tag{1.53}$$

where $E_t(\widetilde{S}_T)$ is the spot price at a future point T expected at time t, where $t < T$. The tilde above S_T indicates that the future spot price is a random variable because future factors such as supply cannot presently be known with certainty.

Equation (1.53) is called the unbiased-expectations hypothesis because it postulates that the current price of a futures contract maturing at time T represents the market's expectation of the future spot price at time T. Which of these expressions for the price of a futures contract at time t will hold in the market – the arbitrage pricing relationship in Equation (1.52) or the unbiased-expectations hypothesis in Equation (1.53)? As the markets are assumed to be efficient the answer is that, the market price of the futures contract will take on the minimum value of either of these two pricing relationship, or:

$$F_{t,T} = \mathrm{Min}[E_t(\widetilde{S}_T), S_t(1 + R_{f,T-t}) + C_{T-t}] \tag{1.54}$$

For any storable commodity on a given day t, the futures price $F_{t,T}$ will be higher than the spot price S_t on day t; $F_{t,T} > S_t$. The amount by which the futures price exceeds the spot price $(F_{t,T} - S_t)$ is called the premium. In most cases this premium is equal to the sum of financial costs $S_t R_{f,T-t}$ and carrying costs C_{T-t}. The condition of $F_{t,T} > S_t$ is associated with a commodity market called a normal carrying-change market.

In general, the difference between the futures price $F_{t,T}$ and spot price S_t is called the basis.

$$\text{Basis} = F_{t,T} - S_t \tag{1.55}$$

1.8.2.5 The Effect of Hedging Demand

John Maynard Keynes (1930), who studied the futures markets as a hobby, proposed that for some commodities there was a strong tendency for hedgers to be concentrated on the short side of the futures market. That is, to protect themselves against the risk of a price decline in the spot commodity, the spot holder or producer (such as a farmer) would hedge the risk by selling futures contracts on his or her particular commodity. This demand for hedging, producing an abundant supply of futures contracts, would force the market price below that of the expected spot price at maturity (time T). Moreover, the hedgers would be transferring their price risk to speculators. This difference between $E_t(\widetilde{S}_T)$ and $F_{t,T}$ when $F_{t,T} < E_t(\widetilde{S}_T)$, can be thought of as a risk premium paid to the speculators for holding the long futures position and bearing the price risk of the hedger. This risk premium can be formulated as:

$$E_t(R_P) = E_t(\widetilde{S}_T) - F_{t,T} \tag{1.56}$$

where $E_t(R_P)$ is the expected risk premium paid to the speculator for bearing the hedger's price risk.

Keynes described this pricing phenomenon as normal backwardation. When the opposite conditions exist – hedgers are concentrated on the long side of the market and bid up the futures spot pricing $F_{t,T}$ over the expected future spot $E_t(\widetilde{S}_T)$ – the pricing relationship is called contango (that is, $E_t(R_P) = F_{t,T} - E_t(\widetilde{S}_T)$). To reflect the effect of normal backwardation or contango on the current futures price, the $E_t(\widetilde{S}_T)$ term in Equation (1.56) must be adjusted for the effects of hedging demand:

$$F_{t,T} = \mathrm{Min}\,[E_t(\widetilde{S}_T) + E(R_P), S_t(1 + R_{f,T-t}) + C_{T-t}] \tag{1.57}$$

Equation (1.57) expresses a broad pricing framework for the value of a futures contract. Over the life of the futures contract the futures price must move toward the cash price, because at the maturity of the futures contract the futures price will be equal to the current cash price. If hedgers are in a net short position, then futures prices must lie below the expected future spot price, and futures prices would be expected to rise over the life of the contract. However, if hedgers are net long, then the futures price must lie above the expected futures spot price and the price of the futures would be expected to fall. Either a falling futures price (normal backwardation) or a rising futures price (contango) determines the boundaries within which the actual futures price will be located.

However, numerous other factors can alter and distort the relationship shown by Equation (1.57). For instance, the analysis implicitly assumes that interest rates remain constant from time t to the contract's maturity date at time T. However, since market interest rates fluctuate, an increasing or decreasing term structure of interest rates would bias the price of the futures contract higher or lower. In fact, the more accurate one's forecast of future interest rates, the more accurate the current valuation of the futures contract.

Empirical research casts rather strong doubt on the size of the expected risk-premium component of futures prices, particularly for financial and index futures.

