THE CASE AGAINST THE USE OF THE CAPITAL ASSET PRICING MODEL IN PUBLIC UTILITY RATEMAKING

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INTRODUCTION

In the mid-1960's, the academic community introduced a mathematical formula called the Capital Asset Pricing Model ("CAPM") which, it was contended, could be reliably employed to estimate any given asset's expected rate of return. In the succeeding years, the formula has received substantial attention and been lent considerable credence, not only in academia, but in the business and investment worlds as well. In addition, and most importantly for purpose of this comment, CAPM has been used extensively by regulatory commissions to establish rates of return for utilities.

The most recent evidence, however, strongly suggests that there are serious shortcomings associated with CAPM, and that, in the utility ratemaking context at least, it can produce totally unreliable results. And yet, at the very time when the case against CAPM has become so formidable, the ratemaking bodies' reliance on it appears to have reached its zenith. The purpose of this comment, therefore, is to marshal the evidence concerning the inappropriateness of CAPM's use as an estimator of a utility's required rate of return, and to question the ratemakers' continued reliance upon it.

The comment is organized as follows. First, a description is offered of the CAPM formula, its theoretical underpinnings, and its key components. This is followed by a survey of CAPM's use by the regulatory commissions in establishing utility rates of return. Finally, the case against that use is made.

Before beginning, one other point should be made. The analysis offered below is based not so much upon our own independent expertise, as upon the work of financial economists, investment analysts, statisticians, and utility managers who are expert in, and have a thorough command of, the complexities of the CAPM theory. The case made here against CAPM, however, is a lawyer's case. It is intended to summarize, in laymen's terms, the evidence which is available to a regulatory body considering the use of CAPM. In our opinion, the evidence shows that CAPM is a highly suspect ratemaking tool, and that until its reliability is more clearly established, it should either be rejected, or at the very least modified, in future rate proceedings.

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I. *The CAPM Theory*

Developed and refined over the past two decades,[1] the theory of CAPM, generally stated, is that the expected rate of return on any given asset is a function of the risk which investors perceive to be associated with that particular asset, as compared with the risk of all other assets in which they might invest; that the only risk for which investors expect to be compensated is that risk which cannot be "diversified away" (cancelled out) by holding the asset as part of a "well-diversified portfolio"; that this "nondiversifiable risk" is composed solely of "market risk," *i.e.*, risk which affects the market as a whole, and which therefore affects every asset in the market; that all risk except this nondiversifiable market risk is in fact diversified away when an asset is held as part of a well-diversified portfolio; that investors therefore regard as irrelevant any risks peculiar to a particular asset or to the business or industry of which that asset is a part, and expect compensation only for the way in which the particular asset is affected by market risk.

It is further said, according to the CAPM theory, that the expected compensation on the particular asset has two components — first, the current return due on a riskless investment (such as a U.S. treasury bill) and, second, a "risk premium" above the riskless rate; that this "risk premium" component (or "excess return" component) of a given asset's expected return should be measured in terms of how volatile these excess returns have been on the particular asset as compared with the volatility of the excess returns on the average - risk asset in the market; that this volatility-comparison measurement may be taken by correlating the past excess returns on the given asset with the past excess returns on the average asset, the latter being represented by some broad market index of equity securities such as the Standard & Poor's 500; that this correlation of past excess returns results in a coefficient called "beta," which quantifies the volatility (and therefore the riskiness) of the asset in question relative to the volatility of the average asset; that every asset's risk premium is directly proportional to how much more or less volatile than the market's excess returns have been the asset's excess returns; that beta reflects this proportionality and fully captures the asset's risk premium; and therefore, that once an asset's beta has been determined, nothing more about the asset need be known in order to reliably estimate its expected rate of return.

Based on the foregoing CAPM assumptions, the expected rate of return (or cost of equity) for a given asset is computed according to the following formula:

expected rate of return = risk-free rate + beta ×
(market rate - risk-free rate) + alpha

The *risk-free rate* in the formula is usually determined by examining the current yields offered on treasury bills, which constitute essentially risk-free investments.

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[1]The original development of CAPM is usually attributed to W.F. Sharpe ("Capital Asset Prices: A Theory of Market Equilibrium Under Conditions of Risk," 19 *Journal of Finance* 425 (Sept. 1964)) and J. Lintner ("The Valuation of Risk Assets and the Selection of Risky Investments in Stock Portfolios and Capital Budgets," 47 *Review of Economics and Statistics* 13 (Feb. 1965)).

The quantity *market rate — risk-free rate* (the excess return) represents the risk premium on the average asset. It is normally assumed to be equal to the average long-term return on the market index in excess of the average long-term risk-free rate.

Beta, as described above, purports to assess the riskiness of the given asset in relation to the riskiness of the average asset, and thereby indicates the amount of the asset's risk premium. A beta of 1.0 is said to indicate that the asset is equally risky as the market index because its excess returns fluctuate in line with and by the same percentage amount as the market's excess return; hence, the asset will have the same risk premium as the market itself. By the same token, a beta of 1.5 indicates that the asset is 50% riskier than the market index (because its excess returns increase (or decrease) at 1.5 times the magnitude of increases (or decreases) in the market's excess return) and therefore has an expected risk premium 50% higher than that of the market. It follows that an asset with a beta of zero has no market risk, and is therefore expected to return the riskless rate.

Finally, *alpha* represents that part of a security's expected return which cannot be attributed to, or explained by, the security's response to fluctuations in the market index. CAPM assumes that alpha is zero.

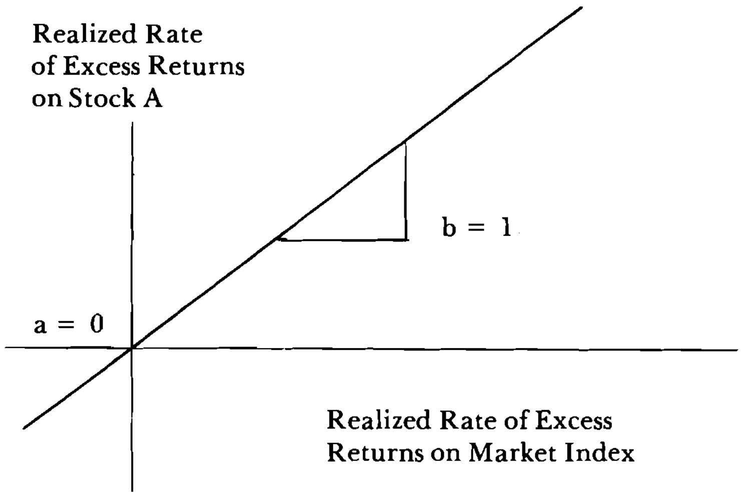
In other words, all that need be done to determine a particular asset's expected return, says CAPM, is, first, determine the asset's beta, then look up the current risk-free return, determine the current market (average asset) return, compute the resulting market "risk premium" by subtracting the risk-free return from the market return, next determine the given asset's risk premium by multiplying the market risk premium by the asset's beta, and, finally, add the current riskless return to the asset's risk premium. The sum, according to the theory, equals the asset's expected rate of return (or, in the case of a utility, its cost of equity).

Plainly, CAPM's centerpiece, and the key to its reliability, is beta. It is important, therefore, to understand how beta is computed, and how, in practice, it is used to estimate an expected rate of return or cost of equity for a particular asset.

Both the beta and the alpha of a particular asset are calculated through the use of a bivariate regression model. Such a model can be used to measure the relationship between any pair of variables. In connection with CAPM, the model is typically used to plot the relationship between the excess returns (*i.e.*, returns in excess of the riskless rate) on the asset in question and the contemporaneous excess returns on a general market index. Beta is determined by a line drawn which best "fits" the pattern of the plotted returns, and is the *slope coefficient* of the regression model; alpha, on the other hand, is determined by the point at which the "beta line" crosses the asset's excess rate-of-return line, and is the *intercept coefficient* of the regression model. Thus, every computation of beta also produces a computation of alpha.

Table 1 illustrates an asset (Stock A) that has a beta of 1.0 and an alpha of 0.

Table 1



Based on its beta of 1.0, Stock A is assumed to have the same nondiversifiable risk (sometimes referred to as "systematic" risk) as the market index, and, according to CAPM, any rise or fall in the market's excess return should lead to a like rise or fall in the excess return on the stock. Therefore, the stock is expected to have a risk premium identical to that for the market. Furthermore, because its alpha is 0, it will be assumed that Stock A's beta captures all of the return (above the riskless rate) which is expected by investors.

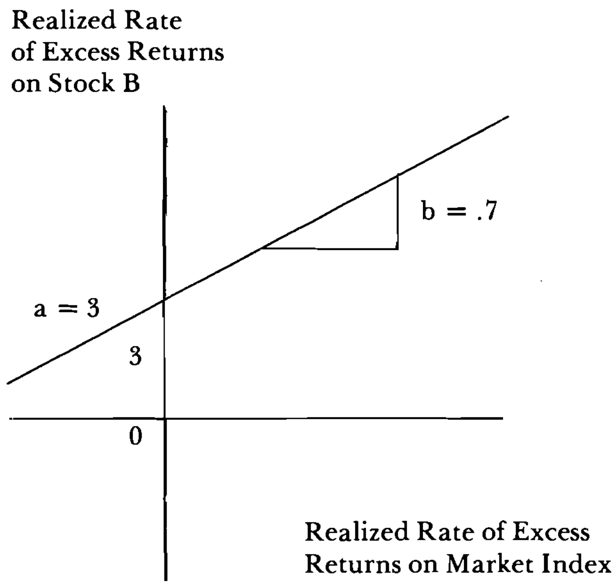
Using the previously-stated CAPM formula, and assuming that the appropriate risk-free rate and market premium can be determined, the cost of equity of Stock A can be easily computed. That equity cost (or required rate of return) is equal to the risk-free rate, plus beta times the risk premium (the return in excess of the risk-free rate) achieved by the market index, plus alpha. Assuming a risk-free rate of 10 percent and a market premium (excess return) of 5 percent, the formula produces the following result:

return (equity cost) = 10% +
1 (beta) × 5% + 0 (alpha) = 15%

Hence the return required on Stock A, and the issuing company's cost of equity, is 15 percent.

