

## **CAPITAL ASSET PRICING MODEL ANALYSIS OF THE COST OF EQUITY CAPITAL**

### **I. Description of the Approach**

The capital asset pricing model (CAPM) is a theory of the relationship between the risk of a security or a portfolio of securities and the expected rate of return that is commensurate with that risk. The theory is based on the assumption that security markets are efficient and dominated by risk averse investors. In other words, the CAPM argues that investors are willing to take on more risk only if they can reasonably expect a higher return.

The CAPM accepts the risk/return trade-off economic principle and quantifies that trade-off. Further, the model assumes that most investors diversify their investment holdings so as to not put “all of their eggs in one basket.” Indeed, the tendency for investors to diversify their investment portfolios implies that, in a CAPM context, the only type of risk that is rewarded or relevant in the risk/return trade-off is systematic or market-related risk. Thus, the additional risk created by not diversifying among investments is not rewarded by the securities markets under the CAPM.

The measurable relationship between risk and expected return in the CAPM is summarized by the following expression:

$$R_i = R_f + \beta_i [ R_m - R_f ],$$

where  $R_i$  is the expected return on security or portfolio  $i$ ,  $R_f$  is the return on a risk-free security like a U.S. Treasury bond,  $\beta_i$  is the beta of security or portfolio  $i$ , and  $R_m$  is the expected return on a broad index of equity market performance like the Standard & Poor's Composite 500 Index (S&P 500).

### **II. Economic Rationale for the Approach**

The rationale for the CAPM equation is the common sense observation that investors must be coaxed to move their money from riskless assets like U.S. Treasury bonds into risky assets. Consider an everyday example wherein investors can obtain about a 7% return on a Treasury security. Investors will not invest in a broad market portfolio of risky securities unless they can expect a significant return premium for accepting the risk in excess of the riskless security. In terms of the above example, investors would want an expected return that is greater than 7% if material risk is present. The usefulness of the CAPM is in measuring how much of an expected return premium is appropriate for investments in light of their riskiness relative to the risk of a benchmark broad market index.

The economic interpretation of the CAPM equation is as the base risk-free rate of return ( $R_f$ ) plus the market-wide risk premium of ( $R_m - R_f$ ) that is required to coax investors away from exclusive investment in risk-free securities. The beta coefficient measures the riskiness of a given security or portfolio relative to the overall market benchmark. Beta expresses how much the given investment's returns tend to vary as the returns on the benchmark market index vary over the business cycle. Beta therefore may be viewed as the appropriate weight to apply to the market-wide risk premium ( $R_m - R_f$ ). The beta of the market portfolio must, by definition, be equal to 1.

Consider an example of how the CAPM estimates the appropriate risk-adjusted expected return on an investment. Assume that the risk-free rate of return on a U.S. Treasury bond is 7%, the expected return on the market is 15%, and that an investor wants to determine the appropriate expected rate of return on a stock with a beta of 1.5. The market-wide risk premium is (15% - 7%) or 8%. This implies that investors will not allocate money to investments with market-like riskiness unless they can expect to get at least an 8% premium over the risk-free rate of 7%. However, a 8% premium will be insufficient if an investment is more variable (i.e., riskier) than the overall market. The returns on a stock with a beta of 1.5 tend to vary 1.5 times more than the return on the overall market. The market-wide risk premium of 8% must therefore be increased 1.5 times to 12% in order to attract investors. Thus, a stock with a beta of 1.5 should generate an expected return of 19% in order to adequately compensate investors for the above-market risk of the investment.

### **III. Consistency of the Approach with Regulatory and Economic Standards**

The CAPM is consistent with the appropriate public utility regulatory and economic standards. Specifically, the CAPM is consistent with the regulatory principle set forth in the Hope case that the allowed return of a public utility should be "... commensurate with the returns on investments in other enterprises having corresponding risk." The CAPM is also consistent with the regulatory standard that emerged from the Bluefield decision, which states that the "... return should be reasonably sufficient to assure confidence in the financial soundness of the utility and ... enable it to raise the money necessary for the proper discharge of its public duties."

In terms of the appropriate economic standards, the CAPM produces return estimates that should meet investors' opportunity costs, satisfy the demands of the risk/return trade-off, and is consistent with the empirical evidence that supports a high degree of efficiency in U.S. financial markets.

### **IV. Usefulness of the CAPM in Estimating the Cost of Equity Capital**

The primary usefulness of the CAPM is as a conceptual tool for systematically relating expected returns to risk. The model requires market-based data inputs that are largely objective and relatively easy to obtain. The shortcoming of the CAPM is that available empirical evidence

indicates that the beta coefficient may not fully capture all of the sources of market risk. This implies that CAPM-based estimates of the cost of equity should be supplemented with alternative approaches that use other measures of risk. For this reason, my cost of equity analysis does not rely solely on the CAPM but also uses the DCF model and the risk premium approach to corroborate the reasonableness of my cost of equity estimates for the target regulated firm.

## **V. Data for CAPM Analysis**

### **A. Beta Coefficients**

Importantly, the beta coefficients presented in Billingsley Exhibit No. RSB-3 are not historical betas like those commonly quoted by Value Line, Standard & Poor's, or Merrill Lynch. While frequently used, such historical estimates of beta are inconsistent with the CAPM's reliance on prospective beta coefficients. Historical estimates only reflect the past riskiness of an equity security that need not be representative of the future riskiness that is relevant to equity investors. The CAPM is formulated in terms of investor expectations, which clearly transcend exclusive reliance on historical measures of riskiness like betas based solely on the past return performance of stocks. The beta coefficients used in my CAPM analysis are prospective measures supplied by BARRA, a widely recognized provider of data and decision support systems for institutional investors.

BARRA describes its predicted beta as follows:

In the BARRA E2 multiple-factor model, factors are estimated for 13 risk indices and for 55 industry groups...each risk index is built from a number of underlying fundamental data items that capture elements of risk. By combining them, we produce a multifaceted measure of risk that best characterizes the single concept we are trying to measure. The individual data items are called descriptors. The combined descriptors make up the risk index (*BARRA U.S. Equity Beta Book*, January 1997).

This approach has been extended in BARRA's E3 version of the model (*United States Equity - Risk Model Handbook*, Version 3 (E3), BARRA, Inc., 1998).

### **B. Risk-Free Rate of Return**

In order to be consistent with the expectational emphasis of the CAPM, I use the average expected yield implied by the prices of the U.S. Treasury bond futures contracts quoted during the most recent month for which data are available. These future contracts are obligations to either take or make delivery of 6% coupon 10-year Treasury bonds for a fixed price (yield) at a specified future date. The prices of these contracts reflect the market's objective consensus forecast of long-term, low-risk interest rates. The rate on long-term Treasury securities is chosen to be consistent with the long-time horizon of equities. A more

detailed explanation of the data and calculations is provided in Billingsley Exhibit No. RSB-5.

### **C. Expected Return on the Equity Market**

In order to focus on the prospective nature of the CAPM, I use expectational data to estimate the return on the S&P 500 as my proxy for overall equity market performance. The S&P 500 data used in the CAPM analysis reflect expected returns as of the most recent month for which data are available (September of 2003).