In fact, the expectation of speculators, along with actual futures contract supply and demand conditions in the pit, can combine to reverse the effect expected by Keynes. This results in part from the makeup of futures' users, a clear majority of whom are not hedgers as suggested by Keynes. Additionally, a futures contract for which an illiquid level of trading volume exists would put the bid and offer prices for the contract further apart. A seller of such a futures contract would require more than the theoretical fair price as compensation for the risk undertaken. The risk is of prices starting to rise in an illiquid market in which the position cannot be immediately closed out. It costs money to maintain the position; therefore, a premium is required to cover this cost.

1.8.3 Hedging Concepts and Strategies

The underlying motivation for the development of futures markets is to aid the holders of the spot commodity in hedging their price risk; consequently, the discussion now focuses on such an application of futures market. Four methodologies based on various risk-return criteria are examined; moreover, to fully clarify the hedger's situation some of the common problems and risks that arise in the hedging process are analyzed.

1.8.3.1 Hedging Risks and Costs

As mentioned previously, hedging refers to a process designed to alleviate the uncertainty of future price changes for the spot commodity. Typically this is accomplished by taking an opposite position in a futures contract on the same commodity that is held. If an investor owns the spot commodity, as is usually the case (a long position), the appropriate action in the futures market would be to sell a contract (a short position). However, disregarding for the moment the correct number of futures contracts to enter into, a problem arises if the prices of the spot commodity and the futures contract on this commodity do not move in a perfectly correlated manner. This nonsynchronicity of spot and futures prices is related to the basis and is called the basis risk.

The basis has been defined as the difference between the futures and spot prices. Basis risk is the chance that this difference will not remain constant over time. Four types of risk contribute to basis risk; these are defined in Table 1.1. These four types of risks prevent the hedger from forming a perfect hedge (which would have zero risk). Even though the hedger is reducing the amount of risk, it has not been reduced to zero. It is often said that hedging replaces price risk with basis risk.

Table 1.1 The components of basis risk

Type of risk	Components
Expiration-date risk	Futures contracts are not usually available for every month. If a hedger needed a futures contract for July and the only contracts that were available were for March, June, September, and December, the hedger would have to select either the June or September contract. Either of these contracts would have a different price series than a July contract (if one existed). Hence, the hedger cannot form a perfect hedge and is faced with the chance that the basis may change
Location risk	The hedger requires delivery of the futures contract in location Y, but the only futures contracts available are for delivery in location X. Hence, the hedger cannot form a perfect hedge because of the transportation costs from X to Y; this may cause the basis to change
Quality risk	The exact standard or grade of the commodity required by the hedger is not covered by the futures contract. Therefore, the price movement of commodity grade A may be different from the price movement of commodity grade B, which will cause the basis to change and prevent the hedger from forming a perfect hedge
Quantity risk	The exact amount of the commodity needed by the hedger is not available by a single futures contract or any integer multiple thereof. Hence, the amount of the commodity is not hedged exactly; this prevents the hedger from forming a perfect hedge, and the underhedged or overhedged amount is subject to risk

The potential causes of basis risk are not necessarily limited to those identified in Table 1.1. Hence, basis risk is the prominent source of uncertainty in the hedging process. Other potential causes are (1) supply-demand conditions and (2) cross-hedging consequences.

Even if the futures contract is written on the exact commodity that the hedger holds, differing supply and demand conditions in the spot market and futures market could cause the basis to vary over time. Occasionally, speculators in the futures market will bid the futures price above or below its equilibrium position, due perhaps to the excitement induced by an unexpected news release. Of course, the market forces of arbitrage will eventually bring the spot and futures prices back in line. The limiting case is at the expiration of the futures contract, when its price must converge to the spot price.

Consequently, the disequilibrating influence on the basis stemming from supply-demand forces can be alleviated by entering a futures contract that matures on the exact day that the hedger intends to sell the spot commodity. But although most futures contracts are quite flexible, it is unlikely that any contract would correlate so precisely with the hedger's needs. In some cases (such as for agricultural commodities, where futures contracts are offered that mature each month) the basis risk due to nonsimultaneous maturities is not so great. However, for other commodities, particularly financial instruments, futures contracts maturing 3 months apart are more typically offered. Thus, at the time the hedger needs to sell the spot commodity in the market, any protection in price risk over the hedging period could conceivably be wiped out by a temporary adverse change in the basis.