Table 2 depicts an asset (Stock B) with a different degree of risk, and one that, as discussed below, is reflective of many utility stocks.

Table 2



Stock B is considered to have less systematic risk than the market index since its excess returns increase or decrease only 70 percent of the extent to which excess returns on the market index increase or decrease. Hence, using CAPM, Stock B will be expected to return a risk premium of only 70 percent of the market risk premium. However, Stock B has an alpha of + 3, indicating that it has earned a 3 percent return premium which is not captured, or measured, by beta. As will be discussed in Part III, experts have advanced several possible explanations for this positive alpha: for example, it could be a measurement of the extent to which beta misestimates the total nondiversifiable risk of the stock, owing to the fact that the particular market index contains less than all the available capital assets in which one might invest; it could demonstrate that the "true" market portfolio of all capital assets is not an "efficient" portfolio; it could indicate that although an asset's premium for nondiversifiable market risk is related to the asset's relative volatility, the premium is not necessarily directly proportional to that volatility; it could capture certain firm-specific (unsystematic) risks of the stock for which investors expect to be compensated; or, stated another way, it could represent the degree to which the well-diversified portfolio which investors could (or do) hold fails to "diversify away" all firm-specific risks; or it could reflect the fact that one of CAPM's necessary assumptions — that investors can freely borrow and lend at the risk-free rate — is not true. Whatever alpha's explanation as to a given asset, if it is not zero it means that beta does not tell the whole story of the asset's risk premium.

Using the previously-stated formula, and assuming the same 10 percent risk-free return and 5 percent excess return as assumed in the Stock-A example, the return required on Stock B (and the cost of equity to the issuer) is computed as follows:

expected return (cost of equity) = 10%
+ (.70 × 5%) + 3% = 16.5%

But CAPM ignores alpha, declaring that beta captures all nondiversifiable risk, and that such risk is the only thing for which investors expect to be compensated (above the riskless rate). Hence, CAPM assumes that alpha is (or in the long run will be) zero, and therefore dictates that Stock B's expected return is not 16.5%, but 13.5%. Clearly, the decision to rely on beta, but to disregard alpha, can be critical in the case of industries which have member-companies with persistent, positive alphas in their past returns. This is the case for the utility industry.

An examination of the data reported by Merrill Lynch in its January 1981 Quantitative Analysis indicates that utilities as a group, on average, had a beta of .6 and an alpha of .2 percent based on market prices as of December 31, 1980. Merrill Lynch Pierce Fenner & Smith Inc., *Quantitative Analysis* 22 (Jan. 1981). More specifically, communication utilities showed, on average, a beta of .5 and an alpha of 1 percent; electric utilities a beta of .6 and an alpha of .4 percent; gas distribution utilities a beta of .8 and an alpha of -1.2 percent; and gas pipeline utilities a beta of 1 and an alpha of -3.3 percent. *Id.* at 7. While these data are of course not definitive — before conclusions could be drawn with respect to the representative beta and alpha of a utility group or an individual utility, a long-term analysis of past betas and alphas would have to be made — nonetheless, the beta and alpha information provided in the Merrill Lynch report is indicative of the importance of alpha's treatment in conjunction with a CAPM analysis.

This importance is highlighted where the alphas of particular securities are examined. Table 3 provides a sample of utilities with high reported alphas.

Table 3

Issuer	Alpha (%)	Beta
Communications		
American Tel. & Tel.	1.1	.5
Cincinnati Bell	2.3	.5
Gen'l Tel. & Elec.	1.5	.7
Western Union	3.7	1.1
Electric		
Carolina Pwr. & Lt.	1.1	.7
Central Ill. Lgt.	2.5	.6
Commonwealth Ed.	3.5	.6
Consumers Power	2.3	.6
Fitchburg G&E	2.0	.7

Maine Pub. Svc.	2.5	.6
Middle South Utl.	1.1	.5
Pennsylvania P&L	2.9	.6
Rochester G&E	3.0	.6
Savannah Elec.	3.1	.6
United Illuminat	2.3	.6
Gas Distribution		
Atlanta Gas Lt.	2.0	.8
Brooklyn Union	1.6	.5
Gas Pipeline		
Pacific Lighting	1.1	.6

Source: Merrill Lynch Pierce Fenner & Smith Inc., *Quantitative Analysis* (Jan. 1981).*

*It should be noted that the alphas and betas reported by Merrill Lynch are estimated alphas and betas, and are therefore subject to estimation errors.

If the positive alphas in Table 3 were representative of the long-term alphas of the indicated companies, and were CAPM employed as a method for establishing those companies' costs of equity, then plainly any decision to ignore the companies' alphas would have a significant downward impact on their resulting rates of return. As will be next discussed (Part II), that, in fact, describes the kind of decisions utility ratemakers have been rendering: in none of the rate cases where CAPM has been advanced or actually employed as a method for establishing a utility's cost of equity has alpha been taken into account. Indeed, in only one case was alpha even mentioned, and there it was ignored. Equally important, the decided rate cases failed to examine the mounting evidence (often because the evidence was not yet available) that the CAPM formula — with or without alpha — can yield highly arbitrary, suspect results.

II. *CAPM's Application in Rate Proceedings*

In the early 1970s, when the issue of CAPM's use in ratemaking was first debated, one of its proponents reported that the CAPM formula "ha[d] not yet been used in a regulatory proceeding."[2] However, over the past decade, CAPM has received increasing attention in rate proceedings before state and

[2] Stewart C. Myers, "The Application of Finance Theory to Public Utility Rate Cases," 3 *The Bell Journal of Economics and Management Science* 58, 69 (Spring 1972). Dr. Myers is Professor of Finance at the Sloan School of Management, Massachusetts Institute of Technology.

federal regulatory agencies. Moreover, it has often been relied upon by those agencies as a justification for lower equity costs than other methodological approaches would have indicated.

For example, as early as 1972, the FCC relied heavily on a CAPM analysis advanced by a trial staff witness in establishing AT&T's cost of equity. *American Telephone & Telegraph Co.*, 38 F.C.C. 2d 213 (1972). In that proceeding, CAPM indicated that AT&T (with a beta of approximately .7) was less risky than the average equity security in the marketplace, and hence that the cost of equity assigned AT&T should be lower than the returns provided on such a security. *Id.* at 237-38. The CAPM analysis endorsed by the Commission supported an equity cost finding substantially lower than that sought by AT&T.[3]

In recent years, state utility commissions have also begun to credit CAPM evidence in assigning equity costs to public utilities. For example, in *Portland General Electric Co.*, 23 PUR 4th 209 (Ore. Pub. Util. Comm'r 1977), Portland General Electric ("PGE") argued for a cost of equity in the range of 13.5 to 16 percent, whereas a witness for the Commissioner's staff, using CAPM, advocated a cost of equity of 11.1 to 12.25 percent. *Id.* at 219-21. After discussing the CAPM approach in detail and the staff's finding that the beta on the utility's stock was between .695 and .781, the Commissioner embraced the staff's CAPM evidence and premised his equity cost finding of 12.5 percent thereon.

The Commissioner's comments reveal how compelling he found the CAPM approach to be:

> Unlike the several common equity returns estimators employed and criticized by company witnesses, the CAP model [*i.e.*, CAPM] has been subjected to the most intensive examination and testing in this proceeding and has been shown to be a reliable and useful measure of the only relevant risk component – systematic (nondiversifiable) risk.
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> The commissioner finds the CAP method and associated concepts advanced by staff to have general application to utilities whose common equity shares are traded and reported publicly. [*Id.* at 222.][4]

[3]Interestingly, three years later when CAPM was advanced by Comsat witness Stewart Myers (the same witness who had offered CAPM testimony for the Commission's trial staff in the AT&T proceeding) to support the proposition that Comsat was significantly more risky than the average equity investment, the FCC was totally unreceptive and assigned Comsat a cost of equity substantially lower than that supported by the CAPM analysis. Communications Satellite Corp., 56 F.C.C. 2d 1101 (1975), *remanded on other grounds sub nom.* Communications Satellite Corp. v. FCC, 611 F.2d 883 (D.C. Cir. 1977). The Commission ruled that the CAPM analysis was unreliable on a number of grounds, including the fact that the beta calculated for Comsat varied materially depending upon the data used in the calculation and the Commission's doubt that the basic premise of CAPM that risk should be assessed in the context of a diversified portfolio of investments was relevant to the Commission's task of determining Comsat's cost of equity. 56 F.C.C. 2d at 1169-70.

