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August 16, 2004

VIA HAND DELIVERY

Pat Miller, Chairman
Tennessee Regulatory Authority
460 James Robertson Parkway
Nashville, TN 37219

Re: Petition of Chattanooga Gas Company for Approval of Adjustment of its Rates and Charges and Revised Tariff
Docket Number 04-00034
Rebuttal Testimony of Chattanooga Gas Company

Dear Chairman Miller:

Enclosed you will find the original and fourteen copies of the rebuttal testimony of Chattanooga Gas Company. This filing includes testimony from Steve Lindsey, Mike Morley, Richard Lonn, Dr. Roger A. Morin, Darilyn Jones and Doug Schantz.

Sincerely,

D. Billye Sanders

D. Billye Sanders
Attorney for Chattanooga Gas Company

DBS/hmd
Enclosures

cc: Archie Hickerson
Steve Lindsey
John Ebert, Esq.
Elizabeth Wade, Esq.

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CERTIFICATE OF SERVICE

I hereby certify that on this 16th day of August 2004, a true and correct copy of the enclosed rebuttal testimony was delivered by hand delivery, email, facsimile or U.S. mail postage prepaid to the other Counsel of Record listed below.

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BEFORE THE

TENNESSEE REGULATORY AUTHORITY

In Re: Petition of Chattanooga Gas Company To)
Place Into Effect a Revised Natural Gas Tariff) Docket No. 04-00034

REBUTTAL TESTIMONY

OF

ROGER A. MORIN

ON BEHALF OF

CHATTANOOGA GAS COMPANY

August 2004

Q. PLEASE STATE YOUR NAME, ADDRESS, AND OCCUPATION.

A. My name is Dr Roger A. Morin. My business address is Georgia State University, Robinson College of Business, University Plaza, Atlanta, Georgia, 30303. I am Professor of Finance at the College of Business, Georgia State University and Professor of Finance for Regulated Industry at the Center for the Study of Regulated Industry at Georgia State University. I am also a principal in Utility Research International, an enterprise engaged in regulatory finance and economics consulting to business and government.

Q. DID YOU FILE DIRECT TESTIMONY IN THIS PROCEEDING ON BEHALF OF THE CHATTANOOGA GAS COMPANY?

A. Yes, I did.

Q. PLEASE DESCRIBE THE PURPOSE OF YOUR REBUTTAL TESTIMONY.

A. I have been asked by Chattanooga Gas Company ("CGC" or the "Company") to provide rebuttal testimony to Dr Brown's rate of return testimony filed on behalf of the Consumer Advocate and Protection Division of the Attorney General's Office.

Q. PLEASE SUMMARIZE DR. BROWN'S RATE OF RETURN RECOMMENDATION.

A. In determining CGC's return on common equity capital ("ROE"), Dr. Brown applies a plain vanilla DCF analysis and a CAPM analysis to a sample of 10 natural gas distributors. Based on the results of these two analyses, he recommends a ROE of only 8 35% on CGC's common equity capital.

Q. DO YOU HAVE ANY GENERAL COMMENTS ON DR. BROWN'S TESTIMONY?

A. Yes. Before I engage in specific criticisms of Dr Brown's testimony, my initial reaction was that his recommended ROE of 8.35% was so radically low and far-fetched that it constituted a typographical error. Further reading, however, confirmed that 8.35% was indeed his recommended return. My next reaction was that Dr Brown's implementation of both the DCF and CAPM analyses must be seriously flawed and I proceeded to investigate the specific details of Dr Brown's methodologies

I find that Dr. Brown's recommended 8 35% ROE for CGC lies completely outside the zone of reasonableness and well outside the zone of currently authorized rates of return for natural gas and electric utilities in the United States, and, as such, is very difficult to take seriously. Dr. Brown's draconian cost of equity recommendation of only 8.35%, if ever adopted, would result in the lowest rate of return award for a natural gas distribution or electric utility in the country, and by a wide margin. I hesitate to think of its adverse consequences on investors and ratepayers. Moreover, Dr. Brown's recommended ROE lies well outside the zone of his own comparable companies' authorized ROEs. These are clear indications that his return on equity recommendation for CGC is too low. Overall, Dr. Brown's testimony contains several errors and logical contradictions.

Q. WHAT ARE THE BASIC CONCLUSIONS OF YOUR REBUTTAL TO DR. BROWN'S COST OF EQUITY TESTIMONY?

A. Dr. Brown seriously understates CGC's required return on common equity. Dr. Brown's testimony is highly irregular and faulty, and grossly understates CGC's cost of equity. Dr Brown employs inappropriate and curious model inputs throughout his analyses, which causes him to recommend returns that are well below investors' required returns. A proper application of cost of capital methodologies would give results substantially higher than those that he obtained Dr. Brown's overall testimony and recommendations are well outside the mainstream of both financial theory and practice. As such, Dr. Brown's opinion as to an ROE for CGC is fundamentally unsupported and unreliable. I do not believe that Dr. Brown's testimony can be credited with providing the Tennessee Regulatory Authority ("TRA") with any expert analysis that can give it insight in responsibly addressing the ROE issue in this case.

Q. PLEASE SUMMARIZE YOUR SPECIFIC CRITICISMS OF DR. BROWN'S TESTIMONY.

A I have thirteen specific criticisms:

1. Return Recommendation Far Out of The Mainstream. Dr. Brown's recommended return is completely outside the zone of currently allowed rates of return for natural gas and electric utilities in the United States and for his own sample of companies. The average allowed return on equity for gas utilities in the years 2002 and 2003 was 11% for the average risk gas utility and is 11.1% for the first quarter of 2004. These authorized returns exceed by a significant margin Dr Brown's anemic 8.35% recommended return for CGC, a riskier than average natural gas utility on account on its relatively small size. Furthermore, the currently authorized ROE for Dr. Brown's own comparable companies is much higher than his recommended ROE for CGC.

2. DCF Dividend Yield. Dr. Brown's dividend yield component is understated by approximately 30 basis points because it does not allow for flotation costs, and a legitimate stockholder expense is left unrecovered.

3. DCF Functional Form. Dr Brown's DCF formulation understates the required return on common equity capital because he has misspecified the DCF model. Use of the proper DCF functional form raises his estimate by approximately 30 basis points.

4. Quarterly Timing of Dividends. Dr. Brown's dividend yield component is understated by 20 basis points because it ignores the time value of quarterly dividend payments.

5. DCF Growth Rates. Dr Brown's virulent denunciation of Value Line information as inaccurate, biased, unreliable, unworthy, and is unwarranted, considering that he himself relied upon it in prior testimonies. Value Line is the most widely circulated, widely-used, and prestigious source of investment information to investors, researchers, educators, and Dr. Brown in past testimonies, and has been in circulation for decades.

6. CAPM Formulation. Dr. Brown's CAPM formulation is plain wrong, misspecified, and contains a logical inconsistency.

7. CAPM Risk-Free Rate. Dr. Brown's CAPM results are improper because, among other reasons, his proxy for the risk-free rate is inappropriate. The correct proxy for the risk-free rate in the CAPM is the return on long-term Treasury bonds, and not the yield on short-term 90-day U.S. Treasury Bills or the yield on corporate bonds

8. CAPM Functional Form. Dr. Brown's unconventional version of the CAPM appears nowhere in the finance literature, much less in regulatory proceedings, and is replete with errors. For example, Dr. Brown uses two different risk-free rates in the same CAPM His peculiar version of the CAPM has never been adopted by a regulatory agency to the best of my knowledge.

9. CAPM Market Risk Premium. Dr. Brown's CAPM estimate is downward-biased by a total of 190 basis points because: 1) it relies on geometric averages of historical returns instead of arithmetic averages, understating the cost of equity by 165 basis points, and 2) it is stale and understates the cost of equity by 25 basis points.

10. Beta Estimates. Dr. Brown's beta estimates are preposterous, for they imply that the common stocks of natural gas utilities are risk-free. His use of homemade raw betas instead of the conventional adjusted betas seriously understate his findings and recommendation.

11. CAPM and the Empirical CAPM (ECAPM). The plain vanilla version of the CAPM used by Dr. Brown understates the Company's required return on equity by another 50 basis points.

12. Risk Premium Approach. Dr Brown's views on the historical risk premium approach are unconventional, unsupported, and wrong.

13. Myriad Confusions. Dr. Brown is confused on several financial issues throughout his testimony. For example, I was astonished by: a) his view that common stock is not a long-term investment, b) his confounding of the expected dividend yield and compounding in the DCF model, c) his mistaken definition of double leverage, d) his view on the negative benefits of diversification, e) his misunderstanding of the distinction between actual realized and expected returns, and f) his perplexing use of two widely different risk-free rates in the same model, to name some. I address each of those items individually below.

I also find that Dr Brown's criticism of my testimony are without foundation and should be disregarded

1. ALLOWED RETURNS

Q. IS DR. BROWN'S RATE OF RETURN RECOMMENDATION COMPATIBLE WITH CURRENTLY ALLOWED RETURNS IN THE NATURAL GAS UTILITY INDUSTRY?

A. No, not at all. Allowed returns, while certainly not a precise indication of a particular company's required return on equity capital, are nevertheless important determinants of investor growth perceptions and investor expected returns. They also serve to provide some perspective on the validity and reasonableness of Dr. Brown's recommendation

The average allowed return in the gas utility industry in both the years 2002 and 2003 as reported by Regulatory Research Associates in its most recent quarterly survey of regulatory decisions dated March 2004 was 11% for both years. In the first quarter of 2004, the average authorized ROE is 11.1%. These ROE awards exceed by a substantial margin Dr. Brown's recommended ROE of 8.35% for CGC, an above average risk utility in view of its small relative size.

I have also examined the range of returns currently allowed on common equity for the ten natural gas utilities in Dr. Brown's sample group as reported in C.A. Turner Utility Reports survey for July 2004. The currently authorized average ROE for Dr. Brown's sample, shown in Table 1 below, is nearly 11%:

TABLE 1

COMPANY	% ALLOWED ROE
Atmos Energy	10.99
Nicor Inc.	
Keyspan Corp	10.20
LaClede Group	
N. J. Resources	11.50
Northwest Natural Gas	10 20
Peoples Energy	11.20
Piedmont Natural Gas	11.30
Southwest Gas	10.69
WGL Holdings	10.95
AVERAGE	**10.88%**

Source C A Turner Utility Reports 07/04

In short, Dr. Brown's recommendation lies completely outside the mainstream of currently allowed rates of return for Dr. Brown's comparable companies, and well outside the mainstream of recently authorized returns for natural gas utilities in Unites States

2. DIVIDEND YIELD AND FLOTATION COST

Q. DO YOU HAVE ANY COMMENT ON DR. BROWN'S DIVIDEND YIELD COMPONENT IN HIS DCF APPROACH?

A. Yes. I disagree with Dr Brown's dividend yield calculation in his DCF analysis because it ignores flotation costs As I discuss below, total flotation costs amount to 5%, which in turn amount to approximately 30 basis points for CGC. Dr. Brown has thus understated CGC's return on equity by 30 basis points as a result of this omission alone.

Q. IN YOUR DIRECT TESTIMONY, YOU STATED THAT THE RETURN ON EQUITY SHOULD BE ADJUSTED TO INCLUDE AN ALLOWANCE FOR FLOTATION COSTS. PLEASE COMMENT ON FLOTATION COSTS.

A. Flotation costs are very similar to the closing costs on a home mortgage. In the case of issues of new equity, flotation costs represent the discounts that must be provided to place the new securities. Flotation costs have a direct and an indirect component. The direct component represents monetary compensation to the security underwriter for marketing/consulting services, for the risks involved in distributing the issue, and for any operating expenses associated with the issue (printing, legal, prospectus, etc). The indirect component represents the downward pressure on the stock price as a result of the increased supply of stock from the new issue. The latter component is frequently referred to as "market pressure".

Flotation costs for common stock is analogous to the flotation costs associated with past bond issues which, as a matter of routine regulatory policy, continue to be amortized over the life of the bond, even though no new bond issues are contemplated. In the case of common stock, which has no finite life, flotation costs are not amortized Therefore, the recovery of flotation cost requires an upward adjustment to the allowed return on equity.

As demonstrated in my original testimony, the expected dividend yield component of the DCF model must be adjusted for flotation cost by dividing it by (1 - f), where f is the flotation cost factor.

Q. WHAT FLOTATION COST TREATMENT DID DR. BROWN RECOMMEND IN THIS CASE?

A Dr. Brown's common equity return recommendation does not include any allowance whatsoever for issuance expense. I am surprised by Dr. Brown's reluctance to accept flotation costs. The flotation cost allowance to the cost of common equity capital is routinely discussed and applied in most corporate finance textbooks.

Q. HOW DOES DR. BROWN RATIONALIZE THE OMISSION OF FLOTATION COSTS?

A. Dr. Brown offers three arguments as to why a flotation cost allowance is unwarranted. As I show below, all three arguments are unfounded.

Dr. Brown's first argument (Page 101 lines 1-9) is that when new stock is issued above book value there is no need to compensate stockholders for a hypothetical dilution of book value that does not exist I disagree. The simple fact of the matter is that in issuing common stock, the company's common equity account is credited by an amount less than the market value of the issue, so that the company must earn slightly more on its reduced rate base in order to produce a return equal to that required by shareholders The stock's market-to-book value is irrelevant. The costs are there irrespective of whether the stock trades above, below, or at book value.

Q. DO YOU AGREE WITH DR. BROWN'S SECOND ARGUMENT AGAINST A FLOTATION COST ALLOWANCE?

A. No, I do not Dr. Brown's second objection is that the flotation cost adjustment *"is a method where ratepayers are compensating the company for the market's judgment"*. I have no idea how this argument relates to flotation costs. He then presents a numerical example that purports to buttress this argument. In his example, AGL Resources sells stock to the public at $25 per share and nets $24 from the issue. Somehow, Dr. Brown draws the conclusion that the ratepayers should not be liable for the difference and that inclusion of flotation costs somehow makes them liable. Dr. Brown is very confused on this issue. The fact that the company nets $24 out of a $25 stock issue is precisely why the flotation cost adjustment is required The simple fact of the matter is that in issuing common stock, the Company's common equity account is credited with an amount less than the market value of the issue, so that the Company must earn slightly more on its reduced rate base in order to produce a return equal to that required by shareholders. Going back to Dr. Brown's example, if common stock is sold for $25, and let us say that investors require a 10% return, that is, $2.50 of earnings, but because of flotation costs the Company nets $24 from the issue, and its common equity account is credited by $24. In order to generate the same $2.50 of earnings to the shareholders, from a reduced equity base of $24, it is clear that a return in excess of 10% must be allowed on this reduced equity base, here 10.42%, or 42 basis points flotation cost allowance. Thus, Dr Brown's own numerical illustration justifies the need for a flotation cost allowance.

Q. DR. MORIN, SHOULD FLOTATION COSTS BE EXPENSED BY A REGULATED UTILITY?

A. No, they should not Dr. Brown ends his confused discourse on flotation cost by asking "*why doesn't the company book the flotation cost as an expense in the first place?*" The answer to that is simple. In theory, flotation costs could be expensed and recovered through rates as they are incurred. This procedure is not considered appropriate, however, because the equity capital raised in a given stock issue remains on the utility's common equity account and continues to provide benefits to ratepayers indefinitely It would be unfair to burden the current generation of ratepayers with the full costs of raising capital when the benefits of that capital extend indefinitely Although flotation costs are not expensed, they must nevertheless be recovered. Besides, expensing issuance costs of new issues assumes that the issuance costs associated with past common stock issues have been fully recovered.

As I indicated in my initial testimony, unlike the case of bonds, common stock has no finite life so that flotation costs cannot be amortized and must therefore be recovered via an upward adjustment to the allowed return on equity.

In short, Dr. Brown should have incorporated a flotation cost allowance in his ROE recommendation. He thus understates the Company's cost of equity by 30 basis points from this omission

3. DCF FUNCTIONAL FORM

Q. DR. MORIN, DO YOU HAVE ANY COMMENT ON THE FUNCTIONAL FORM OF THE DCF MODEL USED BY DR. BROWN?

A. Yes, I do I disagree with Dr. Brown's dividend yield calculation in his DCF analysis because he failed to multiply the *spot dividend yield* by one plus the expected growth rate (1 + g) as clearly required by the annual DCF model. This flaw understates the return expected by the investor by approximately 30 basis points For example, for a spot dividend yield of 5% and a growth rate of 6%, the correct expected dividend yield is 5.0% times (1 + 0.06) which equals 5.3% and not 5 0% The correct dividend yield to employ is the *expected dividend yield*, here 5% times (1 + .06) which equals 5.3%

One fundamental assumption of the annual DCF model is that dividends are received by investors annually at the end of each year and that the first dividend is to be received by the investor one year from now. Since the appropriate dividend to use in the annual DCF model is the prospective dividend one year from now, rather than the current dividend yield, Dr. Brown's approach understates the proper dividend yield This creates a downward bias in his dividend yield component, and underestimates the return on equity by approximately 30 basis points Incidentally, I know of very few rate of return "experts," if any, that utilize the raw spot dividend yield in implementing the DCF model.

Dr. Brown's statements on the dividend yield issue are confusing. He argues on Page 99 that the use of the expected dividend yield rather than the spot dividend yield "builds in compounding" and that is inconsistent with a prior TRA order. Using the appropriate functional form of the DCF model has nothing to do with compounding whatsoever The compounding that Dr. Brown is referring to relates to the quarterly nature of dividend payments discussed below.