Cross-hedging refers to hedging with a futures contract written on a nonidentical commodity (relative to the spot commodity). Although not often necessary with agricultural futures, cross-hedging is frequently the best that can be done with financial and index futures. Changes in the basis risk induced by the cross-hedge are caused by less-than-perfect correlation of price movements between the spot and futures prices – even at maturity. That is, because the spot commodity and futures contract commodity are different, their respective prices will tend to be affected (even though minutely at times) by differing market forces. While the futures price must equal the price of its underlying spot commodity at the contract's maturity date, this condition does not necessarily hold when the hedger's commodity is not the "true" underlying asset. Therefore, even when the liquidation of the spot commodity coincides with the maturity of the futures contract, there is no guarantee of obtaining the original price of the commodity that held at the initiation of the hedge.

1.8.3.2 The Johnson Minimum-Variance Hedge Strategy

Developed within the framework of modern portfolio theory, the Johnson hedge model (1960) retains the traditional objective of risk minimization but defines risk as the variance of return on a two-asset hedge portfolio. As in the two-parameter world of Markowitz (1959), the hedger is assumed to be infinitely risk averse (that is, the investor desires zero variance). Moreover, with the risk-minimization objective defined as the variance of return of the combined spot and futures position, the Johnson hedge ratio is expressed in terms of expectations of variances and covariances for price changes in the spot and futures markets.

The Johnson hedge model can be expressed in regression form as:

$$\Delta S_t = a + H\Delta F_t + e_t \tag{1.58}$$

where:

ΔS_t = change in the spot price at time t;
ΔF_t = change in the futures price at time t;
a = constant;
H = hedged ratio; and
e_t = residual term at time t.

Furthermore, the hedge ratio measure can be better understood by defining it in terms of its components:

$$\frac{X_f^*}{X_s} = -\frac{\sigma_{\Delta S,\Delta F}}{\sigma_{\Delta F}^2} = H \tag{1.59}$$

where:

X_f^* and X_s = the dollar amount invested in futures and spot;
$\sigma_{\Delta S,\Delta F}$ = the covariance of spot and futures price changes; and
$\sigma_{\Delta F}^2$ = the variance of futures price changes.

Thus H, the minimum-variance hedge ratio computed in variability, is also a measure of the relative dollar amount to be invested in futures per dollar of spot holdings. In a sense it is a localized beta coefficient similar in concept to the beta of a stock *à la* capital asset pricing theory.

As a measure of hedging effectiveness, Johnson utilizes the squared simple-correlation coefficient between spot and futures price changes, ρ^2. More formally, Johnson's hedging-effectiveness measure can be ascertained by first establishing the following expression:

$$HE = 1 - \frac{V_H}{V_u} \tag{1.60}$$

where:

V_u = variance of the unhedged spot position = $X_s^2\sigma_{\Delta S}^2$
$\sigma_{\Delta S}^2$ = *variance of spot price changes; and*
V_H = the variance of return for the hedged portfolio = $X_s^2\sigma_{\Delta S}^2(1-\rho^2)$.

By substituting the minimum-variance hedge position in the futures, X_f^*:

$$HE = \left[1 - \frac{X_S^2\sigma_{\Delta S}^2(1-\rho^2)}{X_S^2\sigma_{\Delta S}^2}\right] = \rho^2 \tag{1.61}$$

In simpler terms then, the Johnson measure of hedging effectiveness is the R^2 of a regression of spot-price changes on futures-price changes. To utilize this hedging method, it is necessary to regress historical data of spot-price changes on futures-price changes. The resulting beta coefficient from the regression would be the localized Johnson hedge ratio, and the regression R^2 would represent the expected degree of variance minimization using this hedge ratio over the hedging horizon. "Localized" and "expected" must be emphasized because, first of all, although the Johnson hedge ratio can be re-estimated, it nonetheless is a static measure based on historical data. What held for the past may not hold precisely for the future. Moreover, large price moves may distort this hedge ratio considerably. Hence, R^2 is what can be expected based on the past in terms of variance reduction for the total hedge position. It should not be expected to hold exactly.

1.8.3.3 The Howard-D'Antonio Optimal Risk-Return Hedge Strategy

The classic one-to-one hedge is a naïve strategy based upon a broadly defined objective of risk minimization. The strategy is naïve in the sense that a hedging coefficient of one is used regardless of past or expected correlations of spot- and futures-price changes. Working's strategy brings out the speculative aspects of hedging by analyzing changes in the basis and, accordingly, exercising discrete judgment about when to hedge and when not to hedge. The underlying objective of Working's decision rule for hedgers is one of profit maximization. Finally, Johnson (1960), in applying the mean-variance criteria of modern portfolio theory, emphasizes the risk-minimization objective but defines risk in terms of the variance of the hedged position. Although Johnson's method improves on the naïve strategy of a one-to-one hedge, it however, essentially disregards the return component associated with a particular level of risk. Rutledge (1972) uses both mean and variance information to derive hedge ratio.