[4]In two earlier proceedings, the Commissioner had cautiously premised his cost-of-equity findings upon CAPM analyses advanced by the staff, but in each instance had called upon the staff to provide a more detailed evidentiary development of the CAPM approach in the future, a development ultimately provided in the *PGE* proceeding discussed above. *See* California-Pacific Utils. Co., 20 PUR 4th 479, 487-90 (Ore. Pub. Util. Comm'r 1977); Cascade Natural Gas Corp., 19 PUR 4th 170, 182-85 (Ore. Pub. Util. Comm'r 1977).

Similarly, in *Arkansas Western Gas Co.*, 16 PUR 4th 103 (Ark. Pub. Serv. Comm'n 1976), the Commission explicitly adopted the CAPM evidence sponsored by a witness for the Commission staff to establish the cost of equity for the utility in question. Noting that the "capital asset pricing model is a widely accepted model identifying the relationship between risk and return," the Commission found it "to be the appropriate method for establishing the cost of equity."[5] *Id.* at 108-09.

In *Southern Bell Telephone & Telegraph Co.*, 18 PUR 4th 623 (S.C. Pub. Serv. Comm'n 1977), CAPM received further regulatory endorsement. Southern Bell had petitioned for an increase in its rates and offered evidence that it was entitled to a return on equity ranging from 14 to 15.2 percent. *Id.* at 628. Examining various indicators of AT&T and Southern Bell financial performance, the Commission concluded that a reasonable return on Southern Bell's common equity was less than that sought. The Commission explained that its conclusion was "confirmed" by the CAPM testimony offered by the staff's witness, which indicated that 10.45 percent was the upper limit to Southern Bell's appropriate equity cost (the range being 8.04 - 10.45 percent). *Id.* at 630, 634. The Commission was unimpressed by Southern Bell's claim that CAPM "is an academician's theory, rather than a 'decision maker's' tool" (*id.* at 630), noting that "[w]hile it may be that CAPM requires further development before it is completely accepted in rate making, we believe the theory underlying it is sound and the results produced more in touch with reality than those furnished to us by Southern Bell witnesses." *Id.* at 631. Because CAPM indicated that Southern Bell had already been authorized rate increases which would permit it to earn a return in excess of the CAPM-derived estimate of its cost of equity, the Commission denied outright Southern Bell's petition for a rate increase.[6] *Id.* at 634.

In a substantial number of other rate proceedings, commission staffs have advanced, and regulatory commissions have relied, at least in part, upon CAPM evidence to support a lower cost of equity than that being sought by the regulated utilities. For example, cost of equity findings were importantly influenced by staff-submitted CAPM analyses in *New York State Electric & Gas Corp.*, 38 PUR 4th 220, 245-47 (N.Y. Pub. Serv. Comm'n 1980); *New York Telephone Co.*, 32 PUR 4th 353, 360-62 (N.Y. Pub. Serv. Comm'n 1979); *National Fuel Gas Distribution Corp.*, 28 PUR 4th 42, 62-63 (N.Y. Pub. Serv. Comm'n 1978); *Otter Tail Power Co.*, 30 PUR 4th 26, 47-51 (S.D. Pub. Utils. Comm'n 1979); *Northwestern Bell Telephone Co.*, 20 PUR 4th 462, 464-70

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[5] *But cf.* Southwestern Bell Tel. Co., 22 PUR 4th 209, 217-18 (Ark. Pub. Serv. Comm'n 1977), where the Commission rejected the CAPM evidence sponsored by a witness for Southwestern Bell on grounds that the beta he had calculated had arbitrarily been skewed upward to produce a higher risk assessment.

[6] CAPM has been advanced by the Commission staff in three other proceedings before the South Carolina Public Service Commission, and in each case the Commission has relied significantly, although not exclusively, upon the CAPM evidence in establishing the cost of equity of the utility under consideration. *See* Southern Bell Tel. & Tel. Co., 35 PUR 4th 1, 23-31 (S.C. Pub. Serv. Comm'n 1980); South Carolina Elec. & Gas Co., 34 PUR 4th 458, 477-85 (S.C. Pub. Serv. Comm'n 1979); Southern Bell Tel. & Tel. Co., 30 PUR 4th 263, 277-85 (S.C. Pub. Serv. Comm'n 1979).

(Iowa Commerce Comm'n 1977);[7] and *Intermountain Gas Co.*, 18 PUR 4th 79, 87-89 (Idaho Pub. Utils. Comm'n 1976).[8]

In none of the proceedings identified above was any mention made of the alpha of the utilities whose equity costs were analyzed in those proceedings. Indeed, only one case was found where the use of alpha was even addressed by a ratemaking body.

In the recent decision of *New York Telephone Company — Telephone Rates,* Case Nos. 27651 and 27710 (N.Y. Pub. Serv. Comm'n., Jan. 19, 1981), New York Telephone ("NYT") based its equity cost case in part upon a CAPM analysis that took into account a positive alpha calculation.[9] NYT's evidence showed that beta alone supported a 15.1% equity cost, and that where an alpha of .9% was taken into account, that equity cost became 16%. Administrative Law Judges' Recommended Decision, Case Nos. 27651 and 27710 (Oct. 31, 1980) at 65. The alpha adjustment argued for by NYT was not strictly a reflection of NYT's (or AT&T's) own specific alpha, but rather was an adjustment based on the premium above the riskless rate which has consistently been earned (over the 1926-1978 period) by stocks with a beta of zero. NYT argued that the persistence of this alpha premium was clear evidence that stocks with a zero beta provide a return higher than the riskless rate, thereby demonstrating that beta alone does not adequately reflect the required return on investment. *Id.* at 64-65.

In their recommended decision, the Administrative Law Judges (the "Judges") evaluated the described NYT evidence and a CAPM analysis submitted in rebuttal by the Commission staff and then noted, first, that "[i]f anything is clear from the mass of material presented to us with respect to the CAPM method, it is that in its present stage of development we are far from

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[7]Although basically adopting the staff's recommended cost of equity, the Iowa Commerce Commission was somewhat cautious in endorsing the CAPM methodology:

> Although we find the theory to be consistent with cost of capital and fair rate of return determinations, much of it is still theoretical and subject to great debate.
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> [T]here is the question of the validity of beta as a measure of the cost of capital for an individual stock, not a part of a portfolio. While on each of these points we would have to agree that the record tends to support the staff position, we cannot accept the exact figure generated through this methodology as being the one and only correct cost of equity supported by the record. [20 PUR 4th at 469.]

[8]Commission staffs also submitted CAPM evidence in the following proceedings, although the role that that evidence played in the cost-of-equity determination ultimately made by the utility commission is not entirely clear: Pennsylvania Pub. Util. Comm'n v. Philadelphia Elec .Co., 33 PUR 4th 319, 339-44 (Pa. Pub. Util. Comm'n 1980); Southwestern Bell Tel. Co., 34 PUR 4th 224, 237-262 (Tex. Pub. Util. Comm'n 1979); Granite State Elec. Co., 28 PUR 4th 240, 244 (N.H. Pub. Util. Comm'n 1978); Idaho Power Co., 23 PUR 4th 299, 310-13 (Idaho Pub. Utils. Comm'n 1977); Southern Bell Tel. & Tel. Co., 21 PUR 4th 451, 480-85 (Fla. Pub. Serv. Comm'n 1977).

In a survey as of February 1979, one commentator found that CAPM had been used in rate cases in 13 different states (Georgia, Iowa, Montana, New Hampshire, New Jersey, New Mexico, Nebraska, Ohio, Oregon, Rhode Island, South Carolina, Texas, and Washington). Harrington, "The Changing Use of the Capital Asset Pricing Model in Utility Regulation," 105 *Public Utilities Fortnightly* 28, 29 (Feb. 14, 1980). That survey revealed that in Oregon use of the CAPM model was required, that in South Carolina the commission staff would use CAPM in all future cases, and that only in Texas was there any predisposition against use of the model. *Id.* The survey further indicated that, in total, "38 states were considering or had seen the CAPM used." *Id.*

[9]AT&T offered less than a whole-hearted endorsement of the CAPM method, stating in its opening brief that " '[w]hether CAPM can be used accurately in rate cases is still debatable. . .' " and taking the position that, if CAPM is to be used at all, it must take into account alpha. Administrative Law Judges' Recommended Decision, Case Nos. 27651 and 27710 (Oct. 31, 1980) at 64.

any consensus as to its proper use for regulatory purposes." *Id.* at 68. With this preface, the Judges endorsed the theoretical validity of the alpha adjustment argued for by NYT, but rejected the precise computation of alpha on evidentiary grounds. *Id.* at 64-65, 69. Nevertheless, in order to take account of their view that to ignore alpha would cause the "CAPM-indicated cost of equity" to be understated "in some undetermined amount" (*id.* at 69), in assigning NYT a cost of equity the Judges based their decision on a weighted composite of the cost indicated by the DCF method[10] and that indicated by the CAPM method (without the alpha adjustment), giving two-thirds weight to the former and only one-third weight to the latter. *Id.* at 73.

On appeal to the New York State Public Service Commission, NYT challenged the Judges' failure to take specifically into account the alpha adjustment supported by its evidence when the Judges had conceded the theoretical validity of the adjustment. On grounds that NYT had failed to prove the validity of the specific alpha adjustment for which it contended, the Commission affirmed the Judges' decision without addressing the correctness of that adjustment as a matter of theory. Slip Op. No. 81-3 (Jan. 19, 1981) at 31.[11] The Public Service Commission repeated this view on NYT's Petition for Rehearing, stating that "[t]he possible need for such an adjustment [based on alpha] was a factor that we considered, but the record did not support a particular adjustment." Order Responding to Petitions for Rehearing (May 14, 1981) at 5.