4. QUARTERLY DCF MODEL

Q. PLEASE COMMENT ON THE USE OF THE ANNUAL DCF MODEL.

A. The DCF model used by Dr. Brown assumes that dividend payments are made annually at the end of the year and are increased once a year, while most utilities in fact pay dividends on a quarterly basis. Since the stock price fully reflects the quarterly payment of dividends, it is essential that the DCF model used to estimate equity returns also reflect the actual timing of quarterly dividends. In the same way that bond yield calculations are routinely adjusted to reflect semiannual interest payments, it stands to reason that stock yields should be similarly adjusted for quarterly compounding. It should be pointed out that the quarterly DCF model uses the exact same assumptions as the annual DCF model, but refines the latter so as to capture the exact timing of cash flows received by the investor. By failing to recognize the quarterly nature of dividend payments in his DCF computation, Dr Brown understates the required return on equity capital by about 20 basis points.

A bank rate on deposits which does not take into consideration the timing of the interest payments understates the true yield of the investment if interest payments are received more than once a year. The same is true for stocks. Since the stock price employed in the DCF model reflects a quarterly stream of dividends, it stands to reason that the quarterly nature of dividend payments be explicitly recognized. Cash flows, that is, dividends, are actually received quarterly. Thus, a quarterly model should be applied. This is because investors set prices based on the present value of the cash flows that they receive. Since investors receive dividends quarterly, a quarterly model best matches the investor's expectations to the prices set in the market place and those prices reflect the quarterly receipt of cash flows.

5. DCF GROWTH RATES

Q. WHAT GROWTH RATE ANALYSIS DID DR. BROWN EMPLOY?

A. Dr Brown employs an average of analysts' growth forecasts contained in the Zacks Investment Research and the Yahoo data base. I agree with Dr. Brown's use of analysts' growth forecast as proxies for expected growth in the DCF model. However, I would place considerably more weight on the Zacks estimates rather than the Yahoo estimates. Serious investors, particularly institutional investors, are much more likely to rely on Zacks Investment Research for reliable investment information than on Yahoo.

Q. DO YOU AGREE WITH DR. BROWN'S VIRULENT DENUNCIATIONS OF VALUE LINE INVESTMENT SURVEY?

A No, absolutely not. A recurring theme throughout Dr. Brown's testimony is his systematic denunciation of Value Line information as inaccurate, biased, unreliable, and unworthy, although he himself relied upon it in prior testimonies. Whether it is Value Line growth rates or Value Line betas, Dr. Brown is relentless in his denigration of this prestigious investor information service. Value Line is the most widely circulated, widely-used, and prestigious source of investment information to investors, researchers, and educators, and has been in circulation for decades

Q. DOES DR. BROWN ACCEPT VALUE LINE'S GROWTH RATES?

A. No, he does not. He rejects the use of Value Line's growth rates in the DCF model because, according to Dr Brown, they have not been accurate in forecasting actual growth rates

Q. DO YOU AGREE WITH DR. BROWN'S REJECTION OF VALUE LINE GROWTH FORECASTS?

A. No, his rejection of Value Line growth rates is unwarranted. Leaving aside the strong possibility that Dr. Brown's rejection of Value Line growth data is results-driven, he is wrong for three reasons.

First, at the conceptual level, Dr. Brown has missed the point. On pages 93 and 96, Dr. Brown describes Value Line growth forecasts as flawed because such forecasts are consistently higher than actually achieved growth rates. The accuracy of these forecasts in the sense of whether they turn out to be correct is not at issue here, as long as they reflect widely held expectations. As long as the forecasts are typical and/or influential in that they are consistent with current stock price levels, they are relevant

Second, Dr. Brown offers no serious published academic study refuting the use of Value Line growth forecasts. In a study of his own, he compares Value Line's growth projections with the actual compound growth over the past five years and ten years on his Schedule 22, and concludes that the actual growth rates do not match the forecast.

This study is flawed, for it compares apples and oranges. Dr. Brown computes growth rates using the compounding method while Value Line uses a smoothing technique. Use of the compounding method of calculating growth is vulnerable to a potential distortion. If either the initial or terminal values are unrepresentative, unusually high or low, the resulting growth rate will not truly reflect the developments during the period. For example, if the terminal year happens to be one of severely depressed earnings due to inflation or acute regulatory lag, and the initial year reflects an economic boom, the indicated growth rate will be unrealistically low On the other hand, if conditions were changed, the reverse might be true. Value Line avoids this potential distortion by using smoothed compound growth rates; instead of using single years' data as end points, the averages of the first few and last few years' data are used. The latter method is preferable because it involves less subjective judgment. Base periods used in the Value Line computation are three-year averages in order to temper cyclicality and to mitigate any potential distortion due to sensitivity to end points. Dr Brown did not utilize such smoothed historical compound growth rates when comparing actual growth rates with Value Line growth rates, and has thus compared apples with oranges.

My third objection to Dr. Brown's attack on Value Line growth rates is that the Yahoo and Zacks growth rates he utilizes in his DCF analysis are subject to the same alleged criticism as Value Line's growth rates. Dr. Brown did not conduct any study to gauge the accuracy of Yahoo and Zacks growth rates, as he did Value Line's What if Value Line growth rates turned out to exceed Zacks' and Yahoo's growth rates in accuracy? Dr. Brown is silent on that possibility

6. CAPM ESTIMATES

Q. DOES DR. BROWN EMPLOY A CAPM ESTIMATE?

A Yes, he does. Starting on page 105, Dr. Brown performs a CAPM analysis.

Q. DO YOU AGREE WITH DR. BROWN'S CAPM ANALYSIS?

A No, I do not. Dr. Brown's CAPM analysis is replete with errors, both conceptual and methodological and should be dismissed in its entirety. Dr. Brown's CAPM analysis is flawed for five reasons. First, Dr. Brown's proxy for the risk-free rate is wrong. Second, Dr. Brown has employed a stale and erroneous input in estimating the historical market risk premium. Third, his use of personally crafted raw beta instead of the more conventional adjusted betas is totally inappropriate. Fourth, the use of the plain vanilla CAPM understates the cost of capital. Fifth, and perhaps even more importantly, Dr. Brown's homespun version of the CAPM is wrong, unprecedented, and logically inconsistent. I shall discuss each of these flaws in turn. I find that confusion is rampant in this entire section of Dr Brown's testimony

7. CAPM RISK-FREE RATE

Q. PLEASE COMMENT ON DR. BROWN'S PROXY FOR THE RISK-FREE RATE IN THE CAPM.

A. In his discussion of the CAPM on Page 110, Dr. Brown argues that the appropriate proxy for the risk-free rate of return is the yield on 90-day Treasury bills, rather than the yield on long-term Treasury bonds which I used in my direct testimony. I disagree. The appropriate proxy for the risk-free rate in the CAPM is the return on long-term Treasury bonds, and not the yield on short-term Treasury bills This is simply because common stocks are long-term instruments more akin to long-term bonds than to 90-day short-term securities. In a risk premium model, the ideal estimate for the risk-free rate has a term to maturity equal to the security being analyzed. Because common equity has an infinite life-span, the inflation expectations embodied in its market-required rate of return will be equal to the inflation rate anticipated to prevail over the long-term. Among U.S. Treasury securities, U.S. Treasury bonds have the longest term to maturity. Therefore, U S Treasury bonds will more closely incorporate within their yield the inflation expectations that influence the prices of common stocks than do U.S. Treasury Bills.

While in theory, the yield on 90-day Treasury Bills is virtually riskless, in practice, it fluctuates widely, leading to volatile and unreliable equity return estimates Incidentally, I was astonished by Dr. Brown' statement on page 20 that he does not view the yields on 90-day Treasury Bills as volatile. It is well known that the contrary is true, and that indeed short-term rates are highly volatile relative to long-term interest rates.

Starting on page 88 and through page 90, Dr. Brown makes some astounding statements regarding the use of long-term debt securities in general. First, he argues that investors are not making a long-term investment when buying shares of AGL Resources or comparable companies. He bases this curious statement on his study of the turnover rates of stock ownership for AGL Resources and for each comparable company As far as Dr. Brown is concerned (see also page 122 of his testimony), turnover rates of one to three years in common stocks somehow confirm his viewpoint that common stock is not a long-term investment. This argument is totally without merit.

The expected common stock return is based on very long-term cash flows, regardless of an individual's holding time period Dr. Brown is essentially saying that an investor buying a stock for one day will require a very low return, say the overnight yield on broker call loans of 2%. Another investor buying the same stock for 90 days will require a slightly higher return, say the yield on Treasury bills of 3%. Another investor, still buying the same stock, but for a longer horizon of 5 years will require a higher yield still, say 5%. This view is illogical. An investor will require a return which reflects the risk of the stock, irrespective of holding period. It is a well known fact that the DCF model is insensitive to holding period. The latter point is formally demonstrated on pages 111-114 in Chapter 4 of my book, Regulatory Finance, attached as Exhibit RAMREB-1.

Since common stock is a very long-term investment because the cash flows to investors in the form of dividends last indefinitely, the yield on very long-term government bonds is the best measure of the risk-free rate. The expected common stock return is based on very long-term cash flows, regardless of an individual's holding time period. Moreover, utility asset investments generally have very long-term useful lives and should correspondingly be matched with very long-term maturity financing instruments.

A strange statement on page 110 is indicative of Dr. Brown's confusion:

> *"In this case I am using the three-month U.S. Treasury Bills. The **three-month** rate is based on a **long-term** perspective of the riskless rate....*

I am at a complete loss to make any sense out of this contradictory statement.

8. CAPM FUNCTIONAL FORM

Q. IS THE CAPM VERSION EMPLOYED BY DR. BROWN APPROPRIATE?

A. No, it is not. The standard CAPM as it appears in all finance and investment textbooks and in Dr. Brown's testimony on page 108 has the following form:

$$K_e = R_F + \beta(R_M - R_F)$$

The CAPM expression states that the return required by investors is made up of a risk-free component, R_F, plus a risk premium given by $\beta(R_M - R_F)$. However, this is not the format actually employed by Dr. Brown. After having made a case for the use of 90-day Treasury Bills as proxies for the risk-free rate, Dr. Brown, in a complete turnabout, decides to use the cost of long-term corporate debt of 6 74% as a proxy for the risk-free rate instead of the yield on three-month Treasury Bills

There are serious problems with this approach. First, and clearly, corporate debt is not risk-free Second, there is a flagrant contradiction in Dr.

Brown's CAPM. In the CAPM equation shown above, the risk-free rate R_F is the same risk-free rate in both terms of that equation. Yet, Dr. Brown uses one proxy for the R_F in the first term of that equation (the cost of corporate debt) and a different proxy for the same R_F in the second term (the yield on three-month Treasury Bills This is totally inconsistent and illogical. Dr. Brown has redefined his own version of the CAPM to read as.

$$K_e = K_d + \beta(R_M - R_F)$$

where the risk-free rate is the cost of corporate debt (K_d) in one term of the CAPM and the yield on three-month Treasury Bills in the other term. I have yet to see Dr. Brown's self crafted and unconventional version of the CAPM anywhere in the finance literature, much less in regulatory proceedings.

9. CAPM: MARKET RISK PREMIUM

Q. DR. MORIN, PLEASE COMMENT ON DR. BROWN'S ESTIMATE OF THE MARKET RISK PREMIUM COMPONENT OF THE CAPM.

A. In order to determine the market risk premium component of the CAPM, Dr Brown uses the historical difference between common stock returns (12.2%) and 90-day Treasury Bill returns (3 83%) reported in the Ibbotson Associates Valuation 2003 Yearbook for the 1926 – 2002 period. This difference is 6.41%, as shown on his Schedule 27. I disagree with his estimate of the market risk premium.

First, Dr. Brown relies on the geometric average market risk premium of reported by Ibbotson Associates instead of the correct arithmetic average. Second, Dr. Brown's estimate of the market risk premium is stale and should have relied on the current 2004 version of the Ibbotson Yearbook instead of the 2003 edition I shall now discuss these two issues in turn.

Q. ARE ARITHMETIC AVERAGES OR GEOMETRIC AVERAGES APPROPRIATE IN MEASURING EXPECTED RETURN FROM HISTORICAL RETURN DATA?

A. Only arithmetic averages are appropriate. Dr. Brown has erroneously relied on the geometric mean return rather than on the arithmetic mean return in his CAPM analysis discussed on pages 110-111 and shown on Schedule 27 of his testimony. Only arithmetic means are correct for forecasting purposes and for estimating the cost of capital. As demonstrated formally in Chapter 11 of my book, <u>Regulatory Finance</u>, and in Brealy & Myers' best-selling corporate finance textbook, <u>Principles of Corporate Finance</u>, only arithmetic averages can be used as estimates of cost of capital, and the geometric mean is not an appropriate measure of the cost of capital

Most of the scientific literature argues that, when estimating the cost of capital, the historical risk premium should be measured as the arithmetic mean of the periodic common stock returns minus the arithmetic mean of the periodic government bond returns. Quotes from celebrated university-level textbooks in the field of corporate finance and investment management are noteworthy. Brealey & Myers in their best-selling corporate finance textbook ("<u>Principles of Corporate Finance,"</u> McGraw Hill, 7th ed , 2003) opt strongly for the arithmetic mean.

"Thus the arithmetic average of the returns correctly measures the opportunity cost of capital for investment of similar risk..."

"Moral: If the cost of capital is estimated from historical returns or risk premiums, use arithmetic averages, not compound annual rates of return (geometric averages)."

Brigham & Gapenski in their widely-used corporate finance text ("Financial Management: Theory and Practice," 8th ed., Dryden Press, 2002) point out that the arithmetic average is more consistent with CAPM theory as one of its key underpinning assumptions is that investors are supposed to focus, in their portfolio decisions, upon returns in the next period and the standard deviation of this return. To the extent that this next period is one year, the preference for the arithmetic mean which derives from a set of single one year period returns follows. It is also noteworthy that one of the crucial assumptions inherent in the pioneering CAPM is that investors are single-period expected utility of terminal wealth maximizers who choose among alternative portfolios on the basis of each portfolio's expected return and standard deviation.

The prominent Ibbotson Associates "Stocks, Bonds, Bills and Inflation Yearbook 2004" cites:

"The arithmetic average equity risk premium can be demonstrated to be most appropriate when discount future cash flows. For use as the expected equity risk premium in either the CAPM or the building block approach, the arithmetic mean or the simple difference of the arithmetic means of stock market returns and riskless rates is the relevant number. This is because both the CAPM and the building block approach are

additive models, in which the cost of capital is the sum of its parts. The geometric average is more appropriate for reporting past performance, since it represents the compound average return."

"The argument for using the arithmetic average is quite straightforward. In looking at projected cash flows, the equity risk premium that should be employed is the equity risk premium that is expected to actually be incurred over the future time periods.

Bodie, Kane, and Marcus in their widely-used investment textbook ("Investments," McGraw-Hill Irwin, 2002) cite:

"Which is the superior measure of investment performance, the arithmetic average or the geometric average? The geometric average has considerable appeal because it represents the constant rate of return we would have needed to earn in each year to match actual performance over some past investment period. It is an excellent measure of ***past*** *performance. However, if our focus is on future performance, then the arithmetic average is the statistic of interest because it is an unbiased estimate of the portfolio's expected future return (assuming, of course, that the expected return does not change over time). In contrast, because the geometric return over a sample period is always less than the arithmetic mean, it constitutes a downward-biased estimator of the stock's expected return in any future year."*

"Again, the arithmetic average is the better guide to future performance."

Another way of stating the Bodie, Kane, Marcus argument in favor of the arithmetic mean is that the latter is the best estimate of the future value of the return distribution because it represents the expected value of the distribution. It is most useful for determining the central tendency of a distribution at a particular time, that is, for cross-sectional analysis The geometric mean, on the other hand, is best suited for measuring an investment's compound rate of return over time, that is, for time-series analysis This is the same argument made by Ibbotson Associates in Stocks, Bonds, Bill, and Inflation: 2004 Yearbook cited earlier where it is shown, using probability theory, that future terminal wealth is given by compounding the arithmetic mean, and not the geometric mean. In other words, if we accept the past as prologue, the best estimate of a future year's return based on a random distribution of the prior years' returns is the arithmetic average. Statistically, it is our best guess for the holding-period return in a given year. If we wish to estimate the ending value of an investment over a multiyear horizon conditioned on past experience, however, we should use the geometric return. The following example illustrates this point.

Suppose you plan to invest $1,000 in an Index Fund, and you wish to estimate the most likely value of your investment five years from now. You base your estimates on annual return results ending in 2004, shown on the table below. The arithmetic mean return equals 11.2%, while the geometric mean equals 9 3%. Your best estimate for next year's return, or any single year's return for that matter, equals 11.2% because there is a 1 in 10 chance of experiencing each of the observed returns. However, the best estimate for the terminal value of your fund is $1,562 based on the geometric mean, derived by raising 1.112 (1 + the geometric mean) to the 5th power and multiplying this value by $1,000

Annual Returns Index Fund

1995	9.99%
1996	1.31%
1997	37.43%
1998	23 07%
1999	33.36%
2000	28 58%
2001	21.04%
2002	-9.11%
2003	-11.88%
2004	-22.10%
Arithmetic Mean	**11.2%**
Geometric Mean	**9.3%**

Q. WHAT IS THE EFFECT OF USING THE GEOMETRIC MEAN RATHER THAN THE ARITHMETIC MEAN ON DR. BROWN'S RECOMMENDATION?

A. The effect of using the geometric mean market risk premium of 6.41% rather than the arithmetic mean of 8.6% is to decrease Dr Brown's estimate of the market risk premium by 2.2%, that is, the difference between the arithmetic and geometric mean market risk premium reported in the aforementioned Ibbotson Associates publication.

I also note that the widely-cited Ibbotson Associates publication cited earlier and from which Dr. Brown's market return estimate is derived contains a detailed and rigorous discussion of the impropriety of using geometric averages in estimating the cost of capital There is no theoretical or empirical justification for the use of geometric mean rates of returns. I know of no textbook on finance or scientific journal article which advocates the use of the geometric mean *as a measure of the appropriate discount rate in computing the cost of capital or in* *computing present values* In short, Dr. Brown's estimate of the market risk premium is downward-biased by 220 basis points, that is, the difference between the average of the geometric and arithmetic average market risk premiums reported in the Ibbotson Associates publication and the correct arithmetic average market risk premium Using a beta estimate of 0.75 for natural gas utilities, this in turn translates into a sizable downward bias of 165 basis points.