In a recent paper by Howard and D'Antonio (1984), a hedge ratio and measure of hedging effectiveness are derived in which the hedger's risk and return are both explicitly taken into account. Moreover, some of the variable relationships derived from their analysis help explain some of the idiosyncrasies of hedging that occur in practice.

Using a mean-variance framework, the Howard-D'Antonio strategy begins by assuming that the "agent" is out to maximize the expected return for a given level of portfolio risk. With a choice of putting money into three assets – a spot position, a futures contract, and a risk-free asset – the agent's optimal portfolio will depend on the relative risk-return characteristics of each asset. For a hedger, the optimal portfolio may contain a short futures position, a long futures position, or no futures position at all. In general, the precise futures position to be entered into will be determined by (1) the risk-free rate, (2) the expected returns and the standard deviations for the spot and futures positions, and (3) the correlation between the return on the spot position and the return on the futures.

Howard and D'Antonio arrive at the following expressions for the hedge ratio and the measure of hedging effectiveness:

$$\text{Hedge ratio } H = \frac{(\lambda - \rho)}{\gamma\pi(1 - \lambda\rho)} \tag{1.62}$$

and

$$\text{Hedging effectiveness } HE = \sqrt{\frac{1 - 2\lambda\rho + \lambda^2}{1 - \rho^2}} \tag{1.63}$$

where:

$\pi = \sigma_f/\sigma_s$ = relative variability of futures and spot returns;
$\alpha = \bar{r}_f/(\bar{r}_s - i)$ = relative excess return on futures to that of spot;
$\gamma = P_f/P_s$ = current price ratio of futures to spot;
$\lambda = \alpha/\pi = (\bar{r}_f/\sigma_f)/[(\bar{r}_s - i)/\sigma_s]$ = risk-to-excess-return relative of futures versus the spot position;
P_s, P_f = the current price per unit for the spot and futures respectively;
ρ = simple correlation coefficient between the spot and futures returns;
σ_s = standard deviation of spot returns;
σ_f = standard deviation of futures returns;
$\bar{r}_s$ = mean return on the spot over some recent past interval;
$\bar{r}_f$ = mean return on the futures over some recent past interval; and
i = risk-free rate.

By analyzing the properties of λ these authors discern some important insights for the coordinated use of futures in a hedge portfolio. Numerically, λ expresses the relative attractiveness of investing in futures versus the spot position. When $\lambda < 1$, $\lambda = 1$, and $\lambda > 1$, the futures contract offers less, the same, and more excess return per unit of risk than the spot position, respectively. Since this analysis is being undertaken from a hedger's point of view, it is assumed $\lambda < 1$. An assumption that $\lambda > 1$ would inappropriately imply that theoretically it is possible to hedge the futures position with the spot asset.

From a practitioner's perspective it is also important to note that even when $\lambda \neq \rho$, a hedged position using the futures may not provide a real net improvement in the risk-return performance of a portfolio. Unless HE is significantly greater than 1, other factors such as transaction costs, taxes, the potential for margin calls, and liquidity may negate the overall benefit of hedging with futures. This point, along with the previous results about hedging, helps explain why certain futures contracts highly correlated with their underlying assets are not used extensively as hedging vehicles as might be expected.

This section has focused on the basis concepts of futures markets. Important terms were defined and basic models to evaluate futures contracts were discussed. Finally, hedging concepts and strategies were analyzed and alternative hedging ratios were investigated in detail. These concepts and valuation models can be used in security analysis and portfolio management related to futures and forward contracts. Please see Chap. 57 for a generalized model for optimum futures hedge ratio.

1.9 Conclusion

This chapter has reviewed and summarized alternative valuation theories – discounted cash flow, M and M, CAPM, APT, OPT, and futures valuation – and the Markowitz portfolio theory that are basic to introductory courses in financial management or investments. These theories can directly and indirectly become guidelines for further study of security analysis and portfolio management. Derivations and applications of these valuation models to security analysis and portfolio management are studied in detail in later parts of this handbook.

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