Thus, a review of the regulatory decisions reveals that the CAPM has achieved widespread acceptance among ratemaking bodies and is now routinely used by those bodies to establish rates of return for utilities. For the reasons that follow, we submit that that acceptance and use should be reconsidered.

III. *The Case Against CAPM*

In our estimation, those contending that regulatory commissions should establish utility rates of return based on CAPM should be asked first to show at least the following:

(A) that the CAPM theory is sound, *i.e.,* that its underlying assumptions have been tested and are valid;

(B) that the theory can be appropriately applied in the utility ratemaking context; and

(C) that, in practice, the theory produces reliable, objective estimates of a utility's cost of equity.

We make this suggestion on the assumption that in any given rate proceeding the proponents of a particular rate-producing methodology can fairly be required to establish that methodology's credentials. The required showing

[10]The DCF (discounted cash flow) method, simply stated, assumes that the cost of equity for a particular stock is equal to its dividend yield (current dividend divided by current price) plus the annual expected growth rate in dividends.

[11]However, using updated return data, the Commission assigned NYT a higher cost of equity than that recommended by the Judges, and, although basing its finding upon both the DCF and CAPM methods, did not adopt the weighting approach employed by the Judges.

would of course vary with the proven reliability of the method at issue — we do not suggest that every rate proceeding should be burdened by the reinvention of the wheel as to every methodology employed in the proceeding. But our experience with and review of the regulatory case law is that the CAPM wheel appears never to have been invented at all. Rather, CAPM's basic credentials as a reliable ratemaking tool have simply been assumed.

This, we submit, is a mistake. Some minimal showing — such as the three elements suggested above — should be fairly well established before rates are built on a CAPM foundation.[12] Our review convinces us that the minimal showing has not been made; that, in fact, the weight of the available evidence is heavily against CAPM as to all three elements of that showing. That is the evidence we summarize below.

A. *The Validity of the CAPM Theory*

When we assert that the validity of CAPM's underlying assumptions has not been shown, we intend nothing sweeping. Rather, for purposes of the limited (but, we think, important) point we are attempting to make here, we do not presume to challenge the important principle that CAPM borrows from modern portfolio theory — that, generally speaking, the expected return on a particular asset may properly be assessed as if that asset were part of a portfolio, and that by holding the asset in a portfolio an investor can "diversify away" certain of that asset's risk. Neither do we question what we understand to be the basic proposition of CAPM itself — that investors, being risk-averse, tend to price assets so that the riskier ones have higher expected rates of return. Finally, we do not dispute the basic idea of beta — that assets' returns can generally be expected to move up and down in a pattern related to the movements of "the market" as a whole, and that the way in which a particular asset "responds" to market movements is an important indicator of that asset's risk.

But regulatory bodies should require some degree of *proof* before ascribing to these admittedly sound *general* principles a mathematical precision they have never been shown to have. One can accept that portfolios tend, through diversification, to cancel risks, that assets are generally priced to reflect nondiversifiable risks, that one such risk is market risk, and that beta is designed to capture how market risk affects a particular asset, without having to agree that once one has estimated an asset's beta, all that remains to be done to reliably *quantify* that asset's entire expected return is (in effect) to multiply the asset's beta times the market's expected return.

Rather than catalogue all the material assumptions that underlie the proposition that beta is sufficient to produce such a quantification, we discuss here only two that appear to us to be obvious and particularly important: the first necessary assumption is that there not only be a *relationship* between the market's excess return and every asset's excess return, but that every asset's

[12]The absence of any such showing has persuaded some utility commissions to reject CAPM. *See, e.g.*, Connecticut Nat. Gas Corp., 37 PUR 4th 287, 328-29 (Conn. Div. Pub. Util. Control 1980) (characterizing CAPM as an elegant "black box" that "has not survived extensive regulatory scrutiny").

expected excess return is *directly and exactly proportional* to the market's expected excess return, *i.e.*, that the trade off between market risk and return is a straight line; and the second necessary assumption is that once this measurement of expected return owing to market risk has been made (via beta), all expected return has been captured, *i.e.*, there is, by definition, no other risk but beta-risk for which investors expect to be compensated.

It seems to us plain that these two assumptions would have to be well-founded before the regulatory bodies' reliance on beta can be thought sound; and yet, we can find no specific evidence validating either assumption. Indeed, what evidence there is indicates that both assumptions are invalid.

1. *Beta Does Not Capture an Asset's Market-Risk*

Among the most recent and telling criticisms directed at beta have been those articulated by Richard W. Roll, a Professor of Finance at the UCLA Graduate School of Management and a leading advocate for the large (and growing) cadre of professionals who believe that CAPM provides an unreliable measure of asset risks and returns.[13] Through Professor Roll's work, it has been demonstrated[14] that CAPM depends upon a critical assumption which may or may not be true and which, unfortunately, cannot be (or, at least, to date has not been) tested.

The underlying premise of CAPM's reliance on beta is that every stock's expected excess return is directly proportional to the market's expected excess return, and that the degree of proportionality is exactly measured by beta. But, as a matter of mathematics, beta can be relied upon as a measurement of this assumed direct proportionality if, and only if, the market portfolio itself is what is called "mean-variance efficient." This means that, for beta to be sound, the market portfolio of all available assets must in fact provide the highest possible average (mean) return, given the variability (volatility) associated with that portfolio's return. And therein lies the problem.

As noted above, the market index conventionally employed in connection with a CAPM analysis is a broad index of stocks like the Standard & Poor's 500. However, use of such an index would be correct only if (i) it were a valid proxy (in the sense that it would be expected to yield the same beta) for a portfolio of all invested assets, including such difficult-to-measure assets as human capital and other non-traded assets, and (ii) if that portfolio of all invested assets were "mean-variance efficient."

Thus, there are really two problems, and neither one of them has been solved: first, it must be known whether the particular index being used is

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[13]*See generally* Wallace, "Is Beta Dead?," *Institutional Investor* 23 (July 1980); Blustein, "Money Managers' Bedrock Theory of Investing Comes Under Attack," Wall St. J., Sept. 8, 1980, at 13; Baron, "Assault on Beta Theory Jolting Money Managers," L.A. Times, Oct. 6, 1980, § B, at 1; and 7 *The Journal of Portfolio Management* (Winter 1981), an issue devoted to the "Is Beta Dead?" controversy.

[14]*See* Roll, "Performance Evaluation and Benchmark Errors (I)," 6 *The Journal of Portfolio Management* 5 (Summer 1980); Roll, "Performance Evaluation and Benchmark Error (II)," 7 *The Journal of Portfolio Management* 17 (Winter 1981); Roll, "Testing a Portfolio for Ex Ante Mean/Variance Efficiency," in E. Elton and M. Graber, eds., 11 *TIMS Studies in the Management Sciences* 135 (1979); Roll, "A Reply to Mayers and Rice," 7 *Journal of Financial Economics* 391 (1979); Roll, "Ambiguity When Performance Is Measured by the Securities Market Line," 33 *The Journal of Finance* 1051 (Sept. 1978); Roll, "A Critique of the Asset Pricing Theory's Tests," 4 *Journal of Financial Economics* 129 (Mar. 1977).

indeed a valid (or the best available) proxy for the true market portfolio; and second, it must be known that that true market portfolio is in fact efficient. The reason neither problem has been solved is that a portfolio of all assets (or an acceptable proxy therefor) has never been reliably formed and tested.

On the other hand, it *can* be tested whether the particular index being relied upon to estimate an asset's beta is itself efficient. Professor Roll has demonstrated, for example, that the S&P 500 — ordinarily relied upon in rate proceedings — is not efficient and therefore cannot produce sound betas. Moreover, each inefficient index (such as the S&P 500) will produce a different beta, and a different expected return — none of them reliable.

Since no valid, efficient proxies for the market as a whole have been developed, the beta of a stock as measured against a broad market index is not a reliable indicator and is, in one sense, wholly arbitrary in that it is solely a function of the index chosen. "For every asset, an index can be found to produce a beta of any desired magnitude, however large or small." Roll, "Ambiguity When Performance Is Measured by the Securities Market Line," 33 *The Journal of Finance* 1051, 1056 (Sept. 1978). Thus, since the beta of a stock varies depending upon the market index employed, since there is no dependable index which is truly reflective of the market as a whole, and since there is no way of knowing that that "market as a whole" is efficient, the most recent evidence strongly indicates that no reliable conclusions regarding the risk of an asset or the return required on it can be derived through the beta produced by any given market index. Hence, we submit, conclusions previously reached by the ratemakers through their application of CAPM (relying solely on beta) may have been totally arbitrary.

Moreover, the lack of an efficient, measurable market portfolio is not the only problem with the regulatory reliance on beta. There is considerable evidence that beta in any event does not necessarily capture all of an asset's expected return.