Q. CAN YOU PROVIDE A BRIEF EXPLANATION AS TO WHY THE ARITHMETIC MEAN IS THE CORRECT METHOD FOR ESTIMATING THE COST OF CAPITAL?

A. Yes. The use of the arithmetic mean appears counter-intuitive at first glance, because we commonly use the geometric mean return to measure the average annual achieved return over some time period. For example, the long-term performance of a portfolio is frequently assessed using the geometric mean return.

But performance appraisal is one thing, and cost of capital estimation is another matter entirely In estimating the cost of capital, the goal is to obtain the rate of return that investors expect, that is, a target rate of return. On average, investors expect to achieve their target return. This target expected return is, in effect, an arithmetic average. The achieved or retrospective return is the geometric average. In statistical parlance, the arithmetic average is the unbiased measure of the expected value of repeated observations of a random variable, not the geometric mean

The geometric mean answers the question of what constant return you would have had to achieve in each year to have your investment growth match the return achieved by the stock market. The arithmetic mean answers the question of what growth rate is the best estimate of the future amount of money that will be produced by continually reinvesting in the stock market. It is the rate of return which, compounded over multiple periods, gives the mean of the probability distribution of ending wealth. Only the arithmetic mean is appropriate for calculations of the cost of capital. Appendix 1 in Chapter 11 of my book, Regulatory Finance, provides a numerical example to show that the arithmetic mean is appropriate for calculations of the cost of capital. It is attached as Exhibit RAMREB-2

While the geometric mean may be an adequate estimate of performance over a long period of time, this does not contradict the statement that the arithmetic mean compounded over the number of years that an investment is held provides the best estimate of the ending wealth value of the investment.

The reason is that an investment with uncertain returns will have a higher ending wealth value than an investment that simply earns (with certainty) its compound or geometric rate of return every year. In other words, more money, or terminal wealth, is gained by the occurrence of higher than expected returns than is lost by lower than expected returns

In capital markets, where returns are a probability distribution, the answer that takes account of uncertainty, the arithmetic mean, is the correct one for estimating discount rates and the cost of capital

Q. CAN YOU ILLUSTRATE WHY THE ARITHMETIC MEAN IS A SUPERIOR MEASURE OF INVESTOR EXPECTED RETURN THAN THE GEOMETRIC MEAN BY MEANS OF A NUMERICAL EXAMPLE?

A. Yes. As shown in the table below, consider[1] a stock that will either double in value (return = 100%) with a probability of 0.5, or halve in value (return = -50%) with probability of 0.5

Outcome	Final value Of $1 invested	1-yr return
Double	$2.00	100%
Halve	$0.50	-50%

Suppose that the stock's performance over a two-year period is representative of the probability distribution, doubling in one year (r_1 = 100%) and halving in the next (r_2 = -50%). The stock's price ends up exactly where it started, and the geometric average annual return over the two-year period, r_g, is zero:

$$1 + r_g = [(1 + r_1)(1 + r_2)]^{1/2}$$

$$= [(1 + 1)(1 - 50)]^{1/2} = 1$$

$$r_g = 0$$

confirming that a zero year-by-year return would have replicated the total return earned on the stock The expected annual future rate of return on the stock is not zero, however. It is the arithmetic average of 100% and -50%, (100-50)/2 = 25% There are two equally likely outcomes per dollar invested: either a gain of $1 when r = 100% or a loss of $0 50 when r = -50%. The expected profit is ($1-

$.50)/2 = $ 25 for a 25% expected rate of return. The profit in the good year more than offsets the loss in the bad year, despite the fact that the geometric return is zero The arithmetic average return thus provides the best guide to expected future returns, as shown in Exhibit RAMREB-2 from Chapter 11 of my book, Regulatory Finance.

Q. IS DR. BROWN'S ESTIMATE OF THE HISTORICAL MARKET RISK PREMIUM UP TO DATE?

A. No, it is not. The Ibbotson Associates *Stocks, Bonds, Bills, and Inflation 2003 Yearbook* reports a market risk premium of 6.41% as discussed above. It is not clear to me as to why Dr. Brown did not use the more recent and up to date 2004 edition of the Ibbotson Yearbook The current edition reports a market risk premium of 6.7% versus Dr Brown's 6.4% Using the current edition of the Ibbotson Yearbook instead of the stale version employed by Dr. Brown raises the market risk premium by 30 basis points (6.7% versus 6.4%) and the CAPM return on equity estimate by almost 25 basis points (the difference between 6.7% and 6.4% times a beta estimate of 0.75)

10. CAPM: BETA ESTIMATES

Q. WHAT BETA ESTIMATES DOES DR. BROWN RELY UPON IN HIS CAPM ANALYSIS?

A. Dr. Brown relies on self crafted beta estimates and also on Yahoo, AOL, and Lycos estimates displayed on Schedule 28 of his testimony. Dr. Brown spends a considerable amount of time denouncing Value Line's beta estimates, and

[1] The following illustration is adapted from Bodie, Kane, and Marcus, Investments, McGraw Hill, 5th Edition, Chapter 24

devotes some ten pages of his testimony to that issue. This section of his testimony is reminiscent of his virulent and unjustified attacks on Value Line's growth estimates discussed earlier In a nutshell, Dr Brown finds Value Line's beta estimates of 0 75 for natural gas utility stocks too high for his liking. His distaste for Value Line betas is grounded on Value Line's usage of so-called "adjusted betas" versus unadjusted, or "raw," betas. Dr. Brown argues for the latter and condemns the use of adjusted betas.

To add more fuel (smoke?) to the fire, Dr. Brown compares Value Line betas to his own estimates and concludes that Value Line estimates far exceed his own and therefore must be wrong He further argues that Value Line betas are not standard practice and should be rejected. I disagree entirely with Dr. Brown discussion of beta estimates for reasons discussed below. Dr. Brown's beta estimates of nearly zero are preposterous and imply that natural gas utility stocks are risk-free These estimates should be totally rejected.

Q. ARE RAW BETAS APPROPRIATE FOR USE IN THE CAPM?

A. No, they are not. The unadjusted raw betas computed by Dr. Brown and reported by some commercial services are inappropriate to use in a CAPM analysis, while adjusted betas are appropriate. Current stock prices reflect expected risk, that is, expected beta, rather than historical risk or historical beta. Historical betas, whether raw or adjusted, are only surrogates for expected beta. The best of the two surrogates is adjusted beta. This is why Value Line and other well-known investment information services used by institutional investors such as Bloomberg and Merrill Lynch report adjusted betas. Dr Brown should have employed adjusted betas rather than raw betas for three reasons: (1) the use of adjusted betas is consistent with both the empirical and academic finance literature on the subject, as discussed below; (2) adjusted betas from commercial sources are in fact used by the majority of practitioners and finance professionals In other words, investors are most likely to rely on such widely available betas, and are very unlikely to manufacture betas in making investment decisions or rely on the unconventional betas of the sort estimated by Dr. Brown; (3) the betas implied by regulators' allowed ROE decisions are certainly consistent with the use of adjusted betas. I shall now discuss each of these issues in turn

Q. WHAT DOES THE FINANCE LITERATURE HAVE TO SAY ON THE APPROPRIATE BETA MEASURE?

A. The recommended use of adjusted betas is widespread in mainstream investment and corporate finance textbooks. See for example:

Brigham, E.F. and Gapenski, L.C , Financial Management: Theory and Practice, 8th ed., Dryden Press, 2002, Chapter 7, page 268.

Damodaran, A., Investment Valuation, Wiley Finance, 2001, pages 186-7.

Damodaran, A., Corporate Finance: Theory and Practice, 2nd ed., Wiley Finance, 2001.

Numerous studies have considered the question of beta measurement and generally reached similar conclusions The betas tended to regress toward the mean; high-beta portfolios tended to decline over time toward unity, while low-beta portfolios tended to increase over time toward unity. True betas not only vary over time but have a tendency to move back toward average levels.

Statistically, betas are estimated with error Therefore, high estimated betas will tend to have positive error (overestimated) and low estimated betas will tend to have negative error (underestimated). Therefore, it is necessary to squash the estimated betas in towards 1.00. One way to do this is by the use of adjusted betas, which is commonly performed by investment services such as Value Line, Bloomberg, and Merrill Lynch.

Well-known college-level finance textbooks routinely discuss the use of adjusted betas, as illustrated above Adjusted betas are routinely provided by investment services such as Value Line, the most widely circulated source of investment information to investors, Merrill Lynch, Ibbotson Associates, and Bloomberg. In accordance with this approach and with the empirical literature which strongly supports this procedure, the same beta adjustment procedures are in order Commercial betas computed by various investment services give 2/3 weight to the measured raw beta and 1/3 weight to the prior value of 1.0 for each stock. This widely-used formula essentially pushes high betas down toward 1.0 and low betas up toward 1.0 These orthodox beta adjustment procedures are not only widely performed by investment services but are routinely accepted and used by regulators.

Q. WHAT DOES THE EMPIRICAL FINANCE LITERARURE HAVE TO SAY ABOUT ADJUSTED VERSUS RAW BETAS?

A. With respect to the relevant empirical evidence, Blume ("On the Assessment of Risk", Journal of Finance, March 1971) examined the stability of beta for all common stocks listed on the NYSE, and found a tendency for a regression of the betas toward 1.00. Blume demonstrated that the Value Line adjustment procedure anticipates differences between past and future betas. Chen ("Beta Nonstationarity, Portfolio Residual Risk, and Diversification", Journal of Financial and Quantitative Analysis, March 1981) also analyzed the variability of beta and suggested employing the Bayesian adjustment approach employed by beta producers (Merrill Lynch, Value Line) to estimate time-varying betas.

As far as the time-series behavior of utility betas is concerned, a comprehensive study of utility beta measurement methodology by Kryzanowski and Jalilvand, "Statistical Tests of the Accuracy of Alternative Forecasts. Some Results for U S. Utility Betas," The Financial Review, Fall 1983, concludes that raw unadjusted beta of the type used by Dr. Brown is one of the poorest beta predictors, and is outperformed by the Value Line – Bloomberg - Merrill Lynch Bayesian beta approach. In other words, the beta adjustment procedure used by investment services gives far better predictions than the unadjusted figures. I note that the Ibbotson Associates 2003 Yearbook, the same publication on which Dr. Brown relies elsewhere in his testimony, also uses adjusted betas, as developed by Vasicek, and that the Vasicek adjusted betas are nearly identical to the Value Line adjusted betas, the latter being a special case of the Vasicek adjustment.

As a practical matter, a rational investor is much more likely to rely on widely disseminated commercially-available beta estimates in making investment decisions such as those provided by Value Line and Bloomberg rather than rely on homemade or relatively unknown estimates such as the beta estimates used by Dr Brown.

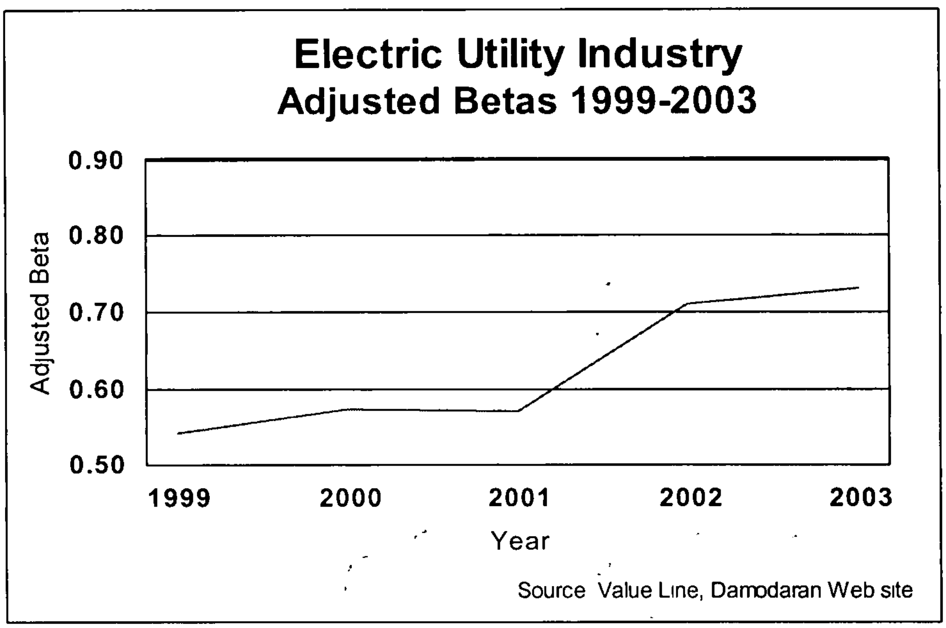
Dr. Brown cites an excerpt from Grinblatt & Titman finance textbook to defend his use of adjusting betas toward their industry averages rather than one. While this may make sense for a stable industry with an unchanging risk pattern, the idea of adjusting beta toward the industry average for an industry in a state of flux and which is experiencing rising risks is unreasonable. Clearly, the historical beta of the energy utility industry is a downward-biased measure of the current beta risk of the industry. Perhaps, Dr. Brown should have heeded Professor William Sharpe's advice in his best-selling investment textbook.

> *"...the adjusted betas are closer in magnitude to the subsequent historical betas than are the unadjusted betas. This suggests that the adjusted historical beta is a more accurate estimate of the future beta than the unadjusted historical beta." (Sharpe, W., Investments, Prentice Hall, 5th ed., N. J., 1995, page 530)*

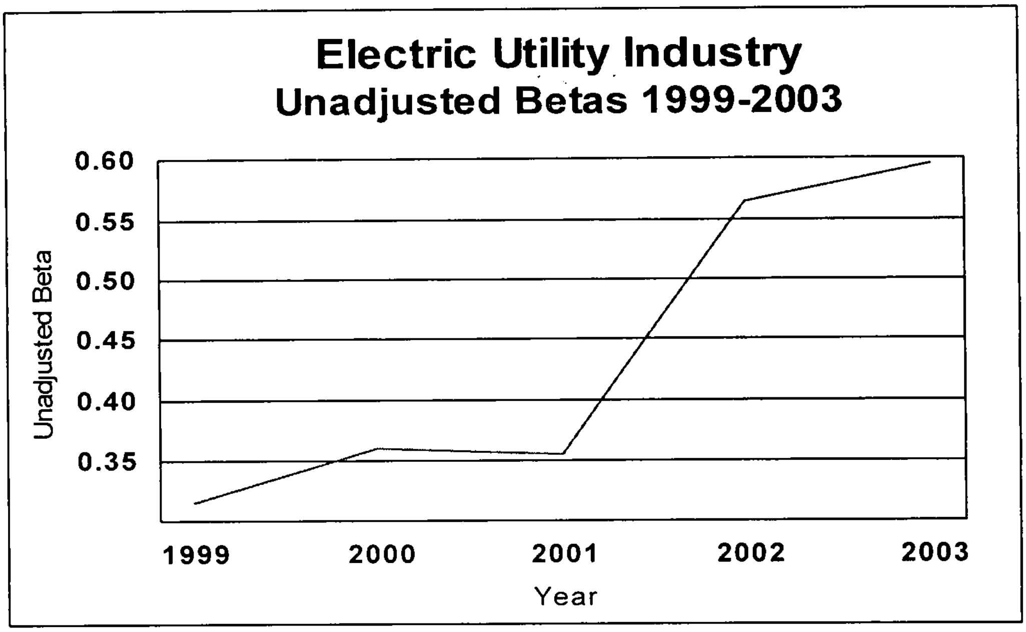
The belief that the empirical studies supporting the use of adjusted betas were not performed exclusively on utility stocks and, therefore, inapplicable to utility companies is premised on a study by Gombola and Kahl ("Time-Series Processes of Utility Betas: Implications for Forecasting Systematic Risk," Financial Management, Autumn 1990) who showed that there is indeed a tendency of betas to regress towards their mean value for individual stocks. But based on their analysis of utility stocks, the Gombola & Kahl results suggest a regression tendency for utility betas to regress toward their grand utility mean and not toward the grand average of 1.0

The difficulty with this argument is that the risks of utility stocks have escalated substantially after the period of study used in these studies because of restructuring, deregulation, and rising competition and, therefore, the true utility betas have escalated toward 1.0, as I show below.

This hypothesis can be verified as follows. To see whether utility raw betas tend toward the market average of 1.00 or toward the industry average, Professor Damodaran's (New York University, Stern School of Business) extensive Web site reports the following Value Line beta estimates for the electric utility industry over the past five years, shown in graphical form. The same is presumably true for natural gas distribution utility betas.



The betas shown in the graph are adjusted betas in keeping with investment practices and in keeping with the academic literature on the subject. As noted earlier, adjusted betas reported by *Value Line* give 2/3 weight to the "raw" or calculated beta and 1/3 weight to the market beta of 1.0[2]. Running the process in reverse, the implied raw betas can be calculated and they are shown in the graph below.



The strong upward escalating trend is clear from the graph, showing a steady uninterrupted ascent of raw betas, rather than convergence toward some industry level. Hence, the need to employ adjusted betas as does the majority of commercial beta services and presumabley the majority of investors.

