IS THE CAPM DEAD?

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I. CONTRIBUTION OF CAPM

The capital asset pricing model (CAPM), developed by Sharpe, Lintner, and Mossin in the 1960's, described a general equilibrium relationship in the capital markets. The standard CAPM is a fundamental contribution to understanding the manner in which capital markets function. The CAPM allows us to determine how the aggregate of investors will behave, and how prices and returns at which markets will clear are set. The construction of general equilibrium models also allow us to determine the relevant measure of risk for any asset and the relationship between expected return and risk for any asset when markets are in equilibrium.

The standard CAPM model was the first general equilibrium model developed, and it is based on the most stringent set of assumptions. These assumptions are the following: no transaction costs, assets are infinitely divisible, no personal taxes, perfect competition, utility maximization, unlimited short sales allowed, unlimited borrowing or lending at the riskless rate, homogeneity of expectations, and all assets are marketable.

Under the assumptions of the CAPM, the only portfolio of risky assets that any investor will own is the market porfolio. The market portfolio is a portfolio in which the fraction invested in any asset is equal to the market value of that asset divided by the market value of all risky assets. Each investor will adjust the risk of the market portfolio to his or her preferred risk-return combination by combining the market portfolio with lending or borrowing at the riskless rate. This leads directly to the two mutual fund theorum, which states that all investors can construct an optimum portfolio

by combining a market fund with the riskless asset. This combination forms a straight line called the capital market line, which describes all efficient portfolios.

From the equilibrium relationship for efficient portfolios, an equilibrium relationship for any security or porfolio was derived. This linear relationship is called the security market line. The security market line clearly shows that return is a linearly increasing function of risk. Furthermore, only market risk affects return.

Thus, the CAPM has made a significant contribution to equilibrium asset pricing for the last two decades.

II. USES AND IMPLICATIONS OF CAPM IN FINANCIAL MANAGEMENT

From the CAPM, value depends not only upon the security or firm itself, but upon other securities available for investment. By analyzing decisions in relation to their likely effect on expected return and systematic risk, one is able to judge their effect on valuation. Using the CAPM and the separation theorum, which states that the utility preferences of the individual affect only the amount that is borrowed or loaned, not the optimal portfolio of risky assets, certain generalizations can be made about the valuation of a firm, without having to determine directly the risk preferences of investors. If management wishes to act in the best interests of the owners, it will attempt to maximize the market value of the stock. The CAPM approach allows us to determine the appropriate discount rate to employ in discounting expected dividends to their present value. That rate will be the risk-free rate plus a premium sufficient

to compensate for the systematic risk associated with the expected dividend stream. The greater the systematic risk, the greater the risk premium and the return required, and the lower the value of the stock, all other things being the same. Thus, the firm is pointed toward determining required rates of return for individual securities.

Supposedly, all decisions of the firm should be judged in a market context, using the capital asset pricing model. However, the CAPM uses many unrealistic assumptions. Nonetheless, the CAPM serves as a useful framework for evaluating financial decisions. The basic tenets of the model hold even when assumptions are relaxed to reflect real-world conditions.

III. ROLL'S CRITICISM OF EMPIRICAL TESTS OF CAPM

There has been a huge amount of empirical testing of the standard form and the two-factor form of the CAPM model. Most of the early empirical tests of the CAPM involved the use of a time series (first pass) regression to estimate Betas and the use of cross-sectional (second pass) regression to test the hypotheses derived from the CAPM model. These hypotheses are: higher risk (Beta) should be associated with higher return, return is linearly related to Beta, and no added return for bearing nonmarket risk.

An early empirical study of the CAPM by Lintner and reproduced by Douglas, published in 1968, had results which seemed to violate the CAPM. Douglas employed a similar methodology and found results, also published in 1968, that were similar to Lintner's. Miller and Scholes in a classic article, published in 1972, provide an analysis of the

statistical problems inherent in all empirical tests of the CAPM.

Two of the best sets of tests that have been performed were by Black, Jensen and Scholes, and Fama and MacBeth. Black, Jensen and Scholes were the first to conduct an in-depth time series test of the CAPM. Their results, published in 1972, were consistent with the two-factor capital asset pricing model rather than the standard CAPM.