2. *Beta Does Not Fully Capture an Asset's Expected Return*

CAPM "says that [beta] is a complete and sufficient risk measure, that the expected risk premium demanded by investors is zero when beta is zero. . . ."[15] But recent evidence shows that this critical CAPM assumption is simply not correct. In fact, the author of the quoted statement, who has offered evidence in several rate proceedings based on beta measurements, and who has generally been a proponent of such a use of beta,[16] recently testified that CAPM "is probably not a complete description of equilibrium trade-off between risks and returns that actually prevails in capital markets."[17]

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[15]Myers "On the Use of Modern Portfolio Theory in Public Utility Rate Cases: Comment," *Financial Management* 66, 67 (Autumn 1978).

[16]*See id.*; Myers, "On the Use of Beta in Regulatory Proceedings: A Comment," 3 *The Bell Journal of Economics and Management Science* 622 (Winter 1972).

[17]Testimony of Stewart C. Myers In the Matter of the Valuation Proceedings Under §§ 303(c) and 306 of the Regional Rail Reorganization Act, Tr. at 609 (June 6, 1979).

Some of the recent evidence shows that if an asset's beta is to be relied on to estimate its expected return, the asset's alpha also must be taken into account; other evidence shows that some assets consistently earn higher returns than that predicted by beta, and that those higher returns can be predicted by non-CAPM methods. Both kinds of evidence are wholly contrary to the assumption that beta is a complete measurement of an asset's expected return, that an asset with a zero beta has a zero risk premium, and that an asset with a beta of one has a risk premium identical to the market risk premium.

We will first describe the alpha-related evidence, and thereafter explain the evidence concerning beta's inability to predict returns.

The use of a market index to compute a given stock's beta and alpha requires, by definition, that the weighted (by market value) average beta of all the stocks in the index will be exactly 1.0, and the weighted average alpha will be zero. But just as a given stock's beta need not be exactly 1.0, neither need its alpha be exactly zero. Those who take into account a stock's estimated beta in estimating its expected return, but ignore its estimated alpha, do so on the theory that over the long term the particular stock's alpha will average to zero and that, therefore, it should not be treated as statistically significant. It is this theory which has been shown to be highly questionable, if not completely unsound.

In the current litigation designed to value the railroad properties taken by the United States for Conrail, Dr. Richard Meyer, Professor of Managerial Economics at the Harvard University Graduate School of Business Administration, presented a comprehensive survey demonstrating the relative predictive powers of beta and alpha in estimating assets' future returns. Beginning with the five-year period 1960-1965 and going up through the five-year period 1968-1973, Professor Meyer calculated the alpha and beta for every United States company for which dividend-adjusted stock return data were available. This ranged from a low of 666 firms for the 1960-1965 period to a high of 909 firms for the 1968-1973 period. He then compared the actual returns on the stocks for various multi-year periods following each of the five-year estimation periods in order to assess the predictive power of alpha and beta. *See* Testimony of Richard F. Meyer, pp. 58-61 (January 30, 1980). *In the Matter of the Valuation Proceedings under Sections 303(c) and 306 of the Regional Rail Reorganization Act of 1973,* Special Court Misc. No. 76-1 ("The Railroad Valuation Proceedings").

Using standard statistical measurements, the comparison showed that in some periods beta was more significant, and that in others alpha was more significant, but "that alpha and beta have approximately equal significance considered overall." *Id.* at 60. Crucial to these results is that "there is no evidence that alpha is systematically insignificant," even though CAPM assumes that it is. *Id.* Moreover, the study showed that "alpha tends to gain significance with the length of the forecasting period," *id.,* a fact of considerable importance in utility ratemaking where future costs of equity are often estimated for several years or more. Hence, Dr. Meyer concluded, notwithstanding CAPM's assumption that beta fully captures expected returns, "alpha may not arbitrarily be ignored. . . ." *Id.*

There are several theories for why particular assets evidence persistent alphas. One view, stated in Dr. Meyer's testimony, is that beta fails to capture all market-related risk associated with a particular asset since the market index used to compute beta does not contain all available assets. Alpha may measure the effect of these "missing" assets on investors' risk perceptions.[18]

A second explanation, presented by Dr. Robert H. Litzenberger in *New York Telephone Company — Telephone Rates, supra,*[19] is that alphas consistently appear for two reasons.[20] First, according to Dr. Litzenberger, CAPM assumes incorrectly that investors are able to borrow and lend in unrestricted amounts at the risk-free rate, and the fact that they are not means that the relationship between risk and return is not directly proportional to the betas of individual securities. Second, the value-weighted portfolio of all New York Stock Exchange stocks often used to calculate the beta of individual stocks is not a representative surrogate for the market as a whole, but instead is relatively more risky than that market on average.[21] As a consequence, contrary to the CAPM theory, stocks with betas of zero have, over the past 50 years, consistently earned a risk premium above the riskless rate. This additional risk premium is captured by alpha.[22]

A third explanation for the appearance of alphas, as described by Dr. Richard Roll, is that alpha is simply a measurement of the inefficiency of the market index being used to compute beta; that is to say, if the market index were, as earlier discussed, mean-variance efficient, beta would be a reliable measurement of expected return and there would be no alphas. But since the index is not efficient, alpha will not necessarily be zero, and will capture that part of an asset's expected return not captured by beta.[23]

Yet another view of alpha, expressed by a strong proponent of CAPM — Dr. Barr Rosenberg[24] — is that beta *is* a reliable measurement of market risk, and that such risk is an important factor affecting expected return; however,

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[18]Testimony of Richard F. Meyer in The Railroad Valuation Proceedings, Tr. at 636 (Aug. 25, 1980).

[19]Dr. Litzenberger is the C.O.G. Miller Distinguished Professor of Finance at the Graduate School of Business, Stanford University.

[20]*See* Testimony of Robert H. Litzenberger, New York Telephone Co. — Telephone Rates, Case Nos. 27651 and 27710 (N.Y. Pub. Serv. Comm'n), Tr. at 2122-28 (May 15, 1980). *See also* Litzenberger, Ramaswamy, & Sosin, "On the CAPM Approach to the Estimation of a Public Utility's Cost of Equity Capital," 35 *The Journal of Finance* 369 (May 1980).

[21]As previously mentioned, beta is usually measured against a broad index of stocks, but theoretically should be assessed in light of all potential investments.

[22]The actual alpha adjustment developed by Dr. Litzenberger to account for this additional risk premium called for a .9% upward adjustment in the 15.1% NYT equity cost indicated by beta alone (or a total equity cost of 16.0%). The Public Service Commission's analysis of Dr. Litzenberger's evidence suggests that had he demonstrated the value of NYT's particular alpha, rather than simply demonstrating the general inability of beta to capture an asset's total expected return, it might have adopted Dr. Litzenberger's cost of equity figure. *See* Order Responding to Petitions for Rehearing (May 14, 1981) at 5 ("The possible need for such an [alpha] adjustment was a factor that we considered, but the record did not support a particular adjustment.").

Recently, Dr. Litzenberger filed testimony in support of New York Telephone's pending application for a rate increase. His testimony included evidence showing that the alpha adjustment necessary for zero-beta stocks may be appropriately applied to stocks with betas in the more common ranges (from .5 to 1.5). *See* Testimony of Robert H. Litzenberger, New York Telephone Co. General Rate Case, Case No. 27795 (N.Y. Pub. Serv. Com'n), Vol. V at 33-36 and Exhibit at Section 11 (May 1981). A decision by the Public Service Commission is not expected in that case until May 1982.

[23]Roll, "Performance Evaluation and Benchmark Errors (II)," *supra,* at pp. 19-20; Testimony of Richard Roll in The Railroad Valuation Proceedings, pp. 72-73 (January 30, 1980), Tr. 102 (July 21, 1980), Tr. 240-44 (July 22, 1980), and Tr. 1277-78, 1290, 1376 (August 19, 1980).

[24]Dr. Rosenberg is Professor and Director of the Berkeley Program in Finance at the Berkeley Business School, University of California.

since it may be that factors *other* than market risk affect investors' perceptions regarding expected returns, by definition there may be an expected return in excess of that measured by beta. It is this excess which, according to Dr. Rosenberg, alpha captures: "There is nothing mysterious about this alpha; it is simply an expression of judgment on the security's expected return." Rosenberg, "The Capital Asset Pricing Model and the Market Model," 7 *Journal of Portfolio Management* 5, 10 (Winter 1981).

Thus, there is substantial evidence indicating that alpha captures expected return missed by beta. There is, in addition, substantial evidence that CAPM simply misestimates expected return, whether or not the misestimation stems from the failure to consider alpha.

For example, in the previously mentioned railroad valuation proceedings, Dr. Richard Roll presented a study in which numerous portfolios of railroad stocks were specifically constructed so that they had betas exactly equal to 1.0. In all, 40 portfolios were observed over two successive five-year periods, and their returns measured relative to the market index (S&P 500) returns. Contrary to CAPM's assumption, all 40 portfolios consistently outperformed the market index, by an average of 5-8 percentage points[25] — meaning that if CAPM had been relied on (*i.e.*, the beta of 1.0 had been used to compute expected returns), the railroads' cost of equity would have been understated by those 5-8 points. Moreover, through the use of certain non-CAPM methods for estimating the railroads' cost of equity, Dr. Roll confirmed that that cost was in fact 5-8 points higher than the figure indicated by CAPM.[26]

Furthermore, in those same railroad valuation proceedings, Dr. Stewart Myers, who *did* rely on beta in estimating the railroads' cost of equity, and who also rejected the need to take alpha into account, nevertheless testified on cross-examination that "the research suggests that the capital asset pricing model formula misses a measure of risk, and that measure of risk may be the standard deviation."[27] "Standard deviation" is a measurement of *total* volatility of the particular asset's returns, as contrasted with beta which is a measurement only of the asset's volatility *relative* to the market's volatility. Thus, to say that standard deviation may capture expected return not captured by beta is to agree that not *all* asset-specific risk is necessarily cancelled out (diversified away) by holding assets in portfolios. This necessarily means that beta-risk (nondiversifiable market risk) is not the only risk affecting investors' expectations — an idea plainly at odds with a key underpinning of the CAPM theory.