Q. WHAT DO REGULATORY DECISIONS IMPLY AS TO THE APPROPRIATE MEASURE OF BETA?

A. I examined the betas implicit in regulatory ROE decisions to see whether they were consistent with raw betas or adjusted betas The CAPM framework can be used to quantify the beta implicit in the allowed risk premiums for regulated

[2] The standard definition of Adjusted Beta used by Value Line is as follows

utilities. According to the CAPM, the risk premium is equal to beta times the market risk premium:

$$\text{Risk Premium} = \beta (R_M - R_F)$$

Solving for beta, we obtain:

$$\beta = \text{Risk Premium} / (R_M - R_F)$$

I examined the betas implied in hundreds of regulatory decisions for utilities in the United States over the period 1995-2004. Inserting the allowed average risk premium of 5 3% in several hundred decisions over the last decade and a market risk premium of 7.0% in the above equation, the implied beta is 0.75. Using a market risk premium of 6 5%, the implied beta is 0.81. These implied regulatory betas are virtually identical to the adjusted beta estimates reported by Value Line for electric and gas utilities and are clearly inconsistent with raw beta estimates and totally at odds with Dr. Brown's beta estimates that are close to zero

Q. DR. MORIN, CAN YOU PROVIDE ADDITIONAL EVIDENCE AS TO THE SUPERIORITY OF ADJUSTED BETAS?

A. Yes. From the preceding discussion, it is quite clear that reliance on adjusted betas – widely used in the financial community – provides a more accurate perspective of the utility risk/return relationship than the raw unadjusted beta. To further confirm Value Line's beta estimate of 0.75, I have examined another measure of risk, namely, relative standard deviations of market returns, which measures total market risk (both diversifiable and non-diversifiable) rather than

Adjusted Beta = 0 3333 + 0 6666 x Raw Beta just non-diversifiable market risk. The average standard deviation of returns of utility companies relative to the standard deviation of the overall aggregate market is 0.75, the same as Value Line's beta estimate, confirming its reasonableness.

Q. WHAT DO DR. BROWN'S BETA ESTIMATES IMPLY ABOUT THE RISK OF UTILITY STOCKS?

A. Dr. Brown's beta estimates shown on the next to last column of his Schedule 28 are virtually zero, implying that natural gas utility stocks are risk-free instruments. Several estimates are even negative, implying that some natural gas stocks should be attributed a return less than the risk-free rate. This is nonsense, unimaginable, and should be rejected by the TRA.

Q. DOES DR. BROWN OFFER ANY EVIDENCE TO SUPPORT HIS USAGE OF RAW BETAS?

A Yes, he does To support his use of raw betas, Dr. Brown cites an obscure consultant report commissioned by the Australian government in 2002, prepared by the Allen Consulting Group in Australia That particular study recommended the use of raw beta estimates, according to Dr. Brown. Dr. Brown does not tell us whether the Australian regulatory authorities endorsed and implemented the findings of that report. In fact, Australian regulators do not subscribe to either that particular consultant's viewpoint or to Dr Brown's notion of raw betas.

The following table reports the betas for Australian utilities actually used by Australian regulators. These estimates are a far cry from Dr. Brown's near-zero beta estimates, and are in the 0.80 – 1 00 range for T&D electric utilities, nearly identical to the Value Line estimates for U S. utilities.

Equity Betas in Regulatory Decisions on Electricity Networks

Determination & Date	Regulator	Equity Beta
NSW electricity DNSPs, 12/1999	IPART	0.77 - 1.14
Transgrid, 1/2000	ACCC	0.78 - 1.24
Victorian electricity distribution 9/2000	ESC	1.00
SMHEA transmission, 2/2001	ACCC	0.75 - 1.24
Qld electricity distribution 5/2001	QCA	0.71
Powerlink, 10/2001	ACCC	1.00
ElectraNet, 12/2002	ACCC	1.00
SPI PowerNet 12/2002	ACCC	1.00

Source KPMG, "The Appropriate Weighted average cost of capital for the electricity distribution network", Table 11, submitted to IPART, March 2003

Q. WHAT BETAS DID THE CONSULTANT REPORT REFERENCED BY DR. BROWN ACTUALLY USE?

A. The report prepared by the Allen Consulting Group for the ACCC on betas for regulated gas transmission activities cited by Dr. Brown in fact recommends the use of adjusted betas sourced from Bloomberg, and not the raw betas championed by Dr. Brown. It appears that Dr. Brown's own reference actually contradicts his position and supports the use of adjusted betas a la Value Line and Bloomberg

Q. DR. MORIN, WHAT DO YOU CONCLUDE FROM DR. BROWN'S BETA ESTIMATES IN HIS CAPM ANALYSIS?

A. Dr. Brown's erroneous beta estimates should be completely disregarded. Value Line beta estimates provide far superior proxies for beta in the CAPM and are relied upon by investors

11. CAPM AND THE EMPIRICAL CAPM

Q. DO YOU AGREE WITH DR. BROWN'S USE OF THE RAW FORM OF THE CAPM TO ESTIMATE THE COST OF CAPITAL?

A. No, I do not I believe that the plain vanilla version of the CAPM should be supplemented by the more refined version of the CAPM. There have been countless empirical tests of the CAPM to determine to what extent security returns and betas are related in the manner predicted by the CAPM. The results of the tests support the idea that beta is related to security returns, that the risk-return tradeoff is positive, and that the relationship is linear. The contradictory finding is that the risk-return tradeoff is not as steeply sloped as the predicted CAPM. That is, low-beta securities earn returns somewhat higher than the CAPM would predict, and high-beta securities earn less than predicted. Dr. Brown ignores completely this important financial literature which reports one of the most well-known results in finance[3] A CAPM-based estimate of the return on capital underestimates the return required from low-beta securities and overstates the return from high-beta securities, based on the empirical evidence.

The downward-bias is particularly significant for low-beta securities, such as the natural gas utilities used by Dr Brown in his comparison group. Dr. Brown's CAPM estimates of required equity returns are understated by about 50 basis points as a result of this bias alone.

Q. WHAT DOES DR. BROWN HAVE TO SAY ABOUT THE ECAPM APPROACH?

A. Very little, actually. On page 107 of his testimony, Dr. Brown claims that I have not explained the reasoning behind the ECAPM. I guess Dr. Brown failed to read Appendix A of my testimony devoted entirely to the conceptual and empirical background underlying the ECAPM. Dr. Brown further argues that I did not provide a copy of Chapter 13 of my book, Regulatory Finance, that deals with the ECAPM. Attached is a copy of Chapter 13 of my book, Exhibit RAMREB-4

13. MISCELLANEOUS ERRORS

Q. WHAT IS DR. BROWN'S UNDERSTANDING OF "DOUBLE LEVERAGE?"

A. On page 46 of his testimony, Dr Brown raises the notion of "double leverage" which he defines as "*setting the subsidiary's utility rates by determining the parent's equity cost and debt cost, and then use that total capital cost as the subsidiary's capital cost.*"

Double Leverage

Q. IS DR. BROWN'S DEFINITION OF DOUBLE LEVERAGE CORRECT?

A. No, Dr Brown's understanding of double leverage is wrong. Under the double leverage approach, the operating subsidiary company's equity capital is traced to its source, namely the parent's debt and equity capital. The cost of equity to the operating subsidiary is then the overall weighted average of capital to the parent, since the equity capital is said to have been raised by the parent through a mixture of debt and equity. The parent's composite capital cost is imputed to the subsidiary's equity, and not as Dr. Brown contends, to the subsidiary's total capital cost.

Dr. Brown has resurrected the double leverage approach from the dead in

[3] See Chapter 13 of Dr Morin's book, Regulatory Finance, for a summary of this literature

regulatory finance. This approach has been largely abandoned in view of its serious conceptual and practical limitations and violations of basic notions of finance, economics, and fairness. The assumptions which underlie its use are questionable, if not unrealistic. I direct the Authority's attention to Chapter 20 of my book, Regulatory Finance, for a complete discussion of the ill-fated double leverage approach, attached as Exhibit RAMREB-3. The double leverage approach should not be used in regulatory proceedings and is not currently being used to the best of my knowledge.

Comparable Groups

Q. DO YOU AGREE WITH DR. BROWN ON THE ISSUE OF COMPARABLE GROUPS?

A. Yes, in part. We both define a virtually identical group of natural gas distribution utilities with some minor differences. However, Dr. Brown disagrees with my group of combination gas & electric utilities as proxies for CGC and dismisses its comparability I disagree. Given the Company's relatively small size, it is reasonable to postulate that the Company's natural gas distribution business possesses an investment risk profile that is at least as risky as investment-grade combination gas and electric utilities. The latter possess economic characteristics similar to those of natural gas distribution utilities, notwithstanding their larger size. They are both involved in the distribution of energy services products at regulated rates in a cyclical and weather-sensitive market. They both employ a capital-intensive network with similar physical characteristics. They are both subject to rate of return regulation. They have both been granted virtually identical rates of return of common equity by regulators in the last decade, further attesting to their risk comparability.

Realized versus Expected Returns

Q. IS DR. BROWN'S REASONABLENESS CHECK ON HIS ROE RECOMMENDATION VALID?

A. No, it is not On page 92 of his testimony, Dr Brown attempts to justify his anemic ROE recommendation of 8.35% by pointing to the realized returns of a large sample of companies in 2004. Had Dr. Brown performed this calculation over a long time period, say over a full business cycle, Dr. Brown's procedure would have some merit. The danger with relying on realized returns measured over a very short time period, in this instance one year, involves the distinction between expected and realized return Realized returns can be substantially different from prospective returns anticipated by investors especially over short time periods, and therefore constitute a hazardous benchmark on which to assess the reasonableness of his ROE recommendation. Dr. Brown should have ignored the realized returns measured over one single year, since they are heavily dependent on short term market movements. He should have relied instead on the long-term results, since the time periods to which the term relates, are long enough to smooth out short-term aberrations, and to encompass several business and interest rate cycles Only over such long periods do investor expectations and realizations converge. In short, Dr Brown's reasonableness check should be ignored.

Stand-Alone Approach

Q. WHAT IS DR. BROWN'S POSITION ON THE STAND-ALONE APPROACH?

A. It is hard to say. On pages 29 and 33 of his testimony, Dr. Brown objects to the so-called stand-alone, or independent company, approach to establishing a fair and reasonable return He describes the stand-alone company approach as somehow granting the parent company a markup I am confused by Dr. Brown's evasive discussion of this issue for he himself develops his return recommendation for CGC based on a set of comparable companies as proxies for CGC, in effect using the stand alone approach.

In any event, I feel compelled to reiterate that the correct approach to determining a subsidiary's cost of capital is the Stand Alone approach. Under this approach, the subsidiary is viewed as an independent operating company, and its cost of equity is inferred as the cost of equity of comparable risk firms. The methodology rests on the basic premise that the required return on an investment depends on its risk, rather than on the parent's financing costs. The identity of the shareholders is immaterial in determining the equity return. The equity return reflects the risk to which the equity capital is exposed and the opportunity return foregone by the company's shareholders in investments of similar risk.

Q. WHAT IS THE EFFECT OF AGL RESOURCES ON CGC'S COST OF CAPITAL?

A. It is beneficial, contrary to Dr. Brown's insinuations on pages 29-33 of his testimony. To the extent that capital markets are not perfect and that individual investors are not perfectly diversified, a larger and more diversified parent company like AGL Resources will enjoy greater diversification than its individual operating activities on a stand-alone basis. Under such a circumstance, it is plausible that the weighted sum of the individual cost of capital rates will exceed the consolidated company cost of capital In effect, risks are pooled, so the risk of the whole is less than the sum of the risks of the parts because of diversification Financial theory clearly states that portfolio diversification reduces risk for a given return if the components of the portfolio are less than perfectly correlated The diversified parent company arrangement may improve earnings and reduce risk, and the cost of capital for individual entities in the group may be reduced by diversification. Therefore, to the extent that investors in utility securities are less than perfectly diversified, diversification activities by the parent reduce investor risk and the cost of capital.

The diversification activities of a diversified parent also reduce risk through a co-insurance effect stemming from its subsidiary activities. If the cash flows of individual operating units are less than perfectly correlated, the probability of default is reduced by their consolidation under one roof. To the extent that this co-insurance effect exists, the cost of debt is impacted directly and favorably. CGC's ratepayers enjoy the benefits of AGL Resources' financial strength and lower cost of capital compared to what CGC's financial strength and cost of capital would be on a stand-alone basis Given its smaller size, CGC would not enjoy the same creditworthiness and financial solidity as AGL Resources as a whole.

Allowed Returns

Q. WHAT IS DR. BROWN'S POSITION ON THE ROLE OF ALLOWED RETURNS?

A Dr Brown's position, expressed on pages 84-85 of his testimony, is to disregard returns allowed by regulators, even though investors do take into account returns granted by various regulators in formulating their risk and return expectations Dr. Brown's rejection of regulatory ROE awards is undeserved.

Dr Brown's only objection to my Allowed Risk Premiums approach is that I have not made available the names of the companies, docket numbers, and various facts from the hundreds of regulatory decisions that I have examined. The source document is the well-known quarterly publication by Regulatory Research Associates, entitled "*Regulatory Focus*", and contains a comprehensive quarter-to-quarter survey of ROE decisions by regulators for gas and electric utilities I suspect that Dr. Brown's rejection of regulatory awards has more to do with the ROE results produced by that particular methodology than it does with the availability of supportive documentation.

Q. DOES DR. BROWN SUBSCRIBE TO THE RISK PREMIUM APPROACH?

A. No, he does not. On page 85 of his testimony, Dr. Brown qualifies the Historical Risk Premium approach as "not standard" He is plainly wrong. The Risk Premium approach is a standard method of gauging investor expected returns discussed in most college-level corporate finance textbooks. Again, I am struck by the fact that Dr. Brown rejects well established theories of corporate finance and the standard Risk Premium approach.

Dr. Brown's other objection to my Risk Premium approach is that it is based on Moody's Natural Gas Index "with unknown members". The identities of the companies that make up the Moody's Natural Gas Index are well-known. Incidentally, most if not all the companies that make up the index appear in Dr. Brown's own group of comparable companies.

CONCLUSIONS

Q. WHAT DO YOU CONCLUDE FROM DR. BROWN'S RATE OF RETURN TESTIMONY?

A. My conclusions are as follows:

1) Dr. Brown's recommended 8.35% ROE for CGC lies completely outside the zone of reasonableness and well outside the zone of currently authorized rates of return for natural gas and electric utilities in the United States. Dr. Brown's draconian cost of equity recommendation of only 8.35%, if ever adopted, would result in the lowest rate of return award for a natural gas distribution or electric utility in the country.

2) Dr. Brown seriously grossly understates CGC's required return on common equity. Dr. Brown's testimony is highly irregular and faulty, replete with errors, confusions, unfounded statements and accusations, and logical contradictions.

3) Dr Brown's dividend yield component in his DCF analysis is understated by approximately 30 basis points because it does not allow for flotation costs, and a legitimate stockholder expense is left unrecovered

4) Dr. Brown's DCF formulation understates the required return on common equity capital because he has misspecified the DCF model. Use of the proper DCF functional form raises his estimate by approximately 30 basis points.

5) Dr. Brown's dividend yield component is understated by 20 basis points because it ignores the time value of quarterly dividend payments.

6) Dr. Brown's denunciation of Value Line information as inaccurate, biased, unreliable, unworthy, and is unwarranted.

7) Dr. Brown's CAPM formulation is plain wrong, misspecified, and contains a logical inconsistency

8) Dr Brown's CAPM results are improper because, among other reasons, his proxy for the risk-free rate is inappropriate. The correct proxy for the risk-free rate in the CAPM is the return on long-term Treasury bonds, and not the yield on short-term 90-day U.S. Treasury Bills or the yield on corporate bonds.

9) Dr. Brown's unconventional version of the CAPM appears nowhere in the finance literature, much less in regulatory proceedings, and is replete with errors.

10) Dr. Brown's CAPM estimate is downward-biased by a total of 190 basis points because a) it relies on geometric averages of historical returns instead of arithmetic averages, understating the cost of equity by 165 basis points, and b) it is stale and understates the cost of equity by 25 basis points.

11) Dr. Brown's beta estimates are preposterous, for they imply that the common stocks of natural gas utilities are risk-free. His use of his self produced raw

betas instead of the conventional adjusted betas seriously understate his findings and recommendation.

12) The plain vanilla version of the CAPM used by Dr. Brown understates the Company's required return on equity by another 50 basis points.

13) Dr. Brown's views on the historical risk premium approach are unconventional, unsupported, and wrong.

14) Dr. Brown espouses unconventional views on a variety of financial issues throughout his testimony. For example, a) his view that common stock is not a long-term investment, b) his confounding of the expected dividend yield and compounding in the DCF model, c) his mistaken definition of double leverage, d) his view on the negative benefits of diversification, e) his misunderstanding of the distinction between actual realized and expected returns, and f) his perplexing use of two widely different risk-free rates in the same model

15) Dr Brown's analysis of the cost of capital is flawed and should be disregarded

Q. DOES THIS CONCLUDE YOUR REBUTTAL TESTIMONY?

A Yes, it does

Assumption #2. The discount rate, *K*, must exceed the growth rate, *g*. In other words, the standard DCF model does not apply to growth stocks. In Equation 4-7, it is clear that as *g* approaches *K*, the denominator gets progressively smaller, and the price of the stock infinitely large. If *g* exceeds *K*, the price becomes negative, an implausible situation. In the derivation of the standard DCF equation (4-7) from the general stock valuation equation (4-5), it was necessary to assume *g* less than *K* in order for the series of terms to converge toward a finite number. With this assumption, the present value of steadily growing dividends becomes smaller as the discounting effect of *K* in the denominator more than offsets the effect of such growth in the numerator.

This assumption is realistic for most public utilities. Investors require a return commensurate with the amount of risk assumed, and this return likely exceeds the expected growth rate in dividends for most public utilities. Although it is possible that a firm could sustain very high growth rates for a few years, no firm could double or triple its earnings and dividends indefinitely.

Assumption #3. The dividend growth rate is constant in every year to infinity. This assumption is not as problematic as it appears. It is not necessary that *g* be constant year after year to make the model valid. The growth rate may vary randomly around some average expected value. Random variations around trend are perfectly acceptable, as long as the mean expected growth is constant. The growth rate must be "expectationally constant," to use formal statistical jargon. This assumption greatly simplifies the model without detracting from its usefulness.