Fama and MacBeth, using an interesting methodology to test CAPM, showed results, published in 1973, which seemed to downplay the importance of residual risk, counter to Lintner and Douglas. Fama and MacBeth concluded that the zero Beta model is more consistent with equilibrium conditions than is the simple CAPM.

Two recent articles have developed new methodologies for testing whether the simple CAPM adequately describes returns. Gibbons, employing the fact that the CAPM places a non-linear restriction on a set of N regression equations, one for each equation, showed results, published in 1970, which rejects both the standard form and the zero-Beta form of the CAPM. Stambaugh, taking a similar appoach to Gibbons in examining the CAPM, used a different statistical test (a Lagrangian Multiplier test rather than a likelihood ratio test) and showed results, published in 1982, which finds strong support for the zero-Beta form of the CAPM and evidence against the standard form.

Recently, however, Roll published an article in which he argues that general equilibrium models of the form of the CAPM are not amenable to testing, or at least, that the tests performed so far provide little evidence in support of, or against, CAPM. His first proof was that if any ex-post mean variance efficient portfolio is selected as the market proxy, then the equation relating the mean

return to Beta of that security must hold. From this proof, he showed that the two-factor form of the CAPM must always hold with respect to ex-post data if the proxy chosen for the market portfolio is ex-post efficient. Furthermore, Roll argues that tests performed with any portfolio other than the true market portfolio are not tests of the CAPM. They are simply tests of whether the portfolio chosen as a proxy for the market is efficient or not. Roll proceeds to show that the choice between alternative forms of the CAPM model is extremely sensitive to the choice of a market proxy.

The logical conclusion of Roll's work is that equilibrium theory is not testable unless the exact compositon of the true market portfolio is known and used in the tests. The true test of the generalized two-parameter CAPM is whether the market portfolio is mean-variance efficient. Alternative forms of the CAPM can be judged only against one another if the true market portfolio is used in these tests.

IV. CAPM VS. APT : COULD THEY BE COMPATIBLE?

The arbitrage pricing theory is an alternative approach which does not try to explain the underlying causes of security returns, which the CAPM attempts. Originally developed by Ross, this theory is based on the idea that in competitve markets, arbitrage will assure that riskless assets provide the same expected return. Rather than the single factor generating the CAPM, multiple factors are involved in the return generation process. The theory suggests that the market equilibrium mechanism is driven by individuals eliminating arbitrage profits across multiple factors. The arbitrage pricing theory does

not tell us why the factors are economically or behaviorally relevant, only that there is a relationship between returns and the factors.

However, the APT model and the existence of a multifactor model is not necessarily inconsistent with the Sharpe-Lintner-Mossin form or one of the other forms of the CAPM. The equilibrium models of the CAPM and APT, are $\bar{R}_i = R_F + B_i(\bar{R}_m - R_F)$ and $\bar{R}_i = R_F + b_{i1}\lambda_1 + b_{i2}\lambda_2$, respectively. If the CAPM is the equilibrium model, it holds for all securities, as well as all portfolios of securities. If the CAPM holds, the equilibrium return on each λ_i is given by the CAPM. Defining B_i as $(b_{i1}B_{\lambda_1} + b_{i2}B_{\lambda_2})$ results in the expected return $\bar{R}_i$ being priced by the CAPM. Thus, the APT solution with multiple factors appropriately priced is fully compatible with the standard form of the CAPM.

V. IS THE CAPM REALLY DEAD?

In spite of the many questions concerning the empirical validity of the CAPM, I do not think the CAPM is dead. Roll's work questioning the testability of the CAPM is very important in that it discredits the many empirical studies performed to date. Ironically, some of these studies favor the eqilibrium CAPM model, while some criticize the model. Roll's feelings about the state of testing of the capital asset pricing theory is that it has never been subjected to an unambiguous empirical test, and doubts that it ever will.

Meanwhile, the APT promises to be a more important contribution to understanding the nature of asset prices. Empirical work on implementing APT is just beginning. While the promise is great, this promise has not yet been achieved. So, no!, CAPM is not really dead.

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