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[25]Testimony of Richard W. Roll in The Railroad Valuation Proceedings, pp. 74-80 (Jan. 30, 1980).

[26]The two non-CAPM methods relied upon by Dr. Roll for estimating costs of equity were, first, measurements over two five-year periods of the actual differences in return between the market index and specially-constructed railroad portfolios ("minimum variance portfolios"), and, second, measurement of the actual difference in returns between the market index and general railroad portfolios over the past 50 years. *Id.* at pp. 42-67. Significantly, by relying on both beta and alpha Dr. Richard F. Meyer estimated virtually the same railroad cost of equity as did Dr. Roll. Testimony of Richard F. Meyer, *supra,* at p. 101. It should be noted that the Court in the Railroad Valuation Proceedings ultimately gave no weight to either Dr. Roll's or Dr. Meyer's testimony. The Court offered no explanation as to why it was unpersuaded by Dr. Meyer's testimony and, as to Dr. Roll's testimony, stated without analysis that his findings were not "statistically significant." Special Court for Regional Rail Reorganization, Opinion with respect to Valuation for Rail Use at 61-62. (Nov. 24, 1981).

[27]Testimony of Stewart C. Myers in The Railroad Valuation Proceedings, Tr. at 565 (July 5, 1979).

In addition, there is recent evidence to suggest that market risk is not the only kind of systematic risk that affects assets' expected returns. Rather, as Professors Roll and Stephen Ross[28] have shown, through application of what they call the arbitrage pricing theory, that there are at least three, and possibly four, systematic factors — not just beta — which should be taken into account in estimating expected returns.[29] *See* Roll and Ross, "An Empirical Investigation of the Arbitrage Pricing Theory," 35 *The Journal of Finance* 1073 (Dec. 1980); Ross, "The Arbitrage Theory of Capital Asset Pricing," 13 *Journal of Economic Theory* 341 (Dec. 1976). As will be discussed below, one such additional systematic factor — interest-rate risk — has been clearly demonstrated to have a risk impact on expected utility returns which is not captured by beta.

Finally, the most recent empirical research demonstrates that portfolios of stocks with higher price/earnings ratios consistently earn higher returns than portfolios of stocks with low price/earnings ratios, even though all the portfolios have identical betas. And, similarly, portfolios of stocks in small firms consistently earn higher returns than portfolios of stocks in larger firms, again notwithstanding that both kinds of portfolios had identical betas. *See* Reinganum, "Misspecification of Capital Asset Pricing: Empirical Anomalies Based on Earnings Yields and Market Values," 9 *Journal of Financial Economics* 19 (Mar. 1981) 19-46; Banz, "The Relationship Between Return and Market Value of Common Stocks," 9 *Journal of Financial Economics* 3 (Mar. 1981).

This research does not necessarily demonstrate that a high P/E or small size is equated by investors with greater risk — it may be that the higher returns are equated with some other factor that happens fortuitously to be associated with high P/E and/or smaller firms. But what *is* necessarily demonstrated by this research is that some factor other than beta-measured risk affects investors' expected returns. *Id.* at 16-17; Reinganum, *supra,* at 44-45. That is enough to make reliance on CAPM questionable.

B. *CAPM's Applicability in the Ratemaking Context*

In addition to the foregoing general problems with the CAPM theory, there are additional problems with the theory when it is specifically considered in the ratemaking context. To date, these problems have not been resolved, nor even addressed by the ratemakers. We raise three of them here.

The first is that while CAPM assumes that an asset's "response" to market movements is all that need be assessed in estimating the asset's expected rate of return, in the case of utilities there is in fact another important risk to consider — the actions of the ratemakers themselves. The second problem is that utilities are peculiarly affected by a nondiversifiable risk other than market risk — interest-rate risk. Finally, the third problem is that CAPM's assump-

[28]Stephen A. Ross is Professor of Finance at the School of Organization and Management, Yale University.

[29]Moreover, the arbitrage pricing theory (APT) has two distinct advantages over CAPM. First, unlike CAPM, APT does not require that the universe of all available assets be included in the measured market portfolio; rather, APT yields statements of relative pricing based on "subsets" of all available assets. Second, unlike CAPM, APT does not require that the market portfolio be mean variance efficient in order that accurate systematic-factor estimates be made.

tion that everything but market (beta) risk will be cancelled out in a well-diversified portfolio depends on the further assumption that the potential up-side and down-side risk of the various assets in the portfolio is largely symmetrical — an assumption that may not be true of utilities, whose up-side potential is subject to regulatory ceilings.

1. *"Regulatory Risk" Is Not Captured by CAPM*

CAPM asserts that the way in which an asset's returns previously moved up or down in relation to the market's movements — a relationship captured by beta — is a fair estimate of the future volatility of the asset's returns. This future volatility, in turn, is said to be a fair indication of the asset's risk, and therefore of its expected return (relative to the market's risk and expected return). Whatever may be the accuracy of these propositions in the case of an unregulated company, there is serious doubt that they can be correct in the case of regulated utilities.

There are at least two reasons for this special doubt in the case of regulated assets. The first is that, as Messrs. Breen and Lerner[30] have pointed out, "[i]t is reasonable to believe . . . that regulatory decisions themselves directly affect the value of beta, for they influence the corporation's growth rate, stability, size, and payout."[31] If this is so, the regulatory body must determine how its own decision may *change* the way in which the company's returns will in the future respond to the market, *i.e.,* how beta may change as a result of the rate-of-return decision.

Though Dr. Stewart Myers criticized some of the Breen and Lerner description of beta's use in regulatory proceedings, he expressly agreed that: "Breen and Lerner are correct in pointing out that regulatory decisions can affect utilities' risks. Further work is needed to identify situations in which the effect is empirically significant and to devise ways of taking the effect into account in such situations."[32] Yet, to date the regulatory bodies have taken no account of the effect of regulatory risk on utility betas, and no study has been done showing how great might be the distortion in the utility betas which the regulatory bodies have relied on.

Second, the distortion in those utility betas may be severe if, as Professor Carleton[33] has argued, "regulation itself has been the main source of [utility] investor risk in recent years."[34] This investor risk stems from, among other things, uncertainty regarding what decision the regulators will make, when it

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[30]Dr. William J. Breen and Dr. Eugene M. Lerner are both Professors of Finance at the Graduate School of Management, Northwestern University.

[31]Breen and Lerner, "On the Use of Beta in Regulatory Proceedings," 3 *The Bell Journal of Economics and Management Science* 612, 621 (Winter 1972).

[32]Myers, "On the Use of Beta in Regulatory Proceedings: A Comment," 3 *The Bell Journal of Economics and Management Science* 622, 626 (Winter 1972).

[33]Dr. William T. Carleton is William R. Kenan, Jr., Professor of Business Administration at the University of North Carolina.

[34]Carleton, "A Highly Personal Comment on the Use of the CAPM in Public Utility Rate Cases," *Financial Management* 57, 59 (Autumn 1978).

will be made, and the built-in lag between investor-expected and company-realized rates of return. This implies both a changing ability of utilities to react to market-wide risks, a changing character in those reactions, and, certainly, "non-constant expected rates of return to the firm and to investors over future periods."[35]

All of this is at odds with CAPM's assumption that a given asset's returns react in a relatively constant manner to market-wide risks. In large part, in the case of a regulated utility, clearly this is not so; rather, the "regulatory risk" skews the reaction to market-wide risks. And there is no reason to suppose, nor evidence to demonstrate, that past betas capture the impact of that regulatory risk.

2. *Market Risk Is Not the Only Systematic Risk Affecting Utilities*

As suggested by the previously-mentioned work of Professors Ross and Roll, there may be several systematic (nondiversifiable) factors which affect a given asset's expected return. While market risk is plainly one such factor, it need not be the only one. For example, some assets may be more sensitive to interest-rate risks than is the market (or market index) as a whole, and, therefore, this greater sensitivity would not necessarily be captured by such assets' market (beta) risk. Recent empirical evidence has shown, as would be expected, that utilities are among those assets that are in fact more interest-rate sensitive than is the market as a whole. Chance, "Progress in Modeling Utility Stock Holding Period Returns," 107 *Public Utilities Fortnightly* 34 (May 7, 1981).

In the cited article, Professor Chance[36] shows that, if CAPM is to be used, an additional systematic-risk factor should be added to the CAPM formula in order to capture the interest-rate risk that beta misses. The value of this factor is determined through use of a bond index and represents the given utility's "response" to movements in that index, in much the same way that beta represents the utility's "response" to movements in a stock market index.[37] This additional nonstock market factor is generally referred to as "extra-market covariance."

What other "extra-market" factors would have to be added to the CAPM formula (in addition to the interest-rate factor) for it to be a full and fair measure of expected utility returns is not yet clear. What does seem clear, however, is that the CAPM formula which has been relied on in the past is not such a measure.