If investors expect growth patterns to prevail in the future other than constant infinite growth, more complex DCF models are available For example, investors may expect dividends to grow at a relatively modest pace for the first 5 years and to resume a higher normal steady-state course thereafter, or conversely. The general valuation framework of Equation 4-5 can handle such situations. The "non-constant growth" model presented later in the chapter is an example of such a model

It should be pointed out that the standard DCF model does not require infinite holding periods to remain valid It simply assumes that the stock will be yielding the same rate of return at the time of sale as it is currently yielding

EXAMPLE 4-2

To illustrate this point, consider a 3-year holding period in the previous numerical example. If both price and dividend grow at the 4% expected rate, dividends for each of the next 3 years are $1.68,

$1.75, and $1.82, respectively, and the price at the end of the third year is $\$13\ (1 + .04)^3 = \$14.62$. If the investor sells the stock at the end of the third year, the return expected by the investor is still 17%, because the present value of the dividend stream and the stock price at resale is exactly equal to the current purchase price:

$$P_0 = \frac{1.68}{1.17} + \frac{1.75}{1.17^2} + \frac{1.82}{1.17^3} + \frac{14.62}{1.17^3}$$

$$= \$13$$

This will be true for any length of holding period. The main result of the DCF model does not depend on the value of n.

Another way of stating this assumption is that the DCF model assumes that market price grows at the same rate as dividends. Although g has been specified in the model to be the expected rate of growth in dividends, it is also implicitly the expected rate of increase in stock price (expected capital gain) as well as the expected growth rate in earnings per share. This can be seen from Equation 4-7, which in period 1 would give:

$$P_1 = D_2/(K - g)$$

but $\quad D_2 = D_1\ (1 + g)$, and $P_0 = D_1/(k - g)$

so that $\quad P_1 = D_1\ (1 + g)/(K - g) = P_0\ (1 + g)$

Hence, g is the expected growth in stock price. Similarly, if a fixed fraction of earnings are distributed in dividends, then:

$$D_1 = aE_1$$

$$D_2 = aE_2$$

where a is the constant payout ratio and E the earnings per share. Since $D_2 = D_1\ (1 + g)$, we also have $E_2 = E_1\ (1 + g)$ and, hence, g is the expected growth in earnings per share.

Still another way to express the idea that the validity of the standard DCF model does not depend on the value of the investor's holding period is to say that investors expect the ratio of market price to dividends (or earnings) in year n, P_n/D_n, to be the same as the current price/dividend ratio, P_0/D_0. This must be true if the infinite growth assumption is made. Investors will only expect $(P/E)_n$ to differ from $(P/E)_0$ if they believe that the growth following year n will differ from the growth expected before year n, since the price in year n is the present value of all subsequent dividends from $n + 1$ to infinity.

The constancy of the price/earnings (P/E) assumption is not prohibitive to DCF usage. If there is reason to believe that stock price will grow at a different rate than dividends, for example, if the stock price is expected to converge to book value, a slightly more complex model is warranted. Such a model is presented in section 4.6.

Assumption #4. Investors require the same return K every year. The assumption of a flat yield curve was alluded to earlier, but requires elaboration. A firm's cost of capital, K, varies directly with the risk of the firm. By assuming the constancy of K, the model abstracts from the effects of a change in risk on the value of the firm. If K is to remain constant, the firm's capital structure policy and dividend payout policy must be assumed to remain stable so as to neutralize any effect of capital structure changes or dividend policy changes on K.

The assumption of a constant dividend payout policy not only simplifies the mathematics but also insulates the model from any effects of dividend policy on risk, if any, and hence on K. Besides, this assumption was indirectly stated earlier; a constant dividend policy implies that dividends and earnings grow at the same rate. The assumption of constant dividend payout is realistic. Most firms, including utilities, tend to maintain a fixed payout rate when it is averaged over several years.

The simplification of a constant capital structure may be acceptable if the utility exhibits a near constant debt-equity ratio over time and is expected to do so in the future.

Assumption #5. The standard DCF model assumes no external financing. All financing is assumed to be conducted by the retention of earnings. No new equity issues are used or, if they are, they are neutral in effect with respect to existing shareholders The latter neutrality occurs if the market-to-book ratio is 1. Without this assumption, the per share dividends could be watered down by a new stock issue, violating the constant growth assumption. A more comprehensive model allowing for external stock financing is presented in a later section.

4.4 The Determinants of Dividend Growth

It is instructive to describe the factors that cause growth in dividends to occur and to disaggregate the g term in the standard DCF model into its contributory elements

The "retention ratio" is defined as the percentage of earnings retained by the firm for reinvestment. The fraction of earnings not ploughed back into the firm's asset base is paid out as dividends, and is referred to as the "dividend payout ratio." Under the DCF assumption of no external financing, if a firm is expected to retain a fraction *b* of its earnings and expected to earn a book return of *r* on common equity investments, then its earnings, dividends, book value, and market price will all grow at the rate *br* In short, a firm's sustainable dividend growth rate is its expected return on book equity times its retention ratio if all incremental equity investments are financed by the ploughback of earnings.

The relationship between a utility's book return on equity, retention ratio, payout ratio, book value, and dividend growth rate can best be understood by reference to the following numerical illustration.

Table 4-1 shows a firm earning a 10% book return on an initial equity capital base of $100. Its dividend policy consists of paying out 50% of its earnings in dividends, and retaining 50% of earnings for reinvestment. Earnings on an initial capital base of $100 are thus $10, from which $5 are paid in dividends, and $5 are retained and added back to the initial equity base of $100. An equity base of $105 is carried forward to the second year. Repeating the cycle in the second year, earnings are $10.50, or 10% on equity, $5.25 are paid out in dividends, and 50%, or $5.25, are reinvested, bringing the equity base to $110 25 in the third year. The process continues in an identical manner in each subsequent year. The stock price is shown in the last column at an arbitrarily assumed price/earnings multiple of 10 times earnings, in keeping with the DCF assumption of a constant price/earnings ratio. Note that if the book return on equity, *r*, and the retention ratio, *b*, remain constant, the dividends per share grow by *r* times *b*, or .10 x .50 = 5% per year. The book value of equity, earnings, and stock price also grow at the same rate of 5%

TABLE 4-1
THE DETERMINANTS OF DIVIDEND GROWTH

Year	Equity Base	Earnings	Dividends	Retained Earnings	Stock Price
1	$100.00	$10.00	$5.00	$5 00	$100 00
2	105.00	10 50	5.25	5 25	105 00
3	110.25	11.02	5 51	5 51	110 25
4	115.76	11.58	5 79	5.79	115.76
	etc.	etc.	etc	etc	etc
	g=5%	g=5%	g=5%	g=5%	g=5%

Appendix 11-A
Comparison of the Use of Arithmetic and Geometric Means in Estimating the Cost of Capital

This appendix shows why arithmetic rather than geometric means should be used for forecasting, discounting, and estimating the cost of capital Similar treatments and demonstrations are available from Brealey and Myers (1991), Ibbotson Associates (1993), and Litzenberger (1984) This appendix draws from the three aforementioned sources, particularly the latter.

By definition, the cost of equity capital is the annual discount rate that equates the discounted value of expected future cash flows (from dividends and the sale of the stock at the end of the investor's investment horizon) to the current market price of a share in the firm The discount rate that equates the discounted value of future expected dividends and the end of period expected stock price to the current stock price is a prospective arithmetic, rather than a prospective geometric mean rate of return. Since future dividends and stock prices cannot be predicted with certainty, the "expected" annual rate of return that investors require is an average "target" percentage rate around which the actual, year-by-year returns will vary. This target rate is, in effect, an arithmetic average.

A numerical illustration adapted from Litzenberger (1984) will clarify this important point. Consider a non-dividend paying stock trading for $100 which has, in every year, an equal chance of appreciating by 20% or declining by 10%. Thus, after one year, there is an equal chance that the stock's price will be $120 and an equal chance the price will be $90. Figure 11A-1 presents all possible eventualities after two periods have elapsed (the rates of return are presented at the end of the lines in the diagram).

The possible stock prices are shown in the following table.

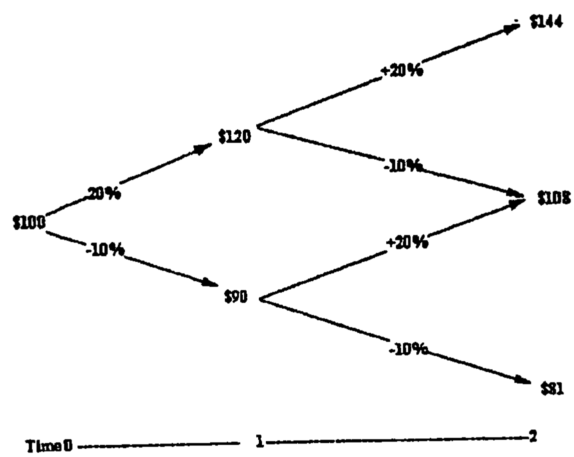
TABLE 11A-1
STOCK PRICES AFTER TWO PERIODS

Price	Chance
$144	1 chance in 4
$108	2 chances in 4
$ 81	1 chance in 4

The expected future stock price after two periods is then:

$$1/4\,(\$144) + 2/4\,(\$108) + 1/4(\$81) = \$110.25$$

FIGURE 11A-1
POSSIBLE STOCK PRICES



The cost of equity capital is calculated as the discount rate that equates the present value of the future expected cash flows to the current stock price. In the present simple example, the only cash flow is the gain from selling the stock after two periods have elapsed. Thus, using the expected stock price of $110.25 calculated above, the expected rate of return is that r, which solves the following equation.

$$\text{Current Stock Price} = \frac{\text{Expected Stock Price}}{(1+r)^2}$$

The factor $(1+r)^2$ discounts the expected stock price to the present. Substituting the numerical values, we have.

$$\$100 = \frac{\$100\ 25}{(1+r)^2}$$

$$r = 5\%$$

Thus, the cost of equity capital is 5% This 5% cost of equity capital is equal to the prospective arithmetic mean rate of return, which is the probability-weighted average single period rate of return on equity. Since in every period there is an equal chance that the stock's return will be 20% or -10%, the probability-weighted average is:

$$1/2\,(20\%) + 1/2\,(-10\%) = 5\%$$

However, the 5% cost of equity capital is not equal to the prospective geometric mean rate of return, which is a probability-weighted average of the possible compounded rates of return over the two periods. Now consider the prospective geometric mean rate of return. Table 11A-2 shows the possible compounded rates of return over two periods, and the probability of each.

TABLE 11A-2
STOCK PRICES AND RETURNS AFTER TWO PERIODS

Price	Chance	Compounded Return
$144	1 chance in 4	20 00%
$108	2 chances in 4	3 92%
$ 81	1 chance in 4	-10.00%

Thus, the prospective geometric mean rate of return is:

$$1/4\,(20\%) = 2/4\,(3.92\%) + 1/4\,(-10\%) = 4.46\%$$

This return is not equal to the 5% cost of equity capital.

Litzenberger (1984) extended the example to include the case of a dividend-paying company and reached the same conclusion: the implied discount rate calculated in the DCF model is an expected arithmetic rather than an expected geometric mean rate of return.

The foregoing analysis shows that it is erroneous to use a prospective multi-year geometric mean rate of return as a "target" rate of return for each year of the period. If, for example, investors currently require an expected future rate of return on an investment of 13% each year, then 13% is the appropriate annual rate of return on equity for ratemaking purposes. Consequently, in using a risk premium approach for the purposes of rate of return regulation, the single-year annual required rate of return should be estimated using arithmetic mean risk premiums.

Docket No. 04-00034
Rebuttal Testimony
Exhibit RAMREB-3

Chapter 20
Double Leverage

The purpose of this chapter is to critically address the Double Leverage (DL) approach to determining the cost of capital of a regulated utility. The double leverage approach has serious conceptual and practical limitations and is not consistent with basic financial theory and the notion of fairness. The assumptions and logic underlying the method are questionable. The double leverage argument violates the core notion that an investment's required return depends on its particular risks. The chapter concludes that the Double Leverage approach has no place in regulatory practice and should be discarded.

The chapter is divided into two sections. Section 20.1 introduces the basic notion of double leverage and describes the alternative approaches of determining the cost of capital for a subsidiary of a parent corporation. Section 20.2 critiques the double leverage approach at both the conceptual and practical levels.

20.1 Intercorporate Ownership and Double Leverage

Determining the cost of capital for a utility operating company owned by a holding company is a controversial capital structure issue. Intercorporate ownership opens the possibility of leveraging the common equity of one corporate entity at two or even more corporate levels. If a parent corporation issues its own debt and if a wholly-owned subsidiary also builds debt over the base of equity invested by the parent, leveraging takes place twice on the single layer of the parent's publicly-held equity A parent company and a single subsidiary can thus create double leverage; even more extensive leveraging can occur through the existence of parent-subsidiary horizontal and vertical networks of subsidiaries. The situation is common among utilities with clusters of subsidiaries and their parents. The term "double leverage" stems from a situation in which there is initial leverage on the earnings for the operating company's common stock and then additional leverage for the holding company's common stock to the extent that the holding company obtains part of the funds invested in the subsidiary's common stock from debt sources

The issue does not arise for electric and gas companies that are subsidiaries of holding companies because the Public Utility Holding Company Act limits the amount of borrowing these companies may undertake. Telecommunications and water utilities are not governed by this Act, however

Even though the DL approach has largely disappeared from regulatory practice, the method is occasionally encountered in regulatory proceedings involving independent telecommunications and water utility companies

There are two methods of computing the cost of capital under double leverage conditions: the Independent Company, or Stand-Alone, approach, and the Double Leverage approach. Consider the following numerical example. An operating company's capital structure consists of equal proportions of debt and equity, with attaching costs of 10% and 20%, respectively. The company is a wholly owned subsidiary of a parent company whose own source of capital is 25% debt and 75% equity. It is assumed that the cost of debt to the parent is also 10%, and that a reasonable return to parent stockholders is 15%. The latter assumption will be revisited in the Example at the end of the chapter. The situation is summarized in Table 20-1 below.

TABLE 20-1
OPERATING AND PARENT COMPANY COST OF CAPITAL

	Amount	Weight	Cost	Weighted Cost
Operating Company				
Debt	$ 50	.50	10	.05
Equity	$ 50	.50	.20	10
	$100	1.00		
			Total Cost	15
Parent Company				
		Weight	Cost	Weighted Cost
Debt		.25	.10	.0250
Equity		.75	.15	.1125
			Total Cost	.1375

Independent Company Approach

One way to proceed is simply to ignore the parent-subsidiary relationship, and treat the operating company's cost of capital in the usual way as the weighted average cost of capital using the operating company's own capital structure and cost rates. Under this approach, often labeled the Stand-Alone Approach or Subsidiary Approach, the subsidiary is viewed as an independent operating company, and its cost of equity is inferred as the cost of equity of comparable risk firms. The methodology rests on the basic premise that the required return on an investment depends on its risk, rather than on the parent's financing costs.

In the example, the weighted cost is 15%. The allowed return of 20% on equity is derived from the techniques described in previous chapters, including DCF, Risk Premium, or CAPM. The equity return reflects the risk to which the equity capital is exposed and the opportunity return foregone by the company's shareholders in investments of similar risk. The identity of the shareholders is immaterial in determining the equity return.

Double Leverage Approach

Another approach is the Double Leverage methodology. This method has several variants One treatment, shown in Table 20-2, traces the operating company's equity capital of $50 to its source, namely the parent's debt and equity capital. The cost of equity to the operating company is simply the overall weighted average of capital to the parent, since the equity capital is said to have been raised by the parent through a mixture of debt and equity. The parent's composite capital cost is imputed to the subsidiary's equity.

TABLE 20-2
OPERATING COMPANY COST OF CAPITAL: DOUBLE LEVERAGE CONCEPT

	Amount	Weight	Cost	Weighted Cost
Debt-Subsidiary	$50 00	500	10	0500
Equity-provided by parent.				
Debt-parent (25%)	$12 50	125	.10	0125
Equity-parent (75%)	$37.50	.375	.15	.0563
			Weighted Cost	1188

Advocates of the double leverage approach argue that the utility subsidiary only requires a 11.88% return on total capital rather than the 15.00% indicated in the previous calculation Although the parent invested $50 in the company, it used leverage itself in raising its capital, so that the true cost of capital to the subsidiary is the cost of its own debt capital, plus the proportionate cost of its parent's debt and equity capital. Moreover, if the parent was allowed a 20% return on its $50 equity investment in the subsidiary, unreasonably high returns would be extracted by the parent's shareholders from ratepayers In the example, gross dollar earnings of .20 x $50 = $10 would accrue to the parent company's shareholders; but since 25% of that $50, or $12 50, was borrowed at an interest rate of 10%, $1.25 must be subtracted from the gross earnings of $10 to produce net equity earnings of $8 75 on an equity investment of $37.50 That is a 23 33% return on equity The theoretical and conceptual fallacies of this reasoning will be discussed shortly

Modified Double Leverage Approach

One refinement to the double leverage method is to recognize that the parent's weighted cost of capital should only be imputed to the portion of equity actually contributed by the parent. The subsidiary's retained earnings should be removed from the double leverage imputation since none of the subsidiary's retained earnings are traceable to the capital raised by the parent. This will associate proportionately the components of parent capital and their respective costs with that part of subsidiary equity ostensibly financed in this way. The revised calculation with retained earnings removed is shown in Table 20-3. It is assumed that $40 of the $50 of subsidiary equity capital was contributed by the parent, and the remaining $10 is the subsidiary's own retained earnings, and the latter continues to be allowed a 20% return.