3. *Non-Market Utility Risk Is Not "Diversified Away"*

The third major problem peculiar to CAPM's application to regulated companies turns on a pivotal CAPM assumption — that all risk other than

[35] *Id.* at 59; *see* Christy & Christy, "Who Says Utilities Are Less Risky?" 105 *Public Utilities Fortnightly* 11, 17-18 (May 8, 1980).

[36] Don M. Chance is Assistant Professor of Finance at Virginia Polytechnic Institute and State University.

[37] Addition of the interest-rate factor is based on the work of Professor Bernell Stone in "Systematic Interest Rate Risk in a Two-Index Model of Returns," 9 *Journal of Financial and Quantitative Analysis* 709-21 (November 1974).

market-related (beta) risk is cancelled out when the particular asset is held in a portfolio. The underpinning of this assumption, as Messrs. Brigham and Crum[38] have explained, is the further assumption that all assets' returns

> are randomly distributed, and that the distribution of returns for each security is reasonably symmetrical. Symmetry means that the random losses on one security can be offset by random gains on another. This makes it possible for investors to diversify away unsystematic, or non-market, risk, leaving systematic risk, which is measured by beta, as the only relevant risk. However, if the distribution of returns on a group of securities is skewed to the left (some probability of large losses but no probability of large gains), then the CAPM breaks down. Diversification can no longer eliminate all unsystematic risk, so market risk as measured by beta is not a complete risk measure.[39]

But as Brigham and Crum further explain, this necessary assumption is simply not true in the case of utility returns. Owing primarily to the fact that utilities' returns are regulated and therefore have a fixed ceiling — but no fixed floor — "investors have reason to view utilities as having more downside risk than upside potential, which translates into a probability distribution of future returns skewed toward negative returns."[40] The result is that utilities — unlike unregulated companies — cannot be assumed to have all their "down-side" non-market risk cancelled out, and, therefore, their "CAPM cost of capital estimates will be downward biased."[41]

Based on the foregoing, there are substantial reasons to conclude that the CAPM theory, both as a general proposition and when specifically considered as a tool for ratemakers, is unsound. Moreover, when actually applied, the theory is no more persuasive, since it has been shown to producc arbitrary, unreliable results.

C. *The CAPM In Practice*

To this point we have tried to show that there currently exists such considerable evidence questioning the validity of the CAPM theory, both generally and in the utility ratemaking context particularly, that regulatory bodies should seriously consider whether to accord it further use. We now wish to make a different point — that even if one were convinced that the CAPM, as theory, had been shown sound enough to warrant regulatory use, there are such significant problems associated with the theory's practical application that the results it produces do not merit regulatory reliance.

Two types of problems will be mentioned here. The first is that the CAPM formula, elegant and simple on its face, is really not simple at all; rather, it requires that choices be made about such matters as holding periods, measurement intervals, the proper risk-free rate, the proper market rate, the proper market index, etc. — all debatable, and some bordering on arbitrary — the resolution of which can produce dramatically differing re-

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[38]Dr. Eugene F. Brigham is Professor of Finance and Director of the Public Utility Research Center at the University of Florida. Dr. Roy C. Crum is Assistant Professor of Finance at the University of Florida.

[39]Brigham and Crum, "Reply to Comments on 'Use of the CAPM in Public Utility Rate Cases,' " 7 *Financial Management* 72, 73-74 (Autumn 1978).

[40]*Id.* at 75.

[41]*Id.*

sults. The second problem that must be confronted — perhaps the most important of all — is that significant evidence exists showing that CAPM produces utility costs of equity out of keeping with common sense.

1. *Application of CAPM Is Prone to Arbitrariness*

Since CAPM states that an asset's expected return is equal to the risk-free rate plus beta times the difference between the market rate and the risk-free rate, one must know only three numbers in order to compute a given asset's expected rate of return: the expected risk-free rate; the expected market rate; and the asset's expected beta. But what each of those numbers should be for any given asset is anything but clear.

Taking the easiest of the three first — the risk-free rate — it is not difficult to determine the expected rate of return on risk-free instruments for any given date. For this purpose, *The Wall Street Journal* may be consulted. But therein lies a two-fold problem for utility regulation: the expected rates of return vary considerably from instrument to instrument, and, at least in the current volatile market, a given instrument's return can vary considerably from day to day (or, in any event, from week to week).

Assuming a current Treasury bill or note is to be relied on, what maturity should be used? In the case of utility ratemaking, it is arguable that, since a cost of equity is being established for a long period — say, five years — the riskless rate on a five-year instrument should be used.[42] On the other hand, CAPM theory provides that whatever measurement interval was used to record periodic returns on the market index and the asset in question must also be used as the maturity period of the riskless asset.[43] This would dictate use of no greater than a 30-day or 90-day bill since measurement intervals less than monthly or quarterly are rarely used for CAPM.

But if only a 30-day or 90-day bill rate is employed, then arguably only a 30-day or 90-day utility cost of equity is being computed.[44] Since regulatory bodies are obviously not going to recompute allowable rates of return every few months, perhaps, alternatively, they should study the differences among prevailing riskless rates of varying maturities, and estimate a different riskless rate (and a different total cost of equity) for each of several successive periods.[45]

However the regulators elect to resolve this risk-free-rate dilemma — particularly if interest rates remain volatile and the spreads among varying maturities remain large — it will potentially have a significant impact on the cost of equity. For example, the rates on all riskless instruments are currently several points higher than they were a few short months ago, and the spread among current riskless instruments of varying maturities is also several points.

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[42]*See, e.g.*, Hyman & Egan, "The Utility Stock Market: Regulation, Risk, and Beta," 105 *Public Utilities Fortnightly* 21, 25 (Feb. 14, 1980).

[43]*See* Brigham and Crum, *supra*, at 75; Carleton, *supra*, at 57-58.

[44]*Id.* at 58.

[45]Messrs. Litzenberger, Ramaswamy, and Sosin have suggested that the risk-free rate should be computed "as a simple average of monthly forward Treasury Bill rates for the period the pending rate order is expected to be in effect." "On the CAPM Approach to the Estimation of a Public Utility's Cost of Equity Capital," 35 *The Journal of Finance* 369, 377 (May 1980).

Hence, using CAPM, the particular risk-free instrument selected and date as of which it is selected can make a substantial difference. And, unfortunately, the end result may produce a cost of equity that bears no resemblance to the utility's *actual* equity costs during the lengthy period for which the rate of return has been set.

The judgmental problems associated with determination of the expected market rate of return are even more formidable. A case can be made that one should determine the expected market return on the basis of long-term historical returns on a broad market index. But, if so, what index, and what historical period should be used? Unfortunately, arguments can be made for various periods and various indices, all resulting in radically different past market returns.[46] And yet, primarily because they *are* past returns, all these numbers now bear little or no resemblance to current returns. Indeed, Ibbotson and Sinquefield, one of the most widely-used sources of determining average market returns, estimate only a 12.5 percent average annual return on the market for the period 1977-2000.[47] If that figure were currently used in the CAPM formula — taking into account that current *risk-free* rates are higher than that 12.5 figure — expected utility rates of return would be computed at *below* Treasury bill rates. Plainly, this is not a sound result.

For several reasons, we do not dwell further here on the problems associated with the expected risk-free rate and the expected market rate: first, because these problems have already been explored in the authorities previously cited in the margin; second, because some of the problems with those two rates are not altogether peculiar to CAPM, but would also affect other methodologies used in ratemaking; and third, because those problems are dwarfed by the difficulties associated with estimating the number that is peculiar to CAPM — beta.

As has already been stated, if one elects to compute a cost of equity based on beta, one can get any number that seems desirable simply by selecting a different market index. But the arbitrariness and ambiguity that surround beta are even more acute than that. Recent evidence demonstrates, unequivocally, that betas — particularly betas for an individual asset (such as, for example, a utility stock) — can change dramatically depending on: the length of the holding period over which the asset's beta is measured; the particular beginning date of the holding period; the ending date of the holding period; and the periodic interval (daily, weekly, monthly, quarterly) at which the asset's and the market's returns are assessed.[48] Because there is no clear-cut reason for necessarily preferring one particular index, holding period, or

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[46] *See, e.g.*, Testimonies of Stewart C. Myers, pp. 28-45 (Dec. 1, 1978), and Richard W. Roll, p. 81 (Jan. 30, 1980) in The Railroad Valuation Proceedings; Hyman and Egan, *supra*, at 25; Glassman, "Discounted Cash Flow Versus the Capital Asset Pricing Model (Is g better than b?)," 102 *Public Utilities Fortnightly* 30, 33-34 (Sept. 14, 1978); Vandell & Malernee, "The Capital Asset Pricing Model and Utility Equity Returns," 102 *Public Utilities Fortnightly* 22, 28 (July 6, 1978).

[47] R. Ibbotson and R. Sinquefield, *Stocks, Bonds, Bills, and Inflation: The Past (1926-1976) and the Future (1977-2000)* 58 (1977).

[48] *See, e.g.*, H. Levy, "The CAPM and the Investment Horizon," 7 *The Journal of Portfolio Management* 32 (1981); B. Fielitz and M. Greene, "Shortcomings in Performance Evaluation via MPT [Modern Portfolio Theory]," 6 *The Journal of Portfolio Management* 13 (Summer 1980); Testimony of Richard F. Meyer, p. 51 (Jan. 30, 1980) in The Railroad Valuation Proceedings (showing that the average beta for the railroad industry for the five-year period July 1969 - June 1974 rose by 40% (from .907 to 1.253) solely by changing from daily to monthly observation of returns).

measurement interval over another, and because the selection among these variables produces altogether different betas, which in turn produce altogether different costs of equity, the process takes on an air of arbitrariness.