TABLE 20-3
OPERATING COMPANY COST OF CAPITAL: MODIFIED DOUBLE LEVERAGE CONCEPT

	Amount	Weight	Cost	Weighted Cost
Debt-Subsidiary	$50	.50	10	050
Retained Earnings—Subsidiary	$10	.10	.20	.020
Equity-provided by parent:				
Debt-parent (25%)	$10	.10	.10	.010
Equity-parent (75%)	$30	.30	.15	045
			Weighted Cost	.125

One procedural flaw in the above double leverage computation is the failure to recognize that the debt ratio of the operating company has increased from 50% to 60%. Hence both debt and equity cost rates should be higher as a result of the increased financial risk. The 20% return on equity should be adjusted upward in recognition of the increased financial risk.

Consolidated Approach

Another method of computing the subsidiary's cost of capital uses consolidated data of the parent and subsidiary companies on the grounds that the holding company and its units are financed as an integrated whole, based on system-wide financing objectives. The cost rates for debt and preferred capital are system-wide averages, and the cost of equity is determined by traditional methods. Before to the divestiture of AT&T, the Bell System supported the use of a consolidated capital structure rather than a double-levered capital structure.

A few points regarding consolidated capital structures are in order. First, the debt of the consolidated company is the sum of the holding company's debt and the subsidiary's debt. Hence, the consolidated cost of debt is a weighted cost of parent and subsidiary debt. Second, the cost of equity of the holding company is identical to that of the consolidated entity. This is because the value of the parent holding company's stock expressly recognizes subsidiary income to parent investment if accounted on an equity basis. Accounting on the equity basis treats subsidiary net income as income to the parent's equity investment whether such income is received as dividends or not. The parent's retained earnings necessarily reflect this. Accordingly, the cost of equity associated with market valuation of holding company equity is also the cost of equity for the consolidated network. Third, a consolidated capital structure is equivalent to a double-levered capital structure when all the parent's subsidiaries have the same amounts of leverage Lastly, some analysts contend that assignment of the consolidated weighted cost to the equity cost of the subsidiary is equivalent to imputation of the holding company's equity cost. This can only be true in the highly unlikely event that the costs of consolidated debt and equity are exactly equal, or, if they are unequal, that the differences in weights between the consolidated and the subsidiary capital structure exactly offset the differences in costs. This is proven formally in Morin and Andrews (1993).

20.2 Critique of Double Leverage

Adherents to the double leverage calculation argue that the true cost of capital to a utility subsidiary is the weighted cost of its own debt and the weighted cost of the parent's debt and equity funding. Moreover, unless the subsidiary's equity is assigned the parent's weighted cost of capital, parent shareholders will reap abnormally high returns. Although persuasive on the surface, these arguments conceal serious conceptual and practical problems Moreover, the validity of double leverage rests on questionable assumptions

The flaws associated with the double leverage approach have been discussed thoroughly in the following academic literature. Pettway and Jordan (1983) and Beranek and Miles (1988) pointed out the flaws in the double leverage argument, particularly the excess return argument, and also demonstrated that the stand-alone method is a superior procedure Rozeff (1983) discussed the ratepayer cross-subsidies of one subsidiary by another when employing double leverage Lerner (1973) concluded that the returns granted an equity investor must be based on the risks to which the investor's capital is exposed and not on the investor's source of funds.

Theoretical Issues

The double leverage approach contradicts the core of the cost of capital concept. Financial theory clearly establishes that the cost of equity is the risk-adjusted opportunity cost to the investors and not the cost of the specific capital sources employed by investors. The true cost of capital depends on the use to which the capital is put and not on its source. The *Hope* and *Bluefield* doctrines have made clear that the relevant considerations in calculating a company's cost of capital are the alternatives available to investors and the returns and risks associated with those alternatives. The specific source of funding and the cost of those funds to the investor are irrelevant considerations.

Carrying the double leverage standard to its logical conclusion leads to even more unreasonable prescriptions. If the common shares of the subsidiary were held by both the parent and by individual investors, the equity contributed by the parent would have one cost under the double leverage computation while the equity contributed by the public would have another. This is clearly illogical. Or, does double leverage require tracing the source of funds used by each individual investor so that its cost can be computed by applying double leverage to each individual investor? Of course not! Equity is equity, irrespective of its source, and the cost of that equity is governed by its use, by the risk to which it is exposed.

For example, if an individual investor borrows money at the bank at an after-tax cost of 8% and invests the funds in a speculative oil exploration venture, the required return on the investment is not the 8% cost but rather the return foregone in speculative projects of similar risk, say 20%. Yet, under the double leverage approach, the individual's fair return on this risky venture would be 8%, which is the cost of the capital source, and not 20%, which is the required return on investments of similar risk. Double leverage implies that for all investors who inherited stock or received stock as a gift, the allowed return on equity would be zero, since the cost of the stock to the investors is zero. It also implies that if, tomorrow morning, a subsidiary were sold to a company with a higher cost of capital than the parent, the subsidiary's cost of equity would suddenly become higher as a result of the change in ownership. If we assumed that the double leverage concept were appropriate, we would also have to assume that the day following AT&T's divestiture in 1984, the cost of equity of the newly created Bell Regional Holding Companies suddenly rose by a substantial amount. This is logically absurd, as it is the use of capital that governs its cost, and not its source. For example, if a subsidiary with a double leverage cost of equity of 12% were sold to another company with a higher cost of capital of, for example, 15%, would regulation alter the return accordingly just because of the change in ownership?

If so, the same utility with the same assets and providing the same service under the new management would have a higher cost of service to ratepayers because of the transfer of ownership. Clearly, if a utility subsidiary were allowed an equity return equal to the parent's weighted cost of capital while the same utility were allowed a fair, presumably higher, return were it not part of a holding company complex, an irresistible incentive to dissolve the holding company structure would exist in favor of the one-copany operating utility format. The attendant benefits of scale economies and diversification would then be lost to the ratepayers.

The cost of capital is governed by the risk to which to the capital is exposed and not by the cost of those funds or whether it is they were obtained from bondholders or common shareholders. The identity of the subsidiary's shareholders should have no bearing on its cost of equity because it is the risk to which the subsidiary's equity is exposed that governs its cost of money, not whether it is borrowed from bondholders or sold to common shareholders for issued shares. Had the parent company not been in the picture, and had the subsidiary's stock been widely held by the public, the subsidiary would be entitled to a return that would fully cover the cost of both its debt and equity.

Just as individual investors require different returns from different assets in managing their personal affairs, why should regulation cause parent companies making investment decisions on behalf of their shareholders to act any differently? A parent company normally invests money in many operating companies of varying sizes and varying risks These operating subsidiaries pay different rates for the use of investor capital, such as long-term debt capital, because investors recognize the differences in capital structure, risk, and prospects between the subsidiaries. Yet, the double leverage calculation would assign the same return to each activity, based on the parent's cost of capital. Investors do recognize that different subsidiaries are exposed to different risks, as evidenced by the different bond ratings and cost rates of operating subsidiaries The same argument carries over to common equity If the cost rate for debt is different because the risk is different, the cost rate for common equity is also different, and the double leverage adjustment should not obscure this fact.

The double leverage concept is at odds with the opportunity cost concept of economics According to this principle of economics, the cost of any resource is the cost of an alternative foregone. The cost of investing funds in an operating utility subsidiary is the return foregone on investments of similar risk If the fair risk-adjusted return assigned by the market on utility investments is 15%, and the regulator assigns a return less than 15% because of a double leverage calculation, there is no incentive or defensible reason for a parent holding company to invest in that utility.

Fairness and Capital Attraction

The double leverage approach is highly discriminatory, and violates the doctrine of fairness. If a utility is not part of a holding company structure, the cost of equity is computed using one method, say the DCF method, while otherwise the cost of equity is computed using the double leverage adjustment. Estimating equity costs by one procedure for publicly held utilities and by another for utilities owned by a holding company is inconsistent with financial theory and discriminates against the holding company form of ownership. Two utilities identical in all respects but their ownership format should have the same set of rates Yet, this would not be the case under the double leverage adjustment.

The capital attraction standard may also be impaired under the double leverage calculation. This is because a utility subsidiary must compete on its own in the market for debt capital, and therefore must earn an appropriate return on equity to support its credit rating. Imputing the parent's weighted cost to the utility's equity capital may result in inadequate equity returns and less favorable coverage, hence impairing the utility subsidiary's ability to attract debt capital under favorable terms.

Questionable Assumptions

Several assumptions underlying the double leverage standard are questionable. One assumption to which the previous numerical illustrations have already alluded, is the traceability of the subsidiary's equity capital to its parent. None of the subsidiary's retained earnings can be traced to the capital raised by the parent. Some analysts salvage the double leverage approach by assigning one cost rate to retained earnings and another to the common equity capital raised by the parent, with the curious result that equity has two cost rates. The traceability issue goes further. If a parent company issues bonds or preferred stock to acquire an operating subsidiary, the traceability assumption is broken. Corporate reorganizations and mergers further invalidate the traceability assumption.

By virtue of using the parent's weighted cost as the equity cost rate for the subsidiary, another questionable assumption is that the parent capital is invested in subsidiaries that all have the same risks Lastly, the double leverage procedure makes the unlikely assumption that the parent holding company invest its funds in each subsidiary proportionately to each subsidiary's debt-equity ratio, which is unreasonable.

Double Leverage: A Tautology

The double leverage approach is a tautology. It is not the parent's weighted average cost of capital (WACC) that determines the subsidiary's cost of equity because the parent's WACC is itself a weighted average of equity costs of all subsidiaries. Double leverage adherents confuse the direction of cause and effect. The equity cost of subsidiaries must be found on a stand-alone basis.

The last nail in the double leverage coffin can be shown as follows. If capital market equilibrium is to hold, the cash flows to the parent company's bondholders and stockholders must equal the cash flows from the parent's equity in each subsidiary. Letting K denote the cost of capital, the subscripts p and s denote the parent and subsidiary, D and E the dollar amounts of debt and equity, and the subscripts d and e denote debt and equity, we can therefore say:

$$K_{dp} D_p + K_{ep} E_p = \sum_{s}^{n} K_{es} W_s \tag{20-1}$$

The various unknowns, including the parent return on equity, can be found in terms of all the other given variables. What the above equation makes clear is that the parent cost of equity is determined by subsidiary cost of equity, and that parent capital costs cannot determine subsidiary capital costs. This can be seen even more clearly by dividing the above equation by total parent value V to obtain:

$$K_{dp} D_p/V + K_{ep} E_p/V = \sum_{s}^{n} K_{es} E_s/V \tag{20-2}$$

The left side of the equation is the usual expression for the parent's WACC, and the right side is the weighted average of equity costs of all subsidiaries However,

$$\sum_{s}^{n} E_s = V \tag{20-3}$$

so that the parent's WACC is itself a weighted average of equity costs of all subsidiaries The fundamental logical fault of double leverage is to arbitrarily equate the equity cost of each subsidiary to the left side of the above equation The inescapable conclusion is that the subsidiary cost of equity must be found on a stand-alone basis, because the parent's WACC is itself a weighted average of subsidiary equity costs

EXAMPLE 20-1

In the numerical example provided at the beginning of the chapter in Table 20-1, the parent's cost of equity capital was arbitrarily and wrongly assumed to be 15%. This example shows that the parent cost of equity consistent with the terms of the example is 23.33%, and not 15%. The fundamental point of the illustration was to show the logical inconsistency of the double leverage argument. When an illustration is constructed with an assumed subsidiary cost of equity, the assumed parent cost of equity must be consistent with it. This is shown below.

If the subsidiary was regulated in the standard correct way, the allowed return is computed as .50 x 10% + .50 x 20% = 15%. According to advocates of double leverage, this implies excess returns to the parent, that is:

Earnings from the subsidiary to the parent: $100 x 15% =	$15.00
less total interest: $50 x 10% + $12.50 x 10%=	$ 6.25
Earnings to parent equity:	$ 8.75

which represents a return of $8.75/$37.50 = 23.33%, far in excess of the *assumed* parent equity cost of 15%.

Double leverage advocates adjust for this alleged excess by assigning the parent's overall return of 13.75% to the subsidiary's equity. The subsidiary's overall return becomes 11.875%, as shown below:

	Amount	Weight	Cost	Weighted Cost
Debt-Subsidiary	$50.00	.500	.10	.05000
Equity-provided by parent				
Debt-parent (25%)	$12.50	.125	.10	.01250
Equity-parent (75%)	$37.50	.375	.15	.05625
		Weighted Cost		.11875

The 11.875% becomes the double leverage allowed return on the subsidiary's total assets. Only with this allowed rate of return, according to the tenets of double leverage, does the parent's equity receive the *assumed* rate of return of 15%. That is, the parent receives $100 x 11.875% = $11.875, less the interest cost of $6.250, or $5.625, on an equity investment of $37.50, which is a is a 15% return. And, so it seems, the parent receives the required rate of return.

The fundamental flaw of this approach is that the assumptions of the example are internally inconsistent and illogical. When an illustration is constructed with assumed subsidiary cost of equity, the assumed parent cost of equity must be consistent with it. It is not the parent's weighted average cost of capital that determines the subsidiary's cost of equity because the parent's cost of capital is itself a weighted average of equity costs of all subsidiaries.

Equation 20-2 makes it clear that the parent cost of equity is determined by the subsidiary cost of equity, and that parent capital costs cannot determine subsidiary capital costs. Given the cost of debt K_{dp}, the subsidiary's cost of equity K_{es}, and the amounts of capital, the above equation implies that the parent equity cost consistent with 20% subsidiary cost of equity is 23.33%:

[$50 x 20% - $12.50 x 10%]/ $37.50 = 23.33%

In summary, the double leverage adjustment has serious conceptual and practical limitations and violates basic notions of finance, economics, and fairness. The assumptions which underlie its use are questionable, if not unrealistic. The approach should not be used in regulatory proceedings.

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Docket No. 04-00034
Rebuttal Testimony
Exhibit RAMREB-4

Chapter 13 CAPM Extensions

13.1 Empirical Validation

The last chapter showed that the practical difficulties of implementing the CAPM approach are surmountable. Conceptual and empirical problems remain, however.

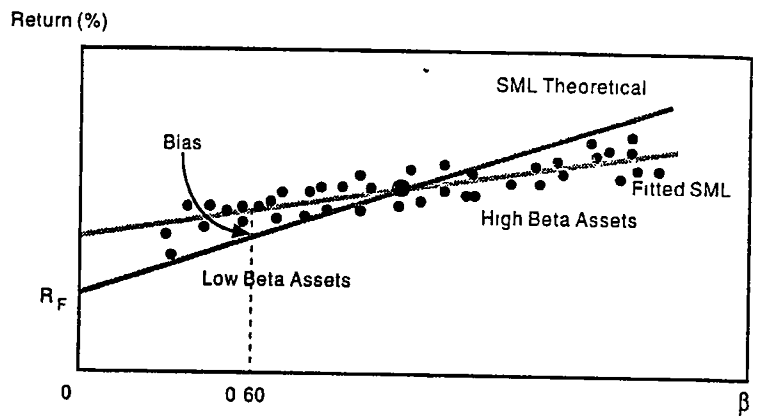
At the conceptual level, the CAPM has been submitted to criticisms by academicians and practitioners.[1] Contrary to the core assumption of the CAPM, investors may choose not to diversify, and bear company-specific risk if abnormal returns are expected. A substantial percentage of individual investors are indeed inadequately diversified. Short selling is somewhat restricted, in violation of CAPM assumptions. Factors other than market risk (beta) may also influence investor behavior, such as taxation, firm size, and restrictions on borrowing.

At the empirical level, there have been countless tests of the CAPM to determine to what extent security returns and betas are related in the manner predicted by the CAPM.[2] The results of the tests support the idea that beta is related to security returns, that the risk-return tradeoff is positive, and that the relationship is linear. The contradictory finding is that the empirical Security Market Line (SML) is not as steeply sloped as the predicted SML. With few exceptions, the empirical studies agree that the implied intercept term exceeds the risk-free rate and the slope term is less than predicted by the CAPM. That is, low-beta securities earn returns somewhat higher than the CAPM would predict, and high-beta securities earn less than predicted. This is shown in Figure 13-1.

1 The use of the CAPM in regulatory proceedings has not escaped criticism See for example Malko and Enholm (1985), Chartoff, Mayo, and Smith (1982), and the Autumn 1978 issue of *Financial Management,* in which several prominent finance scholars address the use of the CAPM in regulatory proceedings.

2 For a summary of the empirical evidence on the CAPM, see Jensen (1972) and Ross (1978) The major empirical tests of the CAPM were published by Friend and Blume (1975), Black, Jensen, and Scholes (1972), Miller and Scholes (1972), Blume and Friend (1973), Blume and Husic (1973), Fama and Macbeth (1973), Basu (1977), Reinganum (1981B), Litzenberger and Ramaswamy (1979), Banz (1981), Gibbons (1982), Stambaugh (1982), and Shanken (1985) CAPM evidence in the Canadian context is available in Morin (1981)

FIGURE 13-1
THEORETICAL V. EMPIRICAL ESTIMATE OF THE CAPM



The slope is less than predicted by the CAPM, and the intercept term is greater than the risk-free rate. This result is particularly pertinent for public utilities whose betas are typically less than 1 00 Based on the evidence, as shown in Figure 13-1, a CAPM-based estimate of the cost of capital underestimates the return required from such securities.

The empirical evidence also demonstrates that the SML is highly unstable over short periods and differs significantly from the long-run relationship. This evidence underscores the potential for error in cost of capital estimates that apply the CAPM using historical data over short time periods. The evidence[3] also shows that the addition of specific company risk, as measured by standard deviation, adds explanatory power to the risk-return relationship.

Roll (1977) argued that the CAPM has never been tested and that such a test is infeasible. Roll argued, moreover, that the market index proxy used in empirical tests of the CAPM is inadequate; since a true comprehensive market index is unavailable, such tests will be biased in the direction shown by the actual empirical results. Deviations of empirical results from the predictions of the CAPM does not necessarily mean that the CAPM is misspecified, but rather that the market index used in testing is inefficient. Roll's conclusion is that the CAPM is not testable unless the exact composition of the true market portfolio is known and used in the tests. Moreover,

3 See Friend, Westerfield, and Granito (1978) and Morin (1980)

the CAPM is a forward-looking expectational model and to test the model it is necessary to predict investor expectations correctly. Any empirical test of the CAPM is thus a test of the joint hypothesis of the model's validity and of the function used to generate expected returns from historical returns.

In short, the currently available empirical evidence indicates that the simple version of the CAPM does not provide a perfectly accurate description of the process determining security returns. Explanations for this shortcoming include some or all of the following:

1 The CAPM excludes other important variables that are important in determining security returns, such as size, skewness, taxes, and uncertain inflation.

2. The market index used in the tests excludes important classes of securities, such as bonds, mortgages, and business investments.

3 Constraints on investor borrowing exist contrary to the assumption of the CAPM.

4. Investors may value the hedging value of assets in protecting them against shifts in later investment opportunities. See Merton (1973) and Morin (1981)

Revised CAPM models have been proposed relaxing the above constraints, each model varying in complexity, each model attempting to inject more realism into the assumptions. Ross (1978) and, more recently, Tallman (1989) presented excellent surveys of the various asset pricing theories and related empirical evidence These enhanced CAPMs produce broadly similar expressions for the relationship between risk and return and a SML that is flatter than the CAPM prediction Section 13.2 focuses on the more tractable extensions of the CAPM that possess some applicability to public utility regulation

13.2 CAPM Extensions

Several attempts to enrich the model's conceptual validity and to salvage the CAPM's applicability have been advanced In this section, extensions of the CAPM and pragmatic solutions to safeguard the model's applicability are discussed The first explanation of the CAPM's inability to explain security returns satisfactorily is that beta is insufficient and that other systematic risk factors affect security returns The implication is that the effects of these other independent variables should be quantified and used in estimating the cost of equity capital The impact of the supplementary variables can be expressed as an additive element to the standard CAPM equation as follows

Letting a stand for these other effects, the CAPM equation becomes

$$K = R_F + a + \beta\,(R_M - R_F) \qquad (13\text{-}1)$$

To capture the variables' impact on the slope of the relationship, a coefficient b is substituted for the market risk premium The revised CAPM equation becomes:

$$K = R_F + a + b \times \beta \qquad (13\text{-}2)$$

The constants a and b capture all the market-wide effects that influence security returns, and must be estimated by econometric techniques. Factors purported to affect security returns include dividend yield, skewness, and size effects.

Dividend Yield Effect

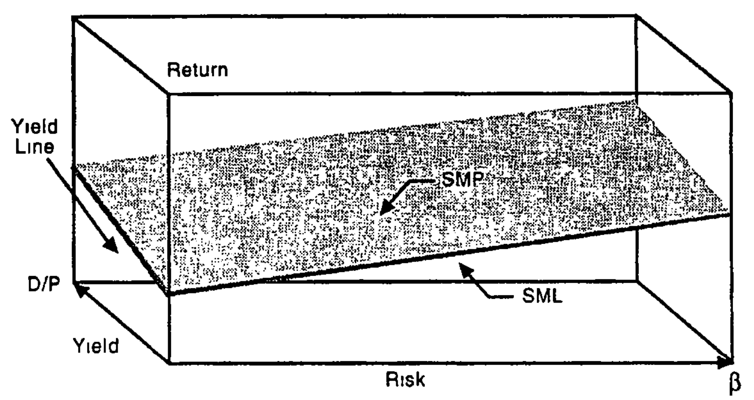
Empirical studies by Litzenberger and Ramaswamy (1979), Litzenberger, Ramaswamy, and Sosin (1980), and Rosenberg and Marathe (1975) find that security returns are positively related to dividend yield as well as to beta. These results are consistent with after-tax extensions of the CAPM developed by Brennan (1970) and Litzenberger and Ramaswamy (1979) and suggest that the relationship between return, beta, and dividend yield should be estimated and employed to calculate the cost of equity capital.

The dividend yield effects stem from the differential taxation on corporate dividends and capital gains. The standard CAPM does not consider the regularity of dividends received by investors Utilities generally maintain high dividend payout ratios relative to the market, and by ignoring dividend yield, the CAPM provides biased cost of capital estimates. To the extent that dividend income is taxed at a higher rate than capital gains, investors will require higher pre-tax returns in order to equalize the after-tax returns provided by high-yielding stocks with those of low-yielding stocks. In other words, high-yielding stocks must offer investors higher pre-tax returns.[4] Even if dividends and capital gains are undifferentiated for tax purposes, there is still a tax bias in favor of earnings retention (lower dividend payout), as capital gains taxes are paid only when gains are realized.

[4] The strength of the tax effect on yield is diluted by non-taxable institutional ownership and by the personal tax exemption on dividend income from electric utility stocks

The traditional return-beta relationship described by the SML fails to recognize the dividend yield dimension. But the two-dimensional SML can be expanded into a three-dimensional security market plane (SMP) by adding a dividend yield line as in Figure 13-2, which portrays the relationship among return, beta, and dividend yield. The positive effect of yield on return can be seen on the graph. In a given risk class, the required return increases with the dividend yield. Some institutional portfolio managers have in fact implemented the SMP approach for actual investment management decision making, in effect recommending for purchase undervalued securities situated above the SMP.

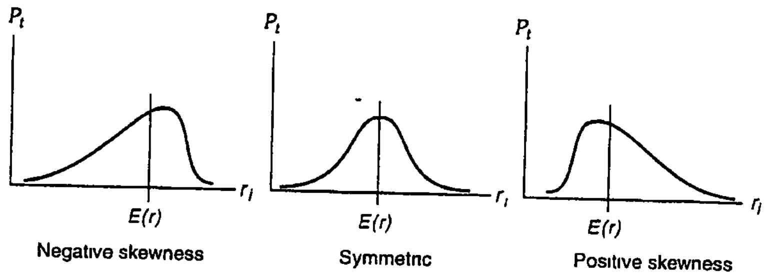
FIGURE 13-2
THE RELATIONSHIP AMONG RETURN, BETA, AND DIVIDEND YIELD



Skewness Effects

Investors are more concerned with losing money than with total variability of return. If risk is defined as the probability of loss, it appears more logical to measure risk as the probability of achieving a return that is below the expected return Figure 13-3 shows three frequency distribution of returns, one symmetrical, one skewed left, and one skewed right. If the probability distribution is symmetrical, specialized measures of downside risk are unnecessary, since a normal symmetrical distribution has no skewness, the areas on either side of the mean expected return are mirror images of one another

FIGURE 13-3
RETURN DISTRIBUIONS



Three probability distributions with different types of skewness

In the context of the CAPM, the traditional CAPM provides downwar biased estimates of cost of capital to the extent that these skewness effec are significant. As shown by Kraus and Litzenberger (1976), expecte return depends on both on a stock's systematic risk (beta) and the systen atic skewness:

RETURN = RISK-FREE RATE + MARKET RISK + SKEWNESS RISK

Denoting the risk-free rate by R_F, the return on the market as a whole b R_M, the stock's systematic market risk by β, the stock's systemat skewness by γ, and the market price of skewness reduction by S_M, th amended CAPM is stated as follows:

$$K_e = R_F + \beta(R_M - R_F) + \gamma(S_M - R_F) \qquad \text{(13-}$$

Systematic skewness, γ, is measured as the ratio of the co-skewness of th stock with the market to the skewness of the market.

Empirical studies by Kraus and Litzenberger (1976), Friend, Westerfielc and Granito (1978), and Morin (1980) found that, in addition to betε skewness of returns has a significant negative relationship with securit returns. This result is consistent with the skewness version of the CAPI developed by Rubinstein (1973) and Kraus and Litzenberger (1976).

This may be particularly relevant for public utilities whose future profit ability is constrained by the regulatory process on the upside an relatively unconstrained on the downside in the face of socio-politica realities of public utility regulation. The distribution of security return for regulated utilities is more likely to resemble the negatively skewed distribution displayed in the left-hand portion of Figure 13-3. The process of regulation, by restricting the upward potential for returns and responding sluggishly on the downward side, may impart some asymmetry to the distribution of returns, and is more likely to result in utilities earning less, rather than more, than their cost of capital. The traditional CAPM provides downward-biased estimates of the cost of capital to the extent that these skewness effects are significant. A security market plane (SMP) similar to that envisaged in the case of dividend yield effects can be imagined, substituting a skewness line for the dividend yield line.

Skewness effects can be illustrated by the nature of the probability distribution of security returns for California water utilities in the 1990s. Because of the asymmetry in the future water supply, there is a greater probability of downside returns to investors under adverse supply conditions, but essentially no probability of correspondingly large positive returns. That is, these water utilities' future profitability is constrained by both the regulatory process and by a negatively skewed water supply. Hence, measures of variability and covariability, such as standard deviation and beta, are likely to provide downward-biased estimates of the true risk relative to that of unregulated firms and other utilities.

The implication is that an additional risk premium must be added to the business-as-usual return on equity to compensate for the added risks. The lack of symmetry in investor returns must be considered. A risk premium sufficient to compensate investors for the limited upside returns/unlimited downside returns versus comparable risk companies and other utilities is required

To illustrate, Figure 13-4 shows the hypothetical probability distributions of revenues, earnings before interest and taxes (EBIT), and net income under normal conditions for a California water utility Note that fluctuations in revenues are magnified when transmitted to EBIT because of operating leverage, and further magnified when transmitted to net income because of financial leverage The coefficient of variation of revenue, EBIT, and net income are 0.14, 0 47, and 1 11, respectively

FIGURE 13-4A
HYPOTHETICAL PROBABILITY DISTRIBUTIONS
OF REVENUE, EBIT, AND NET INCOME

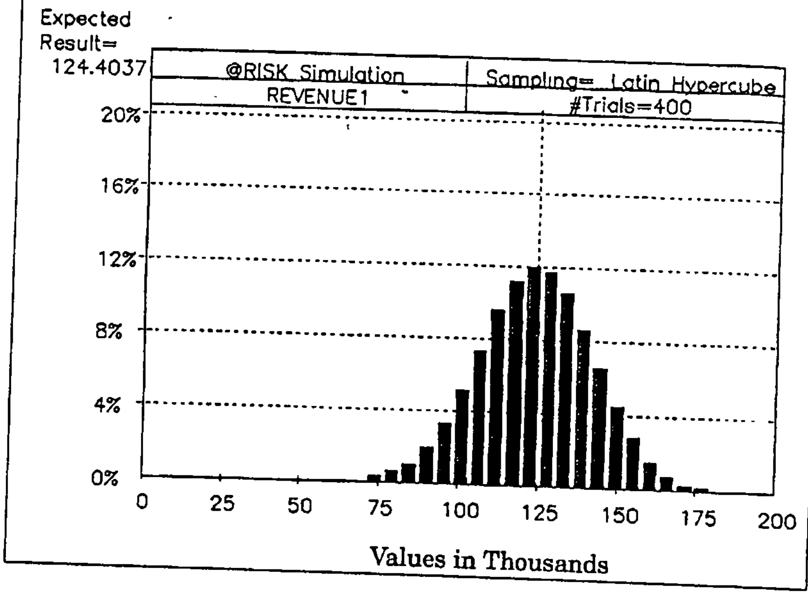


FIGURE 13-4B

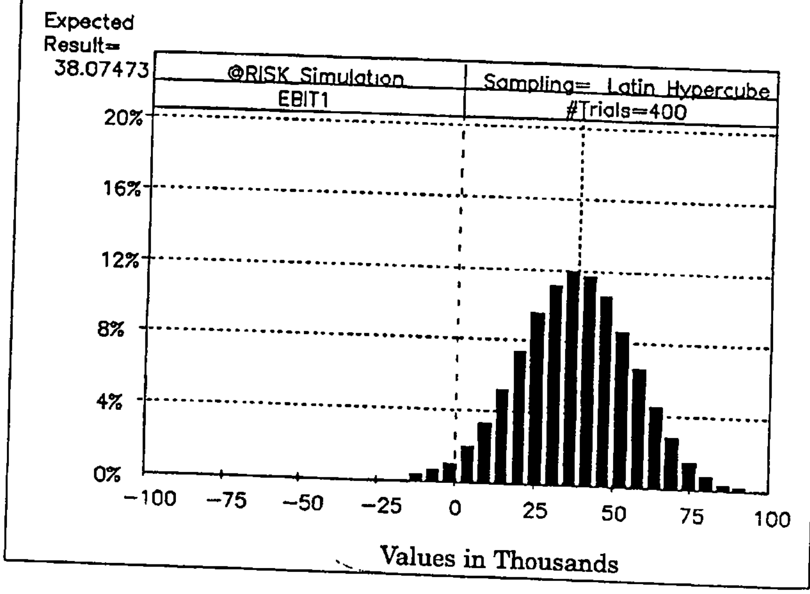


FIGURE 13-4C

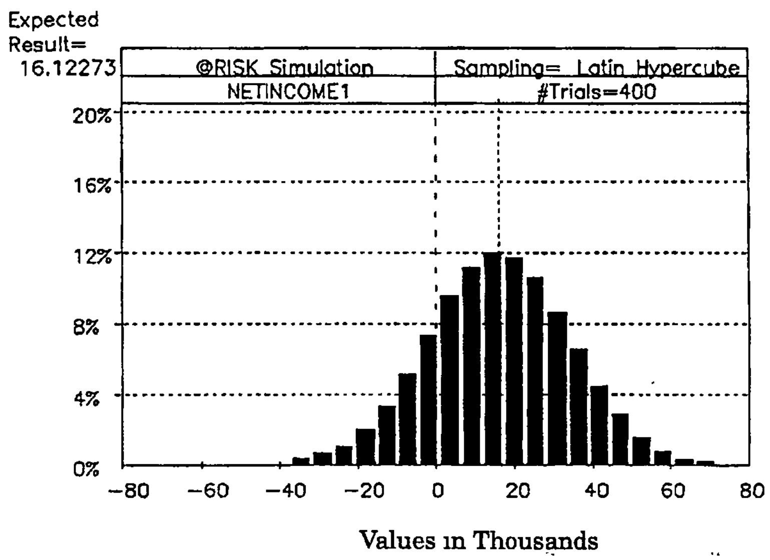


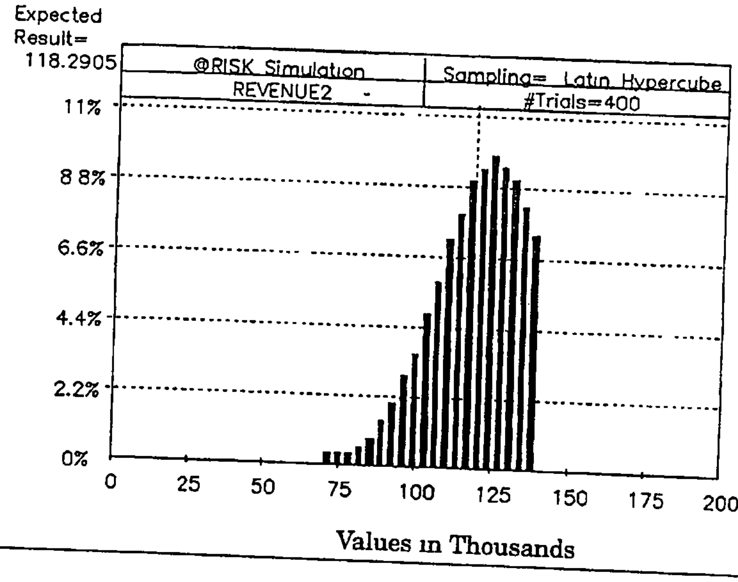
Figure 13-5 shows the same probability distributions if revenues are negatively skewed. Note the increased downside net income potential and, hence, the increased risk. The coefficient of variation of revenue, EBIT, and net income become 0 12, 0 43, and 1.41, respectively. The risk to the shareholder increases from 1 11 to 1 41 as a result of leverage and skewness effects.

This result reinforces that notion that an added premium is required to offset the lack of upside potential. The added premium must be sufficient to produce the same average return that would prevail under conditions of perfect symmetry.

Size Effects

Investment risk increases as company size diminishes, all else remaining constant. The size phenomenon is well documented in the finance literature. Empirical studies by Banz (1981) and Reinganum (1981A) have found that investors in small-capitalization stocks require higher returns than predicted by the standard CAPM. Reinganum (1981A) examined the relationship between the size of the firm and its P/E ratio, and found that small firms experienced average returns greater than those of large firms that were of equivalent systematic risk (beta) He found that small firms produce greater returns than could be explained by their risks These results were confirmed in a separate test by Banz (1981) who examined stock returns

FIGURE 13-5A
HYPOTHETICAL PROBABILITY DISTRIBUTIONS:
NEGATIVELY SKEWED REVENUES



over the much longer 1936-1975 period, finding that stocks of small firms earned higher risk-adjusted abnormal returns than those of large firms.

Small companies have very different returns than large ones, and on average they have been higher. The greater risk of small stocks does not fully account for their higher returns over many historical periods. Ibbotson Associates' widely-used annual historical return series publication covering the period 1926 to the present reinforces this evidence (Ibbotson Associates, 1993). They found that for the period 1926-1992 the average small stock premium was 6% over the average stock, more than could be expected by risk differences alone, suggesting that the cost of equity for small stocks is considerably larger than for large capitalization stocks. One plausible explanation for the size effect is the higher information search costs incurred by investors for small companies relative to large companies. This effect is likely to be negligible for all but the very small public utilities whose equity market value is less than $60 million.

In addition to earning the highest average rates of return, the small stocks also had the highest volatility, as measured by the standard deviation of returns. Ibbotson defines small stocks as those in the lowest size decile among NYSE stocks, with size defined as the dollar value of shares outstanding. The size trigger point occurs at a market value of $60 million.