Moreover, even if one thought that CAPM and its reliance on beta were sound, and thought further that a reliable beta concerning a particular utility could be estimated from past data (notwithstanding the differing betas produced by different indices, holding periods, and measurement intervals),[49] there would still be no assurance that the *past* utility beta was a reasonable estimate of the *future* utility beta. In other words, no evidence has been adduced showing that utility betas are stable over time.

On the other hand, there has been evidence showing that these betas are *not* stable. For example, a recent empirical study demonstrates that, over any given five-year period, only a beta estimate for a portfolio of at least 100 assets or more can be expected to stay within 90% of the beta estimate at the beginning of the period. Thus, in the case of a single utility equity, or even in the case of a group (under 100) of reasonably comparable utility equities, there can be no confidence at all that an historical beta is a reliable guide to the utility's expected return for the next five years. *See* Tole,[50] "How to Maximize Stationarity of Beta," 7 *The Journal of Portfolio Management* 45 (Winter 1981).

Vivid illustration of the instability of utility betas appears in an analysis performed by Messrs. Hyman and Egan.[51] They computed betas for utilities over the period 1958-1978 by observing returns for three utility indices (Moody's electric utilities, Moody's natural gas industry, and S&P's telephones). By using such portfolios, greater stability in betas can be obtained than is possible through observation of returns on individual utilities. Even so, the result was that, over the 20-year period, wide annual variations in beta appeared in all three groups, ranging from .139 in 1959 to 1.190 in 1965, with a 20-year average of .582, .596, and .664 for the electric, telephone, and natural gas groups, respectively.[52] Whether the 20-year average, the immediately previous 5-year average, an average of the 20-year high and low, the previous year alone, or any other of the 20 single-year betas would constitute a reasonable estimate of the future betas — all of which were different, sometimes very different, numbers[53] — would thus be no more than a guess.[54]

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[49]The problem of reliability is further compounded by the fact that the betas produced through this process are typically very uncertain as a statistical matter, *i.e.*, their standard errors (an indication of how "far off" the estimate could be) are high, and their R^2's (an expression of how much of the asset's movements are in fact "explained" by the market's movements) are low. *See* Hyman and Egan, *supra*, at 24-27; Vandell and Malernee, *supra*, at 27; Myers, "On the Use of Modern Portfolio Theory in Public Utility Rate Cases: Comment," *supra*, at 68.

[50]Dr. Tole is an Associate Professor at Auburn University and an experienced management development specialist and stock broker.

[51]Leonard Hyman is Vice President and head of the Utility Research Group at Merrill Lynch. Joseph Egan is a senior utility analyst at Merrill Lynch.

[52]Hyman and Egan, *supra*, at 24.

[53]For example, the electric utilities' annual betas ranged from .139 to .952 in the 20-year period; their previous 5-year average was .655, and its 20-year average was .582. Telephone betas ranged from .251 to 1.190, with a previous 5-year average of .528 and a 20-year average of .596. Similarly, the natural gas betas were .419 at the low end, .927 at the high end, with a previous 5-year average of .571 and a 20-year average of .664. *Id.* at 24.

[54]The testimony of Stewart Myers in The Railroad Valuation Proceedings shows similar instability in the betas for the railroad industry. Thus, for purposes of determining an expected cost of equity for that industry as of 1974, Professor Myers had to reckon with betas for the S&P Railroad Index as follows: 1969, 1.02; 1970, .98; 1971, 1.37; 1972, .65; and 1973, .82. Myers Testimony, *supra*, at p. 51.

And that, we submit, is no basis upon which to determine utility rates of return.

2. *The CAPM Produces Results Unsound on Their Face*

As the foregoing indicates, there is substantial evidence that CAPM is both theoretically and empirically unsound. In light of this evidence, we submit that regulators should give serious thought to abandoning the model's use in utility ratemaking unless and until its credibility is affirmatively rehabilitated. There is one final argument that supports this view — CAPM is not only unreliable in theory, and unreliable in practice, but, regardless of one's views about the merits or demerits of CAPM itself, the results it produces are too often simply implausible. Several recent studies have elaborated upon this issue, addressing both the general beta-based proposition that utilities are less risky than the market itself (the average asset), as well as the specific indications of risk changes implied by particular utility beta measurements.

First, if the betas of utilities are to be believed, and if CAPM's assumption that beta-risk is the only risk that matters to investors is to be accepted, then, since utility betas are, by and large, consistently less than 1.0, it must follow that utilities are a less risky proposition than, say, unregulated companies on average or the Dow Jones Industrials in particular. To our knowledge, no rate proceeding has included evidence confirming (independent of CAPM) the reliability of this proposition. However, two recent analyses of this proposition declare that it simply is not so.

In "Who Says Utilities Are Less Risky?"[55] and"Competition for the Funds of Investors and the Cost of Capital for Utilities,"[56] the Messrs. Christy[57] and Dr. Lerner, respectively, studied the question whether, notwithstanding what beta may suggest, utilities are more risky than the average company. For several reasons, the authors concluded that utilities are more risky.

First, the Christys showed that utilities are riskier in light of two obvious objective measurements of comparative risk — the consistently greater volatility in price changes displayed by utilities when compared to the Dow Jones and the consistently greater rates of return to investors afforded by utilities as compared to the Dow Jones.[58] Second, in comparing utilities with unregulated companies generally, the authors again found utilities by and large to be riskier, on two broad subjective grounds: first, their higher capital intensity and their corresponding greater sensitivity to inflation and interest-rate uncertainties; and second, the greater risk presented by regulation itself, which not only prevents utilities from reacting to market changes on a daily

[55]105 *Public Utilities Fortnightly* 11 (May 8, 1980).

[56]105 *Public Utilities Fortnightly* 15 (Feb. 28, 1980).

[57]Dr. George A. Christy is Professor of Finance at North Texas State University and served for nine years in telephone company commercial and public relations departments. J. Gordon Christy is Assistant Professor of Law at the University of Oklahoma.

[58]For purposes of analyzing volatility, percent price movements were studied over the 1965-1979 period, and for purposes of analyzing returns received, quarterly earnings/price ratios were studied over the 1973-1979 period. 105 *Public Utilities Fortnightly* at 12-13 (May 8, 1980).

basis, but also raises uncertainties concerning whether, and, if so, when, their increased costs can be recovered.[59]

Dr. Lerner, in a separate study, confirmed these views. First, he showed that if past stability (degree of volatility) is to be taken as an indicator of risk — which CAPM assumes it to be — then regardless "whether stability is measured by the deviations from trend of earnings, sales, dividends, or equity, industrials have been either more stable or comparable to utilities over the past five years."[60] Similarly, he showed that the percentage price changes of utilities have been greater than those of the S&P Industrial Index.[61] Hence, he concluded, "[t]he argument that an industrial commands a higher return than a utility because it has more risk is simply not true."[62]

Finally, in their article "The Utility Stock Market: Regulation, Risk and Beta" (previously referred to), Messrs. Hyman and Egan studied the implications of the various beta changes of utilities (electric, telephone, and natural gas) over the 1958-1978 period. Their judgment was that these implications were simply not credible. Two examples are worth mentioning.

The telephone company betas showed those companies to have "greater risk in the middle 1960's than at present." As to this, said the authors, "[c]onsidering that the financial situation of the industry has not improved and that competition has become a threat to the telephone monopoly, we reject that interpretation altogether."[63] Regarding electric utility betas, at least if CAPM is to be credited, those utilities "involved more risk in the mid-1960's than they do today." Yet, as the authors point out, "[c]onsidering that industry conditions deteriorated substantially between the 1960's and the present time, we reject that interpretation and consider it absurd."[64]

Thus, even putting to one side the considerable theoretical problems associated with CAPM — problems that are intensified in the ratemaking context — and even overlooking that betas tend to be unstable, statistically suspect, and given to arbitrary measurement, it would still be true that the results it produces are too often inconsistent with real-world perceptions about utility risk.

CONCLUSION

For the foregoing reasons, we submit that unless and until those who favor the continued use of CAPM in the utility-ratemaking setting affirmatively establish the model's reliability in that setting, the results produced by the model should not be used further as a basis for determining fair rates of return. In our view, the case which can be made against CAPM's continued

[59]*Id.* at 14-18.
[60]105 *Public Utilities Fortnightly* at 15-16 (Feb. 28, 1980).
[61]*Id.* at 16-18.
[62]*Id.* at 16.
[63]Hyman & Egan, *supra,* at 24.
[64]*Id.*

use for such ratemaking is now of such proportions that the proponents' burden cannot be met.

This is not to say that we propose abandonment of CAPM altogether. Rather, the case we have tried to make here is that CAPM in its present form — that is, a formula which relies on beta as the only important systematic factor and which assumes that alpha is zero — is so fraught with error, and has led to such improbable results, that it does not merit further credence. However, it may well be that a modified CAPM — one that recognizes the value of alpha and/or takes into account other systematic factors (such as interest-rate risk) known to affect utilities — can be shown to be a valid ratemaking tool. Such a showing, it seems to us, should be of high priority in future proceedings.