FIGURE 13-5B

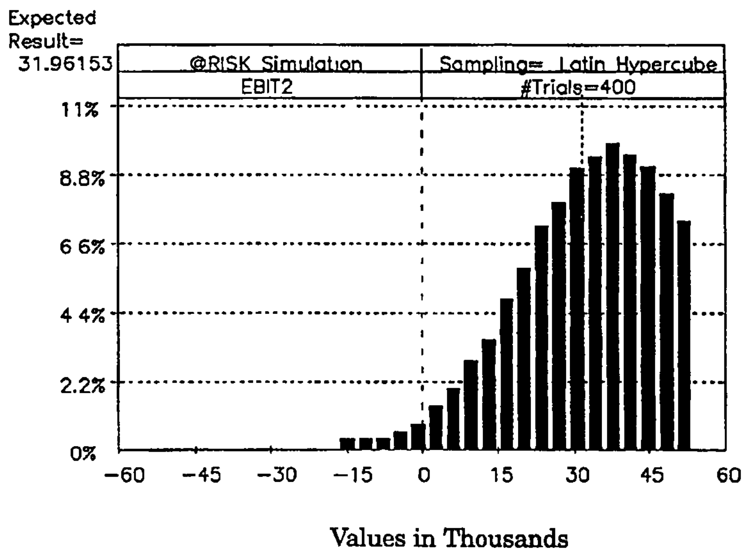
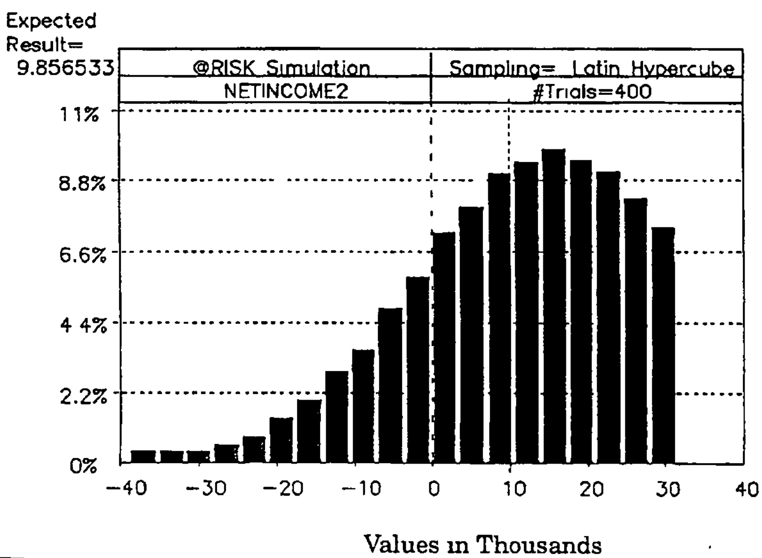


FIGURE 13-5C



The bond ratings of small firms are typically less than those of large firms Figure 13-6 contrasts the Standard & Poor's bond and stock ratings of small versus large capitalization stocks. For bond ratings, the first quintile of companies ranked in descending order of market value of equity is ranked A- on average, versus CC for the last quintile. For stock ratings, the first quintile of companies is ranked A- to B+, versus C for the last quintile.

FIGURE 13-6A
STANDARD & POOR'S AVERAGE BOND RATING: TOP 20% AND BOTTOM 20% OF MARKET
(Compustat Data Base Ranked by Market Value)

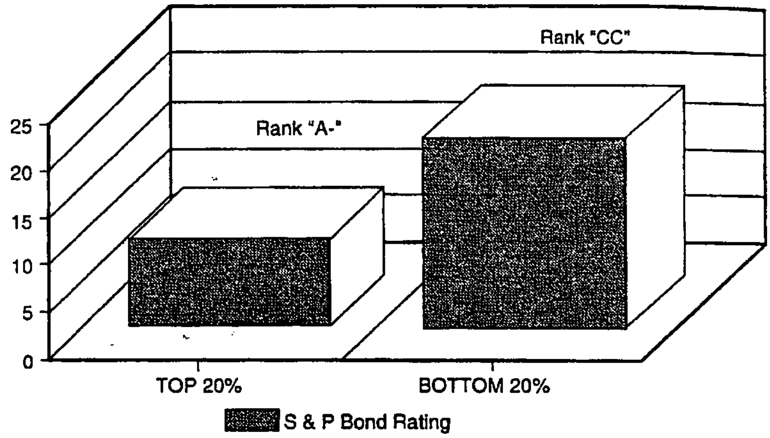
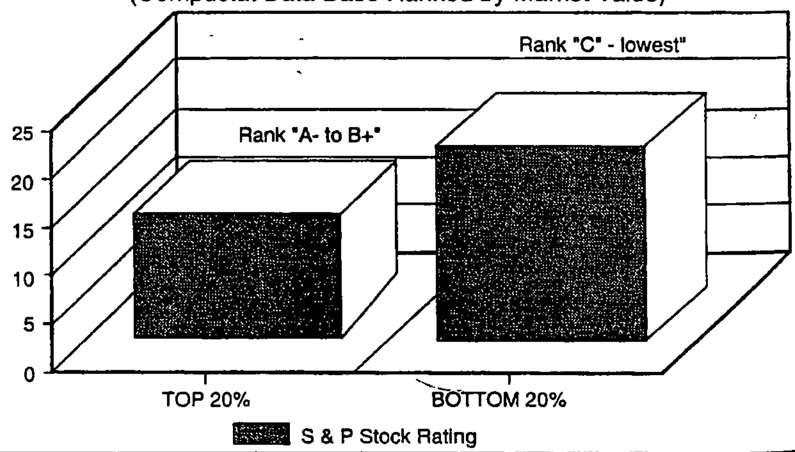


FIGURE 13-6B
STANDARD & POOR'S AVERAGE STOCK RATING: TOP 20% AND BOTTOM 20% OF MARKET
(Compustat Data Base Ranked by Market Value)



Much research effort has gone into investigating the size effect. In addition to statistical measurement problems, the economic rationale for the size effect is difficult to unravel. In fact, Roll (1981) even questioned the evidence on the small firm effect. Presumably, small stocks provided less utility to the investor, and require a higher return. The size effect may be a statistical mirage, whereby size is proxying for the effect of different economic variables. Small firms may have low price-earnings ratios or low market prices, for example. The size effect is most likely the result of a liquidity premium, whereby investors in small stocks demand greater returns as compensation for lack of marketability and liquidity. Investors prefer high to low liquidity, and demand higher returns from less liquid investments, holding other factors constant.

Market Index and Missing Assets

A second explanation for the CAPM's inability to fully explain the process determining security returns involves the use of an inadequate or incomplete market index. Empirical studies to validate the CAPM invariably rely on some stock market index as a proxy for the true market portfolio. The exclusion of several asset categories from the definition of market index misspecifies the CAPM and biases the results found using only stock market data Kolbe and Read (1983) provide an illustration of the biases in beta estimates that result from applying the CAPM to public utilities. Unfortunately, no comprehensive and easily accessible data exist for several classes of assets, such as mortgages and business investments, so that the exact relationship between return and stock betas predicted by the CAPM does not exist. This suggests that the empirical relationship between returns and stock betas is best estimated empirically rather than by relying on theoretical and elegant CAPM models expanded to include missing assets effects In any event, stock betas may be highly correlated with the true beta measured with the true market index.

Constraints on Investor Borrowing

The third explanation for the CAPM's deficiency involves the possibility of constraints on investor borrowing that run counter to the assumptions of the CAPM In response to this inadequacy, several versions of the CAPM have been developed by researchers One of these versions is the so-called zero-beta, or two-factor, CAPM which provides for a risk-free return in a market where borrowing and lending rates are divergent. If borrowing rates and lending rates differ, or there is no risk-free borrowing or lending, or there is risk-free lending but no risk-free borrowing, then the CAPM has the following form

$$K = R_Z + \beta (R_M - R_F) \qquad (13\text{-}$$

The model is analogous to the standard CAPM, but with the return on minimum risk portfolio that is unrelated to market returns, R_Z, replacin the risk-free rate, R_F. The model has been empirically tested by Black Jensen, and Scholes (1972), who found a flatter than predicted SML consistent with the model and other researchers' findings

The zero-beta CAPM cannot be literally employed in cost of capital projec tions, since the zero-beta portfolio is a statistical construct difficult tc replicate. Attempts to estimate the model are formally equivalent tc estimating the constants, a and b, in Equation 13-2

13.3 Empirical CAPM

Whatever the explanation for the flatter than predicted SML, whether it be dividend yield, skewness, size, missing assets, or constrained borrowing effects, the general suggestion is that the empirical relationship between returns and betas should be estimated empirically rather than asserted on an a priori basis. Equation 13-2 has gradually evolved to become known as the Empirical Capital Asset Pricing Model (ECAPM), and represents a pragmatic solution to the limitations of the standard CAPM, whether it be data limitations, unrealistic assumptions, or omitted variables. All the potential vagaries of the model are telescoped into the 2 constants, a and b, which must be estimated econometrically from market data. The technique is formally applied by Litzenberger, Ramaswamy, and Sosin (1980) to public utilities in order to rectify the CAPM's basic shortcomings. Not only do they summarize the criticisms of the CAPM insofar as they affect public utilities, but they also describe the econometric intricacies involved and the methods of circumventing the statistical problems. Essentially, the average monthly returns over a lengthy time period on a large cross-section of securities grouped into portfolios, are related to their corresponding betas by statistical regression techniques; that is, Equation 13-2 is estimated from market data. The utility's beta value is substituted into the equation to produce the cost of equity figure Their own results demonstrate how the standard CAPM underestimates the cost of equity capital of public utilities because of the utilities' high dividend yield and return skewness.

As discussed in Section 13.1, empirical tests of the CAPM have shown that the risk-return tradeoff is not as steeply sloped as that predicted by the CAPM. That is, low-beta securities earn returns somewhat higher than the CAPM would predict, and high-beta securities earn less than predicted.

Several finance scholars have developed refined and expanded versions of the standard CAPM by relaxing the constraints imposed on the CAPM, such as dividend yield, size, and skewness effects. In doing so, they obtained broadly similar expressions for the relationship between risk and expected return These enhanced CAPMs typically produce a risk-return relationship that is flatter than the CAPM prediction. In other words, they obtained a result that is closer to the actual risk-return relationship.[5]

The empirical CAPM formula described below produces a risk-return tradeoff that is flatter than the predicted tradeoff, and approximates the observed relationship between risk and return on capital markets. The empirical approximation to the CAPM is consistent with both theory and empirical evidence, and has the added advantage of computational simplicity. Whereas the traditional version of the CAPM is given by the following:

$$K = R_F + \beta\,(R_M - R_F)$$

the empirical evidence found by Morin (1989) indicates that the expected return on a security over the period 1926-1984 was actually given by:

$$\text{RETURN} = .0829 + .0520\beta$$

Given that the risk-free rate over the estimation period was approximately 6%, this relationship implies that the intercept of the risk-return relationship is higher than the 6% risk-free rate, contrary to the CAPM's prediction. Given the Ibbotson Associates' result that the average return on an average risk stock exceeded the risk-free rate by about 8% during the period from 1926 through 1984, that is $(R_M - R_F) = 8\%$, the intercept of the observed relationship between return and beta exceeds the risk-free rate by about 2%, or 1/4 of 8%, and that the slope of the relationship, .0520, is close to 3/4 of 8% Therefore, the empirical evidence suggests that the expected return on a security is related to its risk by the following approximation.

$$K = R_F + x\,(R_M - R_F) + (1 - x)\,\beta\,(R_M - R_F) \qquad (13\text{-}5)$$

where x is a fraction to be determined empirically. The value of x is actually derived by systematically varying the constant x in that equation from zero

An excellent overview of variants of the CAPM is provided in the corporate finance textbook by Brealey and Myers (1991A), Chapter 8, and particularly in the accompanying instructor's manual (1991B) to 1.00 in steps of 0 05 and choosing that value of x that minimized the mean square error between the observed relationship,

$$\text{RETURN} = .0829 + .0520\,\beta$$

and the empirical shortcut CAPM formula.[6] The value of x that best explains the observed relationship is between 0.25 and 0.30 If $x = 0\ 25$, the equation becomes:

$$K = R_F + 0.25\,(R_M - R_F) + 0\ 75\,\beta\,(R_M - R_F) \tag{13-6}$$

Using a simple numerical example, assuming a risk-free rate of 7%, a market risk premium of 7%, and a beta of 0.80, the empirical CAPM equation above yields a cost of equity estimate of 12.95% as follows:

$$K = 7\% + 0.25\,(14\% - 7\%) + 0.75 \times 0.80\,(14\% - 7\%)$$

$$= 7\% + 1.75\% + 4.2\%$$

$$= 12.95\%$$

The actual historical relationship between risk premiums and the risk of a large population of common stocks can be observed over a long time period and used to estimate the appropriate risk premium for a given utility. The utility's cost of equity can then be estimated as the yield on long-term Treasury bonds plus the estimated risk premium. To illustrate, the actual relationship between risk premiums and betas on common stocks over a long time period can be estimated, and this historical relationship be used to estimate the risk premium on the utility's common equity, on the grounds that over long time periods, investors' expectations are realized.

To execute this method, monthly rates of return for all common stocks listed on the New York Stock Exchange from 1926 to the present are obtained from the University of Chicago's Center for Research in Security Prices (CRISP) data tapes. Five-year betas are then computed for each month for each company. For each month, the securities are assigned to one of 10 portfolios on the basis of ranked betas, from the lowest to the highest beta. Monthly returns for each of the portfolios are compounded to produce annual rates of return on each of the 10 portfolios from 1931 to the

6 The corresponding evidence for Canadian capital markets is scant. For studies of the relationship between return and-risk in Canada, see Morin (1980) and Jobson and Korkie (1985)

present. Historical risk premiums for each of the 10 portfolios are calculated for the period 1931 to the present by averaging the difference between the portfolio's annual rate of return and the government bond yield. For example, if the following hypothetical relationship between the risk premium and the portfolios' betas is obtained for the period 1931 - 1992[7]:

$$Risk\ Premium = 4.21\% + (3.94\% \times Beta)$$

Using the utility's beta of 0.60, for example, the risk premium for the hypothetical utility is:

$$4.21\% + (3.94\% \times 0.60) = 6.6\%$$

A long-term cost of equity capital estimate for the company is obtained by adding the risk premium of 6.6% to the current yield on long-term Treasury bonds or to the projected long-term yield implied by the closing prices on the Treasury bond futures contract traded on the Chicago Board of Trade. The latter measures the consensus long-term interest rate expectation of investors.[8] If the yield on long-term Treasury bonds is 6%, then the cost of equity implied by the empirical relationship is 6.00% + 6 60% = 12.60%. A similar procedure could be developed based on the standard deviation of return rather than on beta as risk measure.

13.4 Conclusions

Although financial theory has shown that beta is a sufficient risk measure for diversified investors and although most of the empirical literature has confirmed its importance in determining expected return, there are notable exceptions. Over the course of its history, the death of beta has been peridically announced, inevitably followed by its rebirth. The Fama and French (1992) article is a case in point. These authors found little explanatory power in beta. But here again the autopsy of beta was premature, and "reports of beta's death are greatly exaggerated." For one thing, the CAPM specifies a relationship between expected returns and beta, whereas Fama and French employed realized returns. Moreover, in a subsequent re-

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7 See Litzenberger (1988) for an excellent example of this empirical CAPM technique.

8 The average market forecasts of rates in the form of interest rate Treasury securities futures contracts data can be used as a proxy for the expected risk-free rate.

compensation for beta risk and little relation to M/B ratios, unlike Fama and French. They also found that market risk premiums are much larger when betas are estimated using annual rather than monthly data.

On the positive side, as a tool in the regulatory arena, the CAPM is a rigorous conceptual framework, and is logical insofar as it is not subject to circularity problems, since its inputs are objective, market-based quantities, largely immune to regulatory decisions The data requirements of the model are not prohibitive, although the amount of data analysis required can be substantial, especially if CAPM extensions are implemented.

On the negative side, the input quantities required for implementing the CAPM are difficult to estimate precisely. These problems are not insurmountable, however, provided that judgment is exercised and that the logic underlying the methodology is well supported. The techniques outlined in this chapter should prove helpful in this regard. Sensitivity analysis over a reasonable range of risk-free rate, market return, and beta is strongly recommended to enhance the credibility of the estimates.

The standard form of the CAPM must be used with some caution. There is strong evidence that the CAPM does not describe security returns perfectly, especially for public utilities. Beta is helpful in explaining security returns only when complemented with other risk indicators, such as dividend yield, size, and skewness variables. Rather than theorize on the effects of such extraneous variables, a more expedient approach to estimating the cost of equity capital is to estimate directly the empirical relationship between return and beta, and let the capital markets speak for themselves as to the relative impact of such variables. The empirical form of the CAPM provides an adequate model of security returns. If a utility's beta can be estimated for a given period, then by knowing the empirical relationship between risk and return, the security's expected return, or cost of capital, can be estimated. Here again, the cost of capital estimates produced by an ECAPM procedure should be sensitized to produce a range of estimates.

The CAPM is one of several tools in the arsenal of techniques to determine the cost of equity capital. Caution, appropriate training in finance and econometrics, and judgment are required for its successful execution, as is the case with the DCF or risk premium methodologies.

It is only natural that the next generation of CAPM models formally account for the presence of several factors influencing security returns. A new finance theory, which extends the standard CAPM to include sensitivity to several market factors other than market risk, has been proposed to replace the CAPM. Proponents of the Arbitrage Pricing Model (APM) contend that APM provides better results than does the CAPM and is not plagued by the shortcomings of the CAPM, while retaining its basic intuition. Chapter 15 discusses this latest paradigm in financial theory, and explores its pertinence in cost of capital determination. But first, Chapter 14 presents numerous applications of the CAPM that are relevant to utilities.

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